schweizerisches implantat-register
registre suisse des implants

siris

# Swiss National Hip & Knee Joint Registry

## Report 2025

Annual Report of the SIRIS Registry Hip & Knee, 2012 – 2024

anq

swiss orthopaedics

UNIVERSITÄT BERN

# Hip and knee replacement results 2012 – 2024

**SIRIS Report 2025**

**Annual Report of the Swiss National Joint Registry, Hip and Knee**

SIRIS – Foundation for Quality Assurance in Implant Surgery

swiss orthopaedics – Swiss Society of Orthopaedics and Traumatology

ANQ – National Association for the Development of Quality in Swiss Hospitals and Clinics

SwissRDL – Medical Registries and Data Linkage, Institute of Social and Preventive Medicine, University of Bern

# Preface

**Among those who worked assiduously on establishing the partnership between SIRIS (the Foundation for Quality Assurance in Implant Surgery), swiss orthopaedics and ANQ was Regula Heller. On the occasion of her retirement as Head of the Department of Acute Care and Deputy Managing Director of ANQ in September 2025, she now looks back at what happened in the beginning and talks about the relevant factors that determined the success of the undertaking.**

The 2025 SIRIS Report is already the 12th annual report concerning the Swiss National Hip & Knee Joint Registry. The continually expanding database and the excellent quality of the data make possible increasingly informative evaluations. This year's report also contains some fascinating innovations. For the first time, it introduces analyses of regional differences, thus providing additional helpful insights for funding agencies, service providers, policymakers and the authorities.

## A SPECIAL PARTNERSHIP

When the SIRIS Foundation and ANQ initiated their collaboration in 2011, they had quite specific expectations. SIRIS was anticipating the nationwide collection of implant data while ANQ was looking forward to the extension of its quality reviews to the realm of orthopaedics. The implant registry was made part of ANQ's review plan in 2012. Since then, all acute care hospitals and clinics have been required to enter the knee and hip implant procedures they carry out in the SIRIS registry. With its data collection rate of greater than 98%, the registry today also stands out in international comparison.

This success is attributable to the close cooperation between the SIRIS Foundation, swiss orthopaedics and ANQ, sharing as they do a common ambition to continuously improve implantation medicine for the benefit of patients. Although the missions of the three organisations differ, they have managed to find ways of reconciling their individual requirements with their shared goals. The SIRIS implant registry thus represents a shining example of how an interprofessional partnership in the healthcare sector can function superlatively - not only that, but the registry itself is an outstanding instance of what can be achieved by means of joining forces.

## EXTENSIVE REPORTING FRAMEWORK – TARGETED IMPROVEMENTS

Considerable planning and persuasion efforts were necessary to both ensure that the data pool was such that risk-adjusted hospital/clinic comparisons were possible and that the initial resistance to disclosing outcomes was overcome. By 2021, all was ready and, for the first time, ANQ was able to publish the two-year revision rates for primary total hip and knee replacements in transparent form.

The registry may have originally served to essentially identify faulty joint implants, but today the focus is also on the surgical services provided and the procedures themselves. Increasing numbers of hospitals and clinics are using the registry evaluations as the basis for the introduction of targeted improvements. This is made possible by the extensive analyses provided, including the quarterly reports on in-house data and the reports of problems with joint replacements. These changes are to be welcomed as the two-year revision rates for primary total hip and knee joint replacements are now exhibiting declining trends.

## FACTORS FOR FUTURE SUCCESS

Thanks to the ANQ National Quality Agreement in 2011 and the commitments entered into by SIRIS and ANQ, the targets, processes, divisions of responsibilities and structures are clearly defined while the financing is guaranteed. SIRIS is well-positioned to continue in future with what has been achieved. There are three factors that are of particular relevance:

**1.** Easing of the burden on hospitals and clinics: the project designed to exploit synergies in data collection processes drawn up in cross-disciplinary partnership with Swissnoso indicates the way ahead.

**2.** Patient-reported outcome measures (PROMs): the point of view of patients must be taken into account if care is to be more patient-oriented and there is increasing focus on this aspect in considerations of cost-benefit factors. With the optional collection of PROMs, the required basics are in place.

**3.** Secure positioning in the discipline of orthopaedics in close cooperation with swiss orthopaedics: so that the registry can develop its full potential, it also needs in future to be closely linked with practice and with the world of the professionals. In this context, swiss orthopaedics can play a key role as both a mediator and as an ambassador.

## PERSONAL THOUGHTS AS I RETIRE

As Head of the Department of Acute Care at ANQ, I was able to work with SIRIS for 14 years. I considered this to be a privilege. I was constantly impressed by the specialist expertise and constructive solidarity that was evident in the committees and the dedication shown by the hospitals and clinics. I should like to express my profound gratitude to all involved for the way we were able to work together. I am convinced that the registry will continue to play an important role in implantation medicine in future and would like to take this opportunity to wish the ‘SIRIS collective’ every success in the coming years!

**Regula Heller**
MNSc, MPH

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All information in this report was composed with the utmost care. If any changes or modifications are made after publication, these will be published on our website www.siris-implant.ch, where you can also download the SIRIS Report 2025 and all previous reports.
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# Introduction, Methods, Demography and Epidemiology

# 1. Introduction

## 1.1 Purpose of the registry

The Swiss National Implant Registry (SIRIS) was implemented in September 2012 to evaluate hip and knee joint replacements, introducing also shoulder joint replacements since January 2025. Registration in SIRIS is mandatory for all Swiss hospitals performing knee and hip arthroplasties, as they are bound to the ANQ's national quality agreement.

To ensure that all contributors and participants pursue a common goal, it is essential to clearly define the aim of the SIRIS registry. This also influences the data architecture within the registry, since there will be different requirements for each stakeholder. The multi-partner association required to set up the registry meant that various points of view had to be considered to ensure success and support. Although each partner naturally tends to focus preferentially on their particular interest, one fundamental interest is common to all, namely the long-term well-being of the patient after a prosthetic joint replacement. The following paragraphs will explain the various perspectives of key stakeholders that were considered during development of SIRIS.

**The patient's perspective.** Since patients expect joint replacement surgery to provide them with long-lasting, pain-free mobility, the surgical procedure must be adapted to their level of activity and should be followed by rapid recovery without complications. Ideally, after a prosthetic joint replacement and successful rehabilitation process, patients should feel well and report about excellent outcome (PROMs – Patient Reported Outcome Measures). From the patient's perspective, the registry data should be presented as to be readily comprehensible, allowing patients to find information of interest despite the complexity of the data and of the methodology behind the analysis. The growing importance of functional results beyond revision rates is reflected the inclusion of PROMs in the annual report since 2022. Nationwide registration of PROMs within SIRIS is planned to be implemented in 2025, but data from the pilot project of the Canton of Zurich already provided a basis for the development of reporting standards of PROMs and delivered first insights into patient-related outcomes. Patients who will read the report may find the information helpful to better understand their past or future surgery and thus be able to better discuss it with their surgeons.

**The surgeon's perspective.** For surgeons, a priority is to avoid surgical complications and shortcomings for their patients. In fact, the needs of patients and the goals of surgeons are fully aligned: obtaining functional, long-lasting and pain-free joint replacement. Introducing shoulder joint replacement added a new group of SIRIS users – shoulder surgeons. By choosing a particular prosthesis, surgeons integrate the performance of the implant with their expertise. The implants must be well designed and impeccably manufactured to avoid problems such as wear particle disease or breakage. Hence, to add value from the surgeon's perspective, the registry should be able to identify problematic implants within a relatively short time frame and provide valuable early warning to surgeons when required. However, entering individual clinical results into a registry is not a welcome addition to an already intense daily schedule of activities. Furthermore, although surgeons certainly appreciate benchmarking their results, the public availability of the information at the individual surgeon's level remains a controversial aspect. PROMs are also adding a new perspective for surgeons – their patients' reports benchmarked relative to PROMs of patients treated by other surgeons in Switzerland.

**The industry's perspective.** The industry's main activity is manufacturing and sales, driven by a legitimate profit-orientation. Designing and providing first-rate, problem-free implants is the most enduring strategy in this domain, as a series of failures may lead to allegations of negligence that could ultimately destabilise the company. Hence, the aspect of economic viability coincides with the primary interest of the patients, namely successful prosthetic joint replacement on the long term. Since progress and technical innovation are extremely important for an industry dedicated to providing safe high-performance implants, the registry is regarded as an essential tool for post-market surveillance that validates improvements in materials, designs, and concepts in the real-life clinical setting. If the industry accepts quality as being the principal market-regulating factor, then the registry is a welcome tool and motivates participation. To date, the publication of two-year revision rates for registered implants in the SIRIS reports was met with great interest from involved industry and orthopaedic surgeons. Adding the medium-term follow-up at 5 and 10-years to the report further improves the function of the registry as quality assessment tool. Introduction of shoulder implants and PROMs enlarges the portfolio of SIRIS registry and offers additional information to industry.

**The hospital's perspective.** It is in hospitals where the surgeons and patients interact, with all parties sharing a common interest. Hospitals aim to provide high-quality healthcare at reasonable costs, integrating volume of patients into considerations. However, hospitals or departments also have an interest in ensuring that patients do not forget the institution where they were treated successfully, making them return to the same hospital if necessary, including for reasons other than a prosthetic joint replacement. The registry is perceived as an instrument for quality control, not only for the implants used but for the entire process, ranging from the preoperative consultation to the procedures in the operating room, as well as the postoperative follow-up. Personal recommendations from satisfied patients are the very best advertising for hospitals and related medical institutions. As institutions providing healthcare in today's competitive environment, hospitals are also very keen to uphold their reputation, and the registry is an invaluable tool for this purpose. Additionally, since certain Swiss cantons require reaching a sufficient volume of procedures in order to keep hospitals on contract lists, it appears that participating in the registry might be crucial for the survival of some institutions, a strong motivation for participation in an environment where hospital mergers and closures are frequently discussed. Performance benchmarks containing the two-year revision rates of institutions registered in SIRIS have been published online since 2020 **(LINK to ANQ)** and are updated with every new report.

**The healthcare insurances's perspective.** Insurers and third-party payers are concerned about healthcare costs, and thus aim to reduce hospitalization costs, to avoid re-admissions for complications, and obtain return to work of the patient as early as possible, if applicable. Insurers are very conscious of costs regarding implant pricing, medical fees, and hospital bills. Because the insurer's objective is to provide equal benefits to all its clients within the available budget, the registry is perceived as an instrument that can provide information regarding the performance of surgeons and institutions, functioning as a cost-quality assessment tool. Since costs for primary prosthetic replacement are constricted within DRG – reimbursement system, but revision surgeries may cause significant additional and potentially avoidable costs, the focus of insurers could be directed to revision rates and re-revisions.

**The government's perspective.** The government organises the healthcare system on behalf of all citizens. Therefore, the main challenge it faces is having to consider and bring together the needs and preferences of all players in the healthcare economy. One specific characteristic of the Swiss healthcare system is that cantons are independent and are the principal political and financial authorities for their healthcare systems. Furthermore, the healthcare system of the Principality of Liechtenstein (FL) interacts closely with the Swiss healthcare system and also participates in

SIRIS. Although the federal government may not have any inherent financial interest in the healthcare system, the cantonal governments directly bear a major share of hospital costs and are very active participants in all debates concerning hospital treatments, including their outcomes and costs. Governments also have an interest in assessing the overall situation concerning the quality of healthcare provision. While patients understandably tend to place their primary focus on receiving treatment that provides optimal and long-lasting results, the government certainly shares this aim but also has to ensure cost-effectiveness, as resources are limited. Nevertheless, political decision makers in Switzerland at all levels have arguably so far largely avoided that aspect, currently leaving the Swiss healthcare system somewhat adrift when it comes to actually allocating the limited resources in a rational and transparent manner. Despite this, governments require data on the overall surgical performance to assess requirements and subsequently plan the macroeconomic policies related to healthcare. Hence, government health agencies are commissioned to ensure that the institutions under their supervision provide high-quality healthcare to the population, whereby the agencies also have an interest in benchmarking hospitals and keeping insurance and third-party payer costs down to a reasonable minimum. Although the fragmentation of the dataset down to the cantonal level may sometimes preclude meaningful statistical analysis, the information can still be of interest to the Swiss cantonal and FL governments, as well as to the general public.

## 1.2 Strong commitment

The annual report 2025 represents a collaborative data collection involving all the institutional partners of SIRIS and includes the surgeons and operating teams of orthopaedic or surgical units performing hip (146 units) or knee (142 units) replacement surgery. Streamlining, improving, and optimising data collection is a continuous effort involving expert groups and all partners. Crucially, this report also contains evidence that hospitals and surgeons are making progress beyond improving data collection. Decreasing early revision rates, fewer outlier implants in the market, and more homogenous early revision rates in general testify real improvements in treatment quality that coincide with SIRIS reporting.

Coverage is one important indicator of the commitment of all parties involved in SIRIS, and it correlates with reporting accuracy. However, it is difficult to assess coverage, because any benchmark registration system will have weaknesses. For SIRIS, only arthroplasties performed and submitted to the registry as closed records can be used in the analysis, as open cases may experience later modification. In 2024, the coverage of SIRIS was over 98% for primary hip and knee replacements. This not only demonstrates the strong commitment to the project by the surgeons and their teams, both in public and private hospitals, but also the high quality of the data collection, coaching, and organisation by the SIRIS team. Further details regarding the coverage are provided in Chapter 2 Methods, Part 2.3 Coverage.

SIRIS has thus achieved excellent coverage within a relatively short period of time since implementation in 2012 and continues to improve the content of the reports. The SIRIS annual report 2025 provides information on the state of hip and knee replacements in Switzerland and the Principality of Liechtenstein and presents a wealth of new information. The report also provides important and verifiable information that we hope patients, healthcare providers, third-party payers, and healthcare regulators will find useful.

| Factors | Variables |
|---|---|
| Patient related | Name |
| | Surname |
| | Date of birth |
| | Gender |
| | Height |
| | Weight |
| Surgery related | Main diagnosis |
| | Previous surgery |
| | Date and place of surgery |
| | Morbidity state |
| | Charnley class |
| | Intervention |
| | Approach |
| | Positioning |
| | Component fixation |
| | Cementing technique |
| Implant related | Type of implant |
| | Article number |
| | LOT number |
| | Company name |
| | Brand name |

**Table 1.1**

**Variables collected by the SIRIS registry**

# 2. Methods

## 2.1 Maintenance and hosting of the registry

The SIRIS registry is hosted and maintained by SwissRDL at the Institute for Social and Preventive Medicine (ISPM), University of Bern. A dedicated team comprising a statistician/methodologist, a data monitoring team, data management/IT specialists, as well as support staff, is responsible for management and maintenance, technical support, analysis, and reporting of the data. The data monitoring team supervises data quality, provides user support and trains collaborators at the participating hospitals to ensure correct and efficient data entry into the registry. The overall project management support at SwissRDL is provided jointly by the data monitoring team and the statistician/methodologist, and both are present in the SIRIS Scientific Advisory Board that directs and oversees the registry and produces this annual report, among other things.

SIRIS data are collected via an online documentation platform (accessible at siris.memdoc.org) to record data on primary arthroplasties, reoperations and component revisions. Furthermore, clinics may also register post-operative follow-up data at their discretion. All individual implants used (including minor components) are registered alongside clinical data from the surgical procedures. The current versions of the SIRIS CRF (v2021) can be downloaded from www.siris-implant.ch. While most participating surgical units use the standard online interface or dedicated apps (mostly on tablet devices) for data registration, some (mostly large) centres send data exports directly from their hospital information systems to SwissRDL via a web service client. Implant data are mostly entered into SIRIS by scanning the barcodes on the implant tags, which also is the recommended procedure, being most reliable. Manual data entry of implants is also possible with multiple-choice drop-down menus containing known implants. New implants first need to be registered by SwissRDL at the request of SIRIS users or upon notification by a producer.

The data of the SIRIS registry are stored on dedicated and protected servers at the University of Bern. Patient identification data (e.g. medical record number, name, and date of birth) are stored on a specific, physically separate, module server, for reasons of data protection and anonymisation. The patient's identification information is encrypted into a salted hash code to facilitate the linking of revisions performed at different healthcare facilities. This is needed to ensure continuity of implant follow-up and to calculate revision rates. Data protection complies with current standards and the methodology of separating the clinical data from the patient-identifying information was reviewed and approved by data protection delegates from the Swiss federal authority. Patients must provide written informed consent for data registration into SIRIS, which is ensured by participating surgeons and hospitals. Furthermore, patients have the right at any time to withdraw participation, check their data, or have their data deleted. Surgeons and hospitals may also use their specific SIRIS data, with certain restrictions applied, for internal quality assessment. The SIRIS Foundation, as the holder of the entire dataset, makes selected parts available in anonymised form upon request for independent academic research.

It is essential that only patients confirmed alive and residing in Switzerland are considered at risk for the analysis of revision rates. Patients who have died or left the country during the observation period are accounted for until death or until leaving Switzerland. For this purpose, patient data from SIRIS were cross-checked with both the database of the Swiss Central Compensation Office (ZAS Geneva) and the Federal Statistical Office (FSO Neuchâtel). Until 2023, SIRIS could verify annually whether a patient had died or left Switzerland. Fewer than 5% of patients had an unknown status or were foreigners operated on in Switzerland without being registered residents. These patients were considered lost to follow-up, unless later revised again in Switzerland, and were subsequently excluded from the analysis of (long-term) revision rates. However, the agreement with the Federal Statistical Office regarding data exchange ended in 2024 and the last update of mortality and migration data was received in April 2023. For the continued application of censoring events beyond April 2023 a simulation model based on 500+ patient typologies per joint was developed in order to project censoring events for a limited time horizon. The purpose of this simulation is not to predict a death or an emigration event (which would be entirely unfeasible), but merely to apply known attrition rates from observed life table information to specific homogeneous cohorts of patients. Patients with unknown status after April 2023 are selected at random for simulated censoring events, replicating the original distributional properties of these events and taking into account known revision or other primary operations. In other words, these simulated events are just “standing in” for the real censoring events until they can be updated again, but the impact on estimates revision rates is entirely comparable to that of the real events if the assumed event proportions per group and year are reasonable estimates. It should be noted that not taking into account censoring events beyond a certain date is certainly introducing bias, especially in groups with high mortality, and therefore even an imperfect adjustment is preferrable to no adjustment. Work is ongoing regarding a new procedure for linking again these crucial data to SIRIS.

## 2.2 Data quality and completeness

The data for this report were exported from the database in June 2025. The consistency and completeness of SIRIS data are checked in part through systematic software-generated validation tests, and additionally, quarterly by the registry’s statistician/methodologist, running automated analysis scripts for identification of likely data errors. These are then fed back to the data monitoring team, which analyses root causes of confirmed problems and provides feedback to affected hospitals.

In addition to the ongoing data quality checking routines, several specific methodological decisions have been made to increase accuracy of reporting. For example, when the information provided on a form and the registered implants contradict each other (e.g. hemiarthroplasty is selected on the form, while THA components were registered), and it has not yet been possible to verify the case, then the implant registration information is given priority (in this example, the case is provisionally accounted for as a THA). This information is indicated in the relevant tables or figures if such decisions are likely to impact the overall results.

Two updates of the CRF have been implemented since the launch of SIRIS. The first version was used from 2012 to 2014, and an updated version was in use between 2015 and 2020. Some changes to the definition of existing variables (particularly for the type of arthroplasty of the knee) were introduced with this update, as well as some new variables, notably the body mass index (BMI) and the morbidity state according to the ASA classification. Inconsistent use among providers of the answer option “unknown” (one institution even reporting unknown ASA status in almost all cases) indicates issues with data collection. Other common problems included impossible or inconsistent responses, which are more frequently observed in some sections of the forms than in others, like revisions relating to acetabular components in hemiarthroplasties. This could be due to a systematic misunderstanding of the meaning of certain response categories (i.e. confusion between revision of the acetabular component and conversion to THA after hemiarthroplasty) or because of random data entry errors likely aggravated by design issues such as long drop-down lists. The latest CRF version 2021 has successfully addressed some of these problems and has led to clear improvements in data quality.

SIRIS conducted organisational surveys in 2023 and 2024. Hospitals were surveyed on several issues including data entry mode, local responsibilities, coverage and availability of PROMs. A noteworthy finding of the surveys was that paper forms still play a major role in data collection. Two thirds of hospitals use them, typically to collect registry data on paper first before registration in the online system. Only a minority of hospitals register cases directly from the operation theatre or shortly after the operation. This is reflected in the relatively long delay in collection of SIRIS data. Only 26% of procedures were registered and completed within 24 hours and 65% within four weeks of operation. Nine percent of cases were registered with a delay of six months or longer. Other noteworthy findings were that most hospitals do not yet use specific PROMs, and most of those which do, already use the ones that SIRIS has decided to use in the near future.

## 2.3 Coverage

Reliable reference data from other sources are needed to estimate the coverage of SIRIS. Nevertheless, any benchmarking system has its specific weaknesses and disadvantages, resulting in a certain degree of incompleteness.

One option is to compare the annual number of cases reported in the registry with the numbers from quality indicators for Swiss acute care hospitals as published by the Federal Office of Public Health (FOPH/BAG). This encompasses a complete annual survey of all hospital discharges in Switzerland, whereby each entry represents the hospital discharge and includes information about the patient's socio-demographic characteristics, diagnosis, and treatment. Codes I.1.8.F, I.1.9.F, and I.1.10.F can be used to identify primary hip prostheses of any kind and for any diagnosis, while codes I.1.15.F and I.1.16.F are used for total and partial knee prostheses. At the time of writing the 2025 annual report, only figures up to 31.12.2023 were available. These figures are published online, but only with a considerable time lag (detailed information provided at www.bag.admin.ch). As shown in **Table 2.1,** primary coverage peaked at 98.7% in 2022, which includes the best value ever for hip arthroplasties and the third best for knee arthroplasties. Having to rely on figures publicly available with a considerable time lag is suboptimal for a registry, but efforts to secure timelier access to the actual raw figures reported by individual hospitals to FOPH/BAG have been rejected on legal grounds.

SIRIS also accesses annual implant sales figures from the participating industry partners in Switzerland, specifically the number of femoral stems (indicator for hip arthroplasties) and tibia plateaus (indicator for knee arthroplasties) sold per year. In previous years, the two different ways of calculating coverage rates were mostly in agreement. However, starting in 2021 and observed increasingly in 2022/2023, we find that these figures are no longer in agreement with registry data or other sources, at least not on a calendar year basis and for specific hospitals. Analysis strongly suggests that yearly sales and implant use figures in hospitals do not always agree. In other words, hospitals can report more procedures per year than implant sales in Switzerland suggest, resulting in a coverage rates above 100%. We also became aware of the possibility that implants may be imported directly from foreign suppliers and are therefore not counted among official sales in Switzerland. However, it is reasonable to assume that such discrepancies tend to even out over time and across hospitals, or appear to be relatively small. For this type of analysis, we thus consider coverage rates between 90% and 110% as the target zone. Feedback from individual manufacturers to implant reports provided by SIRIS indicates that these high coverage rates are realistic. For instance, in specific implant reports, coverage rates tended to be as high as 100% for typical standard implants such as primary hip stems and as low as 80% for less common implants such as acetabular reinforcement cages.

Nevertheless, feedback on implant figures confirms the observed general upward trend in coverage. We also observed a clear progression of coverage at the hospital level since 2017, as all eligible units are currently submitting cases to SIRIS. In previous years, we had reasons to believe that the registry already had a higher, albeit not officially counted, coverage rate, as cases created in the online registration system need to be completed before they can be included in the analysis. For most procedures, at least one implant must be registered before a case may be recognised as completed by the system. A certain number of incomplete and unsubmitted cases are left in the system every year, mostly caused by missing implant entries. The improvements in coverage since 2017 are, to a certain extent, due to monitoring of and support to hospitals by SIRIS to solve submission problems. As a direct result of these efforts, the number of registered cases keeps increasing even after closure of each reporting period.

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| **Primary hip prostheses** | | | | | | | |
| BAG | 22,970 | 23,160 | 23,619 | 23,310 | 24,834 | 26,435 | 27,691 |
| SIRIS* | 20,992 | 21,739 | 22,462 | 22,747 | 24,344 | 26,066 | 27,266 |
| Primary coverage (%) | 91.4 | 93.9 | 95.1 | 97.6 | 98.0 | 98.6 | 98.5 |
| **Primary knee prostheses** | | | | | | | |
| BAG | 18,558 | 18,325 | 19,181 | 18,837 | 20,280 | 23,070 | 24,569 |
| SIRIS** | 17,108 | 17,440 | 18,546 | 18,588 | 19,850 | 22,686 | 24,140 |
| Primary coverage (%) | 92.2 | 95.2 | 96.7 | 98.7 | 98.0 | 98.3 | 98.3 |
| **All primary hip and knee prostheses** | | | | | | | |
| BAG | 41,528 | 41,485 | 42,800 | 42,147 | 45,114 | 49,505 | 52,260 |
| SIRIS | 38,100 | 39,179 | 41,008 | 41,335 | 44,194 | 48,752 | 51,406 |
| Primary coverage (%) | 91.7 | 94.4 | 95.8 | 98.1 | 98.0 | 98.5 | 98.4 |

**Table 2.1**

**Retrospective coverage analysis 2017–2023 based on National Office of Public Health figures (BAG)**

All SIRIS figures excluding Liechtenstein

* l.1.8.F/l.1.9.F/l.1.10.F (all first hip prostheses, all diagnoses)

** l.1.15.F/l.1.16.F (all first knee prostheses, all diagnoses)

In recent years, however, at least part of the gap in data entries could be explained by increasing difficulties in obtaining informed consent from patients. This is a topic to observe in the future, as participation refusal poses a direct threat to the quality of any implant registry, as very high – ideally complete – coverage of all primary and revision procedures is needed for reliable analysis. The very principles of consent-based participation and general data protection rules denying the registry access to certain data without explicit consent are in conflict with the registry's mission of nationwide quality control.

In this report we added a new type of geographic analysis based on the BAG figures reported in **Table 2.1. Figures 2.1 and 2.2** show the cantonal coverage rates for primary hip and knee procedures. In several Cantons SIRIS achieved 2023 coverage rates above 99%, whilst in others they were below 90%. This picture is undoubtedly subject to annual variation as specific data submission problems in important hospitals have the potential to easily distort submission rates by several percentage points. It is also noteworthy that submission rates for hip and knee are not necessarily in agreement at the cantonal and therefore at the hospital level. This highlights the importance of ongoing monitoring in each participating surgical unit.

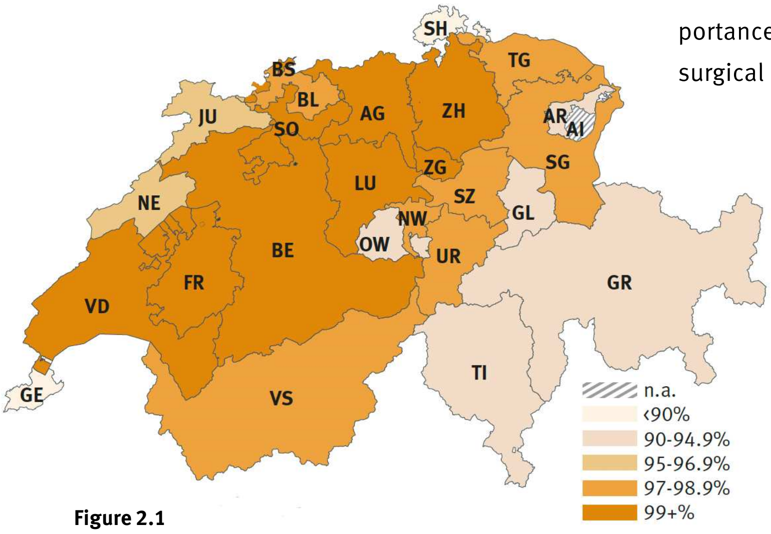

**Figure 2.1**

Coverage rates for primary hip prostheses in the SIRIS registry 2023

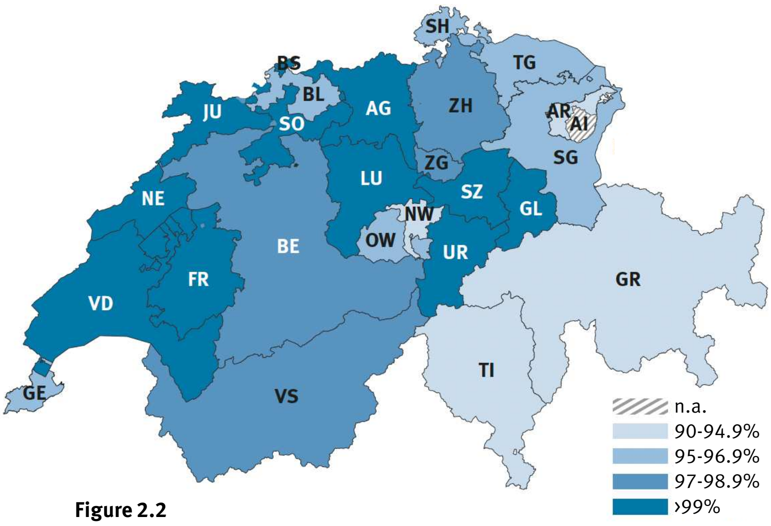

**Figure 2.2**

Coverage rates for primary knee prostheses in the SIRIS registry 2023

## 2.4 Statistical precision, evaluation and outlier detection

The figures in this report are, whenever appropriate, accompanied by 95% confidence intervals. A confidence interval indicates the plausible range within which the true value should lie with the indicated probability, considering random variation of samples of limited size. For an implant combination with large numbers, the confidence interval is usually narrow and, as numbers get smaller, the statistical precision decreases, which results in wider confidence intervals. For practical purposes, any position within the confidence interval should be seen as a plausible value and if confidence intervals overlap, they should be regarded as not statistically different. All confidence intervals are unadjusted for the various forms of clustering that may also affect precision, especially when results depend on small numbers of surgeons, hospitals or implants. The latter aspect is a particular challenge for a medical registry in a small yet diverse country such as Switzerland and must be evaluated on a case-by-case basis during any outlier detection.

In 2022, we started reporting a simple metric that we called the "case concentration score" (CCS) to address this issue. The CCS represents the share of a particular implant combination or system accounted for by the hospital using it most often. We provide this information in the interest of transparency as the performance of implants used in few places may not be an unbiased estimate of their true performance. Since the diversity of knee systems has also been increased to include more complicated designs, we also provide mean age figures for each system, as long as these designs were used for primary osteoarthritis. This is done in the interest of transparency, as knee systems used in younger patients tend to have higher revision risks not necessarily related to implant quality. Several means are used for detection of outliers. For clinics and individual surgeons (the latter not being part of the scope of this report), we rely on risk-adjusted funnel plots and use the 99.8% limit as the relevant threshold. In other words, a clinic is deemed an outlier if the 2-year revision rate is higher than the range of plausible observations in which 99.8% of observations would fall in case of random variation. The likelihood to observe a value outside of this range (above or below the limits) just due to chance would be 1 in 500. Indeed, the specific likelihood of exceeding such an upper boundary solely by chance would be only 1 in 1,000.

For implants, we use a much simpler method but report the results with several caveats and additional context. In this report, we continue with a distinction between the 2-year revision rate and the mid-term evaluation, whereby the latter starts at 5 years follow-up and currently ends at 11 years follow-up. All implant combinations or systems with at least 500 cases initially are evaluated. In the short-term (2-year) evaluation, we rate an implant as potential outlier if the observed 2-year revision rate is more than twice as high as for the average of the reference group ("outlier alert boundary"). The threshold for inclusion in this analysis was at least 50 cases reported in the current evaluation time frame (i.e. all primary operations between 1.1.2019 and 31.12.2022). We benchmark implants within a moving time window of 4 years to ensure that results represent current performance, not being affected by previous period effects. In this report, we refrained from ranking the implants by their 2-year revision rates and we excluded any potential outliers with confidence intervals overlapping with the 95% confidence interval of the reference group average. In other words: the outlier status comes with varying degrees of statistical probability and is considered highly likely when both the estimated revision rate and the complete confidence interval exceed the outlier alert boundary. For this reason, an implant whose revision rate exceeds double the mean revision rate, while the confidence interval overlaps with the outlier boundary, is defined as a potential outlier. If the lower bound of the confidence interval exceeds twice the mean revision rate, it is considered a definitive outlier. Furthermore, we identify three possible deviations from normal midterm performance:

**1.** Implants with elevated revision risk, i.e. those whose revision rate is increased by a factor ranging from 1.5 to 1.99 relative to the group average at any time point of at least 5 years follow-up;

**2.** Implants with long-term outlier status, i.e. those with a revision rate that is increased by at least a factor 2 relative to the group average at any time point of at least 5 years follow-up; and

**3.** Implants with below average revision risk, i.e. those with a revision rate that is decreased by a factor of at least 0.66 relative to the group average at longest available follow-up. In other words, the revision rate of the implant cannot be more than 66% of the relevant group average to be rated as having revision risk below average. All these analyses are subject to further limitations linked to remaining numbers at risk over time and consecutive spread of confidence intervals as specified in the relevant chapters.

We thus benchmark implants directly against the relatively narrow field of comparable products in their normal variety of uses. There is no further risk adjustment, as similar products are already meant to be used for a particular range of comparable patients and diagnoses. However, detailed outlier reports are produced for manufacturers and affected hospitals, and we also provide additional analytical information such as risk-adjusted hazard ratios in this context. As implant group sizes vary markedly, readers must pay attention to the reported confidence intervals and any other contextual information – especially relating to small numbers of clinics involved – indicated on the outlier watch board in this report.

To help readers understand the grouping decisions of implant combinations or systems, an additional online appendix to this report is provided. The appendix lists all implants and provides additional information on the group composition (e.g. included stem or cup variants), and whether or not there is a likelihood of so-called camouflage effects, where unreported subgroups may influence the overall result.

## 2.5 Patient-reported outcome measures (PROMs)

SIRIS benefitted from two local PROMs initiatives that were conducted using the registry's platform. National evaluation of PROMs, with the Swiss Orthopaedics minimal dataset (SO-MDS) at its core, is planned for autumn 2025 on a voluntary basis.

Between 2017 and 2020, nine hospitals in the Cantons of Basel Stadt, Basel Landschaft, and Solothurn collected PROMs for elective THA and TKA using the Core Outcome Measures Index (COMI). Patients were followed up after 6 months and 2 years postoperatively. Another PROMs project in collaboration with SIRIS was initiated in 2019 by the Cantonal Health Authority of Zurich in conjunction with Swiss Orthopaedics. All hospitals receiving public funding for elective hip and knee arthroplasties in the Canton of Zurich had to collect the Swiss Orthopaedics minimal dataset (SO-MDS), consisting of the 5-item version of the EQ-5D quality of life questionnaire and a small selection of additional questions on joint-specific pain and satisfaction. Patients were followed up one year postoperatively. Several other hospitals in other cantons also provided the same data. In the previous years, we reported both PROMs pilot studies for hip and knee results separately. In this report, we continue to report only on the SO-MDS results from all available hospitals and contrast hip and knee results.

The primary patient inclusion rate of all participating hospitals from the Canton of Zurich reached 73% in 2023 and the 1-year follow-up rate for primary cases from 2022 with valid SO-MDS was 79% for hip prostheses and 73% for knee prostheses. These rates remained stable in 2024. The SO-MDS forms, currently provide data with follow-up at 1 year from 9,065 THA patients with primary osteoarthritis, 974 THA patients with secondary osteoarthritis, 7,087 TKA patients with primary osteoarthritis and a further 991 with secondary osteoarthritis. They also provide data with complete 1-year follow-up for 1,351 PKA patients with primary osteoarthritis.

The analysis focused on the so-called treatment effect (TE). This was expressed on one hand as pain reduction and on the other hand as general quality of life improvement. The calculations are performed on converted scales, with 0 defined as no symptoms and positive values designating levels of symptoms. TE is based on the following formula:

$$\mathrm{TE} = \frac{\text{preoperative score - postoperative score}}{\text{preoperative score}}$$

In other words, this metric is the relative symptom reduction expressed on a numerical scale, whereby 1 equals complete symptom regression, 0 representing the complete absence of effect (e.g. same pain reported as before treatment), and a negative value represents an outcome worse than the pre-operative state (e.g. more pain than before treatment). The analysis excludes patients who did not report pre-operative symptoms (= 0). The scale can be presented as approximate percentage categories for comparison between settings or types of procedures. However, readers are advised that this purely numerical analysis may differ from other clinical evaluations of treatment success. We used TE for both the pain score and the EQ-5D summary scores.

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[1] Huber J, Irlenbusch U, Kääb MJ, Reuther F, Kohut G, Judge A.
Treatment effects of reverse total shoulder arthroplasty – a simple method to measure outcomes at 6, 12, 24 and 60 months for each patient. BMC Musculoskelet Disord. 2020 Jun 22;21(1):397. doi: 10.1186/s12891-020-03427-7. PMID: 32571282; PMCID: PMC7310507.

[2] Huber J, Dieppe P, Dreinhoefer K, Günther KP, Judge A.
The Influence of Arthritis in Other Major Joints and the Spine on the One-Year Outcome of Total Hip Replacement: A Prospective, Multicenter Cohort Study (EUROHIP) Measuring the Influence of Musculoskeletal Morbidity. J Bone Joint Surg Am. 2017 Sep 6;99(17):1428-1437. doi: 10.2106/JBJS.16.01040. PMID: 28872524; PMCID: PMC5685421.

# 3. Demography and Epidemiology

## 3.1 Introduction

Switzerland has an intricated and arguably unique healthcare system. In addition to a national health department, which plays a coordinating role, each canton holds full responsibility for its own healthcare services. In fact, the federal government of Switzerland acts on the principle of subsidiarity, intervening only for questions of nationwide importance – as it was the case during the COVID-19 pandemic. Even university hospitals are not part of a centralised, national healthcare system. Instead, they are owned and managed by the individual cantons in which they are located. Furthermore, alongside the public healthcare service overseen by the cantons, a significant portion of the healthcare provision is organised privately. However, most private hospitals hold a public service mandate of the cantons and take part in the public healthcare system of the cantons.

Healthcare insurance is mandatory in Switzerland, but it is likely as complex as the organisation of the healthcare services. Currently, there are three levels of inpatient healthcare insurance coverage: general/public, semi-private and private. In the event of a hospital stay, the patient pays only a small proportion of the costs, while the large majority is covered jointly by the insurance company and the canton, the exact amount and distribution of costs depending on the insurance model. A nationwide insurance system exists for accidents, covering all related expenses, including compensation for work incapacity or a pension, if necessary.

Traditionally, the French speaking, western part of Switzerland has maintained close ties with France, just as the canton Ticino has with northern Italy, or the German speaking part has with Germany and Austria. This has made Switzerland something of a melting pot of different concepts and approaches in orthopaedic surgery, particularly in hip and knee arthroplasty. It may also explain why we are able to report on nearly every existing brand and technology, even only in relatively small numbers due to the country's small size. In this context, it is a fortunate circumstance that the Swiss joint registry is organised at the national level and, thanks to mandatory reporting, achieves a participation rate of 98.5%.

Because of the abovementioned fragmentation of the healthcare system, the chapter Epidemiology will highlight results at the national level, as well as by canton or region, and finally at the level of individual hospitals. The Principality of Lichtenstein is included in the analysis.

## 3.2 Hip arthroplasty

### 3.2.1 Nationwide data, Switzerland and Principality of Liechtenstein

**Incidence of THA and HA**

Since introduction of SIRIS in 2012, a total of 251,930 primary THA and 28,039 primary HA were registered, along with 33,201 revision arthroplasties of the hip. Overall, 41.2% of the revisions could be linked to a previously registered primary or revision procedure. The proportion of linked revisions increased from 13.1% in 2012 to 57.2% in 2024. However, 43.8% of the revisions remain unlinked, mainly because the index procedure was performed prior to implementation of SIRIS in 2012, or because the index arthroplasty was not reported **(Table 3.1).**

The incidence of THA has steadily increased over the years, from 228 per 100,000 inhabitants in 2013 to 286 per 100,000 inhabitants in 2024. This corresponds to an average annual increase of approximately 1%. Among the population most at risk – the age group between 50 to 89 years, who account for 98% of the THA recipients – the incidence reached 672 per 100,000 inhabitants at risk in 2024 **(Figure 3.1).** This corresponds to a yearly growth rate of approximately 2%. As this exceeds the overall growth rate of the incidence, it indicates an age-biased distribution of the population.

| Year | Primary THA | Primary HA | Primary others or type unclear | Primary total[1] | Annual growth rate THA | Annual growth rate HA | Linked Rev./ Reop. of THA[2] | Linked Rev./Reop. of HA[2] | Unlinked Rev./ Reop.[3] | Rev./ Reop. total[4] | % Linked Rev./ Reop. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2012*** | 6,704 | 637 | 3 | 7,344 | | | 113 | 6 | 792 | 911 | 13.1 |
| **2013** | 16,900 | 1,935 | 3 | 18,838 | | | 409 | 39 | 1,871 | 2,320 | 19.3 |
| **2014** | 17,184 | 2,030 | 1 | 19,215 | 1.7% | 4.9% | 572 | 60 | 1,900 | 2,533 | 25.0 |
| **2015** | 17,696 | 1,991 | 5 | 19,692 | 3.0% | -1.9% | 726 | 65 | 1,812 | 2,604 | 30.4 |
| **2016** | 18,712 | 2,007 | 4 | 20,723 | 5.7% | 0.8% | 843 | 85 | 1,714 | 2,644 | 35.1 |
| **2017** | 18,888 | 2,098 | 9 | 20,995 | 0.9% | 4.5% | 865 | 78 | 1,681 | 2,629 | 35.9 |
| **2018** | 19,530 | 2,263 | 5 | 21,798 | 3.4% | 7.9% | 970 | 101 | 1,566 | 2,638 | 40.6 |
| **2019** | 20,201 | 2,359 | 8 | 22,568 | 3.4% | 4.2% | 1,109 | 106 | 1,529 | 2,747 | 44.2 |
| **2020** | 20,362 | 2,430 | 5 | 22,797 | 0.8% | 3.0% | 1,250 | 108 | 1,461 | 2,825 | 48.1 |
| **2021** | 22,117 | 2,409 | 8 | 24,534 | 8.6% | -0.9% | 1,356 | 118 | 1,340 | 2,815 | 52.4 |
| **2022** | 23492 | 2,629 | 1 | 26,122 | 6.2% | 9.1% | 1,342 | 138 | 1,304 | 2,789 | 53.1 |
| **2023** | 24,669 | 2,605 | 5 | 27,279 | 5.0% | -0.9% | 1,472 | 125 | 1,339 | 2,936 | 54.4 |
| **2024** | 25,475 | 2,646 | 1 | 28,122 | 3.3% | 1.6% | 1,468 | 140 | 1,200 | 2,810 | 57.2 |
| **All** | **251,930** | **28,039** | **58** | **280,027** | | | **12,495** | **1,169** | **19,509** | **33,201** | **41.2** |

**Table 3.1**

**Total and partial hip arthroplasty (THA and HA), primary and revisions/reoperations**

All documented operations

[1] Does not represent a full year of data, as data collection in most hospitals started only in October 2012

[2] i.e. primaries already registered in SIRIS

[3] can be of THA and HA

[4] including linked revisions/reoperations of procedures that were classified as „primary others“ or of unclear type

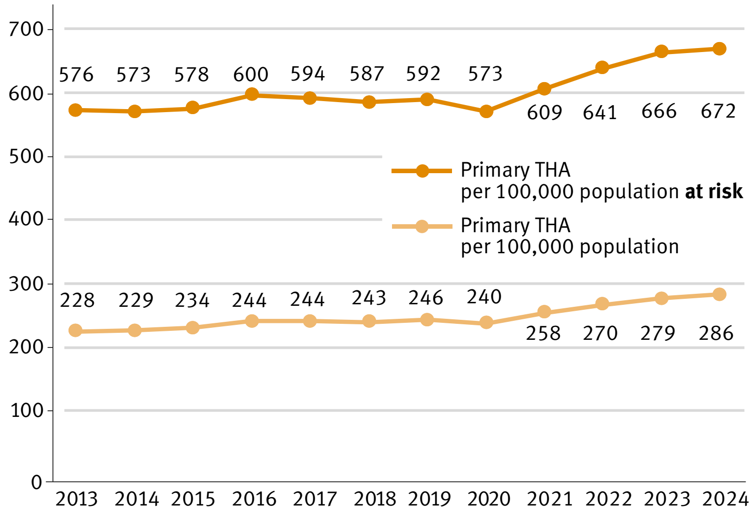


**Figure 3.1**

**Incidence of primary total hip arthroplasties registered in SIRIS**

Per 100,000 residents and per 100,000 residents at-risk*.
Adjusted for estimated coverage. SIRIS figures excluding Liechtenstein.
Coverage rates 2013–2016 estimated at 91% ; 2017–2023 based on federal health office data; 2024 estimated at 98.5%.
*Age group 50–89 years accounts for 93% of all recipients of THA

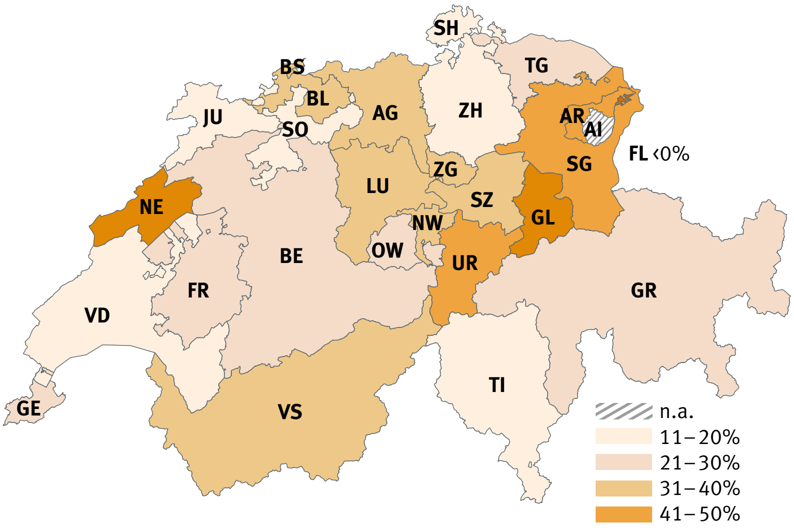


**Figure 3.2**

**Growth rates of primary hip arthroplasties by canton: 2019 – 2024**

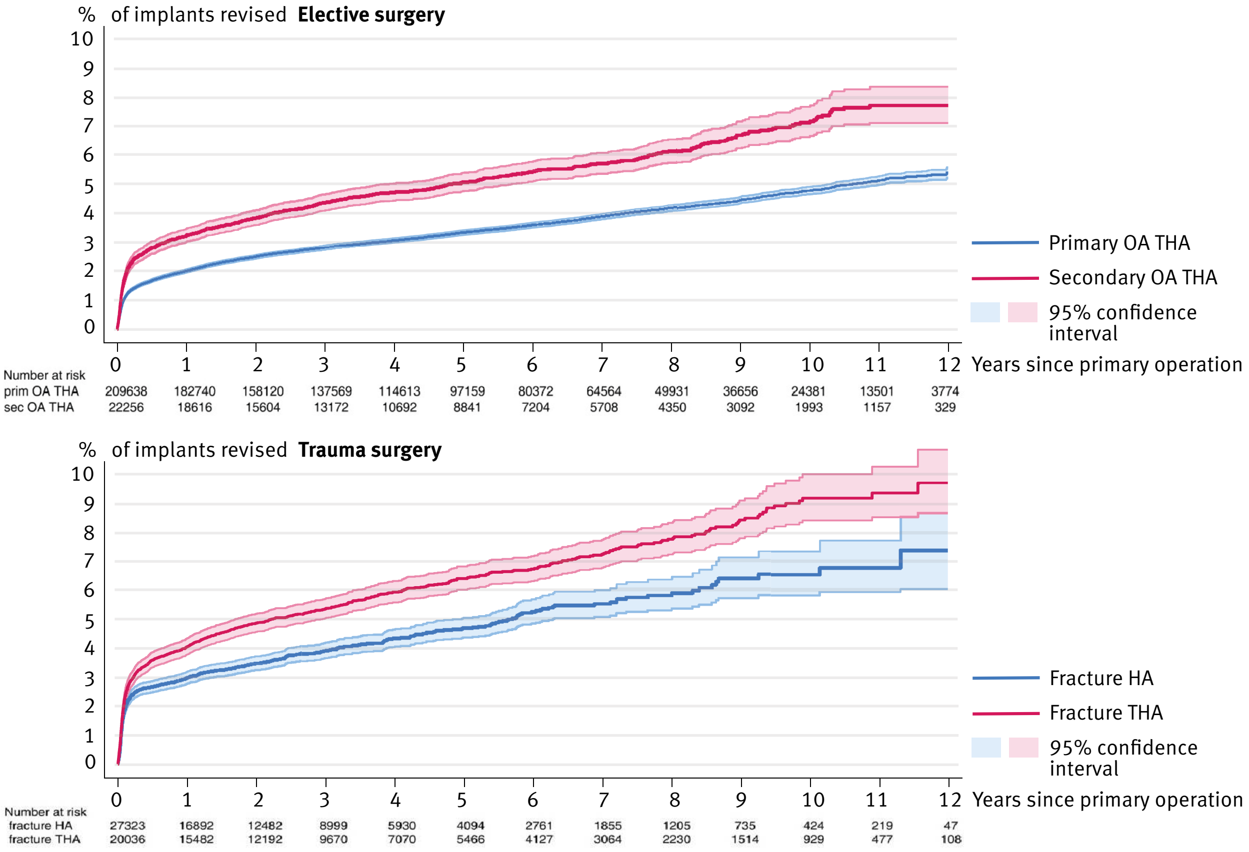
Looking at the incidence per 100,000 population, a significant drop occurred in 2020 due to restrictions linked to the COVID-19 pandemic. Before 2020, the average annual increase was approximately 0.5%. The growth rate peaked at 6.3% in 2021 and 5.3% in 2022, then declined to 3.9% in 2023 and further to 0.9% in 2024. Much of the surge in 2021 and 2022 appears to be a rebound effect following the COVID-19 pandemic.

**Growth rates of primary hip arthroplasty by cantons**

Between 2019 and 2024, the absolute growth rate was 24.6% nationwide. The growth rate per canton shows a heterogeneous pattern **(Figure 3.2)**. However, the figure illustrates the increase of THA performed by each canton, but the origin of the patient remains unknown. Patient flows may not be analysed from the data available to SIRIS.

### Revision rates

Revision rates increased over time since the index arthroplasty. The revision rate differs between reasons leading to surgery. Analysing data from 2012 onwards, at 2 years, the average revision rate for primary THA was 2.5% (CI 2.4 – 2.6%) for primary OA, whereas it was 3.9% (CI 3.6 – 4.1%) for secondary OA and as high as 4.9% (CI 4.6 – 5.2%) for primary THA performed for fracture. The 2-year revision rate for HA was 3.5% (CI 3.2 -3.7%). At 12 years, the revision rates were 5.4% (CI 5.2 – 5.6%), 7.7% (CI 7.1 – 8.4%), 9.7% (8.7 – 10.9%) and 7.4% (6.0 – 9.0%), respectively. Further details are provided in **Figure 3.3.**



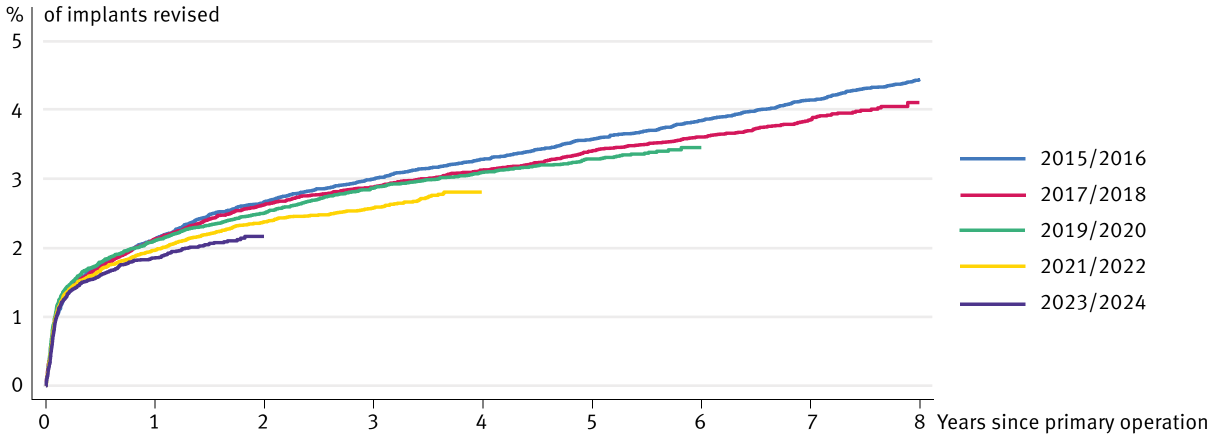
| Failure rate | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| Prim OA THA | **2.0** (2.0-2.1) | **2.5** (2.4-2.6) | **2.8** (2.7-2.9) | **3.3** (3.3-3.4) | **3.6** (3.5-3.7) | **4.2** (4.1-4.3) | **4.5** (4.3-4.6) | **4.8** (4.7-4.9) | **5.4** (5.2-5.6) |
| Sec OA THA | **3.2** (3.0-3.5) | **3.9** (3.6-4.1) | **4.4** (4.1-4.7) | **5.1** (4.8-5.4) | **5.4** (5.1-5.8) | **6.1** (5.7-6.5) | **6.7** (6.2-7.2) | **7.1** (6.6-7.7) | **7.7** (7.1-8.4) |
| Fracture HA | **3.0** (2.8-3.2) | **3.5** (3.2-3.7) | **3.9** (3.7-4.2) | **4.7** (4.4-5.1) | **5.3** (4.8-5.7) | **5.8** (5.3-6.4) | **6.4** (5.7-7.1) | **6.5** (5.8-7.3) | **7.4** (6.0-9.0) |
| Fracture THA | **4.0** (3.8-4.3) | **4.9** (4.6-5.2) | **5.4** (5.0-5.7) | **6.4** (6.0-6.8) | **6.7** (6.3-7.2) | **7.8** (7.2-8.3) | **8.4** (7.8-9.1) | **9.2** (8.4-10.0) | **9.7**(8.7-10.9) |

**Figure 3.3**

**Kaplan Meier estimate of cumulative postoperative revision risk after primary hip arthroplasty**

Time since operation, 2012 – 2024, all services, all diagnoses

The comparison of different periods since 2015 shows a trend of decreasing revision rates over time, particularly since 2021/2022 **(Figure 3.4)**. A statistically significant reduction is present for the one-year revision rate between the periods 2015/2016 and 2023/2024, and also for the three-year revision rates between 2025/2016 and 2021/2022. Such a decrease over time is one of the desired effects of a registry.



| Failure rate | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| 2015/2016 | **2.1** (2.0-2.3) | **2.7** (2.5-2.9) | **3.0** (2.8-3.2) | **3.3** (3.1-3.5) | **3.6** (3.4-3.8) | **3.8** (3.6-4.1) | **4.1** (3.9-4.4) | **4.4** (4.2-4.7) |
| 2017/2018 | **2.1** (2.0-2.3) | **2.6** (2.5-2.8) | **2.9** (2.7-3.1) | **3.1** (2.9-3.3) | **3.4** (3.2-3.6) | **3.6** (3.4-3.8) | **3.9** (3.6-4.1) | |
| 2019/2020 | **2.1** (2.0-2.3) | **2.5** (2.3-2.7) | **2.9** (2.7-3.0) | **3.1** (2.9-3.3) | **3.3** (3.1-3.5) | | | |
| 2021/2022 | **2.0** (1.8-2.1) | **2.4** (2.2-2.5) | **2.6** (2.4-2.7) | | | | | |
| 2023/2024 | **1.9** (1.7-2.0) | | | | | | | |

**Figure 3.4**

**Kaplan Meier estimate of cumulative postoperative revision risk after THA by time period**

Time since operation, 2015 – 2024, primary OA

### 3.2.2 Primary total hip arthroplasty

Since the introduction of SIRIS in 2012, a total of 251,930 primary THA have been registered. Over the last six years, 136,316 primary THA were registered, forming the base of the current analysis **(Table 3.2).** The registry discriminates between THA performed for primary OA (81.4%, the largest group), for secondary OA (9.3%, which includes post-traumatic OA, OA due to inflammatory diseases, avascular necrosis, and sequels of childhood diseases such as developmental dysplasia of the hip or Perthes' disease), and for fractures of the hip (9.3%). The proportion of primary OA continuously declined from 84.4% in 2018 and to 80.5% in 2024, while the proportions of secondary OA and fracture cases increased proportionally.

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|---|
| **N** | | **20,201** | **20,362** | **22,117** | **23,492** | **24,669** | **25,475** | **136,316** |
| Diagnosis [%] | Primary OA | 83.6 | 82.1 | 81.0 | 80.6 | 81.0 | 80.5 | 81.4 |
| | SecondaryOA | 8.5 | 9.1 | 9.4 | 9.6 | 9.4 | 9.8 | 9.3 |
| | Fracture | 7.9 | 8.8 | 9.6 | 9.7 | 9.6 | 9.7 | 9.3 |
| Women [%] | | 53.1 | 52.3 | 53.8 | 53.3 | 53.5 | 53.5 | 53.3 |
| Mean age (SD) | All | 69.1 (11.5) | 69.0 (11.6) | 69.2 (11.7) | 69.5 (11.5) | 69.4 (11.4) | 69.4 (11.5) | 69.3 (11.5) |
| | Women | 70.8 (11.2) | 70.6 (11.4) | 70.8 (11.5) | 71.0 (11.2) | 70.8 (11.0) | 70.9 (11.2) | 70.8 (11.3) |
| | Men | 67.1 (11.6) | 67.1 (11.6) | 67.4 (11.7) | 67.7 (11.6) | 67.6 (11.5) | 67.7 (11.7) | 67.5 (11.6) |
| Age group [%] | ‹45 | 2.5 | 2.5 | 2.7 | 2.4 | 2.5 | 2.7 | 2.5 |
| | 45–54 | 8.6 | 8.9 | 8.6 | 7.9 | 7.5 | 7.5 | 8.1 |
| | 55–64 | 21.6 | 21.9 | 21.3 | 22.0 | 22.2 | 22.3 | 21.9 |
| | 65–74 | 32.3 | 31.6 | 30.9 | 30.6 | 31.4 | 30.4 | 31.2 |
| | 75–84 | 27.7 | 27.8 | 28.7 | 29.5 | 29.0 | 29.6 | 28.8 |
| | 85+ | 7.3 | 7.3 | 7.8 | 7.7 | 7.4 | 7.6 | 7.5 |
| N unknown BMI (%) | | 2,925 (14) | 2,515 (12) | 1,964 (9) | 1,333 (6) | 1,275 (5) | 927 (4) | 10,939 (8) |
| N known BMI | | 17,276 | 17,847 | 20,153 | 22,159 | 23,394 | 24,548 | 125,377 |
| Mean BMI (SD) | | 27.0 (5.0) | 26.9 (5.1) | 26.9 (5.2) | 26.9 (5.2) | 26.9 (5.2) | 26.9 (5.2) | 26.9 (5.1) |
| BMI [%] | ‹18.5 | 2.1 | 2.3 | 2.2 | 2.2 | 2.2 | 2.1 | 2.2 |
| | 18.5–24.9 | 35.6 | 36.5 | 36.2 | 36.6 | 36.5 | 36.9 | 36.4 |
| | 25–29.9 | 39.1 | 38.1 | 37.4 | 36.8 | 37.4 | 37.5 | 37.6 |
| | 30–34.9 | 16.6 | 16.6 | 17.3 | 17.6 | 16.9 | 16.5 | 16.9 |
| | 35–39.9 | 5.2 | 4.8 | 5.1 | 5.2 | 5.2 | 5.0 | 5.1 |
| | 40+ | 1.5 | 1.7 | 1.9 | 1.7 | 1.8 | 1.9 | 1.8 |
| N unknown ASA (%) | | 1,497 (7) | 1,238 (6) | 738 (3) | 385 (2) | 378 (2) | 334 (1) | 4,570 (3) |
| N known ASA | | 18,704 | 19,124 | 21,379 | 23,107 | 24,291 | 25,141 | 131,746 |
| Morbidity | ASA 1 | 12.1 | 11.6 | 11.2 | 9.9 | 9.6 | 8.9 | 10.4 |
| state [%] | ASA 2 | 59.1 | 59.0 | 57.8 | 58.9 | 59.3 | 58.8 | 58.8 |
| | ASA 3 | 27.9 | 28.3 | 29.8 | 29.9 | 29.9 | 31.2 | 29.6 |
| | ASA 4/5 | 0.8 | 1.0 | 1.2 | 1.3 | 1.2 | 1.1 | 1.1 |

**Table 3.2**

**Primary total hip arthroplasty: Baseline patient characteristics by year**

## Sex and age

Both the age and the male/female ratio remained stable over time for primary THA. Women represented 53.3% of the primary THA registered, and their mean age of 70.8 years was higher than the 67.5 years of men.

The distribution among the age groups showed minimal changes over the last 6 years. Overall, 67.5% of THA were performed in patients older than 65 years of age. Patients aged over 85 years represented 7.5%, while patients aged ‹55 years constituted 10.6% of the recipients. The proportion of THA performed on patients ‹45 years of age remained constant over the years, oscillating between 2.5 and 2.7%. This corresponds to 3,470 patients younger than 45 years. In contrast, the largest group were patients between 65 and 74 years of age, representing 31.2% or 42,473 patients **(Table 3.2)**. For fractures, most patients were 85 years and older **(Figure 3.5)**.

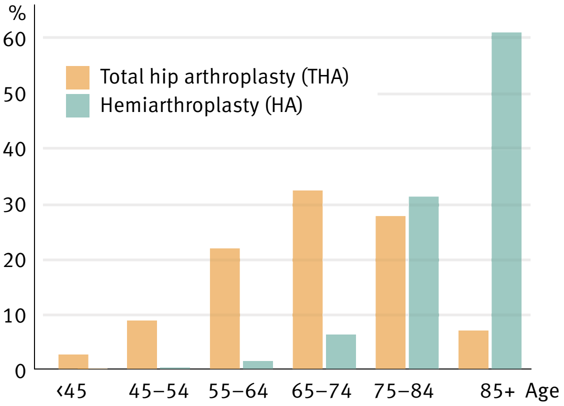


**Figure 3.5**

**Age distribution at surgery of primary total hip arthroplasty and hemiarthroplasty**

All documented operations

## BMI and ASA score

BMI and ASA scores are recorded in SIRIS only since 2015. Data collection is still improving. Pleasingly, the share of unknown BMI decreased continuously from 16% in 2018 to 5% in 2023 and finally 4% in 2024. This is due to the ongoing efforts of the support team supervising the clinics.

The mean BMI was 26.9 kg/m² for all primary THA, whereby 37.6% were performed in overweight patients (BMI 25 – 29.9 kg/m²) and 23.8% in obese patients (BMI ›30 kg/m²) **(Table 3.2)**. Younger patients were observed to have higher BMI, and this observation could be made in both male and female patients **(Figure 3.6)**. The distribution of BMI remained constant during the observation period between 01.01.2019 and 31.12.2024.

Most primary THA were performed on healthy individuals (ASA class 1 and 2), but 32.3% of the THA were performed on patients ASA class ≥3. The proportion of ASA class 3 patients increased from 27.9% in 2019 to 31.2% in 2024. During the same period, the proportion of ASA class 1 patients continued to decrease from 12.1% in 2019 to 8.9% in 2024.

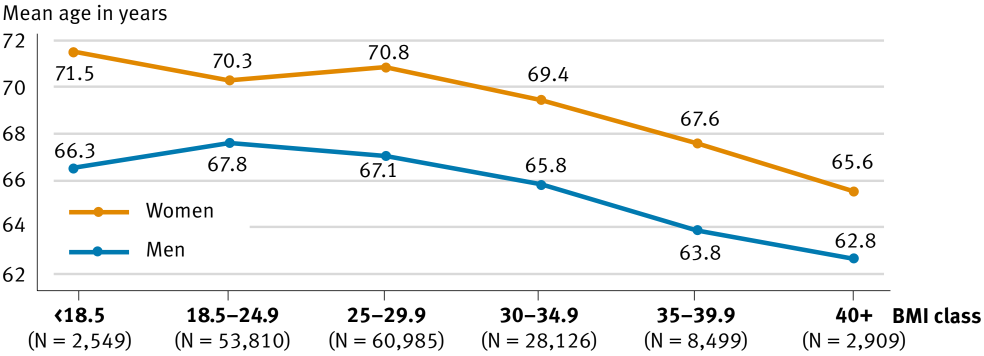


**Figure 3.6**

**Primary total hip arthroplasty: Mean age at primary arthroplasty depending on BMI class**

Primary and secondary osteoarthritis patients only. Please note that group sizes vary considerably. All documented operations

| | | Primary OA | Secondary OA | Fracture |
|---|---|---|---|---|
| N (2019 – 2024) | | **110,954** | **12,706** | **12,656** |
| Women [%] | | 51.7 | 57.4 | 63.1 |
| Mean age | All | 69.2 (10.8) | 63.9 (15.3) | 74.9 (10.9) |
| (SD) | Women | 70.8 (10.4) | 65.5 (15.2) | 76.1 (10.3) |
| | Men | 67.6 (10.9) | 61.7 (15.3) | 73.0 (11.7) |
| Age group | <45 | 1.8 | 11.2 | 0.8 |
| [%] | 45–54 | 7.7 | 16.0 | 3.5 |
| | 55–64 | 22.8 | 22.3 | 13.3 |
| | 65–74 | 32.8 | 22.1 | 25.6 |
| | 75–84 | 28.7 | 20.9 | 37.3 |
| | 85+ | 6.1 | 7.6 | 19.5 |
| Diagnosis | Osteoarthritis | 99.9 | 0.0 | 0.0 |
| [%] | Inflammatory arthritis | 0.0 | 4.0 | 0.0 |
| | Developmental dysplasia | 0.0 | 27.5 | 0.0 |
| | Osteonecrosis | 0.0 | 55.4 | 0.0 |
| | Miscellaneous* | 0.1 | 13.1 | 2.3 |
| | Fracture | 0.0 | 0.0 | 97.7 |
| N unknown BMI (%) | | 8,487 (8) | 826 (7) | 1,626 (13) |
| N known BMI | | 102,467 | 11,880 | 11,030 |
| Mean BMI (SD) | | 27.2 (5.1) | 26.7 (5.5) | 24.2 (4.5) |
| BMI [%] | <18.5 | 1.5 | 2.7 | 7.4 |
| | 18.5–24.9 | 34.0 | 39 | 55.2 |
| | 25–29.9 | 39.0 | 34.4 | 28.3 |
| | 30–34.9 | 18.1 | 16.2 | 7.0 |
| | 35–39.9 | 5.5 | 5.1 | 1.6 |
| | 40+ | 1.8 | 2.3 | 0.5 |
| N unknown ASA | | 3,752 (3) | 338 (3) | 480 (4) |
| N known ASA | | 107,202 | 12,368 | 12,176 |
| Morbidity | ASA 1 | 10.7 | 12.1 | 6.0 |
| state [%] | ASA 2 | 61.5 | 53.5 | 41.3 |
| | ASA 3 | 27.2 | 32.8 | 48.0 |
| | ASA 4/5 | 0.6 | 1.6 | 4.8 |

**Table 3.3**

**Primary total hip arthroplasty: Baseline patient characteristics by main diagnostic group**

* Miscellaneous diagnoses are free text entries that typically describe more complex situations. Most of those must be classified as secondary arthroses, but there are also entries that describe fractures or directly fracture-related conditions such as pathological fractures or complications after osteosynthesis.

### Underlying diagnosis

Patients treated for secondary OA were on average 5.3 years younger than those treated for primary OA. The proportion of developmental dysplasia of the hip among all primary THA performed for secondary OA increased from 20.5% in 2015 to 27.5% in 2024, while the majority of this subgroup (55.4%) were treated for avascular necrosis. Compared to the other main diagnostic groups, an increasing number of young patients (<45 years) were treated for secondary OA, reaching 11.2% in 2024 **(Table 3.3).**

Among the patients treated for fractures, there were considerably more women than men, representing close to two-thirds (63.1%). The average age of these women was 76.1 years, compared to 73.0 years for men. More than 80% of fractures occurred in patients over 65 years of age, and more than 55% in patients over 75 years. There was also a much higher proportion of patients in the fracture group belonging to ASA class ≥ 3 (48%).

### Regional differences in bearing selection

The choice of bearing surfaces has an important impact on durability of an implant combination. The choice of the material of the femoral head (metal, ceramic, ceramicised metal) and acetabular side (ceramic, standard polyethylene, highly crosslinked polyethylene) is based on patient, surgeon and economic factors. In addition to the material, different head sizes can be used. There are distinct regional differences.

The two most common cup materials are highly cross-linked polyethylene (XLPE) and ceramic inlays. In the cantons of Bern, Obwalden and St. Gallen XLPE is used in 81–90% of the cases. In Zug almost always XLPE cups are used. In contrast, in the Wallis, XLPE is rarely used, and ceramic is the predominant bearing **(Figure 3.7).**

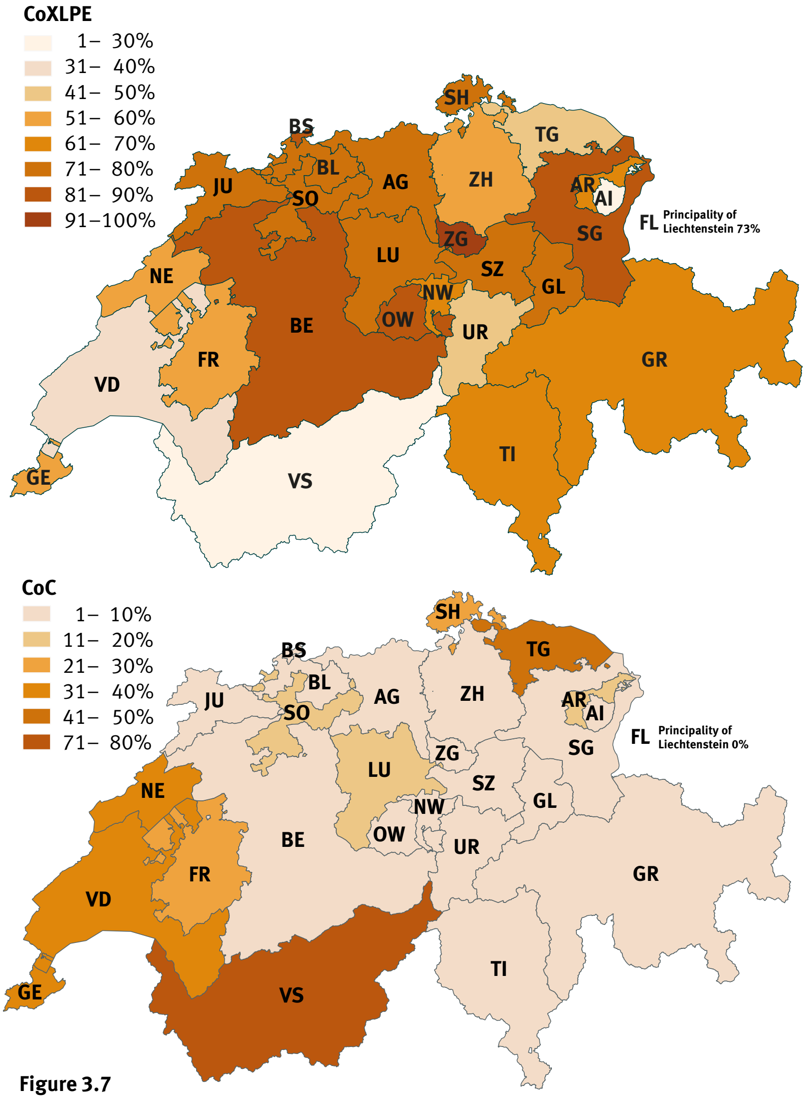


**Figure 3.7**

**Relative share of total hip arthroplasty procedures using different bearing surfaces by canton (2019 – 2024)**

Primary OA

In general head sizes of 36 and 32mm are used. Smaller head (22 and 28mm) are used in special situations with very small hips or implants. Large 36mm heads are used in more than 50% of the cases in the cantons of Vaud, Fribourg, Aargau, Thurgau and Appenzell Aussen- and Innerrhoden. In Nidwalden and Uri there is almost no use of 36mm heads – there 32mm heads are used predominantly. Central Switzerland, Bern and Zurich used 36mm head in 30–40% **(Figure 3.8).**

The use of DMC is also very regional **(Figure 3.9).** It is used more frequently in the French speaking part of Switzerland, in North-Eastern Switzerland and in the canton Schwyz. The rationale is to reduce the risk of dislocations with the use of large femoral heads and is in part triggered by the approach with posterior approaches having an increased rate of dislocations. On the other hand, there is also an influence through neighboring countries, as in France DMC are more commonly used.

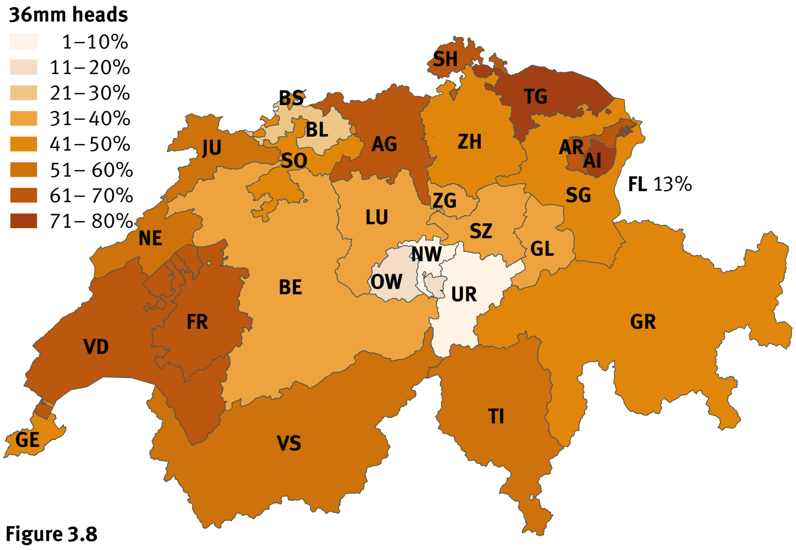


**Figure 3.8**

**Relative share of total hip arthroplasty procedures using 36 mm heads by canton (2019 – 2024)**

Primary OA, only uncemented fixation and regular cups

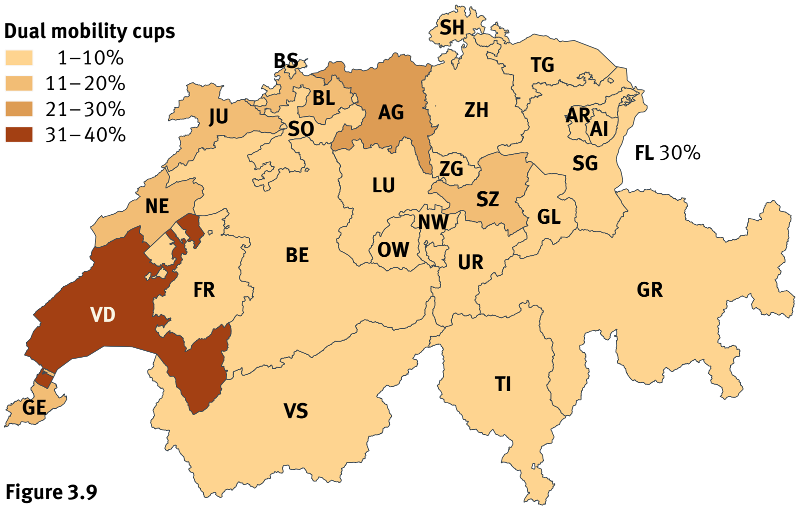


**Figure 3.9**

**Relative share of total hip arthroplasty procedures using dual mobility cups by canton (2019 – 2024)**

Primary OA, only uncemented fixation and regular cups

### 3.2.3 Revision of primary THA

The current 4-year moving window from 01.01.2019 to 31.12.2022 (with 2 years follow-up) included 86,177 documented primary THA, of which 70,465 had been made for primary OA, 7,900 for secondary OA, and 7,812 for the treatment of fractures. A total of 2,395 of these had been revised within 2 years, resulting in an overall revision rate of 2.8% (CI 2.7 – 2.9%) **(Table 4.9).** The revision rate for primary OA was 2.4% (CI 2.3 – 2.6%), for secondary OA 4.0% (CI 3.6 – 4.5%) and for fractures 5.0% (CI 4.5 – 5.5%).

**Sex and age**

There was no significant difference in the 2-year revision rate among men (2.4%, CI 2.2 – 2.6%), compared to women (2.5%, CI 2.3 to 2.7%). The overall revision rate for primary OA improved by 0.1 percentage points compared to the previous 4-year period. The lowest 2-year revision rate (2.0%, CI 1.8 – 2.2%) was observed in the age group 55-64 years old. The age groups ‹55 and 75– 84 years of age had the highest revision rate of 2.7% (CI 2.4 – 3.1% and 2.5 – 3.0%, respectively).

**BMI and ASA-score**

BMI had a relevant impact on the 2-year revision rate. The highest revision rates were found in patients with a BMI ›35kg/m². In these groups it was almost three times higher than in normal weight patients.
The ASA score had a minor influence on the revision rate. The highest revision rate of 3.3% (CI 3.0 – 3.5%) was found in ASA class 3 patients. On the other hand, healthy patients (ASA class 1 and 2) had the lowest revision rate (1.9% CI 1.7 – 2.1% and 2.2% CI 2.0 –2.4%).

**Underling diagnosis**

The revision rate differs between the various underlying diagnosis. For primary OA, the 2-year revision rate was 2.4% (CI 2.3 – 2.6%), whereas for secondary OA it was 4.0% (CI 3.6 – 4.5%) and for fractures it increased to 5.0% (CI 4.0 – 5.5%), each significantly different from the other subgroups.

### 3.2.4 Data by hospitals

In 2024, 146 hospital units performed primary THA, with a yearly average load of 143 THA per unit. The number of units continues to decline from 153 in 2020 to 146 in 2024. However, these numbers also may reflect purely administrative measures, including consolidation of units within hospitals or hospital groups. There is a shift towards larger units performing an increasing number of THA. In 2019, 12.1% of all THA were implanted in units performing ‹100 cases/year. In 2024, this share decreased to 7.8%. The same trend is observed in units performing 100-199 cases/year. On the other hand, the share of units performing ›200 cases/year increased from 54.6% in 2019 to 73.6% in 2024 **(Tables 3.4 and 3.5).**

Since 2013, the contribution of smaller services with ‹200 cases/year declined from 51% to 26%. At the same time, the proportion of implantations in larger services increased from 49% to 74%. There is a clear trend for concentration in larger centres throughout the country **(Figure 3.10).**

**Figure 3.11** illustrates the distribution of the workload among the 149 units participating in 2024, including three units performing only HA. The largest unit performed 1,362 primary THA, while nine units did ‹10 cases/year, two of those performing only one primary THA. Hip revision arthroplasty was performed in 131 units. However, 52 of them did ‹10 revisions per year **(Figure 3.11).**

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|
| Primary total hip arthroplasty | N services | 150 | 153 | 149 | 150 | 147 | 146 |
| | M per service | 87 | 94 | 117 | 122 | 132 | 143 |
| Primary hemiarthroplasty of the hip | N services | 126 | 125 | 105 | 110 | 105 | 101 |
| | M per service | 10 | 10 | 16 | 17 | 16 | 18 |
| Revision arthroplasty (THA or HA) | N services | 137 | 134 | 140 | 142 | 131 | 131 |
| | M per service | 10 | 12 | 12 | 11 | 12 | 13 |

**Table 3.4**

**Number of participating hospital services (N) and median procedures (M) per unit per year**

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|
| ‹100 | N procedures (%) | 2,236 (12.1) | 2,829 (14.0) | 2355 (10.9) | 2,431 (10.4) | 2,439 (9.9) | 1,996 (7.8) |
| | N services (%) | 64 (42.7) | 73 (47.7) | 61 (40.9) | 56 (37.3) | 56 (38.1) | 49 (33.6) |
| 100–199 | N procedures (%) | 6,669 (33.3) | 5,551 (27.5) | 6,097 (27.9) | 6,675 (28.6) | 4,887 (19.9) | 4,750 (18.7) |
| | N services (%) | 51 (34.0) | 43 (28.1) | 46 (30.9) | 50 (33.3) | 37 (25.2) | 38 (26.0) |
| 200–299 | N procedures (%) | 4,424 (22.1) | 4,995 (24.8) | 5,185 (23.8) | 5751 (24.6) | 7,473 (30.5) | 8,170 (32.1) |
| | N services (%) | 20 (13.3) | 22 (14.4) | 24 (16.1) | 26 (17.3) | 34 (23.1) | 34 (23.3) |
| ›300 | N procedures (%) | 6,522 (32.5) | 6,800 (33.7) | 8,178 (37.4) | 8,509 (36.4) | 9,717 (39.6) | 10,559 (41.5) |
| | N services (%) | 15 (10.0) | 15 (9.8) | 18 (12.1) | 18 (12.0) | 20 (13.6) | 20 (13.7) |

**Table 3.5**

**Number of hospital services and number of primary total hip arthroplasties according to hospital volume***

*Note that service volume is defined as the sum of primary procedures per year

The distinction between larger and smaller services is based on the annual volume of THA. However, it does not necessarily indicate that surgery is performed by high volume surgeons in larger services. There are larger services with numerous attending physicians, each of them contributing various number of surgeries. Some of them may perform hundreds of primary THA, whereas others contribute only few procedures. On the other hand, it may well be that in smaller units, only one or a few surgeons are performing THA, at a comparable frequency as others in large services. Therefore, caution is advised before drawing conclusions about the effect of numbers on the quality of THA.

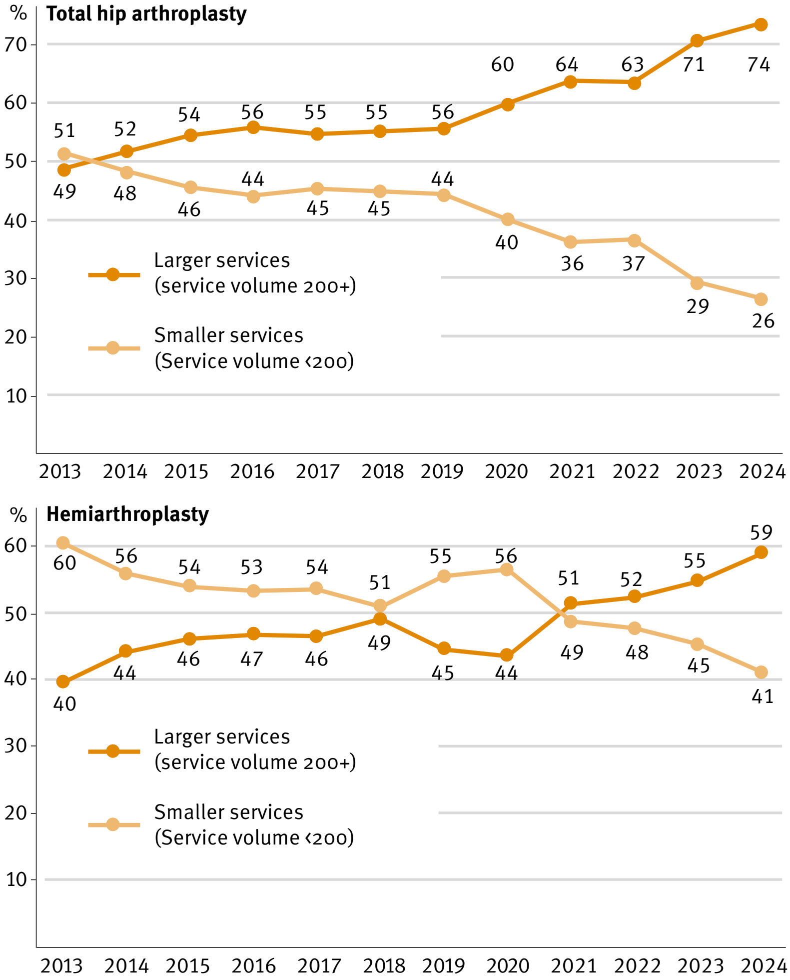


**Figure 3.10**

What share of selected procedures is performed in hospital services with different service volumes*?

* Note that service volume is defined as the sum of primary procedures per year

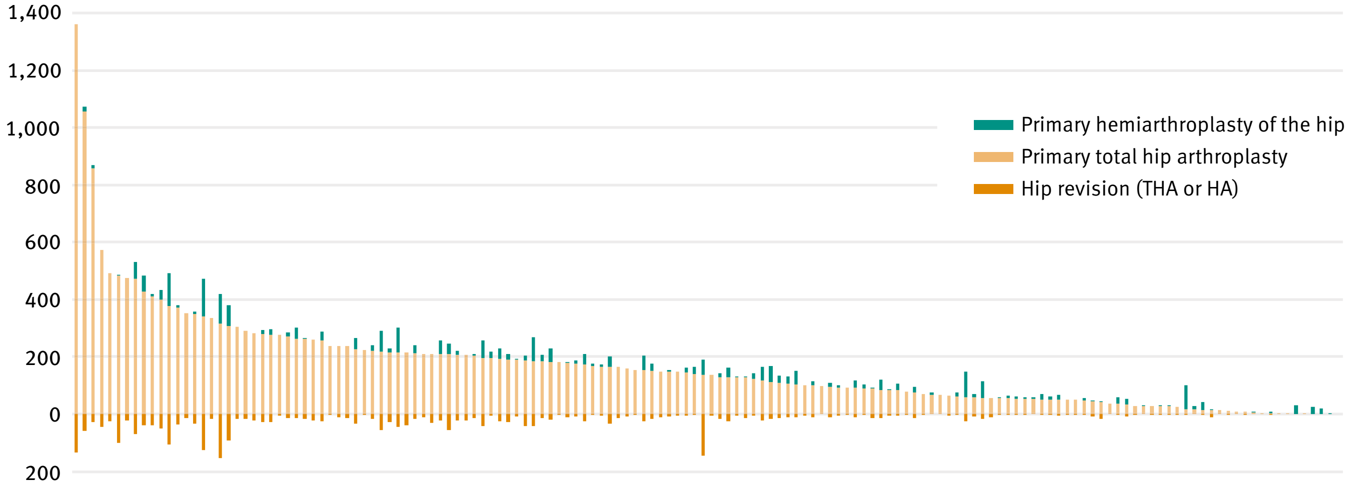


**Figure 3.11**

Cases per hospital service 2024: Total hip arthroplasty and hemiarthroplasty

In 2024, 14,193 THA were implanted in the 49 units performing ‹100 THA/year (10%), corresponding to 999 fewer cases than in 2023. Compared to 2023, an increase of 4,079 cases was observed in the 20 services performing more than 300 THA/year, corresponding to 51,378 primary THA. In these larger units, primary THA for secondary OA were performed more frequently, and the share of young patients was higher **(Table 3.6).**

| Hospital service volume | | ‹100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| N (2019–2024) | | **14,193** | **33,492** | **37,253** | **51,378** |
| Women [%] | | 52.7 | 53.8 | 52.7 | 53.5 |
| Mean age (SD) | All | 70.4 (11.1) | 69.9 (11.3) | 69.5 (11.3) | 68.4 (12.0) |
| | Women | 71.9 (10.9) | 71.5 (10.9) | 71.0 (11.0) | 70.0 (11.7) |
| | Men | 68.8 (11.1) | 68.0 (11.4) | 67.8 (11.3) | 66.6 (12.0) |
| Age group [%] | ‹45 | 1.6 | 2.0 | 2.2 | 3.4 |
| | 45–54 | 7.2 | 7.5 | 7.8 | 8.9 |
| | 55–64 | 20.3 | 21.1 | 21.8 | 22.9 |
| | 65–74 | 31.1 | 31.5 | 31.6 | 30.6 |
| | 75–84 | 30.7 | 29.7 | 29.1 | 27.5 |
| | 85+ | 9.1 | 8.2 | 7.5 | 6.7 |
| Diagnosis [%] | Primary OA | 79.2 | 80.9 | 83.5 | 80.8 |
| | Secondary OA | 7.9 | 7.7 | 7.4 | 12.2 |
| | Fracture | 12.9 | 11.5 | 9.1 | 7.0 |
| N unknown BMI (%) | | 2,216 (16) | 3,166 (9) | 2,362 (6) | 3,195 (6) |
| N known BMI | | 11,977 | 30,326 | 34,891 | 48,183 |
| Mean BMI (SD) | | 26.8 (5.0) | 27.0 (5.1) | 27.1 (5.2) | 26.8 (5.1) |
| BMI [%] | ‹18.5 | 2.4 | 2.3 | 2.0 | 2.2 |
| | 18.5–24.9 | 37.2 | 35.8 | 35.5 | 37.2 |
| | 25–29.9 | 37.6 | 37.4 | 37.9 | 37.6 |
| | 30–34.9 | 16.9 | 17.3 | 17.2 | 16.5 |
| | 35–39.9 | 4.5 | 5.3 | 5.5 | 4.8 |
| | 40+ | 1.4 | 1.8 | 1.9 | 1.7 |
| N unknown ASA (%) | | 335 (2) | 1,382 (4) | 1,049 (3) | 1,804 (4) |
| N known ASA | | 13,858 | 32,110 | 36,204 | 49,574 |
| Morbidity state [%] | ASA 1 | 10.8 | 9.4 | 10.0 | 11.3 |
| | ASA 2 | 59.3 | 58.9 | 59.6 | 58.1 |
| | ASA 3 | 28.6 | 30.5 | 29.4 | 29.5 |
| | ASA 4/5 | 1.2 | 1.1 | 1.0 | 1.1 |

**Table 3.6**

**Primary total hip arthroplasty: Baseline patient characteristics of primary total hip arthroplasty by hospital service volume***

Calculations of hospital service volume based on primary hip surgeries in each included year (2019–2024).

*Note that service volume is defined as the sum of primary procedures per year

**Reporting of prostheses-related revision rates by hospitals**

The national average revision rate at 2 years for THA for primary OA of 2.5% (CI 2.3 – 2.6%) served as reference for calculating the outlier status of individual hospitals, implants and surgeons. The results for all participating units are shown in funnel plots **(Figure 3.12).** Results were risk-adjusted for age, sex, BMI, ASA, and Charnley scores, as available, and restricted to THA performed solely for primary OA. Each dot represents a hospital/service. Confidence intervals were centred on the national average. Following convention, the 99.8% control limits were used to define the outlier status, whereas units between the 95% and 99.8% limits are defined as units with an elevated revision rate. In 2024, there were three units, one less than in 2023, that were detected as outliers and 14 institutions with an elevated revision risk, two less than 2023. Such improvements would be part of the desired effect of an arthroplasty registry.

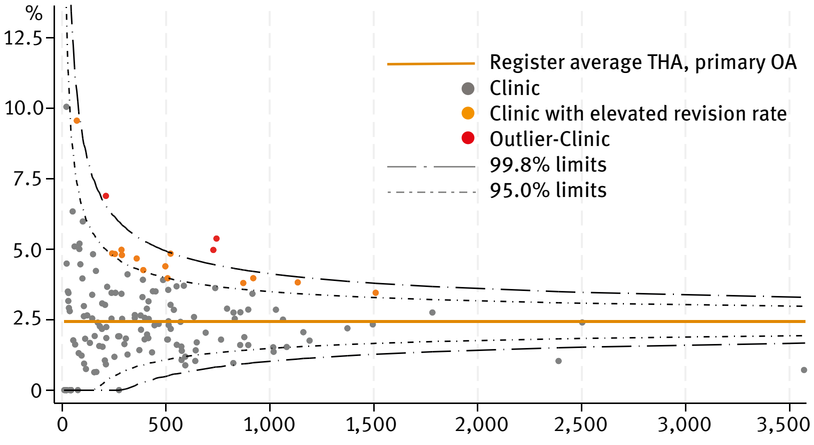


**Figure 3.12**

**2-year revision rate of primary total hip arthroplasty by service***

THA results restricted to patients with primary osteoarthritis (prim OA).
Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available
*Number of operations in the reporting period 01/2019–12/2022 (4-year moving average, follow-up to 12/2024)

## 3.2.5 Arthroplasty for fractures of the hip

Fractures of the hip may be treated by internal fixation, HA or THA. The choice of treatment option depends on the underlying pathology, functional requirements of the patient, availability within the department, as well as the experience of the treating surgeon. The patients' age, the activity level and comorbidities influence functional requirements and thus the choice of treatment option. Only arthroplasties are recorded in SIRIS. Therefore, internal fixation is not recorded. While HA is the preferred option in frail, low-demand patients, THA is more commonly performed in healthier and more active patients. SIRIS collects only data on fractures treated with THA or HA. The number of treatments with osteosynthesis is unknown. Therefore, growth rates may also reflect a change in treatment strategies between prostheses and osteosynthesis.

**Interpretation of funnel plots**

- The coloured line denotes the Swiss average 2-year revision rate
- Clinics that lie between the 95% limits (grey dots) have revision rates that are within the statistically expected range of observations given their operation volume
- Clinics below the 95/99.8% limits are performingbetter than the average
- Clinics above the 95% limit and below the 99.8% limit (orange dots) have elevated 2-year revision rates. This could be due to random variation, but we recommend that possible reasons are investigated, in particular if the position should be stable over time or worsen.
- Clinics above the 99.8% limit (red dots) have 2-year revision rates that deviate markedly from the national average (unlikely to be due to random variation alone).

Between 2019 and 2024, the registry recorded a total of 27,384 primary hip arthroplasties (both THA and HA) performed for fracture, with an annual increase of 7–8% per year. During this period, there was a 31% increase in the annual number of registered arthroplasties (both THA and HA) performed for fracture of the hip, from 3,873 to 5,075. The previously observed increase of hip fracture treatment with THA continued in 2024 **(Table 3.7).** However, growth declined since 2023 and was only 3% for 2024 **(Table 3.7).** In 2024, 46.2% of the patients treated for fractures of the hip got THA and 53.8% HA. There was a clear trend over the years towards treatment with THA, proportions increasing from 41.1% in 2019 to 48.7% in 2024.

### Sex and age

Women represented the majority of the patients treated for fractures, comprising 66.8% of the cases. The vast majority of patients (91.1%) was aged ›65 years, while the age group ›85 years accounted for 42.7% of

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|---|
| N | | **3,873** | **4,149** | **4,495** | **4,865** | **4,27** | **5,075** | **27,384** |
| Treatment with THA* [%] | | 41.1 | 43.1 | 47.5 | 47.1 | 48.3 | 48.7 | 46.2 |
| Treatment with HA** [%] | | 58.9 | 56.9 | 52.5 | 52.9 | 51.7 | 51.3 | 53.8 |
| Women [%] | | 69.1 | 67.1 | 67.0 | 66.9 | 65.8 | 65.4 | 66.8 |
| Mean age (SD) | All | 81.0 (10.7) | 81.1 (10.7) | 80.9 (10.7) | 80.8 (10.7) | 80.6 (10.7) | 80.5 (10.7) | 80.8 (10.7) |
| | Women | 81.7 (10.1) | 82.3 (10.0) | 81.8 (10.3) | 82.0 (10.0) | 81.7 (10.1) | 81.8 (9.7) | 81.9 (10.0) |
| | Men | 79.4 (11.7) | 78.7 (11.7) | 79.2 (11.4) | 78.6 (11.7) | 78.6 (11.6) | 78.1 (12.1) | 78.7 (11.7) |
| Age group [%] | ‹45 | 0.4 | 0.2 | 0.3 | 0.3 | 0.4 | 0.6 | 0.4 |
| | 45–54 | 1.8 | 1.9 | 1.6 | 1.8 | 1.9 | 1.5 | 1.8 |
| | 55–64 | 6.1 | 6.9 | 6.9 | 7.0 | 6.8 | 6.8 | 6.8 |
| | 65–74 | 15.3 | 14.7 | 14.7 | 13.9 | 14.9 | 14.5 | 14.7 |
| | 75–84 | 32.2 | 32.1 | 32.8 | 34.2 | 34.6 | 35.9 | 33.8 |
| | 85+ | 44.1 | 44.2 | 43.6 | 42.7 | 41.5 | 40.6 | 42.7 |
| N unknown BMI (%) | | 895 (23) | 781 (19) | 715 (16) | 609 (13) | 549 (11) | 395 (8) | 3,944 (14) |
| N known BMI | | 2,978 | 3,368 | 3,780 | 4,256 | 4,378 | 4,680 | 23,440 |
| Mean BMI (SD) | | 23.7 (4.3) | 23.6 (4.4) | 23.8 (4.3) | 23.6 (4.2) | 23.8 (4.6) | 23.7 (4.3) | 23.7 (4.4) |
| BMI [%] | ‹18.5 | 9.0 | 10.1 | 8.7 | 9.5 | 9.1 | 9.3 | 9.3 |
| | 18.5–24.9 | 57.4 | 56.7 | 56.7 | 56.5 | 57.3 | 57.4 | 57.0 |
| | 25–29.9 | 26.4 | 25.9 | 26.6 | 26.7 | 25.7 | 26.0 | 26.2 |
| | 30–34.9 | 5.5 | 5.6 | 6.4 | 6.2 | 5.9 | 5.7 | 5.9 |
| | 35–39.9 | 1.4 | 1.4 | 1.2 | 0.9 | 1.4 | 1.3 | 1.2 |
| | 40+ | 0.3 | 0.3 | 0.3 | 0.2 | 0.7 | 0.3 | 0.4 |
| N unknown ASA (%) | | 278 (7) | 247 (6) | 202 (4) | 135 (3) | 135 (3) | 84 (2) | 1,081 (4) |
| N known ASA | | 3,595 | 3,902 | 4,293 | 4,730 | 4,792 | 4,991 | 26,303 |
| Morbidity state [%] | ASA 1 | 3.3 | 3.7 | 3.1 | 3.4 | 2.6 | 2.7 | 3.1 |
| | ASA 2 | 30.7 | 28.9 | 28.0 | 27.4 | 28.6 | 28.6 | 28.6 |
| | ASA 3 | 58.4 | 59.9 | 60.2 | 60.4 | 60.1 | 61.0 | 60.1 |
| | ASA 4/5 | 7.6 | 7.4 | 8.6 | 8.8 | 8.7 | 7.7 | 8.2 |

**Table 3.7**

**Fracture of the hip: Baseline patient characteristics by year**

*THA= Total Hip Arthroplasty. **HA= Hemiarthroplasty the hip arthroplasties **(Table 3.7)**. On the other hand, only 2.2% of the patients were younger than 55 years, whereas 6.8% were aged between 55 and 64 years. Patients treated with HA were on average 11 years older than those treated with THA **(Table 3.8)**. As discussed above, younger patients were more likely to receive THA. Overall, there were more HA than THA. A total of 583 patients ‹55 years of age had hip arthroplasty for hip fractures and 90% of these (N = 536) were treated with THA. Interestingly, 47 of these patients ‹55 years of age were treated with HA. On the other hand, 62.6% of HA were performed in patients aged 85 years and older. However, 26.8% of the patients ›85 years of age received THA, the other 73.2% being treated with HA **(Table 3.8)**.

### BMI and ASA score

Most patients treated for fractures of the hip had a normal BMI. This was the case for 83% for both THA and HA. THA patients were slightly more often obese (9.2% versus 6.2%), whereas more HA patients had a BMI ‹18.5 kg/m², reflecting more prevalent malnutrition and sarcopenia in this subgroup **(Table 3.8)**. The ASA score had an influence of the treatment modality. An ASA score ›3 was prevalent in 81.6% of patients treated with HA but only in 52.8% of those treated with THA. That indicates that frailer patients were treated preferably with HA.

| | | THA | HA |
|---|---|---|---|
| **N (2019–2024)** | | **12,656** | **14,728** |
| Women [%] | | 63.1 | 69.9 |
| Mean age (SD) | All | 74.9 (10.9) | 85.9 (7.5) |
| | Women | 76.1 (10.3) | 86.3 (7.1) |
| | Men | 73.0 (11.7) | 84.8 (8.1) |
| Age group [%] | ‹45 | 0.8 | 0.0 |
| | 45–54 | 3.5 | 0.3 |
| | 55–64 | 13.3 | 1.1 |
| | 65–74 | 25.6 | 5.3 |
| | 75–84 | 37.3 | 30.7 |
| | 85+ | 19.5 | 62.6 |
| N unknown BMI (%) | | 1,626 (13) | 2,318 (16) |
| N known BMI | | 11,030 | 12,410 |
| Mean BMI (SD) | | 24.2 (4.5) | 23.3 (4.2) |
| BMI [%] | ‹18.5 | 7.4 | 11.0 |
| | 18.5–24.9 | 55.2 | 59 |
| | 25–29.9 | 28.3 | 24.4 |
| | 30–34.9 | 7.0 | 4.9 |
| | 35–39.9 | 1.6 | 1.0 |
| | 40+ | 0.5 | 0.2 |
| N unknown ASA | | 480 (4) | 601 (4) |
| N known ASA | | 12,176 | 14,127 |
| Morbidity state [%] | ASA 1 | 6.0 | 0.7 |
| | ASA 2 | 41.3 | 17.7 |
| | ASA 3 | 48.0 | 70.6 |
| | ASA 4/5 | 4.8 | 11.0 |

**Table 3.8**
**Fracture of the hip: Baseline patient characteristics by type of treatment**

### 3.2.6 Data analysis by hospitals for fractures of the hip

Only 18.4% of all patients with a fracture were treated in a hospital with a volume of ‹100 cases/year **(Table 3.9)**, while 30% were treated in institutions that performed between 100–199 primary arthroplasties per year. Larger units (200–299 and 300+) each treated 26% of all patients. The age distribution in the four categories (‹100 cases/year, 100–199, 200–299, ›300) was comparable, with a mean age varying between 80.5 and 81.5 years. Hospitals with smaller caseloads (‹100 cases/year) treated more octogenarians and it is interesting to note that the percentage of patients treated by HA in the low-volume institutions was significantly higher (63.7% vs 48.8%) than in the other units **(Table 3.9)**. This may indicate undertreatment, whereby no more detailed analysis is possible

| **Hospital service volume*** | | **‹100** | **100–199** | **200–299** | **300+** |
|---|---|---|---|---|---|
| **N (2019 – 2024)** | | **5,027** | **8,207** | **7,099** | **7,051** |
| Treatment with THA [%]** | | 36.3 | 46.8 | 47.6 | 51.2 |
| Treatment with HA [%]*** | | 63.7 | 53.2 | 52.4 | 48.8 |
| Women [%] | | 68.3 | 68.0 | 66.6 | 64.5 |
| Mean age (SD) | All | 81.5 (10.0) | 80.8 (10.7) | 80.7 (10.7) | 80.5 (11.3) |
| | Women | 82.2 (9.6) | 81.8 (10.0) | 81.8 (10.0) | 81.7 (10.4) |
| | Men | 80.0 (10.7) | 78.6 (11.7) | 78.6 (11.6) | 78.2 (12.4) |
| Age group [%] | ‹45 | 0.1 | 0.3 | 0.3 | 0.7 |
| | 45–54 | 1.3 | 1.6 | 1.7 | 2.3 |
| | 55–64 | 5.7 | 7.0 | 6.8 | 7.3 |
| | 65–74 | 14.2 | 14.9 | 15.3 | 14.0 |
| | 75–84 | 33.8 | 34.0 | 33.8 | 33.4 |
| | 85+ | 44.9 | 42.1 | 42.0 | 42.4 |
| N unknown BMI (%) | | 1,204 (24) | 1,293 (16) | 794 (11) | 653 (9) |
| N known BMI | | 3,823 | 6,914 | 6,305 | 6,398 |
| Mean BMI (SD) | | 23.7 (4.3) | 23.7 (4.4) | 23.7 (4.4) | 23.7 (4.4) |
| BMI [%] | ‹18.5 | 8.7 | 9.6 | 8.9 | 9.6 |
| | 18.5–24.9 | 57.8 | 56.8 | 57.0 | 56.8 |
| | 25–29.9 | 26.2 | 26.2 | 26.7 | 25.8 |
| | 30–34.9 | 6.0 | 5.6 | 5.8 | 6.2 |
| | 35–39.9 | 1.0 | 1.4 | 1.2 | 1.3 |
| | 40+ | 0.3 | 0.4 | 0.4 | 0.3 |
| N unknown ASA (%) | | 179 (4) | 461 (6) | 249 (4) | 192 (3) |
| N known ASA | | 4,848 | 7,746 | 6,850 | 6,859 |
| Morbidity state [%] | ASA 1 | 3.6 | 2.9 | 3.2 | 3.0 |
| | ASA 2 | 28.3 | 29.7 | 29.1 | 27.3 |
| | ASA 3 | 58.9 | 59.4 | 60.0 | 61.8 |
| | ASA 4/5 | 9.2 | 8.0 | 7.8 | 8.0 |

**Table 3.9**

**Fracture of the hip: Baseline patient characteristics by hospital service volume**

Calculations of hospital service volume based on primary hip surgeries in each included year (2019–2024).

* Note that service volume is defined as the sum of primary procedures per year

** THA = Total Hip Arthroplasty

*** HA = Hemiarthroplasty

from the data available in SIRIS. One explanation may be that surgeons not trained in THA participated in the treatment of hip fractures in these smaller institutions, therefore performing HA only.

The proportion of hip arthroplasties performed in large and small units has changed significantly since 2013. Since then, the proportion of patients treated in smaller facilities has decreased from 60% to 41%, whereas the proportion of patients treated in larger facilities has risen from 40% to 59%. However, this trend was interrupted during 2019 and 2020. The reasons are not clear for 2019. In 2020 it may be a side effect of the COVID-19 pandemic, smaller hospitals having been less affected by governmental restrictions than larger providers of elective surgery.

Overall, there is a clear trend to treat fractures of the proximal femur in high volume institutions **(Figure 3.10).** The contribution of low volume centres is declining.

## Reporting of revision rates of hemiarthroplasties by hospitals

The national average 2-year revision rate for HA of 3.5% (CI 3.2 – 3.7%) served as reference for calculating the outlier status of individual hospitals, implants and surgeons. The results of the participating units are shown in the funnel plot **(Figure 3.13).** For HA, there were two outlier units, one more than 2023, but only one service with an elevated revision risk, three less than 2023.

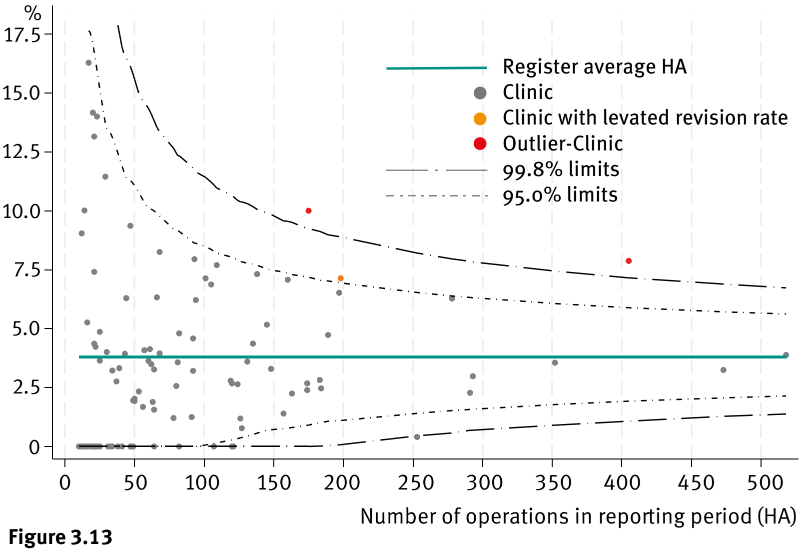


**Figure 3.13**

**2-year revision rate of primary hemiarthroplasty by service***

Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available

*Number of operations in the reporting period 01/2019–12/2022 (4-year moving average, follow-up to 12/2024)

**Interpretation of funnel plots**

- The coloured line denotes the Swiss average 2-year revision rate
- Clinics that lie between the 95% limits (grey dots) have revision rates that are within the statistically expected range of observations given their operation volume
- Clinics below the 95/99.8% limits are performingbetter than the average
- Clinics above the 95% limit and below the 99.8% limit (orange dots) have elevated 2-year revision rates. This could be due to random variation, but we recommend that possible reasons are investigated, in particular if the position should be stable over time or worsen.
- Clinics above the 99.8% limit (red dots) have 2-year revision rates that deviate markedly from the national average (unlikely to be due to random variation alone).

## 3.3 Knee arthroplasty

### 3.3.1 Nationwide data, including the Principality of Liechtenstein

**Incidence of TKA and PKA**

Since 2012, 233,166 primary knee arthroplasties were registered in SIRIS, of which 197,143 were TKA and 35,908 were PKA **(Table 3.10 and 3.11).** The incidence of knee arthroplasties (including both TKA and PKA) has steadily increased over the past years, growing from 201 per 100,000 inhabitants in 2013 to 284 per 100’000 inhabitants in 2024. Considering only the population most at risk (the age group between 50 to 89 years, accounting for 98% of the recipients of TKA and PKA), the incidence of TKA and PKA together was 699 per 100,000 inhabitants at risk in 2024 **(Figure 3.14).** This represents one of the highest incidences for TKA in Europe as well as worldwide.

| Year | Primary TKA | Primary PKA | Primary others or type unclear | Primary Total | Share of PKA | Annual growth rate primary | Linked Rev./ Reop. of TKA | Linked Rev./ Reop. of PKA | Unlinked Rev./Reop. can be of TKA or PKA | Rev./ Reop. Total[2] | Share of linked Rev./ Reop. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2012**[1] | 4,653 | 939 | 8 | 5,600 | | | 19 | 2 | 510 | 531 | 4.0% |
| **2013** | 12,656 | 2,402 | 17 | 15,075 | 15.9% | | 182 | 51 | 1,251 | 1,489 | 15.6% |
| **2014** | 13,051 | 2,339 | 14 | 15,404 | 15.2% | 2.2% | 397 | 113 | 1,119 | 1,629 | 31.3% |
| **2015** | 13,485 | 2,389 | 6 | 15,880 | 15.0% | 3.1% | 597 | 126 | 1,070 | 1,794 | 40.3% |
| **2016** | 14,606 | 2,457 | 7 | 17,070 | 14.4% | 7.5% | 840 | 195 | 1,133 | 2,171 | 47.7% |
| **2017** | 14,477 | 2,618 | 15 | 17,110 | 15.3% | 0.2% | 948 | 265 | 1,087 | 2,303 | 52.7% |
| **2018** | 14,727 | 2,726 | 12 | 17,465 | 15.6% | 2.1% | 1,045 | 291 | 1,086 | 2,424 | 55.1% |
| **2019** | 15,614 | 3,086 | 4 | 18,704 | 16.5% | 7.1% | 1,213 | 302 | 1,063 | 2,579 | 58.7% |
| **2020** | 15,468 | 3,150 | 5 | 18,623 | 16.9% | -0.4% | 1,331 | 402 | 1,064 | 2,797 | 62.0% |
| **2021** | 16,816 | 3,208 | 4 | 20,028 | 16.0% | 7.5% | 1,389 | 406 | 1,028 | 2,826 | 63.5% |
| **2022** | 19,316 | 3,431 | 5 | 22,752 | 15.1% | 13.6% | 1,567 | 458 | 926 | 2,955 | 68.5% |
| **2023** | 20,706 | 3,438 | 8 | 24,152 | 14.2% | 6.2% | 1,672 | 481 | 1,017 | 3,173 | 67.9% |
| **2024** | 21,568 | 3,725 | 10 | 25,303 | 14.7% | 4.8% | 1,732 | 508 | 983 | 3,225 | 69.5% |
| **All** | **197,143** | **35,908** | **115** | **233,166** | **15.4%** | | **12,932** | **3,600** | **13,337** | **29,896** | **55.3%** |

**Table 3.10**

**Total and partial knee arthroplasty (TKA, PKA), primary and revisions/reoperations**

All documented operations

[1] Does not represent a full year of data, as data collection in most hospitals started only in October 2012

[2] including linked revisions/reoperations of procedures that were classified as “primary others” or of unclear type

During the first decade of the registry, which had been introduced in 2012, the increase in the incidence could mainly be explained by improvements of coverage, as the number of participating services and the data completeness both increased over time. The high growth rate of 13.6% observed in 2022 was mostly explainable by a considerable rebound effect after the restrictions on elective surgery during the COVID-19 pandemic **(Table 3.10, Figure 3.15).** While the growth rate decreased from 6.2% in 2023 to 4.8% in 2024 **(Table 3.10),** an unbroken and steeper increase since 2020 resulted in an increase in the incidence of both TKA and PKA by 35.3% over the last six years **(Figure 3.15 and 3.10).** Although indirect signs of widening of the indication for knee arthroplasty, such as increasing numbers in particularly young or old patients, could still not be detected in the SIRIS dataset **(Table 3.11),** the mean growth rate is clearly above the growth rate of the population at risk for TKA and PKA of 7.4 % over the same period. While the

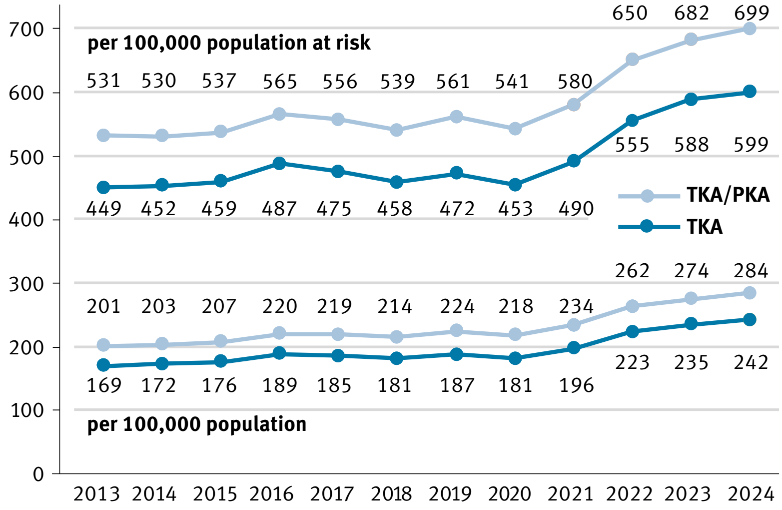


**Figure 3.14**

**Incidence of all primary knee arthroplasties registered in SIRIS**

Per 100,000 residents and per 100,000 residents at-risk (Age group 50–89 years accounts for 97% of all recipients of TKA/PKA) Adjusted for estimated coverage. SIRIS figures excluding Liechtenstein. Coverage rates 2013–2016 estimated at 92%; 2017–2023 based on federal health office data; 2024 estimated at 98.3%.

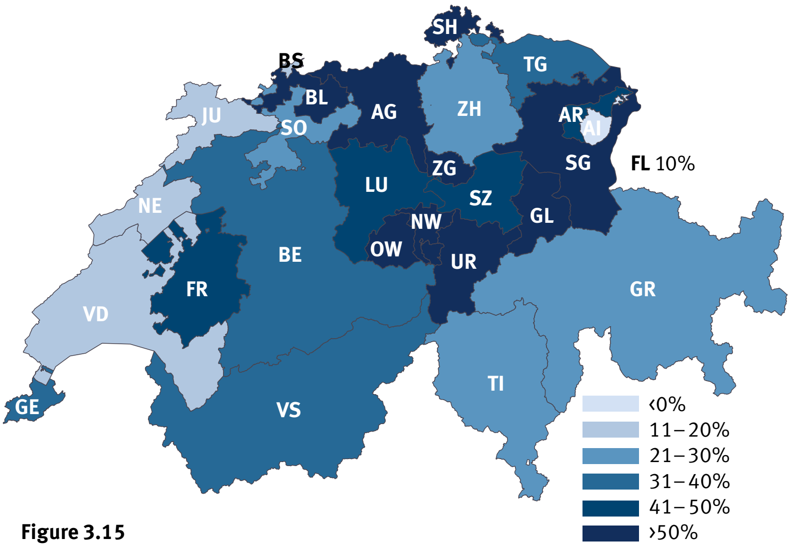


**Figure 3.15**

**Growth rates of primary knee arthroplasties by Canton: 2019 – 2024**

effect of the extensive ban of arthroscopy in elderly patients for meniscal pathology or the economic impact of lower reimbursement for arthroscopy in the ambulatory setting remain unclear, there is no doubt that TKA and PKA are unbowed successful with high request by patients and enthusiastic proposal by surgeons and hospitals.

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|---|
| **N** | | **15,614** | **15,469** | **16,816** | **19,316** | **20,706** | **21,568** | **109,489** |
| Diagnosis [%] | Primary OA* | 88.9 | 88.6 | 87.0 | 87.0 | 87.3 | 87.4 | 87.6 |
| | Secondary OA | 11.1 | 11.4 | 13.0 | 13.0 | 12.7 | 12.6 | 12.4 |
| | Inflammatory origin | 0.9 | 0.9 | 1.0 | 1.0 | 1.1 | 1.0 | 1.0 |
| | Fracture | 2.2 | 2.2 | 2.4 | 2.3 | 2.3 | 2.1 | 2.2 |
| | Lesion of ligament | 5.2 | 5.7 | 5.9 | 5.9 | 5.7 | 6.1 | 5.8 |
| | Infection | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Osteonecrosis | 1.5 | 1.4 | 1.9 | 1.9 | 1.8 | 1.5 | 1.7 |
| | Other** | 1.4 | 1.2 | 1.7 | 1.8 | 1.8 | 1.8 | 1.6 |
| Women [%] | | 59.7 | 58.5 | 59.9 | 59.1 | 58.7 | 58.6 | 59.0 |
| Mean age (SD) | All | 69.8 (9.5) | 69.5 (9.5) | 69.6 (9.5) | 69.8 (9.5) | 69.9 (9.3) | 69.9 (9.4) | 69.8 (9.5) |
| | Women | 70.5 (9.6) | 70.1 (9.6) | 70.1 (9.7) | 70.4 (9.6) | 70.3 (9.4) | 70.3 (9.5) | 70.3 (9.6) |
| | Men | 68.9 (9.3) | 68.8 (9.2) | 68.8 (9.3) | 69.0 (9.2) | 69.4 (9.2) | 69.3 (9.3) | 69.0 (9.2) |
| Age group [%] | ‹45 | 0.4 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.5 |
| | 45–54 | 6.0 | 5.7 | 5.7 | 5.4 | 4.8 | 5.0 | 5.4 |
| | 55–64 | 23.0 | 24.6 | 24.6 | 24.5 | 24.6 | 25.0 | 24.4 |
| | 65–74 | 36.3 | 36.0 | 35.3 | 35.3 | 35.3 | 34.6 | 35.4 |
| | 75–84 | 29.3 | 28.9 | 29.6 | 29.8 | 30.6 | 30.6 | 29.9 |
| | 85+ | 5.0 | 4.2 | 4.4 | 4.6 | 4.3 | 4.4 | 4.5 |
| N unknown BMI (%) | | 2,313 (15) | 1,924 (12) | 1,535 (9) | 1,341 (7) | 1,165 (6) | 854 (4) | 9,132 (8) |
| N known BMI | | 13,301 | 13,545 | 15,281 | 17,975 | 19,541 | 20,714 | 100,357 |
| Mean BMI (SD) | | 29.5 (5.6) | 29.2 (5.5) | 29.2 (5.6) | 29.2 (5.5) | 29.2 (5.6) | 29.3 (5.6) | 29.3 (5.6) |
| BMI [%] | ‹18.5 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.4 | 0.5 |
| | 18.5–24.9 | 20.8 | 22.2 | 22.1 | 22.2 | 22.1 | 22.2 | 22.0 |
| | 25–29.9 | 38.8 | 38.2 | 38.0 | 37.8 | 38.2 | 37.5 | 38.0 |
| | 30–34.9 | 24.9 | 24.6 | 24.8 | 24.8 | 24.6 | 25.2 | 24.8 |
| | 35–39.9 | 10.2 | 10.1 | 9.9 | 10.5 | 10.4 | 10.1 | 10.2 |
| | 40+ | 4.8 | 4.3 | 4.6 | 4.2 | 4.3 | 4.5 | 4.4 |
| N unknown ASA (%) | | 1,166 (7) | 1,017 (7) | 577 (3) | 445 (2) | 428 (2) | 718 (3) | 4,351 (4) |
| N known ASA | | 14,448 | 14,452 | 16,239 | 18,871 | 20,278 | 20,850 | 105,138 |
| Morbidity state [%] | ASA 1 | 8.1 | 7.9 | 6.9 | 6.9 | 6.3 | 6.1 | 6.9 |
| | ASA 2 | 61.5 | 62.1 | 61.8 | 63.0 | 63.5 | 62.1 | 62.4 |
| | ASA 3 | 29.9 | 29.6 | 30.9 | 29.5 | 29.8 | 31.4 | 30.2 |
| | ASA 4/5 | 0.5 | 0.4 | 0.4 | 0.6 | 0.4 | 0.5 | 0.5 |

**Table 3.11**

**Primary total knee arthroplasty: Baseline patient characteristics by year**

* As of SIRIS version 2021, this category includes the category “secondary arthritis after meniscus surgery”. This category accounts for more than 6% of current entries, but shows large variability between hospitals.

** A small number of cases with “secondary OA caused by patellar instability” were added to this category.

### 3.3.2 Primary total knee arthroplasty

In 2024, the total number of primary TKA registered in SIRIS reached 197,143 cases **(Table 3.10).** Between 2019 and 2024 109,489 primary TKA were performed **(Table 3.11).**

#### Sex and age

The share of women (59.0%) and the mean age of the patients (69.8 years) remained constant between 2019 and 2024. The proportion of younger patients (0.5% younger than 45 years of age and 5.4% aged 45 to 54 years) and of patients older than 85 years (4.5%) did not change significantly in recent years **(Table 3.11 and Figure 3.16).** On average, women were older than men when TKA was performed in all BMI classes **(Figure 3.17).**

Patients with secondary OA were significantly younger (mean age 65.3 years) than those with primary OA (mean age 70.4 years) when receiving TKA. In addition, the share of men was higher in secondary OA (52.4%) than for women (47.6%) **(Table 3.12).** Patients older than 65 years of age were less frequently classified as secondary OA.

Younger age was the main reason for differences in revision rates after TKA between primary and secondary OA. When comparing the corresponding age groups, revision rates did not differ between primary and secondary OA (see Chapters 5.3 and 5.4).

#### BMI and ASA-score

The share of unknown BMI constantly decreased from 15% in 2019 to 4% in 2024. It seems that almost all participating institutions have realised the importance of BMI for risk adjustment, as missing values lead to overestimation of revision rates. These data allow for a risk adjustment most often favourable to the provider. Between 2019 and 2024, the BMI re-

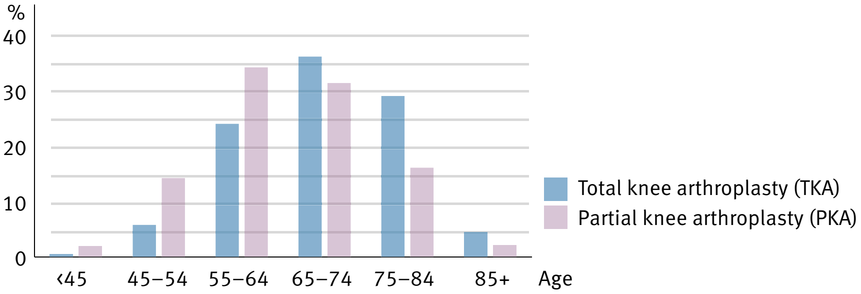


**Figure 3.16**

**Age distribution at surgery of primary total and partial knee arthroplasty**

All documented operations

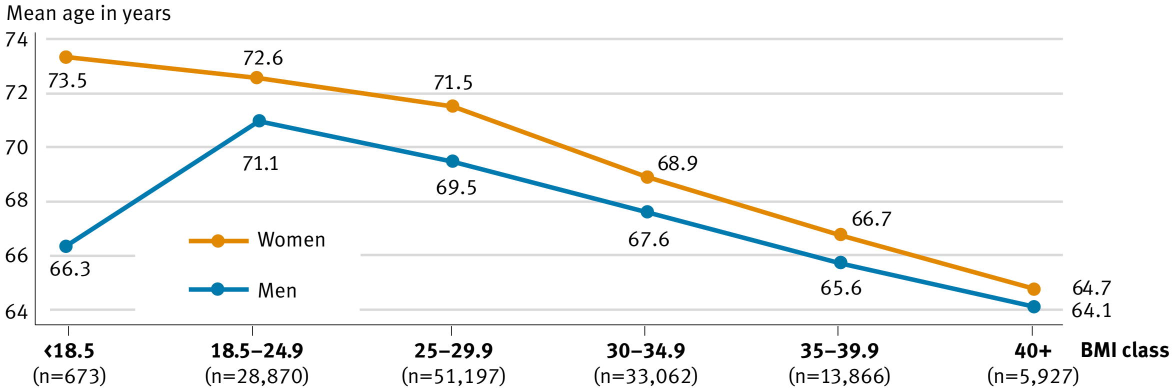


**Figure 3.17**

**Primary total knee arthroplasty: Mean age at primary arthroplasty depending on BMI class**

All documented operations. Please note that group sizes vary considerably.

mained constant at mean 29.3 kg/m². The distribution among the BMI subgroups did not change relevantly during this period **(Table 3.11).**

In all BMI subgroups, women were older than men at primary TKA, although the difference decreased with age and when the BMI exceeded 30 kg/m² **(Figure 3.17).** The difference in younger patients was mainly due to men's higher share of post-traumatic OA. Younger patients tended to be obese more frequently. The mean age at surgery was approximately 70 years for patients with a BMI under 30 kg/m², whereas patients with a BMI of more than 40 kg/m² had surgery performed between 5 and 6 years earlier **(Figure 3.11).** In posttraumatic (secondary) OA, the mean BMI was significantly lower overall and in all BMI subgroups **(Table 3.12).**

As with the BMI, the share of unknown ASA-score decreased continuously from 7% in 2019 to 3% in 2024. This score is another important factor for risk adjustments. The distribution of the ASA-score also remained constant over the past 6 years.

BMI and ASA-score did not differ between the groups of primary and secondary OA.

| | | Primary OA* | Secondary OA |
|---|---|---|---|
| **N** (2019–2024) | | **95,940** | **13,549** |
| Women [%] | | 60.7 | 47.6 |
| Mean age (SD) | All | 70.4 (9.1) | 65.3 (10.5) |
| | Women | 70.7 (9.3) | 66.5 (11.2) |
| | Men | 70.0 (8.9) | 64.1 (9.7) |
| Age group [%] | ‹45 | 0.2 | 2.1 |
| | 45–54 | 4.4 | 12.2 |
| | 55–64 | 22.8 | 35.7 |
| | 65–74 | 36.3 | 28.9 |
| | 75–84 | 31.5 | 18.1 |
| | 85+ | 4.7 | 3.0 |
| N unknown BMI (%) | | 8,124 (8) | 1,008 (7) |
| N known BMI | | 87,816 | 12,541 |
| Mean BMI (SD) | | 29.4 (5.6) | 28.2 (5.1) |
| BMI [%] | ‹18.5 | 0.5 | 0.8 |
| | 18.5–24.9 | 21.3 | 27 |
| | 25–29.9 | 37.7 | 40.2 |
| | 30–34.9 | 25.1 | 22.7 |
| | 35–39.9 | 10.7 | 6.9 |
| | 40+ | 4.7 | 2.5 |
| N unknown ASA (%) | | 3,884 (4) | 467 (3) |
| N known ASA | | 92,056 | 13,082 |
| ASA state [%] | ASA 1 | 6.3 | 11.1 |
| | ASA 2 | 62.4 | 62.7 |
| | ASA 3 | 30.9 | 25.7 |
| | ASA 4/5 | 0.4 | 0.6 |

**Table 3.12**

**Primary total knee arthroplasty: Baseline patient characteristics by main diagnostic group**

* Including "arthritis after meniscus surgery"

### Underlying diagnosis

The most frequent indication for TKA was classified as primary OA, representing 87.6% of the cases during the period from 2019 to 2024 **(Table 3.11).** This proportion indicates a probable issue of underreporting of secondary causes of OA. As additional causes for secondary OA (such as ligament lesions or infection) were introduced on the CRF in 2015, and as the awareness of risk factors for knee OA has steadily increased during the recent decades, a higher proportion of secondary OA would be expected.

Secondary OA had a share of 12.4% between 2019 and 2024, not varying significantly over time. Ligament lesions formed the most frequent subgroup, followed by sequels of fractures and osteonecrosis, representing 5.8%, 2.2% and 1.7% of all TKA, respectively. All other conditions were rare, the proportion of inflammatory disease as reason for TKA was 1.0%, while the category "other" represented 1.6%.

For more details regarding sex, age, BMI and ASA see above. Of note, there were considerable differences in distribution of diagnosis among high-volume hospitals (please refer to 3.3.5).

### 3.3.3 Primary partial knee arthroplasty

A total of 35,908 primary PKA were registered since inception of SIRIS in 2012 **(Table 3.10).** The proportion of PKA among all knee arthroplasties was 15.4% over the past 13 years. It showed a peak at 16.5% in 2019, 16.9% in 2020 and 16.0% in 2021 and tended to decrease from 2022 onwards. In 2024, 21,568 TKA and 3,725 PKA were registered, resulting in a share of PKA of 14.7%. The mean proportion over the past 6 years was 15.5%. This is clearly less than in Denmark, where PKA rates were 30.6% in 2023. It is important to note that the proportion of PKA varies greatly across Switzerland, changing considerably depending on cantons, regions, hospitals or individual surgeons. Whereas in some units PKA are rarely performed, other centres performed PKA in more than 40% of their primary knee arthroplasty cases.

| Hospital service volume* | | ‹100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| **N** (2019–2024) | | **2,304** | **4,364** | **4,495** | **8,874** |
| Women [%] | | 47.5 | 45.4 | 47.1 | 46.4 |
| Mean age (SD) | All | 64.3 (10.3) | 64.6 (10.0) | 65.3 (10.1) | 64.8 (10.1) |
| | Women | 64.1 (11.1) | 64.3 (10.5) | 64.7 (10.4) | 64.6 (10.5) |
| | Men | 64.4 (9.6) | 64.8 (9.6) | 65.8 (9.8) | 65.0 (9.7) |
| Age group [%] | ‹45 | 2.0 | 1.7 | 2.0 | 1.8 |
| | 45–54 | 15.7 | 14.5 | 12.5 | 14.1 |
| | 55–64 | 35.2 | 36.1 | 33.6 | 34.3 |
| | 65–74 | 29.9 | 29.4 | 31.9 | 31.5 |
| | 75–84 | 14.5 | 16.4 | 17.8 | 16.2 |
| | 85+ | 2.7 | 2.0 | 2.2 | 2.1 |
| Diagnosis [%] | Primary OA | 90.7 | 90.1 | 90.2 | 88.7 |
| | Secondary OA | 9.3 | 9.9 | 9.8 | 11.3 |
| N unknown BMI (%) | | 359 (16) | 340 (8) | 155 (3) | 870 (10) |
| N known BMI | | 1,945 | 4,024 | 4,340 | 8,004 |
| Mean BMI (SD) | | 28.5 (4.8) | 28.8 (4.9) | 28.3 (4.9) | 28.1 (4.7) |
| BMI [%] | ‹18.5 | 0.4 | 0.2 | 0.3 | 0.5 |
| | 18.5–24.9 | 22.6 | 22.3 | 25.2 | 27.0 |
| | 25–29.9 | 43.7 | 40.4 | 42.3 | 41.7 |
| | 30–34.9 | 24.1 | 26.3 | 23.5 | 22.8 |
| | 35–39.9 | 7.5 | 8.6 | 6.9 | 6.4 |
| | 40+ | 1.8 | 2.2 | 1.8 | 1.6 |
| N unknown ASA (%) | | 116 (5) | 123 (3) | 179 (4) | 273 (3) |
| N known ASA | | 2,188 | 4,241 | 4,316 | 8,601 |
| ASA state [%] | ASA 1 | 15.2 | 14.5 | 10.9 | 13.3 |
| | ASA 2 | 66.7 | 65.7 | 69.0 | 66.7 |
| | ASA 3 | 17.7 | 19.7 | 19.6 | 19.8 |
| | ASA 4/5 | 0.4 | 0.2 | 0.4 | 0.2 |

**Table 3.13**

**Baseline patient characteristics of primary partial knee arthroplasty by hospital service volume**

Calculations of hospital service volume based on primary knee surgeries in each included year (2019 – 2024).

* Note that service volume is defined as the sum of primary procedures per year

Hospitals with >100 knee arthroplasties per year performed 88.5% of the PKA between 2019 and 2024 **(Table 3.13).**

### Sex and age

Age at surgery was lower for PKA than for TKA, with the age peak at 55 – 64 years for the former, compared to 65 – 74 years for the latter **(Table 3.14).** In 15.9% of the PKA, the patients were younger than 54 years of age, whereas the age group 75 – 84 years for accounted 16.4% and patients older than 85 years for 2.2%. Elderly patients are of special interest as surgical and general health risks can be reduced remarkably by PKA compared to TKA.

### BMI and ASA-score

The BMI was not recorded in 9% of the cases between 2019 and 2024. The mean BMI of PKA patients was 28.3 kg/m², slightly lower than in TKA (29.3 kg/m²).

The ASA-scores not reported in 3% of the cases registered between 2019 and 2024. Over the whole period, patients with an ASA-score of 3 and 4 represented 19.8%. This was significantly less than in TKA, where ASA-score 3 and 4 represented 30.7% of the cases **(Table 3.14).** The distribution of BMI or ASA-score did not vary relevantly over the past six years **(Table 3.14).**

Recipients of PKA were not only healthier but also significantly younger than the TKA cohort (64.8 versus 69.8 years of age) **(Table 3.11 and 3.14).**

Participants are encouraged to provide information about risk factors such as BMI and ASA-score, as it allows risk adjustments for revision rates, which are mostly favourable to the providers.

### Underlying diagnosis

Between 2019 and 2024, 89.6% of the OA were classified as primary, the remaining 10.4% being secondary. In 5.3% of the latter, an osteonecrosis was registered, in 2.1% a ligament lesion and 2.0% were classified as “other reason”. Fractures were rare indications (0.8%). In 0.2%, only a PKA was performed when an inflammatory arthritis was present **(Table 3.14).** The distribution of the underlying diagnosis did not vary relevantly over the past six years **(Table 3.13).**

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019-2024 |
|---|---|---|---|---|---|---|---|---|
| **N** | | **3,086** | **3,149** | **3,208** | **3,431** | **3,438** | **3,725** | **20,037** |
| Diagnosis [%] | Primary OA* | 90.6 | 91.2 | 89.0 | 88.8 | 89.4 | 88.7 | 89.6 |
| | Secondary OA | 9.4 | 8.8 | 11.0 | 11.2 | 10.6 | 11.3 | 10.4 |
| | Inflammatory origin | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.2 |
| | Fracture | 0.6 | 0.8 | 0.7 | 0.9 | 0.8 | 0.9 | 0.8 |
| | Lesion of ligament | 2.1 | 2.1 | 2.4 | 2.1 | 2.0 | 2.1 | 2.1 |
| | Infection | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 |
| | Osteonecrosis | 5.5 | 4.5 | 5.5 | 5.2 | 5.2 | 5.6 | 5.3 |
| | Other** | 1.1 | 1.2 | 2.1 | 2.7 | 2.3 | 2.4 | 2.0 |
| Women [%] | | 48.5 | 47.9 | 46.6 | 44.9 | 46.5 | 44.9 | 46.5 |
| Mean age (SD) | All | 64.7 (10.3) | 64.6 (10.2) | 64.5 (10.0) | 65.0 (10.0) | 65.0 (10.0) | 65.0 (10.1) | 64.8 (10.1) |
| | Women | 64.5 (10.9) | 64.2 (11.0) | 64.2 (10.1) | 64.7 (10.4) | 64.8 (10.5) | 64.4 (10.6) | 64.5 (10.6) |
| | Men | 64.8 (9.8) | 64.9 (9.5) | 64.7 (10.0) | 65.3 (9.6) | 65.2 (9.6) | 65.5 (9.7) | 65.1 (9.7) |
| Age group [%] | ‹45 | 2.1 | 2.3 | 1.9 | 1.5 | 1.7 | 1.6 | 1.9 |
| | 45–54 | 14.5 | 14.4 | 14.5 | 13.4 | 13.5 | 13.7 | 14.0 |
| | 55–64 | 34.1 | 34.1 | 34.7 | 35.3 | 34.8 | 34.8 | 34.6 |
| | 65–74 | 30.5 | 31.1 | 31.7 | 30.8 | 31.0 | 30.7 | 31.0 |
| | 75–84 | 16.4 | 16.0 | 15.2 | 16.8 | 16.8 | 17.0 | 16.4 |
| | 85+ | 2.3 | 2.2 | 2.0 | 2.2 | 2.2 | 2.2 | 2.2 |
| N unknown BMI (%) | | 447 (14) | 347 (11) | 300 (9) | 258 (8) | 205 (6) | 167 (4) | 1724 (9) |
| N known BMI | | 2,639 | 2,802 | 2,908 | 3,173 | 3,233 | 3,558 | 18,313 |
| Mean BMI (SD) | | 28.4 (5.0) | 28.5 (4.9) | 28.4 (5.0) | 28.2 (4.7) | 28.3 (4.9) | 28.3 (4.6) | 28.3 (4.8) |
| BMI [%] | ‹18.5 | 0.5 | 0.5 | 0.3 | 0.2 | 0.3 | 0.5 | 0.4 |
| | 18.5–24.9 | 25.1 | 24.7 | 25.7 | 26.1 | 24.9 | 24.0 | 25.1 |
| | 25–29.9 | 41.5 | 40.8 | 39.9 | 42.5 | 42.7 | 42.6 | 41.7 |
| | 30–34.9 | 23.0 | 24.8 | 24.1 | 23.0 | 23.4 | 24.9 | 23.9 |
| | 35–39.9 | 8.1 | 7.4 | 8.0 | 6.6 | 6.4 | 6.4 | 7.1 |
| | 40+ | 1.8 | 1.7 | 1.9 | 1.5 | 2.3 | 1.6 | 1.8 |
| N unknown ASA (%) | | 167 (5) | 152 (5) | 59 (2) | 83 (2) | 82 (2) | 148 (4) | 691 (3) |
| N known ASA | | 2,919 | 2,997 | 3,149 | 3,348 | 3,356 | 3,577 | 19,346 |
| Morbidity state [%] | ASA 1 | 16.9 | 14.5 | 14.8 | 12.3 | 11.1 | 10.8 | 13.3 |
| | ASA 2 | 65.1 | 68.4 | 65.9 | 66.8 | 67.7 | 67.8 | 67.0 |
| | ASA 3 | 17.8 | 16.8 | 19.0 | 20.7 | 21.0 | 21.0 | 19.5 |
| | ASA 4/5 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.4 | 0.3 |

**Table 3.14**

**Primary partial knee arthroplasty: Baseline patient characteristics by year**

* As of SIRIS version 2021, this category includes “secondary arthritis after meniscus surgery”. This category accounts for more than 6% of current entries, but shows large variability between hospitals.

** A small number of newly added cases with “secondary OA caused by patellar instability” were added to this category.

### 3.3.4 Revision of primary TKA

During the current 4-year moving window from 1.1.2019 to 31.12.22 with a complete 2-year follow-up until 31.12.2024, a total of 67,217 TKA had been performed. Of those, 2,280 had been revised, resulting in a 2-year revision rate of 3.4% (CI 3.3 – 3.6%) **(Table 5.3).** The risk of revision within 5 years after primary TKA was 5.7%. Ten years after primary TKA, the global revision rate increased to 7.8%.
When considering revisions after five years 85.6% were first revisions, only 3.8% were revised twice. Third and fourth revisions were rare **(Figure 3.18).**
Taking revisions after 10 years 81.1% of these were revised once, 14.9% twice and 3.1% three times. Fourth and fifth revisions remained rare **(Figure 3.18).**

#### Sex and age

Younger patients were more at risk of early revision, with a two-year revision rate of 5.4% (CI 4.6-6.2%) for the age group ‹55 years old and of 4.0% (CI 3.7-4.4%) for the age group 55 – 64 years old. On the other hand, older patients (›75 years) were revised significantly less often than all the other age groups. One reason for this difference could be explained by the higher functional demands of younger patients. Additionally, one could assume that unsatisfactory results after primary TKA were better accepted by older patients due to other compromising medical reasons and possibly higher tolerance for inferior results.
There was no statistically significant difference in the early revision rates among women (3.2%, CI 3.0 – 3.4%) and men (3.6%, CI 3.3 – 3.8%) **(Table 5.3).**

#### BMI and ASA-score

The BMI was moderately associated with short-term revision rates. Normal weight patients had the lowest early revision rate. With BMI ›30 kg/m², the revision rate increased to 3.5% (CI 3.2-3.8%), while it reached 4.0% (CI 3.5-4.6%) at BMI ›35 kg/m². The latter value represents a statistically significant difference from the normal weight reference group. Small numbers may have influenced the apparently increased revision rate in low BMI patients, as only 247 TKA patients had a BMI ‹18 kg/m² and accounted for only 11 early revisions. One revision more or less could therefore dramatically influence the outcome. Small group size is also reflected by a wide confidence interval (CI 2.6 – 8.1%).
Patients with ASA-score 4/5 tended to be revised more often, the difference however remaining statistically not significant **(Table 5.3).**

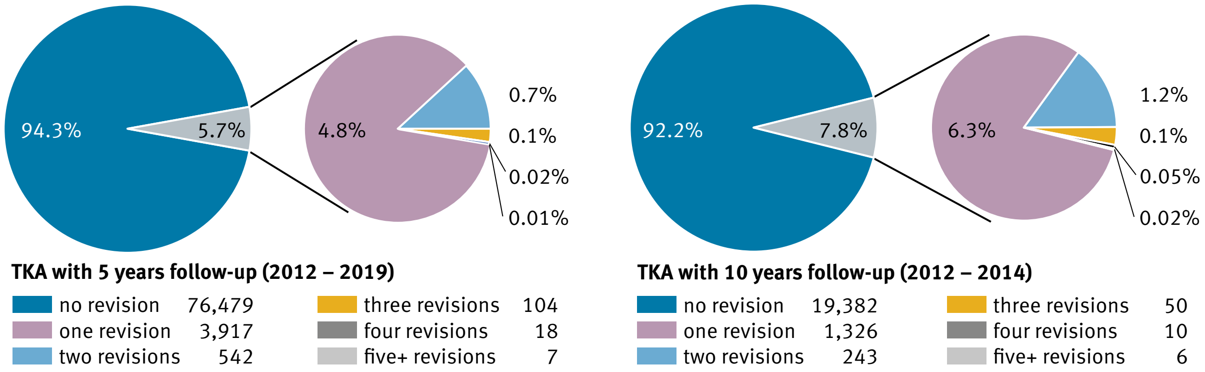


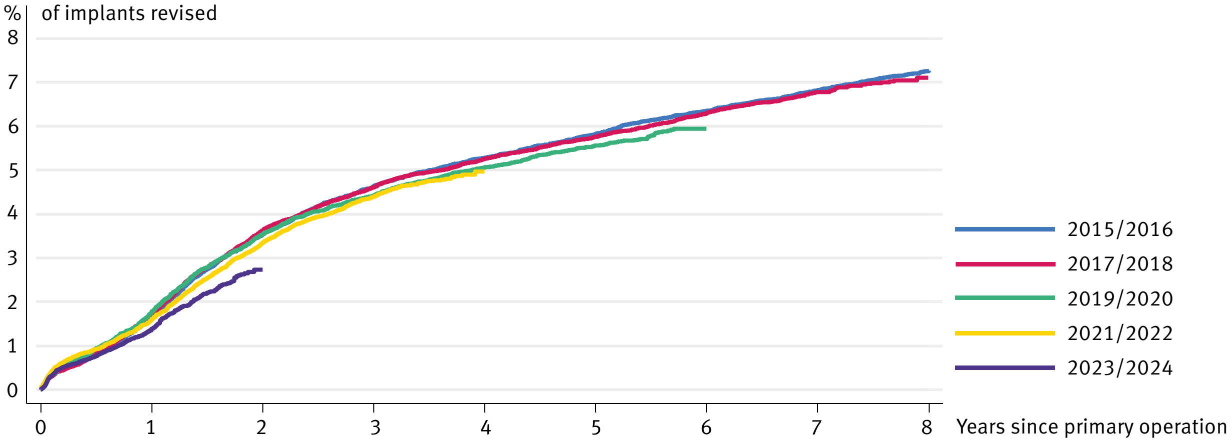
**Figure 3.18**
**Risk of revision within 5 years and 10 years after primary TKA in percent**
Multi-stage operations are counted as one revision

### Underlying diagnosis

Whereas the 2-year revision rate was 3.3% (CI 3.2 – 3.5%) in primary OA, this increased significantly to 4.2% (CI 3.8 – 4.6%) in secondary OA. This is however mainly an effect of the age difference at the index arthroplasty, which was 70.4 years on average between 2019 and 2024 for primary OA, compared to 65.3 years for secondary OA **(Table 3.11)**. Please refer also to chapter 3.3.2.

### TKA revision rates over time

Comparing the revision rates of TKA over different time periods using Kaplan-Meier estimates, a trend towards continuous improvement may be observed since 2021/2022 **(Figure 3.19)**. TKA revision rates for the period 2023/2024 had logically a follow-up limited to two years only but were significantly reduced compared to all previous periods. Such improvements over time would be one of the main goals of an implant registry.



| Failure rate | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| 2015/2016 | **1.6** (1.5-1.8) | **3.5** (3.3-3.8) | **4.6** (4.4-4.9) | **5.3** (5.0-5.6) | **5.8** (5.5-6.1) | **6.4** (6.1-6.6) | **6.8** (6.5-7.1) | **7.3** (7.0-7.6) |
| 2017/2018 | **1.7** (1.6-1.9) | **3.6** (3.4-3.8) | **4.6** (4.4-4.9) | **5.3** (5.0-5.5) | **5.8** (5.5-6.0) | **6.3** (6.0-6.6) | **6.8** (6.5-7.1) | |
| 2019/2020 | **1.8** (1.6-1.9) | **3.5** (3.3-3.8) | **4.4** (4.2-4.7) | **5.1** (4.8-5.3) | **5.6** (5.3-5.8) | | | |
| 2021/2022 | **1.6** (1.5-1.7) | **3.3** (3.2-3.5) | **4.4** (4.2-4.6) | | | | | |
| 2023/2024 | **1.4** (1.3-1.5) | | | | | | | |

**Figure 3.19**

**Kaplan Meier estimate of cumulative postoperative revision risk after TKA by time period**

Time since operation, 2015–2024, all services, all diagnoses

### 3.3.5 Revision of primary PKA

Compared to previous years up to 2021, the revision rate of PKA has increased, as it did for TKA. The reason for this is likely the improved linkage rate, leading to the detection of formerly unrecognised revisions.

First revisions are revisions linked to primary PKA registered in SIRIS and occurring for the first time. Of the 35,908 PKA documented since 2012, 12,874 had been performed between 01.01.2019 and 31.12.2022 and were at risk for revision in the 4-year moving window used to calculate the current 2-year revision rate. Of the implants in this cohort, 633 were revised, accounting for a 2-year revision rate of 5.0% (CI 4.6 – 5.3%) **(Table 5.11).** The risk of revision 5 years after primary PKA was 8.4%.

At revision 5 years after primary PKA 84.9% of those were revised once, 12.2% twice compared to 3.8% 5 years after primary TKA (see 3.3.4), 2% were third revisions **(Figure 3.20).**

There was a significant difference in survival of TKA compared to PKA, being significant from the first postoperative year onwards, as depicted in a cumulative Kaplan-Meier estimate **(Figure 3.21).** At 12 years, revision rate for TKA was 8.5% (8.2 – 8.7%), whereas it was 15.2% (14.4 – 16.0%) for PKA.

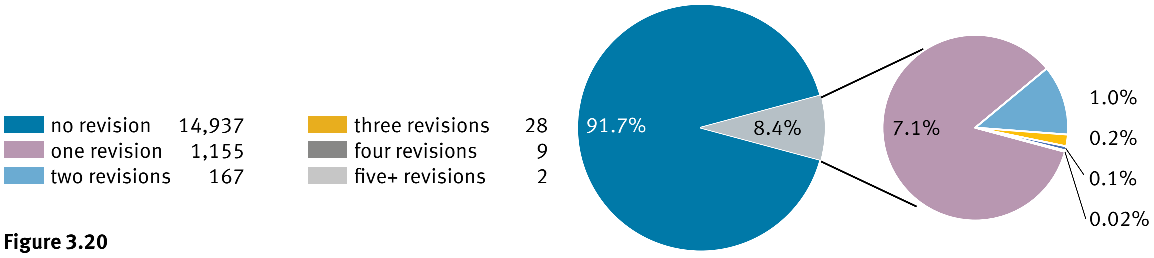
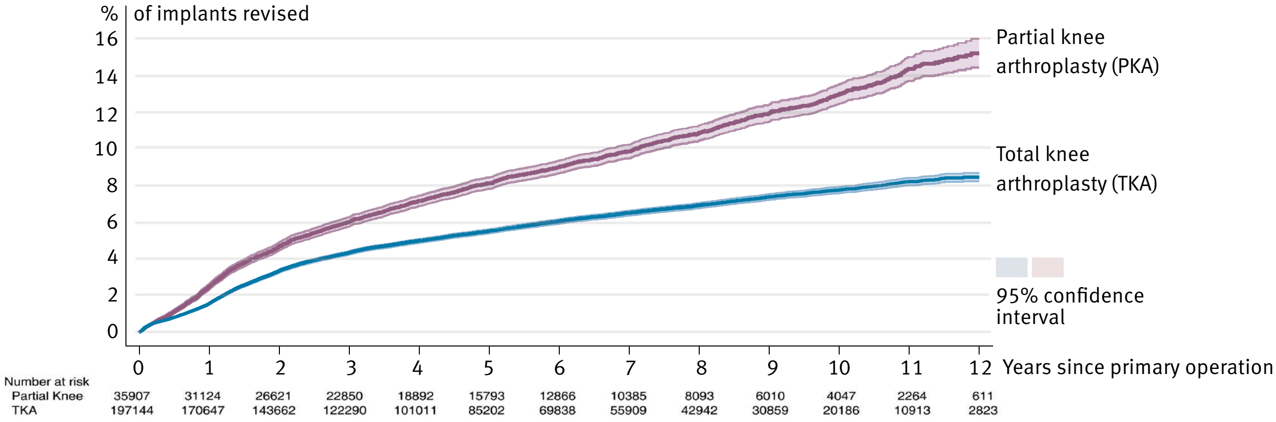


**Figure 3.20**

**Risk of revision within 5 years after primary PKA in percent**

2012 – 2019. Multi-stage operations are counted as one revision



| Failure rate | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| **TKA** | **1.6** (1.5-1.6) | **3.3** (3.3-3.4) | **4.3** (4.2-4.4) | **5.5** (5.4-5.6) | **6.0** (5.9-6.2) | **6.9** (6.8-7.1) | **7.4** (7.2-7.5) | **7.8** (7.6-7.9) | **8.5** (8.2-8.7) |
| **PKA** | **2.5** (2.3-2.7) | **4.7** (4.5-4.9) | **6.0** (5.8-6.3) | **8.1** (7.8-8.5) | **9.0** (8.7-9.4) | **10.9** (10.4-11.3) | **12.0** (11.5-12.5) | **13.0** (12.5-13.5) | **15.2** (14.4-16.0) |

**Figure 3.21**

**Kaplan Meier estimate of cumulative postoperative revision risk after primary knee arthroplasty**

Time since operation, 2012–2024, all services, all diagnoses

**Sex and age**

Younger patients had a significantly higher revision risk, with two-year revision rates of 7.0% (CI 5.9–8.3%) in the age group under 55 years, compared to 3.1% (CI 2.4–3.9%) in the age group 75 – 84 years. As in TKA, younger patients were more prone to early revision, reflecting the higher functional demands in this group and perhaps more acceptance of inferior results by older patients on the other hand due to lower activity levels or because of reluctance of any additional surgery.

The 2-year revision rates for women were 5.2% (CI 4.6 – 5.8%), whereas for men it was 4.4% (CI 3.9 – 4.9%), a difference not statistically significant **(Table 5.11).**

### 3.3.6 Two-year revision rates for TKA and PKA

Funnel plots (**Figures 3.22–3.24**) illustrate risk-adjusted early revision rates for primary OA, considering age, sex, BMI, ASA, and Charnley scores, as available, for TKA and PKA, as well as for revision of TKA excluding isolated patella resurfacing. Each dot represents a hospital service.

The spread of outcomes in Switzerland was relatively homogeneous, although there were exceptions, and there appears to be more variation with knee than with hip procedures. More clinics with elevated revision rates (orange dots) and outliers (red dots) could be identified for both TKA and PKA than for THA.

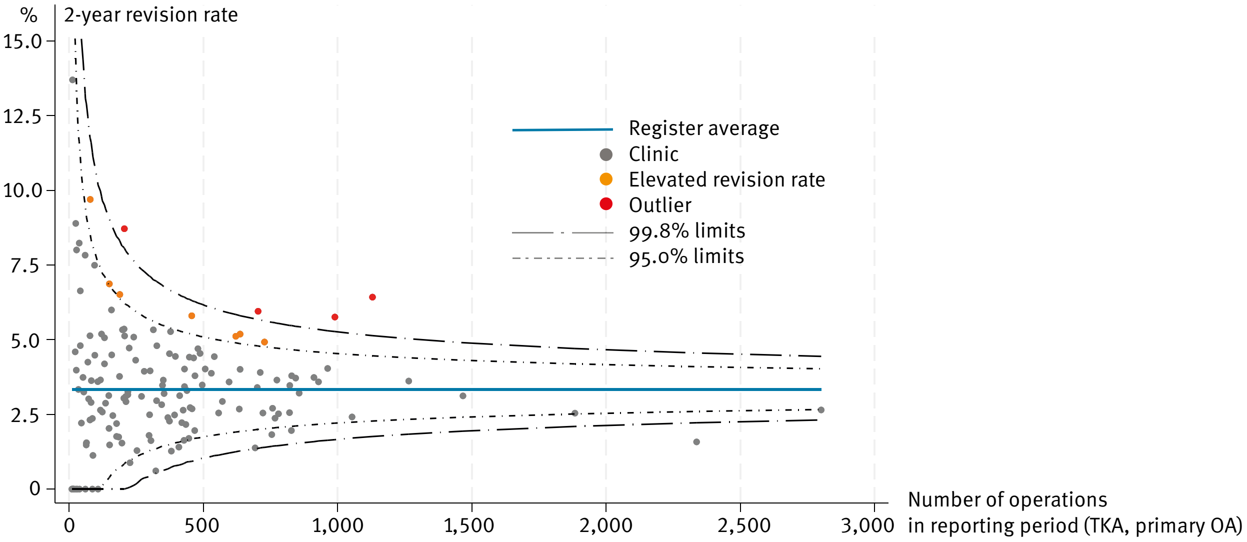


**Figure 3.22**

**2-year revision rate of primary total knee arthroplasty by service***

TKA results restricted to patients with primary osteoarthritis (prim OA). Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available
*Number of operations in the reporting period 01/2019–12/2022 (4-year moving average, follow-up to 12/2024)

**Interpretation of funnel plots**

- The coloured line denotes the Swiss average 2-year revision rate
- Clinics that lie between the 95% limits (grey dots) have revision rates that are within the statistically expected range of observations given their operation volume
- Clinics below the 95/99.8% limits are performingbetter than the average
- Clinics above the 95% limit and below the 99.8% limit (orange dots) have elevated 2-year revision rates. This could be due to random variation, but we recommend that possible reasons are investigated, in particular if the position should be stable over time or worsen.
- Clinics above the 99.8% limit (red dots) have 2-year revision rates that deviate markedly from the national average (unlikely to be due to random variation alone).

When isolated secondary patella resurfacing in primary TKA is excluded, the spread of results becomes less pronounced, with numbers of outliers decreasing from 4 to 3, unfortunately leaving three mid-volume hospitals **(Figure 3.23)**. However, any addition of an implant, such as a secondary patella resurfacing or an additional PKA, counts by definition as a revision. If a secondary patella resurfacing has to be performed within two years of the primary TKA, it cannot be considered as a good result. Considering Kaplan Meier estimation of cumulative revision risk a lower revision risk after primary TKA can be assumed in the cohort 2023/2024 in short term, though not being statistically significant **(Figure 3.19)**.

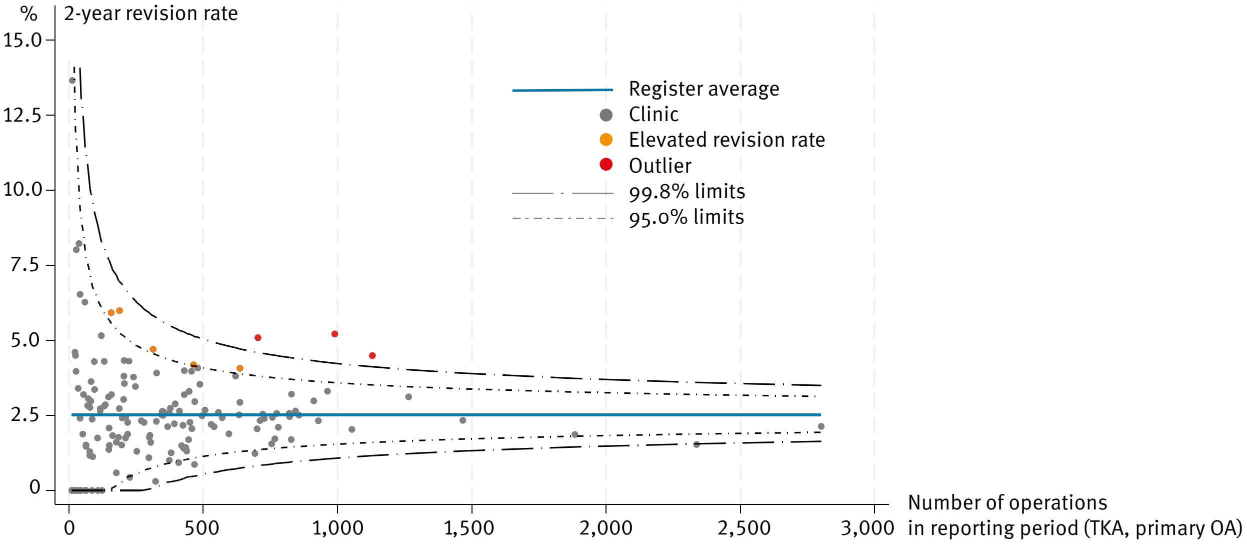


**Figure 3.23**

**2-year revision rate of primary total knee arthroplasty by service*, without isolated secondary patella resurfacing**

TKA results restricted to patients with primary osteoarthritis (prim OA). Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available
*Number of operations in the reporting period 01/2019–12/2022 (4-year moving average, follow-up to 12/2024)

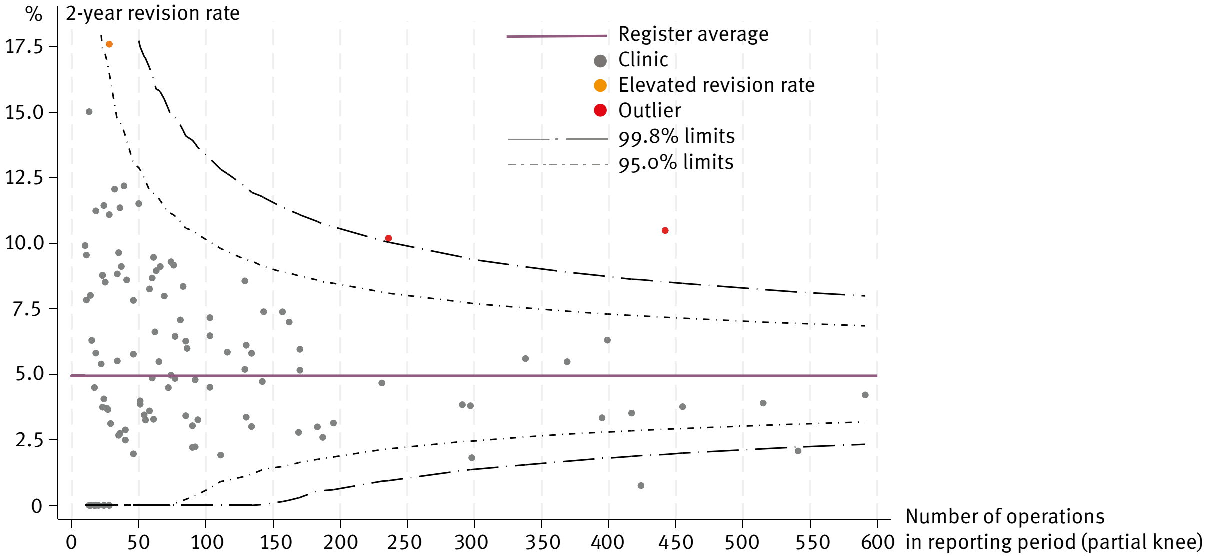


**Figure 3.24**

**2-year revision rate of partial knee arthroplasty by service***

PKA results restricted to patients with primary osteoarthritis (prim OA). Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available
*Number of operations in the reporting period 01/2019–12/2022 (4-year moving average, follow-up to 12/2024)

### 3.3.7 Regional data

As mentioned above (Section 3.3.1), the numbers of knee arthroplasties increased nationwide by 35.3% between 2019 and 2024. Growth rates differed significantly between individual cantons **(Figure 3.15).** Only in Appenzell Innerrhoden TKA and PKA did not increase in numbers. This is most probably due to closure of a hospital 2021, the patients having to be taken care of in another canton. It can be assumed that patients were treated in Appenzell Ausserrhoden or St. Gallen, both cantons with high growth rates. It is interesting to note that only the cantons Vaud, Neuchâtel and Jura had a growth rate less than the increase of the population at risk for TKA and PKA, followed by Solothurn, Zürich, Ticino and Graubünden, with rates ranging 21 to 30% over the past six years.

#### Type of knee systems

Of note is the fact that the knee replacement systems used varied significantly between individual hospitals and cantons, respectively regions. Traditionally, posterior stabilised (PS) TKA were used more commonly in the western part of Switzerland, whereas in the German-speaking cantons, cruciate retaining (CR) and cruciate sacrificing (CS), including ultra-congruent (UC) TKA, were favoured. In contrast, the implantation of medial-pivot (MP) knees did not appear to follow a particular regional pattern but seemed to be preferred in specific hospitals. **Figure 3.25** illustrates the variability of the different types of TKA used in Switzerland, respectively changes between the periods spanning 2019 – 2024.

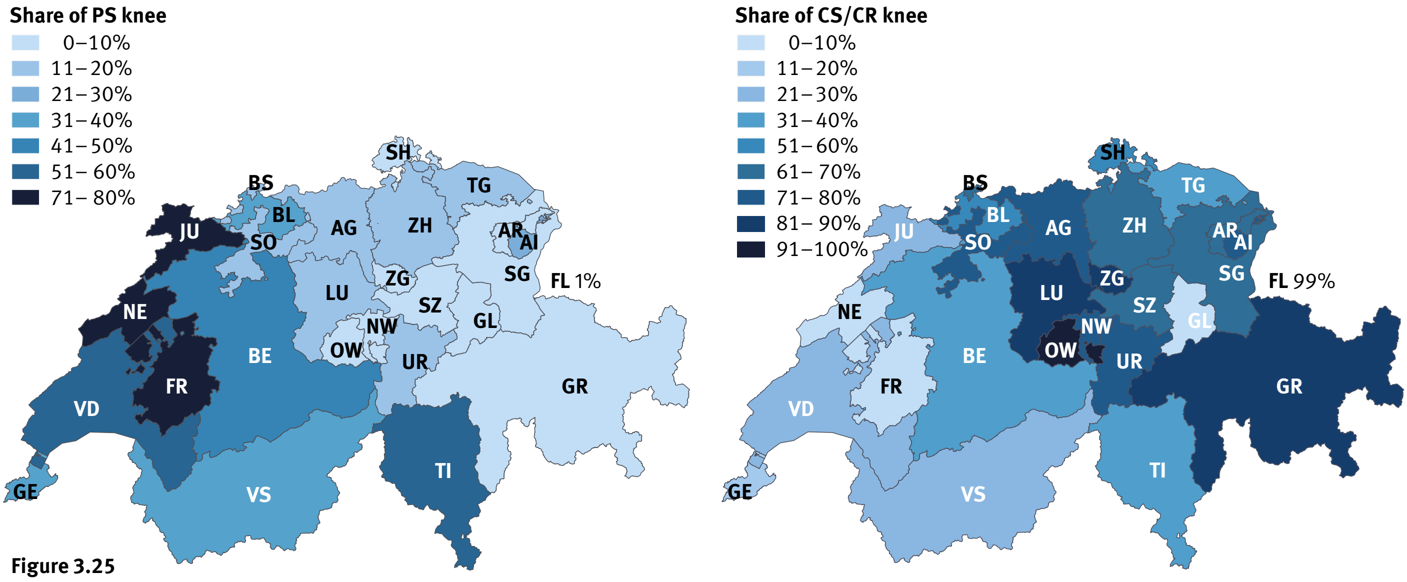
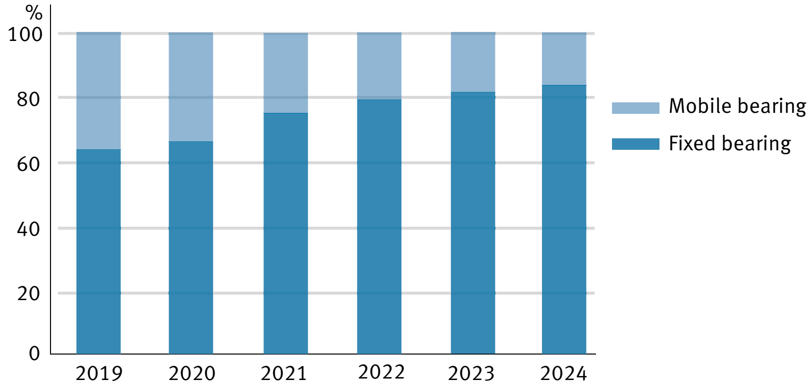


**Figure 3.25**

**Relative share of TKA procedures using PS or CS/CR systems by Canton: 2019 – 2024**

### Bearing type

The proportion of mobile bearings did rapidly decrease nationwide over the past six years, from 36.5% in 2019 to 16.4% in 2024 **(Figure 3.26).** However, the bearing type showed again a high regional variability **(Figure 3.27).** While cantons like Basel Landschaft, Solothurn, Bern, Ob- and Nidwalden, Schaffhausen, Glarus and the Principality of Liechtenstein had a low share of mobile bearings (ranging from only 0.7% in Obwalden to 8.7% in Nidwalden), this bearing type was used in 79.6% in Ticino.



| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|
| N | 13,762 | 13,525 | 16,331 | 18,931 | 20,284 | 21,140 | 103,973 |
| Mobile bearing | 36.5 | 34.0 | 25.1 | 20.9 | 18.7 | 16.4 | 24.0 |
| Fixed bearing | 63.5 | 66.0 | 74.9 | 79.1 | 81.3 | 83.6 | 76.0 |

**Figure 3.26**

**Primary total knee arthroplasty: Type of bearing**

Percentage by year, all diagnoses

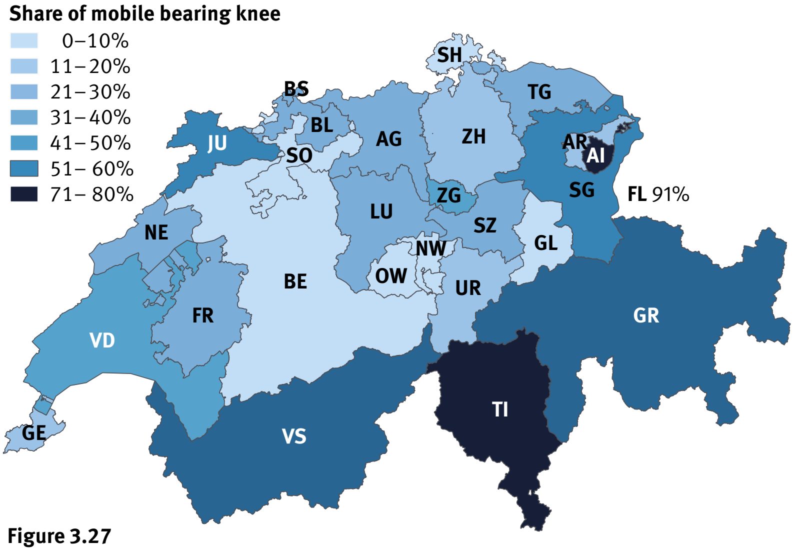


**Figure 3.27**

**Relative share of TKA procedures using mobile bearing by Canton: 2019– 2024**

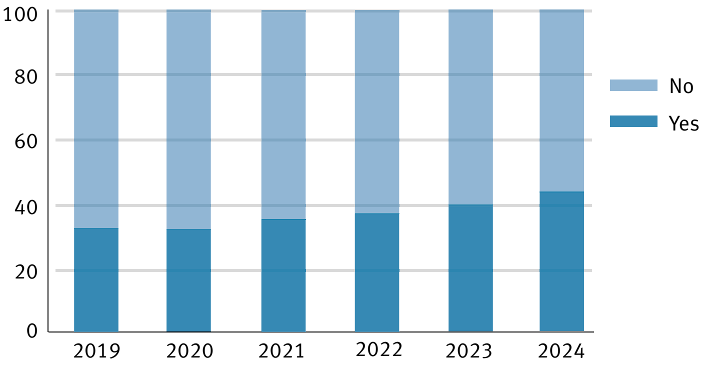
### Patella resurfacing

The patella was not resurfaced in 63.1% of the primary TKA performed between 2019 and 2024 **(Figure 3.28)**. However, the nationwide resurfacing rate increased continuously over the last years, from 32.0% in 2019 to 43.2% in 2024. As for the type of knee system or regarding the selection between fixed and mobile bearings, there were considerable differences between the cantons **(Figure 3.29)**.

As an example, patella resurfacing was performed in 0.5% only in Glarus. On the other hand, cantons like Geneva, Vaud, Valais, Fribourg, Jura, Luzern and Thurgau resurfaced the patella between 60.9% (VS) and 70.5% (GE) of the cases. Some of these differences may be explained by the use of PS TKA, traditionally more popular in the western, French-speaking part of Switzerland, as well as in some specific centres in the German-speaking part of Switzerland. In PS TKA resurfacing of the patella is recommended more vigorously than in other designs.

Please refer to the annual report 2021 regarding more details about patella resurfacing. Particularly, it could be demonstrated that whether the patella is resurfaced primarily or not is more dependent on the surgeon's personal preference than on the knee system type or the geographic region.

The observed general trend towards more frequent primary patella resurfacing in the past years may well be explained by a surgeon's intent to prevent early revision and improve the two-year revision rates reported for himself and the hospital, independent of functional outcomes. The same effect could be observed in Australia over the past 15 years.



| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|
| N | 15,607 | 15,467 | 16,814 | 19,315 | 20,706 | 21,568 | 109,477 |
| No | 67.9 | 68.2 | 65.1 | 63.2 | 60.7 | 56.8 | 63.1 |
| Yes | 32.0 | 31.8 | 34.9 | 36.7 | 39.3 | 43.2 | 36.8 |

**Figure 3.28**

**Primary total knee arthroplasty: Patellar component**

Percentage by year, all diagnoses

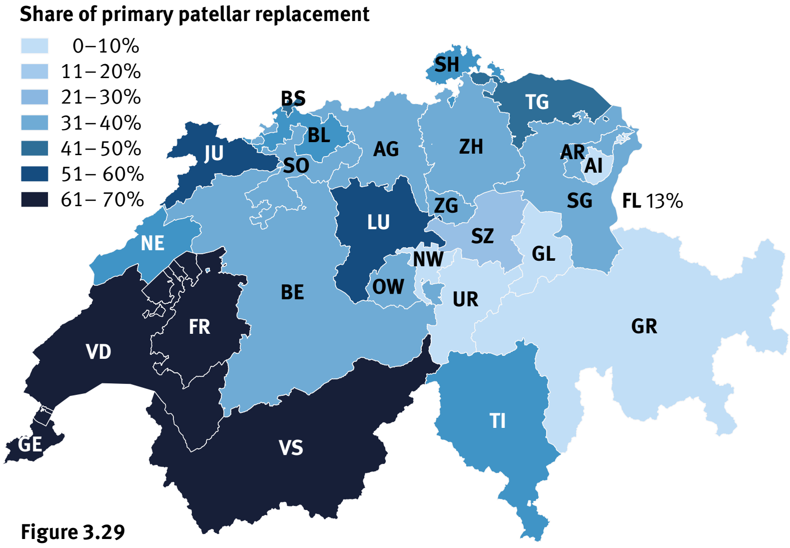


**Figure 3.29**

**Relative share of TKA procedures using primary patellar replacement by Canton: 2019 – 2024**

### 3.3.8 Data by hospitals

In 2024, 142 hospitals registered TKA, 122 PKA, and 134 revision arthroplasties of the knee **(Tables 3.15 and 3.16)**. SIRIS has achieved a 100% participation rate of the hospital services since 2018 for primary TKA and PKA, as well as revision arthroplasty for relevant institutions. As SIRIS is highly dependent on data quality, such a deed merits congratulations of the providers.

**Number of procedures per year**

The median procedure figures per hospital **(Table 3.15)** remained relatively stable between 2017 and 2021 but jumped upwards considerably in 2022 and maintained that growth rate until 2024. The median annual number of primary TKA per hospital increased from 67 in 2015 to 119 in 2024, a clear increase in volume per unit. **Tables 3.15 and 3.16** highlight the distribution of case numbers within service size categories (yearly numbers of procedures ‹100, 100 – 199, 200 – 300, ›300).

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|
| Primary arthroplasty of the knee (TKA) | N services | 147 | 146 | 145 | 145 | 144 | 142 |
| | M per service | 79 | 77 | 86 | 106 | 111 | 119 |
| Primary partial arthroplasty of the knee | N services | 127 | 128 | 127 | 127 | 126 | 122 |
| | M per service | 12 | 12 | 13 | 14 | 14.5 | 17.5 |
| Revision arthroplasty of the knee (TKA or partial) | N services | 133 | 130 | 134 | 135 | 135 | 134 |
| | M per service | 9 | 13 | 12 | 13 | 16 | 13.5 |

**Table 3.15**

Number of participating hospital services (N) and median procedures (M) per unit per year

| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|
| ‹100 | N procedures (%) | 3,184 (20.5) | 2,721 (17.7) | 2,551 (15.4) | 2,699 (14.1) | 2,904 (14.2) | 2,299 (10.7) |
| | N services (%) | 81 (54.7) | 78 (53.4) | 72 (49.3) | 65 (44.6) | 66 (45.8) | 57 (40.1) |
| 100–199 | N procedures (%) | 4,523 (29.1) | 4,698 (30.5) | 4,778 (28.9) | 5,551 (28.9) | 5,235 (25.5) | 4,285 (19.9) |
| | N services (%) | 37 (25.0) | 39 (26.7) | 40 (27.4) | 42 (28.9) | 38 (26.3) | 34 (40.0) |
| 200–299 | N procedures (%) | 3,461 (22.3) | 3,240 (21.0) | 4,041 (24.4) | 3,452 (18.0) | 3,590 (17.5) | 5,475 (25.4) |
| | N services (%) | 17 (11.5) | 16 (10.9) | 19 (13.0) | 18 (12.4) | 17 (11.8) | 27 (19.0) |
| ›300 | N procedures (%) | 4,352 (28.0) | 4,754 (30.8) | 5,185 (31.3) | 7,493 (39.0) | 8,766 (42.8) | 9,509 (44.1) |
| | N services (%) | 12 (8.1) | 13 (8.9) | 14 (9.6) | 20 (13.8) | 23 (16.0) | 24 (16.9) |

**Table 3.16**

Number of hospital services and number of primary total knee arthroplasties according to hospital volume

Simplifying the classification into centres with less than 200 and more than 200 interventions per year shows a continuous concentration over time towards larger centres for TKA. This trend is even more pronounced and occurred earlier for PKA **(Figure 3.30).** High-volume services tended to perform more PKA and revision arthroplasties than smaller units, while some centres seemed to focus on PKA and/or revision, perhaps reflecting a sort of sub-specialisation **(Figure 3.31).** Hospitals with more than 100 knee arthroplasties of all types per year performed 89.3% of the PKA between 2019 and 2024 **(Table 3.17).**

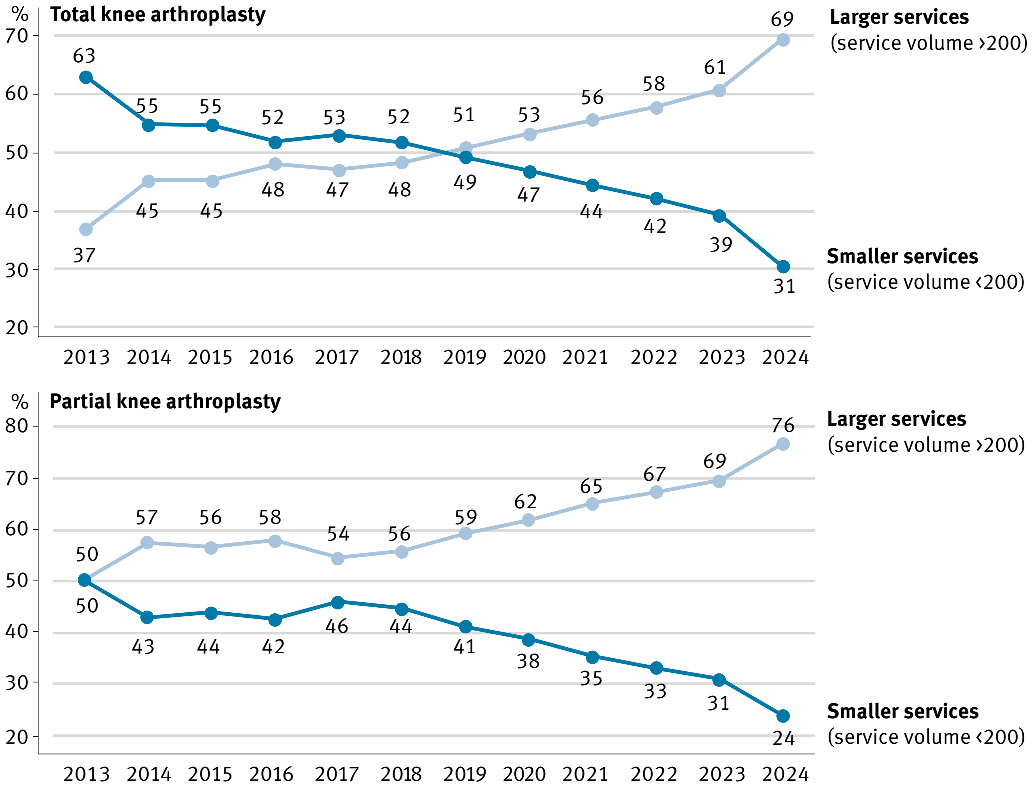


**Figure 3.30**

What share of selected procedures is performed in hospital services with different service volumes*?

* Note that service volume is defined as the sum of primary procedures per year

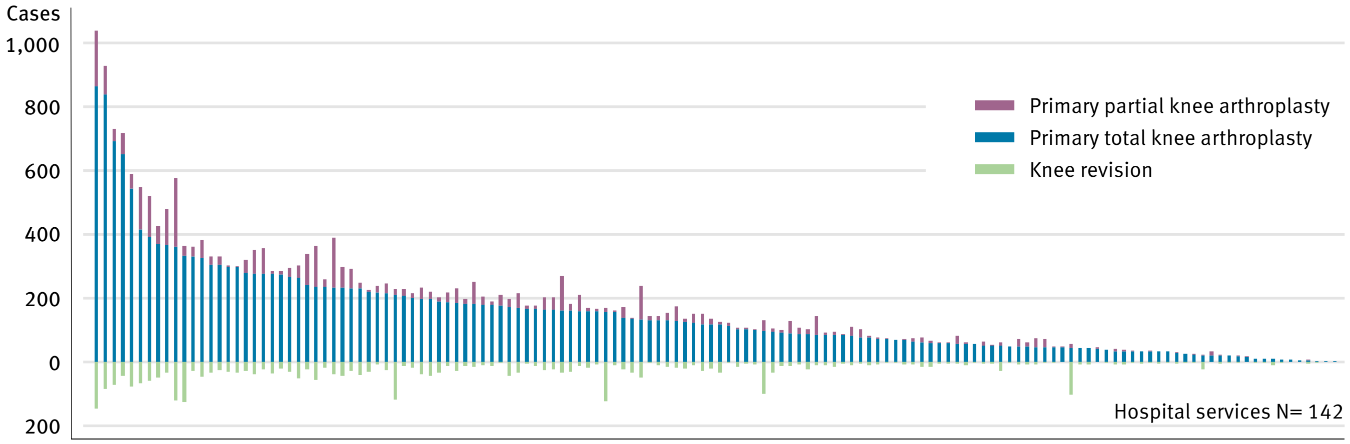


**Figure 3.31**

Cases per hospital service 2024: Total and partial knee arthroplasty

The distinction between large and small service units is based on the volume of knee arthroplasties performed. However, it does not necessarily indicate that surgery is performed in large services by high volume surgeons. There are services with multiple attending physicians, each of them contributing various number of cases. Some of them may perform hundreds of implantations, others contribute with only few interventions. On the other hand, it may well be that in small units only one or few surgeons are performing arthroplasties – at a comparable frequency as others in large services. Therefore, conclusions about the effect of numbers on the quality of surgery must be considered carefully.

| **Hospital service volume** | | **<100** | **100–199** | **200–299** | **300+** |
|---|---|---|---|---|---|
| **N** (2019–2024) | | **15,765** | **29,472** | **23,355** | **40,897** |
| Women [%] | | 59.0 | 58.8 | 60.0 | 58.7 |
| Mean age (SD) | All | 70.1 (9.6) | 70.1 (9.4) | 69.9 (9.5) | 69.3 (9.4) |
| | Women | 70.7 (9.6) | 70.6 (9.5) | 70.3 (9.6) | 69.8 (9.5) |
| | Men | 69.3 (9.6) | 69.3 (9.1) | 69.4 (9.3) | 68.6 (9.1) |
| Age group [%] | <45 | 0.5 | 0.4 | 0.5 | 0.5 |
| | 45–54 | 5.5 | 4.9 | 5.2 | 5.7 |
| | 55–64 | 23.1 | 24.0 | 23.8 | 25.6 |
| | 65–74 | 34.7 | 35.4 | 35.6 | 35.5 |
| | 75–84 | 31.1 | 30.5 | 30.2 | 28.7 |
| | 85+ | 5.2 | 4.8 | 4.7 | 3.9 |
| Diagnosis [%] | Primary OA | 88.3 | 88.7 | 88.6 | 86.0 |
| | Secondary OA | 11.7 | 11.3 | 11.4 | 14.0 |
| N unknown BMI (%) | | 2,178 (14) | 1,882 (6) | 1,208 (5) | 3,864 (9) |
| N known BMI | | 13,587 | 27,590 | 22,147 | 37,033 |
| Mean BMI (SD) | | 29.3 (5.6) | 29.6 (5.7) | 29.4 (5.6) | 29.0 (5.4) |
| BMI [%] | <18.5 | 0.6 | 0.5 | 0.5 | 0.5 |
| | 18.5–24.9 | 21.9 | 20.6 | 21.4 | 23.4 |
| | 25–29.9 | 38.2 | 37.3 | 37.6 | 38.7 |
| | 30–34.9 | 24.3 | 25.9 | 25.3 | 23.9 |
| | 35–39.9 | 10.6 | 10.9 | 10.3 | 9.5 |
| | 40+ | 4.3 | 4.9 | 4.8 | 3.9 |
| N unknown ASA (%) | | 583 (4) | 820 (3) | 806 (3) | 2,142 (5) |
| N known ASA | | 15,182 | 28,652 | 22,549 | 38,755 |
| ASA state [%] | ASA 1 | 6.9 | 6.5 | 5.6 | 8.0 |
| | ASA 2 | 61.9 | 62.6 | 62.0 | 62.6 |
| | ASA 3 | 30.5 | 30.4 | 31.8 | 29.1 |
| | ASA 4/5 | 0.7 | 0.5 | 0.5 | 0.3 |

**Table 3.17**

**Primary total knee arthroplasty: Baseline patient characteristics by hospital service volume**

Calculations of hospital service volume based on primary hip surgeries in each included year (2019 – 2024).

### Demography and type of OA

Sex, mean age, age groups, BMI, and ASA classifications did not differ among low or high-volume (‹100, 100 – 199, 200 – 299, 300+ primary TKA per year) hospitals **(Table 3.17).**

The most frequent indication for TKA had been classified as primary OA, representing 87.6% of the cases over the period 2019 to 2024 **(Table 3.11).** Classification of primary and secondary OA in the 36 hospitals with more than 200 procedures per year varied remarkably. Primary OA was registered as the diagnosis leading to the operation between 49% and up to more than 91% of the cases, indicating varying practice in coding of diagnosis **(Figure 3.32).** In units with a high share of secondary OA, a meniscectomy was indicated most frequently as a previous operation, although this diagnosis does not significantly influence demography nor outcome after knee arthroplasty and is thus included among primary OA cases for calculations of revision rates **(Figure 3.32).** The increasing share of secondary OA in some hospitals can partially be explained by the introduction of more reporting options with the 2015 version of the CFR. Rates of secondary OA due to other causes also greatly varied among the high-volume centres, similarly to proportions of post meniscectomy OA.

A technical bias towards primary OA is possible, as this diagnosis is on the top in the selection menu and thus possibly decreases the probability of selecting other alternatives, even if more appropriate. Real discrepancies in patient demographics among the 36 high-volume hospitals do not explain these considerable differences, as all other parameters were comparable. Increasing rates of secondary OA risk can influence revision rates, a benchmark established solely on arthroplasty performed for primary OA. Providers are encouraged to improve coding as proper identification of secondary OA is necessary for correct benchmarking, just as comorbidities like BMI or ASA-scores.

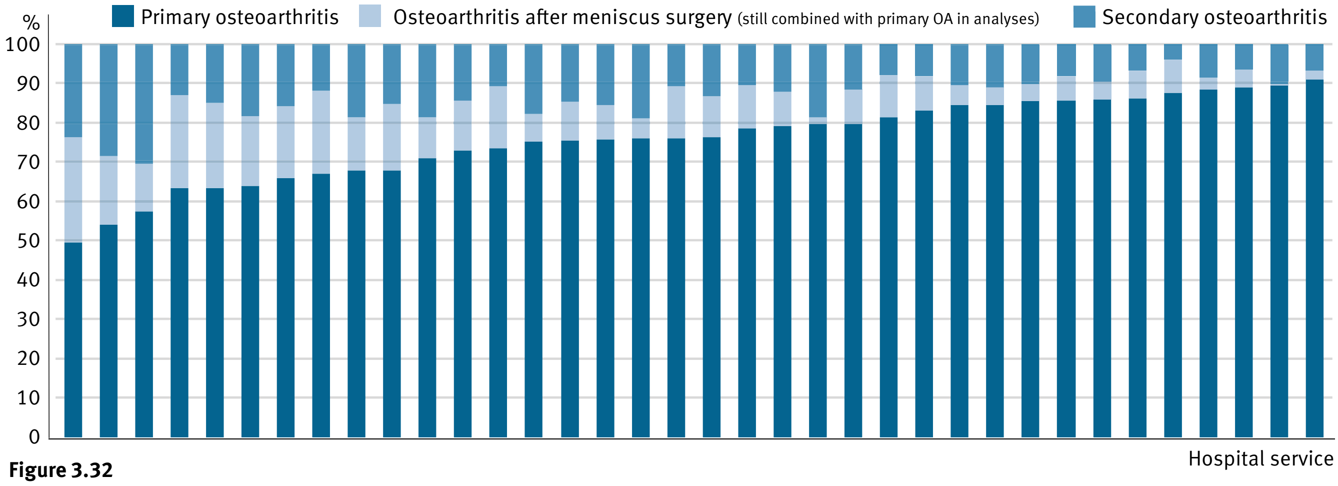


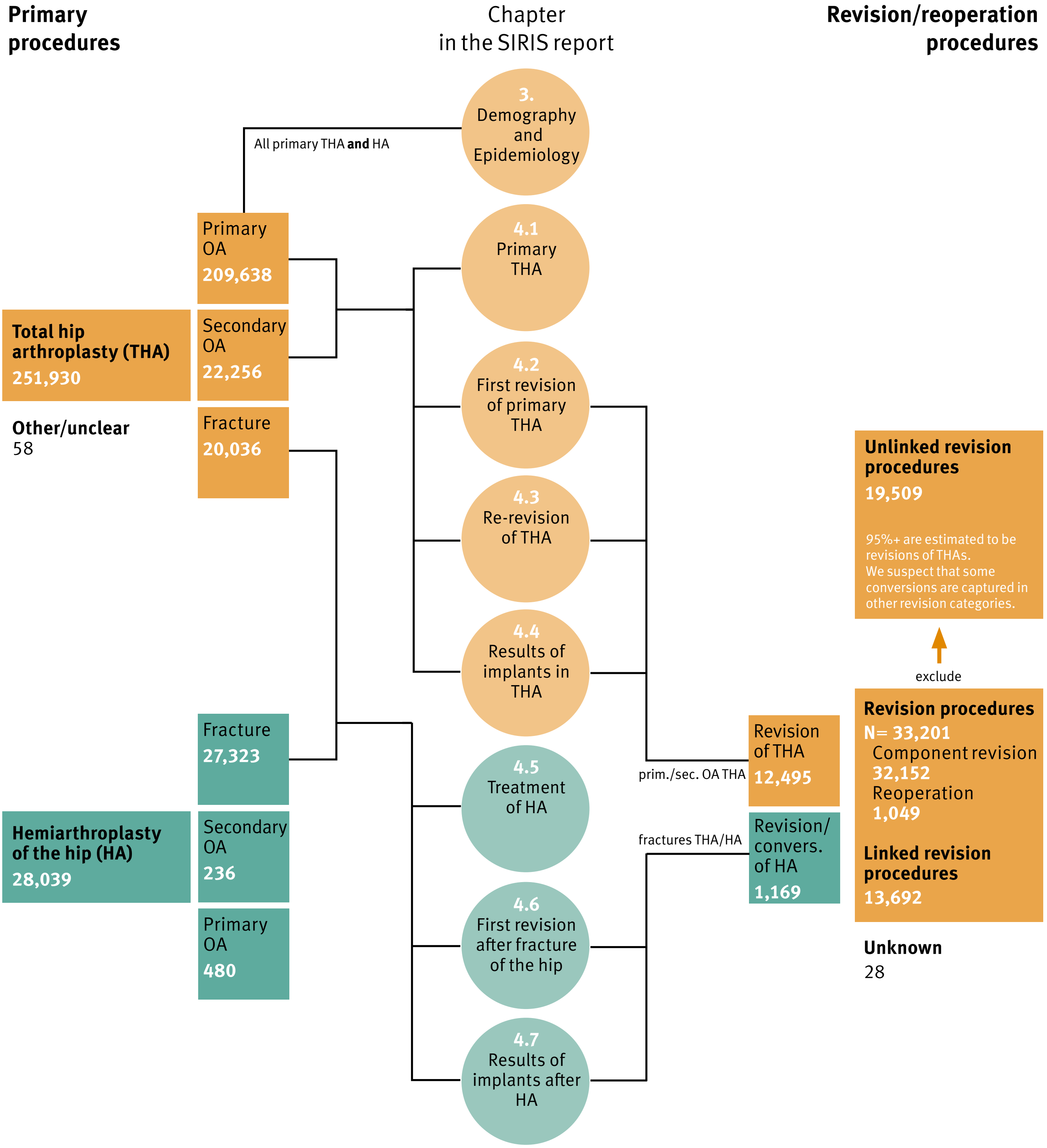
**Figure 3.32**

Distributions of different diagnoses in 36 hospitals ›200 cases (2024)

# Hip arthroplasty

# 4. Hip arthroplasty

## Overview of data structure



## Overview of types of analyses for determining revision rates

| **Types of analysis**<br>**Report section** | **Kaplan-Meier estimates**<br>2012 – 2024<br>**Adjusted for censoring events** | **2-year revision rates**<br>(implants 2019 – 2022 with completed 2-year follow-up)<br>**Adjusted for censoring events** | **Funnel plots of 2-year hospital revision rates**<br>(implants 2019 – 2022 with completed 2-year follow-up)<br>**Risk-adjusted and adjusted for censoring events** |
|---|---|---|---|
| **Hip overview** | All total hip arthroplasties (THA)<br>All hemi arthroplasties (HA) | | THA after primary osteoarthritis (primary OA). **ANQ online reporting, above 99.8%= outlier status**<br>All hemi arthroplasties (HA) |
| **First revision of primary THA** | THA for various subgroups | THA for various subgroups | |
| **First revision of THA/HA after fracture of the hip** | HA with bipolar versus unipolar heads<br>THA after fracture of the hip | HA for various subgroups<br>THA for various subgroups | |
| **Hip implants** (minimal number in group) | Uncemented stem-cup combinations, THA after primary OA (500+)<br>Hybrid fixation stem-cup combinations, THA after primary OA (500+)<br>Uncemented stem-cup combinations, THA after **secondary** OA (500+)<br>**Long-term evaluation 5–10 years: elevated revision rate or outlier** | Uncemented stem-cup combinations, THA after primary OA (50+)<br>Hybrid fixation stem-cup combinations, THA after primary OA (50+)<br>Uncemented stem-cup combinations, THA after **secondary** OA (50+)<br>Uncemented stem-cup combinations, THA after fracture OA (50+)<br>Hybrid fixation stem-cup combinations, THA after fracture (50+)<br>Cemented stem-head combinations, HA after fracture (50+)<br>**2-year evaluation (two times group average= outlier status)** | |

## 4.1 Primary total hip arthroplasty

Until 31.12.2024, the total number of primary THA registered in SIRIS reached 251,930 cases **(Table 3.1).** The current 4-year moving window includes 136,316 THA performed between 01.01.2019 and 31.12.2022, providing a complete 2-year follow-up. The share of women (53.3%) and the mean age of the patients (69.3 years) remained constant throughout the current period of observation from 2019 to 2024. Please consult Chapter 3 Demography and Epidemiology for further details regarding incidence and demographic characteristics.

### Main diagnostic groups

The register categories primary THA into three groups, depending on the diagnosis leading to the operation: THA for primary OA, for secondary OA and for the treatment of fractures, as the revisions rates differ significantly between these groups **(Table 4.1).** The latter group, behaving relevantly differently from the other two groups, is considered more in detail in **chapter 4.5** Fractures of the hip.

Primary THA for primary OA accounts for 83% of all primary THA. The share of secondary OA was 8.3% and for fractures it was 8.7%.

| **Main diagnostic group** | | **Primary OA** | | **Secondary OA** | | **Fracture** | |
|---|---|---|---|---|---|---|---|
| **N** (2019–2024) | | **N** | **%** | **N** | **%** | **N** | **%** |
| Previous surgery | None | 107,608 | 97.0 | 10,772 | 84.8 | 11,328 | 89.5 |
| | Internal fixation femur | | | 747 | 5.9 | 1,022 | 8.1 |
| | Osteotomy femur | | | 487 | 3.8 | 60 | 0.5 |
| | Internal fixation acetabulum | | | 95 | 0.7 | 120 | 0.9 |
| | Osteotomy pelvis | | | 310 | 2.4 | 8 | 0.1 |
| | Arthrodesis | | | 6 | 0.1 | 3 | 0.0 |
| | Open impingement surgery (v2021) | | | 69 | 0.5 | 5 | 0.0 |
| | Arthroscopic impingement surgery (v2021) | | | 81 | 0.6 | 2 | 0.0 |
| | Other previous surgery | 3,346 | 3.0 | 383 | 3.0 | 158 | 1.2 |
| Intervention | Total hip replacement (as entered on SIRIS form) | 110,806 | 99.9 | 12,659 | 99.6 | 12,570 | 99.3 |
| | Hip resurfacing | 21 | 0.0 | 1 | 0.0 | 0 | 0.0 |
| | Other (other cat. and free text entr. recog. as THA)* | 127 | 0.1 | 46 | 0.4 | 86 | 0.7 |
| Approach | Anterior | 61,409 | 55.3 | 6,280 | 49.4 | 7,311 | 57.8 |
| | Anterolateral | 31,931 | 28.8 | 3,846 | 30.3 | 2,953 | 23.3 |
| | Posterior | 14,135 | 12.7 | 1,719 | 13.5 | 1,514 | 12.0 |
| | Lateral | 3,086 | 2.8 | 609 | 4.8 | 665 | 5.3 |
| | Other approach | 393 | 0.4 | 252 | 2.0 | 213 | 1.7 |
| Fixation | All uncemented | 97,004 | 87.4 | 10,313 | 81.2 | 6,317 | 49.9 |
| | Hybrid (acetabulum uncemented, femur cemented) | 12,469 | 11.2 | 1,707 | 13.4 | 5,289 | 41.8 |
| | All cemented | 877 | 0.8 | 329 | 2.6 | 645 | 5.1 |
| | Reverse hybrid (acetabulum cemented, femur uncemented) | 400 | 0.4 | 173 | 1.4 | 200 | 1.6 |
| | Reinforcement ring, femur uncemented | 75 | 0.1 | 69 | 0.5 | 54 | 0.4 |
| | Reinforcement ring, femur cemented | 129 | 0.1 | 115 | 0.9 | 151 | 1.2 |

**Table 4.1 Part one**

**Primary total hip arthroplasty: Surgery characteristics by main diagnostic group**

* in case of inconsistencies between form entry and implant registration, we use the implant in determining the relevant category (e.g. entered „bipolar prosthesis“ but registered stem and dual mobility cup) . Such cases are routinely counted as THAs, but still retained in the „other“ category chosen by the user.

### Type of hip prosthesis

In over 99% of the cases, conventional THA had been performed in all three main diagnostic groups. Resurfacing of the hip has largely been abandoned in Switzerland, only 22 cases were registered during the past 5 years **(Table 4.1)**.

The use of dual mobility cups (DMC) has increased over the last 10 years, particularly in the fracture group, where more than one-third of the THA performed in 2024 were made using a DMC. The use of DMC also increased in primary and secondary OA, albeit at a lower level **(Figure 4.1)**.

| **Main diagnostic group** | | **Primary OA** | | **Secondary OA** | | **Fracture** | |
|---|---|---|---|---|---|---|---|
| **N** (2021–2024) | | **N** | **%** | **N** | **%** | **N** | **%** |
| Technology | Conventional | 49,616 | 64.7 | 5,569 | 61.7 | 5,294 | 57.5 |
| | Computer assisted cup | 1,450 | 1.9 | 88 | 1.0 | 36 | 0.4 |
| | Computer assisted stem | 1,651 | 2.2 | 96 | 1.1 | 20 | 0.2 |
| | Robotic assisted (image guided, CT based) | 654 | 0.9 | 83 | 0.9 | 12 | 0.1 |
| | Patient specific cutting blocks | 851 | 1.1 | 39 | 0.4 | 5 | 0.1 |
| | Intraoperative fluoroscopy/radiography | 25,075 | 32.7 | 3,301 | 36.5 | 3,877 | 42.1 |
| | **Total THA (multiple responses)** | **76,702** | | **9,033** | | **9,210** | |
| Add. intervention | None | 74,579 | 96.4 | 8,031 | 87.9 | 8,021 | 86.5 |
| | Acetabular roof reconstruction | 890 | 1.2 | 257 | 2.8 | 105 | 1.1 |
| | Central osseous reconstruction | 598 | 0.8 | 202 | 2.2 | 178 | 1.9 |
| | Proximal femur osteotomy | 12 | 0.0 | 28 | 0.3 | 26 | 0.3 |
| | ORIF/CRIF acetabulum | 35 | 0.0 | 25 | 0.3 | 157 | 1.7 |
| | Cerclage femur | 548 | 0.7 | 236 | 2.6 | 491 | 5.3 |
| | ORIF/CRIF femur | 47 | 0.1 | 31 | 0.3 | 119 | 1.3 |
| | Augments | 15 | 0.0 | 15 | 0.2 | 9 | 0.1 |
| | Other | 796 | 1.0 | 481 | 5.3 | 453 | 4.9 |
| | **Total THA (multiple responses)** | **77,341** | | **9,138** | | **9,274** | |

**Table 4.1 Part two**

Primary total hip arthroplasty: Surgery characteristics by main diagnostic group

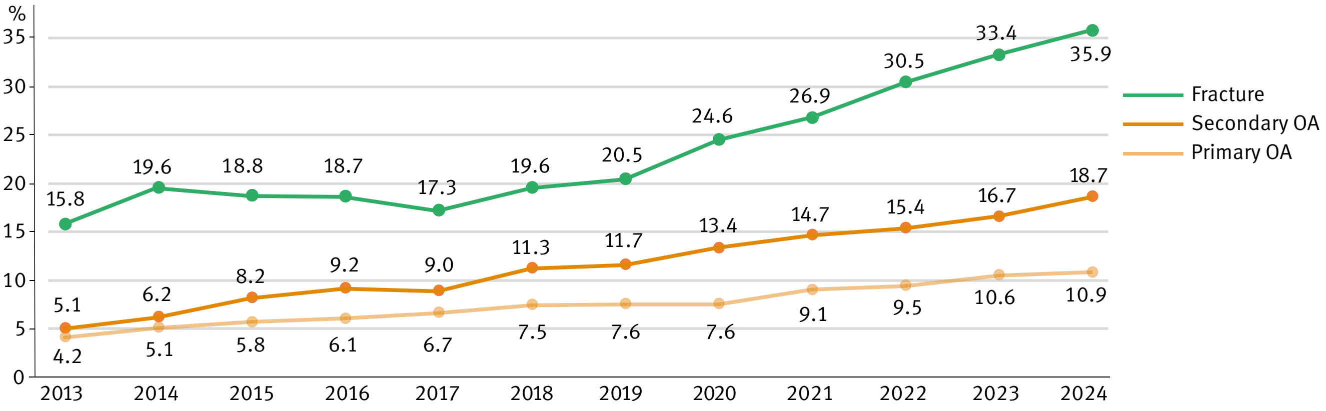


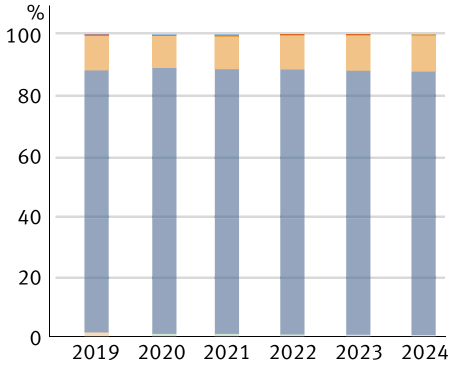
**Figure 4.1**

Share of dual-mobility cups over time by main pathology (%)

Fixation of the stem differed significantly among the main diagnostic groups but did not change significantly since 2019 **(Table 4.2).** Uncemented stems were used in more than 80% of primary and secondary OA, whereas approximately 50% of the stems had cemented fixation when treating fractures. The use of all uncemented fixation declined slightly since 2022. Cages and reinforcement rings were used noticeably more frequently in the secondary OA and the fracture groups. This is most probably due to more complex deformities or fractures of the acetabulum needing advanced reconstruction techniques.

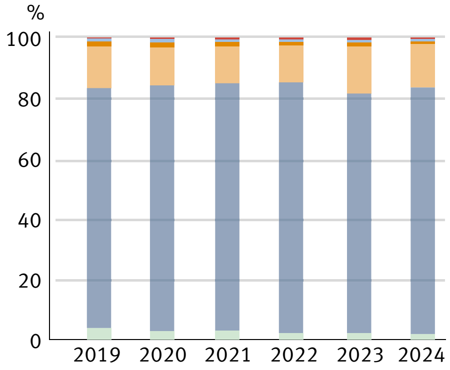
### Primary osteoarthritis

| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | |
|---|---|---|---|---|---|---|
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | **Reinforcement ring femur uncem.** |
| 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.0 | **Reinforcement ring femur cemented** |
| 0.4 | 0.4 | 0.5 | 0.3 | 0.3 | 0.3 | **Reverse hybrid** |
| 11.3 | 10.4 | 10.8 | 11.2 | 11.6 | 11.9 | **Hybrid** |
| 86.7 | 88.0 | 87.6 | 87.7 | 87.4 | 87.2 | **All uncemented** |
| 1.3 | 0.9 | 0.9 | 0.7 | 0.6 | 0.5 | **All cemented** |
| **16,892** | **16,721** | **17,907** | **18,946** | **19,973** | **20,515** | **N** |



### Secondary osteoarthritis

| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | |
|---|---|---|---|---|---|---|
| 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 0.5 | **Reinforcement ring femur uncem.** |
| 1.0 | 1.2 | 0.8 | 0.8 | 0.9 | 0.8 | **Reinforcement ring femur cemented** |
| 1.6 | 1.7 | 1.6 | 1.3 | 1.2 | 0.9 | **Reverse hybrid** |
| 13.8 | 12.4 | 12.1 | 12.1 | 15.6 | 14.3 | **Hybrid** |
| 79.4 | 81.4 | 81.9 | 83.1 | 79.4 | 81.6 | **All uncemented** |
| 3.9 | 2.8 | 3.0 | 2.2 | 2.2 | 1.9 | **All cemented** |
| **1,716** | **1,852** | **2,076** | **2,256** | **2,316** | **2,490** | **N** |



### Fracture

| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | |
|---|---|---|---|---|---|---|
| 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.3 | **Reinforcement ring femur uncem.** |
| 1.3 | 1.2 | 1.2 | 1.0 | 1.6 | 0.9 | **Reinforcement ring femur cemented** |
| 2.1 | 1.9 | 1.9 | 1.5 | 1.1 | 1.2 | **Reverse hybrid** |
| 41.2 | 39.4 | 39.7 | 39.8 | 43.9 | 45.6 | **Hybrid** |
| 47.6 | 52.2 | 51.2 | 52.3 | 48.6 | 47.7 | **All uncemented** |
| 7.3 | 4.9 | 5.6 | 4.9 | 4.4 | 4.2 | **All cemented** |
| **1,593** | **1,789** | **2,134** | **2,290** | **2,380** | **2,470** | **N** |

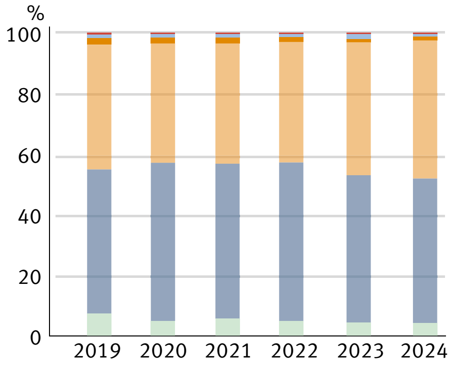


**Table 4.2**

**Primary total hip arthroplasty: Component fixation methods by diagnostic group by year**

## Approach

For primary OA, the anterior approach was used most often, followed by the anterolateral approach. Approaches first started to be recorded in 2015. Since then, the use of the anterior approach has gradually increased, reaching 58.6% in 2024. The anterolateral approach was quite popular in 2019, being used in 31.2% of the primary THA, but is use declined to 27.6% in 2024. The lateral approach is getting less and less popular. The share of the posterior approach is also declining; it was used in 11.9% of the cases in 2024 **(Table 4.3).**

The anterior approach is most frequently used in northeastern Switzerland, as well as in the Cantons of Lucerne, Wallis and Geneva. On the other hand, the anterolateral approach is used most often in the Cantons of Bern, Jura, Solothurn, Uri, Nidwalden and Graubünden **(Figure 4.2).**

| Surgical approach | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|
| Anterior | 50.5 | 52.8 | 55.8 | 56.9 | 56.4 | 58.6 | 55.3 |
| Anterolateral | 31.2 | 30.6 | 27.7 | 27.8 | 28.4 | 27.6 | 28.8 |
| Lateral | 4.6 | 3.6 | 2.9 | 2.5 | 1.9 | 1.6 | 2.8 |
| Posterior | 13.0 | 12.5 | 13.3 | 12.6 | 13.1 | 11.9 | 12.7 |
| Other approach | 0.7 | 0.5 | 0.3 | 0.2 | 0.2 | 0.2 | 0.4 |
| **Total [N]** | **16,892** | **16,721** | **17,907** | **18,946** | **19,973** | **20,515** | **110,954** |

**Table 4.3**

Surgical approach in total hip arthroplasty for primary osteoarthritis by year (in %)

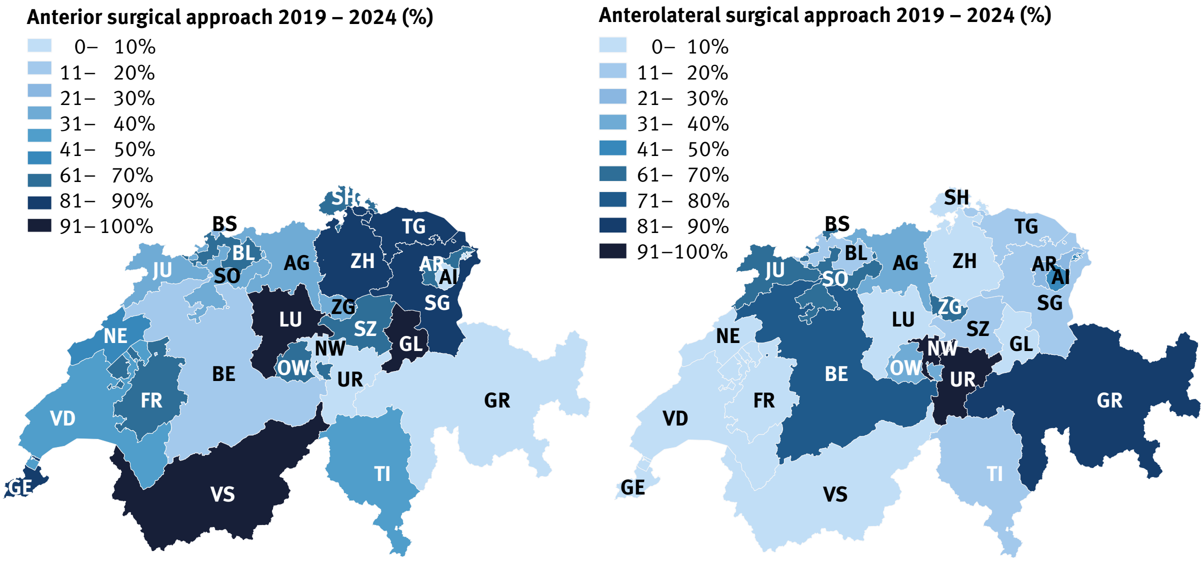


**Figure 4.2**

Relative share of total hip arthroplasty procedures using different surgical approaches by Canton (2019 – 2024)

### Bearing

The bearing is one of the most important key factors for wear resistance and consequently long-term implant survival. Improvement of bearing materials has led to a decrease in osteolysis and loosening, with decreasing necessity for consecutive revisions. The selection of the bearing depends, amongst other criteria, on the activity level and the age of the patient. Bearings with favourable wear characteristics, e.g., ceramic on highly crosslinked polyethylene (CoXLPE) and ceramic on ceramic (CoC), were most frequently used in younger patients. Currently, the most frequently used bearing in Switzerland was CoXLPE and its use continued to increase. In 2024, this combination was chosen in 69.4% of all primary THA for primary OA **(Table 4.4 and Figure 4.3).** Metal on conven-

| **Bearing surface** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2019–2024** |
|---|---|---|---|---|---|---|---|
| Metal on conventional polyethylene (MoCPE) | 1.8 | 1.5 | 2.1 | 1.3 | 1.6 | 1.4 | 1.6 |
| Ceramic on conventional polyethylene (CoCPE) | 4.2 | 3.9 | 4.5 | 4.7 | 5.6 | 5.4 | 4.8 |
| Metal on cross-linked polyethylene (MoXLPE) | 11.3 | 9.6 | 9.0 | 7.8 | 6.7 | 7.0 | 8.5 |
| Ceramic on cross-linked polyethylene (CoXLPE) | 60.3 | 62.6 | 63.9 | 66.7 | 67.7 | 69.4 | 65.3 |
| Ceramic on ceramic (CoC) | 15.2 | 15.0 | 14.0 | 12.9 | 12.1 | 10.4 | 13.1 |
| Ceramicised metal on conventional polyethylene (CMoCPE) | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Ceramicised metal on cross-linked polyethylene (CMoXLPE) | 6.8 | 7.1 | 6.2 | 6.4 | 6.2 | 6.2 | 6.5 |
| **N** (bearing surface known) | **16,515** | **16,455** | **17,655** | **18,664** | **19,524** | **20,032** | **108,845** |
| **N** (bearing surface unknown) | **377** | **266** | **252** | **282** | **449** | **483** | **2,109** |

**Table 4.4**

**Primary total hip arthroplasty: bearing surface* in primary osteoarthritis by year (in %)**

* Femoral heads and acetabular inserts/monobloc cups

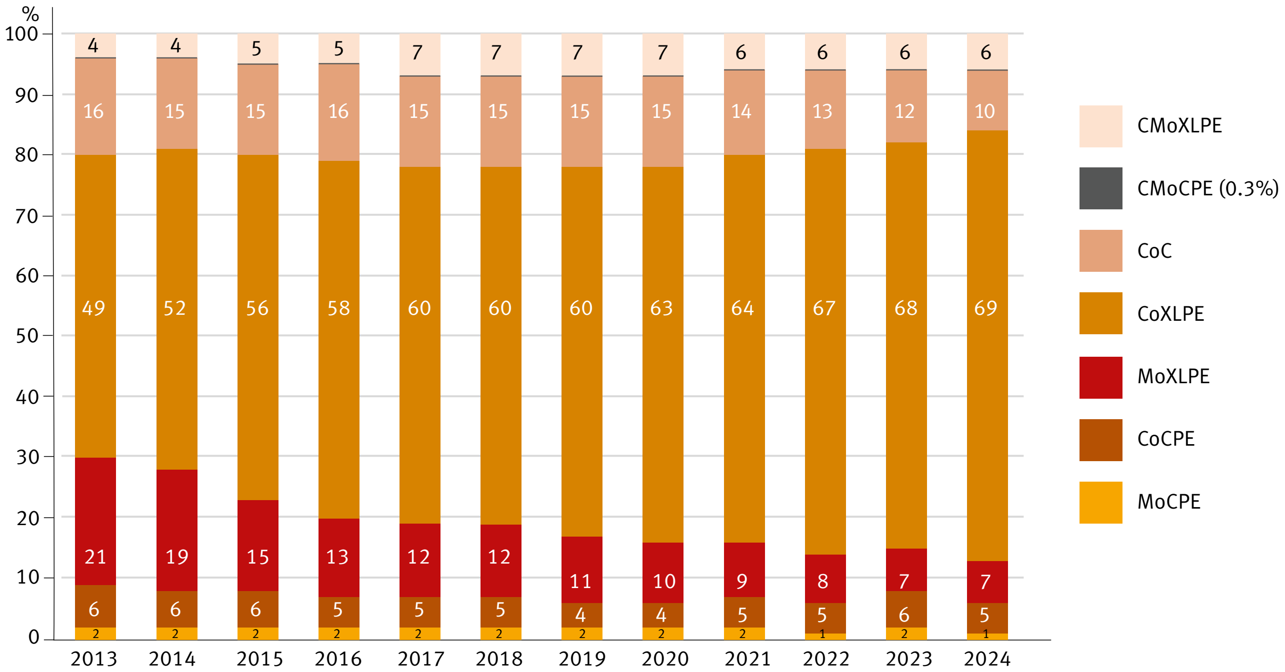


**Figure 4.3**

**Relative shares of bearing surfaces in total hip arthroplasty over time**

Primary OA

tional polyethylene (MoCPE) continued to have a very low share, essentially unchanged around 1.6% over the years. Ceramised metal (CM) was used in 6.8% of the cases, mostly in combination with XLPE. The second most frequently used bearing was CoC, accounting overall for 13.1% of all THA for primary OA. However, its use slowly declined over the years and was used in only 10.4% in 2024. It was used most often in patients ‹45 years of age, where it was chosen in 24.1% **(Table 4.5).** XLPE is the most commonly used acetabular bearing in the age group above 75 years of age. However, it is more often combined with metal heads, while in the younger patients CoXLPE or CoC are prevalent. The age-related use of the various bearings is shown in **Figure 4.4.**

| Bearing surface | ‹45 | 45–54 | 55–64 | 65–74 | 75–84 | 85+ | All |
|---|---|---|---|---|---|---|---|
| Metal on conventional polyethylene (MoCPE) | 0.1 | 0.2 | 0.4 | 0.8 | 2.8 | 7.2 | 1.6 |
| Ceramic on conventional polyethylene (CoCPE) | 1.2 | 1.4 | 2.2 | 4.2 | 7.4 | 10.4 | 4.8 |
| Metal on cross-linked polyethylene (MoXLPE) | 3.4 | 4.9 | 5.5 | 7.7 | 11.1 | 17.0 | 8.5 |
| Ceramic on cross-linked polyethylene (CoXLPE) | 64.9 | 65.4 | 68.2 | 67.3 | 63.3 | 53.4 | 65.3 |
| Ceramic on ceramic (CoC) | 24.1 | 20.8 | 16.4 | 13.0 | 9.3 | 7.0 | 13.1 |
| Ceramicised metal on conventional polyethylene (CMoCPE) | 0.00 | 0.04 | 0.09 | 0.16 | 0.53 | 0.89 | 0.29 |
| Ceramicised metal on cross-linked polyethylene (CMoXLPE) | 6.37 | 7.21 | 7.26 | 6.91 | 5.62 | 4.05 | 6.46 |
| **N** (bearing surface known) | **1,901** | **8,435** | **24,856** | **35,795** | **31,220** | **6,637** | **108,844** |
| **N** (bearing surface unknown)** | **46** | **128** | **466** | **637** | **656** | **176** | **2,109** |

**Table 4.5**

Primary total hip arthroplasty: bearing surface* in primary osteoarthritis by age** (in %)

*  Femoral heads and acetabular inserts/monobloc cups

** please note that age is missing in one case

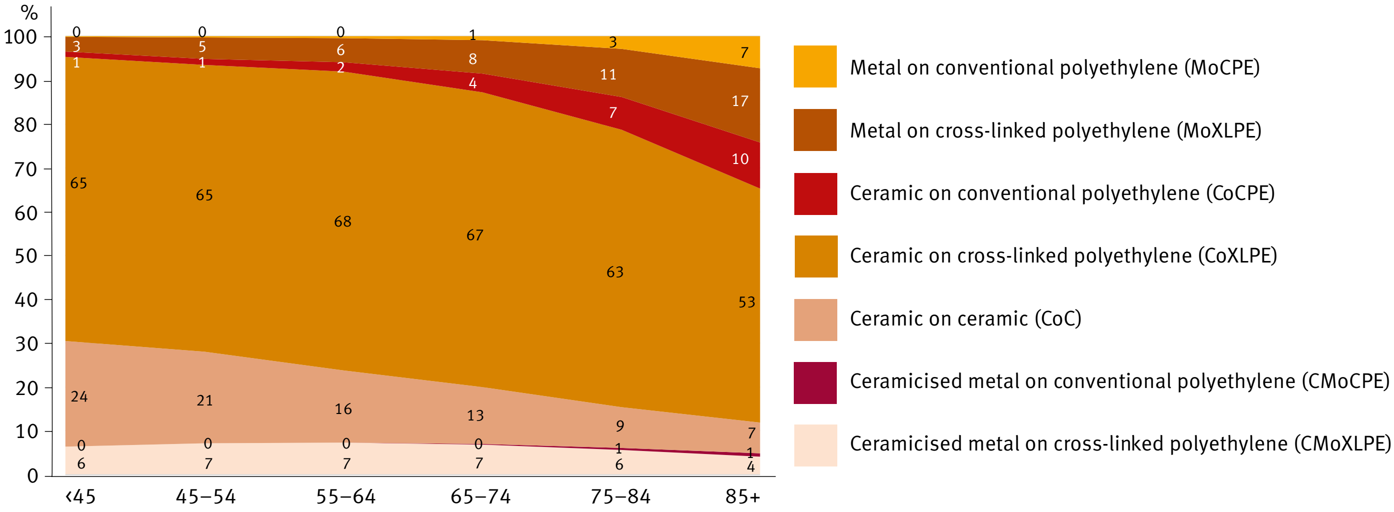


**Figure 4.4**

Primary total hip arthroplasty: bearing surface in primary osteoarthritis by age (in %)

Primary OA, 2019 – 2024

### Fixation

Uncemented fixation of both components was standard for primary THA performed for primary OA, accounting for 87.4% of all the cases and more than 95% of patients under the age of 65. Patients older than 85 years still received cementless implants in 59% of the cases **(Table 4.6)**. Hybrid fixation with cemented stems and uncemented cups was chosen more frequently in females (15.6%) than in males (6.6%) **(Table 4.7)**.

| Fixation method | <45 | 45–54 | 55–64 | 65–74 | 75–84 | 85+ | All |
|---|---|---|---|---|---|---|---|
| All cemented | 0.3 | 0.2 | 0.2 | 0.5 | 1.2 | 3.5 | 0.8 |
| All uncemented | 97.6 | 97.5 | 96.4 | 91.3 | 78.6 | 59.0 | 87.4 |
| Hybrid acetabulum uncemented, femur cemented | 1.3 | 1.8 | 3.0 | 7.8 | 19.5 | 36.1 | 11.2 |
| Reverse hybrid acetabulum cemented, femur uncemented | 0.7 | 0.3 | 0.2 | 0.3 | 0.5 | 0.9 | 0.4 |
| Reinforcement ring, femur cemented | 0.00 | 0.07 | 0.08 | 0.07 | 0.16 | 0.40 | 0.12 |
| Reinforcement ring, femur uncemented | 0.2 | 0.2 | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 |
| **N** | **1,947** | **8,563** | **25,322** | **36,432** | **31,876** | **6,813** | **110,953** |

**Table 4.6**

Primary total hip arthroplasty: fixation methods in primary osteoarthritis by age* (in %)

* please note that age is missing in one case

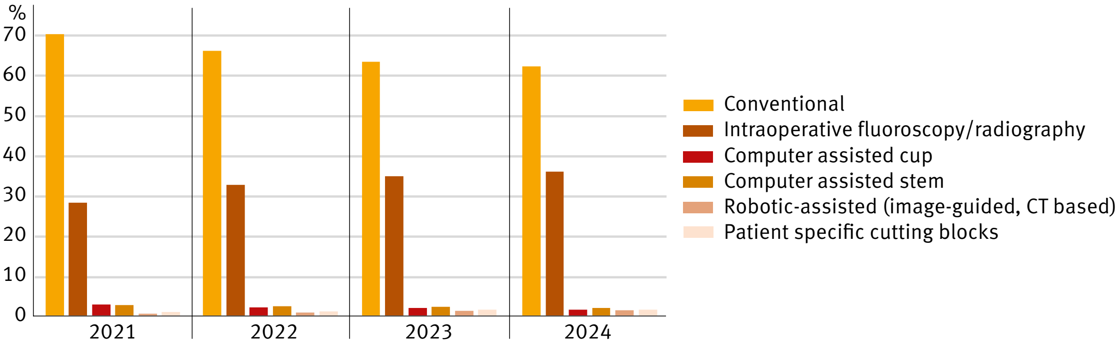
| Fixation method | Women | Men | All |
|---|---|---|---|
| All cemented | 1.1 | 0.5 | 0.8 |
| All uncemented | 82.6 | 92.6 | 87.4 |
| Hybrid acetabulum uncemented, femur cemented | 15.6 | 6.6 | 11.2 |
| Reverse hybrid acetabulum cemented, femur uncemented | 0.5 | 0.2 | 0.4 |
| Reinforcement ring, femur cemented | 0.16 | 0.07 | 0.12 |
| Reinforcement ring, femur uncemented | 0.1 | 0.1 | 0.1 |
| **N** | **57,338** | **53,616** | **110,954** |

**Table 4.7**

Primary total hip arthroplasty: fixation methods in primary osteoarthritis by sex (in %)

## Technology

Navigation, robotics or patient specific instruments (PSI) are not widely used in THA in Switzerland, contrary to knee arthroplasty. Such aids were used in 6.1% of all cases only. On the other hand, intraoperative fluoroscopy was reported to be used in about one third of all cases (32.7%). The use of fluoroscopy increased over the last three years **(Figure 4.5).**



| Technology [%] | 2021 | 2022 | 2023 | 2024 | 2021–2024 |
|---|---|---|---|---|---|
| Conventional | 69.6 | 65.5 | 62.7 | 61.7 | 64.5 |
| Intraoperative fluoroscopy/radiography | 27.9 | 32.2 | 34.4 | 35.5 | 32.7 |
| Computer assisted cup | 2.6 | 2.0 | 1.7 | 1.4 | 1.9 |
| Computer assisted stem | 2.6 | 2.2 | 2.1 | 1.8 | 2.2 |
| Robotic-assisted (image guided, CT based) | 0.4 | 0.6 | 1.1 | 1.2 | 0.9 |
| Patient specific cutting blocks | 0.8 | 1.0 | 1.4 | 1.3 | 1.1 |
| **N** | **17,268** | **18,946** | **19,973** | **20,515** | **76,702** |

**Figure 4.5**

**Primary total hip arthroplasty: technologies used in primary OA**

Multiple responses possible (percentages do not sum to 100)

## 4.2 First revision within 2 years of primary total hip arthroplasty

First revisions are revisions that are linked to a primary THA registered in SIRIS, occurring for the first time, as opposed to re-revisions, which are repeated revisions after previous revisions. SIRIS differentiates between early revisions, performed within the first 2 years after implantation and long-term revisions, now up to 12 years after the index operation.

The 2-year revision rates were calculated for a moving 4-year window, which includes the last 4 years with a full 2-year follow-up. For this report, this corresponds to primary THA implanted between 01.01.2019 and 31.12.2022. For long-term outcomes, cumulative revision rates were calculated using KM survival estimations.

For primary OA, the 2-year revision rate was 2.4% (CI 2.3 – 2.6%), whereas for secondary OA it was 4.0% (CI 3.6 – 4.5%) and for fractures 5.0% (CI 4.0 – 5.5%), each significantly different from the others **(Table 4.9).**

The lowest 2-year revision rate (1.8%) was observed in the age group 55 – 64 years old. The revision rate for primary OA improved by 0.01% compared to previous 4-year period.

| | | Primary | Revised within 24 months | | | |
|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | |
| | | N at risk* | N | %** | lower | upper |
| Overall (moving average) | | 86,177 | 2,395 | 2.8 | 2.7 | 2.9 |
| Diagnosis | Primary OA | 70,465 | 1,707 | 2.4 | 2.3 | 2.6 |
| | Secondary OA | 7,900 | 316 | 4.0 | 3.6 | 4.5 |
| | Fracture | 7,812 | 372 | 5.0 | 4.5 | 5.5 |
| Overall Primary OA | | 70,465 | 1,707 | 2.4 | 2.3 | 2.6 |
| Sex | Women | 36,261 | 897 | 2.5 | 2.3 | 2.7 |
| | Men | 34,204 | 810 | 2.4 | 2.2 | 2.6 |
| Age group | ‹55 | 6,955 | 189 | 2.7 | 2.4 | 3.1 |
| | 55–64 | 15,894 | 319 | 2.0 | 1.8 | 2.2 |
| | 65–74 | 23,241 | 543 | 2.3 | 2.2 | 2.6 |
| | 75–84 | 20,030 | 543 | 2.7 | 2.5 | 3.0 |
| | 85+ | 4,345 | 113 | 2.6 | 2.2 | 3.2 |
| BMI group | ‹18.5 | 985 | 20 | 2.1 | 1.3 | 3.2 |
| | 18.5–24.9 | 21,561 | 401 | 1.9 | 1.7 | 2.1 |
| | 25–29.9 | 24,851 | 545 | 2.2 | 2.0 | 2.4 |
| | 30–34.9 | 11,603 | 331 | 2.9 | 2.6 | 3.2 |
| | 35–39.9 | 3,477 | 153 | 4.4 | 3.8 | 5.2 |
| | 40+ | 1,132 | 65 | 5.8 | 4.6 | 7.3 |
| | Unknown | 6,856 | 192 | 2.8 | 2.5 | 3.2 |
| Morbidity state | ASA 1 | 7,704 | 129 | 1.7 | 1.4 | 2.0 |
| | ASA 2 | 41,218 | 894 | 2.2 | 2.0 | 2.3 |
| | ASA 3 | 17,958 | 581 | 3.3 | 3.0 | 3.5 |
| | ASA 4/5 | 433 | 13 | 3.1 | 1.8 | 5.3 |
| | Unknown | 3,152 | 90 | 2.9 | 2.3 | 3.5 |

**Table 4.9**

**First revision of primary total hip arthroplasty within 24 months overall and according to baseline characteristics**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

** Rates adjusted for effects of mortality and emigration.

### Reason for early first revision of THA for primary OA

A total of 1,707 revisions of primary THA performed for primary OA were registered during the current 4-year moving window. This is almost the same number (1,708 revisions) as during the window 2018 – 2021 used in the last annual report. However, the number of primary THA has increased from 67,616 to 70,465. The most frequent cause of early first revision of primary THA for primary OA was infection (30.5%), followed by periprosthetic fracture (19.6%), dislocation (17.0%), and femoral loosening (16.0%) **(Table 4.10).** There was a substantial increase in the share of revisions attributed to infections from 27.9% in the previous report to currently 30.5%. Approximately one-sixth of all revisions (14.9%) were undertaken for malposition of either acetabular or femoral components.

| Reason | revised | % |
|---|---|---|
| Infection | 520 | 30.5 |
| Periprosthetic fracture | 334 | 19.6 |
| Dislocation | 291 | 17.0 |
| Loosening femoral | 273 | 16.0 |
| Position/orientation of cup | 143 | 8.4 |
| Loosening acetabular | 134 | 7.9 |
| Position/orientation of stem | 112 | 6.6 |
| Wear | 17 | 1.0 |
| Spacer | 14 | 0.8 |
| Implant failure | 13 | 0.8 |
| Impingement | 8 | 0.5 |
| Osteolysis FE | 7 | 0.4 |
| Trochanter pathology | 6 | 0.4 |
| Osteolysis AC | 5 | 0.3 |
| Acetabular protrusion | 4 | 0.2 |
| Squeaking | 3 | 0.2 |
| Other | 201 | 11.8 |
| **Total Revisions** | **1,707** | |

**Table 4.10**

**Reason for early first revision of primary total hip arthroplasty (primary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)
Early first revisions are those occurring within 2 years of the primary arthroplasty. Multiple responses possible (percentages do not sum to 100).

### Type of revision surgery

During the current 4-year moving period, there were in total 1,707 first revisions. The spectrum reached from sole exchange of the head or of the inlay to complete exchange of all components (the latter making 13.9% of all revisions) **(Table 4.11).** The most frequently performed operation was the exchange of the femoral component only (24.7%). An exchange of the head and of the inlay was performed in 16.3%. There were 47 (2.8%) component reimplantations after Girdlestone or spacer implantation registered as first revision, despite no previous component removal being registered. Obviously, these were not first revisions but appeared as first revisions because no other revision such as spacer implantation or Girdlestone resection had been documented. The registry does not correct this faulty entry, as it documents that there was a revision performed, which is sufficient for the analysis. Surgeons are invited to document all the revisions performed, and to carefully choose among the options available during data entry to avoid such mistakes.

| Type | N revised | % |
|---|---|---|
| Exchange femoral component | 422 | 24.7 |
| Exchange head and inlay | 279 | 16.3 |
| Exchange acetabular and femoral components | 237 | 13.9 |
| Exchange acetabular component and head | 227 | 13.3 |
| Exchange head | 198 | 11.6 |
| Exchange femoral component and inlay | 92 | 5.4 |
| Exchange acetabular component | 79 | 4.6 |
| Component reimplantation (after spacer or Girdlestone) | 47 | 2.8 |
| Other intervention | 44 | 2.6 |
| Component removal, spacer implantation | 30 | 1.8 |
| Exchange inlay | 22 | 1.3 |
| Exchange femoral component, inlay and osteosynthesis | 19 | 1.1 |
| Girdlestone | 11 | 0.6 |
| **Total Revisions** | **1,707** | **100** |

**Table 4.11**

**Type of early first revision of total hip arthroplasty (primary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).
Early first revisions are those occurring within 2 years of the primary arthroplasty.

### Implants and fixation

Three different situations of early first revision were analysed more in detail, revision of both the acetabular and the femoral implants, femoral revision only, and component reimplantation after spacer/ Girdlestone procedures. The type of fixation, whether primary or revision implants were used, and the patient's age at revision were considered in the analysis. The distribution of implants used differed among these three revision situations **(Table 4.12, see next page).** Overall, primary stems were used in 65.3% of all these revisions. Among the cases with primary stems, uncemented stems (including uncemented short stems) were used in 40% of all revisions and cemented primary stems in 26%. Uncemented revision stems were implanted in 33.8%. Uncemented stems were used more frequently in younger patients, the share of cemented stems increasing with age. The use of cemented revision stems was exceptional.

For acetabular revisions, standard uncemented acetabular cups were used in 79.5% of the revisions, while cemented cups without cages were used in 9.7%. Reconstruction cages were used in 9.1%. Specific revision cups were used only rarely. An overview of the implants used is provided in **Table 4.13.**

| Femoral components | N |
|---|---|
| **Cem. primary stems** 10+ | |
| Twinsys | 61 |
| SPII Lubinus | 43 |
| Corail | 37 |
| Quadra-C | 27 |
| Quadra-P (cem) | 27 |
| Avenir | 19 |
| Weber | 18 |
| Centris | 12 |
| MS-30 | 11 |
| Other stems | 57 |
| **Uncem. primary stems** 10+ | |
| Corail collared | 83 |
| Avenir | 50 |
| Polarstem | 40 |
| Twinsys | 40 |
| Quadra-P | 34 |
| Quadra-H | 30 |
| Corail | 24 |
| CLS Spotorno | 20 |
| Stellaris | 10 |
| Other stems | 47 |

| | N |
|---|---|
| **Short stems*** 10+ | |
| Optimys | 40 |
| Amistem-C | 25 |
| Fitmore | 21 |
| Other stems | 25 |
| **Cem. revision stems** 10+ | |
| Arcad L XL | 10 |
| Other stems | 3 |
| **Uncem. revision stems** 10+ | |
| Corail collared | 122 |
| Revitan | 55 |
| Wagner SL | 39 |
| MRP-titan | 29 |
| Quadra-R | 29 |
| Lima revision | 25 |
| M-Vizion | 21 |
| Mathys modular revision | 21 |
| Restoration modular | 18 |
| Alloclassic SLL | 17 |
| Redapt | 17 |
| Other stems | 21 |

| Acetabular comp. | N |
|---|---|
| **Cem. primary cups** 10+ | |
| Polarcup | 27 |
| Versacem | 16 |
| DS evolution (cem) | 15 |
| Avantage | 10 |
| Other cups | 20 |
| **Uncem. primary cups** 10+ | |
| RM pressfit vitamys | 80 |
| Pinnacle | 72 |
| Allofit | 58 |
| Versafitcup DM | 56 |
| Bi-Mentum | 54 |
| Polarcup | 48 |
| Versafitcup trio/ccl. | 40 |
| Symbol DMHA | 34 |
| Avantage | 25 |
| Mpact | 24 |
| DS evolution | 23 |
| G7 DM hemispherical | 22 |
| TM | 20 |
| Fitmore | 19 |
| R3 | 15 |

| | N |
|---|---|
| Delta TT DM | 13 |
| Liberty | 12 |
| Mpact DM | 10 |
| Other cups | 82 |
| **Revision cups** (7+) | |
| Pinnacle | 7 |
| Other cups | 8 |
| **AC roof ring or cage** 10+ | |
| ZB reinforcement rings | 51 |
| Burch-Schneider cage | 16 |
| Other cages | 12 |

**Table 4.13**

**Hip early first revision of primary OA THA: main brands used (2019 – 2024)**

eclass categories used: 34-32-10-01, 34-32-10-02, 34-32-10-03, 34-32-10-05, 34-32-10-06, 34-32-10-08, 34-32-10-09, 34-32-10-10, 34-32-10-11.
A small proportion of tumor systems such as MUTARS is excluded.
All registered component revisions of four main types 2019-2024 with at least one FE/AC revision component with a known e-class
* Please note that both Fitmore and Amistem are originally classified as a regular primary stems. We reclassified them as short stems.

|  | Category of implant | Age at revision |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  |  | <45 | 45-54 | 55-64 | 65-74 | 75-84 | 85+ |  |
| **Type of revision of femoral components** |  | % | % | % | % | % | % | N |
| AC + FE revision | cem. primary stems | 0.0 | 14.3 | 14.8 | 18.1 | 27.1 | 41.2 | 72 |
|  | uncem. primary stems | 55.6 | 54.8 | 45.7 | 37.1 | 33.3 | 29.4 | 145 |
|  | short stems | 11.1 | 7.1 | 7.4 | 10.3 | 10.4 | 5.9 | 33 |
|  | cem. revision stems | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1 |
|  | uncem. revision stems | 33.3 | 23.8 | 30.9 | 34.5 | 29.2 | 23.5 | 110 |
|  |  | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **361** |
| FE revision (with or without inlay) | cem. primary stems | 10.0 | 26.3 | 22.6 | 31.3 | 26.1 | 46.2 | 203 |
|  | uncem. primary stems | 90.0 | 47.4 | 33.1 | 23.2 | 22.3 | 13.5 | 189 |
|  | short stems | 0.0 | 13.2 | 13.5 | 6.6 | 10.7 | 1.9 | 68 |
|  | cem. revision stems | 0.0 | 0.0 | 0.0 | 1.0 | 2.4 | 0.0 | 9 |
|  | uncem. revision stems | 0.0 | 13.2 | 30.8 | 37.9 | 38.5 | 38.5 | 253 |
|  |  | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **722** |
| Component reimplantation (after spacer) | cem. primary stems | 0.0 | 0.0 | 11.1 | 24.0 | 38.5 | 0.0 | 12 |
|  | uncem. primary stems | 100.0 | 100.0 | 22.2 | 36.0 | 23.1 | 66.7 | 18 |
|  | short stems | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 1 |
|  | cem. revision stems |  |  |  |  |  |  | 0 |
|  | uncem. revision stems | 0.0 | 0.0 | 66.7 | 36.0 | 38.5 | 33.3 | 21 |
|  |  | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **52** |
| **Type of revison of acetabular components** |  |  |  |  |  |  |  |  |
| AC + FE revision | cem. primary cups | 0.0 | 0.0 | 6.3 | 8.7 | 11.6 | 18.8 | 29 |
|  | uncem. primary cups | 100.0 | 100.0 | 89.9 | 83.5 | 78.9 | 68.8 | 301 |
|  | revision cups | 0.0 | 0.0 | 1.3 | 2.6 | 1.1 | 0.0 | 5 |
|  | AC roof ring or cage | 0.0 | 0.0 | 2.5 | 5.2 | 8.4 | 12.5 | 18 |
|  |  | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **353** |
| AC revision (with or without head) | cem. primary cups | 0.0 | 6.1 | 5.6 | 6.9 | 19.1 | 10.3 | 45 |
|  | uncem. primary cups | 100.0 | 87.9 | 82.0 | 79.4 | 63.2 | 69.0 | 322 |
|  | revision cups | 0.0 | 0.0 | 4.5 | 1.5 | 0.7 | 0.0 | 7 |
|  | AC roof ring or cage | 0.0 | 6.1 | 7.9 | 12.2 | 16.9 | 20.7 | 54 |
|  |  | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **428** |
| Component reimplantation (after spacer) | cem. primary cups | 0.0 | 0.0 | 0.0 | 8.7 | 30.0 | 33.3 | 6 |
|  | uncem. primary cups | 100.0 | 100.0 | 66.7 | 78.3 | 70.0 | 66.7 | 35 |
|  | revision cups | 0.0 | 0.0 | 11.1 | 8.7 | 0.0 | 0.0 | 3 |
|  | AC roof ring or cage | 0.0 | 0.0 | 22.2 | 4.3 | 0.0 | 0.0 | 3 |
|  |  | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **47** |

**Table 4.12**

**Hip early first revision of primary OA THA: main components used by age at revision (2019 – 2024)**

eclass categories used: 34-32-10-01, 34-32-10-02, 34-32-10-03, 34-32-10-05, 34-32-10-06, 34-32-10-08, 34-32-10-09, 34-32-10-10, 34-32-10-11.
A small proportion of tumor systems such as MUTARS is excluded.
All registered component revisions of four main types 2019-2024 with at least one FE/AC revision component with a known e-class

### Early revision rate according to stem fixation, bearing and approach

**Table 4.14** gives an overview of the revision rates depending on implant fixation, bearing and surgical approach, whereby the overall 2-year revision rate was 2.4% (1,7087 of 70,465 primary THA performed for primary OA). The parameters that were associated with above average revision rates included all cemented fixation (2.9%) and bearings using CPE (3.4% – 4.9%). The use of a posterior approach and other unspecified approaches accounted for 3.3% and 3.8%, respectively.

### Timing of revision

**Figures 4.6** shows the cause and frequency distribution (Kernel density estimation) of early revision overall and separately for cemented and uncemented femoral implants. With the exception of aseptic loosening, most revisions occurred during the first 3 months after primary THA, including high and early peaks of periprosthetic fractures and dislocation as reasons for revision. Although periprosthetic joint infection and aseptic loosing were more frequent complications, their curves were flatter and remained elevated over a longer period. In case of cemented

| | | Revised | | 95% CI | |
|---|---|---|---|---|---|
| | **N at risk*** | **N** | **%**** | **lower** | **upper** |
| Overall (moving average) | 70,465 | 1,707 | 2.4 | 2.3 | 2.6 |
| **Fixation** | | | | | |
| All cemented | 639 | 18 | 2.9 | 1.8 | 4.5 |
| All uncemented | 61,666 | 1,474 | 2.4 | 2.3 | 2.5 |
| Hybrid | 7,999 | 206 | 2.6 | 2.3 | 3.0 |
| **Articulation** | | | | | |
| Metal on conventional polyethylene (MoCPE) | 1,152 | 39 | 3.4 | 2.5 | 4.7 |
| Ceramic on conventional polyethylene (CoCPE) | 3,009 | 103 | 3.5 | 2.9 | 4.2 |
| Metal on cross-linked polyethylene (MoXLPE) | 6,499 | 192 | 3.0 | 2.6 | 3.4 |
| Ceramic on cross-linked polyethylene (CoXLPE) | 43,989 | 1,007 | 2.3 | 2.2 | 2.4 |
| Ceramic on ceramic (CoC) | 9,858 | 248 | 2.5 | 2.2 | 2.9 |
| Ceramicised metal on conventional polyethylene (CMoCPE) | 209 | 10 | 4.9 | 2.7 | 8.9 |
| Ceramicised metal on cross-linked polyethylene (CMoXLPE) | 4,572 | 74 | 1.6 | 1.3 | 2.0 |
| **Approach** | | | | | |
| Anterior | 38,120 | 869 | 2.3 | 2.1 | 2.4 |
| Anterolateral | 20,612 | 476 | 2.3 | 2.1 | 2.5 |
| Lateral | 2,371 | 57 | 2.4 | 1.9 | 3.1 |
| Posterior | 9,066 | 294 | 3.3 | 2.9 | 3.7 |
| Other approach | 296 | 11 | 3.8 | 2.1 | 6.8 |

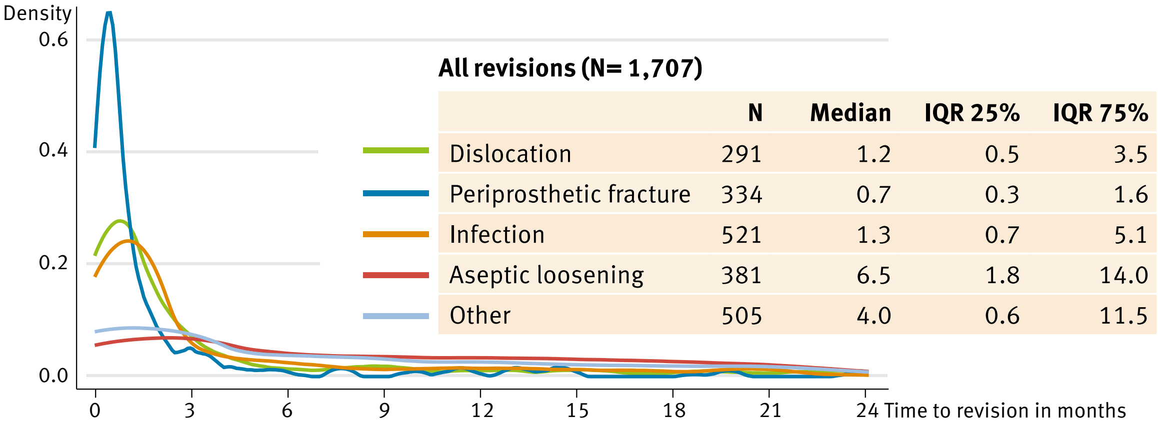
**Table 4.14**

**First revision of primary total hip arthroplasty within 24 months according to stem fixation, articulation and approach**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

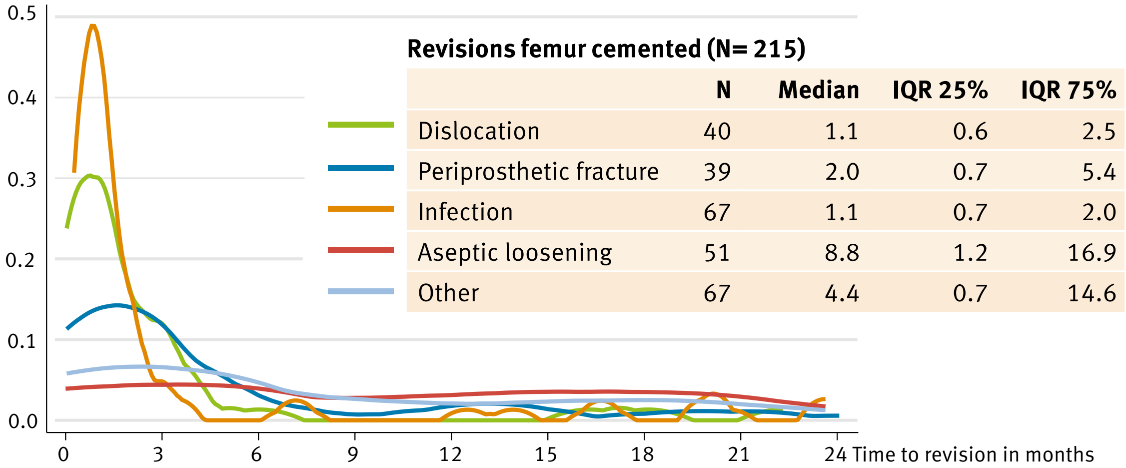
* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

** Rates adjusted for effects of mortality and emigration.



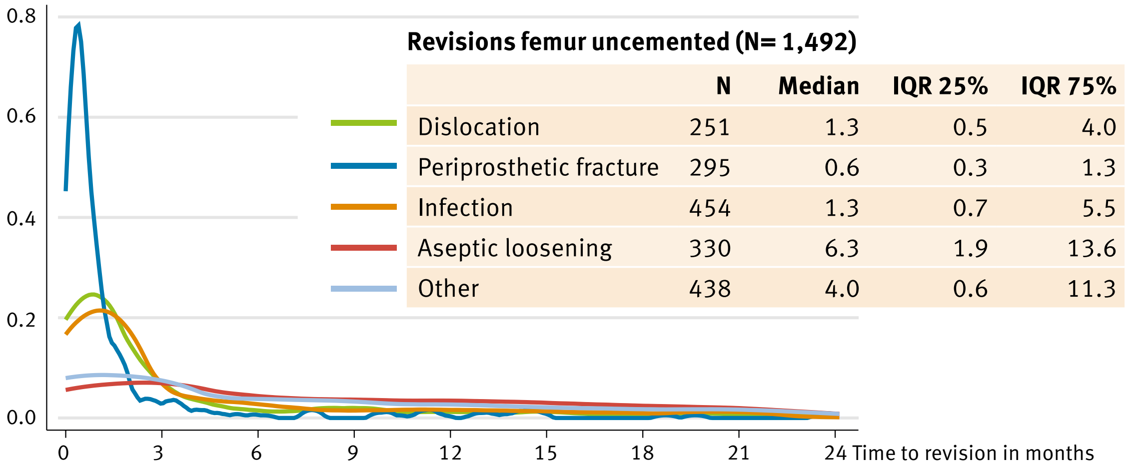
**All revisions (N= 1,707)**

| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Dislocation | 291 | 1.2 | 0.5 | 3.5 |
| Periprosthetic fracture | 334 | 0.7 | 0.3 | 1.6 |
| Infection | 521 | 1.3 | 0.7 | 5.1 |
| Aseptic loosening | 381 | 6.5 | 1.8 | 14.0 |
| Other | 505 | 4.0 | 0.6 | 11.5 |



**Revisions femur cemented (N= 215)**

| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Dislocation | 40 | 1.1 | 0.6 | 2.5 |
| Periprosthetic fracture | 39 | 2.0 | 0.7 | 5.4 |
| Infection | 67 | 1.1 | 0.7 | 2.0 |
| Aseptic loosening | 51 | 8.8 | 1.2 | 16.9 |
| Other | 67 | 4.4 | 0.7 | 14.6 |



**Revisions femur uncemented (N= 1,492)**

| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Dislocation | 251 | 1.3 | 0.5 | 4.0 |
| Periprosthetic fracture | 295 | 0.6 | 0.3 | 1.3 |
| Infection | 454 | 1.3 | 0.7 | 5.5 |
| Aseptic loosening | 330 | 6.3 | 1.9 | 13.6 |
| Other | 438 | 4.0 | 0.6 | 11.3 |

**Figures 4.6**

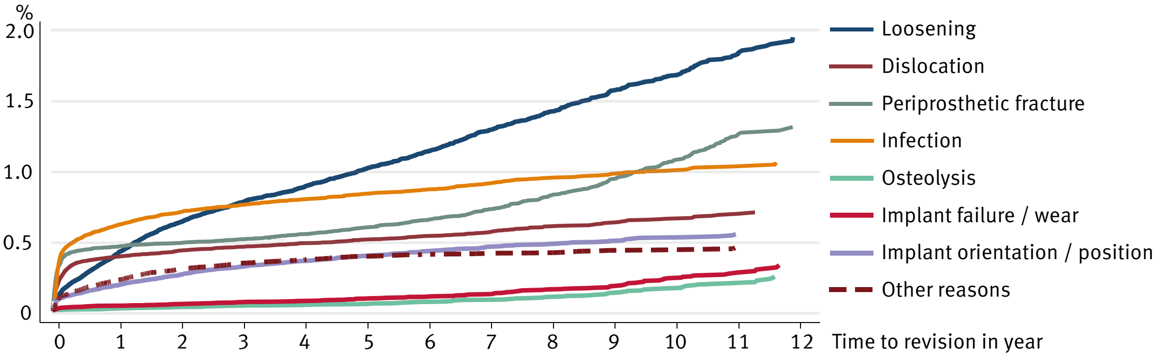
**Reason for early first revision by time interval since primary total hip arthroplasty**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)
Early first revisions are those occurring within 2 years of the primary arthroplasty

stems, dislocation and infection were the predominant reasons for early revision, whereas other complications occurred later and were distributed over a longer period. In uncemented stems, periprosthetic fractures predominated the early postoperative period and occurred at a higher frequency.

The cumulative incidence rates show the long-term behaviour of implants, illustrating the proportion of implants having experienced at least one revision. **Figures 4.7** presents the cumulative incidence rates up to 12 years postoperatively for all THA performed for primary OA, overall and separately for cemented and uncemented femoral components. Cumulative revision rates for infection, dislocation and osteolysis did not differ between cemented and uncemented stems, whereas periprosthetic fractures occurred more frequently with uncemented stems, both on the short term and up to eleven years postoperatively. Loosening and periprosthetic fractures were the dominant reasons for revisions over the whole observation period. The curve for loosening shows linear increase. The curve for periprosthetic fractures rises faster in the three first months for uncemented stems but flattens out until the fifth year for uncemented and the seventh year for cemented stems. Thereafter, the curves start to rise until it becomes the second most important cause for revision after nine years for uncemented stems.

**Primary osteoarthritis (OA) total hip arthroplasty – all fixation methods**

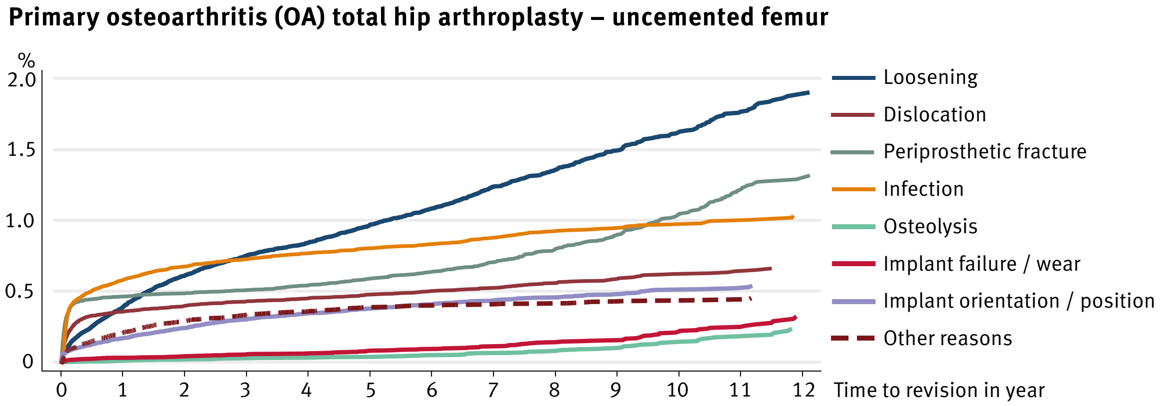


| Diagnoses | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Loosening | **0.3** (0.3-0.4) | **0.6** (0.5-0.7) | **0.7** (0.6-0.9) | **1.1** (1.0-1.3) | **1.7** (1.5-1.9) | **1.8** (1.6-2.1) | **2.2** (1.6-2.8) |
| Dislocation | **0.5** (0.4-0.6) | **0.5** (0.5-0.6) | **0.6** (0.5-0.7) | **0.6** (0.5-0.8) | **0.8** (0.7-0.9) | **0.8** (0.7-1.0) | **0.9** (0.7-1.2) |
| Periprosthetic fracture | **0.3** (0.3-0.4) | **0.4** (0.3-0.5) | **0.4** (0.4-0.5) | **0.5** (0.4-0.6) | **0.9** (0.7-1.1) | **1.0** (0.8-1.3) | **1.1** (0.9-1.4) |
| Infection | **0.7** (0.6-0.8) | **0.8** (0.7-0.9) | **0.8** (0.7-0.9) | **0.9** (0.8-1.1) | **1.0** (0.9-1.2) | **1.1** (0.9-1.2) | **1.1** (0.9-1.3) |
| Osteolysis | **0.0** (0.0-0.0) | **0.0** (0.0-0.1) | **0.1** (0.0-0.1) | **0.1** (0.0-0.1) | **0.2** (0.1-0.3) | **0.2** (0.1-0.4) | **0.2** (0.1-0.4) |
| Implant failure / wear | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.1** (0.0-0.1) | **0.2** (0.1-0.3) | **0.3** (0.2-0.4) | **0.3** (0.2-0.4) |
| Implant orientation / position | **0.2** (0.1-0.3) | **0.3** (0.2-0.3) | **0.3** (0.2-0.4) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) |
| Other reasons | **0.2** (0.1-0.2) | **0.2** (0.2-0.3) | **0.3** (0.2-0.3) | **0.3** (0.2-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) |

**Figure 4.7 Part one**

**Cumulative incidence rates for different revision diagnoses (primary OA THA)**

Time since operation, 2012–2024, % of implants revised



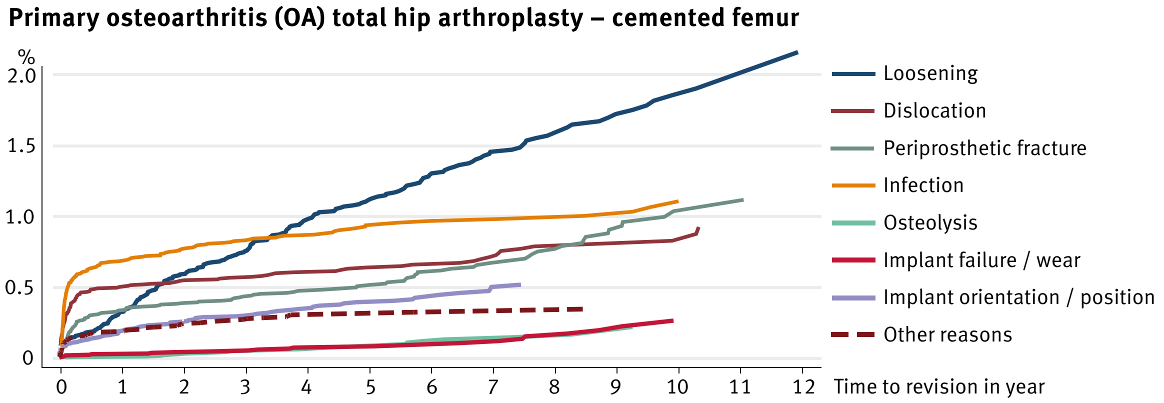
Primary osteoarthritis (OA) total hip arthroplasty – uncemented femur

| | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Loosening | **0.4** (0.4-0.4) | **0.6** (0.6-0.7) | **0.8** (0.7-0.8) | **1.0** (0.9-1.0) | **1.5** (1.4-1.6) | **1.6** (1.5-1.7) | **1.9** (1.8-2.0) |
| Dislocation | **0.4** (0.3-0.4) | **0.4** (0.4-0.4) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.6** (0.5-0.6) | **0.6** (0.6-0.7) | **0.7** (0.6-0.7) |
| Periprosthetic fracture | **0.5** (0.4-0.5) | **0.5** (0.5-0.5) | **0.5** (0.5-0.5) | **0.6** (0.6-0.6) | **0.9** (0.9-1.0) | **1.1** (1.0-1.1) | **1.3** (1.2-1.4) |
| Infection | **0.6** (0.5-0.6) | **0.7** (0.6-0.7) | **0.7** (0.7-0.8) | **0.8** (0.8-0.8) | **1.0** (0.9-1.0) | **1.0** (0.9-1.0) | **1.0** (1.0-1.1) |
| Osteolysis | **0.0** (0.0-0.0) | **0.0** (0.0-0.0) | **0.0** (0.0-0.0) | **0.0** (0.0-0.1) | **0.1** (0.1-0.1) | **0.1** (0.1-0.2) | **0.2** (0.2-0.3) |
| Implant failure / wear | **0.0** (0.0-0.0) | **0.0** (0.0-0.1) | **0.1** (0.0-0.1) | **0.1** (0.1-0.1) | **0.2** (0.1-0.2) | **0.2** (0.2-0.3) | **0.3** (0.3-0.4) |
| Implant orientation / position | **0.2** (0.2-0.2) | **0.2** (0.2-0.3) | **0.3** (0.3-0.3) | **0.4** (0.4-0.4) | **0.5** (0.4-0.5) | **0.5** (0.5-0.6) | **0.5** (0.5-0.6) |
| Other reasons | **0.2** (0.2-0.3) | **0.3** (0.3-0.3) | **0.4** (0.3-0.4) | **0.4** (0.4-0.4) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) |

**Figure 4.7 Part two**

**Cumulative incidence rates for different revision diagnoses (primary OA THA)**

Time since operation, 2012–2024, % of implants revised



Primary osteoarthritis (OA) total hip arthroplasty – cemented femur

| | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Loosening | **0.3** (0.3-0.4) | **0.6** (0.5-0.7) | **0.7** (0.6-0.9) | **1.1** (1.0-1.3) | **1.7** (1.5-1.9) | **1.8** (1.6-2.1) | **2.2** (1.6-2.8) |
| Dislocation | **0.5** (0.4-0.6) | **0.5** (0.5-0.6) | **0.6** (0.5-0.7) | **0.6** (0.5-0.8) | **0.8** (0.7-0.9) | **0.8** (0.7-1.0) | **0.9** (0.7-1.2) |
| Periprosthetic fracture | **0.3** (0.3-0.4) | **0.4** (0.3-0.5) | **0.4** (0.4-0.5) | **0.5** (0.4-0.6) | **0.9** (0.7-1.1) | **1.0** (0.8-1.3) | **1.1** (0.9-1.4) |
| Infection | **0.7** (0.6-0.8) | **0.8** (0.7-0.9) | **0.8** (0.7-0.9) | **0.9** (0.8-1.1) | **1.0** (0.9-1.2) | **1.1** (0.9-1.2) | **1.1** (0.9-1.3) |
| Osteolysis | **0.0** (0.0-0.0) | **0.0** (0.0-0.1) | **0.1** (0.0-0.1) | **0.1** (0.0-0.1) | **0.2** (0.1-0.3) | **0.2** (0.1-0.4) | **0.2** (0.1-0.4) |
| Implant failure / wear | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.1** (0.0-0.1) | **0.2** (0.1-0.3) | **0.3** (0.2-0.4) | **0.3** (0.2-0.4) |
| Implant orientation / position | **0.2** (0.1-0.3) | **0.3** (0.2-0.3) | **0.3** (0.2-0.4) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) |
| Other reasons | **0.2** (0.1-0.2) | **0.2** (0.2-0.3) | **0.3** (0.2-0.3) | **0.3** (0.2-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) |

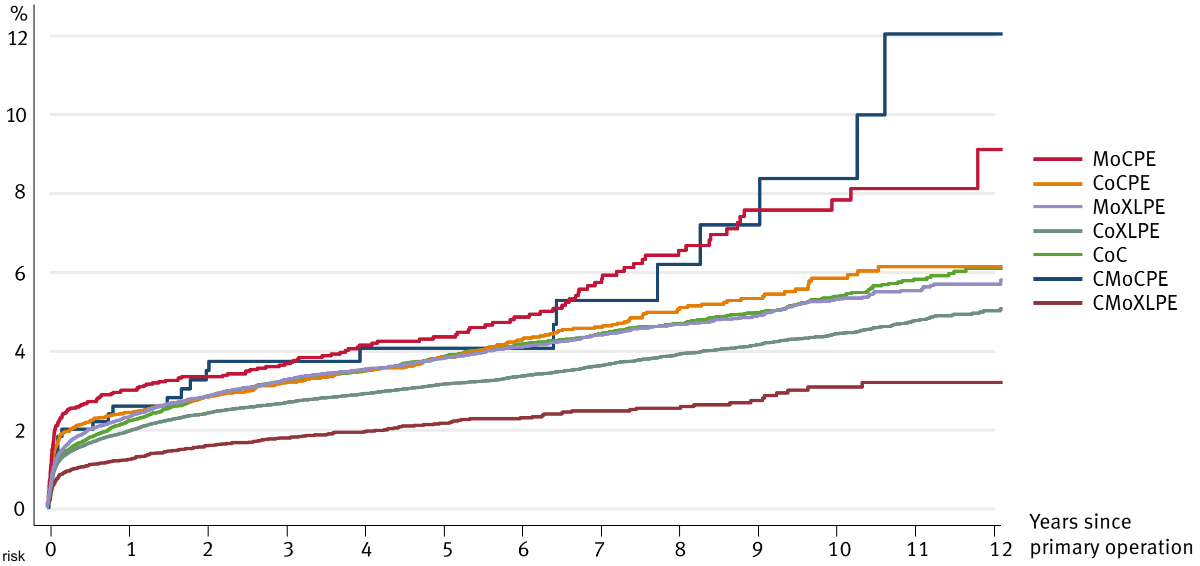
**Figure 4.7 Part three**

**Cumulative incidence rates for different revision diagnoses (primary OA THA)**

Time since operation, 2012–2024, % of implants revised

## Bearings and head sizes

The 2-year revision rate for the current 4-year moving window was lowest for MCoXLPE (1.6%) and CoXLPE (2.4%), followed by CoC and MoXLPE (2.8%) **(Figure 4.8).** At 12 years, the estimated cumulative revision rate for CMoXLPE had the lowest revision rate of 3.2% (CI 2.7 – 3.8%) and CoXLPE had a revision rate of 5.0% (CI 4.8 – 5.3%). In contrast, the highest cumulative revision rate was observed for CMoCPE with 12.0% (CI 7.0 – 20.2%), followed by MoCPE with 9.1% (CI 6.9 – 11.8) **(Figure 4.8).** However, this observation has to be taken with care for both bearings, considering small numbers with consecutively wide confidence intervals.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CMoCPE | 559 | 476 | 411 | 346 | 275 | 228 | 175 | 132 | 95 | 78 | 59 | 35 | 19 |
| CMoXLPE | 12091 | 10593 | 9151 | 7879 | 6490 | 5329 | 4244 | 3237 | 2290 | 1560 | 976 | 521 | 111 |
| CoC | 29163 | 26234 | 23286 | 20649 | 17575 | 15024 | 12519 | 10197 | 8033 | 5960 | 3992 | 2252 | 570 |
| CoCPE | 10370 | 8827 | 7489 | 6449 | 5334 | 4539 | 3744 | 3003 | 2314 | 1693 | 1083 | 553 | 142 |
| CoXLPE | 125014 | 107586 | 91627 | 78564 | 64591 | 54127 | 44398 | 35211 | 26783 | 19198 | 12372 | 6608 | 1839 |
| MoCPE | 3768 | 3264 | 2841 | 2491 | 1986 | 1664 | 1351 | 1035 | 748 | 521 | 325 | 167 | 52 |
| MoXLPE | 24434 | 22166 | 20260 | 18471 | 16027 | 14198 | 12254 | 10309 | 8514 | 6715 | 4866 | 2904 | 875 |

| Bearing surf. | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| MoCPE | **3.0** (2.5-3.6) | **3.3** (2.8-3.9) | **3.6** (3.1-4.3) | **4.3** (3.7-5.1) | **4.8** (4.1-5.7) | **6.5** (5.5-7.7) | **7.5** (6.3-8.9) | **7.8** (6.5-9.3) | **9.1** (6.9-11.8) |
| CoCPE | **2.4** (2.1-2.7) | **2.8** (2.5-3.1) | **3.2** (2.8-3.5) | **3.8** (3.4-4.2) | **4.3** (3.9-4.8) | **5.1** (4.5-5.6) | **5.3** (4.8-6.0) | **5.8** (5.2-6.5) | **6.1** (5.4-6.9) |
| MoXLPE | **2.3** (2.1-2.5) | **2.8** (2.6-3.0) | **3.2** (3.0-3.5) | **3.8** (3.5-4.1) | **4.1** (3.8-4.4) | **4.6** (4.3-4.9) | **4.9** (4.6-5.2) | **5.3** (4.9-5.6) | **5.8** (5.3-6.2) |
| CoXLPE | **1.9** (1.8-2.0) | **2.4** (2.3-2.5) | **2.7** (2.6-2.7) | **3.1** (3.0-3.2) | **3.3** (3.2-3.5) | **3.9** (3.8-4.0) | **4.2** (4.0-4.3) | **4.4** (4.2-4.6) | **5.0** (4.8-5.3) |
| CoC | **2.2** (2.0-2.3) | **2.8** (2.6-3.0) | **3.2** (3.0-3.4) | **3.8** (3.6-4.1) | **4.1** (3.9-4.4) | **4.7** (4.4-5.0) | **5.0** (4.6-5.3) | **5.4** (5.0-5.7) | **6.0** (5.6-6.5) |
| CMoCPE | **2.6** (1.5-4.3) | **3.5** (2.2-5.5) | **3.7** (2.4-5.8) | **4.0** (2.6-6.2) | **4.0** (2.6-6.2) | **6.2** (3.8-9.9) | **8.3** (5.0-13.6) | **8.3** (5.0-13.6) | **12.0** (7.0-20.2) |
| CMoXLPE | **1.2** (1.0-1.4) | **1.6** (1.4-1.8) | **1.8** (1.5-2.0) | **2.1** (1.9-2.4) | **2.3** (2.0-2.6) | **2.6** (2.2-2.9) | **2.8** (2.4-3.2) | **3.0** (2.6-3.6) | **3.2** (2.7-3.8) |

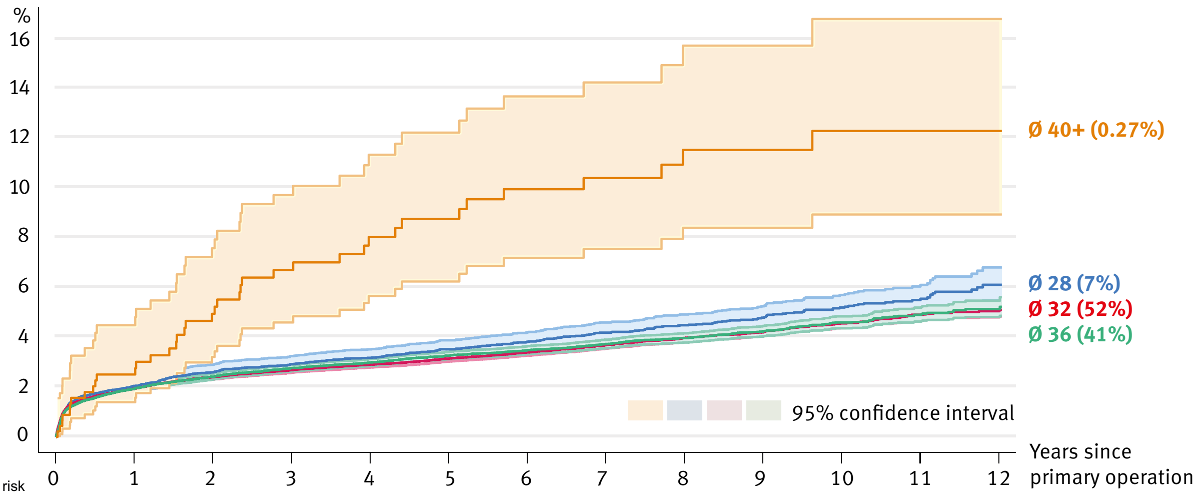
**Figure 4.8**

**Estimated failure rates of primary total hip arthroplasty for different bearing surfaces**

Time since operation, 2012–2024, % of implants revised

Head size and bearing type influence wear, which can lead in the long term to osteolysis and loosening. Head size has an impact on stability, with larger heads being more stable, reducing the risk of dislocation, compared to smaller diameters. However, large heads bear the risk of increased wear, an issue particularly relevant with CPE. Heads with a diameter ≥40 mm had an excessively high revision rate of 12.3% at 12 years **(Figure 4.9).** However, these were used mostly in CoC bearings. Bearings with diameter 32 or 36 mm had an almost identical 12-year revision rate of 5.1% (CI 4.8 – 5.4%) and 5.2% (CI 4.9 – 5.6%), respectively. The 28 mm heads were associated with a significantly higher revision rate at 12 years of 6.1% (CI 5.5 – 6.8%), compared to 32 mm heads 5.1% (CI 4.8 – 5.4%).

The relationship between head size and bearing type was further analysed, whereby results were broken down between head sizes of 28, 32, and 36 mm and the bearings MoCPE, CoCPE, MoXLPE, CoXLPE, CMoXLPE, and CoC. The results are presented in **Table 4.15.** MoCPE was used only in combination with 32 mm



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 (7%) | 11922 | 11125 | 10375 | 9714 | 8785 | 8052 | 7237 | 6247 | 5255 | 4160 | 2972 | 1782 | 621 |
| 32 (52%) | 88009 | 78563 | 69201 | 61107 | 51383 | 44057 | 36639 | 29587 | 22866 | 16579 | 10960 | 6059 | 1628 |
| 36 (41%) | 69618 | 59031 | 49796 | 42197 | 34493 | 28413 | 23054 | 18179 | 13920 | 10271 | 6828 | 3693 | 958 |
| 40+ (0.27%) | 454 | 383 | 332 | 301 | 261 | 234 | 218 | 184 | 148 | 124 | 102 | 63 | 19 |

| Head size | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| 28 (7%) | **2.0** (1.8-2.3) | **2.6** (2.3-2.9) | **2.9** (2.6-3.2) | **3.5** (3.2-3.9) | **3.8** (3.5-4.2) | **4.5** (4.1-4.9) | **4.8** (4.4-5.3) | **5.2** (4.7-5.7) | **6.1** (5.5-6.8) |
| 32 (52%) | **1.9** (1.9-2.0) | **2.4** (2.3-2.5) | **2.7** (2.6-2.8) | **3.2** (3.0-3.3) | **3.4** (3.3-3.5) | **4.0** (3.8-4.1) | **4.2** (4.1-4.4) | **4.6** (4.4-4.8) | **5.1** (4.8-5.4) |
| 36 (41%) | **1.9** (1.8-2.1) | **2.4** (2.3-2.6) | **2.8** (2.6-2.9) | **3.3** (3.1-3.4) | **3.5** (3.3-3.7) | **4.0** (3.8-4.2) | **4.3** (4.1-4.5) | **4.6** (4.4-4.8) | **5.2** (4.9-5.6) |
| 40+ (0.27%) | **2.5** (1.4-4.5) | **4.9** (3.2-7.6) | **6.7** (4.6-9.7) | **8.8** (6.2-12.2) | **10.0** (7.2-13.7) | **11.5** (8.4-15.7) | **11.5** (8.4-15.7) | **12.3** (8.9-16.8) | **12.3** (8.9-16.8) |

**Figure 4.9**

**Estimated failure rates of primary total hip arthroplasty for different types of head sizes (standard cups: all uncemented fixation)**

Time since operation, 2012–2024, diagnosis primary OA

heads (32/MoCPE) and appeared to have the highest revision rate at 11 years of 11.5% (CI 8.3 – 15.9%). MoCPE with 28 mm heads (28/MoCPE) were mainly used in fractures, cemented stems and with dual mobility cups. These subgroups were not part of this analysis.

For the head diameters 32 and 36 mm, ceramicised metal on cross-linked PE (CMoXLPE) had the lowest revision rates with 2.6% (CI 2.1 – 3.3%) and 3.2% (CI 2.3 – 4.4%) respectively at 12 years. Although 32/CMoXLPE had the lowest revision rates, these results should be interpreted with caution. It is used with a limited number of stems and cups from one company only, all of which perform very well in the registry. In addition, CM is not widely used but concentrates on few centres and few surgeons, further introducing a potential bias.

At 12 years 32/CoXLPE had a revision rate of 4.8% (CI 4.4 -5.2%). The revision rate for 36/CoXLPE was not significantly different with 4.7% (CI 4.3 - 5.1%). In contrast, the 36 diameter heads for CoC (6.2%, CI 5.6-7.0%) and MoXLPE (5.4%, CI 4.0-7.2%) showed higher revision rates.

| Head size | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| **28mm** | | | | | | | | | |
| CoCPE | **2.7** (1.8-4.0) | **2.8** (1.9-4.2) | **3.3** (2.3-4.8) | **4.0** (2.9-5.6) | **4.2** (3.0-5.7) | **4.8** (3.5-6.6) | **4.8** (3.5-6.6) | **4.8** (3.5-6.6) | **5.5** (4.0-7.6) |
| MoXLPE | **2.5** (1.9-3.1) | **2.9** (2.3-3.6) | **3.4** (2.8-4.2) | **3.9** (3.2-4.7) | **4.4** (3.6-5.3) | **5.1** (4.3-6.1) | **5.4** (4.5-6.4) | **5.9** (4.9-7.0) | **6.2** (5.2-7.5) |
| CoXLPE | **1.8** (1.5-2.1) | **2.4** (2.1-2.8) | **2.6** (2.2-3.0) | **3.2** (2.8-3.7) | **3.5** (3.0-4.0) | **4.1** (3.6-4.7) | **4.4** (3.8-5.0) | **4.7** (4.1-5.4) | **6.0** (5.0-7.0) |
| CoC | **2.1** (1.3-3.3) | **3.0** (2.0-4.4) | **3.4** (2.3-4.9) | **4.1** (2.9-5.8) | **4.5** (3.2-6.3) | **4.9** (3.6-6.8) | **5.3** (3.8-7.3) | **5.3** (3.8-7.3) | **5.3** (3.8-7.3) |
| **32mm** | | | | | | | | | |
| MoCPE | **5.0** (3.4-7.3) | **5.6** (3.9-8.1) | **5.9** (4.1-8.3) | **6.7** (4.8-9.4) | **7.3** (5.3-10.2) | **10.0** (7.3-13.7) | **11.5** (8.3-15.9) | **11.5** (8.3-15.9) | |
| CoCPE | **2.7** (2.1-3.5) | **3.1** (2.4-3.9) | **3.5** (2.8-4.4) | **4.1** (3.3-5.0) | **4.6** (3.8-5.7) | **5.4** (4.4-6.6) | **6.0** (4.9-7.4) | **7.4** (5.9-9.2) | **7.7** (6.1-9.7) |
| MoXLPE | **2.6** (2.3-3.0) | **3.2** (2.9-3.6) | **3.7** (3.3-4.1) | **4.3** (3.9-4.7) | **4.5** (4.1-5.0) | **5.1** (4.6-5.6) | **5.3** (4.9-5.9) | **5.7** (5.2-6.3) | **6.2** (5.6-6.8) |
| CoXLPE | **1.8** (1.7-2.0) | **2.3** (2.2-2.4) | **2.5** (2.4-2.7) | **2.9** (2.8-3.1) | **3.1** (3.0-3.3) | **3.7** (3.5-3.9) | **4.0** (3.8-4.2) | **4.2** (4.0-4.4) | **4.8** (4.4-5.2) |
| CoC | **2.0** (1.7-2.3) | **2.6** (2.3-3.0) | **2.9** (2.6-3.3) | **3.5** (3.1-3.9) | **3.9** (3.4-4.3) | **4.3** (3.8-4.8) | **4.5** (4.0-5.1) | **4.9** (4.3-5.5) | **5.3** (4.6-6.1) |
| CMoXLPE | **0.9** (0.7-1.2) | **1.3** (1.0-1.6) | **1.5** (1.2-1.8) | **1.8** (1.5-2.3) | **2.0** (1.6-2.4) | **2.3** (1.9-2.9) | **2.5** (2.0-3.1) | **2.6** (2.1-3.3) | **2.6** (2.1-3.3) |
| **36mm** | | | | | | | | | |
| MoXLPE | **1.8** (1.5-2.2) | **2.4** (2.0-2.9) | **2.8** (2.3-3.2) | **3.2** (2.7-3.7) | **3.4** (3.0-4.0) | **3.8** (3.3-4.5) | **4.1** (3.6-4.8) | **4.4** (3.7-5.1) | **5.4** (4.0-7.2) |
| CoXLPE | **2.0** (1.9-2.2) | **2.4** (2.3-2.6) | **2.7** (2.6-2.9) | **3.2** (3.0-3.4) | **3.3** (3.1-3.5) | **3.8** (3.6-4.1) | **4.1** (3.8-4.4) | **4.3** (4.0-4.7) | **4.7** (4.3-5.1) |
| CoC | **2.1** (1.9-2.3) | **2.7** (2.5-3.0) | **3.1** (2.9-3.4) | **3.8** (3.5-4.1) | **4.1** (3.8-4.4) | **4.6** (4.2-5.0) | **4.9** (4.5-5.3) | **5.4** (4.9-5.9) | **6.2** (5.6-7.0) |
| CMoXLPE | **0.9** (0.7-1.3) | **1.3** (1.0-1.7) | **1.6** (1.3-2.1) | **2.0** (1.6-2.5) | **2.0** (1.6-2.5) | **2.2** (1.7-2.8) | **2.4** (1.9-3.2) | **2.9** (2.2-3.9) | **3.2** (2.3-4.4) |

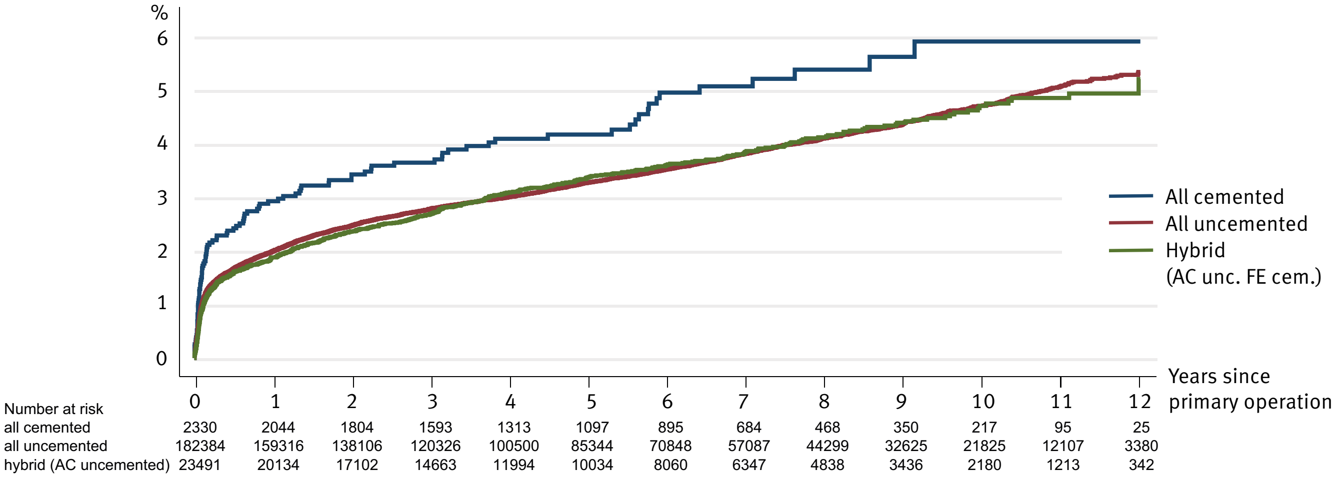
**Table 4.15**

**Estimated failure rates of primary total hip arthroplasty for different types of head sizes by bearing surface (standard cups: all uncemented fixation)**

Time since operation, 2012–2024,diagnosis primary OA. Only showing combinations with 500+ cases.

### Fixation

Component fixation also affected revision rates **(Figure 4.10).** Hybrid fixation showed slightly better revision rates at 12 years with 5.2% (CI 4.6 – 6.0%) than uncemented fixation with 5.4% (CI 5.2 – 5.6%) or all cemented with 5.9% (CI 4.7 – 7.4%). Although the revision rates for hybrid fixation tended to run below the revision rates for uncemented fixation for most of the observation time, confidence intervals remained largely overlapping, indicating no statistical significance **(Figure 4.11).**

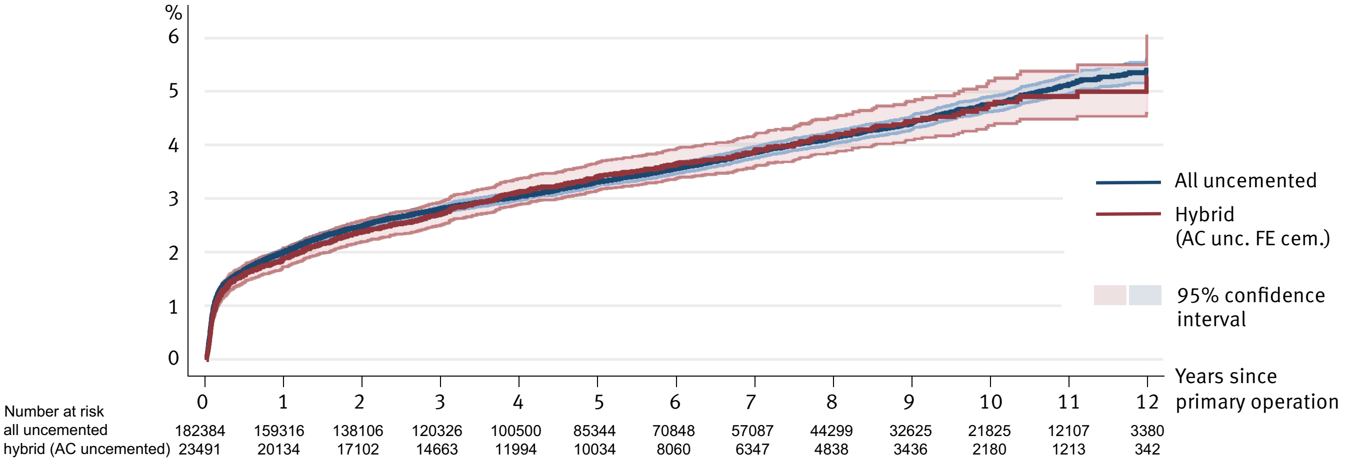


| Fixation | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| all cemented | **2.9** (2.3-3.7) | **3.4** (2.8-4.3) | **3.7** (3.0-4.5) | **4.2** (3.4-5.1) | **5.0** (4.1-6.1) | **4.2** (3.4-5.1) | **5.0** (4.1-6.1) | **5.9** (4.7-7.4) | **5.9** (4.7-7.4) |
| all uncemented | **2.0** (1.9-2.1) | **2.5** (2.4-2.6) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **3.5** (3.4-3.6) | **3.3** (3.2-3.4) | **3.5** (3.4-3.6) | **4.7** (4.6-4.9) | **5.4** (5.2-5.6) |
| hybrid* | **1.9** (1.7-2.1) | **2.4** (2.2-2.6) | **2.7** (2.5-2.9) | **3.4** (3.1-3.6) | **3.6** (3.3-3.9) | **3.4** (3.1-3.6) | **3.6** (3.3-3.9) | **4.7** (4.3-5.2) | **5.2** (4.6-6.0) |

**Figure 4.10**

**Estimated failure rates of primary total hip arthroplasty for different fixation methods**

Time since operation, 2012–2024, diagnosis primary OA. * acetabulum uncemented, femur cemented.



| Fixation | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| all uncemented | **2.0** (1.9-2.1) | **2.5** (2.4-2.6) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **3.5** (3.4-3.6) | **3.3** (3.2-3.4) | **3.5** (3.4-3.6) | **4.7** (4.6-4.9) | **5.4** (5.2-5.6) |
| hybrid* | **1.9** (1.7-2.1) | **2.4** (2.2-2.6) | **2.7** (2.5-2.9) | **3.4** (3.1-3.6) | **3.6** (3.3-3.9) | **3.4** (3.1-3.6) | **3.6** (3.3-3.9) | **4.7** (4.3-5.2) | **5.2** (4.6-6.0) |

**Figure 4.11**

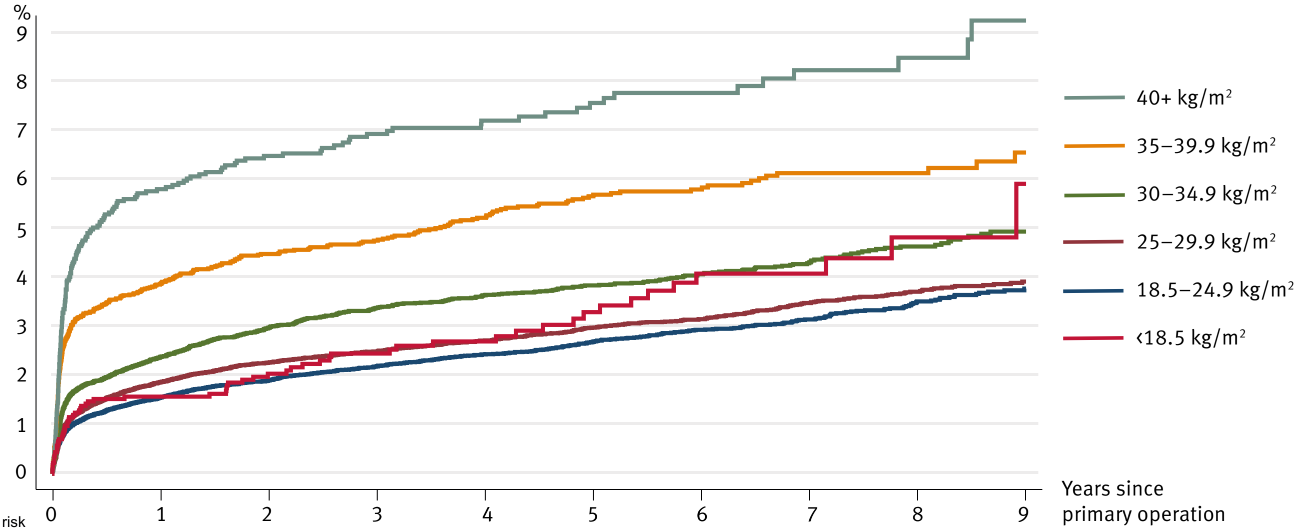
**Estimated failure rates of primary total hip arthroplasty for different fixation methods**

Time since operation, 2012–2024, diagnosis primary OA.  * acetabulum uncemented, femur cemented.

## BMI

Data on BMI is collected by SIRIS since 2015. The observation time for this parameter therefore is limited to nine years. BMI had a high impact on the risk of revision **(Figure 4.12),** with a positive correlation (meaning increasing risk with increasing BMI).

The 2-year revision rate for patients with BMI ›40 kg/m² was 6.4% (CI 5.6 – 7.4%), more than three times higher than in patients with normal weight. Most revisions occurred within the first 2 to 3 months and the most frequent reason for revision was infection, accounting for up to one-third of all revisions in this population. This was followed by periprosthetic fracture, femoral loosening, and dislocation. However, only infections were more frequent in this subgroup, whereas revisions for periprosthetic fractures and dislocations occurred approximately at the same rates as in patient with normal weight, while femoral and acetabular loosening were even less frequent.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 18.5-24.9 | 52006 | 43831 | 36291 | 29927 | 23512 | 18487 | 13942 | 9797 | 6023 | 2805 |
| 25-29.9 | 60380 | 51009 | 42380 | 35304 | 27932 | 22203 | 16724 | 11853 | 7375 | 3432 |
| 30-34.9 | 27767 | 23369 | 19370 | 15890 | 12461 | 9932 | 7500 | 5241 | 3231 | 1486 |
| 35-39.9 | 8425 | 6960 | 5775 | 4759 | 3772 | 3029 | 2284 | 1561 | 954 | 451 |
| 40+ | 2823 | 2255 | 1877 | 1556 | 1205 | 942 | 741 | 509 | 320 | 153 |
| <18.5 | 2297 | 1917 | 1556 | 1267 | 930 | 725 | 523 | 330 | 196 | 76 |

| BMI (kg/m²) | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| ‹18.5 | **1.6** (1.1-2.2) | **2.0** (1.5-2.7) | **2.4** (1.8-3.2) | **3.3** (2.5-4.3) | **4.0** (3.1-5.3) | **4.8** (3.5-6.5) | **5.9** (3.8-9.1) |
| 18.5–24.9 | **1.5** (1.4-1.7) | **1.9** (1.8-2.0) | **2.2** (2.0-2.3) | **2.7** (2.5-2.8) | **2.9** (2.7-3.1) | **3.5** (3.3-3.7) | **3.7** (3.5-4.0) |
| 25–29.9 | **1.9** (1.7-2.0) | **2.2** (2.1-2.4) | **2.5** (2.3-2.6) | **3.0** (2.8-3.1) | **3.1** (3.0-3.3) | **3.7** (3.5-3.9) | **3.9** (3.6-4.1) |
| 30–34.9 | **2.4** (2.2-2.6) | **3.0** (2.8-3.2) | **3.3** (3.1-3.6) | **3.8** (3.6-4.1) | **4.0** (3.8-4.3) | **4.6** (4.3-4.9) | **4.9** (4.5-5.3) |
| 35–39.9 | **3.8** (3.4-4.3) | **4.4** (4.0-4.9) | **4.7** (4.3-5.2) | **5.6** (5.1-6.2) | **5.7** (5.2-6.3) | **6.1** (5.5-6.7) | **6.5** (5.8-7.3) |
| 40+ | **5.7** (4.9-6.7) | **6.4** (5.6-7.4) | **6.9** (6.0-7.9) | **7.5** (6.5-8.6) | **7.7** (6.7-8.9) | **8.4** (7.2-9.8) | **9.2** (7.6-11.0) |

**Figure 4.12**

**Estimated failure rates of primary total hip arthroplasty for different BMI**

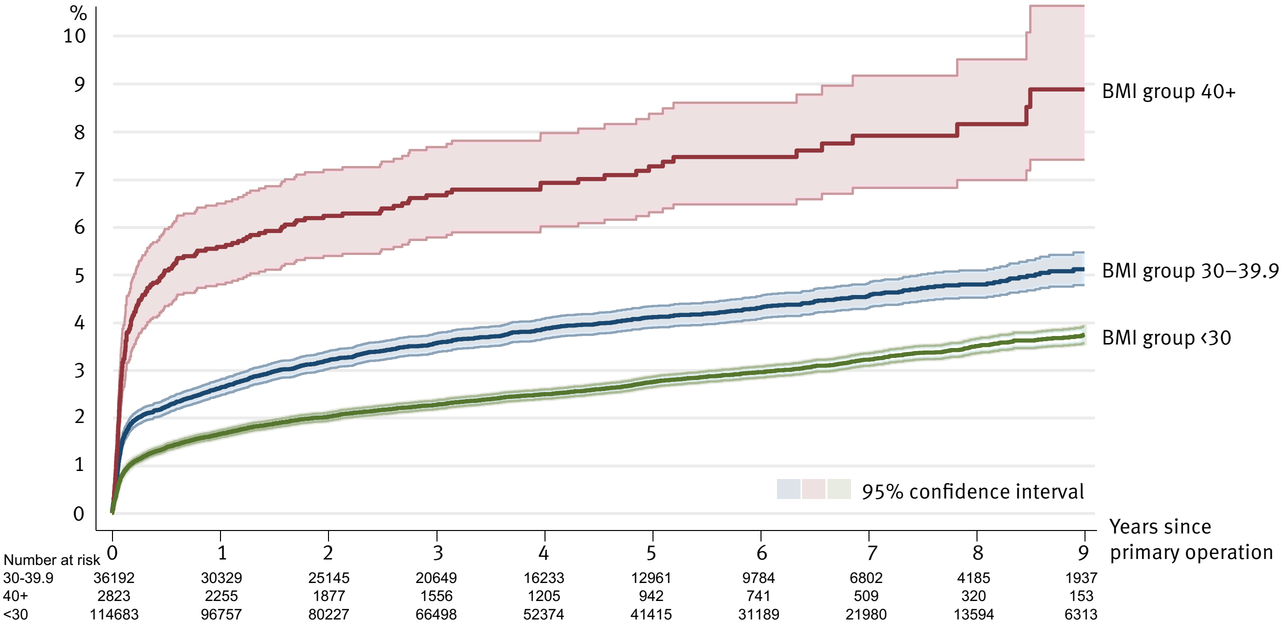
Time since operation, 2015–2024, diagnosis primary OA

While underweight patients initially had a lower revision risk, the revision rate started to rise at 5 years. At 9 years, the revision rates were comparable to those patients with a BMI between 35 and 39.9 kg/m². **Figure 4.13** shows the estimated failure rates with confidence intervals for the different groups. The differences are highly significant.

## Dual mobility cups

Dual mobility cups (DMC) were increasingly used both for primary THA **(Figure 4.1)** as well as at revision. The main indication is to reduce the risk of dislocation, respectively the risk of revision for instability. The exact role of DMC is still debated, and several questions concerning their use are not yet fully answered.

Compared to regular cups, the cumulative revision rate for all DMC in the presence of an uncemented stem was elevated for the whole observation period **(Figure 4.14).**



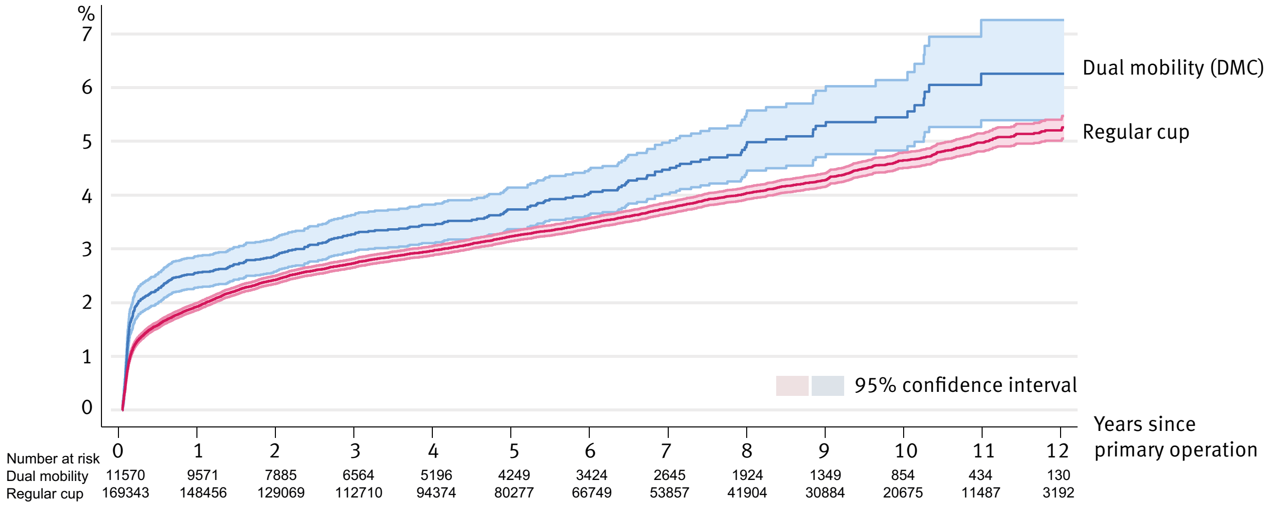
| BMI (kg/m²) | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| 30–39.9 | **2.7** (2.5-2.9) | **3.3** (3.1-3.5) | **3.7** (3.5-3.9) | **4.2** (4.0-4.5) | **4.4** (4.2-4.7) | **4.9** (4.7-5.2) | **5.3** (4.9-5.6) |
| 40+ | **5.7** (4.9-6.7) | **6.4** (5.6-7.4) | **6.9** (6.0-7.9) | **7.5** (6.5-8.6) | **7.7** (6.7-8.9) | **8.4** (7.2-9.8) | **9.2** (7.6-11.0) |
| ‹30 | **1.7** (1.6-1.8) | **2.1** (2.0-2.2) | **2.3** (2.2-2.4) | **2.8** (2.7-2.9) | **3.0** (2.9-3.2) | **3.6** (3.5-3.8) | **3.8** (3.7-4.0) |

**Figure 4.13**

**Estimated failure rates of primary total hip arthroplasty for different BMI**

Time since operation, 2015–2024, diagnosis primary OA

The difference is statistically significant for the entire time period. The revision rate for DMC with cemented stem fixation (hybrid fixation) was lower, but still increased compared to THA with regular cups, with both cemented and uncemented stems **(Figure 4.15)**. This is most probably to be explained by a negative selection bias of patients.

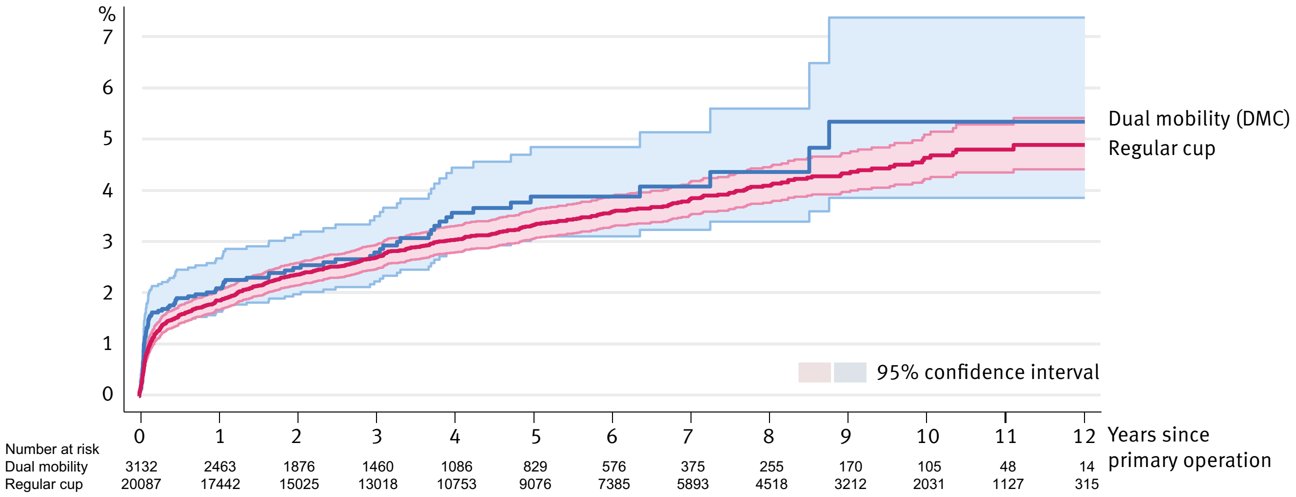


| Typ of cup | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| Regular | **2.0** (1.9-2.0) | **2.4** (2.4-2.5) | **2.8** (2.7-2.8) | **3.2** (3.2-3.3) | **3.5** (3.4-3.6) | **4.0** (3.9-4.2) | **4.3** (4.2-4.4) | **4.6** (4.5-4.8) | **5.3** (5.1-5.5) |
| Dual mobility | **2.6** (2.3-2.9) | **2.9** (2.6-3.2) | **3.3** (3.0-3.7) | **3.7** (3.4-4.1) | **4.1** (3.7-4.5) | **5.0** (4.5-5.6) | **5.4** (4.8-6.0) | **5.4** (4.8-6.1) | **6.3** (5.4-7.3) |

**Figure 4.14**

**Estimated failure rates of primary total hip arthroplasty for different types of cups (all uncemented fixation)**

Time since operation, 2012–2024, diagnosis primary OA



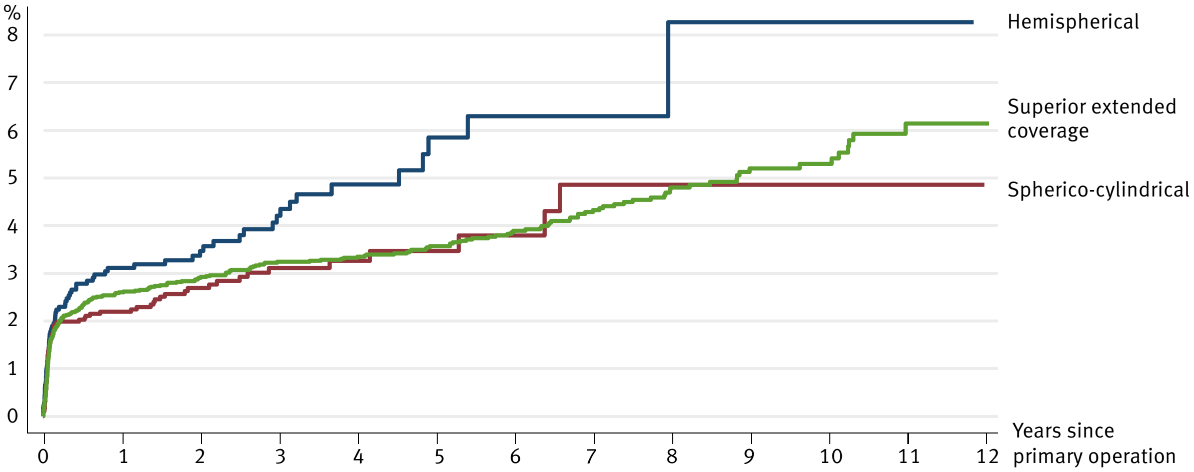
| Typ of cup | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| Regular | **1.9** (1.7-2.1) | **2.4** (2.1-2.6) | **2.7** (2.5-2.9) | **3.3** (3.0-3.6) | **3.6** (3.3-3.9) | **4.1** (3.7-4.4) | **4.3** (4.0-4.7) | **4.6** (4.2-5.1) | **4.9** (4.4-5.4) |
| Dual mobility | **2.1** (1.6-2.7) | **2.5** (2.0-3.1) | **2.8** (2.2-3.5) | **3.9** (3.1-4.8) | **3.9** (3.1-4.8) | **4.3** (3.4-5.6) | **5.3** (3.8-7.3) | **5.3** (3.8-7.3) | **5.3** (3.8-7.3) |

**Figure 4.15**

**Estimated failure rates of primary total hip arthroplasty for different types of cups (hybrid fixation)**

Time since operation, 2012–2024, diagnosis primary OA

DMC are provided in three different design philosophies: hemispherical, spherico-cylindrical, and with superior extended coverage. Comparison of these three types is possible until 8 years of follow-up, limited by the shorter observation time of the hemispherical cups. Uncemented dual mobility cups with superior extended coverage had the lowest revision rate with 4.7% (CI 4.2– 5.7%) at eight years. increasing to 6.2% (CI 5.2 – 7.2%) at 12 years. Details regarding the DMC models are displayed in **Figure 4.16.**



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hemispherical | 1837 | 1336 | 959 | 676 | 386 | 251 | 177 | 98 | 44 | 9 | 2 | 2 | 0 |
| Spherico-cylindrical | 2834 | 2077 | 1396 | 939 | 492 | 331 | 221 | 152 | 100 | 60 | 31 | 10 | 0 |
| Superior extended cov. | 6895 | 6155 | 5527 | 4949 | 4318 | 3667 | 3026 | 2395 | 1780 | 1280 | 821 | 422 | 130 |

| Typ of DM-cup | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| Hemispherical | **3.1** (2.4-4.0) | **3.4** (2.7-4.4) | **4.2** (3.2-5.4) | **5.8** (4.4-7.7) | **6.2** (4.6-8.4) | **8.2** (4.9-13.6) | | | |
| Spherico-cylindrical | **2.2** (1.7-2.8) | **2.7** (2.1-3.4) | **3.1** (2.4-3.9) | **3.4** (2.7-4.4) | **3.8** (2.8-5.0) | **4.8** (3.3-7.0) | **4.8** (3.3-7.0) | **4.8** (3.3-7.0) | |
| Sup. extended cov. | **2.6** (2.2-3.0) | **2.9** (2.5-3.3) | **3.2** (2.8-3.7) | **3.5** (3.1-4.0) | **3.9** (3.4-4.4) | **4.7** (4.2-5.4) | **5.1** (4.5-5.9) | **5.2** (4.6-6.0) | **6.1** (5.2-7.2) |

**Figure 4.16**

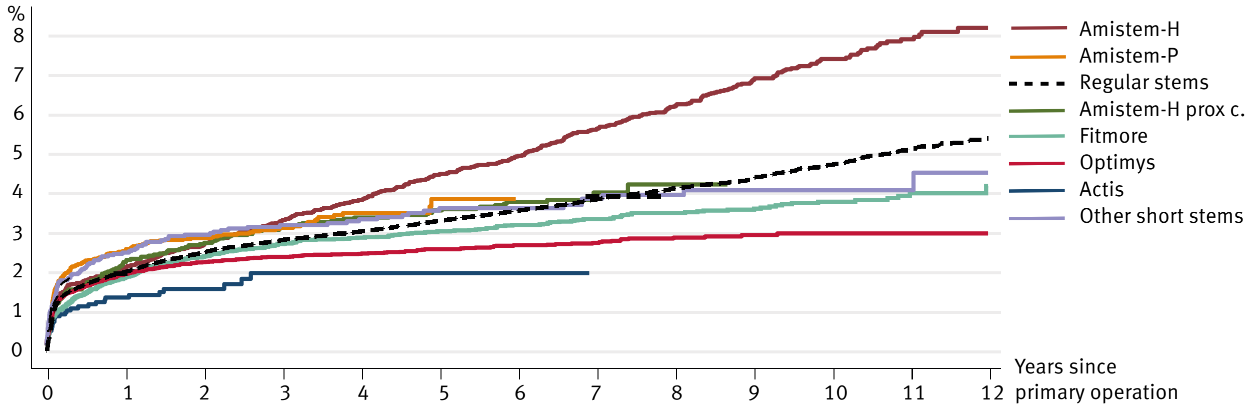
**Estimated failure rates of primary total hip arthroplasty for different types of dual mobility cups (all uncemented fixation)**

Time since operation, 2012–2024, diagnosis primary OA

* The hemispherical group is not well represented in SIRIS data. It comprises Symbol/DS evolution cups as well as the modular G7 cups

### Short stems

The definition of a short stem remains a matter of debate, as no internationally accepted classification is available yet. Particularly, there is no consensus whether shortened stems with diaphyseal fixation should also be considered as short stems. For this analysis, the classification of the French Hip & Knee Society was used, which includes shortened stems with diaphyseal fixation[1]. This classification separates short stems into five types, depending on the theoretical zone of fixation: cephalic (type 1), isolated cervical (type 2), calcar femoral (type 3), metaphyseal (type 4), and conventional metaphyseal-diaphyseal shortened stems (type 5). The classification of a wide variety of implants is provided in the publication. There are currently twenty-four different short stems or shortened stems in use in Switzerland. For statistical analysis, only stems with more than 500 implantations were considered individually in this report. The remaining short stems were grouped as "other short stems". Compared to the standard uncemented stems, the short stems showed a wider range of revision rates **(Figure 4.17)**, whereby the so-called calcar-guided short stems (type 3) performed well. Particularly the type 5 short stems showed a wide range of revision rates with some associated with excellent results, while others performed far less well. It is important to note that short stems did not universally perform well or poorly as a group. The reason for the heterogenous revision rates most likely is multifactorial, including the design of the stem, of any coating, the bearings used, etc. Hence, as in primary uncemented stems, each implant has to be assessed separately for its performance and longevity. However, the well-performing implants had a flatter revision curve than regular stems.



| Typ of short stem | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| Actis | **1.2** (0.8-1.8) | **1.5** (1.0-2.1) | **1.9** (1.3-2.7) | **1.9** (1.3-2.7) | **1.9** (1.3-2.7) | | | | |
| Amistem-H | **2.0** (1.7-2.4) | **2.6** (2.3-3.0) | **3.2** (2.9-3.6) | **4.4** (4.0-4.9) | **4.9** (4.4-5.4) | **6.2** (5.7-6.8) | **6.9** (6.3-7.5) | **7.4** (6.8-8.1) | **8.2** (7.5-9.0) |
| Amistem-H prox c. | **2.2** (1.7-2.7) | **2.6** (2.2-3.2) | **3.1** (2.5-3.7) | **3.5** (2.9-4.1) | **3.7** (3.1-4.4) | **4.2** (3.4-5.0) | | | |
| Amistem-P | **2.4** (2.1-2.8) | **2.8** (2.4-3.2) | **3.0** (2.6-3.5) | **3.8** (3.1-4.6) | | | | | |
| Fitmore | **1.8** (1.6-2.0) | **2.3** (2.1-2.5) | **2.6** (2.4-2.9) | **3.0** (2.7-3.2) | **3.1** (2.8-**3.4)** | **3.4** (3.1-3.8) | **3.5** (3.2-3.9) | **3.7** (3.4-4.1) | **4.1** (3.6-4.7) |
| Optimys | **1.8** (1.7-2.0) | **2.2** (2.0-2.3) | **2.3** (2.1-2.5) | **2.5** (2.3-2.7) | **2.6** (2.4-2.8) | **2.8** (2.6-3.0) | **2.9** (2.6-3.1) | **2.9** (2.6-3.2) | **2.9** (2.6-3.2) |
| Other short stems | **2.4** (1.9-3.0) | **2.9** (2.3-3.5) | **3.1** (2.5-3.8) | **3.5** (2.9-4.2) | **3.6** (2.9-4.3) | **3.9** (3.2-4.7) | **4.0** (3.3-4.9) | **4.0** (3.3-4.9) | **4.5** (3.4-5.8) |
| Regular stems | **2.0** (2.0-2.1) | **2.6** (2.5-2.7) | **2.9** (2.8-3.0) | **3.4** (3.3-3.5) | **3.6** (3.5-3.8) | **4.2** (4.1-4.4) | **4.5** (4.3-4.6) | **4.8** (4.6-5.0) | **5.5** (5.3-5.8) |

**Figure 4.17**

**Estimated failure rates of primary total hip arthroplasty for different types of short stems (all uncemented fixation)**

Time since operation, 2012–2024, diagnosis primary OA

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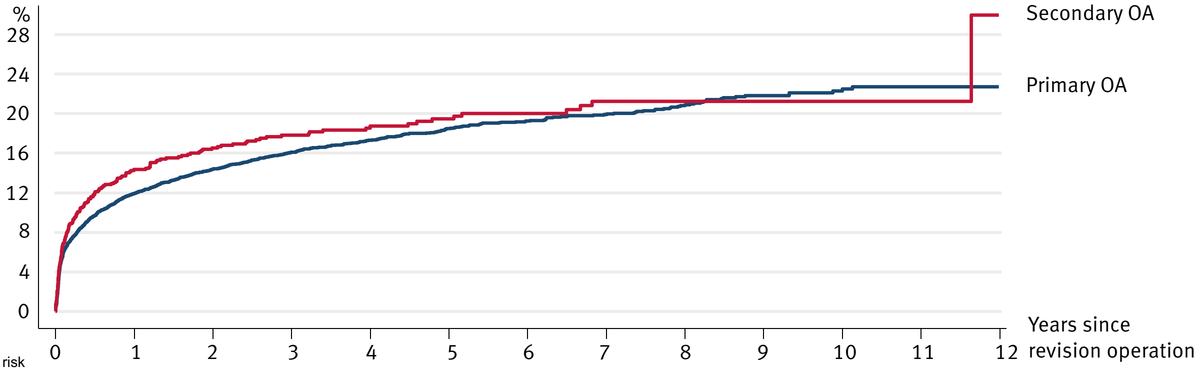
[1] Erivan R et al. French Hip & Knee Society classification of short-stem hip prostheses: Inter- and intra-observer reproducibility. Orthop Traumatol Surg Res. 2022, 108(1):103126.

## 4.3 Re-revision of total hip arthroplasty

Re-revisions are revisions occurring after the first revision of a THA. The first or index revision includes partial or complete revisions and sometimes re-implantations after Girdlestone, when the removal of the implant was not documented in the register.

The re-revision rate is excessively high and reaches 11.9% (CI 11.1 – 12.7%) for primary OA after the first year and 14.4% (CI 12.3 – 16.7%) for secondary OA. That means that every 7th to 8th revision is revised within the first year. After the first year the curves flatten out and after the 7th year the revision rate barely increases. At eleven years the revision rate is approximately 22% for both primary and secondary OA **(Figure 4.18).**

However, there is a number of patients who undergo additional revisions that may sum up to five or more revisions in selected cases. After five years 3.5% have been revised at least once, of which 0.46% had two revisions, 0.1% had three revisions, 0.02% had four revisions and 0.01% had five revisions or more **(Figure 4.19).** After 10 years overall 5.2% were revised. 4.2% had one re-revision, 0.72% two, 0.12% three, 0.07% four and 0.02% more than five revisions **(Figure 4.19).**



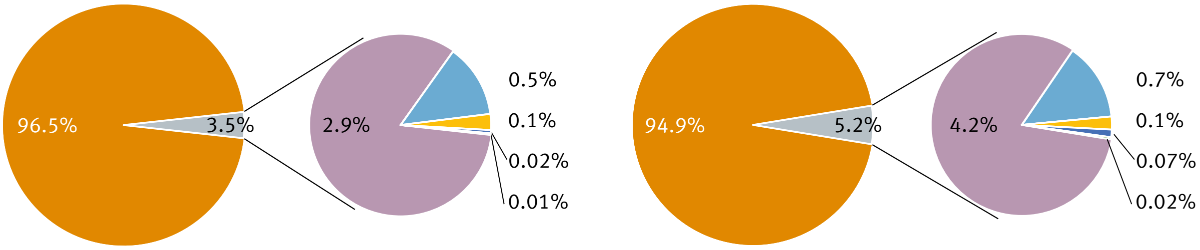
| Number at risk | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary OA | 6918 | 5281 | 4394 | 3646 | 2877 | 2313 | 1795 | 1356 | 986 | 648 | 382 | 182 | 31 |
| Secondary OA | 1058 | 766 | 628 | 509 | 389 | 307 | 232 | 182 | 130 | 87 | 52 | 24 | 5 |

| OA | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| Primary OA | **11.9** (11.1-12.7) | **14.4** (13.6-15.3) | **16.1** (15.2-17.1) | **18.5** (17.5-19.6) | **19.3** (18.2-20.4) | **20.8** (19.7-22.1) | **22.3** (20.9-23.8) | **22.8** (21.3-24.3) |
| Sec. OA | **14.4** (12.3-16.7) | **16.5** (14.4-19.0) | **17.8** (15.5-20.4) | **19.5** (17.0-22.3) | **20.0** (17.5-23.0) | **21.3** (18.4-24.5) | **21.3** (18.4-24.5) | |

**Figure 4.18**

**Estimated failure rates after revision of total hip arthroplasty: primary and secondary OA**

Time since revision, 2012–2024. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria. End point of analysis: next registered component revision.



**THA with 5 years follow-up (2012 – 2019)**

| | | | |
|---|---|---|---|
| no revision | 95,215 | three revisions | 96 |
| one revision | 2,865 | four revisions | 25 |
| two revisions | 454 | five+ revisions | 12 |

**THA with 10 years follow-up (2012 – 2014)**

| | | | |
|---|---|---|---|
| no revision | 25,473 | three revisions | 33 |
| one revision | 1,132 | four revisions | 18 |
| two revisions | 194 | five+ revisions | 5 |

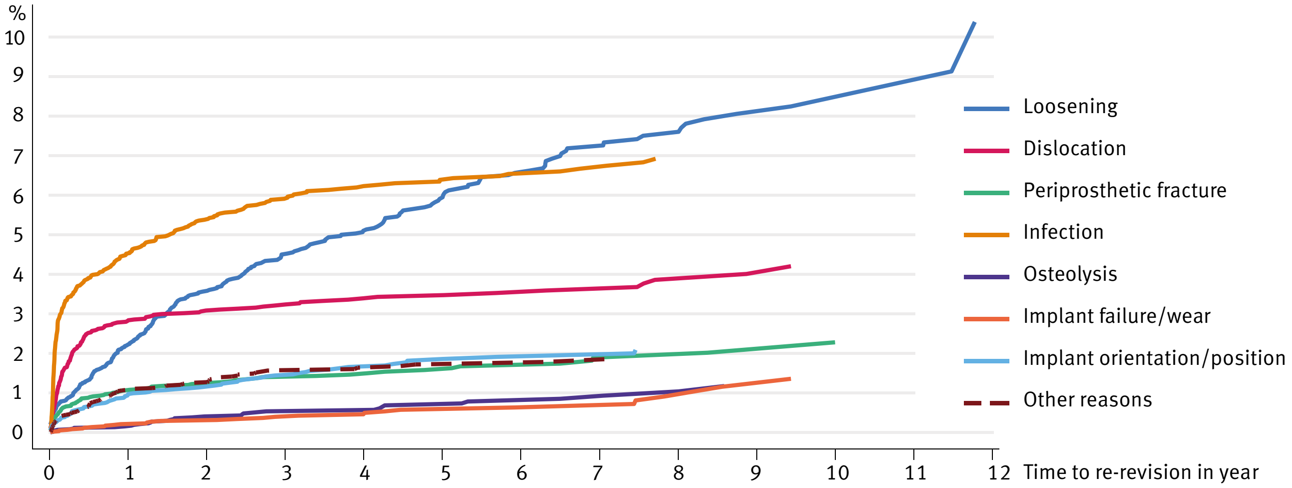
**Figure 4.19**

**Risk of revision within 5 years and 10 years after primary THA (primary OA or secondary OA) in percent**

Multi-stage operations are counted as one revision

## 4.3.1 Reasons for re-revision THA

In the first four years infection is the predominant diagnosis leading to a re-revision, followed by loosening and dislocations. From the sixth year onwards, loosening is the main reason for re-revisions. The cumulative incidence rate for loosening reaches 10.4% after 12 years (CI 7.6-14.0%) **(Figure 4.20).**



| **Diagnoses** | **1 year** | **2 years** | **3 years** | **5 years** | **9 years** | **10 years** | **12 years** |
|---|---|---|---|---|---|---|---|
| Loosening | **2.2** (1.9-2.6) | **3.6** (3.1-4.1) | **4.5** (4.0-5.1) | **6.1** (5.4-6.8) | **8.0** (7.1-9.1) | **8.2** (7.2-9.4) | **10.4** (7.6-14.0) |
| Dislocation | **2.8** (2.5-3.3) | **3.1** (2.7-3.5) | **3.2** (2.8-3.7) | **3.5** (3.0-4.0) | **4.0** (3.4-4.7) | **4.2** (3.5-5.0) | **4.2** (3.5-5.0) |
| Periprosthetic fracture | **1.1** (0.8-1.4) | **1.3** (1.0-1.6) | **1.4** (1.1-1.7) | **1.6** (1.3-2.0) | **2.0** (1.6-2.6) | **2.3** (1.7-3.1) | **2.3** (1.7-3.1) |
| Infection | **4.5** (4.0-5.1) | **5.4** (4.9-6.0) | **5.9** (5.4-6.6) | **6.4** (5.8-7.1) | **6.9** (6.2-7.7) | **6.9** (6.2-7.7) | **6.9** (6.2-7.7) |
| Osteolysis | **0.2** (0.1-0.3) | **0.4** (0.3-0.6) | **0.5** (0.4-0.8) | **0.7** (0.5-1.0) | **1.2** (0.8-1.8) | **1.2** (0.8-1.8) | **1.2** (0.8-1.8) |
| Implant failure / wear | **0.2** (0.1-0.4) | **0.3** (0.2-0.5) | **0.4** (0.3-0.6) | **0.6** (0.4-0.9) | **1.2** (0.7-1.8) | **1.4** (0.8-2.2) | **1.4** (0.8-2.2) |
| Implant orientation / position | **1.0** (0.8-1.3) | **1.2** (0.9-1.5) | **1.4** (1.2-1.8) | **1.9** (1.5-2.3) | **2.1** (1.7-2.6) | **2.1** (1.7-2.6) | **2.1** (1.7-2.6) |
| Other reasons | **1.1** (0.9-1.4) | **1.3** (1.1-1.7) | **1.6** (1.3-2.0) | **1.7** (1.4-2.2) | **1.9** (1.5-2.4) | **1.9** (1.5-2.4) | **1.9** (1.5-2.4) |

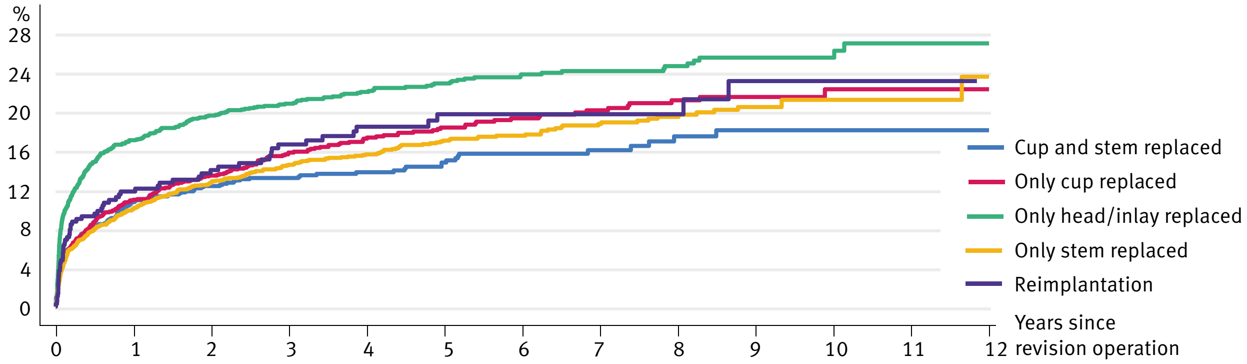
**Figure 4.20**

**Cumulative incidence rates for different re-revision diagnoses after main component changes**

Time since operation, 2012 – 2024, % of implants re-revised

## 4.3.2 Influence of type of previous THA revision

The re-revision rate after two years accounts for 11.8% (CI 10.2–13.7%). After eleven years the revision rate rises to 18.3% (CI 15.5–21.6%). The lowest revision rate is seen after complete revisions, including revision of both stem and cup. Revision of the cup or stem alone and re-implantations have similar revision rates around 13% at two years and 22% at eleven years (for precise numbers consult **Figure 4.21).** However, head and inlay exchange have a significantly higher revision rate at two years (19.4%, CI 17.8–21.2%) that continues until eight years. The main reason for re-revision after isolated head and inlay exchange at one year is infection with a re-revision



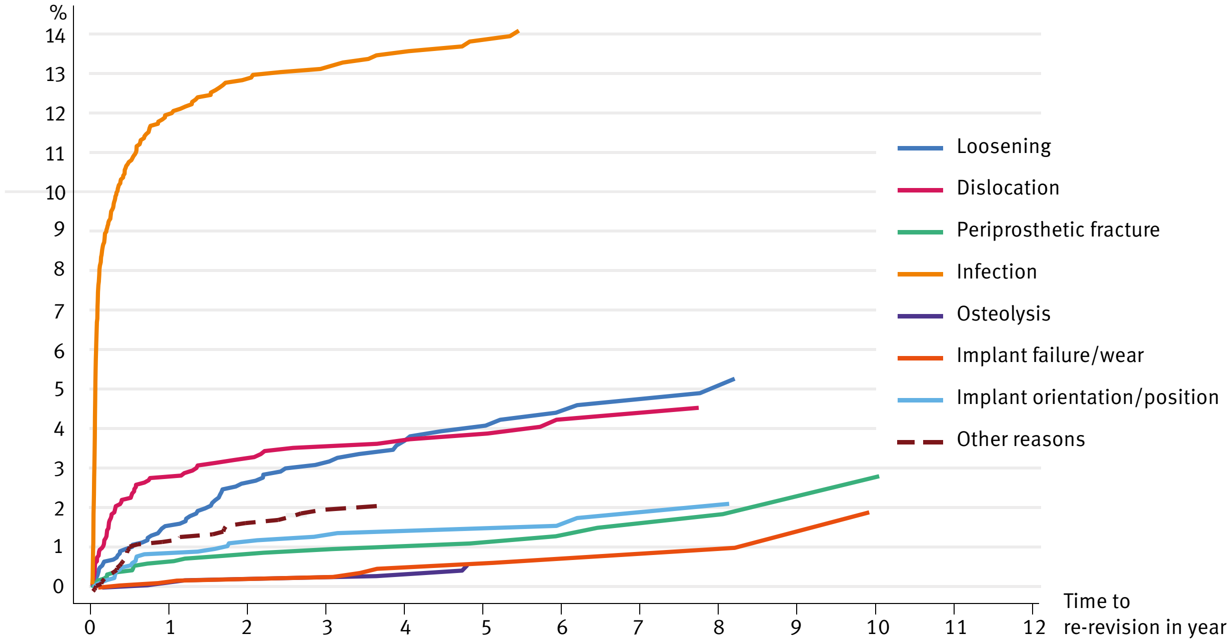
| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cup and stem replaced | 1258 | 944 | 775 | 636 | 508 | 390 | 287 | 224 | 156 | 104 | 65 | 23 | 1 |
| Only cup replaced | 1729 | 1339 | 1118 | 916 | 714 | 583 | 447 | 344 | 261 | 155 | 90 | 48 | 11 |
| Only head/inlay replaced | 2029 | 1441 | 1191 | 1000 | 777 | 631 | 499 | 380 | 281 | 189 | 105 | 56 | 11 |
| Only stem replaced | 2581 | 2024 | 1688 | 1398 | 1108 | 895 | 690 | 511 | 363 | 251 | 154 | 73 | 13 |
| Reimplantation | 379 | 299 | 250 | 205 | 159 | 121 | 104 | 79 | 55 | 36 | 20 | 6 | 0 |

| Typ of procedure | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Cup and stem repl. | **10.3**(8.8-12.0) | **11.8**(10.2-13.7) | **13.0**(11.3-15.0) | **14.4**(12.5-16.6) | **18.3**(15.5-21.6) | **18.3**(15.5-21.6) | |
| Only cup replaced | **10.9**(9.6-12.4) | **13.4**(11.9-15.1) | **15.7**(14.1-17.5) | **18.1**(16.2-20.1) | **21.0**(18.7-23.5) | **21.7**(19.1-24.7) | **23.8** (19.4-29.0) |
| Only stem replaced | **10.4** (9.3-11.6) | **13.2**(11.9-14.5) | **14.9**(13.6-16.4) | **17.4**(15.9-19.1) | **21.0**(18.9-23.1) | **21.7**(19.5-24.1) | **24.0** (19.5-29.6) |
| Only head/inlay repl. | **16.7**(15.2-18.3) | **19.4**(17.8-21.2) | **20.7**(19.0-22.5) | **22.6**(20.8-24.6) | **25.4**(23.2-27.7) | **25.4**(23.2-27.7) | **26.8** (23.9-29.8) |
| Reimplantation | **11.1**(8.5-14.6) | **13.1**(10.2-16.9) | **15.5**(12.2-19.6) | **18.3**(14.5-22.9) | **21.5**(16.2-28.2) | **21.5**(16.2-28.2) | |

**Figure 4.21**

**Estimated failure rates after revision of total hip arthroplasty (primary and secondary OA): types of procedures**

Time since revision, 2012–2024. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria. End point of analysis: next registered component revision rate of 11.9% (CI 10.6-13.3%) **(Figure 4.22).** Head and inlay exchange mainly is performed in prosthetic joint infections as DAIR procedure (Debridement, Antibiotics and Implant Retention). These findings indicate that this concept is not successful in every 10th DAIR procedure for acute infections.



| Diagnoses | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Loosening | **1.6** (1.1-2.3) | **2.7** (2.0-3.5) | **3.1** (2.4-4.1) | **4.0** (3.1-5.1) | **5.3** (4.0-7.0) | **5.3** (4.0-7.0) | **5.3** (4.0-7.0) |
| Dislocation | **2.8** (2.2-3.6) | **3.3** (2.6-4.1) | **3.6** (2.8-4.5) | **3.8** (3.0-4.8) | **4.6** (3.5-5.9) | **4.6** (3.5-5.9) | **4.6** (3.5-5.9) |
| Periprosthetic fracture | **0.7** (0.4-1.1) | **0.8** (0.5-1.4) | **0.9** (0.6-1.5) | **1.2** (0.7-1.9) | **1.9** (1.1-3.2) | **1.9** (1.1-3.2) | **2.8** (1.3-6.0) |
| Infection | **11.9**(10.6-13.3) | **12.8**(11.5-14.3) | **13.1**(11.7-14.6) | **13.8**(12.3-15.4) | **14.0**(12.6-15.7) | **14.0**(12.6-15.7) | **14.0**(12.6-15.7) |
| Osteolysis | **0.2** (0.1-0.5) | **0.2** (0.1-0.6) | **0.2** (0.1-0.6) | **0.6** (0.3-1.4) | **0.6** (0.3-1.4) | **0.6** (0.3-1.4) | **0.6** (0.3-1.4) |
| Implant failure / wear | **0.2** (0.1-0.5) | **0.2** (0.1-0.6) | **0.2** (0.1-0.6) | **0.5** (0.2-1.1) | **1.0** (0.4-2.4) | **1.0** (0.4-2.4) | **1.9** (0.7-5.3) |
| Implant orientation / position | **0.9** (0.6-1.4) | **1.2** (0.8-1.8) | **1.3** (0.9-2.0) | **1.4** (0.9-2.1) | **2.2** (1.3-3.5) | **2.2** (1.3-3.5) | **2.2** (1.3-3.5) |
| Other reasons | **1.3** (0.9-1.9) | **1.8** (1.3-2.5) | **2.1** (1.5-2.9) | **2.2** (1.6-3.1) | **2.2** (1.6-3.1) | **2.2** (1.6-3.1) | **2.2** (1.6-3.1) |

**Figure 4.22**

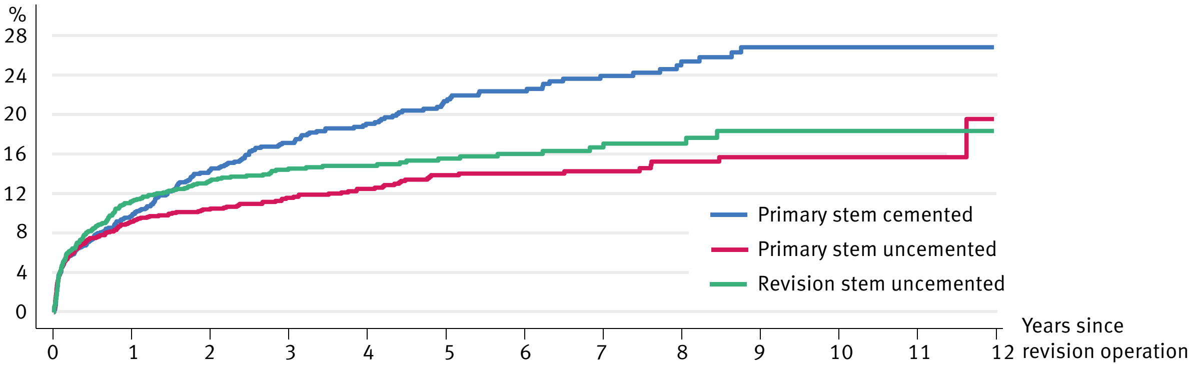
**Cumulative incidence rates for different re-revision diagnoses after head/inlay changes**

Time since operation, 2012–2024, % of implants re-revised

## 4.3.3 Implant selection and impact on re-revision

Not only the type of revision but also the choice of the implant influences the re-revision rate. Often the choice of the implant is limited by the underlying pathology. Therefore, the revision rates may be biased, and interpretations must be carefully made. As a general indication what implant should be used, the presented date may be helpful.

The use of primary uncemented stems for a first-time revision comes with the lowest revision rate of 8.9% (CI 7.5-10.4%) at one year. Uncemented revision stems have a slightly higher revision rate over the entire period of 11 years. Primary cemented stems have initially a lower revision rate, which then increases to 25.8% (CI 22.6-29.3%) at eleven years. The difference is statistically significant **(Figure 4.23).**



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary stem cemented | 1180 | 955 | 773 | 653 | 508 | 412 | 324 | 269 | 193 | 131 | 72 | 30 | 5 |
| Primary stem uncemented | 1474 | 1170 | 1000 | 850 | 707 | 555 | 441 | 321 | 224 | 157 | 94 | 42 | 6 |
| Revision stem uncemented | 1493 | 1099 | 888 | 691 | 521 | 412 | 302 | 218 | 148 | 97 | 67 | 25 | 2 |

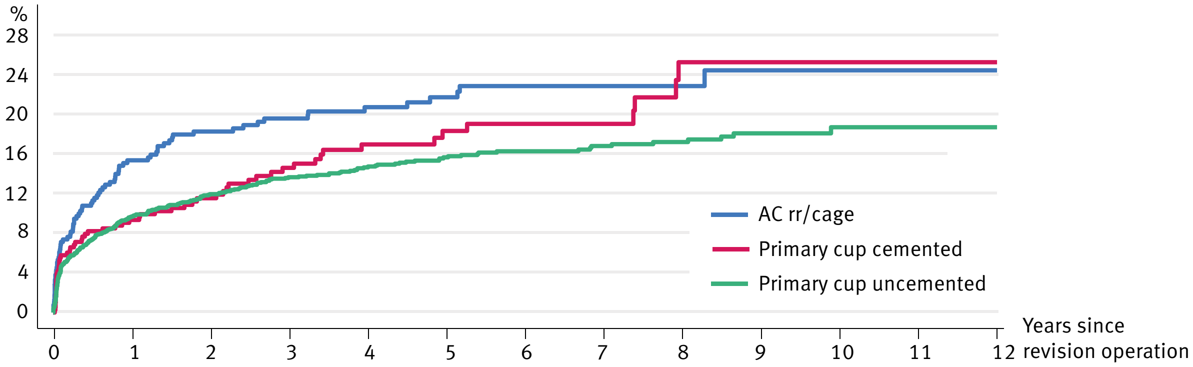
| Typ of stem | 1 year | 2 years | 3 years | 5 years | 8 years | 9 years | 10 years |
|---|---|---|---|---|---|---|---|
| Primary stem cem. | **9.7** (8.2-11.4) | **14.0** (12.2-16.1) | **16.5** (14.5-18.8) | **20.4** (18.1-23.0) | **24.1** (21.3-27.3) | **25.8** (22.6-29.3) | **25.8** (22.6-29.3) |
| Primary stem uncem. | **8.9** (7.5-10.4) | **10.3** (8.9-12.0) | **11.5** (10.0-13.3) | **13.7** (11.9-15.7) | **15.2** (13.1-17.6) | **15.6** (13.4-18.2) | **15.6** (13.4-18.2) |
| Rev. stem uncem. | **11.4** (10.0-13.1) | **13.3** (11.8-15.1) | **14.6** (12.9-16.5) | **15.6** (13.8-17.6) | **17.6** (15.3-20.2) | **18.8** (16.1-21.8) | **18.8** (16.1-21.8) |

**Figure 4.23**

**Estimated failure rates after revision of total hip arthroplasty (primary and secondary OA): types of stems used in revision**

Time since revision, 2012–2024. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria.
End point of analysis: next registered component revision.

On the acetabular side, revisions with primary uncemented cups yields the lowest revision rates (9.4%, CI 8.3-10.6%) at one year, whereas reconstruction rings come with the highest revision rates after one year (14.3%, CI 11.5-17.9%) **(Figure 4.24).**



| Number at risk | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AC rr/cage | 398 | 305 | 264 | 236 | 180 | 148 | 106 | 79 | 55 | 33 | 16 | 6 | 1 |
| Primary cup cemented | 385 | 317 | 251 | 206 | 145 | 119 | 93 | 69 | 42 | 21 | 15 | 11 | 1 |
| Primary cup uncemented | 2364 | 1799 | 1480 | 1188 | 942 | 748 | 585 | 456 | 335 | 213 | 123 | 53 | 10 |

| Typ of cup | 1 year | 2 years | 3 years | 5 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Primary cup cemented | **9.6** (7.2-12.7) | **11.7** (9.0-15.1) | **14.7** (11.6-18.6) | **18.0** (14.3-22.6) | **24.1** (18.2-31.4) | **24.1** (18.2-31.4) | |
| Primary cup uncem. | **9.4** (8.3-10.6) | **11.6** (10.3-12.9) | **13.4** (12.1-14.9) | **15.2** (13.7-16.9) | **16.8** (15.1-18.7) | **18.2** (16.0-20.7) | **18.2** (16.0-20.7) |
| AC rr/cage | **14.3** (11.5-17.9) | **17.3** (14.1-21.1) | **18.4** (15.1-22.3) | **20.3** (16.7-24.5) | **23.0** (18.7-28.0) | **24.3** (19.5-30.0) | |

**Figure 4.24**

**Estimated failure rates after revision of total hip arthroplasty (primary and secondary OA): types of cups used in revision**

Time since revision, 2012–2024. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria.
End point of analysis: next registered component revision.

## 4.4 Results of implants in total hip arthroplasty

One of the key elements of an arthroplasty registry is to analyse the performance of implants regarding revision rates over time. While short-term results largely reflect a surgeon's or a hospital's performance, long-term results depend more on the design and quality of the implants. A total hip replacement comprises at least three components: the stem, the cup, and the head. Considering the modularity of the cup, including dual mobility systems, it is sensible to focus investigations on combinations in current use and to compare those with each other as it could be that a cup works well with one stem but poorly with another – and vice versa. THA performed for primary and for secondary OA are considered separately. The internationally recognised benchmark considers only primary OA. The reader is reminded to consider statistical precision of the results. A single revision weighs much more in a small group than in a large group. Hence, there is always a trade-off between statistical stability and the necessity to identify possible low-volume outliers. Methodological details are provided in Chapter 2 Methods.

Currently, SIRIS documents 169 different brands of stems (including all currently identified sub-variants), of which 36 were implanted less than 10 times, while another 32 were used in 10 to 49 cases only. There were 136 different brands of cups, of which 26 were implanted less than 10 times and another 25 were used in 10 to 49 cases. This resulted in 1,377 different stem/cup combinations, of which only 275 were used in more than 50 cases. It is noteworthy that almost half of all recognised combinations (47.9%) were registered less than 5 times. Yet, this remarkable diversity accounted for 0.46% of all THA. In contrast, the ten most used implant combinations covered 51.5% of all THA. The current 4-year moving window covers 80 combinations with more than 50 cases. This is a significant reduction from the 108 combinations in 2024.

A so-called case concentration score (CCS) was introduced since the annual report 2022. It indicates the percentage of implantations performed by the main user hospital service. A higher value signifies an increased likelihood of bias due to local effects induced by a single provider unit. Hence, a share of >50% would suggest that reported results are likely dominated by data from one hospital service while a score of 100% indicates that the implant is used in one hospital only.

**Currently documented in SIRIS:**

169 brands of hip stems
and
136 brands of hip cups

## 4.4.1 Twelve-year revision rates

### Uncemented combinations for primary OA

The register now can provide an overview of the 12-year performance of implant combinations. The revision rates are shown for 1, 2-, 3-, 5-, 6-, 8-, 9-, 10- and 12-years follow-up.

**Table 4.16** shows the stem/cup combinations used in 75% of the uncemented THA performed for primary OA and their evolution between 2019 and 2024. This list is shorter by two combinations than in the 2024 report, which indicates a concentration to fewer implant combinations. **Table 4.17** shows the revision rates since 2012 for THA conducted for primary OA, whereby only uncemented stem/cup combinations with N›500 are presented. At 12 years, the average revision rate for all uncemented stem/cup combinations was 5.3% (CI 5.1 – 5.5%). The lowest revision rate at 12 years was documented for the combination SL-plus/R3 with 2.4% (CI 1.6 –3.4%). The highest revision rate was found in the combination Exception/Avantage with 9.2% (CI 7.1 – 12.0%). Interestingly, both had a rather high case concentration score (CCS) of 64 and 78 respectively, indicating the dominant use in one hospital only.

| Stem component | Cup component | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 119 | 185 | 222 | 406 | 538 | 606 | **2,076** |
| Amistem-P | Versafitcup trio/ccl. | 383 | 1,183 | 1,229 | 1,213 | 1,149 | 1,032 | **6,189** |
| Avenir | Allofit | 1,143 | 1,040 | 714 | 619 | 518 | 542 | **4,576** |
| Corail | Pinnacle | 1,158 | 1,222 | 1,135 | 936 | 848 | 638 | **5,937** |
| Corail collared | Novae TH/Bi-Mentum | 45 | 97 | 343 | 357 | 519 | 521 | **1,882** |
| Corail collared | Pinnacle | 1,406 | 1,610 | 2,004 | 2,291 | 2,361 | 2,421 | **12,093** |
| Fitmore | Allofit | 527 | 561 | 617 | 681 | 850 | 1,097 | **4,333** |
| Fitmore | Fitmore | 622 | 625 | 596 | 607 | 541 | 230 | **3,221** |
| Optimys | RM pressfit vitamys | 1,845 | 2,107 | 2,488 | 3,045 | 3,444 | 3,780 | **16,709** |
| Polarstem | Polarcup | 189 | 209 | 173 | 217 | 205 | 196 | **1,189** |
| Polarstem | R3 | 687 | 766 | 809 | 935 | 1,006 | 1,237 | **5,440** |
| Quadra-H | Versafitcup trio/ccl. | 983 | 752 | 482 | 182 | 16 | 0 | **2,415** |
| Quadra-P | Versafitcup trio/ccl. | 33 | 244 | 571 | 866 | 1,078 | 1,179 | **3,971** |
| Twinsys | RM pressfit vitamys | 409 | 397 | 416 | 424 | 458 | 492 | **2,596** |
| other combinations | - | 4,870 | 3,573 | 3,728 | 3,637 | 3,668 | 3,732 | **23,208** |
| **Total** | | **14,419** | **14,571** | **15,527** | **16,416** | **17,199** | **17,703** | **95,835** |

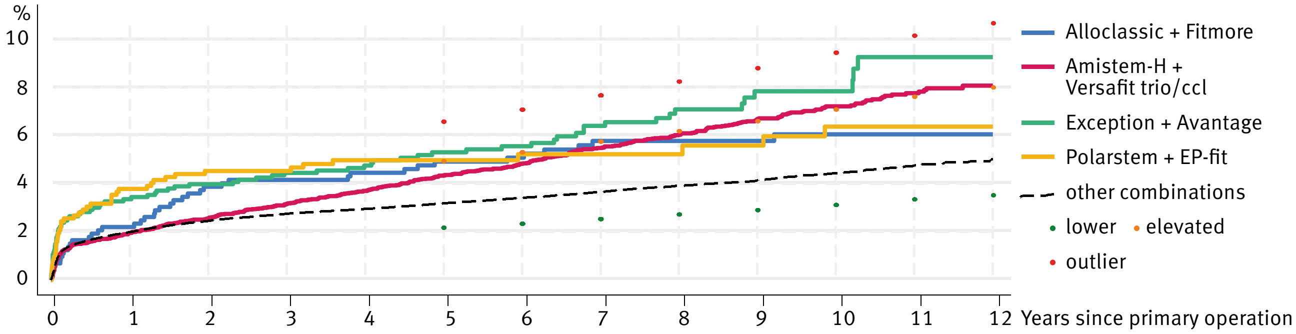
**Table 4.16**
Top 75% of primary total hip arthroplasty uncemented combinations (primary OA) 2019 – 2024

| Stem component | Cup component | Total N | CCS* | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 2,104 | 29 | **1.3** (0.9-1.9) | **1.8** (1.2-2.6) | **1.8** (1.2-2.6) | | |
| Alloclassic | Fitmore | 729 | 66 | **2.2** (1.4-3.6) | **4.2** (2.9-5.9) | **4.9** (3.5-6.8) | **6.0** (4.5-8.2) | **6.0** (4.5-8.2) |
| Amistem-H | Versafitcup trio/ccl. | 7,350 | 15 | **2.0** (1.7-2.3) | **3.1** (2.8-3.6) | **4.3** (3.9-4.8) | **7.2** (6.6-7.9) | **8.1** (7.3-8.9) |
| Amistem-H collared | Versafitcup trio/ccl. | 556 | 100 | **0.9** (0.4-2.2) | **1.8** (1.0-3.4) | **1.8** (1.0-3.4) | **2.7** (1.6-4.7) | |
| Amistem-H prox coating | Versafitcup trio/ccl. | 3,250 | 12 | **2.2** (1.7-2.7) | **3.0** (2.4-3.6) | **3.4** (2.8-4.1) | | |
| Amistem-P | Mpact | 690 | 45 | **2.9** (1.8-4.5) | **3.6** (2.3-5.7) | **5.9** (3.0-11.6) | | |
| Amistem-P | Versafitcup trio/ccl. | 6,191 | 14 | **2.4** (2.1-2.9) | **3.1** (2.6-3.5) | **3.7** (3.0-4.4) | | |
| Avenir | Alloclassic | 591 | 68 | **1.9** (1.0-3.3) | **2.4** (1.4-4.0) | **2.8** (1.7-4.5) | **3.7** (2.4-5.8) | **4.6** (2.7-7.5) |
| Avenir | Allofit | 11,364 | 11 | **2.0** (1.8-2.3) | **2.7** (2.4-3.0) | **3.0** (2.7-3.4) | **4.0** (3.5-4.4) | **4.2** (3.7-4.7) |
| Avenir | Fitmore | 2,765 | 16 | **3.2** (2.6-3.9) | **4.0** (3.3-4.8) | **4.2** (3.5-5.0) | **4.9** (4.0-5.8) | **5.4** (4.2-6.9) |
| CLS Spotorno | Allofit | 1,583 | 31 | **2.7** (2.0-3.7) | **4.0** (3.2-5.2) | **4.5** (3.6-5.7) | **6.0** (4.7-7.5) | **6.2** (4.9-7.9) |
| CLS Spotorno | Fitmore | 1,910 | 26 | **1.6** (1.1-2.3) | **2.2** (1.6-3.0) | **2.9** (2.2-3.7) | **3.7** (2.8-4.9) | **4.3** (3.2-5.8) |
| Corail | Pinnacle | 13,501 | 12 | **2.2** (1.9-2.4) | **3.1** (2.8-3.4) | **3.7** (3.3-4.0) | **5.3** (4.8-5.9) | **6.0** (5.4-6.7) |
| Corail collared | Gyros | 967 | 65 | **2.1** (1.3-3.2) | **2.7** (1.9-4.0) | **2.8** (2.0-4.1) | **4.9** (3.1-7.7) | |
| Corail collared | Novae TH/Bi-Mentum | 1,927 | 26 | **1.6** (1.1-2.3) | **2.4** (1.7-3.5) | **2.4** (1.7-3.5) | | |
| Corail collared | Pinnacle | 16,879 | 21 | **1.4** (1.3-1.6) | **2.0** (1.8-2.3) | **2.3** (2.1-2.6) | **3.1** (2.6-3.7) | **3.1** (2.6-3.7) |
| Exception | Avantage | 1,136 | 78 | **3.4** (2.4-4.6) | **4.4** (3.4-5.8) | **5.3** (4.1-6.8) | **7.8** (6.2-9.9) | **9.2** (7.1-12.0) |
| Fitmore | Allofit | 8,750 | 66 | **1.8** (1.5-2.1) | **2.7** (2.3-3.0) | **3.0** (2.6-3.4) | **3.7** (3.3-4.3) | **4.0** (3.5-4.6) |
| Fitmore | Fitmore | 6,211 | 26 | **1.8** (1.5-2.2) | **2.6** (2.2-3.1) | **3.1** (2.6-3.5) | **4.0** (3.4-4.7) | **5.0** (3.5-7.3) |
| Fitmore | RM pressfit vitamys | 1,684 | 84 | **1.3** (0.8-1.9) | **2.0** (1.4-2.8) | **2.2** (1.5-3.1) | **2.5** (1.7-3.8) | |
| H-Max S | Delta TT | 531 | 23 | **1.5** (0.8-3.0) | **1.9** (1.1-3.6) | **2.4** (1.4-4.2) | **6.0** (3.6-9.9) | |
| Individual/custom hip | April ceramic | 1,439 | 24 | **1.9** (1.3-2.7) | **2.9** (2.1-4.0) | **3.5** (2.6-4.7) | **3.7** (2.7-5.1) | **4.6** (2.9-7.0) |
| Optimys | Anexys | 577 | 25 | **1.4** (0.7-2.9) | **1.9** (1.0-3.4) | **1.9** (1.0-3.4) | | |
| Optimys | RM pressfit | 819 | 19 | **2.6** (1.7-4.0) | **2.9** (1.9-4.4) | **3.4** (2.3-5.0) | **4.2** (2.7-6.3) | |
| Optimys | RM pressfit vitamys | 24,591 | 9 | **1.8** (1.7-2.0) | **2.3** (2.1-2.5) | **2.5** (2.3-2.7) | **2.8** (2.5-3.1) | **2.8** (2.5-3.1) |
| Polarstem | EP-fit | 823 | 53 | **3.8** (2.7-5.3) | **4.5** (3.3-6.2) | **5.0** (3.7-6.7) | **6.4** (4.6-8.7) | **6.4** (4.6-8.7) |
| Polarstem | Polarcup | 2,573 | 74 | **2.2** (1.7-2.9) | **2.4** (1.9-3.1) | **2.5** (1.9-3.2) | **3.0** (2.3-3.9) | **3.8** (2.6-5.3) |
| Polarstem | R3 | 9,240 | 62 | **1.2** (1.0-1.4) | **1.7** (1.4-2.0) | **1.9** (1.6-2.3) | **2.6** (2.1-3.1) | **2.7** (2.2-3.4) |
| Quadra-H | Mpact | 540 | 43 | **2.2** (1.3-3.9) | **2.8** (1.7-4.6) | **3.0** (1.9-4.9) | | |
| Quadra-H | Versafitcup trio/ccl. | 7,219 | 19 | **2.0** (1.7-2.4) | **3.0** (2.6-3.4) | **3.8** (3.3-4.2) | **6.7** (5.9-7.6) | **7.8** (6.6-9.1) |
| Quadra-P | Mpact | 789 | 59 | **2.0** (1.2-3.3) | **2.8** (1.7-4.6) | | | |
| Quadra-P | Versafitcup trio/ccl. | 3,971 | 21 | **1.5** (1.2-2.0) | **1.9** (1.5-2.5) | **2.3** (1.7-3.1) | | |
| SBG | R3 | 1,668 | 42 | 1.3 (0.9-2.0) | **1.9** (1.3-2.7) | **2.4** (1.7-3.3) | **3.9** (2.6-5.7) | |
| SL-plus MIA | EP-fit | 1,254 | 30 | **2.0** (1.4-2.9) | **2.2** (1.6-3.2) | **2.6** (1.8-3.6) | **2.9** (2.1-4.2) | **2.9** (2.1-4.2) |
| SL-plus MIA | HI | 882 | 43 | **2.1** (1.3-3.2) | **3.9** (2.8-5.5) | **5.2** (3.9-7.0) | **9.3** (7.0-12.3) | **10.2** (7.5-14.0) |
| SL-plus MIA | R3 | 2,024 | 64 | **1.0** (0.7-1.6) | **1.4** (0.9-2.0) | **1.5** (1.0-2.1) | **2.2** (1.5-3.1) | **2.4** (1.6-3.4) |
| SPS evolution | April ceramic | 1,712 | 40 | **5.0** (4.1-6.2) | **6.5** (5.4-7.8) | **6.8** (5.7-8.2) | **7.3** (6.1-8.8) | 7.8 (6.3-9.5) |
| Tri-Lock | Pinnacle | 768 | 65 | **1.3** (0.7-2.4) | **2.8** (1.8-4.3) | **3.3** (2.2-4.8) | **3.6** (2.5-5.3) | **3.6** (2.5-5.3) |
| Twinsys | RM pressfit vitamys | 5,040 | 13 | **2.3** (2.0-2.8) | **3.0** (2.6-3.5) | **3.4** (2.9-4.0) | **5.1** (4.3-6.0) | **5.9** (4.8-7.2) |
| other combinations | - | 23,126 | | **2.6** (2.4-2.8) | **3.8** (3.5-4.1) | **4.6** (4.3-4.9) | **6.5** (6.1-7.0) | **7.6** (7.0-8.3) |
| **CH average for group** | | | | **2.0** (1.9-2.1) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **4.7** (4.6-4.9) | **5.3** (5.1-5.5) |

**Table 4.17**

Long term evaluation: Failure rates of primary total hip arthroplasty uncemented combinations (primary OA)

Four implant combinations with an elevated revision rate were detected. The corresponding KM estimates are illustrated in **Figure 4.25.** Exception/Avantage and Polarstem/EP fit already appeared in 2023 as implant combinations with elevated revision rates. Quadra-H/Versafitcup trio/ccl, which appeared as outlier in 2023, improved and no longer had an elevated revision rate. The combination Alloclassic/Fitmore and Fitmore/Allofit reached the status of elevated revision rate in 2024. However, Amistem-H was only implanted until 2019 and no longer is in active use and has been replaced by new evolutions of the stem. There are two implant combinations with outlier level revision rates during the 12 years observation period. SL plus MIA/HI and April ceramic, which already had an outlier status at 2 years. After a steep early rise of the cumulative revision rate, the curve flattened over the subsequent years, although the outlier boundary was still exceeded at 5 years follow-up. The revision rate of this combination amounts to 7.8% (CI 6.3 – 9.6%) at 12 years **(Figure 4.26).**

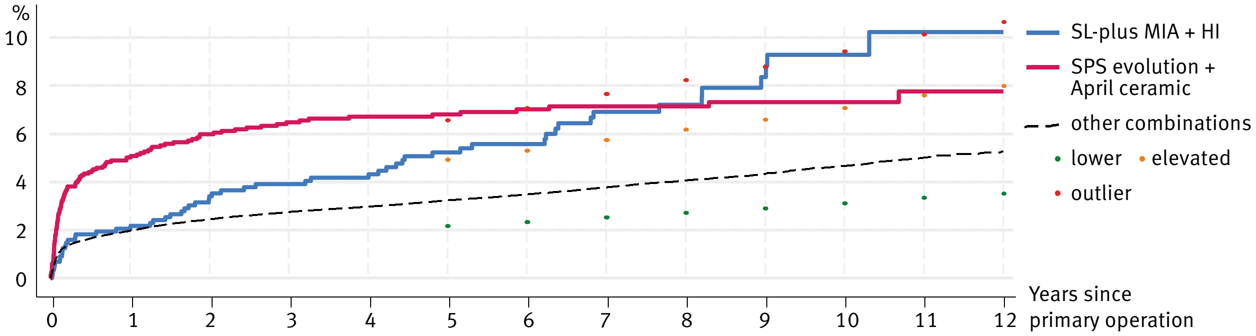


| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alloclassic + Fitmor | 729 | 706 | 678 | 660 | 627 | 612 | 572 | 517 | 452 | 378 | 263 | 165 | 52 |
| Amistem-H + Versafit | 7350 | 7145 | 6957 | 6806 | 6472 | 6298 | 6062 | 5757 | 5010 | 3824 | 2596 | 1469 | 431 |
| Exception + Avantage | 1136 | 1091 | 1068 | 991 | 898 | 804 | 706 | 615 | 500 | 351 | 222 | 117 | 34 |
| Polarstem + EP-fit | 823 | 782 | 742 | 667 | 546 | 449 | 383 | 305 | 261 | 248 | 226 | 115 | 26 |
| other combinations | 169686 | 147242 | 126653 | 109450 | 90471 | 75868 | 62059 | 48996 | 37351 | 27249 | 18073 | 9959 | 2751 |

**Figure 4.25**

**Implant combinations with elevated long-term revision rates (primary OA, uncemented THA)**

An elevated revision rate was defined as a deviation of at least 50% above the group average at any time between year 5 and year 12 (and lower bounds of the 95% confidence interval exceeding the upper bound of the group average; and at least 50 cases at risk at 5 years). The dots indicate upper and lower limits.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-plus MIA + HI | 882 | 824 | 769 | 727 | 666 | 577 | 466 | 372 | 283 | 198 | 118 | 57 | 16 |
| SPS evolution + April | 1712 | 1525 | 1394 | 1253 | 1099 | 957 | 810 | 677 | 564 | 440 | 295 | 157 | 19 |
| other combinations | 177130 | 154617 | 133935 | 116594 | 97249 | 82497 | 68506 | 55141 | 42727 | 31412 | 20967 | 11611 | 3259 |

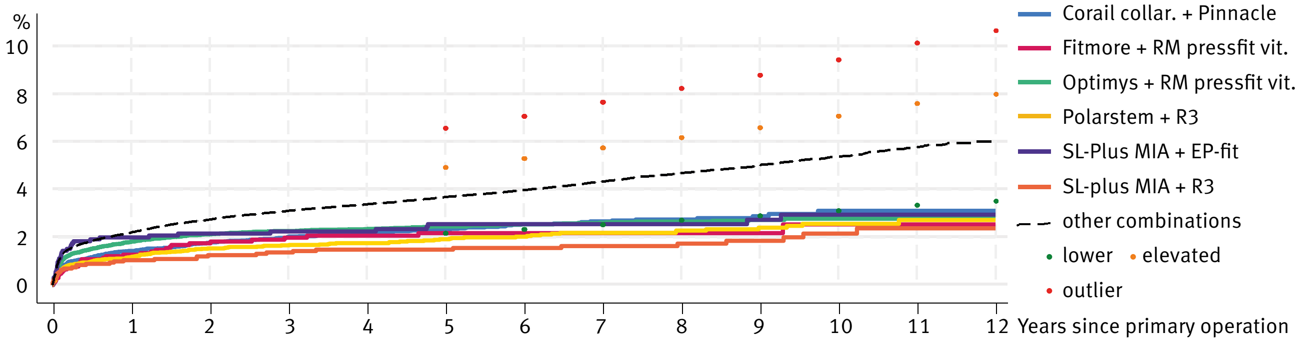
**Figure 4.26**

**Implant combinations with long-term evaluation outlier status (primary OA, uncemented THA)**

Outlier status was defined as a revision rate of twice the group average at any time between year 5 and year 12 (and lower bounds of the 95% confidence interval exceeding the upper bound of the group average; and at least 50 cases at risk at 5 years). The dots indicate upper and lower limits.

There are six uncemented implant combinations with a below-average revision rate to be reported in 2024, two more than in 2023 **(Figure 4.27).** The curves of these well-performing implant combinations have an almost horizontal continuation after the initial rise in the first 3 months. The combination Optimys/RM pressfit Vitamys, Polarstem/R3 and SL-plus MIA/R3 belonged already 2023 to the best performing implant combinations. In addition, Corail collared/Pinnacle, Fitmore/RM pressfit Vitamys and SL-plus MIA/EP fit are newly identified as implants with a below average revision rate.

The KM estimate of the cumulative revision risks for all other uncemented implant combinations are shown in **Figures 4.28.** These curves run between the upper and lower limits corresponding to the elevated revision risk at 150%, respectively the below-average revision risk at 66% from the groups' average.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Corail collared + Pinn. | 16879 | 14070 | 11424 | 9112 | 6937 | 5354 | 4032 | 2871 | 1828 | 1122 | 584 | 302 | 76 |
| Fitmore + RM pressfit | 1684 | 1506 | 1354 | 1182 | 1014 | 882 | 725 | 596 | 447 | 320 | 198 | 78 | 7 |
| Optimys + RM pressfit | 24591 | 20215 | 16404 | 13336 | 10542 | 8491 | 6690 | 5027 | 3535 | 2305 | 1266 | 496 | 64 |
| Polarstem + R3 | 9240 | 7821 | 6632 | 5656 | 4645 | 3891 | 3220 | 2590 | 1990 | 1441 | 928 | 504 | 118 |
| SL-plus MIA + EP-fit | 1254 | 1222 | 1156 | 1090 | 998 | 922 | 844 | 769 | 659 | 509 | 345 | 161 | 46 |
| SL-plus MIA + R3 | 2024 | 1963 | 1801 | 1692 | 1563 | 1435 | 1284 | 1129 | 948 | 740 | 505 | 275 | 48 |
| other combinations | 124052 | 110169 | 97327 | 86506 | 73315 | 63056 | 52987 | 43208 | 34167 | 25613 | 17554 | 10009 | 2935 |

**Figure 4.27**

**Implant combinations with below-average long-term revision rates (primary OA, uncemented THA)**

Below-average was defined as an 9-year/10-year revision rate of up to 66% of the group average (and upper bounds of the 95% confidence interval staying below the lower bound of the group average; and at least 25 cases at risk at 9 years/10 years). The dots indicate upper and lower limits.

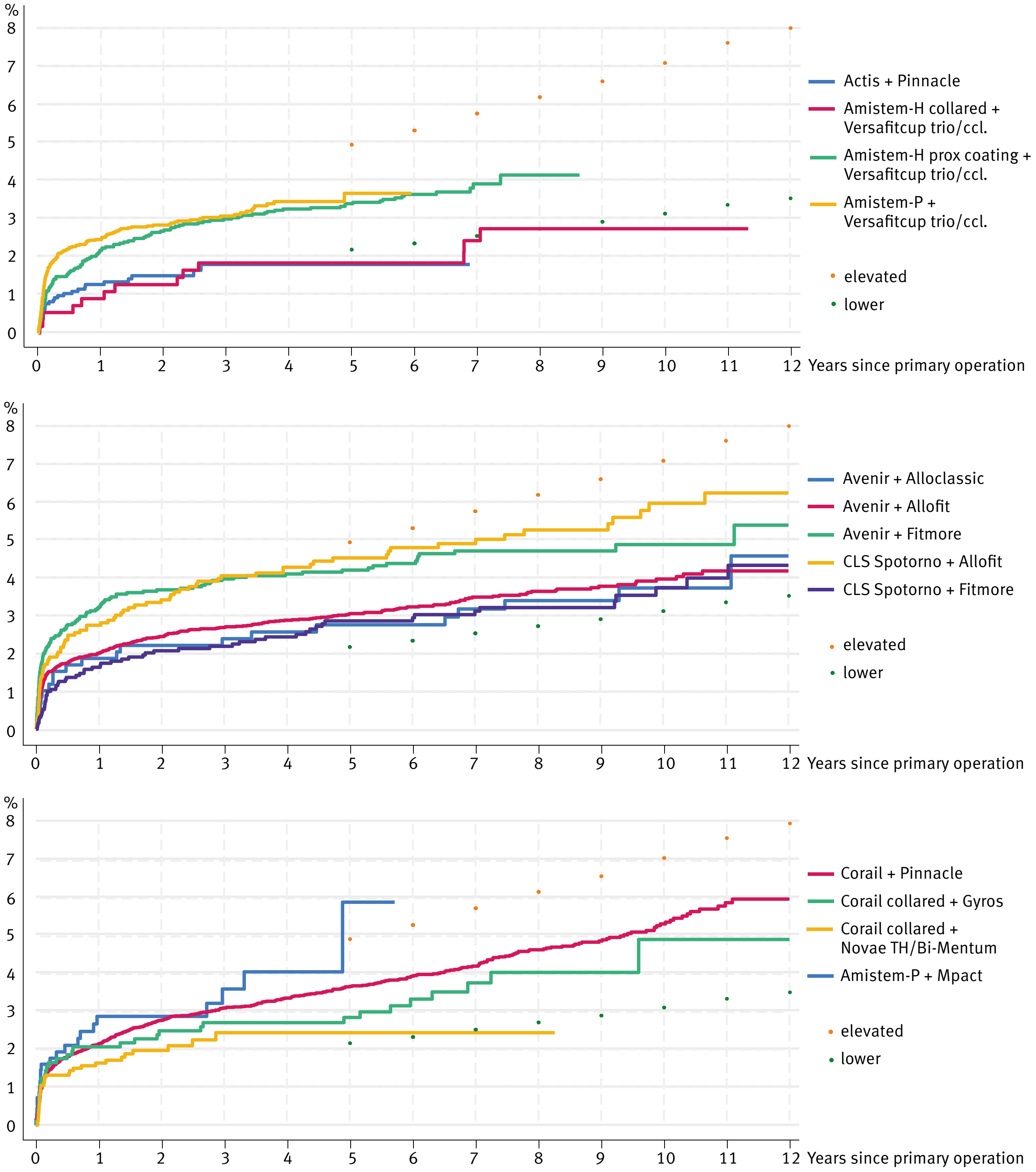


**Figure 4.28 – Part one**

All remaining implant combinations with average revision risks (primary OA, uncemented THA)

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively).

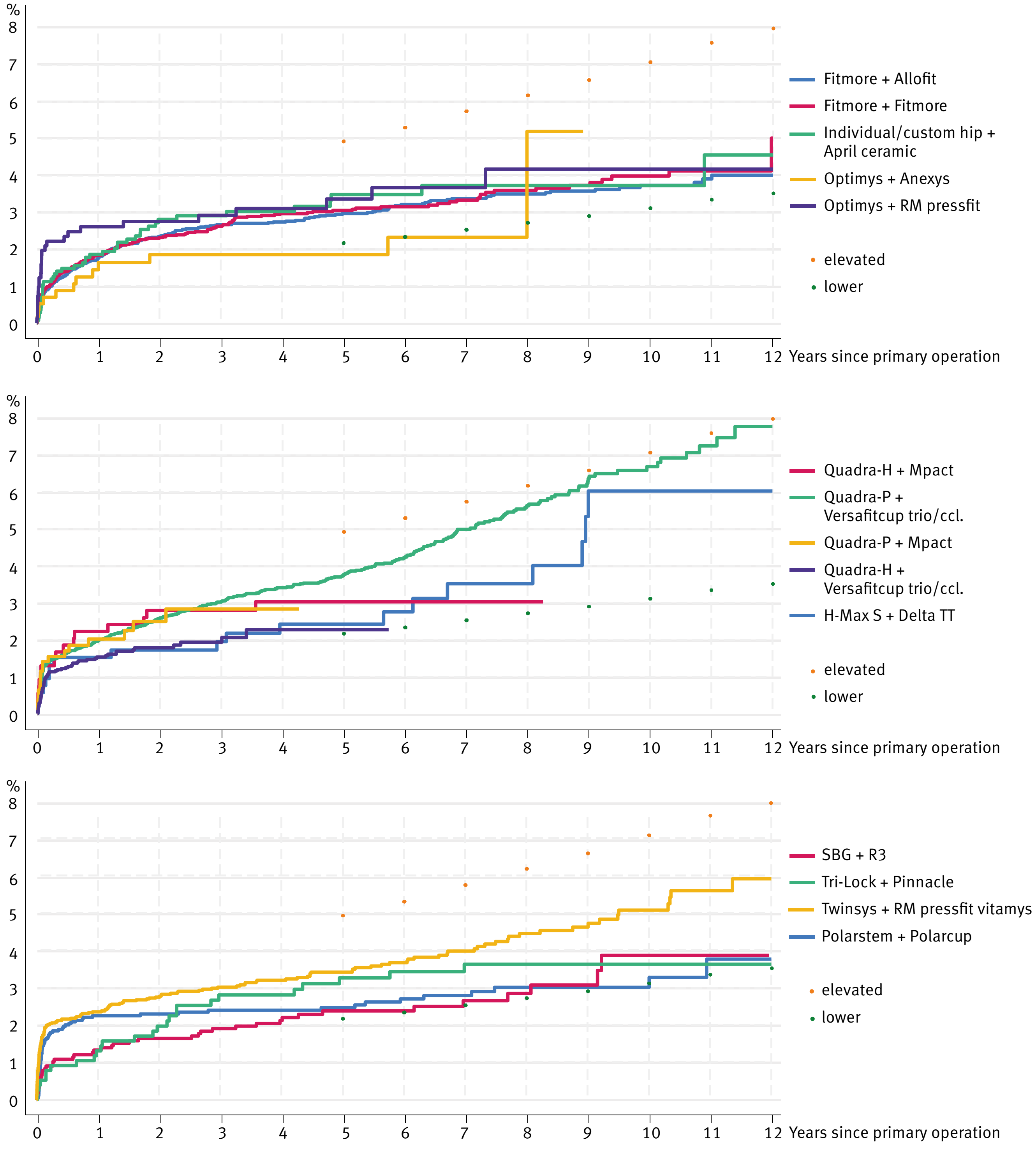


**Figure 4.28 – Part two**

**All remaining implant combinations with average revision risks (primary OA, uncemented THA)**

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively).

Most cup systems are modular allowing the use of different bearings. For the most commonly used 75% of implant combinations, the revision rates were calculated depending on the bearing surface. The results, sorted by implant combination, are shown in **Table 4.18.** Although there were differences between the various bearings, these did not reach statistical significance. Overall, the pattern is not uniform as shown by examples in which CoXLPE had more revisions than MoXLPE.

| Stem component | Cup component | Total N | Bearing surface | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 621 | CoC | 1.2 (0.6-2.5) | 1.5 (0.7-3.0) | 1.5 (0.7-3.0) | | |
| Actis | Pinnacle | 1,457 | CoXLPE | 1.3 (0.8-2.1) | 2.0 (1.2-3.1) | 2.0 (1.2-3.1) | | |
| Alloclassic | Fitmore | 681 | CoXLPE | 1.9 (1.1-3.3) | 3.8 (2.6-5.6) | 4.6 (3.3-6.5) | 5.9 (4.3-8.0) | 5.9 (4.3-8.0) |
| Amistem-H | Versafitcup trio/ccl. | 2,421 | CoC | 1.6 (1.1-2.2) | 2.8 (2.2-3.5) | 3.7 (3.0-4.5) | 5.7 (4.8-6.8) | 6.0 (5.0-7.2) |
| Amistem-H | Versafitcup trio/ccl. | 3,159 | CoXLPE | 1.5 (1.1-2.0) | 2.8 (2.3-3.4) | 3.9 (3.3-4.6) | 6.6 (5.7-7.6) | 7.7 (6.7-9.0) |
| Amistem-H | Versafitcup trio/ccl. | 1,292 | MoXLPE | 2.9 (2.1-3.9) | 4.1 (3.1-5.3) | 5.8 (4.7-7.3) | 9.5 (7.9-11.5) | 10.1 (8.3-12.3) |
| Amistem-H collared | Versafitcup trio/ccl. | 546 | CoC | 0.9 (0.4-2.2) | 1.9 (1.0-3.4) | 1.9 (1.0-3.4) | 2.8 (1.6-4.8) | |
| Amistem-H prox coating | Versafitcup trio/ccl. | 1,390 | CoC | 1.5 (1.0-2.3) | 2.2 (1.6-3.2) | 2.6 (1.9-3.6) | | |
| Amistem-H prox coating | Versafitcup trio/ccl. | 1,339 | CoXLPE | 2.7 (2.0-3.7) | 3.5 (2.6-4.6) | 3.8 (2.9-5.0) | | |
| Amistem-P | Versafitcup trio/ccl. | 3,087 | CoC | 1.8 (1.4-2.4) | 2.4 (1.9-3.0) | 2.7 (2.1-3.4) | | |
| Amistem-P | Versafitcup trio/ccl. | 2,420 | CoXLPE | 2.5 (1.9-3.2) | 3.0 (2.3-3.8) | 3.9 (2.9-5.4) | | |
| Amistem-P | Versafitcup trio/ccl. | 568 | MoXLPE | 5.3 (3.7-7.5) | 6.8 (4.9-9.5) | 7.3 (5.3-10.1) | | |
| Avenir | Allofit | 8,620 | CoXLPE | 1.8 (1.6-2.1) | 2.5 (2.1-2.8) | 2.8 (2.5-3.2) | 3.7 (3.2-4.2) | 3.9 (3.4-4.5) |
| Avenir | Allofit | 2,283 | MoXLPE | 2.3 (1.8-3.0) | 3.1 (2.5-3.9) | 3.3 (2.7-4.2) | 4.0 (3.2-5.1) | 4.3 (3.3-5.5) |
| Avenir | Fitmore | 2,080 | CoXLPE | 3.3 (2.6-4.1) | 3.9 (3.2-4.9) | 4.3 (3.5-5.3) | 5.0 (4.1-6.3) | 5.0 (4.1-6.3) |
| Avenir | Fitmore | 566 | MoXLPE | 2.7 (1.6-4.4) | 3.7 (2.5-5.7) | 3.7 (2.5-5.7) | 4.3 (2.9-6.4) | 5.8 (3.2-10.3) |
| CLS Spotorno | Allofit | 1,203 | CoXLPE | 3.2 (2.4-4.4) | 4.6 (3.6-6.0) | 5.0 (3.9-6.5) | 6.8 (5.3-8.8) | 7.4 (5.6-9.7) |
| CLS Spotorno | Fitmore | 932 | CoXLPE | 1.9 (1.2-3.1) | 2.5 (1.7-3.8) | 3.5 (2.5-5.0) | 4.1 (2.9-5.7) | 4.8 (3.2-7.2) |
| CLS Spotorno | Fitmore | 952 | MoXLPE | 1.4 (0.8-2.3) | 1.9 (1.2-3.0) | 2.3 (1.5-3.5) | 3.5 (2.2-5.4) | 4.0 (2.5-6.2) |
| Corail | Pinnacle | 1,859 | CoC | 2.1 (1.5-2.9) | 3.5 (2.7-4.4) | 4.4 (3.6-5.5) | 5.9 (4.8-7.3) | 6.8 (5.5-8.5) |
| Corail | Pinnacle | 10,557 | CoXLPE | 2.2 (1.9-2.5) | 3.1 (2.7-3.4) | 3.5 (3.1-3.9) | 5.1 (4.5-5.7) | 5.6 (4.9-6.4) |
| Corail | Pinnacle | 917 | MoXLPE | 1.9 (1.2-3.0) | 2.6 (1.7-3.9) | 3.0 (2.0-4.4) | 6.6 (4.5-9.4) | 7.9 (5.0-12.2) |
| Corail collared | Gyros | 816 | CoCPE | 2.1 (1.3-3.3) | 2.8 (1.9-4.2) | 3.0 (2.0-4.5) | 5.1 (3.1-8.2) | |
| Corail collared | Novae TH/Bi-Mentum | 1,554 | CoCPE | 1.8 (1.2-2.6) | 2.6 (1.8-3.8) | 2.6 (1.8-3.8) | | |
| Corail collared | Pinnacle | 2,283 | CoC | 1.9 (1.4-2.5) | 2.5 (1.9-3.3) | 3.0 (2.4-3.9) | 3.9 (2.9-5.3) | 3.9 (2.9-5.3) |
| Corail collared | Pinnacle | 14,002 | CoXLPE | 1.3 (1.1-1.5) | 1.8 (1.6-2.1) | 2.1 (1.9-2.4) | 2.8 (2.3-3.4) | 2.8 (2.3-3.4) |
| Exception | Avantage | 904 | CoXLPE | 3.5 (2.5-5.0) | 4.5 (3.3-6.0) | 5.3 (4.0-7.0) | 7.4 (5.7-9.6) | 9.0 (6.7-12.0) |

**Table 4.18 – Part one**

**Long term evaluation: Failure rates of primary total hip arthroplasty uncemented combinations and different bearing surfaces (primary OA)**

Time since operation, 2012–2024. Please note that if reported stem-cup combinations involve multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

| Stem component | Cup component | Total N | Bearing surface | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Fitmore | Allofit | 6,270 | CoXLPE | 1.5 (1.2-1.9) | 2.3 (2.0-2.8) | 2.6 (2.2-3.0) | 3.1 (2.7-3.7) | 3.5 (2.7-4.4) |
| Fitmore | Allofit | 2,340 | MoXLPE | 2.2 (1.7-2.9) | 3.2 (2.5-4.0) | 3.6 (2.9-4.5) | 4.3 (3.5-5.3) | 4.6 (3.7-5.7) |
| Fitmore | Fitmore | 3,108 | CoXLPE | 1.6 (1.2-2.2) | 2.2 (1.7-2.8) | 2.9 (2.3-3.6) | 3.3 (2.5-4.2) | 3.3 (2.5-4.2) |
| Fitmore | Fitmore | 3,044 | MoXLPE | 2.0 (1.6-2.6) | 3.0 (2.5-3.7) | 3.3 (2.7-4.0) | 4.4 (3.6-5.4) | 5.7 (3.8-8.5) |
| Fitmore | RM pressfit vitamys | 1,545 | CoXLPE | 1.1 (0.7-1.7) | 1.5 (1.0-2.3) | 1.6 (1.1-2.5) | 2.2 (1.2-3.8) | |
| Individual/custom hip | April ceramic | 1,410 | CoC | 1.8 (1.2-2.7) | 2.9 (2.1-4.0) | 3.5 (2.5-4.7) | 3.7 (2.7-5.1) | 4.6 (2.9-7.1) |
| Optimys | RM pressfit vitamys | 24,054 | CoXLPE | 1.8 (1.7-2.0) | 2.3 (2.1-2.5) | 2.5 (2.2-2.7) | 2.8 (2.5-3.1) | 2.8 (2.5-3.1) |
| Optimys | RM pressfit | 662 | CoCPE | 1.7 (0.9-3.0) | 1.9 (1.1-3.3) | 2.4 (1.4-4.1) | 3.3 (1.9-5.7) | |
| Polarstem | Polarcup | 1,351 | CMoXLPE | 2.4 (1.7-3.4) | 2.5 (1.8-3.5) | 2.5 (1.8-3.5) | | |
| Polarstem | Polarcup | 862 | CoXLPE | 2.2 (1.4-3.4) | 2.5 (1.6-3.7) | 2.6 (1.7-3.9) | 3.2 (2.2-4.7) | 4.1 (2.7-6.3) |
| Polarstem | R3 | 6,165 | CMoXLPE | 0.9 (0.7-1.1) | 1.4 (1.1-1.8) | 1.7 (1.4-2.2) | 2.4 (1.7-3.3) | |
| Polarstem | R3 | 2,837 | CoXLPE | 1.8 (1.3-2.3) | 2.2 (1.7-2.8) | 2.4 (1.9-3.1) | 2.9 (2.3-3.7) | 3.1 (2.4-4.0) |
| Quadra-H | Versafitcup trio/ccl. | 1,130 | CoC | 1.5 (0.9-2.4) | 2.3 (1.6-3.4) | 2.8 (2.0-4.0) | 4.4 (3.1-6.3) | |
| Quadra-H | Versafitcup trio/ccl. | 4,509 | CoXLPE | 2.1 (1.7-2.6) | 3.2 (2.7-3.8) | 4.0 (3.5-4.6) | 7.2 (6.2-8.5) | 8.6 (7.0-10.5) |
| Quadra-H | Versafitcup trio/ccl. | 1,429 | MoXLPE | 2.2 (1.6-3.2) | 3.0 (2.3-4.1) | 3.8 (2.9-5.0) | 6.5 (5.1-8.2) | 6.9 (5.3-8.9) |
| Quadra-P | Versafitcup trio/ccl. | 994 | CoC | 1.4 (0.8-2.4) | 2.2 (1.3-3.7) | 2.2 (1.3-3.7) | | |
| Quadra-P | Versafitcup trio/ccl. | 2,711 | CoXLPE | 1.6 (1.2-2.1) | 1.8 (1.3-2.4) | 2.1 (1.4-3.1) | | |
| SBG | R3 | 778 | CMoXLPE | 1.3 (0.7-2.4) | 2.2 (1.4-3.6) | 3.0 (2.0-4.6) | 3.7 (2.3-5.9) | |
| SBG | R3 | 857 | CoC | 1.4 (0.8-2.5) | 1.7 (1.0-2.8) | 1.8 (1.1-3.1) | 4.5 (2.4-8.4) | |
| SL-plus MIA | EP-fit | 572 | CoC | 2.8 (1.7-4.5) | 2.8 (1.7-4.5) | 3.0 (1.9-4.8) | 3.4 (2.1-5.5) | 3.4 (2.1-5.5) |
| SL-plus MIA | R3 | 1,981 | CMoXLPE | 1.0 (0.7-1.6) | 1.3 (0.9-2.0) | 1.5 (1.0-2.1) | 2.2 (1.5-3.1) | 2.4 (1.6-3.5) |
| SPS evolution | April ceramic | 1,694 | CoC | 5.0 (4.1-6.2) | 6.5 (5.4-7.8) | 6.8 (5.7-8.2) | 7.3 (6.1-8.8) | 7.8 (6.3-9.6) |
| Tri-Lock | Pinnacle | 737 | CoXLPE | 1.1 (0.5-2.2) | 1.9 (1.1-3.2) | 2.4 (1.5-3.8) | 2.8 (1.8-4.3) | 2.8 (1.8-4.3) |
| Twinsys | RM pressfit vitamys | 4,920 | CoXLPE | 2.3 (2.0-2.8) | 3.0 (2.5-3.5) | 3.4 (2.9-4.0) | 5.1 (4.3-6.0) | 5.9 (4.8-7.3) |

**Table 4.18 – Part two**

### Long term evaluation: Failure rates of primary total hip arthroplasty uncemented combinations and different bearing surfaces (primary OA)

Time since operation, 2012–2024. Please note that if reported stem-cup combinations involve multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

### Hybrid combinations for primary OA

There were 23 hybrid implant combinations, indicating an uncemented cup combined with a cemented stem, covering 75% of all primary THA for primary OA **(Table 4.19).** The combinations are based on eleven stems which were combined with twelve different cups. At 12 years, the average revision rate for all hybrid stem/cup combinations was 4.9% (CI 4.5– 5.4%) **(Table 4.20).**

| Stem component | Cup component | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019-2024 |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | Mpact | 26 | 31 | 15 | 20 | 22 | 37 | **151** |
| Amistem-C | Versafitcup DM | 29 | 28 | 27 | 24 | 44 | 49 | **201** |
| Amistem-C | Versafitcup trio/ccl. | 206 | 160 | 181 | 191 | 163 | 183 | **1,084** |
| Avenir (cem) | Allofit | 100 | 95 | 94 | 96 | 103 | 197 | **685** |
| Avenir (cem) | Fitmore | 53 | 53 | 77 | 132 | 111 | 13 | **439** |
| Centris | RM pressfit vitamys | 32 | 56 | 65 | 0 | 0 | 0 | **153** |
| Corail (cem) | Novae TH/Bi-Mentum | 1 | 14 | 41 | 74 | 96 | 104 | **330** |
| Corail (cem) | Pinnacle | 130 | 151 | 170 | 189 | 232 | 232 | **1,104** |
| Exeter V40 | Symbol DMHA/DS evol. | 0 | 0 | 25 | 38 | 40 | 22 | **125** |
| MS-30 | Allofit | 48 | 43 | 66 | 235 | 224 | 215 | **831** |
| MS-30 | Fitmore | 71 | 56 | 16 | 32 | 35 | 11 | **221** |
| Original Mueller | Fitmore | 30 | 20 | 19 | 5 | 16 | 0 | **90** |
| Polarstem (cem) | Polarcup | 10 | 15 | 18 | 18 | 23 | 15 | **99** |
| Quadra-C | Versafitcup trio/ccl. | 211 | 155 | 80 | 13 | 1 | 0 | **460** |
| Quadra-P (cem) | Versafitcup DM | 0 | 1 | 11 | 20 | 28 | 38 | **98** |
| Quadra-P (cem) | Versafitcup trio/ccl. | 0 | 10 | 49 | 71 | 87 | 65 | **282** |
| Twinsys (cem) | RM pressfit | 18 | 19 | 34 | 13 | 10 | 8 | **102** |
| Twinsys (cem) | RM pressfit vitamys | 198 | 199 | 283 | 317 | 417 | 526 | **1,940** |
| Twinsys (cem) | Symbol DMHA/DS evol. | 12 | 20 | 14 | 31 | 19 | 27 | **123** |
| Weber | Allofit | 49 | 38 | 31 | 30 | 29 | 23 | **200** |
| Weber | Fitmore | 180 | 162 | 148 | 104 | 39 | 9 | **642** |
| other combinations | - | 539 | 429 | 497 | 483 | 580 | 692 | **3,220** |
| **Total** | | **1,943** | **1,755** | **1,961** | **2,136** | **2,319** | **2,466** | **12,580** |

**Table 4.19**
Top 75% of primary total hip arthroplasty hybrid combinations (primary OA) 2019 – 2024

There were no combinations with elevated mid-term revision rates, nor outliers, to be observed. Two implant combinations (Corail [cem]/Pinnacle and MS-30/Allofit) had a below-average long-term revision rate **(Figure 4.29).** All remaining implants were within the upper and lower limits **(Figures 4.30).** Some curves did run below the lower limit but were not implant combinations with below-average long-term revision rates because their confidence intervals were wide due to small numbers and overlapping with the reference group and therefore were not statistically different.

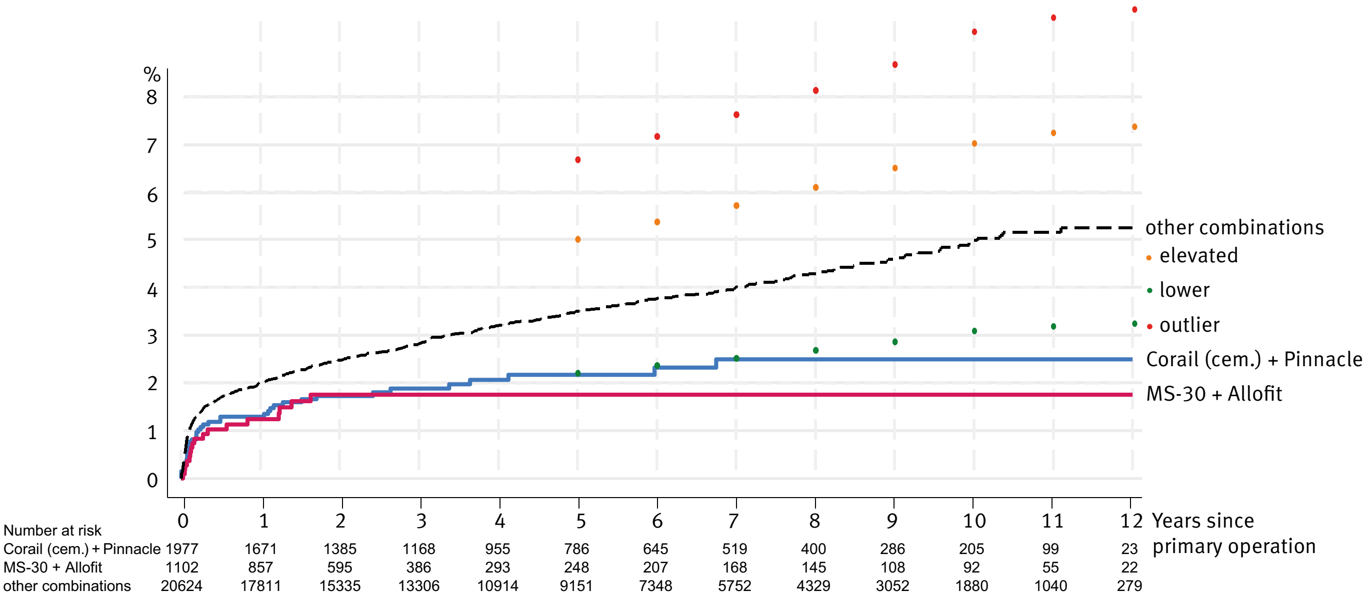
| Stem component | Cup component | Total N | CCS* | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---:|---:|---|---|---|---|---|
| Amistem-C | Versafitcup trio/ccl. | 2,530 | 21 | 2.5 (2.0-3.2) | 3.1 (2.5-3.9) | 3.7 (3.0-4.5) | 5.4 (4.3-6.8) | 5.4 (4.3-6.8) |
| Avenir (cem) | Allofit | 985 | 18 | 1.7 (1.1-2.8) | 2.5 (1.6-3.8) | 3.2 (2.1-4.9) | | |
| Avenir (cem) | Fitmore | 501 | 58 | 2.0 (1.1-3.7) | 3.0 (1.8-5.0) | 3.0 (1.8-5.0) | | |
| Corail (cem) | Pinnacle | 1,977 | 16 | 1.3 (0.9-1.9) | 1.9 (1.3-2.6) | 2.2 (1.6-3.0) | 2.5 (1.8-3.5) | 2.5 (1.8-3.5) |
| MS-30 | Allofit | 1,102 | 50 | 1.2 (0.7-2.1) | 1.8 (1.1-2.8) | 1.8 (1.1-2.8) | 1.8 (1.1-2.8) | 1.8 (1.1-2.8) |
| MS-30 | Fitmore | 863 | 52 | 1.3 (0.7-2.3) | 1.7 (1.0-2.8) | 1.8 (1.1-3.0) | 3.0 (1.8-5.0) | 3.0 (1.8-5.0) |
| Quadra-C | Versafitcup trio/ccl. | 1,051 | 32 | 2.5 (1.7-3.6) | 3.3 (2.4-4.6) | 4.0 (2.9-5.4) | 7.5 (3.7-14.9) | |
| Twinsys (cem) | RM pressfit vitamys | 2,366 | 19 | 1.1 (0.7-1.6) | 1.6 (1.1-2.2) | 2.6 (1.8-3.7) | 2.8 (1.9-4.1) | |
| Weber | Allofit | 804 | 27 | 1.9 (1.1-3.1) | 3.0 (2.0-4.5) | 3.5 (2.4-5.1) | 5.6 (3.8-8.3) | 6.4 (4.2-9.6) |
| Weber | Fitmore | 2,416 | 28 | 1.6 (1.2-2.2) | 2.6 (2.0-3.3) | 3.5 (2.8-4.4) | 5.7 (4.6-7.2) | 6.3 (5.0-8.0) |
| other combinations | - | 9,108 | | 2.2 (1.9-2.5) | 3.1 (2.8-3.6) | 3.9 (3.4-4.3) | 4.9 (4.3-5.6) | 5.1 (4.5-5.9) |
| **CH average for group** | | | | **1.9 (1.7-2.1)** | **2.7 (2.5-2.9)** | **3.3 (3.1-3.6)** | **4.7 (4.3-5.1)** | **4.9 (4.5-5.4)** |

**Table 4.20**

**Long term evaluation: Failure rates of primary total hip arthroplasty hybrid combinations (primary OA)**

Time since operation, 2012–2024. Please note that if reported stem-cup combinations involve multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

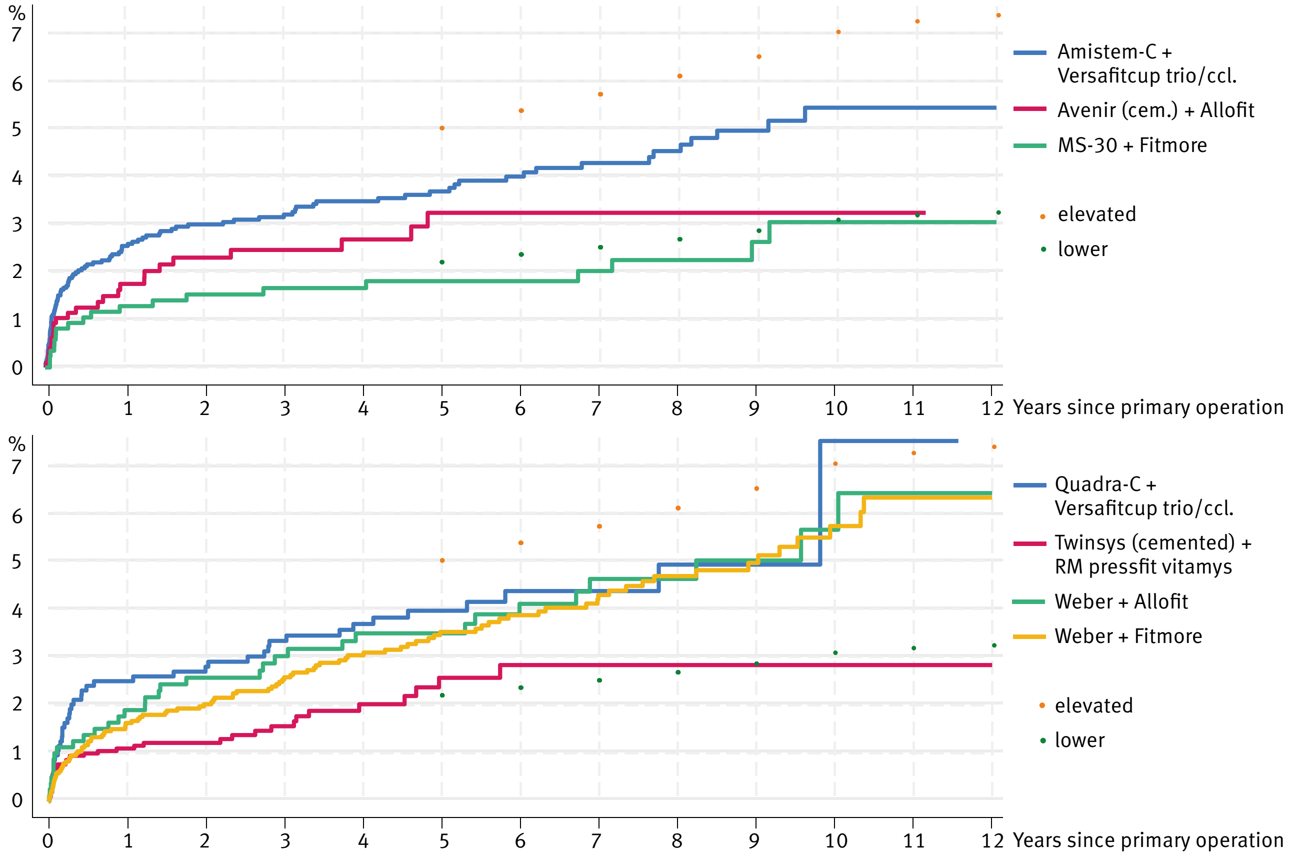


| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Corail (cem.) + Pinnacle | 1977 | 1671 | 1385 | 1168 | 955 | 786 | 645 | 519 | 400 | 286 | 205 | 99 | 23 |
| MS-30 + Allofit | 1102 | 857 | 595 | 386 | 293 | 248 | 207 | 168 | 145 | 108 | 92 | 55 | 22 |
| other combinations | 20624 | 17811 | 15335 | 13306 | 10914 | 9151 | 7348 | 5752 | 4329 | 3052 | 1880 | 1040 | 279 |

**Figure 4.29**

**Implant combinations with below-average long-term revision rates (primary OA, hybrid THA)**

Below-average was defined as an 9-year/10-year revision rate of up to 66% of the group average (and upper bounds of the 95% confidence interval staying below the lower bound of the group average; and at least 25 cases at risk at 9 years/10 years). The dots indicate upper and lower limits.



**Figures 4.30**

**All remaining implant combinations with average revision risks (primary OA, hybrid fixation THA)**

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively).

### Uncemented combinations for secondary OA

**Table 4.21** shows the 17 implant combinations that cover 75% of all uncemented THA performed for secondary OA and their use over the last 5 years. The 12-year revision rates for the period since 2012 was 7.0% (CI 6.4 – 7.7%) **(Table 4.22),** being significantly higher than the revision rates observed for uncemented and hybrid THA performed for primary OA, this illustrates the importance of coding the underlying diagnosis correctly for proper analysis of the results.

| Stem component | Cup component | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 9 | 15 | 36 | 69 | 71 | 84 | **284** |
| Amistem-P | Versafitcup trio/ccl. | 41 | 111 | 117 | 98 | 78 | 78 | **523** |
| Avenir | Allofit | 90 | 101 | 54 | 67 | 62 | 58 | **432** |
| Avenir complete | G7 hemispherical | 0 | 0 | 4 | 31 | 27 | 31 | **93** |
| Corail | Pinnacle | 77 | 73 | 99 | 62 | 55 | 43 | **409** |
| Corail collared | Novae TH/Bi-Mentum | 6 | 17 | 40 | 40 | 57 | 69 | **229** |
| Corail collared | Pinnacle | 107 | 128 | 211 | 266 | 215 | 234 | **1,161** |
| Fitmore | Allofit | 123 | 131 | 173 | 179 | 163 | 176 | **945** |
| Fitmore | Fitmore | 58 | 53 | 38 | 46 | 52 | 12 | **259** |
| Fitmore | RM pressfit vitamys | 11 | 33 | 23 | 23 | 16 | 12 | **118** |
| Individual/custom hip | April ceramic | 21 | 18 | 35 | 23 | 29 | 30 | **156** |
| Optimys | RM pressfit vitamys | 145 | 179 | 218 | 266 | 295 | 339 | **1,442** |
| Polarstem | Polarcup | 19 | 30 | 29 | 46 | 37 | 33 | **194** |
| Polarstem | R3 | 74 | 89 | 89 | 91 | 99 | 143 | **585** |
| Quadra-H | Versafitcup trio/ccl. | 70 | 53 | 43 | 12 | 1 | 0 | **179** |
| Quadra-P | Versafitcup trio/ccl. | 2 | 21 | 43 | 100 | 130 | 148 | **444** |
| Twinsys | RM pressfit vitamys | 26 | 33 | 40 | 37 | 39 | 43 | **218** |
| other combinations | - | 467 | 401 | 385 | 393 | 375 | 466 | **2,487** |
| **Total** | | **1,346** | **1,486** | **1,677** | **1,849** | **1,801** | **1,999** | **10,158** |

**Table 4.21**
Top 75% of primary total hip arthroplasty uncemented combinations (secondary OA) 2019– 2024

Although there were no outliers at 12 years, one combination (Quadra-H/Versafitcup Trio/ccl.) continued to have an elevated long-term revision rate **(Figure 4.31).** There was one combination (Fitmore/Allofit) showing a below-average long-term revision rate until 12 years **(Figure 4.32). Figures 4.33** show the results of the implant combination with average revision risk.

| Stem component | Cup component | Total N | CCS* | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Amistem-H | Versafitcup trio/ccl. | 557 | 14 | 1.8 (1.0-3.3) | 2.6 (1.5-4.3) | 3.8 (2.5-5.8) | 8.0 (5.8-11.1) | 10.4 (7.5-14.4) |
| Amistem-P | Versafitcup trio/ccl. | 524 | 17 | 3.5 (2.2-5.5) | 4.0 (2.6-6.1) | 4.0 (2.6-6.1) | | |
| Avenir | Allofit | 868 | 13 | 3.5 (2.5-5.0) | 4.5 (3.3-6.2) | 4.9 (3.6-6.6) | 5.4 (3.9-7.3) | 5.4 (3.9-7.3) |
| Corail | Pinnacle | 966 | 11 | 2.8 (1.9-4.1) | 3.9 (2.8-5.3) | 4.5 (3.3-6.1) | 7.4 (5.3-10.2) | 8.3 (5.8-11.8) |
| Corail collared | Pinnacle | 1,647 | 29 | 2.1 (1.5-3.0) | 3.2 (2.4-4.2) | 3.7 (2.8-5.0) | 4.3 (3.0-6.0) | 4.3 (3.0-6.0) |
| Fitmore | Allofit | 1,681 | 88 | 1.5 (1.0-2.2) | 2.5 (1.8-3.4) | 2.6 (1.9-3.5) | 4.0 (2.7-5.8) | 4.0 (2.7-5.8) |
| Optimys | RM pressfit vitamys | 2,028 | 18 | 2.5 (1.9-3.3) | 3.2 (2.5-4.1) | 3.7 (2.9-4.8) | 4.6 (3.5-6.1) | |
| Polarstem | R3 | 945 | 79 | 2.2 (1.4-3.3) | 3.0 (2.1-4.5) | 3.3 (2.2-4.8) | 4.5 (3.0-6.9) | 4.5 (3.0-6.9) |
| Quadra-H | Versafitcup trio/ccl. | 604 | 26 | 3.5 (2.3-5.3) | 5.2 (3.7-7.4) | 7.8 (5.8-10.4) | 10.3 (7.5-13.9) | 12.9 (8.9-18.5) |
| other combinations | - | 7747 | | 3.5 (3.1-3.9) | 4.6 (4.2-5.2) | 5.4 (4.9-6.0) | 7.2 (6.4-8.0) | 7.2 (6.4-8.0) |
| **CH average for group** | | | | **2.9 (2.7-3.2)** | **3.9 (3.7-4.3)** | **4.6 (4.3-5.0)** | **6.5 (6.0-7.1)** | **7.0 (6.4-7.7)** |

**Table 4.22**

**Long term evaluation: Failure rates of primary total hip arthroplasty uncemented combinations (secondary OA)**

Time since operation, 2012–2024. Please note that if reported stem-cup combinations involve multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

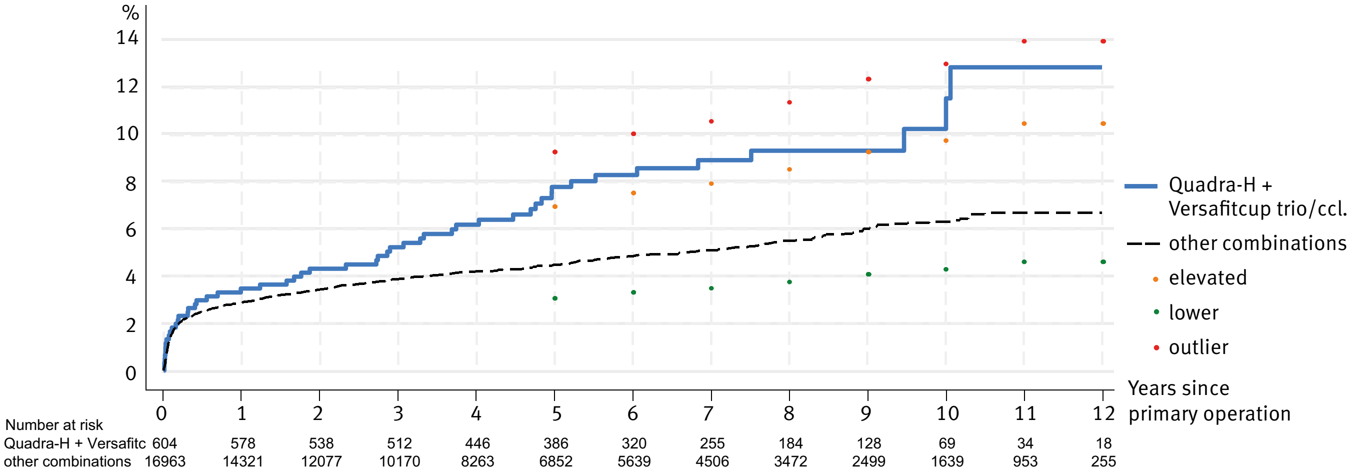


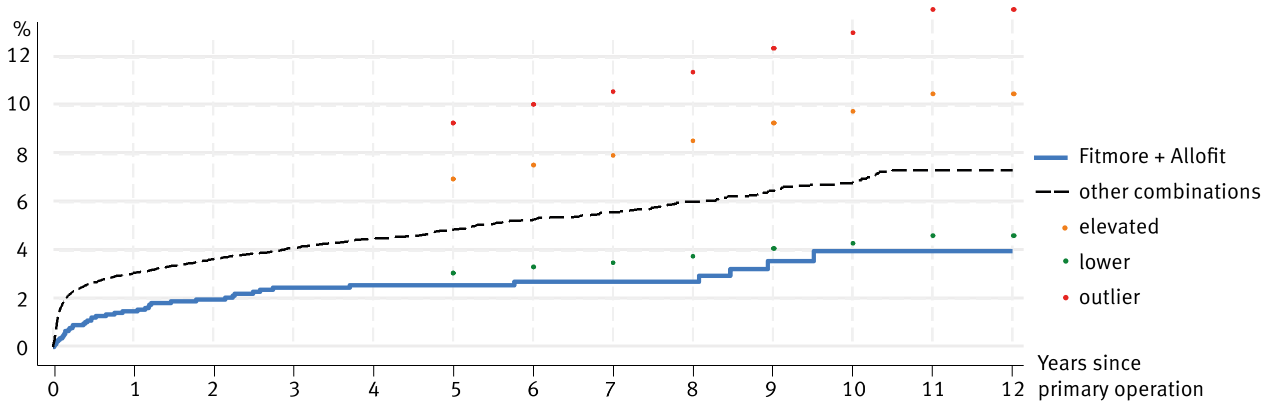
**Figure 4.31**

**Implant combinations with elevated long-term revision rates (secondary OA, uncemented THA)**

An elevated revision rate was defined as a deviation of at least 50% above the group average at any time between year 5 and year 12 (and lower bounds of the 95% confidence interval exceeding the upper bound of the group average; and at least 50 cases at risk at 5 years). The dots indicate upper and lower limits.

## Hybrid and cemented combinations for secondary OA

Because of the relatively small numbers entered in the database, the data for all cemented and hybrid fixations for secondary OA are not presented, while the results for THA used to treat fractures are presented in **Chapter 4.7**.

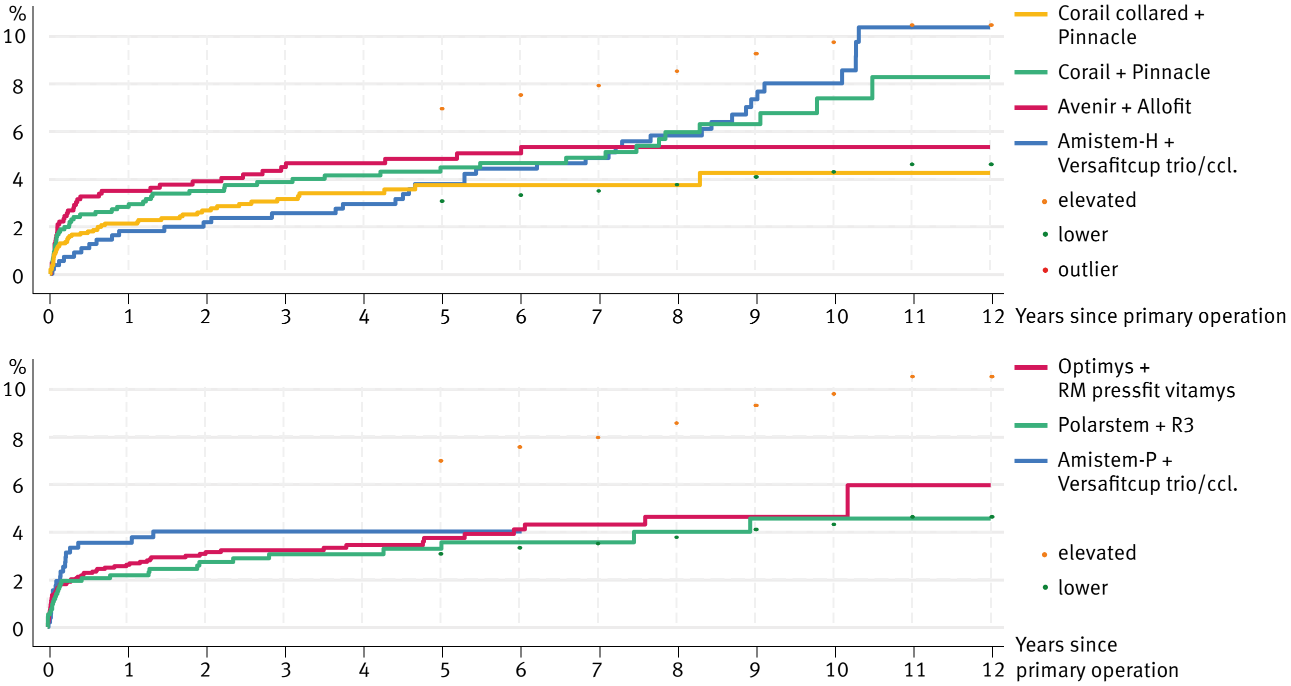


| Number at risk | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fitmore + Allofit | 1681 | 1467 | 1280 | 1083 | 883 | 758 | 633 | 512 | 402 | 284 | 195 | 119 | 43 |
| other combinations | 15886 | 13432 | 11335 | 9599 | 7826 | 6480 | 5326 | 4249 | 3254 | 2343 | 1513 | 868 | 230 |

**Figure 4.32**

**Implant combinations with below-average long-term revision rates (secondary OA, uncemented THA)**

Below-average was defined as an 9-year/10-year revision rate of up to 66% of the group average (and upper bounds of the 95% confidence interval staying below the lower bound of the group average; and at least 25 cases at risk at 9 years/10 years). The dots indicate upper and lower limits.



**Figures 4.33**

**All remaining implant combinations with average revision risks (secondary OA, uncemented THA)**

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively).

## 4.4.2 Two-year revision rates

The 2-year revision rate is an important time point for gathering initial results about the early performance of an implant, especially since most early complications occur within the first 3 months after surgery. The average revision rate is calculated for the moving 4-year window period from 01.01.2019 to 31.12.2022. Due to the moving 4-year window for the analysis of the 2-year revision rates, some results may differ from those reported in 2023.

### Uncemented combinations for primary OA

A total of 60,853 uncemented THA had been performed during the period of interest for primary OA. Compared to the previous observation period, the average revision rate has improved from 2.5% (CI 2.4 – 2.6%) to 2.4% (CI 2.3 – 2.5%). **Table 4.23** shows the 2-year revision rates of all uncemented implant combinations used more than 50 times for primary OA, representing 96% of all combinations. Overall, 346 implant combinations were used in less than 50 cases during the current 4-year observation period. Eight stem/cup combinations were identified as potential outliers and were further analysed following the protocol in Chapter 2 Methods and presented in the outlier watchlist at the end of this report. Compared to the previous report, two combinations disappeared from the list of outliers, four remained and four implant combinations were newly identified as outliers. GTS/G7 bispherical, a previous outlier, is not in use anymore. Polarstem/EP-fit was a potential outlier in 2023 but was already improving. It continued to improve and is no outlier anymore. SPS Evolution/April ceramic turned out to be outliers four years in a row, but the results are slightly improving. Symbol/Symbol DMHA/DS evol. identifies for the third year in a row as outlier but has improved. The combination Nanos/R3 is a second-time outlier, however with a worsening revision rate. First time outliers are CLS Spotorno/Allofit, Exception/Avantage, SPS Evolution/April poly and Twinsys/RM pressfit. A detailed assessment of the outliers is presented in the outlier watch list at page 192.

**Figure 4.34** shows the alphabetical list of stem/cup combinations with respect to the group average and outlier boundary, being twice the value of the group average of 2.4%.

### Hybrid combinations for primary OA

A total of 7,742 hybrid THA had been performed for primary OA within the moving 4-year window period from 01.01.2019 to 31.12.2022. The average 2-year revision rate improved by 0.1% to 2.5% (CI 2.2 – 2.9%) **(Figure 4.35).** There were no outliers regarding the short-term revision rates detected in the current period of observation.

### Uncemented combinations for secondary OA

A total of 6,349 uncemented THA had been performed for secondary OA within the current moving 4-year window period. The average 2-year revision rate was 3.6% (CI 3.2–4.1%) **(Figure 4.36).** None of the implant combinations were considered to be outliers. There was one implant combination (Fitmore/Allofit) with a below average revision rate **(Figure 4.32).**

| Stem component | Cup component | CCS* | at risk N** | N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Accolade II | Trident II | 32 | 130 | 8 | 6.2 (3.1-12.0) |
| Actis | Pinnacle | 33 | 932 | 11 | 1.2 (0.7-2.1) |
| Alloclassic | Allofit | 80 | 85 | 1 | 1.2 (0.2-8.2) |
| Alloclassic | Fitmore | 66 | 50 | 0 | 0.0 (.-.) |
| Amistem-H collared | Versafitcup trio/ccl. | 100 | 68 | 0 | 0.0 (.-.) |
| Amistem-H prox coating | Mpact | 31 | 121 | 3 | 2.5 (0.8-7.6) |
| Amistem-H prox coating | Versafitcup trio/ccl. | 17 | 935 | 30 | 3.2 (2.3-4.6) |
| Amistem-P | Mpact | 39 | 385 | 11 | 2.9 (1.6-5.1) |
| Amistem-P | Versafitcup DM | 27 | 106 | 3 | 2.8 (0.9-8.6) |
| Amistem-P | Versafitcup trio/ccl. | 15 | 4,008 | 107 | 2.7 (2.2-3.2) |
| Ana.Nova alpha proxy | Ana.Nova alpha | 96 | 153 | 2 | 1.3 (0.3-5.1) |
| Avenir | Allofit | 15 | 3,516 | 83 | 2.4 (1.9-2.9) |
| Avenir | Avantage | 17 | 77 | 1 | 1.3 (0.2-8.9) |
| Avenir | Fitmore | 27 | 841 | 37 | 4.4 (3.2-6.0) |
| Avenir | G7 DM hemispherical | 72 | 60 | 0 | 0.0 (.-.) |
| Avenir | G7 hemispherical | 32 | 60 | 3 | 5.2 (1.7-15.3) |
| Avenir complete | Allofit | 50 | 126 | 4 | 3.2 (1.2-8.3) |
| Avenir complete | G7 DM hemispherical | 83 | 76 | 2 | 2.7 (0.7-10.3) |
| Avenir complete | G7 hemispherical | 37 | 75 | 3 | 4.0 (1.3-11.9) |
| CLS Spotorno | Allofit | 44 | 273 | 14 | 5.1 (3.1-8.5) |
| CLS Spotorno | Fitmore | 35 | 470 | 7 | 1.5 (0.7-3.1) |
| Corail | Fitmore | 97 | 208 | 3 | 1.4 (0.5-4.4) |
| Corail | Pinnacle | 17 | 4,451 | 129 | 2.9 (2.5-3.5) |
| Corail collared | Fitmore | 87 | 111 | 2 | 1.8 (0.5-7.0) |
| Corail collared | Gyros | 54 | 276 | 8 | 2.9 (1.5-5.7) |
| Corail collared | Novae TH/Bi-Mentum | 31 | 842 | 19 | 2.3 (1.5-3.6) |
| Corail collared | Pinnacle | 22 | 7,311 | 121 | 1.7 (1.4-2.0) |
| Corail collared | RM pressfit vitamys | 64 | 70 | 0 | 0.0 (.-.) |
| Corehip | Plasmafit | 78 | 198 | 1 | 0.5 (0.1-3.6) |
| Exacta | Jump system/JS traser | 87 | 163 | 4 | 2.5 (0.9-6.4) |
| Exacta S | Jump system/JS traser | 52 | 202 | 6 | 3.0 (1.4-6.5) |
| Exception | Allofit | 46 | 92 | 1 | 1.1 (0.2-7.5) |
| Exception | Avantage | 70 | 304 | 16 | 5.3 (3.3-8.5) |

**Table 4.23 – Part one**

**2-year evaluation: Revision rates of uncemented primary total hip arthroplasty combinations within 24 months (primary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

| Stem component | Cup component | CCS* | at risk N** | Revised | |
|---|---|---|---|---|---|
| | | | | N | % (95% CI)*** |
| Exception | Exceed | 100 | 63 | 2 | 3.2 (0.8-12.1) |
| Expersus | Primaro | 99 | 73 | 2 | 2.7 (0.7-10.5) |
| Fitmore | Allofit | 77 | 2,386 | 33 | 1.4 (1.0-1.9) |
| Fitmore | Fitmore | 37 | 2,450 | 52 | 2.1 (1.6-2.8) |
| Fitmore | G7 hemispherical | 55 | 64 | 2 | 3.2 (0.8-12.0) |
| Fitmore | RM pressfit vitamys | 91 | 565 | 6 | 1.1 (0.5-2.4) |
| H-Max S | Delta TT | 35 | 160 | 1 | 0.6 (0.1-4.4) |
| H-Max S | Symbol DMHA/DS evol. | 85 | 106 | 4 | 3.8 (1.5-9.9) |
| Harmony | April ceramic | 40 | 52 | 3 | 5.8 (1.9-16.8) |
| Individual/custom hip | April ceramic | 28 | 585 | 12 | 2.1 (1.2-3.6) |
| Individual/custom hip | Pinnacle | 53 | 120 | 2 | 1.7 (0.4-6.5) |
| LCU Hip system | Mobilelink acetabular Cup system | 80 | 169 | 8 | 4.8 (2.4-9.3) |
| Metafix | Trinity | 73 | 215 | 7 | 3.3 (1.6-6.7) |
| Minimax | Versafitcup trio/ccl. | 47 | 144 | 5 | 3.5 (1.5-8.1) |
| Nanos | R3 | 46 | 89 | 7 | 8.0 (3.9-16.0) |
| Optimys | Anexys | 24 | 225 | 7 | 3.1 (1.5-6.5) |
| Optimys | RM pressfit | 18 | 297 | 13 | 4.4 (2.6-7.5) |
| Optimys | RM pressfit vitamys | 8 | 9,485 | 202 | 2.1 (1.9-2.5) |
| Optimys | Symbol DMHA/DS evol. | 61 | 157 | 2 | 1.3 (0.3-5.0) |
| Optimys | Trident II | 92 | 152 | 2 | 1.3 (0.3-5.2) |
| Polarstem | EP-fit | 94 | 329 | 13 | 4.0 (2.3-6.7) |
| Polarstem | HI | 96 | 57 | 0 | 0.0 (.-.) |
| Polarstem | Novae TH/Bi-Mentum | 100 | 66 | 4 | 6.1 (2.3-15.4) |
| Polarstem | Polarcup | 58 | 788 | 15 | 1.9 (1.2-3.2) |
| Polarstem | R3 | 52 | 3,197 | 49 | 1.5 (1.2-2.0) |
| Quadra-H | Allofit | 100 | 50 | 2 | 4.0 (1.0-15.1) |
| Quadra-H | Mpact | 36 | 410 | 9 | 2.2 (1.2-4.2) |
| Quadra-H | Versafitcup DM | 48 | 132 | 3 | 2.3 (0.7-6.9) |
| Quadra-H | Versafitcup trio/ccl. | 18 | 2,399 | 74 | 3.1 (2.5-3.9) |
| Quadra-P | Mpact | 72 | 321 | 5 | 1.6 (0.7-3.7) |
| Quadra-P | Versafitcup DM | 61 | 97 | 3 | 3.1 (1.0-9.3) |
| Quadra-P | Versafitcup trio/ccl. | 27 | 1,714 | 25 | 1.5 (1.0-2.2) |

**Table 4.23 – Part two**

**2-year evaluation: Revision rates of uncemented primary total hip arthroplasty combinations within 24 months (primary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

| Stem component | Cup component | CCS* | at risk N** | N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| SBG | R3 | 42 | 633 | 10 | 1.6 (0.9-2.9) |
| SBG | Xentrax | 100 | 71 | 1 | 1.4 (0.2-9.6) |
| SL-plus | HI | 100 | 93 | 2 | 2.2 (0.5-8.3) |
| SL-plus MIA | EP-fit | 47 | 222 | 4 | 1.8 (0.7-4.7) |
| SL-plus MIA | HI | 39 | 245 | 7 | 2.9 (1.4-6.0) |
| SL-plus MIA | R3 | 73 | 383 | 6 | 1.6 (0.7-3.5) |
| SMS | Versafitcup trio/ccl. | 56 | 192 | 6 | 3.2 (1.4-6.9) |
| SPS evolution | April ceramic | 39 | 541 | 37 | 6.9 (5.0-9.4) |
| SPS evolution | April poly | 38 | 61 | 5 | 8.3 (3.6-18.9) |
| SPS evolution | Liberty | 40 | 82 | 3 | 3.7 (1.2-10.9) |
| Stelia-Stem | BSC pressfit | 100 | 93 | 3 | 3.2 (1.1-9.7) |
| Symbol | Symbol DMHA/DS evol. | 70 | 152 | 9 | 5.9 (3.1-11.1) |
| Tri-Lock | Pinnacle | 68 | 94 | 3 | 3.2 (1.0-9.6) |
| Twinsys | Anexys | 47 | 124 | 3 | 2.5 (0.8-7.4) |
| Twinsys | RM pressfit | 41 | 74 | 7 | 9.5 (4.6-18.8) |
| Twinsys | RM pressfit vitamys | 16 | 1,646 | 39 | 2.4 (1.7-3.2) |
| Twinsys | Symbol DMHA/DS evol. | 52 | 67 | 1 | 1.5 (0.2-10.1) |
| other combinations | - |  | 2,188 | 86 | 4.0 (3.2-4.9) |
| **CH average for group** |  |  |  |  | **2.4 (2.3-2.5)** |

**Table 4.23 – Part three**

**2-year evaluation: Revision rates of uncemented primary total hip arthroplasty combinations within 24 months (primary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

## Important information on the use of the implant performance tables below

- 🟠 Estimated revision rate exceeds the alert boundary, but we do not identify this implant combination as an outlier because the 95% confidence interval overlaps the confidence zone of the reference group.
- 🔴 Identified as potential outliers. Please note the statistical confidence intervals. The outlier status comes with varying degrees of statistical probability. We consider the potential outlier status „highly likely“ when both the estimated revision rate and the complete confidence interval exceed the outlier alert boundary.

Please be aware that relatively rare implant combinations are frequently used in only a small number or indeed only in one hospital in Switzerland. Observed revision rates may be determined by local factors and performance may differ significantly between locations. Manufacturers of detected outlier implants and the hospitals where they were used (and revisions occurred) have been informed by SIRIS.

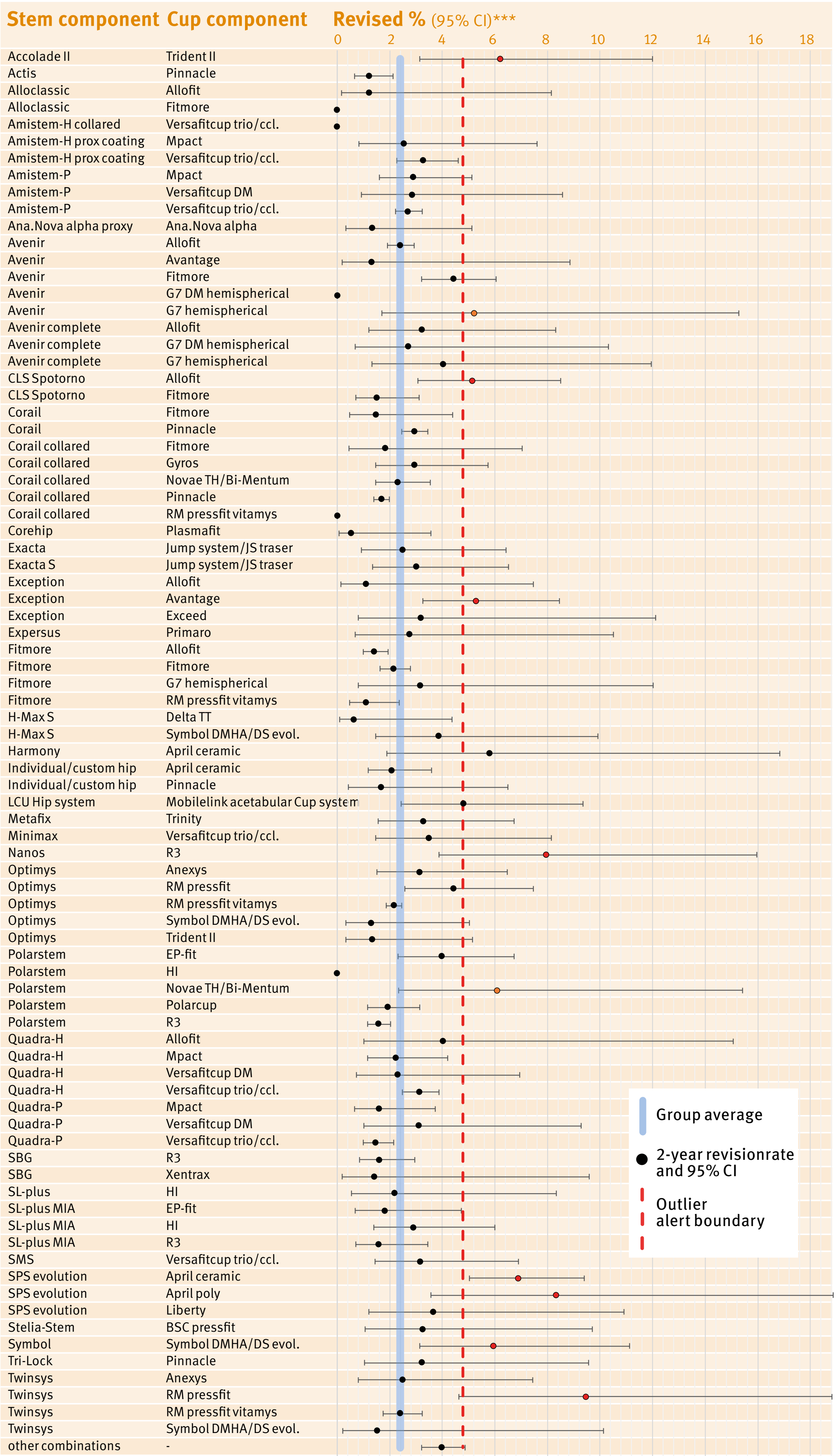


**Figure 4.34**

2-year evaluation: Revision rates of uncemented primary total hip arthroplasty combin. within 24 months (primary OA)

| Stem component | Cup component | CCS* | at risk N** | Revised N | % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-C | Mpact | 35 | 92 | 5 | 5.5 (2.3-12.7) |
| Amistem-C | Versafitcup DM | 33 | 108 | 4 | 3.8 (1.4-9.7) |
| Amistem-C | Versafitcup trio/ccl. | 18 | 738 | 21 | 2.9 (1.9-4.4) |
| Avenir (cem) | Allofit | 19 | 385 | 9 | 2.4 (1.2-4.5) |
| Avenir (cem) | Fitmore | 57 | 315 | 11 | 3.5 (2.0-6.3) |
| CCA | RM pressfit vitamys | 50 | 50 | 2 | 4.3 (1.1-16.1) |
| Centris | RM pressfit vitamys | 43 | 153 | 3 | 2.0 (0.6-6.0) |
| Corail (cem) | Novae TH/Bi-Mentum | 37 | 130 | 1 | 0.8 (0.1-5.3) |
| Corail (cem) | Pinnacle | 21 | 639 | 9 | 1.4 (0.7-2.7) |
| Exeter V40 | Symbol DMHA/DS evol. | 100 | 63 | 1 | 1.6 (0.2-10.7) |
| Harmony (cem) | Liberty | 58 | 77 | 1 | 1.3 (0.2-9.0) |
| MS-30 | Allofit | 59 | 392 | 9 | 2.3 (1.2-4.4) |
| MS-30 | Fitmore | 37 | 175 | 4 | 2.3 (0.9-6.0) |
| MS-30 | Versafitcup trio/ccl. | 100 | 88 | 1 | 1.1 (0.2-7.8) |
| Original Mueller | Allofit | 60 | 73 | 2 | 2.7 (0.7-10.5) |
| Original Mueller | Fitmore | 77 | 74 | 1 | 1.4 (0.2-9.5) |
| Polarstem (cem) | Polarcup | 66 | 61 | 2 | 3.3 (0.8-12.7) |
| Quadra-C | Mpact | 49 | 51 | 0 | 0.0 (.-.) |
| Quadra-C | Mpact DM | 80 | 76 | 2 | 2.6 (0.7-10.1) |
| Quadra-C | Versafitcup trio/ccl. | 29 | 459 | 14 | 3.1 (1.8-5.1) |
| Quadra-P (cem) | Versafitcup trio/ccl. | 30 | 130 | 3 | 2.3 (0.8-7.0) |
| Twinsys (cem) | RM pressfit | 21 | 84 | 1 | 1.2 (0.2-8.4) |
| Twinsys (cem) | RM pressfit vitamys | 22 | 997 | 15 | 1.5 (0.9-2.5) |
| Twinsys (cem) | Symbol DMHA/DS evol. | 42 | 77 | 0 | 0.0 (.-.) |
| Weber | Allofit | 38 | 148 | 5 | 3.5 (1.5-8.2) |
| Weber | Fitmore | 31 | 594 | 12 | 2.0 (1.2-3.6) |
| X-Acta | Versafitcup trio/ccl. | 96 | 53 | 1 | 1.9 (0.3-12.9) |
| other combinations | | | 1,460 | 56 | 3.9 (3.0-5.0) |
| **CH average for group** | | | | | **2.5** (2.2-2.9) |

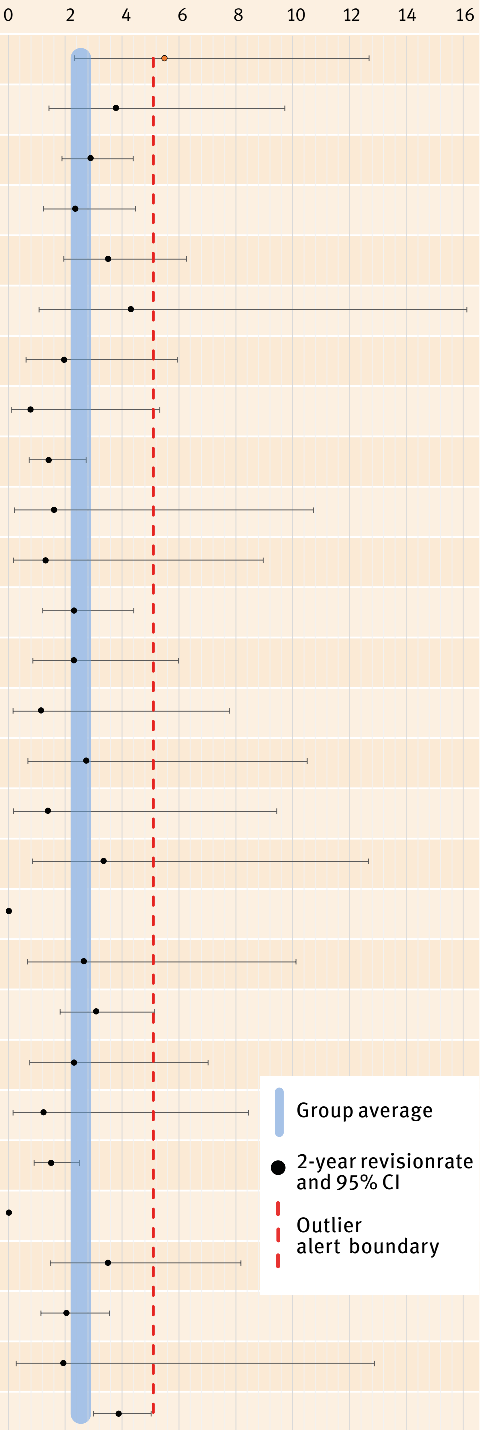


**Figure 4.35**

**2-year evaluation: Revision rates of hybrid primary total hip arthroplasty combinations within 24 months (primary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

| Stem component | Cup component | CCS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Actis | Pinnacle | 43 | 129 | 3 | 2.3 (0.8-7.0) |
| Amistem-H prox coating | Versafitcup trio/ccl. | 18 | 61 | 3 | 5.0 (1.6-14.6) |
| Amistem-P | Versafitcup trio/ccl. | 16 | 367 | 13 | 3.6 (2.1-6.1) |
| Avenir | Allofit | 16 | 312 | 13 | 4.2 (2.5-7.1) |
| Avenir | Fitmore | 55 | 77 | 5 | 6.5 (2.8-14.9) |
| CLS Spotorno | Allofit | 46 | 72 | 3 | 4.2 (1.4-12.4) |
| Corail | Pinnacle | 14 | 311 | 7 | 2.3 (1.1-4.7) |
| Corail collared | Novae TH/Bi-Mentum | 38 | 103 | 6 | 5.8 (2.7-12.5) |
| Corail collared | Pinnacle | 37 | 712 | 18 | 2.5 (1.6-4.0) |
| Evok | Vento | 69 | 52 | 2 | 3.8 (1.0-14.5) |
| Fitmore | Allofit | 94 | 606 | 8 | 1.3 (0.7-2.6) |
| Fitmore | Fitmore | 35 | 195 | 10 | 5.1 (2.8-9.3) |
| Fitmore | RM pressfit vitamys | 100 | 90 | 1 | 1.1 (0.2-7.7) |
| Individual/custom hip | April ceramic | 18 | 97 | 3 | 3.1 (1.0-9.3) |
| Optimys | RM pressfit vitamys | 20 | 808 | 25 | 3.1 (2.1-4.6) |
| Polarstem | EP-fit | 98 | 59 | 2 | 3.4 (0.9-12.9) |
| Polarstem | Polarcup | 76 | 124 | 5 | 4.0 (1.7-9.4) |
| Polarstem | R3 | 73 | 343 | 13 | 3.8 (2.2-6.4) |
| Quadra-H | Versafitcup trio/ccl. | 32 | 178 | 8 | 4.5 (2.3-8.9) |
| Quadra-P | Versafitcup trio/ccl. | 64 | 166 | 3 | 1.8 (0.6-5.5) |
| SBG | R3 | 46 | 79 | 3 | 3.8 (1.2-11.3) |
| Twinsys | RM pressfit vitamys | 13 | 136 | 9 | 6.7 (3.5-12.4) |
| other combinations | | | 1,272 | 65 | 5.2 (4.1-6.6) |
| **CH average for group** | | | | | **3.6** (3.2-4.1) |

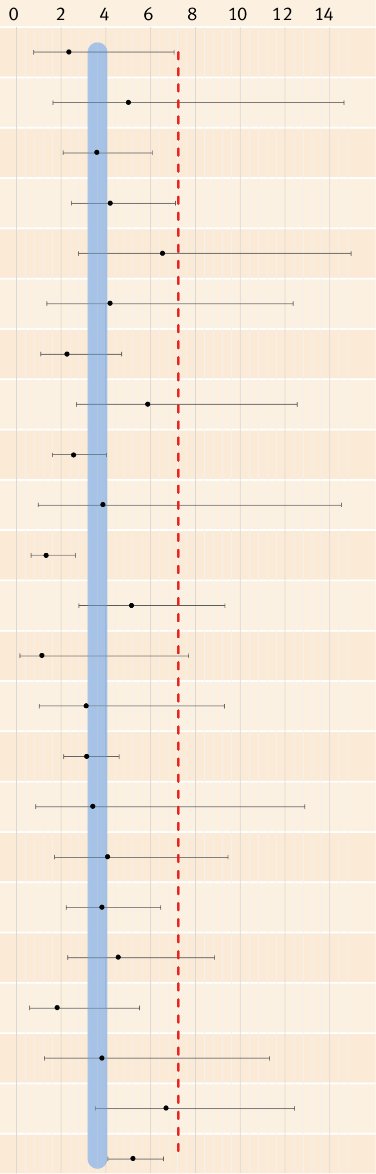


**Figure 4.36**

**2-year evaluation: Revision rates of uncemented primary total hip arthroplasty combinations within 24 months (secondary OA)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

▮ Group average

● 2-year revisionrate and 95% CI

¦ Outlier alert boundary

# Fracture of the hip

## 4.5 Treatment of hip fractures

Between 2019 and 2024, the registry recorded a total of 27,384 primary hip arthroplasties performed for fractures, of which 46.2% were THA and 53.8% HA **(Table 3.7).** Previous internal fixation of the femur was registered in 8.1% of the THA and 1.0% of the HA. Previous internal fixation of acetabular fractures was recorded in 0.9% of the patients treated with THA. However, the lapse of time between internal fixation and arthroplasty is unknown, as internal fixation is not registered.

| **Main treatment group** | | **THA** | | **HA** | |
|---|---|---|---|---|---|
| **N (2019 – 2024)** | | **N revised** | **%** | **N revised** | **%** |
| Previous surgery[1] | None | 11,328 | 89.5 | 14,452 | 98.1 |
| | Internal fixation femur | 1,022 | 8.1 | 149 | 1.0 |
| | Osteotomy femur | 60 | 0.5 | 15 | 0.1 |
| | Internal fixation acetabulum | 120 | 0.9 | 5 | 0.0 |
| | Osteotomy pelvis | 8 | 0.1 | 1 | 0.0 |
| | Arthrodesis | 2 | 0.0 | 0 | 0.0 |
| | Other previous surgery | 166 | 1.3 | 108 | 0.7 |
| Approach | Anterior | 7,311 | 57.8 | 7,149 | 48.5 |
| | Anterolateral | 2,953 | 23.3 | 4,044 | 27.5 |
| | Posterior | 1,514 | 12.0 | 2,120 | 14.4 |
| | Lateral | 665 | 5.3 | 1,265 | 8.6 |
| | Other approach | 213 | 1.7 | 150 | 1.0 |
| Fixation | All uncemented / uncemented stem | 6,317 | 49.9 | 1,837 | 12.5 |
| | Hybrid acetabulum uncemented, femur cemented | 5,289 | 41.8 | | |
| | All cemented / cemented stem | 645 | 5.1 | 12,798 | 86.9 |
| | Reverse hybrid acetabulum cemented, femur uncemented | 200 | 1.6 | | |
| | Reinforcement ring, femur uncemented | 54 | 0.4 | | |
| | Reinforcement ring, femur cemented | 151 | 1.2 | | |

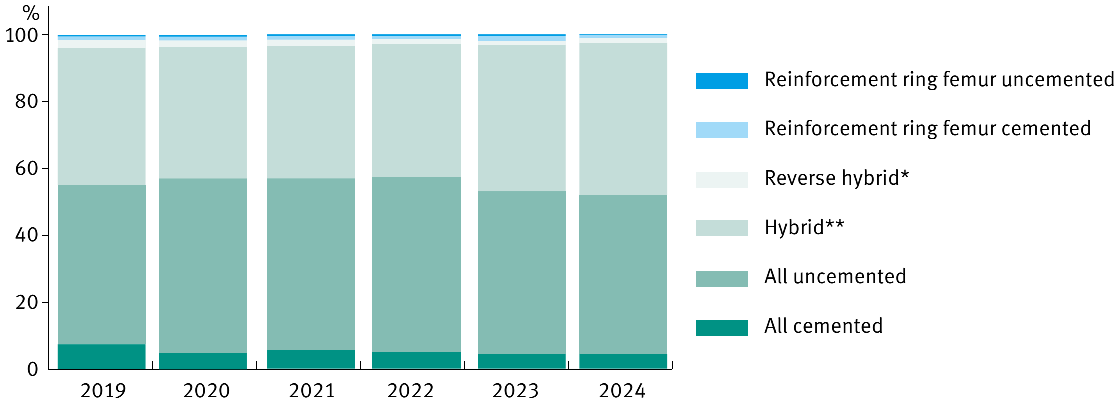
**Table 4.24**

**Fractures of the hip: Surgery characteristics by treatment group**

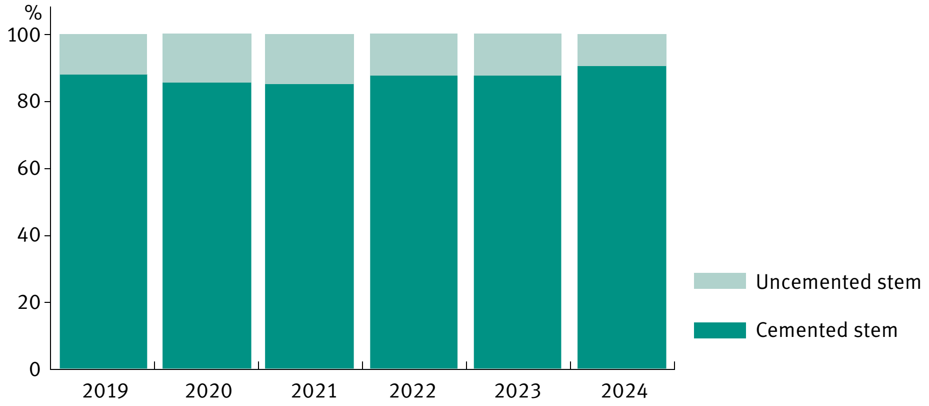
[1] multiple responses possible; does not sum to 100%

Most HA stems were cemented (86.9%) compared to 49.9% uncemented stems in the THA group **(Table 4.24).** The share of cemented stems for HA increased from 88.1% in 2019 to 90.5% in 2024. The use of uncemented stems in the THA group reached a maximum in 2022 with 52.3%, thereafter declining to 47.7% in 2024. Simultaneously, the hybrid fixation showed a compensatory rise **(Tables 4.25 and Figures 4.37).**

| **Total hip arthroplasty (THA)** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|
| Reinforcement ring, femur uncemented | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.3 |
| Reinforcement ring, femur cemented | 1.3 | 1.2 | 1.2 | 1.0 | 1.6 | 0.9 |
| Reverse hybrid* | 2.1 | 1.9 | 1.9 | 1.5 | 1.1 | 1.2 |
| Hybrid** | 41.2 | 39.4 | 39.7 | 39.8 | 43.9 | 45.6 |
| All uncemented | 47.6 | 52.2 | 51.2 | 52.3 | 48.6 | 47.7 |
| All cemented | 7.3 | 4.9 | 5.6 | 4.9 | 4.4 | 4.2 |
| **Total [N]** | **1,593** | **1,789** | **2,134** | **2,290** | **2,380** | **2,470** |



| **Hemiarthroplasty (HA)** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|
| Uncemented stem | 11.9 | 14.3 | 14.7 | 12.6 | 12.6 | 9.5 |
| Cemented stem | 88.1 | 85.7 | 85.3 | 87.4 | 87.4 | 90.5 |
| **Total [N]** | **2,274** | **2,351** | **2,326** | **2,558** | **2,536** | **2,590** |



**Tables 4.25 and Figures 4.37**

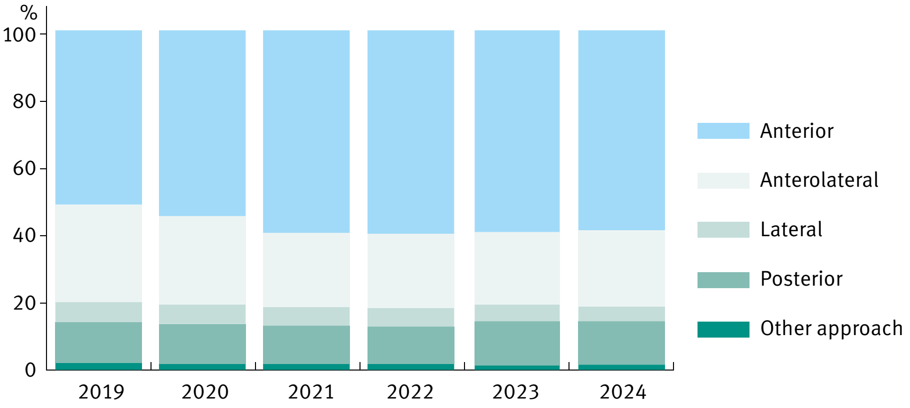
**Fracture of the hip: Component fixation methods by type of treatment by year**

* acetabulum cemented, femur uncemented = Reverse hybrid

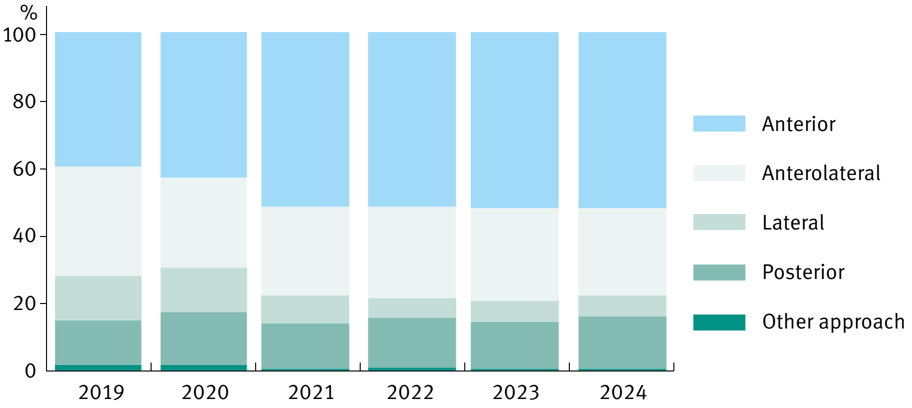
** acetabulum uncemented, femur cemented = Hybrid

The most common approaches for both procedures were a direct anterior approach, followed by an anterolateral approach. The choice of the approach changed significantly between 2019 and 2024, particularly for HA. The use the anterior approach for HA rose from 39.6% in 2019 to 52.1% in 2024. The use of the anterolateral approach declined, as did the other approaches. The development was similar for THA, however less pronounced **(Tables 4.26 and Figures 4.38).**

| **Total hip arthroplasty (THA)** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|
| Anterior | 51.3 | 54.7 | 59.7 | 59.9 | 59.3 | 58.9 |
| Anterolateral | 28.5 | 26.0 | 21.9 | 21.9 | 21.5 | 22.4 |
| Lateral | 6.2 | 5.9 | 5.3 | 5.3 | 5.0 | 4.3 |
| Posterior | 12.1 | 11.5 | 11.2 | 11.1 | 12.9 | 12.8 |
| Other approach | 1.9 | 1.9 | 1.8 | 1.7 | 1.3 | 1.5 |
| **Total [N]** | **1,593** | **1,789** | **2,134** | **2,290** | **2,380** | **2,470** |



| **Hemiarthroplasty (HA)** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|
| Anterior | 39.6 | 42.9 | 51.4 | 51.8 | 52.2 | 52.1 |
| Anterolateral | 32.3 | 26.8 | 26.3 | 26.9 | 27.1 | 25.8 |
| Lateral | 13.0 | 12.9 | 8.3 | 5.7 | 6.2 | 6.2 |
| Posterior | 13.1 | 15.5 | 13.3 | 14.7 | 14.1 | 15.5 |
| Other approach | 1.9 | 1.9 | 0.6 | 0.9 | 0.5 | 0.4 |
| **Total [N]** | **2,280** | **2,360** | **2,361** | **2,575** | **2,547** | **2,605** |



**Tables 4.26 and Figures 4.38**

**Fracture of the hip: Surgical approach by type of treatment by year**

## 4.6 Early revision after arthroplasty for fracture of the hip

The 2-year revision rate after THA for fracture of the hip was 5.0% (CI 4.5 – 5.5%) and higher than in HA patients, where 3.7% (CI 3.3 – 4.1%) had been revised. The 2-year revision rate of THA for the treatment of fractures was more than twice that of THA for primary OA (5.0% vs 2.4%).

An elevated BMI was a risk factor for revision, whereby the risk increase for THA already was observed at a BMI >30 kg/m². Higher ASA scores tended to be associated with more frequent revisions in the THA group **(Table 4.27).**

| | | Total hip arthroplasty | | | | | Hemiarthroplasty | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | At risk* | Revised | | 95% CI | | At risk* | Revised | | 95% CI | |
| | | N | N | %** | lower | upper | N | N | %** | lower | upper |
| Overall (moving average) | | 7,812 | 372 | 5.0 | 4.5 | 5.5 | 9,574 | 310 | 3.7 | 3.3 | 4.1 |
| Gender | Women | 4,967 | 218 | 4.5 | 4.0 | 5.2 | 6,763 | 211 | 3.5 | 3.1 | 4.0 |
| | Men | 2,845 | 154 | 5.7 | 4.9 | 6.7 | 2,811 | 99 | 4.3 | 3.5 | 5.2 |
| Age group | <55 | 332 | 20 | 6.1 | 4.0 | 9.3 | 31 | 4 | 14.4 | 5.7 | 34.0 |
| | 55–64 | 1,058 | 62 | 6.0 | 4.7 | 7.6 | 119 | 7 | 6.2 | 3.0 | 12.6 |
| | 65–74 | 2,040 | 92 | 4.6 | 3.8 | 5.6 | 508 | 34 | 7.6 | 5.5 | 10.5 |
| | 75–84 | 2,841 | 136 | 5.0 | 4.2 | 5.9 | 2,878 | 105 | 4.1 | 3.4 | 4.9 |
| | 85+ | 1,541 | 62 | 4.4 | 3.5 | 5.7 | 6,038 | 160 | 3.1 | 2.6 | 3.6 |
| BMI group | <18.5 | 501 | 21 | 4.5 | 3.0 | 6.8 | 842 | 21 | 3.0 | 2.0 | 4.6 |
| | 18.5–24.9 | 3,633 | 146 | 4.2 | 3.6 | 4.9 | 4,533 | 114 | 2.9 | 2.4 | 3.4 |
| | 25–29.9 | 1,886 | 109 | 6.0 | 5.0 | 7.2 | 1,921 | 86 | 5.1 | 4.1 | 6.2 |
| | 30–34.9 | 463 | 35 | 7.9 | 5.7 | 10.8 | 393 | 24 | 6.6 | 4.4 | 9.6 |
| | 35–39.9 | 92 | 9 | 10.0 | 5.3 | 18.3 | 79 | 10 | 14.0 | 7.8 | 24.5 |
| | 40+ | 27 | 1 | 3.7 | 0.5 | 23.5 | 13 | 1 | 8.3 | 1.2 | 46.1 |
| | Unknown | 1,210 | 51 | 4.6 | 3.5 | 6.0 | 1,793 | 54 | 3.6 | 2.7 | 4.7 |
| Morbidity state | ASA 1 | 486 | 14 | 2.9 | 1.7 | 4.8 | 72 | 5 | 7.7 | 3.3 | 17.6 |
| | ASA 2 | 3,087 | 126 | 4.1 | 3.5 | 4.9 | 1,647 | 47 | 3.0 | 2.3 | 4.0 |
| | ASA 3 | 3,498 | 198 | 6.0 | 5.3 | 6.9 | 6,386 | 214 | 3.9 | 3.4 | 4.4 |
| | ASA 4/5 | 342 | 15 | 5.0 | 3.0 | 8.2 | 1,005 | 28 | 3.5 | 2.4 | 5.1 |
| | Unknown | 399 | 19 | 5.0 | 3.2 | 7.8 | 464 | 16 | 4.0 | 2.4 | 6.4 |

**Table 4.27**

**Fracture of the hip: First revisions within 24 months overall and according to baseline characteristics**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

** Rates adjusted for effects of mortality and emigration.

In the HA group, uncemented stems had an increased risk for revision caused by a periprosthetic fracture. A posterior approach bore a higher risk of revision for both THA and HA, whereby for THA the effect was higher (7.4% vs 6.3%) as shown in **Table 4.28.** The difference was not significant.

## Reasons for early first revision

Dislocation, periprosthetic fractures and infections were the three leading reasons for revision in both the THA and the HA groups **(Table 4.29).** However, infections remained by far the most important cause of revision in the HA group, representing 34.8% of the registered cases, while the most frequent cause for revision in fracture THA was dislocation (26.3%), followed closely by revision for periprosthetic fracture (25.0%).

| | Total hip arthroplasty (THA) | | | | | Hemiarthroplasty (HA) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | At risk* | Revised | | 95% CI | | At risk* | Revised | | 95% CI | |
| | N | N | %** | lower | upper | N | N | %** | lower | upper |
| Overall (moving average) | 7,812 | 372 | 5.0 | 4.5 | 5.5 | 9,574 | 310 | 3.7 | 3.3 | 4.1 |
| All cemented / cemented stem | 438 | 20 | 5.1 | 3.3 | 7.7 | 8,235 | 239 | 3.4 | 3.0 | 3.8 |
| All uncemented / uncem. stem | 3,983 | 199 | 5.1 | 4.5 | 5.9 | 1,272 | 68 | 5.9 | 4.7 | 7.4 |
| Hybrid | 3,123 | 137 | 4.6 | 3.9 | 5.4 | | | | | |
| Anterior | 4,449 | 195 | 4.6 | 4.0 | 5.3 | 4,462 | 142 | 3.7 | 3.1 | 4.3 |
| Anterolateral | 1,889 | 88 | 4.9 | 4.0 | 5.9 | 2,682 | 62 | 2.7 | 2.1 | 3.4 |
| Lateral | 439 | 14 | 3.3 | 2.0 | 5.5 | 946 | 25 | 3.2 | 2.2 | 4.7 |
| Posterior | 892 | 64 | 7.4 | 5.9 | 9.4 | 1,358 | 77 | 6.3 | 5.1 | 7.8 |
| Other approach | 143 | 11 | 8.1 | 4.6 | 14.2 | 126 | 4 | 4.1 | 1.5 | 10.6 |

**Table 4.28**

**Fracture of the hip: First revisions according to stem fixation and approach**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

** Rates adjusted for effects of mortality and emigration.

| | THA | | HA | |
|---|---|---|---|---|
| | N | % | N | % |
| Dislocation | 98 | 26.3 | 81 | 26.1 |
| Infection | 96 | 25.8 | 108 | 34.8 |
| Periprosthetic fracture | 93 | 25.0 | 67 | 21.6 |
| Loosening femoral | 49 | 13.2 | 32 | 10.3 |
| Loosening acetabular | 31 | 8.3 | | |
| Position/Orientation of cup | 28 | 7.5 | | |
| Position/Orientation of stem | 20 | 5.4 | 11 | 3.5 |
| Implant breakage | 6 | 1.6 | 1 | 0.3 |
| Acetabular protrusion | 2 | 0.5 | 9 | 2.9 |
| Wear | 1 | 0.3 | 5 | 1.6 |
| Metallosis | 1 | 0.3 | 0 | 0.0 |
| Acetabular osteolysis | 1 | 0.3 | 1 | 0.3 |
| Femoral osteolysis | 1 | 0.3 | 0 | 0.0 |
| Trochanter pathology | 1 | 0.3 | 0 | 0.0 |
| Status after spacer | 1 | 0.3 | 0 | 0.0 |
| Impingement | 1 | 0.3 | 0 | 0.0 |
| Other | 38 | 10.2 | 34 | 11.0 |
| **Total revisions** | **372** | | **310** | |

**Table 4.29**

**Fracture of the hip: Reasons for early first revisions**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

Early first revisions are those occurring within 2 years of the primary arthroplasty. Multiple responses possible (percentages do not sum to 100)

A more detailed analysis of the reasons for revision of HA, analysing separately unipolar and bipolar heads, showed notable differences. However, small numbers limit any further analysis **(Table 4.30).**

The revision rates of unipolar and bipolar heads for cemented HA showed that bipolar heads had a higher revision rate in the first year, whereas afterwards the difference was not significant. After 4 years and up to 12 years of follow-up, the revision rates of unipolar heads and bipolar heads remained similar **(Figure 4.39).**

The analysis again is limited by small numbers remaining at risk at the end of the observation period. The higher early revision rate of bipolar heads was due to revision for dislocation, which occurred significantly more frequently as in unipolar HA. Dislocations also occurred earlier in this subgroup. Periprosthetic fractures were more frequent in HA with unipolar heads, as were infections.

The cumulative incidence figures of revision rates over time provide an additional perspective on the reasons for revision **(Figures 4.40).** It highlights revisions for infection and for dislocation tended to

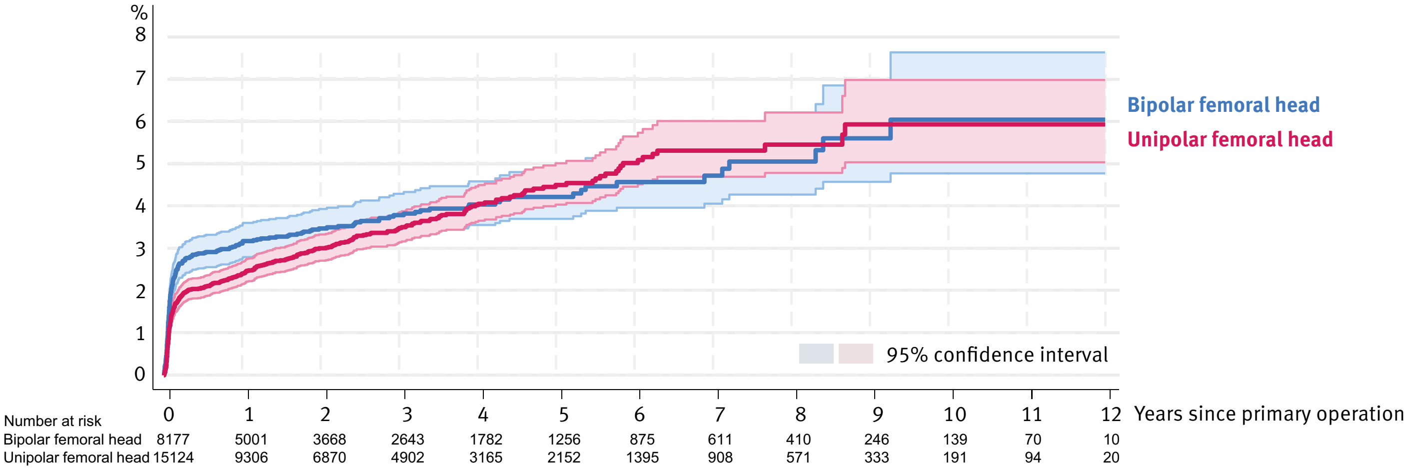
| **Reason** | **Unipolar heads** | | **Bipolar heads** | |
|---|---|---|---|---|
| | **N** | **%** | **N** | **%** |
| Infection | 65 | 43.6 | 29 | 32.6 |
| Dislocation | 26 | 17.4 | 36 | 40.4 |
| Periprosthetic fracture | 24 | 16.1 | 11 | 12.4 |
| Loosening femoral | 14 | 9.4 | 13 | 14.6 |
| Impingement | 7 | 4.7 | 1 | 1.1 |
| Acetabular osteolysis | 0 | 0.0 | 1 | 1.1 |
| Other | 18 | 12.1 | 7 | 7.9 |
| **Total revisions** | **149** | | **89** | |

**Table 4.30**

**Fracture of the hip: Reasons for early first revisions (unipolar vs. bipolar hemi heads; cemented stems only)**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

Early first revisions are those occurring within 2 years of the primary arthroplasty. Multiple responses possible (percentages do not sum to 100).



| **Head type** | **1 year** | **2 years** | **3 years** | **5 years** | **6 years** | **8 years** | **10 years** | **12 years** |
|---|---|---|---|---|---|---|---|---|
| Unipolar femoral head | 2.4 (2.1-2.7) | 3.0 (2.7-3.3) | 3.4 (3.1-3.8) | 4.5 (4.0-5.0) | 5.0 (4.4-5.6) | 5.4 (4.8-6.2) | 5.9 (5.0-7.0) | 5.9 (5.0-7.0) |
| Bipolar femoral head | 3.1 (2.7-3.5) | 3.5 (3.1-3.9) | 3.8 (3.3-4.3) | 4.2 (3.7-4.8) | 4.6 (3.9-5.2) | 5.0 (4.3-6.0) | 6.0 (4.8-7.6) | 6.0 (4.8-7.6) |

**Figure 4.39**

**Fracture of the hip: Estimated failure rates of hemiarthroplasty of the hip: unipolar heads versus bipolar heads**

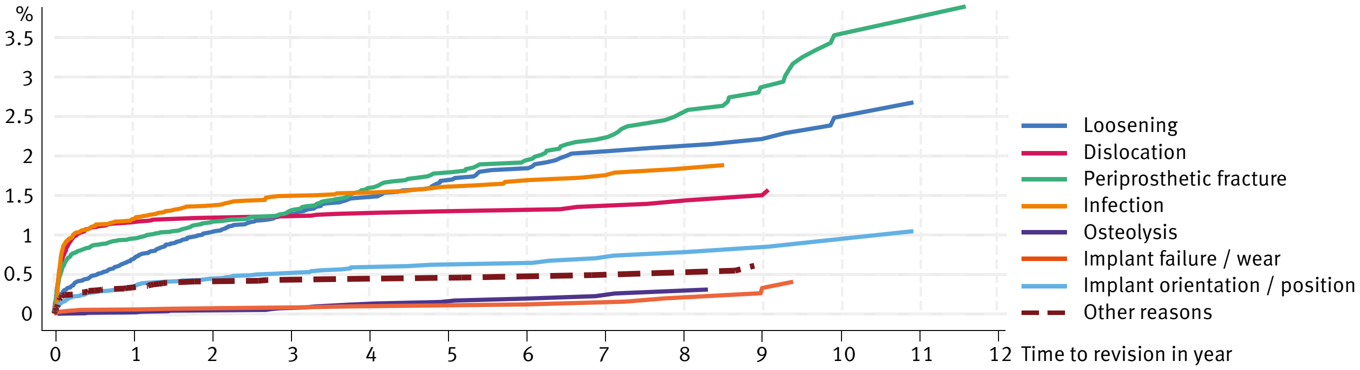
Time since operation, 2012–2024, only cemented stems % of implants revised.

occur rather early on, as indicated by a steep initial increase of the curve, followed by very gradual long-term rise. These observations were more frequent in THA. Incidents of loosening and periprosthetic fractures were the drivers of later revisions.

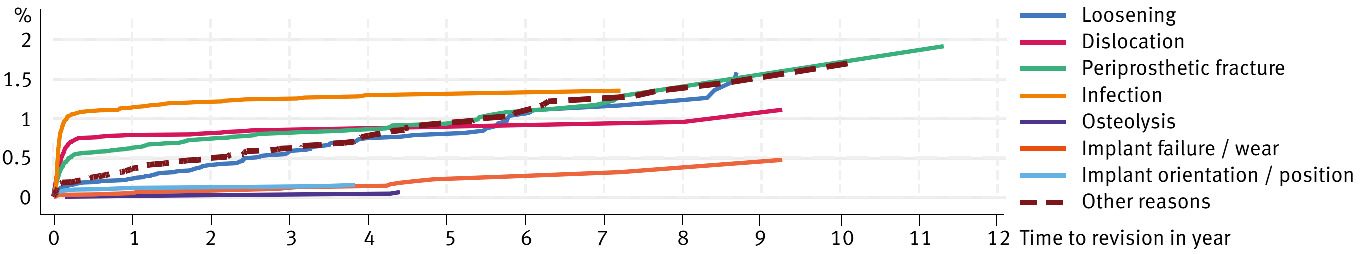
### Type of revisions

Among the hip arthroplasties performed for fracture of the hip, 372 revisions of THA and 310 revisions of HA were carried out during the current moving observation period. The most frequent type of revision was

| Total hip arthroplasty | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Loosening | 0.7 (0.6-0.8) | 1.0 (0.9-1.2) | 1.3 (1.1-1.4) | 1.7 (1.5-1.9) | 2.2 (1.9-2.6) | 2.5 (2.1-3.0) | 2.7 (2.1-3.3) |
| Dislocation | 1.2 (1.0-1.3) | 1.2 (1.1-1.4) | 1.2 (1.1-1.4) | 1.3 (1.1-1.5) | 1.5 (1.3-1.8) | 1.6 (1.3-1.9) | 1.6 (1.3-1.9) |
| Periprosthetic fracture | 1.0 (0.8-1.1) | 1.2 (1.0-1.3) | 1.3 (1.1-1.5) | 1.8 (1.6-2.0) | 2.9 (2.4-3.4) | 3.5 (2.9-4.2) | 3.9 (3.0-5.0) |
| Infection | 1.2 (1.1-1.4) | 1.4 (1.2-1.5) | 1.5 (1.3-1.7) | 1.6 (1.4-1.8) | 1.9 (1.6-2.2) | 1.9 (1.6-2.2) | 1.9 (1.6-2.2) |
| Osteolysis | 0.0 (0.0-0.1) | 0.0 (0.0-0.1) | 0.1 (0.0-0.1) | 0.2 (0.1-0.3) | 0.3 (0.2-0.5) | 0.3 (0.2-0.5) | 0.3 (0.2-0.5) |
| Implant failure / wear | 0.1 (0.0-0.1) | 0.1 (0.0-0.1) | 0.1 (0.0-0.1) | 0.1 (0.1-0.2) | 0.3 (0.2-0.6) | 0.4 (0.2-0.8) | 0.4 (0.2-0.8) |
| Implant orientation / position | 0.3 (0.3-0.4) | 0.4 (0.4-0.6) | 0.5 (0.4-0.6) | 0.6 (0.5-0.8) | 0.8 (0.6-1.0) | 0.9 (0.6-1.1) | 1.0 (0.7-1.6) |
| Other reasons | 0.3 (0.3-0.4) | 0.4 (0.3-0.5) | 0.4 (0.3-0.5) | 0.4 (0.4-0.6) | 0.6 (0.4-0.9) | 0.6 (0.4-0.9) | 0.6 (0.4-0.9) |



| Hemiarthroplasty | 1 year | 2 years | 3 years | 5 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|
| Loosening | 0.2 (0.2-0.3) | 0.4 (0.3-0.5) | 0.6 (0.5-0.7) | 0.8 (0.6-1.0) | 1.6 (1.2-2.2) | 1.6 (1.2-2.2) | 1.6 (1.2-2.2) |
| Dislocation | 0.8 (0.7-0.9) | 0.8 (0.7-0.9) | 0.8 (0.7-1.0) | 0.9 (0.8-1.0) | 1.0 (0.8-1.2) | 1.1 (0.8-1.5) | 1.1 (0.8-1.5) |
| Periprosthetic fracture | 0.6 (0.5-0.7) | 0.7 (0.6-0.9) | 0.8 (0.7-0.9) | 0.9 (0.8-1.1) | 1.3 (1.0-1.6) | 1.3 (1.0-1.6) | 1.9 (1.0-3.7) |
| Infection | 1.1 (1.0-1.3) | 1.2 (1.1-1.4) | 1.2 (1.1-1.4) | 1.3 (1.1-1.5) | 1.4 (1.2-1.6) | 1.4 (1.2-1.6) | 1.4 (1.2-1.6) |
| Osteolysis | 0.0 (0.0-0.0) | 0.0 (0.0-0.0) | 0.0 (0.0-0.1) | 0.1 (0.0-0.2) | 0.1 (0.0-0.2) | 0.1 (0.0-0.2) | 0.1 (0.0-0.2) |
| Implant failure / wear | 0.0 (0.0-0.1) | 0.1 (0.0-0.1) | 0.1 (0.1-0.2) | 0.2 (0.1-0.4) | 0.3 (0.2-0.5) | 0.5 (0.2-1.0) | 0.5 (0.2-1.0) |
| Implant orientation / position | 0.1 (0.1-0.2) | 0.1 (0.1-0.2) | 0.1 (0.1-0.2) | 0.2 (0.1-0.2) | 0.2 (0.1-0.2) | 0.2 (0.1-0.2) | 0.2 (0.1-0.2) |
| Other reasons | 0.4 (0.3-0.4) | 0.5 (0.4-0.6) | 0.6 (0.5-0.7) | 0.9 (0.8-1.1) | 1.5 (1.1-1.9) | 1.5 (1.1-1.9) | 1.7 (1.2-2.5) |



**Figures 4.40**

**Fracture of the hip: cumulative incidence rates for different revision diagnoses, THA and HA**

Time since operation, 2012–2024, % of implants revised

conversion of HA to THA (almost 35.5% of the revisions). The second most frequent revision in the HA group was the exchange of the head followed by revision of the stem **(Table 4.31).**

| Type of revision | Total hip arthroplasty | | Hemiarthroplasty | |
|---|---|---|---|---|
| | **N revised** | **%** | **N revised** | **%** |
| Exchange acetabular and femoral components | 55 | 14.8 | | |
| Exchange acetabular component | 27 | 7.3 | | |
| Exchange acetabular component and head | 52 | 14.0 | | |
| Exchange femoral component | 82 | 22.0 | 70 | 22.6 |
| Exchange femoral component and inlay | 20 | 5.4 | 2 | 0.6 |
| Exchange head | 39 | 10.5 | 100 | 32.3 |
| Exchange inlay | 7 | 1.9 | 0 | 0.0 |
| Exchange head and inlay | 61 | 16.4 | 14 | 4.5 |
| Conversion of hemi-prosthesis to THA without stem exchange | | | 61 | 19.7 |
| Conversion of hemi-prosthesis to THA with stem exchange | | | 49 | 15.8 |
| Component removal, spacer implantation | 8 | 2.2 | 5 | 1.6 |
| Component reimplantation (after spacer or Girdlestone) | 1 | 0.3 | 2 | 0.6 |
| Girdlestone | 4 | 1.1 | 2 | 0.6 |
| Exchange femoral component, inlay and osteosynthesis | 5 | 1.3 | 2 | 0.6 |
| Other intervention | 11 | 3.0 | 3 | 1.0 |
| **Total** | **372** | **100.0** | **310** | **100.0** |

**Table 4.31**

**Fracture of the hip: Type of revisions by primary treatment modality, THA versus HA**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)
HA: in approx. 11% of cases response categories involving acetabular components were chosen.
These were recoded to conversions.

## 4.7 Results of implants after hip fracture

### Uncemented THA combinations for fractures

There were 19 uncemented stem/cup combinations, accounting for 75% of all uncemented THA performed for fracture of the hip **(Table 4.32)**. The table also shows the distribution of the implants used between 2019 and 2024.

The revision rates for combinations with N>50 are shown in **Figure 4.41.** None of the implant combinations was conspicuous.

| Stem component | Cup component | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|---|
| Amistem-H prox coating | Versafitcup trio/ccl. | 63 | 6 | 9 | 0 | 0 | 0 | **78** |
| Amistem-P | Versafitcup trio/ccl. | 15 | 83 | 87 | 119 | 96 | 76 | **476** |
| Avenir | Allofit | 70 | 78 | 69 | 65 | 77 | 86 | **445** |
| CLS Spotorno | Allofit | 15 | 11 | 10 | 2 | 5 | 12 | **55** |
| Corail | Pinnacle | 61 | 66 | 72 | 57 | 51 | 23 | **330** |
| Corail collared | Bimobile | 0 | 0 | 20 | 122 | 94 | 99 | **335** |
| Corail collared | Liberty | 0 | 13 | 53 | 4 | 1 | 0 | **71** |
| Corail collared | Novae TH/Bi-Mentum | 4 | 28 | 65 | 74 | 101 | 118 | **390** |
| Corail collared | Pinnacle | 49 | 65 | 110 | 155 | 146 | 136 | **661** |
| Fitmore | Allofit | 18 | 15 | 26 | 20 | 39 | 38 | **156** |
| Fitmore | Fitmore | 15 | 21 | 14 | 26 | 12 | 6 | **94** |
| Fitmore | RM pressfit vitamys | 4 | 10 | 12 | 13 | 6 | 10 | **55** |
| Optimys | RM pressfit | 12 | 9 | 9 | 12 | 4 | 8 | **54** |
| Optimys | RM pressfit vitamys | 91 | 115 | 157 | 158 | 157 | 182 | **860** |
| Optimys | Symbol DMHA/DS evol. | 5 | 11 | 19 | 16 | 25 | 21 | **97** |
| Polarstem | R3 | 13 | 16 | 11 | 23 | 19 | 12 | **94** |
| Quadra-H | Versafitcup trio/ccl. | 28 | 31 | 19 | 10 | 0 | 0 | **88** |
| Quadra-P | Versafitcup trio/ccl. | 0 | 10 | 16 | 22 | 31 | 34 | **113** |
| Twinsys | RM pressfit vitamys | 24 | 26 | 34 | 31 | 36 | 31 | **182** |
| other combinations | - | 238 | 277 | 259 | 250 | 241 | 265 | **1,530** |
| **Total** | | **725** | **891** | **1,071** | **1,179** | **1,141** | **1,157** | **6,164** |

**Table 4.32**
Top 75% of primary total hip arthroplasty uncemented combinations to treat fractures 2019 – 2024

| Stem component | Cup component | CCS[*] | at risk | | Revised |
|---|---|---|---|---|---|
| | | | N[**] | N | % (95% CI)[***] |
| Amistem-H prox coating | Versafitcup trio/ccl. | 33 | 78 | 3 | 3.9 (1.3-11.6) |
| Amistem-P | Versafitcup trio/ccl. | 28 | 304 | 16 | 5.3 (3.3-8.6) |
| Avenir | Allofit | 25 | 282 | 11 | 4.1 (2.3-7.2) |
| Corail | Pinnacle | 12 | 256 | 8 | 3.2 (1.6-6.3) |
| Corail collared | Bimobile | 59 | 142 | 4 | 3.0 (1.1-7.8) |
| Corail collared | Liberty | 86 | 70 | 5 | 8.0 (3.4-18.4) |
| Corail collared | Novae TH/Bi-Mentum | 57 | 171 | 4 | 2.4 (0.9-6.3) |
| Corail collared | Pinnacle | 11 | 379 | 19 | 5.2 (3.3-8.0) |
| Fitmore | Allofit | 68 | 79 | 2 | 2.5 (0.6-9.8) |
| Fitmore | Fitmore | 42 | 76 | 2 | 2.6 (0.7-10.1) |
| Optimys | RM pressfit vitamys | 15 | 521 | 21 | 4.1 (2.7-6.2) |
| Optimys | Symbol DMHA/DS evol. | 69 | 51 | 2 | 4.0 (1.0-15.1) |
| Polarstem | R3 | 43 | 63 | 2 | 3.3 (0.8-12.4) |
| Quadra-H | Versafitcup trio/ccl. | 24 | 88 | 7 | 8.0 (3.9-16.0) |
| Twinsys | RM pressfit vitamys | 16 | 115 | 6 | 5.3 (2.4-11.3) |
| other combinations | - | | 1,171 | 80 | 7.0 (5.7-8.7) |
| **CH average for group** | | | | | **5.1 (4.5-5.9)** |

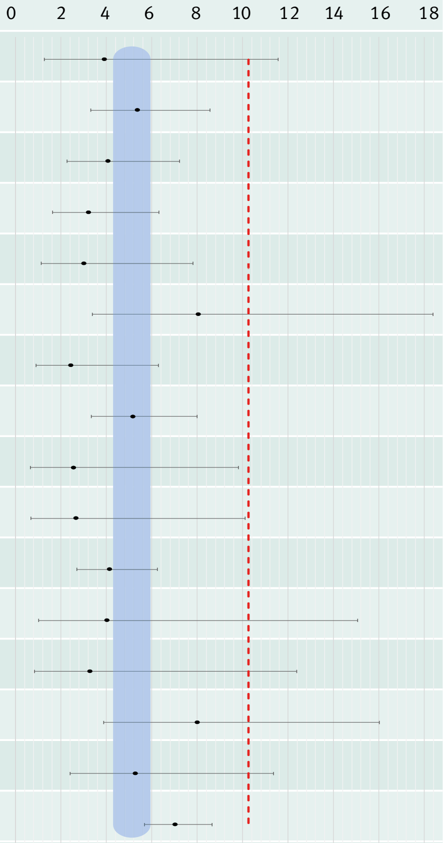


**Figure 4.41**

2-year evaluation: Revision rates within 24 months of uncemented primary total hip arthroplasty comb. to treat fractures

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

▮ Group average

● 2-year revisionrate and 95% CI

┆ Outlier alert boundary

### Important information on the use of the implant performance tables below

- 🟠 Estimated revision rate exceeds the alert boundary, but we do not identify this implant combination as an outlier because the 95% confidence interval overlaps the confidence zone of the reference group.
- 🔴 Identified as potential outliers. Please note the statistical confidence intervals. The outlier status comes with varying degrees of statistical probability. We consider the potential outlier status „highly likely“ when both the estimated revision rate and the complete confidence interval exceed the outlier alert boundary.

Please be aware that relatively rare implant combinations are frequently used in only a small number or indeed only in one hospital in Switzerland. Observed revision rates may be determined by local factors and performance may differ significantly between locations. Manufacturers of detected outlier implants and the hospitals where they were used (and revisions occurred) have been informed by SIRIS.

### Hybrid THA combinations for fractures

There were 20 stem/cup combinations covering 75% of the hybrid THA performed for fractures of the hip, but nine of these combinations were used fewer than 100 times during the observed period between 2018 and 2023 **(Table 4.33)**. The revision rates for the 10 combinations with N>50 are presented in **Figure 4.42** and show that none of the implants reached potential outlier status.

| Stem component | Cup component | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | Mpact DM | 0 | 5 | 4 | 0 | 18 | 15 | **42** |
| Amistem-C | Versafitcup DM | 16 | 12 | 9 | 6 | 17 | 11 | **71** |
| Amistem-C | Versafitcup trio/ccl. | 86 | 94 | 108 | 106 | 81 | 124 | **599** |
| Avenir (cem) | Allofit | 30 | 33 | 39 | 49 | 77 | 137 | **365** |
| Avenir (cem) | Fitmore | 26 | 37 | 65 | 58 | 45 | 14 | **245** |
| CCA | RM pressfit vitamys | 19 | 9 | 10 | 19 | 6 | 5 | **68** |
| Centris | RM pressfit vitamys | 30 | 32 | 53 | 0 | 0 | 0 | **115** |
| Corail (cem) | Novae TH/Bi-Mentum | 2 | 8 | 29 | 53 | 70 | 98 | **260** |
| Corail (cem) | Pinnacle | 38 | 38 | 79 | 120 | 146 | 99 | **520** |
| Corail (cem) | RM pressfit vitamys | 0 | 0 | 0 | 11 | 14 | 33 | **58** |
| Exacta S | Symbol DMHA/DS evol. | 0 | 0 | 5 | 24 | 39 | 49 | **117** |
| Exeter V40 | Symbol DMHA/DS evol. | 0 | 0 | 7 | 16 | 29 | 14 | **66** |
| MS-30 | Allofit | 0 | 0 | 10 | 29 | 43 | 24 | **106** |
| Quadra-C | Mpact | 26 | 19 | 16 | 8 | 15 | 4 | **88** |
| Quadra-C | Mpact DM | 9 | 32 | 35 | 33 | 14 | 17 | **140** |
| Quadra-C | Versafitcup trio/ccl. | 72 | 64 | 35 | 21 | 4 | 4 | **200** |
| Quadra-P (cem) | Versafitcup trio/ccl. | 0 | 4 | 5 | 3 | 17 | 18 | **47** |
| Twinsys (cem) | RM pressfit | 5 | 6 | 6 | 12 | 5 | 8 | **42** |
| Twinsys (cem) | RM pressfit vitamys | 69 | 74 | 74 | 119 | 148 | 145 | **629** |
| Twinsys (cem) | Symbol DMHA/DS evol. | 4 | 3 | 5 | 13 | 13 | 19 | **57** |
| Weber | Fitmore | 51 | 46 | 37 | 33 | 26 | 8 | **201** |
| other combinations | - | 185 | 204 | 226 | 186 | 226 | 274 | **1,301** |
| **Total** | | **668** | **720** | **857** | **919** | **1,053** | **1,120** | **5,337** |

**Table 4.33**

Top 75% of primary total hip arthroplasty hybrid combinations to treat fractures 2019 – 2024

| Stem component | Cup component | CCS* | at risk N** | Revised N | % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-C | Versafitcup trio/ccl. | 23 | 394 | 15 | 3.9 (2.4-6.4) |
| Avenir (cem) | Allofit | 58 | 150 | 5 | 3.4 (1.4-8.0) |
| Avenir (cem) | Fitmore | 64 | 187 | 9 | 5.0 (2.6-9.3) |
| CCA | RM pressfit vitamys | 54 | 57 | 4 | 7.2 (2.7-18.0) |
| Centris | RM pressfit vitamys | 29 | 115 | 7 | 6.6 (3.2-13.4) |
| Corail (cem) | Novae TH/Bi-Mentum | 29 | 92 | 3 | 3.4 (1.1-10.3) |
| Corail (cem) | Pinnacle | 17 | 272 | 10 | 3.9 (2.1-7.1) |
| Quadra-C | Mpact | 83 | 69 | 3 | 5.4 (1.8-15.9) |
| Quadra-C | Mpact DM | 64 | 109 | 4 | 4.0 (1.5-10.4) |
| Quadra-C | Versafitcup trio/ccl. | 61 | 192 | 10 | 5.4 (2.9-9.8) |
| Twinsys (cem) | RM pressfit vitamys | 17 | 337 | 12 | 3.7 (2.1-6.5) |
| Weber | Fitmore | 56 | 168 | 6 | 3.8 (1.7-8.4) |
| other combinations | | | 992 | 49 | 5.2 (4.0-6.9) |
| **CH average for group** | | | | | **4.6 (3.9-5.4)** |

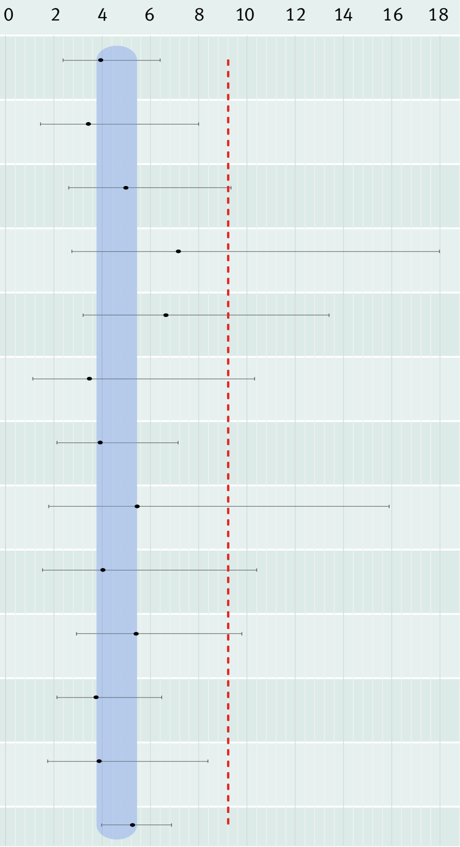


**Figure 4.42**

2-year evaluation: Revision rates within 24 months of hybrid primary total hip arthroplasty combinations to treat fractures

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

Group average

● 2-year revisionrate and 95% CI

Outlier alert boundary

### Hemiarthroplasty

The choice of implant combination for the treatment of hip fractures with HA was less variable than for THA and there were only nine stem/head combinations accounting for 75% of all implantations **(Table 4.34).** These combinations were used rather frequently over the last 12 years, and it is worth noting that neither combination was used fewer than 300 times during the last 5 years. Centris was withdrawn from the market. Therefore, it is a matter of time until it disappears from this analysis. The revision rates for combinations with n>50, which are more than the above-mentioned nine combinations, are shown in **Figure 4.43.** The average revision rate of this subgroup was 3.3% (CI 2.9–3.8%). There were two implant combinations that were detected as outliers. Among these, the combination Harmony (cem)/Symbios bibop was used in one centre only, illustrating the importance of single centres on the revision rates of specific implants, as a single combination **(Table 4.33).**

| Stem component | Head component | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | Medacta bipolar head | 92 | 114 | 150 | 171 | 196 | 221 | **944** |
| Amistem-C | Medacta endohead | 282 | 329 | 377 | 415 | 380 | 345 | **2,128** |
| Avenir (cem.) | ZB bipolar head | 79 | 99 | 69 | 100 | 118 | 151 | **616** |
| Avenir (cem.) | ZB unipolar head | 28 | 44 | 72 | 69 | 69 | 77 | **359** |
| CCA | Hemihead SS | 437 | 395 | 350 | 289 | 190 | 166 | **1,827** |
| Centris | Hemihead SS | 109 | 103 | 113 | 0 | 0 | 0 | **325** |
| Corail (cem) | J&J modular head carthcart | 87 | 106 | 180 | 260 | 277 | 300 | **1,210** |
| Twinsys (cem.) | Hemihead SS | 97 | 127 | 121 | 238 | 330 | 293 | **1,206** |
| Twinsys (cem.) | Mathys bipolar steel head | 38 | 46 | 30 | 65 | 57 | 91 | **327** |
| Weber | ZB unipolar head | 225 | 168 | 140 | 151 | 104 | 69 | **857** |
| other combinations | - | 524 | 450 | 368 | 459 | 459 | 586 | **2,846** |
| **Total** | | **1,998** | **1,981** | **1,970** | **2,217** | **2,180** | **2,299** | **12,645** |

**Table 4.34**
**Fracture of the hip: top 75% stem/head combinations used in hemiarthroplasty (HA) 2019 – 2024**

| Stem component | Head component |
|---|---|
| Amistem-C | Hemihead SS |
| Amistem-C | Medacta bipolar head |
| Amistem-C | Medacta endohead |
| Arcad | OHST bipolar head |
| Avenir (cem) | ZB bipolar head |
| Avenir (cem) | ZB unipolar head |
| CCA | Hemihead SS |
| CCA | Mathys bipolar steel head |
| Centris | Hemihead SS |
| Corail (cem) | J&J modular head carthcart |
| Corail (cem) | S&N bipolar ballhead |
| Exacta S | Endoheads |
| Harmony (cem) | Acropole bipolar head |
| Harmony (cem) | OHST bipolar head |
| Harmony (cem) | Symbios bibop |
| MS-30 | ZB bipolar head |
| Original Mueller | ZB unipolar head |
| Quadra-C | Medacta bipolar head |
| Quadra-C | Medacta endohead |
| Twinsys (cem) | Hemihead SS |
| Twinsys (cem) | Mathys bipolar steel head |
| Weber | ZB bipolar head |
| Weber | ZB unipolar head |
| other combinations | - |

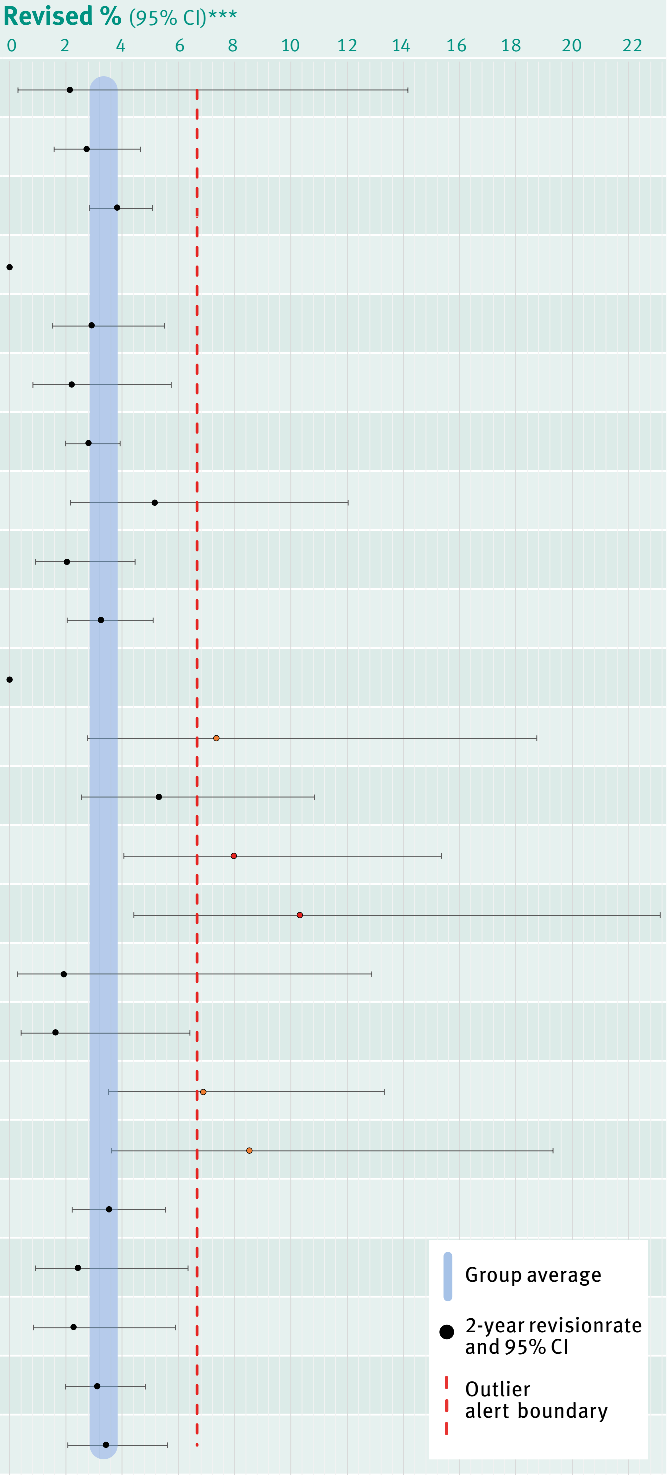


**Figure 4.43 – Part one**

2-year evaluation: Revision rates within 24 months of hybrid primary total hip arthroplasty combinations to treat fractures

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

| Stem component | Head component | CCS* | at risk N** | Revised N | % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-C | Hemihead SS | 54 | 54 | 1 | 2.1 (0.3-14.2) |
| Amistem-C | Medacta bipolar head | 24 | 526 | 13 | 2.7 (1.6-4.7) |
| Amistem-C | Medacta endohead | 29 | 1,403 | 45 | 3.8 (2.8-5.1) |
| Arcad | OHST bipolar head | 73 | 56 | 0 | 0.0 (.-.) |
| Avenir (cem) | ZB bipolar head | 30 | 347 | 9 | 2.9 (1.5-5.5) |
| Avenir (cem) | ZB unipolar head | 21 | 213 | 4 | 2.2 (0.8-5.8) |
| CCA | Hemihead SS | 32 | 1,469 | 33 | 2.8 (2.0-3.9) |
| CCA | Mathys bipolar steel head | 27 | 124 | 5 | 5.1 (2.2-12.0) |
| Centris | Hemihead SS | 40 | 324 | 6 | 2.0 (0.9-4.5) |
| Corail (cem) | J&J modular head carthcart | 19 | 633 | 18 | 3.2 (2.0-5.1) |
| Corail (cem) | S&N bipolar ballhead | 89 | 61 | 0 | 0.0 (.-.) |
| Exacta S | Endoheads | 100 | 69 | 4 | 7.3 (2.8-18.7) |
| Harmony (cem) | Acropole bipolar head | 97 | 154 | 7 | 5.3 (2.5-10.8) |
| Harmony (cem) | OHST bipolar head | 84 | 111 | 8 | 8.0 (4.1-15.3) |
| Harmony (cem) | Symbios bibop | 100 | 54 | 5 | 10.3 (4.4-23.1) |
| MS-30 | ZB bipolar head | 69 | 59 | 1 | 1.9 (0.3-12.9) |
| Original Mueller | ZB unipolar head | 26 | 152 | 2 | 1.6 (0.4-6.4) |
| Quadra-C | Medacta bipolar head | 46 | 125 | 8 | 6.9 (3.5-13.3) |
| Quadra-C | Medacta endohead | 46 | 68 | 5 | 8.5 (3.6-19.3) |
| Twinsys (cem) | Hemihead SS | 21 | 583 | 18 | 3.5 (2.2-5.5) |
| Twinsys (cem) | Mathys bipolar steel head | 22 | 179 | 4 | 2.4 (0.9-6.3) |
| Weber | ZB bipolar head | 50 | 193 | 4 | 2.3 (0.8-5.9) |
| Weber | ZB unipolar head | 34 | 683 | 19 | 3.1 (2.0-4.8) |
| other combinations | - |  | 500 | 15 | 3.4 (2.1-5.6) |
| **CH average for group** |  |  |  |  | **3.3 (2.9-3.8)** |

**Figure 4.43 – Part two**

**2-year evaluation: Revision rates within 24 months of hybrid primary total hip arthroplasty combinations to treat fractures**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

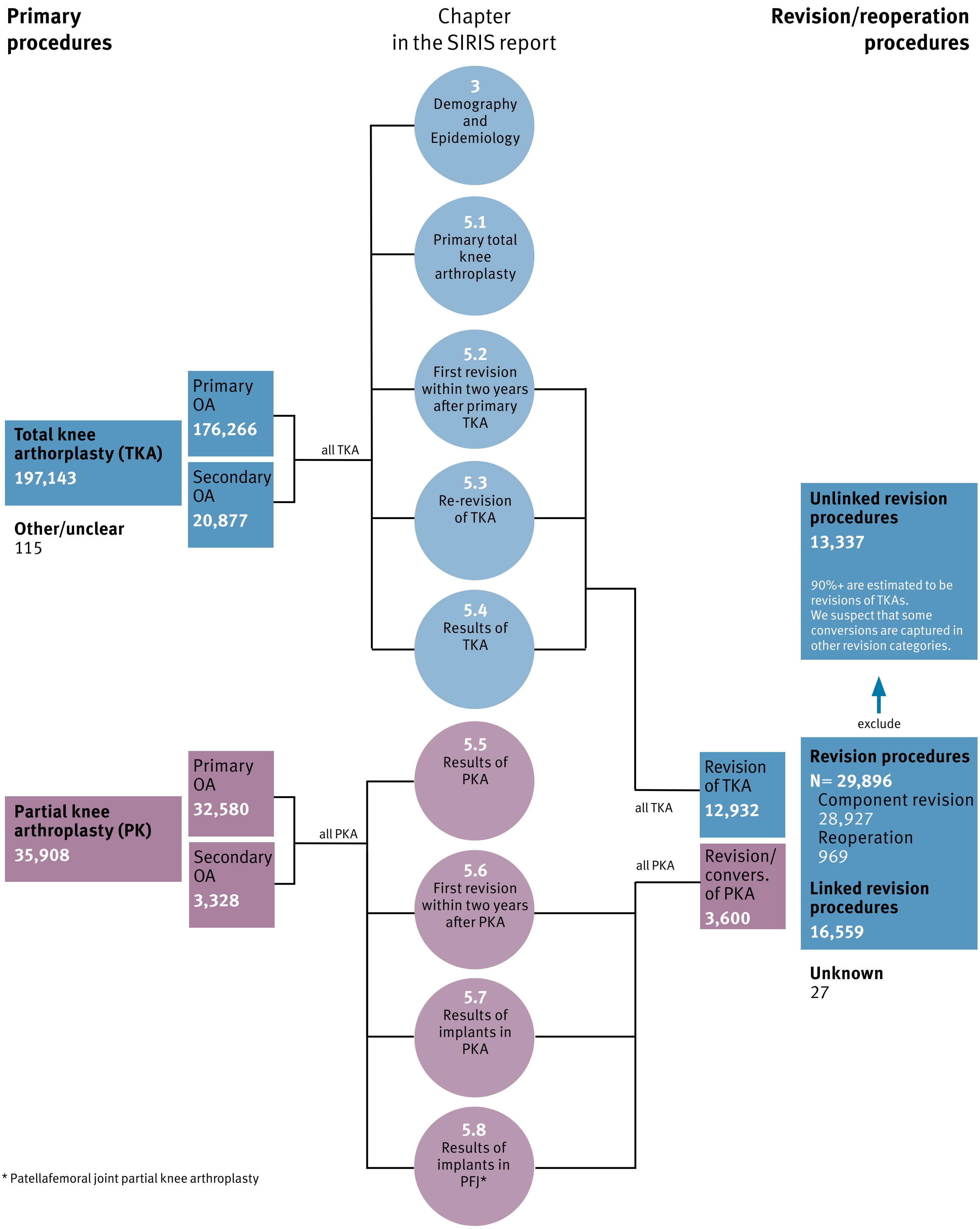
** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

# Knee arthroplasty

# 5. Knee arthroplasty

## Overview of data structure



* Patellafemoral joint partial knee arthroplasty

## Overview of of types of analyses for determining revision rates

| Types of analysis<br>Report section | **Kaplan-Meier estimates** 2012 – 2024<br>**Adjusted for censoring events** | **2-year revision rates** (implants 2019 – 2022 with completed 2-year follow-up)<br>**Adjusted for censoring events** | **Funnel plots of 2-year hospital revision rates** (implants 2019 – 2022 with completed 2-year follow-up)<br>**Risk-adjusted and adjusted for censoring events** |
|---|---|---|---|
| **Knee overview** | All total knee arthroplasties (TKA)<br>All partial knee arthroplasties (PKA) | | TKA after primary osteoarthritis (primary OA). **ANQ online reporting, above 99.8%= outlier status**<br>All partial knee arthroplasties (PKA)<br>TKA after primary OA without isolated patella resurfacing |
| **First revision of primary TKA** | TKA for various subgroups | TKA for various subgroups | |
| **First revision of primary PKA** | PKA for various subgroups | PKA for various subgroups | |
| **Re-revision after revision of TKA/PKA** | Re-revision after revised TKA for various subgroups<br>Re-revision after conversion from PKA to TKA | | |
| **Knee implants** (minimal number in group) | Bicondylar total knee systems, all diagnoses (500+)<br>Unicondylar partial knee systems, all diagnoses (500+)<br>Patellofemoral joint systems, all diagnoses (500+)<br>**Long-term evaluation 5–10 years: elevated revision rate or outlier** | Bicondylar total knee systems, all diagnoses (50+)<br>Unicondylar partial knee systems, all diagnoses (50+)<br>Patellofemoral joint systems, all diagnoses (50+)<br>**2-year evaluation (two times group average= outlier status)** | |

## 5.1 Primary total knee arthroplasty

The total number of primary TKA registered in SIRIS at the end of 2024 reached 197,143 cases **(Table 3.10)**. The share of women (59.0%) and the mean age of the patients (69.8 years) remained constant throughout the entire registration period **(Table 3.11)**. Please consult also **Chapter 3.3.2** for further details regarding incidence and demographic characteristics.

| **N (2019 – 2024)** | **N** | **%** |
|---|---|---|
| **Previous surgery** | | |
| None | 74,793 | 68.3 |
| Knee arthroscopy | 16,658 | 15.2 |
| Meniscectomy | 19,786 | 18.1 |
| ACL reconstruction | 6,089 | 5.6 |
| Osteotomy tibia close to knee | 2,618 | 2.4 |
| Osteosynthesis tibia close to knee | 1,578 | 1.4 |
| Surgery for patella stabilization | 1,369 | 1.3 |
| Synovectomy | 834 | 0.8 |
| Osteotomy femur close to knee | 449 | 0.4 |
| Osteosynthesis femur close to knee | 549 | 0.5 |
| Surgery for treating infection | 198 | 0.2 |
| Surgery for tumor | 44 | 0.0 |
| Other | 2,034 | 1.9 |
| **Total TKA (multiple responses)** | **109,489** | |
| **Intervention** | | |
| CS (cruciate sacrificing) / UCOR | 26,065 | 23.8 |
| PS (posterior stabilised) | 29,105 | 26.6 |
| PCR (posterior cruciate retaining) | 27,851 | 25.4 |
| BCR (bicruciate retaining) | 946 | 0.9 |
| Hinge type | 2,186 | 2.0 |
| SC/ CCK (semi-constrained/ constrained) | 1,414 | 1.3 |
| Other (Medial-Pivot)* | 21,291 | 19.4 |
| Other | 565 | 0.5 |
| **Technology** | | |
| Conventional (including minimally invasive) | 73,540 | 67.2 |
| Computer assisted / navigation | 10,165 | 9.3 |
| Patient specific instrumentation | 19,861 | 18.1 |
| Robotic-assisted (v2021) | 6,568 | 6.0 |
| Other | 1,394 | 1.3 |
| **Total TKA (multiple responses)** | **109,489** | |

| **N (2021 – 2024)** | **N** | **%** |
|---|---|---|
| **Additional intervention** | | |
| None | 74,327 | 95.6 |
| Osteosynthesis FE | 90 | 0.1 |
| Osteosynthesis TI | 73 | 0.1 |
| Osteosynthesis PAT | 6 | 0.0 |
| Removal of metalwork | 993 | 1.3 |
| Operation extensors | 462 | 0.6 |
| Reconstruction plasty | 82 | 0.1 |
| Tibial tubercle osteotomy | 1,057 | 1.4 |
| Other additional intervention(s) | 858 | 1.1 |
| **Total TKA (multiple responses)** | **77,746** | |
| **Addtional components** | | |
| Stem FE (cemented)* | 1,321 | 1.7 |
| Stem FE (uncemented)** | 431 | 0.6 |
| Stem TI (cemented)*** | 4,652 | 6.0 |
| Stem TI (uncemented)*** | 711 | 0.9 |
| Sleeve FE | 47 | 0.1 |
| Sleeve TI | 140 | 0.2 |
| Augments FE | 98 | 0.1 |
| Augments TI | 164 | 0.2 |
| Augments PAT | 2 | 0.0 |
| Bone homologous | 47 | 0.1 |
| Bone autologous | 135 | 0.2 |
| Cone FE | 6 | 0.0 |
| Cone TI | 43 | 0.1 |
| **Total TKA (multiple responses)** | **77,935** | |

* 60% with cement restrictor.
** 32% with coating.
*** 25% with cement restrictor.
**** 35% with coating

**Table 5.1**

**Primary total knee arthroplasty: Surgery characteristics**

All diagnoses. *Medial pivot was not available as a response category before SIRIS v2021.
All GMK Sphere knee systems are counted as medial pivot, regardless of the type chosen locally at data entry.

### Previous surgery

Between 2019 and 2024, no previous surgery was recorded in 68.3% of the TKA registered, while 18.1% had former meniscectomy and 15.2% arthroscopy. Preceding ACL reconstruction was registered in 5.6%, and osteotomy at tibial level in 2.4%, but at the femur only in 0.4%. All other conditions were rare, in 1.9% “other” former surgeries were reported **(Table 5.1).** The rate of previous arthroscopies preceding TKA in primary OA was constantly decreasing since 2012 and reached only 13% in 2024. The share of previous arthroscopy was much higher in secondary OA, reaching 25% in 2024, a rate remaining constant over the past 4 years **(Figure 5.1).**

### Type of knee prosthesis

The classification of the TKA systems registered in SIRIS was adapted in 2021 with the last revision of the case report form (CRF), because of previously not unambiguous terminology. Between 2019 and 2024, the share of cruciate-sacrificing/ultra congruent systems (CS/UCOR) was 23.8%, for posterior stabilised (PS) it was 26.6% and posterior cruciate-retaining (PCR/CR) it was 25.4%. A medial pivot (MP) was used in 19.4%, whereas semi-constrained/constrained condylar knees (SC/CCK) or hinged implants were used only in 1.3% and 2.0% of the cases, respectively. Bi cruciate-retaining knees (BCR) were rarely used (0.9%) as well **(Table 5.1).** The share of MP implants seemed to further increase nationwide and replace more traditional designs such as PS, PCR/CR and CS/UCOR. The proportion of SC/CCK TKA was approximately 1.5% in primary and approximately 3.1% in secondary OA. For hinged systems, the share almost tripled in secondary OA (approx. 4.6% versus approx. 1.6% in primary OA). Of note, the knee replacement systems used varied significantly between cantons, regions, and hospitals **(see chapter 3.3.5).**

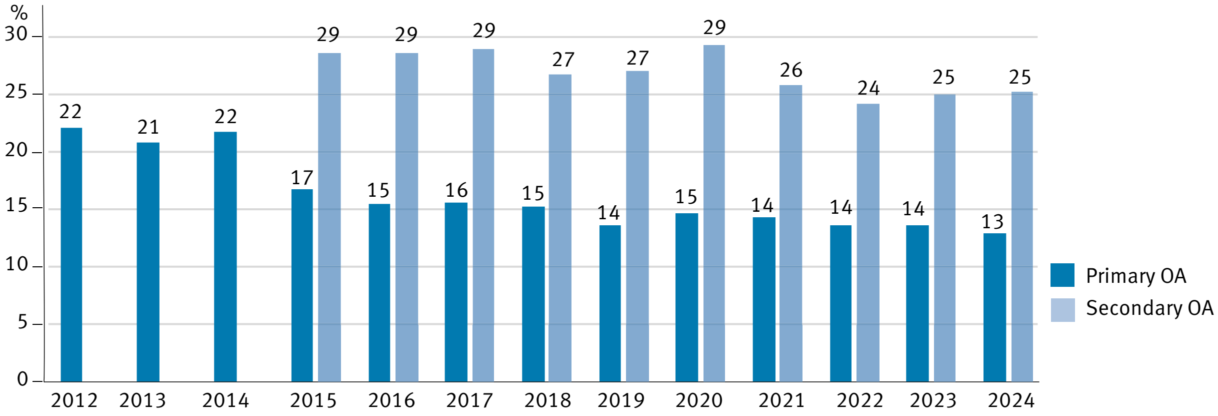


**Figure 5.1**

**Share of TKA patients who had knee arthroscopy prior to arthroplasty (%)**

Sec. OA categories were different before 2015 and therefore cannot be compared

* Including “arthritis after meniscus surgery”

### Type of bearing

The rate of mobile polyethylene (PE) liners rapidly decreased over the past six years, from 36.5% in 2019 to 16.4% in 2024 **(Figure 3.26)**. However, one must note that the choice of bearing type showed again a high variability among the different cantons, including the Principality of Liechtenstein **(Figure 3.27) (see also chapter 3.3.5)**. As the Swiss joint registry started in 2012, most of the implanted polyethylene (PE) liners were made of highly cross-linked PE (HX-LPE) and comparison to conventional, ultra-high molecular weight PE does not make sense.

### Patella resurfacing

The patella was not resurfaced in 63.1% of primary TKA during the period 2019 to 2024 **(Figure 3.28)**. However, the resurfacing rate increased continuously from 32.0% in 2019 to 43.2% in 2024. However, there were again considerable differences between the cantons **(see chapter 3.3.5)**.

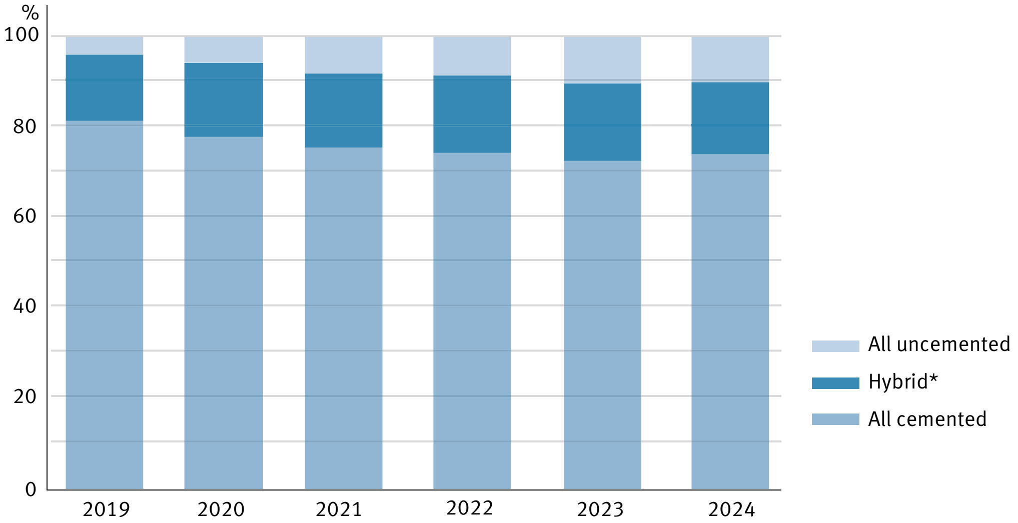
### Fixation

Fixation of TKA was predominantly fully cemented, with a proportion of 75.7% over the past six years. Use of hybrid fixation of the components remained constant with 16.1%. Interestingly, cementless fixation represented only 4.0% of the TKA in 2019, but the share more than doubled within 6 years to 10.0% in 2024 **(Figure 5.2)**.

### Stems and additional components

More information about components in primary TKA was introduced with the 2021 version of the CRF, improving registering precision.

Stems (femoral and/or tibial) were used in 9.2% of primary TKA. In three quarters (75.4%) of the cases, this was on the tibial side (6.9% of all TKA), and 83.9% of the stems were cemented. Tibial stems were cemented in 86.7%, femoral ones in 75.4% **(Table 5.1)**.



| Component fixation [%] | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|
| **N** | **15,607** | **15,467** | **16,814** | **19,315** | **20,706** | **21,568** | **109,477** |
| All uncemented | 4.0 | 5.5 | 8.0 | 8.5 | 10.2 | 10.0 | 8.0 |
| Hybrid* | 14.1 | 16.3 | 16.2 | 17.0 | 17.0 | 15.7 | 16.1 |
| All cemented | 81.5 | 77.7 | 75.6 | 74.4 | 72.6 | 74.1 | 75.7 |

**Figure 5.2**

**Primary total knee arthroplasty: Component fixation**

All diagnoses. * femur uncemented, tibia cemented

Use of a tibial stem was not associated with obesity (BMI ≥30 kg/m²) , despite such recommendations from several studies. The use of stems, both on the tibial and femoral side, was mainly associated with higher intrinsic stability of the knee system (SC/CCK or hinge type) causing more stress at the interface between bone and implant. Stems were also used more frequently in PS than in the PCR/CR, CS, or MP designs **(Figure 5.3).** Over time there was nevertheless a clear increase in using stems in cemented tibial components since 2021 compared to former years **(Figure 5.4).**

Sleeves, cones, augments, or additional homologous or autologous bone grafting were rarely necessary in primary TKA **(Table 5.1)**.

## Additional interventions

Additional interventions were rarely performed during primary TKA (4.4% of the cases on average between 2019 to 2024). The removal of internal fixation devices (1.3%) and osteotomies of the tibial tubercle (1.4%) were the most common additional surgical steps, while 1.1% were reported as "other" **(Table 5.1).**

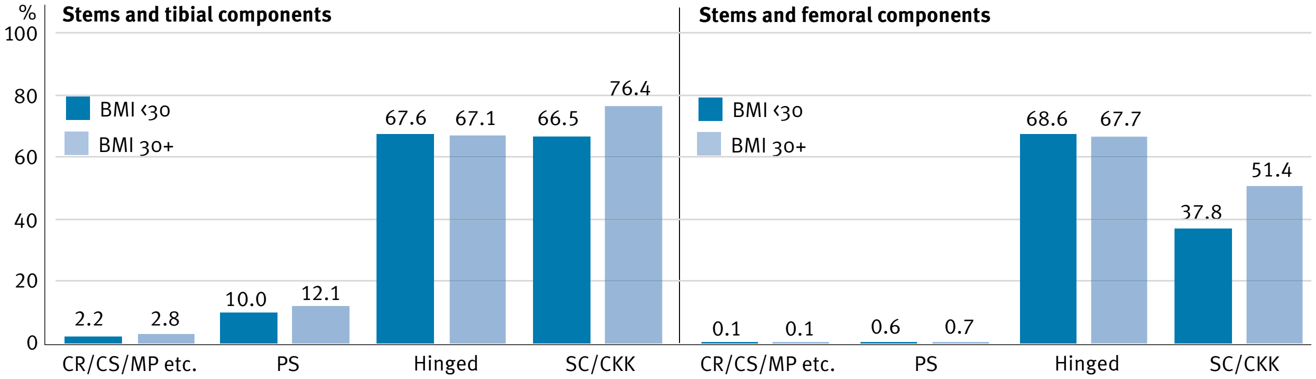


**Figure 5.3**

Use of stems by BMI and type of knee system (%)

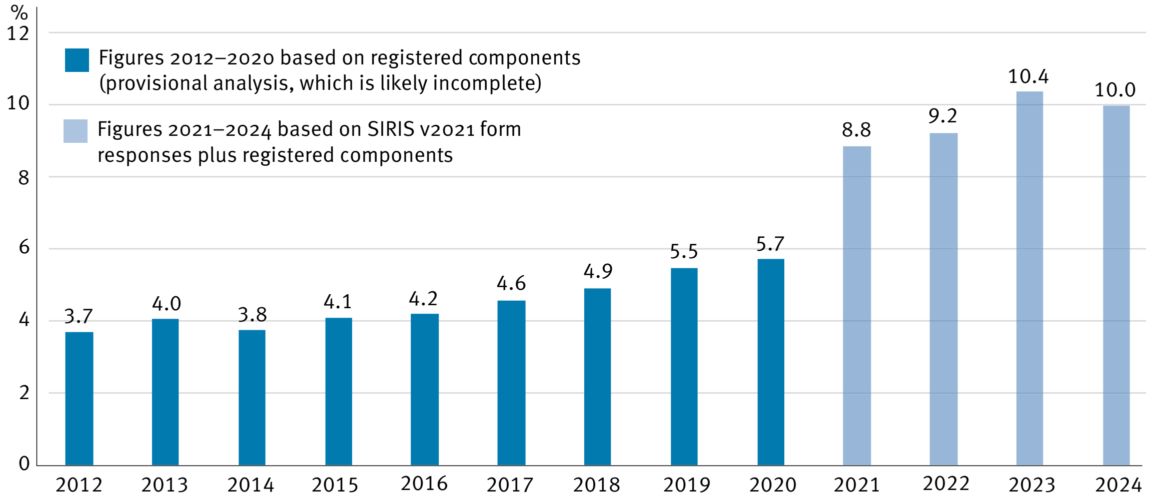


**Figure 5.4**

Use of stems as a percentage of primary TKAs with cemented tibial components

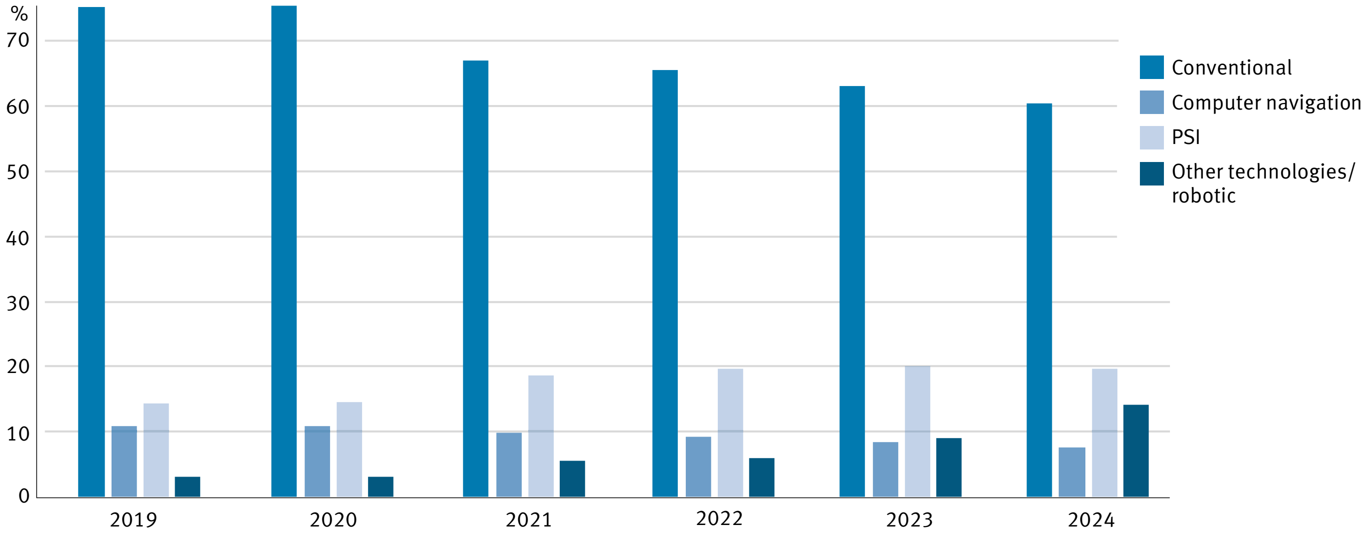
Can be femoral or tibial stems; form responses suggest 3:1 TI stems to FE stems

### Technology

Between 2019 and 2024, 67.2% of the primary TKA in Switzerland were performed conventionally, without additional technological assistance. The share of conventional TKA decreased continuously from 70.9% in 2019 to 60.5% in 2024 **(Table 5.1, Figure 5.5).**

The share of computer navigation continuously decreased from 10.8% in 2019 to 7.5% in 2024. On the other hand, the use of patient-specific instrumentation (PSI) increased from 14.4% in 2019 and 14.6% in 2020 to approximately 20% in the following years reaching 19.7% in 2024. Robotic-assisted TKA (imageless and image-based), formerly classified as "other", increased from 3.1% in 2019 to 14.0% in 2024 (Figure 5.5). Of note, the different robotic systems are not yet differentiated due to limited numbers.

In summary, surgeons used technical support in 44.2% of TKA over the past 6 years **(Table 5.1).** Minimal invasive surgery is no longer a topic in Switzerland. It was removed from the CRF in 2021, as there was no uniformly accepted definition, limiting the reliability of the data.



| **Technology [%]** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2019–2024** |
|---|---|---|---|---|---|---|---|
| **N** | **15,614** | **15,469** | **16,816** | **19,316** | **20,706** | **21,568** | **109,489** |
| Conventional | 75.8 | 75.5 | 66.8 | 65.5 | 63.1 | 60.5 | 65.8 |
| Computer navigation | 10.8 | 10.8 | 9.8 | 9.2 | 8.5 | 7.5 | 9.3 |
| PSI | 14.4 | 14.6 | 18.7 | 19.7 | 20.1 | 19.7 | 18.1 |
| Other technologies/robotic | 3.1 | 3.1 | 5.4 | 6.0 | 8.9 | 14.0 | 7.2 |

**Figure 5.5**

**Primary total knee arthroplasty: technologies used**

All diagnoses. Multiple responses possible (percentages do not sum to 100).

## 5.2 Revision of primary total knee arthroplasty implanted before 2012

Revisions that cannot be linked to an index arthroplasty registered in SIRIS are named “unlinked” revisions, whereas index arthroplasties were registered in SIRIS for “linked” revisions (see below).

The share of unlinked revisions steadily decreased from 96% in 2013 to 32.7% in 2023 (848 cases). The proportion of unlinked TKA revisions over the whole observation period therefore was 46.7%. A total of 5,325 unlinked TKA revisions were performed between 2018 and 2023. The rate of unlinked revision TKA decreases more rapidly than in THA, most probably attributable to the fact that TKA are revised earlier and more frequently than THA.

Because of rapidly decreasing share of unlinked revisions, these older cases are of limited and continuously decreasing value and were not analysed further in this report.

| | | Primary | Revised within 24 months | | | |
|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | |
| | | N at risk* | N | %** | lower | upper |
| Overall (moving average) | | 67,217 | 2,280 | 3.4 | 3.3 | 3.6 |
| Diagnosis | Primary OA | 59,018 | 1,942 | 3.3 | 3.2 | 3.5 |
| | Secondary OA | 8,199 | 338 | 4.2 | 3.8 | 4.6 |
| Overall Primary OA | | 59,018 | 1,942 | 3.3 | 3.2 | 3.5 |
| Gender | Women | 35,999 | 1,131 | 3.2 | 3.0 | 3.4 |
| | Men | 23,018 | 811 | 3.6 | 3.3 | 3.8 |
| Age | <55 | 2,894 | 154 | 5.4 | 4.6 | 6.2 |
| group [%] | 55–64 | 13,406 | 536 | 4.0 | 3.7 | 4.4 |
| | 65–74 | 21,634 | 722 | 3.4 | 3.1 | 3.6 |
| | 75–84 | 18,258 | 468 | 2.6 | 2.4 | 2.8 |
| | 85+ | 2,824 | 62 | 2.3 | 1.8 | 2.9 |
| BMI group | <18.5 | 275 | 11 | 4.1 | 2.3 | 7.3 |
| | 18.5–24.9 | 11,147 | 310 | 2.8 | 2.5 | 3.1 |
| | 25–29.9 | 19,977 | 632 | 3.2 | 3.0 | 3.5 |
| | 30–34.9 | 13,185 | 450 | 3.5 | 3.2 | 3.8 |
| | 35–39.9 | 5,603 | 223 | 4.0 | 3.5 | 4.6 |
| | 40+ | 2,493 | 95 | 3.9 | 3.2 | 4.7 |
| | BMI unknown | 6,338 | 221 | 3.5 | 3.1 | 4.0 |
| Morbidity | ASA 1 | 3,797 | 113 | 3.0 | 2.5 | 3.6 |
| state | ASA 2 | 34,889 | 1,129 | 3.3 | 3.1 | 3.5 |
| | ASA 3 | 17,181 | 609 | 3.6 | 3.3 | 3.9 |
| | ASA 4/5 | 250 | 11 | 4.6 | 2.6 | 8.2 |
| | ASA unknown | 2,901 | 80 | 2.8 | 2.2 | 3.5 |

**Table 5.3**

**First revision of primary total knee arthroplasty within 24 months overall and according to baseline characteristics**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

** Rates adjusted for effects of mortality and emigration.

## 5.3 First revision within two years after primary TKA

Following international guidelines, a revision is defined as the addition or the exchange of any component. Therefore, a secondary patella resurfacing is a revision by definition. SIRIS has been recording all revision procedures since 2012, irrespective of whether it was the first or any subsequent revision. Linked revisions form the basis for calculations of survival and revision rates and may be separated into first revisions and repeat revisions. The first revision serves to define primary implant survival, but only primary OA is used for this benchmark. Cases with isolated previous meniscus surgery were also included in the group of primary OA.

Other causes of secondary OA, such as previous ligament surgery, fracture fixation, osteotomy or inflammatory arthritis, etc., were excluded, as associated revision rates may be influenced by and increased due to the underlying diagnosis.

In the current 4-year moving window from 1.1.2019 to 31.12.2022 with a complete 2-year follow-up until 31.12.2024, a total of 67,217 TKA have been registered. Of those, 2,280 were revised within two years, resulting in a 2-year revision rate of 3.4% (CI 3.3 – 3.6%) **(Table 5.3).**

For incidence and demography please consult **chapter 3.3.4.**

## 5.3.1 Reasons for first revision

The most frequent reason for first revision were patella problems, registered in 36.0%. Additionally, an instability of the patella was reported in 4.4%. Infection (21.5%) and femorotibial instability (18.5%) were the second and third most frequent reasons. Loosening of the tibial component was indicated in 7.7% of the cases, joint stiffness in 8.6% and pain of unclear origin in 3.6%. Wear of the liner was reported rarely (0.7%) but represents a surprising reason for early revision **(Table 5.4).** Periprosthetic fractures of the femur, tibia, and/or patella were rarely responsible for early revision. However, most cases treated only with internal fixation were probably not registered, respectively do not represent revisions following the usual definition. Still, 10.5% of the reasons for revision were classified as “other”. This diverse group mostly includes the same reasons as listed above, but with added details and includes wound healing problems and further reasons, such as liner dislocation. Excluding periprosthetic infections and fractures, most of the other reasons appeared to be related to surgeon’s errors in technique and/or indication.

| Reason for revision | N | % |
|---|---|---|
| Patella problems | 821 | 36.0 |
| Infection | 490 | 21.5 |
| Femorotibial instability | 422 | 18.5 |
| Loosening tibia | 176 | 7.7 |
| Pain (of unclear origin)* | 81 | 3.6 |
| Joint stiffness/arthrofibrosis | 195 | 8.6 |
| Component malposition femur | 89 | 3.9 |
| Component malposition tibia | 112 | 4.9 |
| Loosening femur | 86 | 3.8 |
| Patellar instability | 100 | 4.4 |
| Wear of inlay | 15 | 0.7 |
| Loosening patella | 19 | 0.8 |
| Periprosthetic fracture femur | 29 | 1.3 |
| Sizing femoral component | 41 | 1.8 |
| Periprosthetic fracture tibia | 19 | 0.8 |
| Sizing tibial component | 18 | 0.8 |
| Periprosthetic fracture patella | 14 | 0.6 |
| Other | 240 | 10.5 |
| **Total Revisions** | **2,280** | |

**Table 5.4**

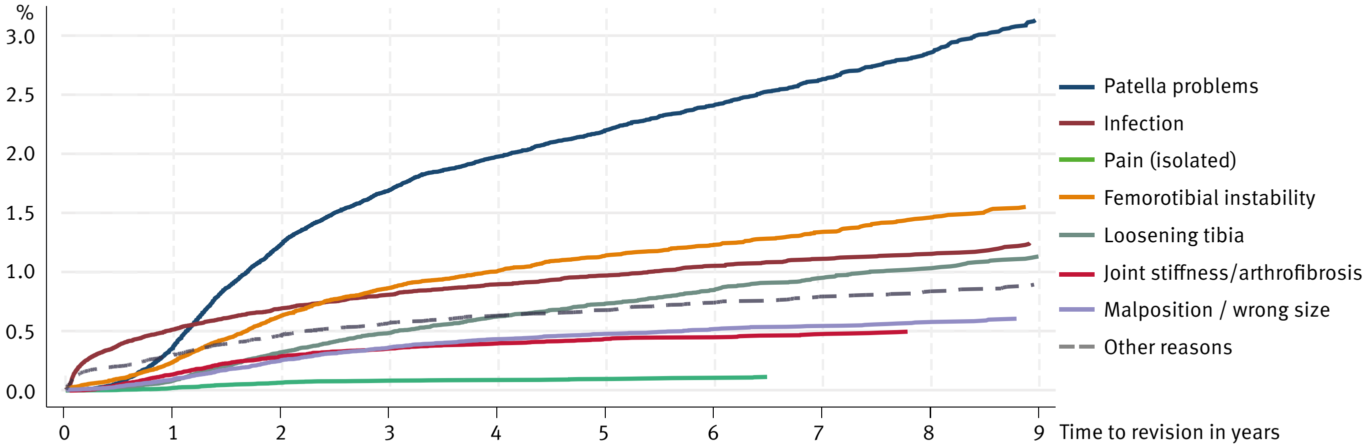
**Reason for revision* of primary total knee arthroplasty**

All diagnoses. 4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024). Early first revisions are those occurring within 2 years of the primary arthroplasty. Multiple responses possible (percentages do not sum to 100)

* Pain was frequently reported alongside other reasons. The proportion of “isolated pain” was 3.2%. The wording was adapted in v2021 and the share dropped accordingly in 2021

Cumulative incidence rates of revision from 2015 to 2024 show patella problems to be the most frequent reason for revision within one year after TKA, and corresponding revision rates increase thereafter more rapidly than for all other reasons **(Figure 5.6).**

Kernel density estimation – an evaluation of the frequency of an event at a given time – depicts that infections were the most prominent reason for revision early after primary TKA, later declining, whereas peaks for other reasons such as patella problems, femorotibial instability, isolated pain of unknown origin and loosening of the tibial component, appeared after 9 months follow-up to culminate at 15 months, reflecting the usual pattern in patients with unsatisfactory results after TKA, “wait and see” often being recommended initially. The bell-like pattern shows the increasing revision rates over time, in what might resemble logistic growth curves (slow increase fol-



| Revision diagnosis | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **0.4** (0.3-0.4) | **1.2** (1.2-1.3) | **1.7** (1.6-1.8) | **2.2** (2.1-2.3) | **2.4** (2.3-2.5) | **2.9** (2.7-3.0) | **3.1** (3.0-3.3) |
| Infection | **0.5** (0.5-0.6) | **0.7** (0.7-0.7) | **0.8** (0.8-0.9) | **1.0** (0.9-1.0) | **1.1** (1.0-1.1) | **1.2** (1.1-1.2) | **1.2** (1.2-1.3) |
| Pain (isolated) | **0.0** (0.0-0.0) | **0.1** (0.1-0.1) | **0.1** (0.1-0.1) | **0.1** (0.1-0.1) | **0.1** (0.1-0.1) | **0.1** (0.1-0.1) | **0.1** (0.1-0.1) |
| Femorotibial instability | **0.2** (0.2-0.3) | **0.6** (0.6-0.7) | **0.9** (0.8-0.9) | **1.1** (1.1-1.2) | **1.2** (1.2-1.3) | **1.5** (1.4-1.5) | **1.6** (1.5-1.7) |
| Loosening TI | **0.1** (0.1-0.1) | **0.3** (0.3-0.4) | **0.5** (0.5-0.5) | **0.7** (0.7-0.8) | **0.9** (0.8-0.9) | **1.0** (1.0-1.1) | **1.1** (1.0-1.2) |
| Joint stiffness / arthrofibrosis | **0.1** (0.1-0.2) | **0.3** (0.3-0.3) | **0.4** (0.3-0.4) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.5-0.5) | **0.5** (0.5-0.5) |
| Malposition / wrong size | **0.1** (0.1-0.1) | **0.3** (0.2-0.3) | **0.4** (0.3-0.4) | **0.5** (0.4-0.5) | **0.5** (0.5-0.6) | **0.6** (0.5-0.6) | **0.6** (0.6-0.7) |
| Other reasons | **0.3** (0.3-0.3) | **0.5** (0.4-0.5) | **0.6** (0.5-0.6) | **0.7** (0.6-0.7) | **0.7** (0.7-0.8) | **0.8** (0.8-0.9) | **0.9** (0.8-1.0) |

**Figure 5.6**

**Cumulative incidence rates for different revision diagnosis of primary total knee arthroplasty**

Time since operation, 2015–2024, all services, % of implants revised. Detailed reasons for revisions available since 2015 lowed by steeper growth and finally flattening-out). Patella problems contributed to the observed pattern of revisions, causing a disproportionate number of revisions between 11.3 and 18.8 months after implantation, with the peak at 14.9 months. Revision for joint stiffness showed a flatter pattern, with a maximum at 12.4 months **(Figure 5.7 and Table 5.5).**

## 5.3.2 Fixation and first revision

Uncemented TKA were revised significantly more often (4.2%, CI 3.6 – 4.8%) than fully cemented TKA (3.4%, CI 3.2 – 3.5%) within the first two years after the index surgery **(Table 5.6).** The wider confidence interval of uncemented TKA reflects the smaller number of cases (the share of uncemented TKA was 10.0% only in 2024). The difference among the revision rates of the various fixation types was statistically significant only the first three years after TKA **(Figure 5.8).** It seems that the higher revision rate of uncemented TKA is mainly due to an increased risk for up to three years after operation, perhaps reflecting failed osteointegration or failures due to malalign-

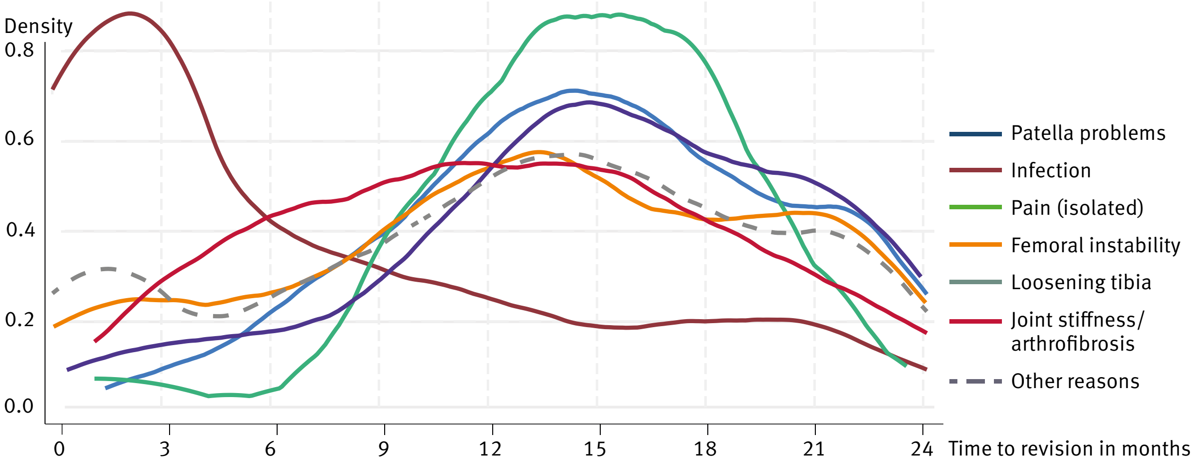


**Figure 5.7**

**Time interval between primary total knee arthroplasty and first revision by reason**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

| Reason for revision | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Patella problems | 821 | 14.9 | 11.3 | 18.8 |
| Infection | 490 | 4.5 | 1.2 | 11.7 |
| Pain (isolated) | 24 | 14.9 | 12.0 | 17.4 |
| Femoral instability | 422 | 13.5 | 8.4 | 18.9 |
| Loosening tibia | 176 | 15.5 | 11.8 | 19.7 |
| Joint stiffness/arthrofibrosis | 195 | 12.4 | 8.1 | 17.1 |
| Other | 1,290 | 13.4 | 7.9 | 18.0 |

**Table 5.5**

**Median time interval between primary total knee arthroplasty and early first revision (in months) according to reason**

All diagnoses. Early first revisions are those occurring within 2 years of the primary arthroplasty.
4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024)

ment and/or insufficient bone quality. From the 4th year after index surgery onwards, the curve is moving on a higher level than for the cemented and the hybrid fixation TKA but evolving in parallel. All curves seem to converge 8 years after surgery **(Figure 5.8).** Hybrid fixation performed as well as fully cemented TKA, with a 2-year revision rate of 3.4% (CI 3.1 – 3.8%) and lost therefore advantages regarding revision rates observed in former SIRIS reports.

Younger age (<60 years) was correlated with an elevated early revision rate, irrespective of the fixation method (see above). It is important to consider that all TKA brands were included in this KM estimation of cumulative revision risk, mixing in various effects.

| | | Primary TKA | Revised within 24 months | | | |
|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | |
| | | N at risk[1] | N | %[2] | lower | upper |
| | Overall | 67,217 | 2,280 | 3.4 | 3.3 | 3.6 |
| **Component fixation** | All cemented | 51,824 | 1,723 | 3.4 | 3.2 | 3.5 |
| | All uncemented | 4,452 | 185 | 4.2 | 3.6 | 4.8 |
| | Hybrid[3] | 10,732 | 363 | 3.4 | 3.1 | 3.8 |
| | Reverse hybrid[4] | 197 | 8 | 4.1 | 2.1 | 8.0 |
| **Patellar replacement** | With patellar replacement | 22,877 | 637 | 2.8 | 2.6 | 3.0 |
| | Without patellar replacem. | 44,303 | 1,642 | 3.8 | 3.6 | 3.9 |
| | Status after patellectomy | 25 | 0 | 0.0 | | |

[1] Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

[2] Rates adjusted for effects of mortality and emigration.

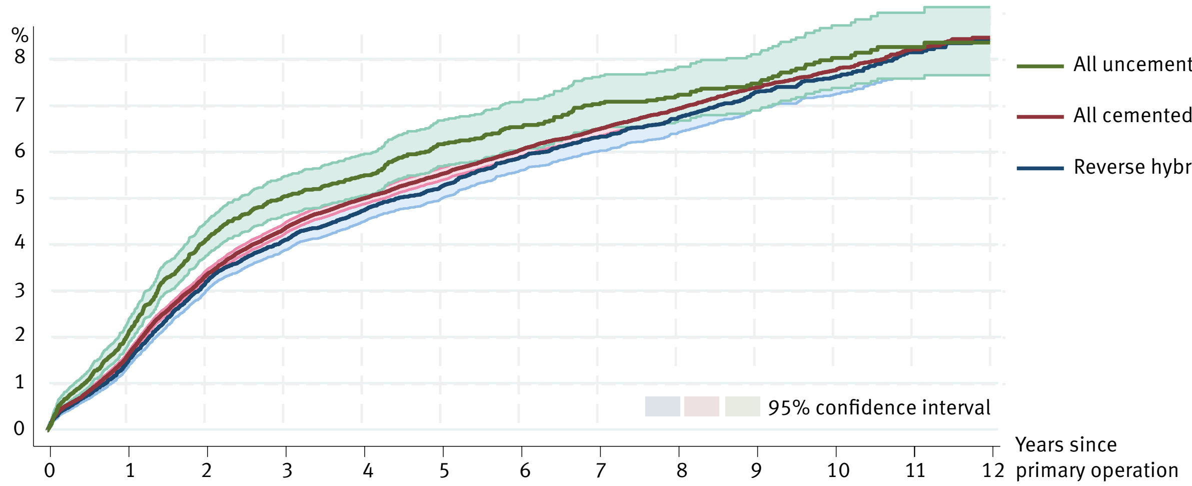
[3] femur uncemented, tibia cemented

[4] femur cemented, tibia uncemented

**Table 5.6**

**First revision of primary total knee arthroplasty within 24 months overall and according to component fixation**

All diagnoses. 4-year moving average covering impl. between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reverse hybrid | 35279 | 31010 | 26441 | 22808 | 19186 | 16496 | 14155 | 11959 | 9754 | 7557 | 5296 | 3092 | 843 |
| All cemented | 148064 | 128347 | 108381 | 92361 | 76191 | 63977 | 51581 | 40388 | 30166 | 20860 | 13074 | 6714 | 1676 |
| All uncemented | 13713 | 11204 | 8756 | 7041 | 5560 | 4657 | 4036 | 3506 | 2983 | 2425 | 1816 | 1107 | 304 |

| Fixation method | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| All cemented | **1.6** (1.5-1.6) | **3.3** (3.2-3.4) | **4.3** (4.2-4.4) | **5.5** (5.4-5.7) | **6.0** (5.9-6.2) | **6.9** (6.8-7.1) | **7.4** (7.2-7.6) | **7.8** (7.6-8.0) | **8.5** (8.2-8.8) |
| All uncemented | **2.0** (1.8-2.3) | **4.1** (3.7-4.5) | **5.0** (4.6-5.5) | **6.2** (5.7-6.7) | **6.5** (6.0-7.1) | **7.2** (6.7-7.8) | **7.5** (6.9-8.1) | **8.0** (7.4-8.7) | **8.4** (7.7-9.1) |
| Reverse hybrid | **1.4** (1.3-1.6) | **3.2** (3.0-3.4) | **4.1** (3.9-4.3) | **5.2** (5.0-5.5) | **5.9** (5.6-6.2) | **6.7** (6.4-7.1) | **7.3** (6.9-7.7) | **7.6** (7.2-8.0) | **8.4** (8.0-8.9) |

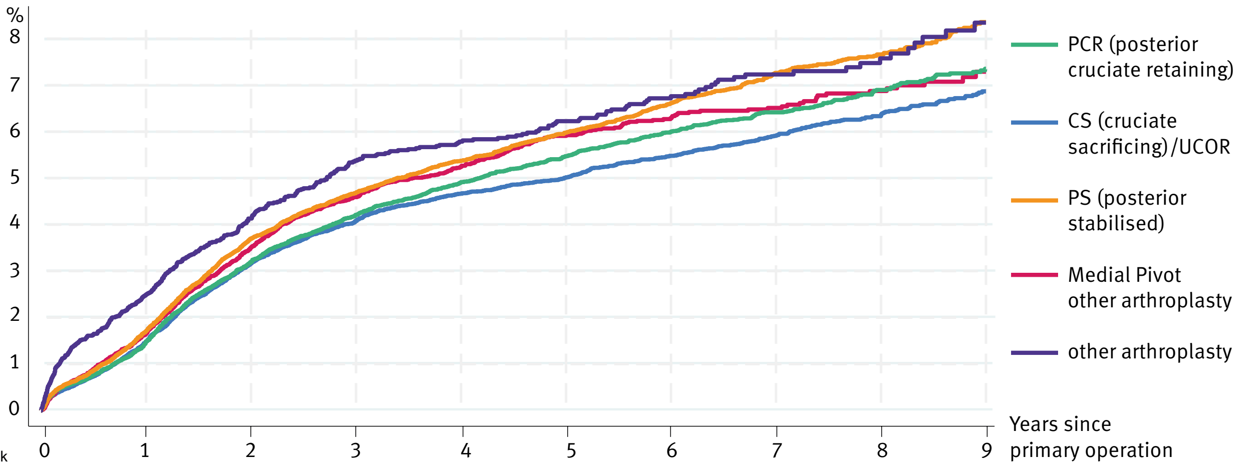
**Figure 5.8**

**Estimated failure rates of primary total knee arthroplasty for different fixation methods**

Time since operation, 2012–2024, all diagnoses.

### 5.3.3 The influence of the type of knee arthroplasty, the use of stems and the BMI on first revision

At two years of follow-up, differences in revision rates among types of TKA were small. Only PS showed a significantly higher revision rate (3.7%, CI 3.5 – 3.9%) than PCR/CR, UCOR or MP **(Figure 5.9)**. Different systems grouped as "other arthroplasty" had a higher early revision rate than all other TKA systems but this difference remained statistically not significant due to small numbers and therefore wider confidence intervals (4.1%, CI 3.7 – 4.6%). Up to mid-term, CS/UCOR seemed to perform best. This could be partially explained by a certain selection bias, as PS knees are usually selected for more complex cases with more pronounced deformities and ligament insufficiencies.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| CS / UCOR | 43577 | 37915 | 31610 | 26874 | 21870 | 17817 | 14058 | 10531 | 6800 | 3276 |
| Medial Pivot | 26668 | 20836 | 15479 | 11420 | 8278 | 6218 | 4341 | 2794 | 1636 | 677 |
| PCR | 42457 | 36031 | 29910 | 24642 | 19529 | 15578 | 11792 | 8557 | 5393 | 2543 |
| PS | 45891 | 39307 | 32486 | 26866 | 21534 | 17497 | 13242 | 9261 | 5808 | 2586 |
| other arthroplasty | 7947 | 6756 | 5642 | 4753 | 3757 | 2853 | 2056 | 1390 | 915 | 470 |

| Implant type | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| PCR (posterior cruciate retaining) | **1.5** (1.4-1.6) | **3.2** (3.0-3.4) | **4.2** (4.0-4.4) | **5.5** (5.2-5.7) | **6.0** (5.7-6.3) | **6.9** (6.6-7.3) | **7.4** (7.0-7.8) |
| CS (cruciate sacrificing) / UCOR | **1.5** (1.4-1.6) | **3.2** (3.0-3.3) | **4.1** (3.9-4.3) | **5.0** (4.8-5.3) | **5.5** (5.2-5.7) | **6.4** (6.1-6.7) | **6.9** (6.5-7.2) |
| PS (posterior stabilised) | **1.7** (1.6-1.8) | **3.7** (3.5-3.9) | **4.7** (4.5-4.9) | **6.0** (5.7-6.2) | **6.6** (6.3-6.9) | **7.7** (7.3-8.0) | **8.4** (7.9-8.8) |
| Medial Pivot* | **1.7** (1.5-1.8) | **3.5** (3.3-3.8) | **4.6** (4.3-4.9) | **5.9** (5.5-6.3) | **6.3** (5.9-6.7) | **6.9** (6.4-7.4) | **7.3** (6.7-7.9) |
| other arthroplasty | **2.5** (2.2-2.9) | **4.1** (3.7-4.6) | **5.4** (4.9-5.9) | **6.2** (5.6-6.9) | **6.8** (6.1-7.5) | **7.6** (6.8-8.4) | **8.3** (7.4-9.4) |

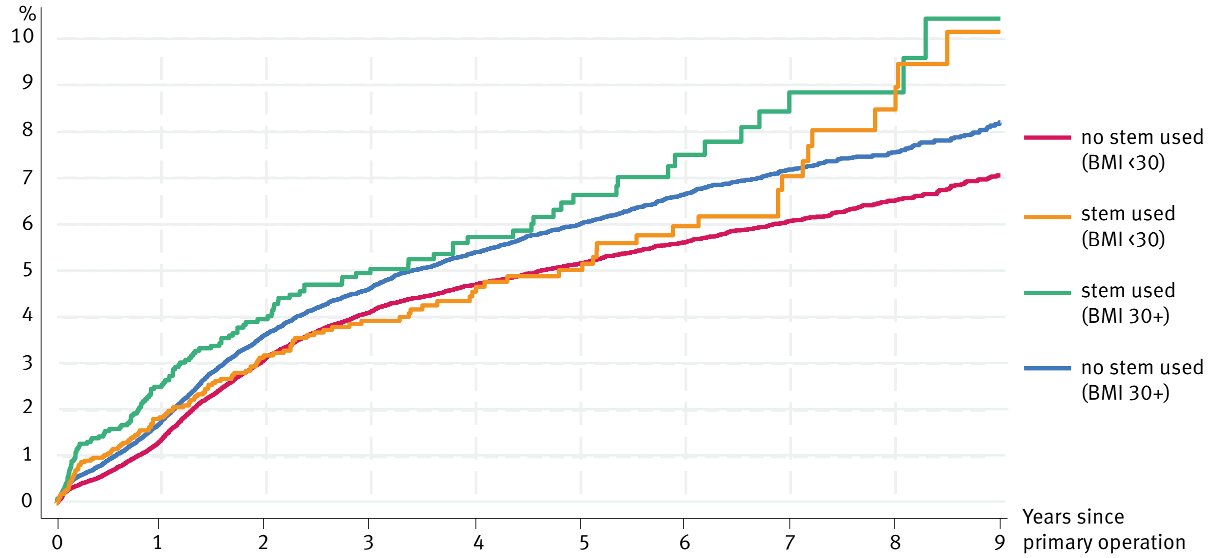
**Figure 5.9**

**Estimated failure rates of primary total knee arthroplasty for different implant types**

Time since operation, 2015–2024, all diagnoses. Confidence intervals not shown in graphic for reasons of clarity.

*Medial pivot was not available as a response category before SIRIS v2021. In the annual report 2020, only free text "other" responses were identified as and recoded to medial pivot. However, this missed a number of GMK Sphere total knee systems that were incorrectly registered as other types, mainly CS/UCOR. In this report, all GMK Sphere knee systems are counted as medial pivot, regardless of the type chosen locally at data entry.

As the vast majority of stems were used in primary TKA with cemented tibial components, the analysis was limited to this subgroup for the TKA types PCR/CR, CS, PS or MP. The revision rates did not differ with or without stem when the BMI was less than 30 kg/m². According to the results in the registry, the use of stems in patients with BMI ≥30 kg/m² was associated with an even higher revision rate compared to no stem use **(Figure 5.10)**, though the difference never was statistically significant. This was not expected, as the literature is reporting significantly lower revision rates when using tibial stems in obese patients. The opposite observation in SIRIS could speak for a certain selection bias with other influencing factors than BMI alone (e.g. osteoporosis). Definitive conclusions however may not be drawn, as further subgrouping would be necessary, which is currently impossible due to small numbers.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| no stem used (BMI 30+) | 48819 | 41041 | 33462 | 27359 | 21665 | 17304 | 13112 | 9189 | 5628 | 2455 |
| no stem used (BMI<30) | 74644 | 62876 | 51082 | 41562 | 32729 | 26056 | 19635 | 13847 | 8527 | 3800 |
| stem used (BMI 30+) | 2819 | 2093 | 1486 | 1049 | 718 | 547 | 356 | 222 | 124 | 48 |
| stem used (BMI<30) | 3473 | 2727 | 1940 | 1331 | 898 | 679 | 456 | 301 | 188 | 73 |

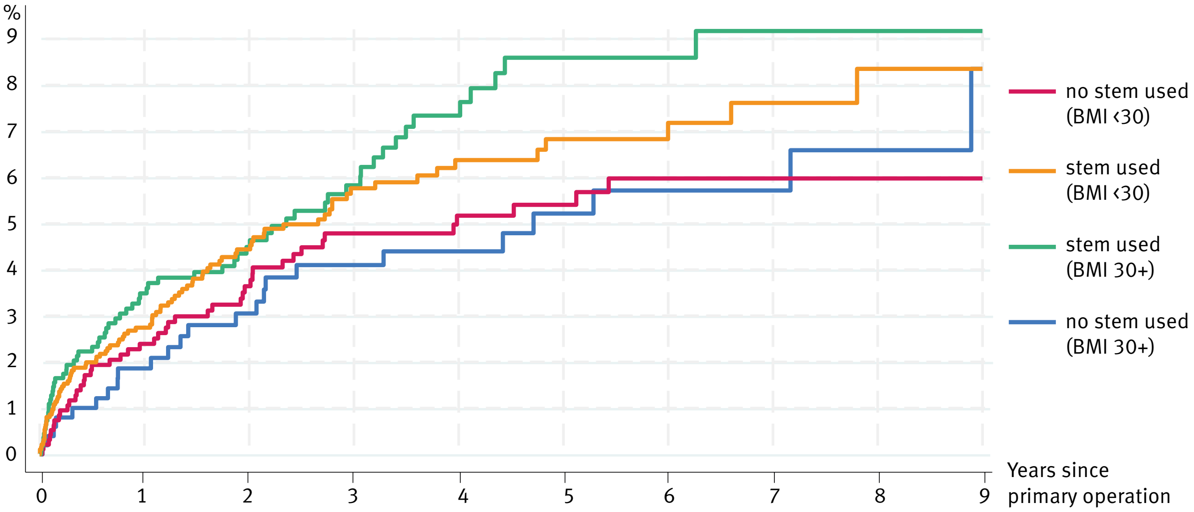
| **Use of stems** | **1 year** | **2 years** | **3 years** | **5 years** | **6 years** | **8 years** | **9 years** |
|---|---|---|---|---|---|---|---|
| no stem used (BMI‹30) | **1.4** (1.3-1.5) | **3.1** (3.0-3.3) | **4.1** (4.0-4.3) | **5.2** (5.0-5.4) | **5.6** (5.4-5.8) | **6.5** (6.3-6.8) | **7.1** (6.7-7.4) |
| stem used (BMI‹30) | **1.8** (1.4-2.4) | **3.2** (2.6-3.9) | **3.9** (3.2-4.8) | **5.0** (4.1-6.1) | **6.0** (4.8-7.3) | **9.0** (6.9-11.6) | **10.1** (7.7-13.4) |
| stem used (BMI 30+) | **2.5** (2.0-3.2) | **4.0** (3.2-4.9) | **5.0** (4.2-6.1) | **6.6** (5.4-8.1) | **7.5** (6.1-9.2) | **8.8** (7.0-11.1) | **10.4** (7.8-13.8) |
| no stem used (BMI 30+) | **1.8** (1.7-1.9) | **3.6** (3.5-3.8) | **4.6** (4.4-4.8) | **6.0** (5.8-6.3) | **6.7** (6.4-6.9) | **7.5** (7.2-7.9) | **8.2** (7.8-8.6) |

**Figure 5.10**

**Estimated failure rates of primary total knee arthroplasty: use of stems (CR/CS/PS/MP)**

Time since operation, 2015–2024, all diagnoses, only cemented tibias.

For primary TKA with higher intrinsic stability (SC/CCK or hinge type) survival up to 9 years after TKA was comparable with or without stems for all types of subsystems when the BMI was lower than 30 kg/m². Again, stemmed constrained TKA with BMI >30 kg/m² was associated with higher revision rates from the 4th year after index surgery but not reaching statistical significance due to small numbers and therefore wide confidence intervals **(Figure 5.11).**



| Number at risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| no stem used (BMI 30+) | 512 | 436 | 377 | 335 | 276 | 208 | 158 | 112 | 86 | 42 |
| no stem used (BMI<30) | 965 | 839 | 709 | 602 | 475 | 353 | 260 | 183 | 128 | 57 |
| stem used (BMI 30+) | 1106 | 862 | 651 | 484 | 315 | 235 | 175 | 115 | 66 | 28 |
| stem used (BMI<30) | 1873 | 1454 | 1087 | 789 | 522 | 381 | 263 | 180 | 107 | 43 |

| Stem | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| no stem used (BMI‹30) | **2.4** (1.6-3.6) | **3.6** (2.6-5.1) | **4.8** (3.5-6.5) | **5.4** (4.0-7.3) | **6.0** (4.4-8.0) | **6.0** (4.4-8.0) | **6.0** (4.4-8.0) |
| stem used (BMI‹30) | **2.7** (2.1-3.6) | **4.4** (3.5-5.6) | **5.8** (4.6-7.1) | **6.8** (5.5-8.5) | **7.2** (5.7-9.0) | **8.4** (6.3-11.0) | **8.4** (6.3-11.0) |
| stem used (BMI 30+) | **3.5** (2.5-4.8) | **4.5** (3.4-6.0) | **5.8** (4.4-7.6) | **8.6** (6.6-11.1) | **8.6** (6.6-11.1) | **9.2** (7.0-12.0) | **9.2** (7.0-12.0) |
| no stem used (BMI 30+) | **1.9** (1.0-3.5) | **3.1** (1.8-5.1) | **4.1** (2.6-6.4) | **5.2** (3.4-8.0) | **5.7** (3.7-8.7) | **6.6** (4.2-10.3) | **8.4** (4.9-14.2) |

**Figure 5.11**

**Estimated failure rates of primary total knee arthroplasty: use of stems (Hinged, SC/CCK)**

Time since operation, 2015–2024, all diagnoses, only cemented tibias of primary TKA with increased intrinsic stability (Hinge, SC/CCK).

## 5.3.4 Patella resurfacing and first revision

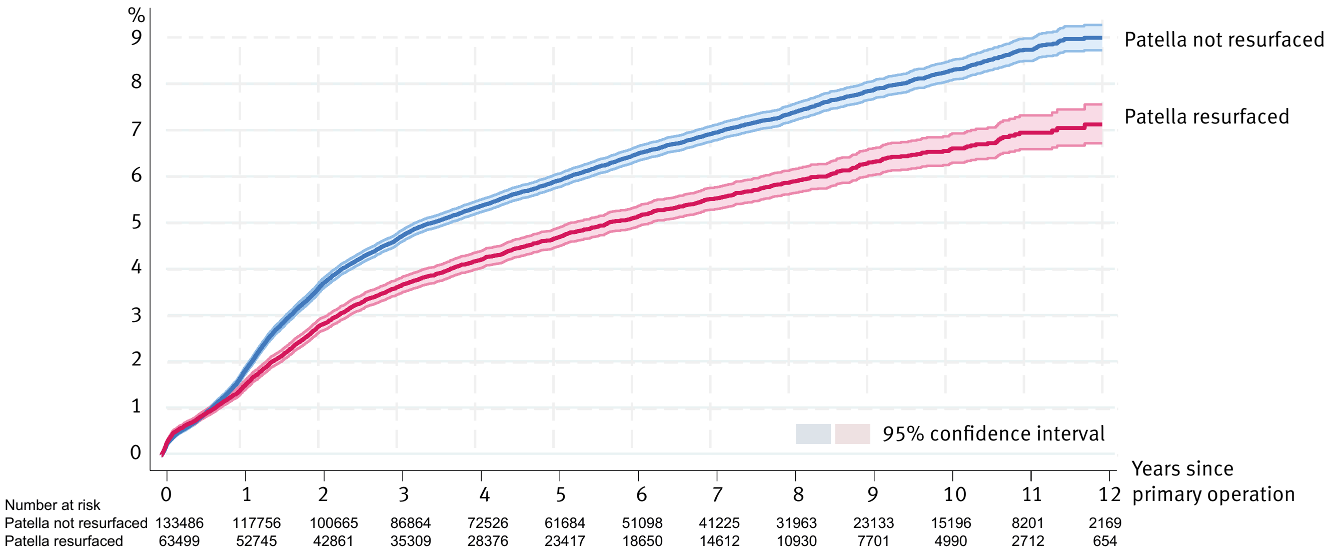
There was clearly a higher probability of revision when the patella was not resurfaced initially, becoming significant from the first year on and remaining significant at up to twelve years of follow-up **(Figure 5.12).** Early revision rates at two years after primary TKA differed significantly from 2.8% (CI 2.6 – 2.9%) to 3.6% (CI 3.5 – 3.7%), respectively. Between 3 and 12 years after TKA, the revision rates developed in a more linear manner for TKA without and with patella resurfacing, still worsening if patella was not resurfaced **(Figure 5.12).**

## 5.3.5 Type of surgery at first early revision

Complete revision of both femoral and tibial components was performed in 22.7% of the cases when revision had to be performed within two years of follow-up. In 26.5% of the cases, only the liner was exchanged. Isolated tibial revision was registered in 5.7%, and isolated femoral revision in 3.7%. Patella surgery is discussed below. Component removal with spacer implantation was recorded in 3.3%, without spacer in 0.2%, reimplantation of prosthesis in 1.4%, all three representing surgical procedures for periprosthetic infections.

### Type of implants

With 30.4%, SC/CCK systems formed the largest group of implants used at first TKA revision, followed by PS in 23.5% and hinge-type prosthesis in 21.5%. PCR/CR TKA were used in 6.5% of the revisions, 8.7% were classified as CS or UCOR implants, whereas MP was used in 5.9% of the revisions **(Table 5.7).**



| Status of patella | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|---|
| Patella resurfaced | **1.4** (1.3-1.5) | **2.8** (2.6-2.9) | **3.6** (3.5-3.8) | **4.7** (4.5-4.9) | **5.1** (4.9-5.3) | **5.9** (5.6-6.1) | **6.3** (6.0-6.6) | **6.6** (6.3-6.9) | **7.1** (6.7-7.6) |
| Patella not resurfaced | **1.7** (1.6-1.7) | **3.6** (3.5-3.7) | **4.6** (4.5-4.8) | **5.9** (5.7-6.0) | **6.4** (6.3-6.6) | **7.3** (7.2-7.5) | **7.8** (7.6-8.0) | **8.2** (8.0-8.5) | **9.0** (8.7-9.3) |

**Figure 5.12**

**Estimated failure rates of primary total knee arthroplasty: status of patella after primary operation**

Time since operation, 2012–2024, all diagnoses.

### Patella

Early revision TKA was associated with patella resurfacing in 76.7% of cases, but this includes cases where the primary patella component was left in place. Considering the different types of revisions, the combined percentage of procedures where a patella component could have been replaced or added barely exceeds 60% of first revisions. (i.e. complete

| Intervention type[1] | N | % |
|---|---|---|
| complete revision | 518 | 22.7 |
| exchange of PE | 604 | 26.5 |
| subsequent patella prosthesis | 530 | 23.2 |
| tibial revision | 131 | 5.7 |
| reimplantation of prosthesis | 33 | 1.4 |
| subsequent patella prosthesis with exchange of PE | 148 | 6.5 |
| patella revision | 123 | 5.4 |
| component removal with spacer implantation | 76 | 3.3 |
| femoral revision | 84 | 3.7 |
| prosthesis preserving revision | 2 | 0.1 |
| osteosynthesis | 2 | 0.1 |
| arthrodesis | 29 | 1.3 |
| component removal without spacer implantation | 11 | 0.2 |
| reconstruction after injury of extensor mechanism | 4 | 0.1 |
| plastic reconstruction | 4 | 0.1 |
| other | 104 | 2.0 |

| Additional intervention | N | % |
|---|---|---|
| None | 1,323 | 78.6 |
| Osteosynthesis FE | 11 | 0.7 |
| Osteosynthesis TI | 4 | 0.2 |
| Osteosynthesis PAT | 1 | 0.1 |
| Removal of metalware | 18 | 1.1 |
| Operation extensors | 76 | 4.5 |
| Reconstruction plasty | 20 | 1.2 |
| Tibial tubercle osteotomy | 133 | 7.9 |
| Other additional intervention(s) | 137 | 8.1 |
| **Total revisions** (multiple responses) | **1,683** | |

| Type of arthroplasty | N | % |
|---|---|---|
| SC / CCK (semi-constrained / constrained) | 238 | 30.4 |
| Hinge type | 168 | 21.5 |
| PS (posterior stabilized) | 184 | 23.5 |
| CS (cruciate sacrificing) / UCOR | 68 | 8.7 |
| PCR (posterior cruciate retaining) | 51 | 6.5 |
| Medial-Pivot[2] | 46 | 5.9 |
| BCR (bicruciate retaining) | 8 | 1.0 |
| Other | 20 | 2.6 |

| Technology | N | % |
|---|---|---|
| Conventional | 2,123 | 97.5 |
| Computer assisted / navigation | 23 | 1.1 |
| Patient specific instrumentation | 23 | 1.1 |
| Robotic-assisted (v2021) | 2 | 0.1 |
| Other | 11 | 0.5 |

| Addtional components[3] | N | % |
|---|---|---|
| Stem FE (cemented)* | 303 | 38.8 |
| Stem FE (uncemented)** | 150 | 19.2 |
| Stem TI (cemented)*** | 349 | 44.7 |
| Stem TI (uncemented)*** | 165 | 21.2 |
| Sleeve FE | 32 | 4.1 |
| Sleeve TI | 103 | 13.2 |
| Augments FE | 239 | 30.6 |
| Augments TI | 86 | 11.0 |
| Augments PAT | 0 | 0.0 |
| Bone homologous | 11 | 1.4 |
| Bone autologous | 21 | 2.7 |
| Cone FE | 6 | 0.8 |
| Cone TI | 26 | 3.3 |
| **Total revisions** (multiple responses) | **780** | |

* 61% with cement restrictor
** 27% with coating
*** 52% with cement restrictor
**** 30% with coating

**Table 5.7**
**Early first revision of primary total knee arthroplasty: Surgery characteristics**
4-year moving average covering implants between 01.01.2019 and 31.12.2022,
with two years follow-up (31.12.2024)

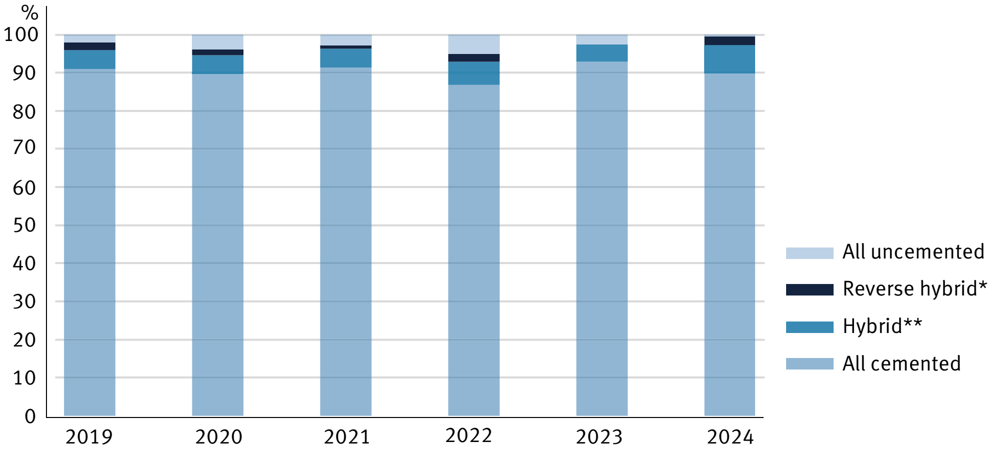
[1] includes a small proportion of reoperations that are not counted as component revisions in the evaluative parts of this report
[2] Entered as "other" intervention and then recoded before 2021. As of form version 2021, SIRIS lists Medial Pivot as a separate main category
[3] After complete, FE, TI revisions or component reimplantations. Detailed data available since 2021, but main categories available since 2015.

revisions, secondary resurfacing and patella revision). An exact count of how many patella components were added at complete revision is limited by incomplete registration of the primary components, but is likely in the area of 55% or higher.

Isolated patella resurfacing was performed in 23.2% of the first revisions. An additional 6.5% had secondary patella resurfacing combined with liner exchange **(Table 5.7).** The share of primary patella resurfacing not revised at revision TKA remains unknown, possibly explaining the rather low rate of patella resurfacing at first revision, although patella problems were the most frequent reason for reoperation. A revision of a patella component was registered in 5.4%, making any patella revision the most frequent component revision. However, reasons for revision cannot be simply added up, as several options can be combined at registration.

### Fixation

Fixation of the revision implants was fully cemented in the vast majority, with a mean value of 90.3% over the last 6 years, fluctuating between 86.8% and 92.8% since 2019 **(Figure 5.14).**



| Component fixation [%] | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|
| **N** | **200** | **184** | **186** | **182** | **195** | **186** | **1,133** |
| All uncemented | 2.0 | 3.8 | 2.7 | 4.9 | 2.6 | 0.5 | 2.7 |
| Reverse hybrid* | 2.0 | 1.6 | 1.1 | 2.2 | 0.0 | 2.2 | 1.5 |
| Hybrid** | 5.0 | 4.9 | 4.8 | 6.0 | 4.6 | 7.5 | 5.5 |
| All cemented | 91.0 | 89.7 | 91.4 | 86.8 | 92.8 | 89.8 | 90.3 |

* femur cemented, tibia uncemented

** femur uncemented, tibia cemented

**Figure 5.14**

**Early first revision of primary total knee arthroplasty: Component fixation**

Component fixation only applicable when new components were implanted. Early first revisions are those occurring within 2 years of the primary arthroplasty.

### Stems and additional components

Since 2021, increasing numbers of tibial and femoral stems were used **(Figure 5.4 and 5.15).** Augments were also used more frequently on the femoral side, stayed on the same level on the tibial side. Tibial and femoral sleeves were constantly used since 2015 **(Figure 5.15).**

At first TKA revision, 65.9% received a tibial and 58.0% a femoral stem, and 67.9% of the tibial and 66.9% femoral stems were cemented. Femoral augments were used in 30.6%, tibial ones in 11.0%. Reinforcement of the metaphysis by tibial sleeves was registered in 13.2%, femoral ones in 4.1%. Cones were rarely used, in 3.3% at the tibial and in 0.8% at the femoral level. Cones were used less frequently as sleeves. Whereas cones are available in most of the brands providing revisions systems, sleeves are mainly associated with one brand. Therefore, this is influenced mainly by the selection of revision TKA used in Switzerland. Bone grafting was used in 4.1% only of the first revisions, and then autologous bone in 65.6% and can be considered as replaced mostly by stems, augments, cones and sleeves **(Table 5.7).**

### Additional interventions

In 78.6% of first revisions, no additional intervention was necessary. Tibial tubercle osteotomy was performed in 7.3% of the cases, compared to 1.4% in primary TKA. In 4.5% of the cases, an additional intervention at the extensor apparatus was performed, while a formal reconstruction of the extensor apparatus was registered in 1.2%. Removal of orthopaedic or fracture fixation devices was done in combination with revision in only 1.1%. In 8.1%, “other” additional interventions were recorded **(Table 5.7).**

### Technology

Technology was mostly conventional (97.5%), technical assistance was registered rarely (2.3% for all technological together). Computer navigation (1.1%) or PSI (1.1%) did play minor rolls. Robotic assistance (0.1%) would technically be possible in revision TKA but may be hindered by medicolegal constraints in some of the systems available **(Table 5.7).**

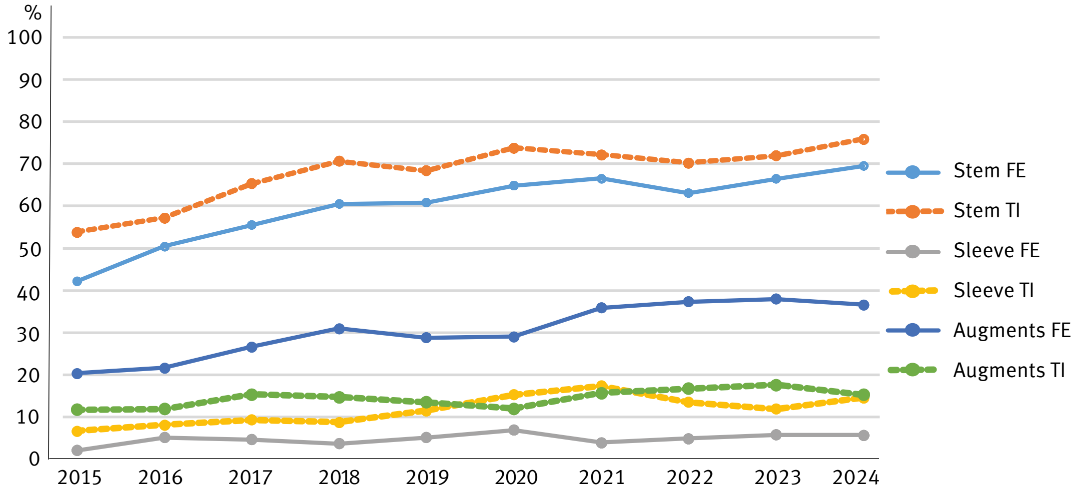


**Figure 5.15**

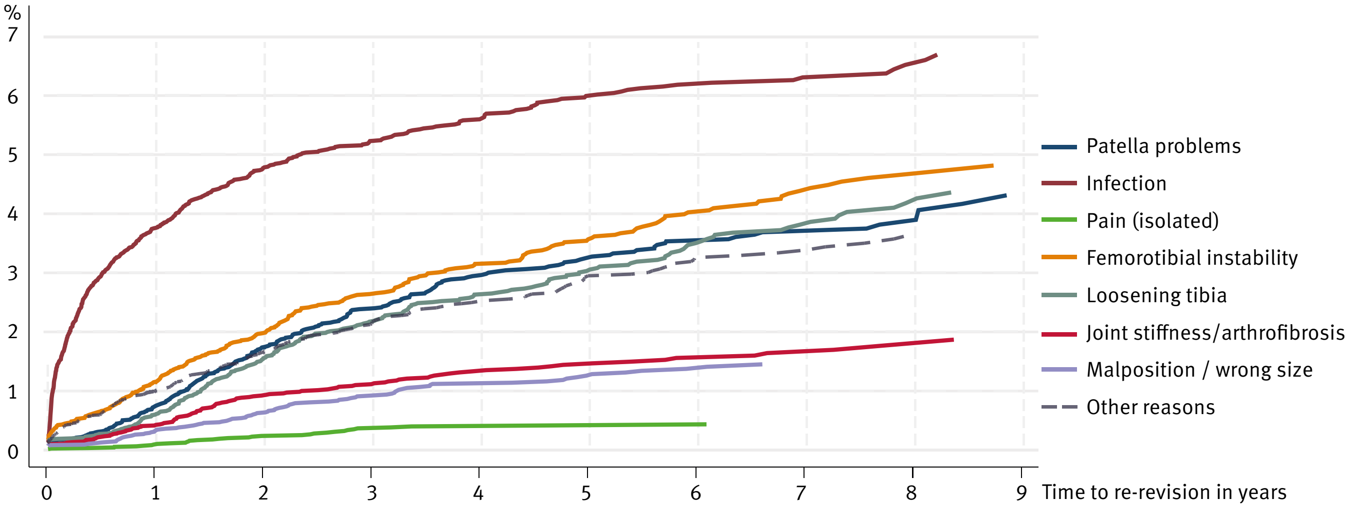
Selected additional components used in early first revisions (%)

## 5.4 Re-revision of total knee arthroplasty

Re-revisions after revision TKA were considered when they occurred after partial or complete revisions, re-implantations or isolated exchange of the liner. We call these first revisions “index revisions” for this analysis. Please note that this does not include revisions after conversions of PKA to TKA, which are presented in a separate analysis **(see 5.4.2).**

### 5.4.1 Reasons for TKA re-revision

As multiple reasons for revision may be registered, individual rates do not add up to 100%. This may also lead to under- or overestimation of some topics. Cumulative repeated revision rates after TKA revision from 2015 onwards are depicted in **Figure 5.16.** Infection took the lead early on as reason for re-revision, followed by a clear gap by the equally prevalent problems of femorotibial instability, patella problems, loosening of the tibial component and “other reasons”. Interestingly, patella problems still played an important role in TKA re-revisions, even while one would assume the patella was resurfaced either at primary TKA or at the first revision. The share of unresurfaced patellae at time of re-revision is unknown, as is the rate of revision for malposition or wear/



| Diagnosis for re-revision | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **0.8** (0.6-0.9) | **1.7** (1.5-2.0) | **2.4** (2.1-2.7) | **3.3** (2.9-3.7) | **3.5** (3.1-4.0) | **3.8** (3.4-4.3) | **4.3** (3.7-5.0) |
| Infection | **3.8** (3.4-4.1) | **4.8** (4.4-5.2) | **5.2** (4.8-5.7) | **6.0** (5.5-6.5) | **6.2** (5.7-6.7) | **6.5** (6.0-7.1) | **6.7** (6.1-7.3) |
| Pain (isolated) | **0.1** (0.1-0.2) | **0.2** (0.2-0.4) | **0.4** (0.3-0.5) | **0.4** (0.3-0.6) | **0.4** (0.3-0.6) | **0.4** (0.3-0.6) | **0.4** (0.3-0.6) |
| Femorotibial instability | **1.2** (1.0-1.4) | **2.0** (1.7-2.3) | **2.6** (2.3-3.0) | **3.6** (3.2-4.0) | **4.0** (3.6-4.5) | **4.6** (4.1-5.2) | **4.8** (4.2-5.5) |
| Loosening TI | **0.6** (0.5-0.8) | **1.5** (1.3-1.8) | **2.2** (1.9-2.5) | **3.0** (2.7-3.5) | **3.5** (3.1-4.0) | **4.2** (3.6-4.8) | **4.3** (3.8-5.0) |
| Joint stiffness / arthrofibrosis | **0.4** (0.3-0.5) | **0.9** (0.7-1.1) | **1.1** (0.9-1.3) | **1.4** (1.2-1.7) | **1.5** (1.3-1.8) | **1.7** (1.4-2.1) | **1.8** (1.5-2.3) |
| Malposition / wrong size | **0.3** (0.2-0.5) | **0.6** (0.5-0.8) | **0.9** (0.7-1.1) | **1.3** (1.0-1.5) | **1.4** (1.1-1.7) | **1.4** (1.2-1.8) | **1.4** (1.2-1.8) |
| Other reasons | **1.0** (0.8-1.2) | **1.7** (1.4-1.9) | **2.2** (1.9-2.5) | **3.0** (2.6-3.4) | **3.3** (2.9-3.7) | **3.7** (3.2-4.2) | **3.7** (3.2-4.2) |

**Figure 5.16**

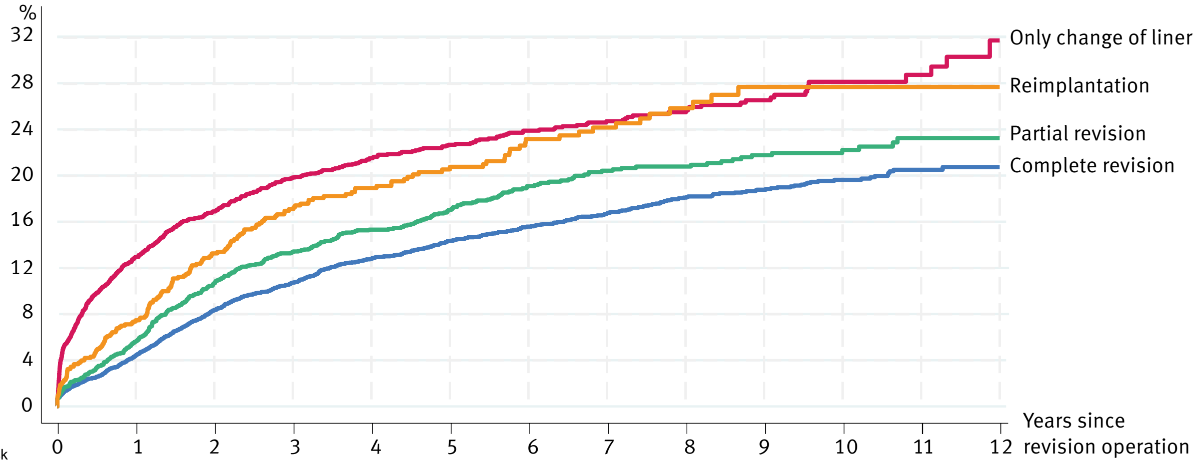
**Cumulative incidence rates for different re-revision diagnosis of primary total knee arthroplasty**

Time since revision, 2015–2024, % of implants re-revised. Detailed reasons for revisions available since 2015.
Comprises of all complete revisions, partial revisions, reimplantations and PE replacements.

loosening of patella buttons. Joint stiffness seemed to play a minor role, as did malposition or wrong sizing of the components. Presumably the frustrating results after revision for a stiff knee after TKA are better known meanwhile, preventing further surgery for this indication. Isolated pain of unknown origin was rarely the reason for a re-revision.

### 5.4.2 Type of previous TKA revision and TKA re-revision

Early, 2-year re-revision rates reached 10.7% (CI 9.5 – 12.0%) for partial and 8.3% (CI 7.7 – 9.0%) for complete revision respectively, whereas it was 3.4% (CI 3.3 – 3.6%) after revision of primary TKA (Table 5.3). If only the liner was exchanged at the first revision, the early re-revision rate was 16.9% (CI 15.7 – 18.3%) significantly worse compared to partial or complete revision. The re-revision rate at 12 years was 23.3% (CI 21.0 – 25.8%) for partial and 20.8% (CI 19.4 – 22.3%) for complete revision **(Figure 5.17).** This rate is almost three times higher than after primary TKA **(Figure 3.21).** Despite cumulative re-revision risk curves appearing to run separately from each other,



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Complete revision | 7940 | 6837 | 5742 | 4929 | 4015 | 3353 | 2735 | 2147 | 1633 | 1205 | 835 | 432 | 109 |
| Only change of liner | 3369 | 2484 | 2026 | 1678 | 1324 | 1071 | 840 | 662 | 483 | 319 | 197 | 103 | 39 |
| Partial revision | 2692 | 2255 | 1848 | 1566 | 1260 | 1050 | 852 | 696 | 535 | 413 | 293 | 154 | 40 |
| Reimplantation | 964 | 789 | 648 | 532 | 425 | 347 | 269 | 208 | 138 | 96 | 68 | 34 | 8 |

| Typ of revision | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| Complete rev. | **4.4** (4.0-4.9) | **8.3** (7.7-9.0) | **10.7** (10.0-11.5) | **14.4** (13.5-15.3) | **15.6** (14.7-16.6) | **18.1** (17.1-19.3) | **19.7** (18.4-21.0) | **20.8** (19.4-22.3) |
| Partial revision | **5.7** (4.8-6.6) | **10.7**(9.5-12.0) | **13.4** (12.1-14.9) | **17.1** (15.5-18.8) | **19.1** (17.4-21.0) | **20.8** (19.0-22.8) | **22.3** (20.2-24.5) | **23.3** (21.0-25.8) |
| Only change of liner | **13.0**(11.9-14.2) | **16.9**(15.7-18.3) | **19.9** (18.5-21.4) | **22.7** (21.2-24.4) | **24.0** (22.3-25.7) | **25.6** (23.7-27.5) | **28.2** (25.9-30.6) | **31.8** (27.7-36.3) |
| Reimplantation | **7.4** (5.9-9.3) | **13.2**(11.1-15.6) | **17.0** (14.6-19.8) | **20.7** (18.0-23.8) | **23.1** (20.1-26.6) | **25.8** (22.3-29.7) | **27.7** (23.7-32.1) | |

**Figure 5.17**

**Estimated failure rates after revision of total knee arthroplasty: types of revisions**

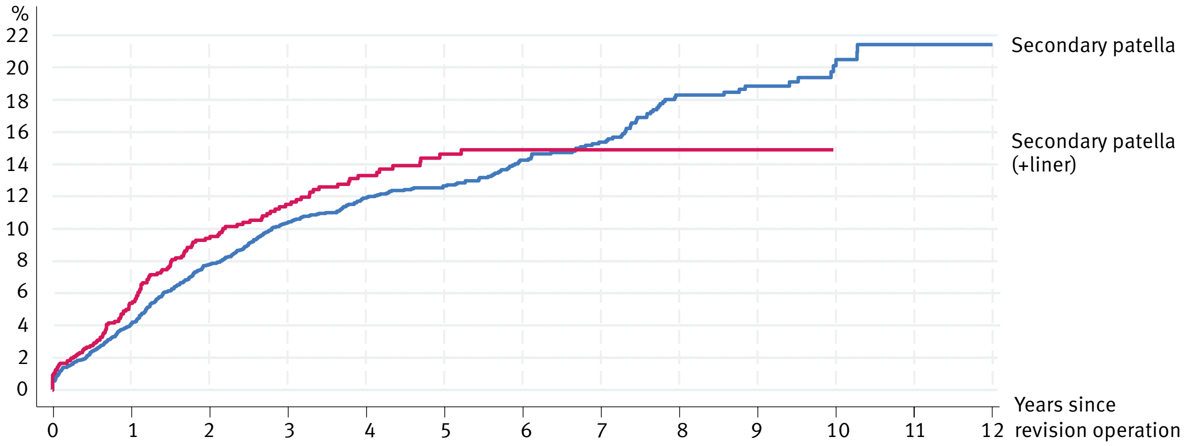
Time since revision, 2012–2024. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria.
End point of analysis: next registered component revision. Partial revision comprises femoral revision, tibial revision and patella revision.
Reimplantation refers to implantation of total knee system after spacer (revisions due to infection).
Comprises linked and unlinked revisions. A small proportion of revisions of partial knees may be included because they cannot be reliably excluded when the revision is not linked to a primary SIRIS case.

there was no statistically significant difference, as illustrated by overlapping CI. At twelve years exchange of liner alone had a re-revision rate of 31.8% (CI 27.7-36.3%) significantly worse results than partial or complete revision **(Figure 5.17).**

Component reimplantation – standing mostly for staged revision due to periprosthetic joint infection and previous temporary spacer implantation – had an early (two-year) re-revision rate of 13.2% (CI 11.1 – 15.6%). The re-revision rate increased over time up to 27.7% (CI 23.7 – 32.1%) 11 years after reimplantation. Reimplantation performed even better regarding re-revision than partial revision until seven and a half years and then picked up to the same level from the eighth year up to the last follow-up at 12 years **(Figure 5.17).**

### 5.4.3 Patella and TKA re-revision

Isolated secondary patella resurfacing was associated with an early re-revision rate of 7.8% (CI 6.9 – 8.7%), which is in the range of the results after complete revision. Secondary patella resurfacing combined with liner exchange led to 9.5% (CI 7.9 – 11.4%) of re-revisions, not significantly worse than isolated secondary patella resurfacing **(Figure 5.18).** At 9 years of follow-up, secondary patella resurfacing in combination with liner exchange performed better than secondary resurfacing alone, again not statistically significantly. This was comparable to the re-revision rates after complete TKA revision **(Figure 5.17).** It is unclear if PE wear played a role in cases of isolated patella resurfacing from 7 years after revision onwards, where the curves are crossing each other, indicating advantages for combined patella resurfacing with liner exchange **(Figure 5.18).** As stated before, the type of PE (CPE vs HXLPE) was not analysed



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sec. patella | 3566 | 3028 | 2516 | 2114 | 1736 | 1451 | 1124 | 851 | 577 | 376 | 210 | 110 | 29 |
| Sec. patella (+liner) | 1273 | 986 | 760 | 602 | 452 | 340 | 245 | 170 | 98 | 39 | 0 | 0 | 0 |

| Replacement | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| Secondary patella | **4.1** (3.4-4.8) | **7.8** (6.9-8.7) | **10.4** (9.3-11.5) | **12.6** (11.4-13.9) | **14.2** (12.9-15.7) | **18.3** (16.5-20.2) | **20.1** (17.9-22.5)) | **21.4** (18.8-24.2) |
| Secondary patella (+liner) | **5.5** (4.3-6.9) | **9.5** (7.9-11.4) | **11.6** (9.7-13.7) | **14.7** (12.4-17.3) | **15.0** (12.7-17.6) | **15.0** (12.7-17.6) | | |

**Figure 5.18**

**Estimated failure rates after revision of total knee arthroplasty: secondary patella replacement**

Time since revision, 2012–2024. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria. End point of analysis: next registered component revision. Comprises of linked and unlinked revisions. A small proportion of revisions of partial knees may be included because they cannot be reliably excluded when the revision is not linked to a primary SIRIS case.

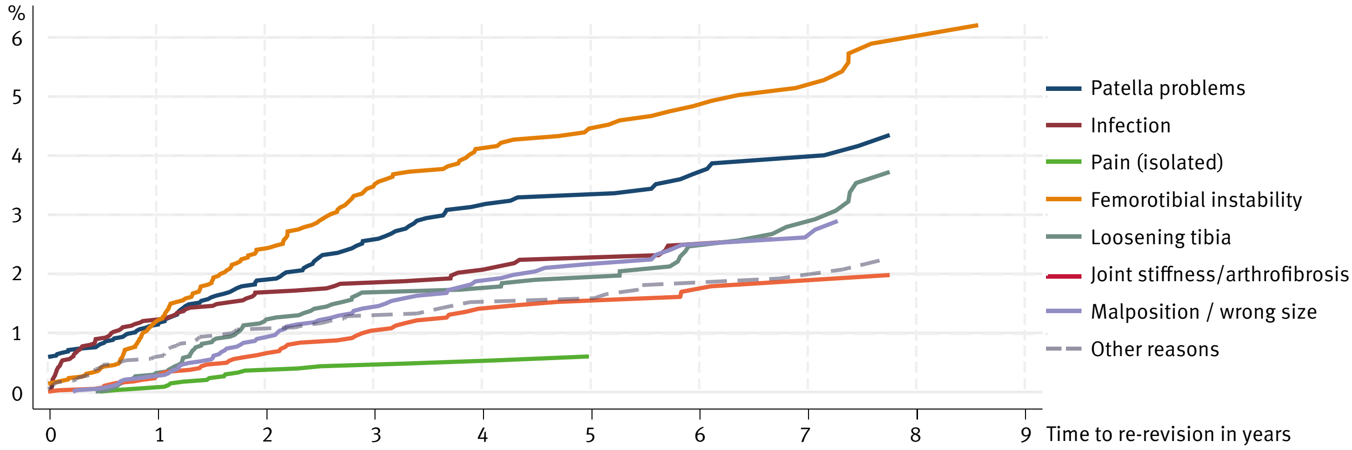
in knee arthroplasty.

The main reason for re-revision after secondary patella resurfacing, with or without liner exchange, was femorotibial instability **(Figure 5.19)**. Astonishingly, (persistent) patella problems were the second most frequent reason, confirming that anterior knee pain after TKA often has other causes, which cannot be solved by secondary patella resurfacing alone. Loosening of the tibial component was an important cause of re-revision, whereas joint stiffness, isolated pain or “other reasons”, fortunately, did not play an important role in this context **(Figure 5.19)**.

## 5.4.4 Re-revision after Conversion of PKA to TKA

Re-revision rates after conversion of a PKA to TKA reached 9.9% (CI 8.6 – 11.3%) after two years and 21.0% (CI 18.5 – 23.7%) after 11 years, respectively **(Figure 5.20)**. This is comparable to the re-revision rates after revision TKA (Figure 5.17) but far worse than the revision rates after primary TKA (3.4% at two years (CI 3.3 – 3.6%), and 8.5% at 12 years (CI 8.2 – 8.7%) **(Table 5.3, Figure 3.21)**.

Therefore, the widespread opinion that a PKA would be the preferred first surgery as a later conversion to TKA would lead to comparable results as after primary TKA cannot be supported by this report. Obviously, a conversion from PKA to TKA is not equivalent to a



| Re-revision diagnosis | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **1.1** (0.9-1.5) | **1.9** (1.5-2.4) | **2.6** (2.1-3.1) | **3.3** (2.7-4.0) | **3.7** (3.0-4.5) | **4.3** (3.5-5.4) | **4.3** (3.5-5.4) |
| Infection | **1.2** (0.9-1.6) | **1.7** (1.3-2.1) | **1.8** (1.5-2.3) | **2.2** (1.8-2.8) | **2.5** (2.0-3.1) | **2.6** (2.0-3.3) | **2.6** (2.0-3.3) |
| Pain (isolated) | **0.1** (0.0-0.2) | **0.4** (0.2-0.6) | **0.5** (0.3-0.7) | **0.6** (0.4-1.0) | **0.6** (0.4-1.0) | **0.6** (0.4-1.0) | **0.6** (0.4-1.0) |
| Femorotibial instability | **1.2** (0.9-1.6) | **2.4** (2.0-3.0) | **3.5** (2.9-4.2) | **4.5** (3.8-5.3) | **4.8** (4.1-5.7) | **5.9** (4.9-7.1) | **6.2** (5.1-7.6) |
| Loosening TI | **0.3** (0.2-0.6) | **1.2** (0.9-1.6) | **1.7** (1.3-2.2) | **1.9** (1.5-2.5) | **2.5** (1.9-3.2) | **3.7** (2.8-4.9) | **3.7** (2.8-4.9) |
| Joint stiffness / arthrofibrosis | **0.3** (0.1-0.5) | **0.6** (0.4-0.9) | **1.0** (0.7-1.4) | **1.5** (1.1-2.1) | **1.7** (1.2-2.3) | **2.0** (1.4-2.8) | **2.0** (1.4-2.8) |
| Malposition / wrong size | **0.3** (0.2-0.5) | **0.9** (0.6-1.3) | **1.4** (1.1-1.9) | **2.2** (1.7-2.8) | **2.5** (1.9-3.2) | **2.9** (2.2-3.8) | **2.9** (2.2-3.8) |
| Other reasons | **0.6** (0.4-0.9) | **1.1** (0.8-1.5) | **1.3** (1.0-1.7) | **1.5** (1.2-2.0) | **1.8** (1.4-2.4) | **2.3** (1.6-3.1) | **2.3** (1.6-3.1) |

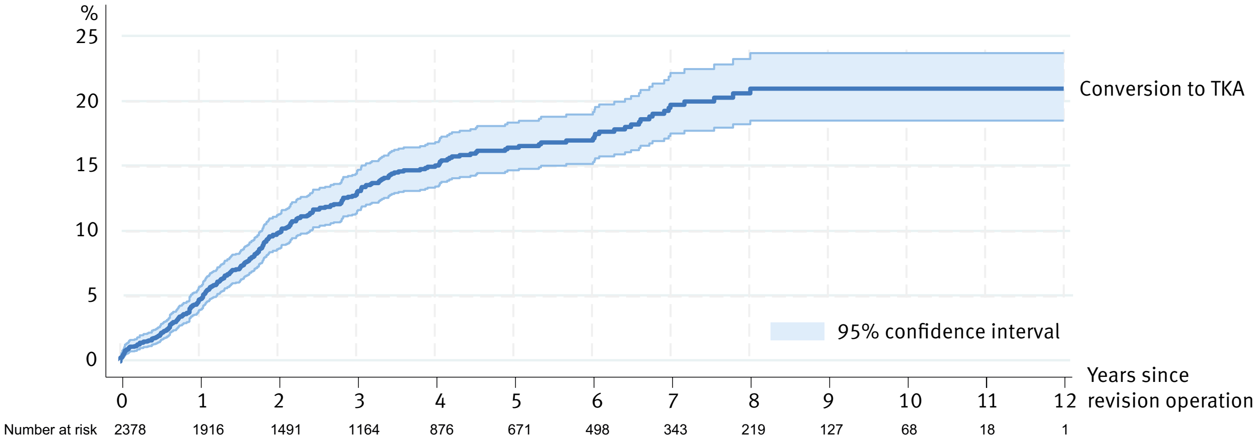
**Figure 5.19**

**Cumulative incidence rates for different re-revision diagnosis after secondary patella replacements (TKA)**

Time since revision, 2015–2024, % of implants re-revised. Detailed reasons for revisions available since 2015.
Comprises of all secondary patella replacements (with or without PE replacement)

primary TKA but remains a revision with higher re-revision rates than observed after primary TKA.

The main reasons for re-revision after conversion of PKA to TKA were femorotibial instability and tibial loosening, followed by patella problems. All other reasons were noted less frequently, isolated pain playing only a limited role this time (compare to first revision of PKA in chapter 5.7) **(Figure 5.21).**

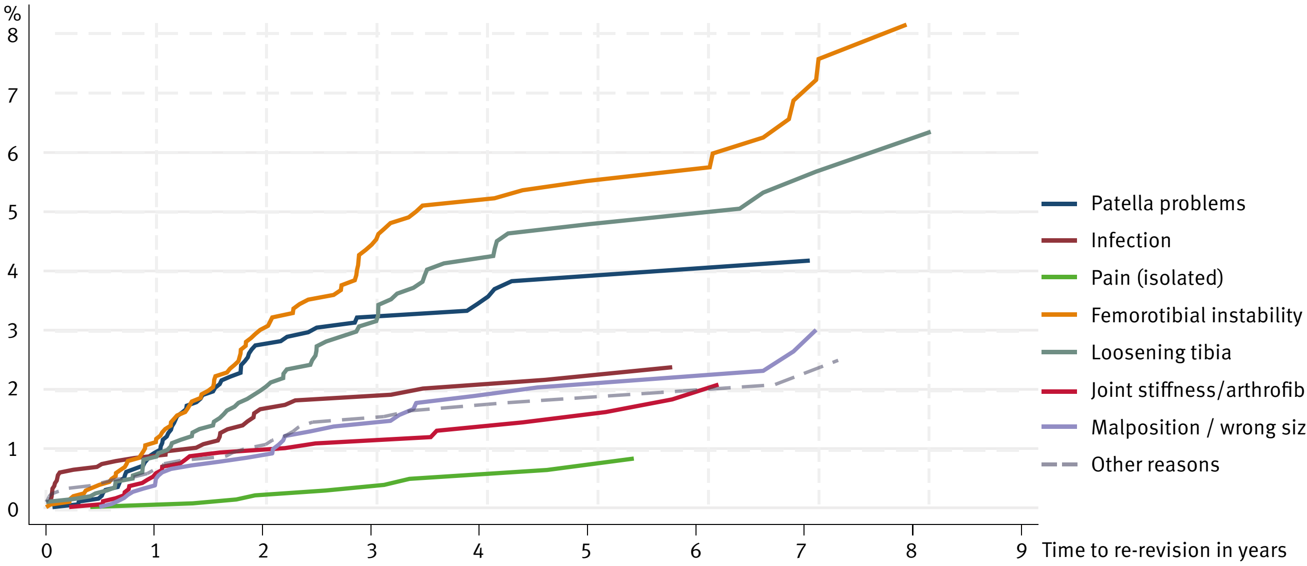


| Typ of revision | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Conversion to TKA | **4.7** (3.9-5.7) | **9.9** (8.6-11.3) | **12.8** (11.4-14.4) | **16.5** (14.7-18.4) | **17.0** (15.2-19.0) | **20.6** (18.3-23.3) | **21.0** (18.5-23.7) | **21.0** (18.5-23.7) |

**Figure 5.20**

**Estimated failure rates after conversion from partial knee to total knee arthroplasty**

Time since revision, 2012–2024, % of implants re-revised



| Diagnosis for re-revision | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **1.0** (0.6-1.5) | **2.8** (2.1-3.6) | **3.2** (2.5-4.2) | **3.8** (3.0-5.0) | **3.8** (3.0-5.0) | **4.2** (3.1-5.6) | **4.2** (3.1-5.6) |
| Infection | **0.9** (0.6-1.4) | **1.7** (1.2-2.4) | **1.8** (1.3-2.6) | **2.2** (1.6-3.1) | **2.4** (1.7-3.4) | **2.4** (1.7-3.4) | **2.4** (1.7-3.4) |
| Pain (isolated) | **0.0** (0.0-0.3) | **0.2** (0.1-0.6) | **0.3** (0.1-0.8) | **0.7** (0.3-1.4) | **0.9** (0.4-1.8) | **0.9** (0.4-1.8) | **0.9** (0.4-1.8) |
| Femorotibial instability | **1.2** (0.8-1.8) | **3.0** (2.3-3.9) | **4.5** (3.6-5.7) | **5.5** (4.4-6.9) | **5.5** (4.4-6.9) | **8.2** (6.2-10.7) | **8.2** (6.2-10.7) |
| Loosening TI | **0.8** (0.5-1.3) | **2.1** (1.5-2.9) | **3.2** (2.4-4.2) | **4.8** (3.7-6.2) | **4.8** (3.7-6.2) | **5.7** (4.3-7.5) | **6.4** (4.6-8.7) |
| Joint stiffness / arthrofibrosis | **0.6** (0.3-1.1) | **1.0** (0.6-1.5) | **1.1** (0.7-1.7) | **1.5** (1.0-2.3) | **1.9** (1.2-2.9) | **2.1** (1.3-3.3) | **2.1** (1.3-3.3) |
| Malposition / wrong size | **0.5** (0.3-1.0) | **0.9** (0.5-1.4) | **1.4** (0.9-2.1) | **2.1** (1.4-3.0) | **2.1** (1.4-3.0) | **3.0** (1.9-4.7) | **3.0** (1.9-4.7) |
| Other reasons | **0.7** (0.4-1.1) | **1.1** (0.7-1.7) | **1.5** (1.0-2.2) | **1.8** (1.2-2.6) | **1.8** (1.2-2.6) | **2.5** (1.6-4.1) | **2.5** (1.6-4.1) |

**Figure 5.21**

**Cumulative incidence rates for different re-revision diagnoses of conversions to primary total knee arthroplasty**

Time since revision, 2015–2024, % of implants re-revised. Detailed reasons for revisions available since 2015.

## 5.5 Results of implants in total knee arthroplasty

### 5.5.1 Two-year revision rates of TKA systems and brands

The two-year revision rate of the individual implants is shown in **Figure 5.27**, reflecting results from TKA performed between 01.01.2019 and 31.12.2022, providing a completed two-year follow-up by 31.12. 2024. Of the 58 implant combinations used (the rest being summarised under "other systems"), one system must be considered as a potential outlier. Please refer to **Chapter 2 Methods** regarding methodological details of this definition. As usual, the potential outlier identification results in a more detailed outlier report investigating the reasons for the observed deviations from the national average. The potential outlier system at two years concerns a subtype of an older implant with otherwise solid results overall. A CCS of 52 indicates these short term problems could be related to certain hospitals or surgeons. "Other systems", summarising TKA with insufficient numbers to be represented individually, had an elevated 2-year revision rate but within the boundaries of Swiss average. Of interest is that the two mentioned potential long-term outliers **(compare 5.5.1)** had results with only slightly elevated revision rates at two years.

### 5.5.2 Long-term survival

**Table 5.8** shows the TKA systems used most commonly in Switzerland, representing 74.6% (80,916) of the primary TKA from 2019 until 2024. The 25.4% less commonly used implants accounted for 27,551 cases only during this period. Only 355 implant combinations (0.3%) could not be classified, similarly to the rate of missing implants observed in the previous annual reports.

The long-term evaluation for all systems, all diagnoses, and all fixation types is depicted in **Table 5.9**, showing results up to 12 years after surgery. Wider confidence intervals reflect higher variability due to small numbers. Please take note of the case concentration score (CCS), indicating the share of the largest providing hospital, as individual providers may

| System* | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019–2024 |
|---|---|---|---|---|---|---|---|
| Attune CR-FB | 677 | 841 | 1,248 | 1,693 | 2,091 | 2,690 | **9,240** |
| Attune CR-RP | 1,170 | 1,336 | 1,424 | 1,604 | 1,494 | 1,411 | **8,439** |
| Attune PS-FB | 543 | 463 | 503 | 675 | 660 | 596 | **3,440** |
| Attune PS-RP | 842 | 750 | 753 | 1,036 | 1,082 | 1,092 | **5,555** |
| Balansys CR | 294 | 356 | 526 | 923 | 752 | 928 | **3,779** |
| Balansys PS | 663 | 600 | 623 | 571 | 611 | 672 | **3,740** |
| Balansys UC | 357 | 387 | 442 | 598 | 759 | 655 | **3,198** |
| GMK sphere | 2,029 | 2,084 | 2,504 | 3,067 | 3,273 | 3,432 | **16,389** |
| Origin PS | 219 | 354 | 422 | 537 | 553 | 681 | **2,766** |
| Persona CR-MC | 716 | 975 | 1,284 | 1,805 | 2,172 | 2,631 | **9,583** |
| Persona CR-UC | 1,145 | 1,162 | 1,108 | 1,258 | 1,400 | 1,080 | **7,153** |
| Persona PS | 600 | 477 | 784 | 937 | 914 | 835 | **4,547** |
| Triathlon PS | 184 | 356 | 553 | 516 | 640 | 838 | **3,087** |
| Other systems | 5,960 | 5,193 | 4,490 | 3,937 | 4,141 | 3,830 | **27,551** |
| **Total** | **15,399** | **15,334** | **16,664** | **19,157** | **20,542** | **21,371** | **108,467** |

**Table 5.8**

**Top 75% of primary total knee arthroplasty systems (all diagnoses, all component fixations) 2019 – 2024**

*Constrained/hinged systems were included if used for cases of primary OA including OA after meniscectomy influence results of systems not widely used. A higher share indicates an increased likelihood of bias due to local effects. A CCS of 50% and more means that the results are likely determined by one hospital/ surgeon. Primary TKA subsystems (such as PCR/ CR or PS) were analysed separately if numbers were both sufficient and showed relevantly different revision rates. The 12-year revision rate for all TKA systems was 8.4% (CI 8.2 – 8.6%). However, the various implant systems performed rather differently in the short, medium, and long term **(Table 5.9).**

### 5.5.3 Survival of different knee systems

The revision rate after 12 years varied from 4.5% for the best to 11.0% for the worst system of the implant list. “Other systems”, accounting for 25.4% of the TKA and grouped together because of small numbers, had the highest failure rate with a revision rate of 11.4% (CI 10.2–12.7%) after twelve years, significantly worse than average of 8.4% (CI 8.2–8.6%) **(Table 5.9).** Therefore, it should be recommended to surgeons using more exotic implants should review

| System | Total N | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Advance | 2,106 | 19 | 68 | **2.2** (1.7-2.9) | **5.4** (4.5-6.5) | **6.5** (5.5-7.7) | **8.5** (7.1-10.0) | **9.1** (7.6-11.0) |
| Attune CR-FB | 11,803 | 12 | 69 | **1.3** (1.1-1.5) | **3.6** (3.2-4.1) | **4.7** (4.2-5.2) | **7.5** (6.4-8.8) | |
| Attune CR-RP | 13,883 | 11 | 69 | **1.9** (1.6-2.1) | **5.2** (4.8-5.6) | **6.4** (6.0-6.9) | **8.9** (8.1-9.8) | |
| Attune PS-FB | 6,084 | 14 | 70 | **1.4** (1.1-1.7) | **4.0** (3.5-4.6) | **5.1** (4.5-5.8) | **8.5** (7.4-9.9) | |
| Attune PS-RP | 8,581 | 15 | 70 | **1.6** (1.4-1.9) | **4.8** (4.4-5.4) | **6.3** (5.7-6.9) | **8.9** (7.8-10.1) | |
| Balansys CR | 4,847 | 15 | 70 | **1.1** (0.8-1.4) | **3.3** (2.8-4.0) | **4.5** (3.8-5.3) | **7.3** (5.8-9.1) | **7.3** (5.8-9.1) |
| Balansys PS | 5,944 | 56 | 70 | **1.2** (0.9-1.5) | **3.6** (3.2-4.2) | **4.9** (4.3-5.6) | **7.5** (6.3-8.8) | **9.4** (7.5-11.8) |
| Balansys RP | 7,171 | 14 | 70 | **1.4** (1.2-1.7) | **4.3** (3.8-4.8) | **5.5** (5.0-6.1) | **8.4** (7.6-9.2) | **9.4** (8.4-10.5) |
| Balansys UC | 6,318 | 22 | 71 | **1.4** (1.2-1.8) | **4.5** (3.9-5.1) | **5.7** (5.1-6.4) | **8.7** (7.7-9.8) | **9.1** (8.0-10.4) |
| E.Motion FP/UC | 2,042 | 84 | 70 | **1.5** (1.0-2.1) | **3.5** (2.8-4.5) | **4.8** (3.9-6.0) | **7.7** (6.3-9.5) | **8.2** (6.7-10.2) |
| Evolution | 904 | 26 | 68 | **1.5** (0.8-2.8) | **7.0** (4.6-10.5) | **7.8** (5.1-11.9) | | |
| First/First REV | 2,812 | 36 | 70 | **1.6** (1.2-2.1) | **4.8** (4.0-5.6) | **5.8** (4.9-6.7) | **7.9** (6.8-9.2) | **9.1** (7.1-11.6) |
| GKS prime flex | 516 | 22 | 69 | **1.3** (0.6-2.9) | **7.5** (5.0-11.1) | **8.0** (5.4-11.9) | | |
| GMK primary CR/UC-RP | 2,652 | 19 | 70 | **1.6** (1.2-2.2) | **4.1** (3.4-4.9) | **5.0** (4.2-5.9) | **7.2** (6.1-8.4) | **7.6** (6.5-8.9) |
| GMK primary PS | 2,179 | 23 | 71 | **1.2** (0.8-1.8) | **3.8** (3.0-4.7) | **5.2** (4.3-6.3) | **7.8** (6.6-9.2) | **8.5** (7.1-10.3) |
| GMK sphere | 22,080 | 11 | 69 | **1.6** (1.5-1.8) | **4.5** (4.2-4.9) | **5.9** (5.5-6.3) | **7.4** (6.8-8.1) | **7.8** (6.9-8.8) |
| ITotal | 2,050 | 24 | 68 | **0.8** (0.5-1.3) | **3.0** (2.3-3.9) | **4.0** (3.2-5.1) | **5.6** (4.0-7.9) | **5.6** (4.0-7.9) |
| Innex FB | 1,730 | 42 | 71 | **1.4** (0.9-2.1) | **4.3** (3.4-5.3) | **5.3** (4.3-6.5) | **7.7** (6.4-9.2) | **8.6** (7.1-10.4) |
| Innex RP | 4,809 | 17 | 69 | **1.7** (1.4-2.1) | **4.6** (4.0-5.2) | **5.6** (5.0-6.3) | **7.7** (6.9-8.6) | **9.1** (8.1-10.3) |
| Journey II | 2,630 | 27 | 67 | **3.1** (2.5-3.8) | **7.5** (6.5-8.6) | **9.2** (8.1-10.4) | **12.6** (10.7-14.9) | |
| LCS compl. cem./hybrid | 6,739 | 22 | 70 | **1.5** (1.2-1.8) | **4.8** (4.3-5.3) | **5.9** (5.3-6.5) | **7.2** (6.6-8.0) | **7.5** (6.8-8.3) |
| LCS compl. cementless | 3,098 | 29 | 69 | **1.9** (1.5-2.5) | **5.3** (4.6-6.2) | **6.1** (5.3-7.0) | **7.1** (6.2-8.2) | **7.4** (6.3-8.6) |
| Legion | 2,185 | 15 | 68 | **1.9** (1.4-2.6) | **6.9** (5.8-8.2) | **9.2** (7.9-10.8) | **14.2** (11.9-16.8) | |
| NK flex | 1,841 | 41 | 70 | **1.3** (0.8-1.9) | **4.0** (3.2-5.0) | **5.1** (4.1-6.2) | **6.7** (5.5-8.0) | **7.1** (5.9-8.5) |

**Table 5.9 Part one**

**Long term evaluation: Failure rates of primary total knee arthroplasty systems (all diagnoses, all component fixations)**

Time since operation, 2012–2024. Please note that if reported system involves multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Younger mean age signifies that the case mix is less “usual” and potentially biased towards higher revision risk.

their own results thoroughly and switch to a brand more frequently used in Switzerland. Mobile bearings did perform worse in all knee systems compared to other subtypes of TKA of the same brand, except for those from Medacta. Interestingly, their system with mobile bearing was associated with lower long-term revision rates compared to the other knee systems in their portfolio. Medial pivot (MP) had an elevated revision rate in an old system but within the limits of the Swiss average (rate at 12 years: 9.1%, CI 7.6-11.0%). The market leader MP system from Medacta had a better rate of 7.8% (CI 6.9-8.8%) at 12 years than the national average of 8.4% (CI 8.2-8.6%). Even more promising was a newer system (Persona) with a significantly lower failure rate after five years of 4.5% (CI 4.0-5.1%) for the CR-MC and 3.4% (CI 3.0-3.85) for the CR-UC version compared to the average of 5.5% (CI 5.4-5.6%). Persona CPS missed significance due to wider confidence intervals **(Table 5.9).**

Some problematic brands lack ten-year results so far. They had an acceptable revision rate at one year, but then significantly elevated revision rates up to seven years **(Table 5.9).** Both problematic systems were identified as potential outliers. None of the knee systems used in Switzerland was classified as definitive outlier anymore.

| System | Total N | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Nexgen CR/LPS-Flex | 2,320 | 14 | 69 | **1.5** (1.1-2.1) | **3.6** (2.8-4.4) | **4.6** (3.7-5.6) | **6.6** (5.5-8.0) | **6.9** (5.7-8.3) |
| Nexgen LCCK | 514 | 15 | 71 | **1.6** (0.8-3.2) | **3.2** (2.0-5.3) | **4.8** (3.1-7.5) | **6.1** (4.0-9.2) | |
| Origin PS | 2,794 | 23 | 69 | **1.9** (1.5-2.6) | **4.4** (3.6-5.5) | **6.1** (4.8-7.7) | | |
| Persona CPS | 1,188 | 15 | 72 | **1.2** (0.7-2.1) | **2.7** (1.8-3.9) | **3.7** (2.6-5.4) | | |
| Persona CR-MC | 10,556 | 9 | 69 | **1.3** (1.1-1.6) | **3.6** (3.2-4.1) | **4.5** (4.0-5.1) | | |
| Persona CR-UC | 11,195 | 37 | 70 | **0.9** (0.8-1.1) | **2.5** (2.2-2.9) | **3.4** (3.0-3.8) | **4.9** (4.2-5.6) | |
| Persona PS | 7,672 | 11 | 70 | **1.7** (1.5-2.1) | **4.0** (3.6-4.6) | **5.2** (4.7-5.8) | **7.9** (7.0-9.0) | |
| RT-plus | 1,383 | 14 | 77 | **3.0** (2.2-4.0) | **4.5** (3.5-5.9) | **5.1** (4.0-6.6) | **5.6** (4.3-7.2) | **5.6** (4.3-7.2) |
| Sigma CR-FB | 4,829 | 28 | 71 | **0.9** (0.6-1.2) | **2.4** (2.0-2.9) | **3.4** (2.9-3.9) | **4.3** (3.7-5.0) | **4.5** (3.8-5.2) |
| Sigma CR-RP | 2,256 | 40 | 68 | **2.5** (1.9-3.2) | **5.8** (4.9-6.8) | **6.6** (5.6-7.7) | **8.3** (7.1-9.7) | **9.1** (7.8-10.6) |
| Sigma PS-FB | 1,334 | 59 | 72 | **1.1** (0.6-1.8) | **3.3** (2.4-4.4) | **4.1** (3.1-5.4) | **5.6** (4.3-7.2) | **6.2** (4.7-8.2) |
| Sigma PS-RP | 1,661 | 11 | 70 | **1.6** (1.1-2.4) | **3.9** (3.1-5.0) | **4.7** (3.8-5.9) | **6.2** (5.1-7.5) | **6.7** (5.5-8.2) |
| TC-plus primary FB | 2,766 | 32 | 69 | **1.5** (1.1-2.0) | **3.8** (3.1-4.6) | **5.0** (4.2-5.9) | **7.4** (6.2-8.8) | **8.5** (7.0-10.3) |
| TC-plus primary RP | 2,077 | 31 | 70 | **1.2** (0.8-1.8) | **3.7** (3.0-4.7) | **5.1** (4.2-6.2) | **8.8** (7.3-10.6) | **10.1** (8.1-12.7) |
| Triathlon CR/CS | 2,164 | 32 | 69 | **2.2** (1.6-2.9) | **5.3** (4.4-6.5) | **6.5** (5.4-7.8) | **8.8** (7.4-10.6) | **11.0** (8.6-14.1) |
| Triathlon PS | 3,852 | 34 | 69 | **2.0** (1.6-2.6) | **5.5** (4.7-6.4) | **6.6** (5.7-7.8) | **9.1** (7.4-11.1) | **9.1** (7.4-11.1) |
| Unity | 661 | 36 | 69 | **1.1** (0.5-2.4) | **3.0** (1.8-4.9) | **3.3** (2.0-5.3) | | |
| Vanguard CR | 1,240 | 32 | 67 | **1.5** (0.9-2.3) | **4.4** (3.3-5.7) | **5.7** (4.5-7.3) | **7.6** (6.1-9.6) | **8.1** (6.3-10.3) |
| Vanguard PS | 1,072 | 57 | 68 | **2.0** (1.3-3.0) | **5.1** (3.9-6.6) | **6.7** (5.4-8.4) | **9.1** (7.3-11.3) | **9.1** (7.3-11.3) |
| Other systems | 8,606 | | 71 | **2.0** (1.7-2.4) | **5.3** (4.8-5.9) | **7.0** (6.4-7.7) | **10.4** (9.5-11.4) | **11.4** (10.2-12.7) |
| **CH average for group** | | | | **1.6** (1.5-1.6) | **4.3** (4.2-4.4) | **5.5** (5.4-5.6) | **7.7** (7.5-7.9) | **8.4** (8.2-8.6) |

**Table 5.9 Part two**

**Long term evaluation: Failure rates of primary total knee arthroplasty systems (all diagnoses, all component fixations)**

Time since operation, 2012–2024. Please note that if reported system involves multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

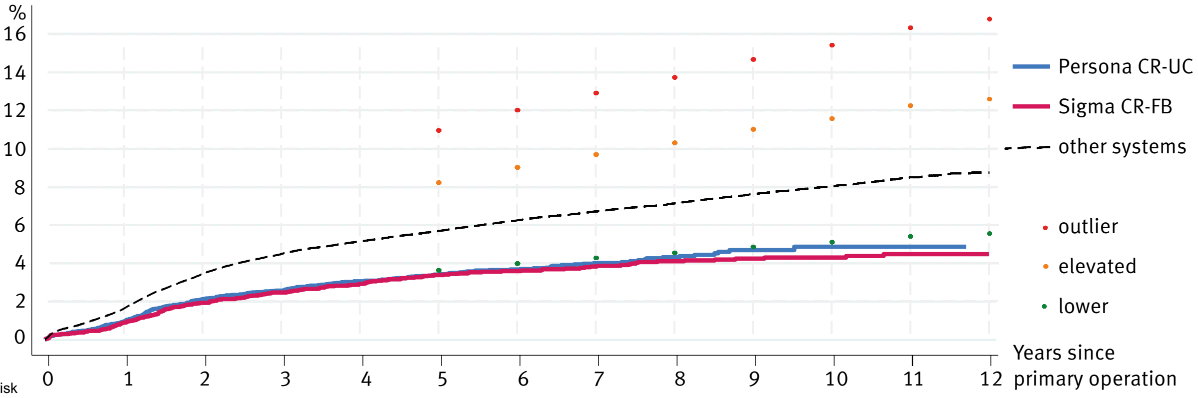
* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Younger mean age signifies that the case mix is less “usual” and potentially biased towards higher revision risk.

One older (Sigma CR-FB) and one of the newer TKA systems (Persona CR-UC) performed significantly better at long term than the average **(Figure 5.22).** For Sigma CR-FB, this does not speak by itself for a better performance, as older systems were often used in older patients, inherently more reluctant to revision than younger and more active patients.

Two newer systems from one manufacturer (Journey II and Legion, from Smith&Nephew) performed significantly worse than the Swiss average, but still below long-term outlier limits. The effect started early after primary TKA, and the revision rates remained elevated up to 12 years of follow-up **(Figure 5.23).**

With one exception, the newer systems did not lead to improved revision rates at medium and long term. The remaining brands of TKA had revision risks within the margins of the lower and upper limits at 66% and 150% of the group average, respectively **(Figures 5.22 and 5.23).**

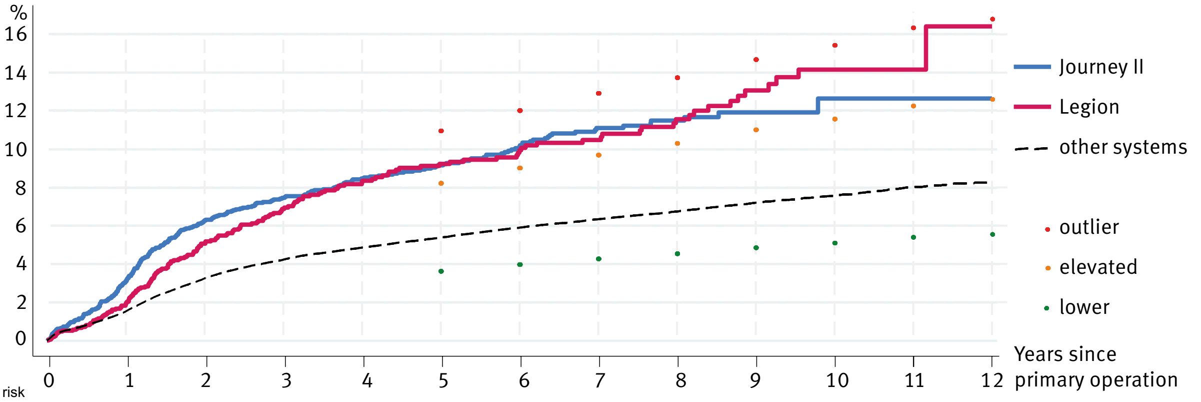


| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Persona CR-UC | 11195 | 9901 | 8204 | 6880 | 5522 | 4375 | 3287 | 2392 | 1599 | 820 | 294 | 54 | 0 |
| Sigma CR-FB | 4829 | 4698 | 4426 | 4181 | 3729 | 3383 | 3013 | 2604 | 2213 | 1800 | 1319 | 758 | 228 |
| other systems | 179120 | 154387 | 129622 | 110008 | 90727 | 76552 | 62852 | 50360 | 38677 | 27878 | 18329 | 9967 | 2560 |

**Figure 5.22**

**Implant combinations with below-average long-term revision rates (all TKA)**

Below-average was defined as an 9-year/10-year revision rate of up to 66% of the group average (and upper bounds of the 95% confidence interval staying below the lower bound of the group average; and at least 25 cases at risk at 9 years/10-years). The dots indicate upper and lower limits.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Journey II | 2630 | 2458 | 2264 | 2118 | 1850 | 1586 | 1243 | 890 | 522 | 223 | 99 | 42 | 4 |
| Legion | 2185 | 1869 | 1592 | 1301 | 1019 | 862 | 716 | 551 | 432 | 283 | 163 | 46 | 4 |
| other systems | 190329 | 164659 | 138396 | 117650 | 97109 | 81862 | 67193 | 53915 | 41535 | 29992 | 19680 | 10691 | 2780 |

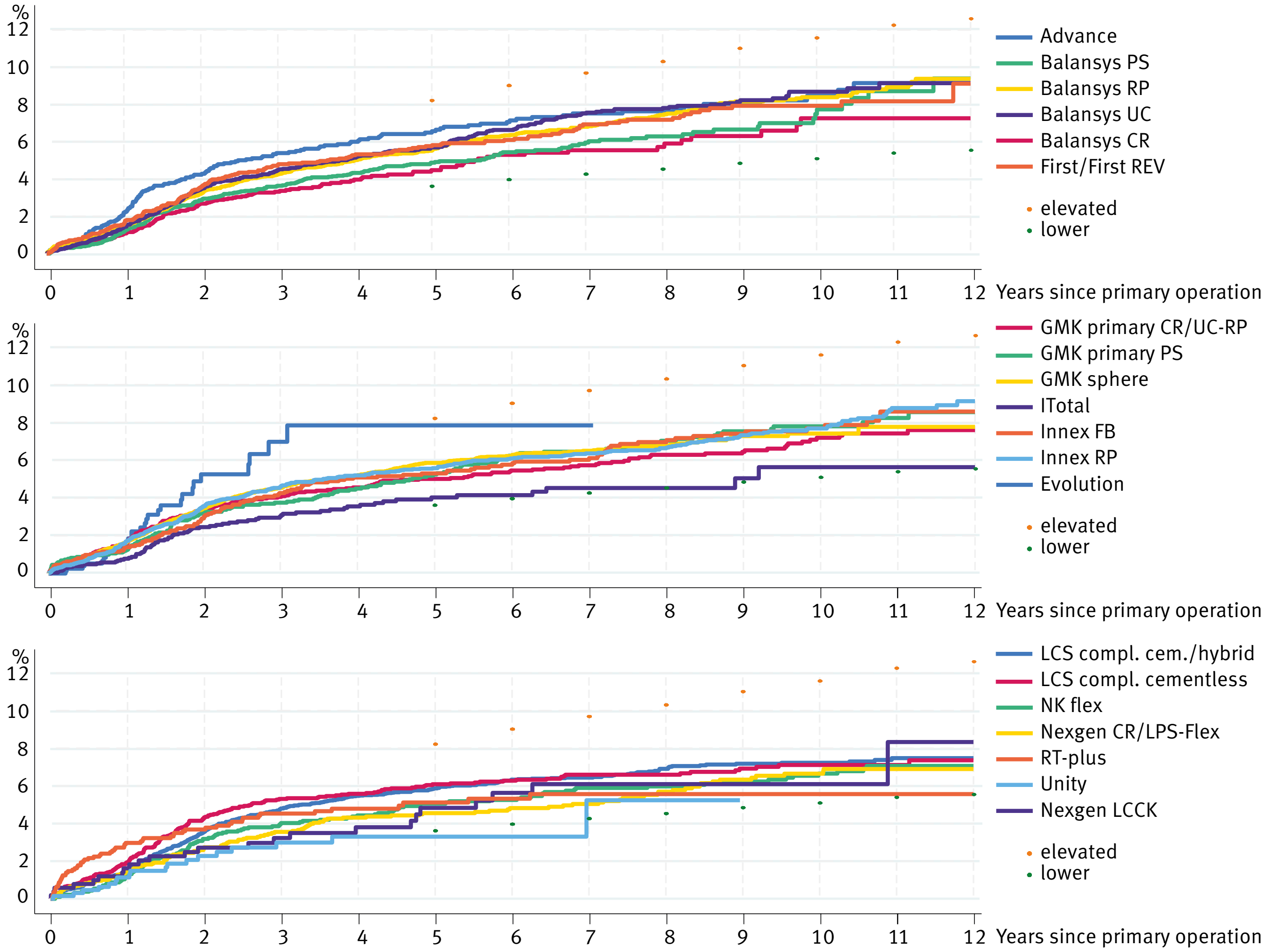
**Figure 5.23**

**Implant combinations with elevated long-term revision rates (all TKA)**

An elevated revision rate was defined as a deviation of at least 50% above the group average at any time between year 5 and year 12 (and lower bounds of the 95% confidence interval exceeding the upper bound of the group average; and at least 50 cases at risk at 5 years). The dots indicate upper and lower limits.

### 5.5.4 Brands and subsystems

**Figures 5.24** show performance of the remaining TKA brands, including subsystems, up to twelve years after primary arthroplasty. The upper and lower limits of the Swiss average are illustrated by green (lower) and orange (upper margin) dots. The goal of this differentiation is to reduce camouflage effects. It could be demonstrated some years ago by other registers, such as the British NJR, that subdividing subsystems – for which the average performance of the whole brand was within the countywide range or even better – some subtypes performed significantly worse or were even outliers, the effect though hidden by the rest of the well performing variants. In Switzerland, such an example is the well-known Sigma TKA **(Figures 5.24)**, of which the subsystems show differing results. While Sigma CR-FB had excellent results **(Figure 5.22)**, the other variants (CR-RP, PS-FB, PS-RP) showed a spread of results in the long-term evaluation. All subsystems grouped together had revision rates within the expected range, even with a tendency toward decent 12-year results. However, PS-RP cases from 2019 to 2022 had outlier status already in the 2-year evaluation **(Figures 5.25)**. It could be assumed in this case that not only the knee system,



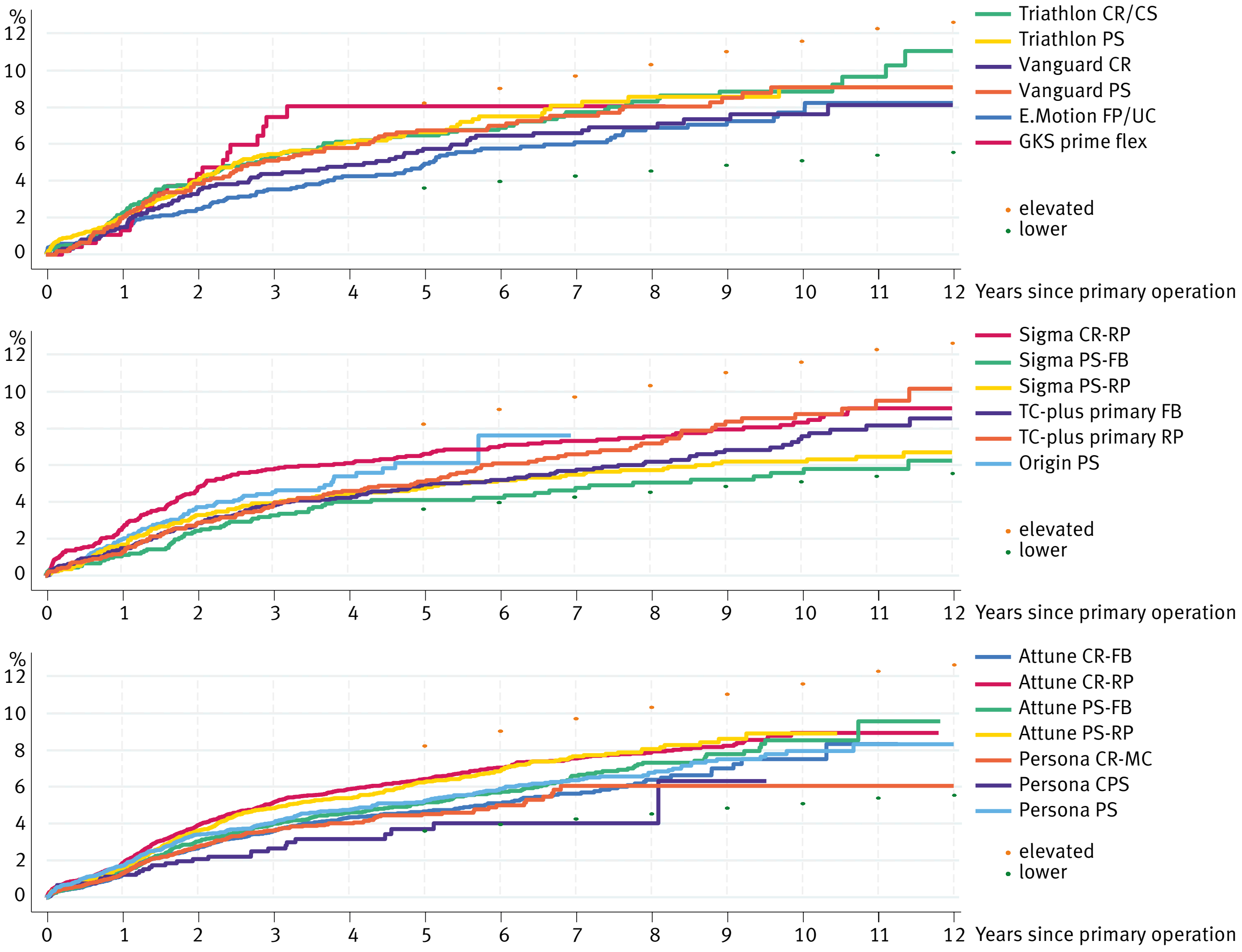
**Figures 5.24 Part one**

**All remaining implant combinations with average revision risks (all TKA)**

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively). upper and lower limits.

but the surgeons influenced the results significantly, particularly due to this temporal specificity and as the 12-year revision rates of this system are excellent. The PS-RP variation was rarely used from 2021 onwards, the brand Sigma completely disappeared from the Swiss marked in 2025.

All remaining knee systems showed long-term results close to the Swiss average **(Figures 5.24)**. ITotal and Unity tended to perform better than Swiss average, the latter with a follow up to 9 years only. Interestingly, a rotating hinge implant (RT-plus) had elevated revision rates up to three years after surgery but was performing at the lower margin of Swiss average in long-term. Two older subsystems of a brand (Sigma PS-FB and PS-RP) tended to perform better than average as well as two newer subsystems (Persona CR-MC and CPS). Persona CPS however has only 9 years of follow-up available and had a remarkable step to worse at 8 years. This may however best be explained by small numbers remaining at risk at this time point.



**Figures 5.24 Part two**

**All remaining implant combinations with average revision risks (all TKA)**

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively). upper and lower limits.

| System | CCS* | Mean age | at risk N** | Revised | |
|---|---|---|---|---|---|
| | | | | N | % (95% CI)*** |
| Advance | 24 | 68 | 708 | 31 | 4.4 (3.1-6.3) |
| Anatomic | 28 | 69 | 128 | 4 | 3.2 (1.2-8.3) |
| Attune CR-FB | 14 | 69 | 4,459 | 111 | 2.5 (2.1-3.0) |
| Attune CR-RP | 9 | 69 | 5,534 | 212 | 3.9 (3.4-4.4) |
| Attune CRS | 11 | 69 | 127 | 6 | 4.8 (2.2-10.4) |
| Attune PS-FB | 15 | 70 | 2,184 | 54 | 2.5 (1.9-3.3) |
| Attune PS-RP | 15 | 70 | 3,381 | 125 | 3.7 (3.2-4.4) |
| Balansys CR | 19 | 70 | 2,101 | 72 | 3.5 (2.8-4.4) |
| Balansys PS | 50 | 70 | 2,457 | 84 | 3.5 (2.8-4.3) |
| Balansys RP | 18 | 71 | 1,597 | 60 | 3.8 (3.0-4.9) |
| Balansys UC | 22 | 71 | 1,784 | 74 | 4.2 (3.4-5.2) |
| E.Motion FP/UC | 100 | 70 | 602 | 15 | 2.5 (1.5-4.2) |
| E.Motion PS | 100 | 73 | 56 | 1 | 1.8 (0.3-12.0) |
| Endo-Model SL | 20 | 77 | 137 | 5 | 3.8 (1.6-8.8) |
| Endo-Model rotation | 50 | 80 | 102 | 2 | 2.0 (0.5-7.9) |
| Enduro | 40 | 77 | 91 | 3 | 3.4 (1.1-10.1) |
| Evolution | 46 | 68 | 265 | 15 | 5.7 (3.5-9.3) |
| First/First REV | 30 | 71 | 717 | 34 | 4.8 (3.5-6.7) |
| GKS prime flex | 26 | 69 | 296 | 12 | 4.1 (2.3-7.1) |
| GMK hinge | 14 | 76 | 156 | 4 | 2.6 (1.0-6.8) |
| GMK primary CR/UC-FB | 48 | 71 | 80 | 3 | 3.8 (1.2-11.4) |
| GMK primary CR/UC-RP | 27 | 70 | 347 | 11 | 3.2 (1.8-5.7) |
| GMK primary PS | 26 | 71 | 303 | 19 | 6.5 (4.2-9.9) |
| GMK sphere | 12 | 69 | 9,684 | 345 | 3.6 (3.2-4.0) |
| Gemini SL | 64 | 67 | 109 | 2 | 1.9 (0.5-7.2) |
| Genus | 99 | 72 | 123 | 8 | 6.5 (3.3-12.6) |
| ITotal | 29 | 69 | 1,082 | 31 | 2.9 (2.0-4.1) |
| Innex FB | 90 | 72 | 246 | 4 | 1.6 (0.6-4.3) |
| Innex RP | 32 | 71 | 633 | 21 | 3.4 (2.2-5.1) |
| Journey II | 28 | 68 | 909 | 36 | 4.0 (2.9-5.5) |
| LCS complete cemented/hybrid | 34 | 70 | 1,935 | 78 | 4.1 (3.3-5.1) |
| LCS complete cementless | 40 | 68 | 577 | 31 | 5.4 (3.8-7.6) |
| Legion | 24 | 68 | 814 | 38 | 4.7 (3.5-6.4) |
| NK flex | 45 | 70 | 141 | 5 | 3.6 (1.5-8.4) |
| Nexgen CR/LPS-Flex | 23 | 68 | 397 | 14 | 3.6 (2.1-6.0) |

**Figures 5.25 Part one**

**2-year evaluation: Revision rates of primary total knee arthroplasty systems within 24 months**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

| System | CSS* | Mean age | at risk N** | Revised | |
|---|---|---|---|---|---|
| | | | | N | % (95% CI)*** |
| Nexgen LCCK | 22 | 72 | 156 | 3 | 2.0 (0.6-6.0) |
| Nexgen RHK | 28 | 77 | 128 | 3 | 2.4 (0.8-7.1) |
| Optetrak logic | 86 | 67 | 84 | 1 | 1.2 (0.2-8.2) |
| Origin CR | 56 | 68 | 52 | 0 | 0.0 (.-.) |
| Origin PS | 21 | 69 | 1,532 | 57 | 3.7 (2.9-4.8) |
| Persona CPS | 16 | 72 | 568 | 9 | 1.6 (0.8-3.0) |
| Persona CR-MC | 8 | 69 | 4,780 | 131 | 2.8 (2.3-3.3) |
| Persona CR-UC | 39 | 70 | 4,673 | 91 | 2.0 (1.6-2.4) |
| Persona PS | 13 | 70 | 2,798 | 98 | 3.5 (2.9-4.3) |
| RT-plus | 22 | 78 | 511 | 19 | 3.8 (2.5-5.9) |
| Score / Score II | 84 | 69 | 166 | 5 | 3.0 (1.3-7.2) |
| Sigma CR-FB | 31 | 72 | 953 | 24 | 2.5 (1.7-3.8) |
| Sigma CR-RP | 52 | 68 | 461 | 27 | 5.9 (4.1-8.5) |
| Sigma PS-FB | 90 | 72 | 337 | 11 | 3.3 (1.8-5.9) |
| Sigma PS-RP | 42 | 71 | 91 | 8 | 8.9 (4.5-16.9) |
| TC-plus primary FB | 42 | 70 | 754 | 28 | 3.8 (2.6-5.4) |
| TC-plus primary RP | 32 | 71 | 595 | 16 | 2.7 (1.7-4.4) |
| Triathlon CR/CS | 39 | 69 | 583 | 19 | 3.3 (2.1-5.1) |
| Triathlon PS | 38 | 68 | 1,609 | 70 | 4.4 (3.5-5.5) |
| U2 | 93 | 70 | 162 | 8 | 4.9 (2.5-9.6) |
| Unity | 33 | 69 | 339 | 10 | 3.0 (1.6-5.5) |
| Vanguard CR | 51 | 67 | 263 | 7 | 2.7 (1.3-5.5) |
| Vanguard PS | 42 | 68 | 198 | 6 | 3.0 (1.4-6.7) |
| Other systems | | 70 | 501 | 23 | 4.7 (3.1-7.0) |
| CH average for group | | | | | 3.4 (3.3-3.6) |

**Figures 5.25 Part two**

**2-year evaluation: Revision rates of primary total knee arthroplasty systems within 24 months**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

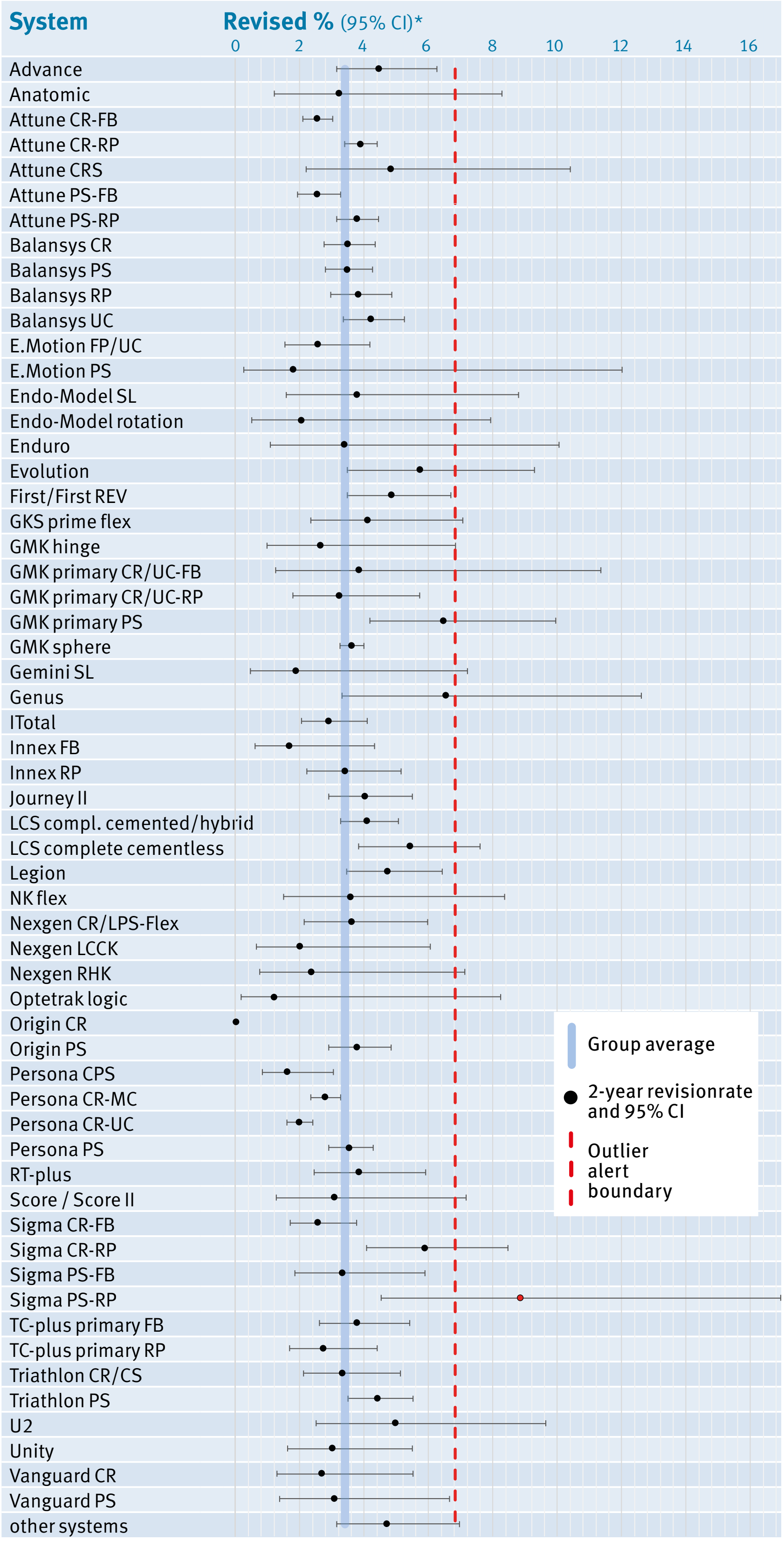
*** Rates adjusted for effects of mortality and emigration.

## Important information on the use of the implant performance tables below

● Estimated revision rate exceeds the alert boundary, but we do not identify this implant combination as an outlier because the 95% confidence interval overlaps the confidence zone of the reference group.

● Identified as potential outliers. Please note the statistical confidence intervals. The outlier status comes with varying degrees of statistical probability. We consider the potential outlier status „highly likely“ when both the estimated revision rate and the complete confidence interval exceed the outlier alert boundary.

Please be aware that relatively rare implant combinations are frequently used in only a small number or indeed only in one hospital in Switzerland. Observed revision rates may be determined by local factors and performance may differ significantly between locations. Manufacturers of detected outlier implants and the hospitals where they were used (and revisions occurred) have been informed by SIRIS.



**Figures 5.25 Part three**

2-year evaluation: Revision rates of primary total knee arthroplasty systems within 24 months

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Rates adjusted for effects of mortality and emigration.

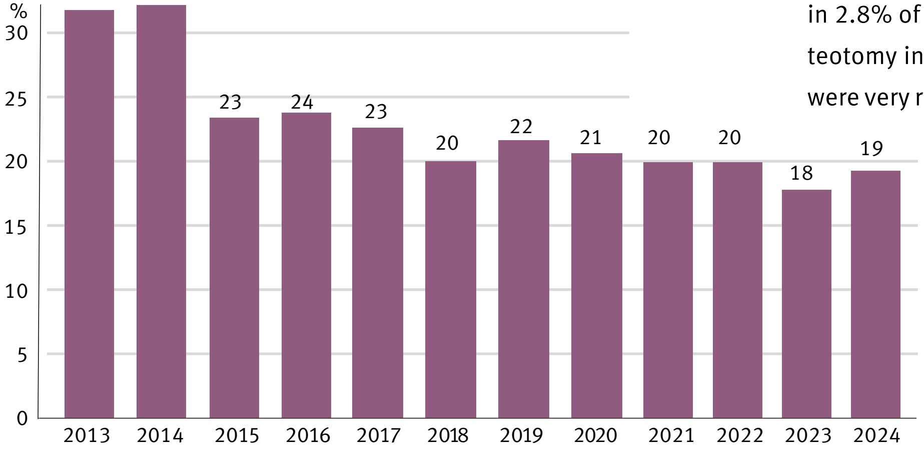
# Partial knee arthroplasty

## 5.6 Primary partial knee arthroplasty

Since 2012, a total of 35,908 primary PKA were registered **(Table 3.10).** The proportion of PKA was 15.4% over the past 12 years. In 2024, 21,568 TKA and 3,725 PKA had been performed, resulting in a share of PKA of 14.7%. For further details regarding incidence and demography please consult also **Chapter 3.3.3.**

### 5.6.1 Previous surgery

Over the past six years, no previous operations were registered in 64.8% of the PKA, whereas 23.8% had a meniscectomy, and 19.7% an arthroscopy. As both these options could be selected simultaneously, one may expect that an earlier open meniscectomy was performed in 4.1%. Prior meniscal surgery declined steadily since 2012 (32%), plateauing around 19% **(Figure 5.26).** Former ACL reconstruction was noted in 2.8% of the cases, followed next by high tibial osteotomy in 1.1%. All other previous types of surgery were very rare **(Table 5.10).**



**Figures 5.26**

Share of partial knee patients who had knee arthroscopy prior to arthroplasty (%)

| Previous surgery | N | % |
|---|---|---|
| None | 12,980 | 64.8 |
| Knee arthroscopy | 3,951 | 19.7 |
| Meniscectomy | 4,771 | 23.8 |
| ACL reconstruction | 401 | 2.0 |
| Osteotomy tibia close to knee | 212 | 1.1 |
| Osteosynthesis tibia close to knee | 100 | 0.5 |
| Surgery for patella stabilization | 215 | 1.1 |
| Synovectomy | 122 | 0.6 |
| Osteotomy femur close to knee | 33 | 0.2 |
| Osteosynthesis femur close to knee | 35 | 0.2 |
| Surgery for treating infection | 9 | 0.0 |
| Surgery for tumor | 6 | 0.0 |
| Other | 339 | 1.7 |

| Intervention | N | % |
|---|---|---|
| Unicompartment medial | 16,769 | 83.7 |
| Unicompartment lateral | 1,146 | 5.7 |
| Femoropatellar | 1,336 | 6.7 |
| Other (including combinations) | 251 | 1.3 |
| Other (type unknown)* | 535 | 2.7 |
| Conventional (including minimally invasive) | 17,346 | 86.6 |

| Technology | N | % |
|---|---|---|
| Computer assisted / navigation | 340 | 1.7 |
| Patient specific instrumentation | 1,398 | 7.0 |
| Robotic-assisted (v2021) | 890 | 4.4 |
| Other | 371 | 1.9 |

**Table 5.10**

Primary partial knee arthroplasty: Surgery characteristics

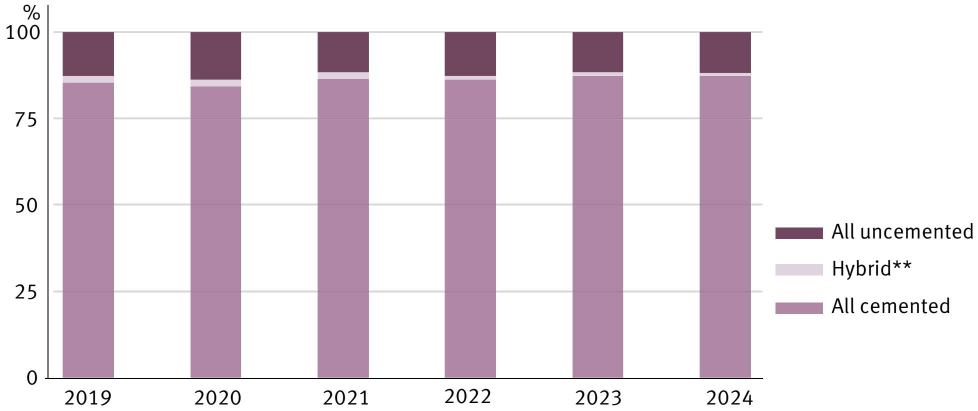
All diagnoses, all component fixations (2019–2023).

* In those cases TKA categories were chosen on the data entry form but partial knee systems registered. We consider implant registration more reliable than form entry and therefore recognise them as partial knee procedures.

## 5.6.2 Type of PKA and fixation

Medial PKA represented 83.7% of all the PKA cases, lateral PKA 5.7%, and PFJ replacement 6.7%. Others, including combinations, were rare (1.3%). In 2.7%, the type was incorrectly classified as a TKA (mentioned as "other, type unknown"), but the implant data identified them as PKA **(Table 5.10)**. This underscores the importance of checking properly the options available at case registration.

Most of the PKA were fully cemented during the period from 2019 to 2024. The share of cemented components continuously increased and reached 87.2% in 2024. Correspondingly, the share of uncemented PKA continuously decreased over the same period, hybrid fixation playing no relevant role **(Figure 5.27)**.



| Component fixation | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|
| **N** | **2,915** | **2,919** | **2,998** | **3,183** | **3,206** | **3,480** | **18,701** |
| All uncemented | 12.4 | 13.4 | 11.8 | 12.8 | 11.7 | 11.6 | 12.3 |
| Reverse hybrid* | 0.6 | 0.4 | 0.2 | 0.2 | 0.2 | 0.4 | 0.3 |
| Hybrid** | 1.6 | 1.9 | 1.8 | 0.8 | 0.7 | 0.7 | 1.2 |
| All cemented | 85.4 | 84.3 | 86.3 | 86.2 | 87.3 | 87.2 | 86.2 |

**Figure 5.27**

Primary partial knee arthroplasty: Component fixation (%)

All diagnoses

* femur cemented, tibia uncemented

** femur uncemented, tibia cemented

### 5.6.3 Technology

Between 2019 and 2024, PKA were implanted conventionally in 86.6% of the cases. Technical support was still rarely used during PKA in Switzerland, accounting for 13.1% of all cases during the same period **(Table 5.10),** although a slight increase could be observed since 2018 mainly for robotic assistance **(Figure 5.28).** Conventional computer navigation was used in 1.7%, PSI in 7.0% and robotics in 4.4% **(Table 5.10).** It would have been expected that technical support would be more frequently used in PKA than in TKA to reduce the risk of surgical errors, mainly on the tibial side, mostly responsible for elevated early revisions after PKA. Obviously, Swiss surgeons rely far less on technological support than surgeons in other countries like Australia.

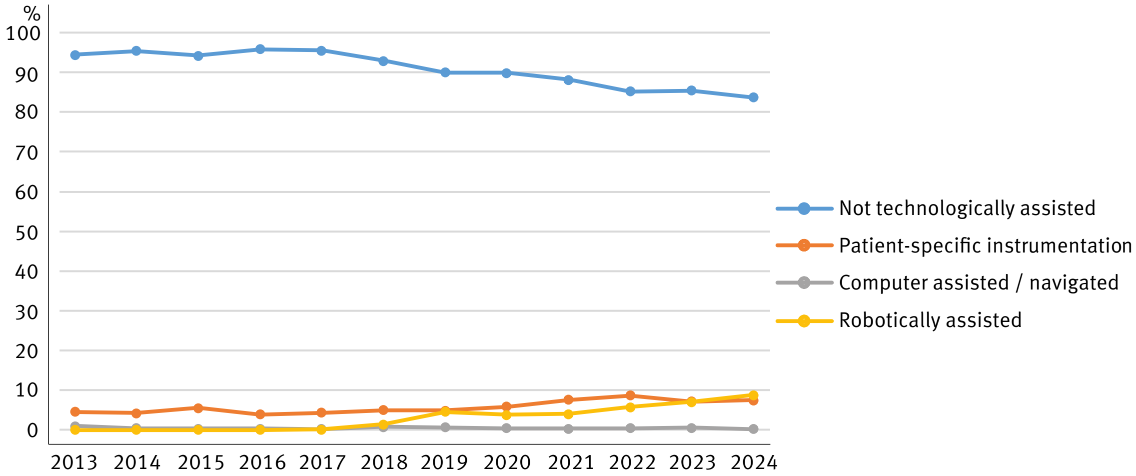


**Figure 5.28**

**Partial knee arthroplasty: technological assistance over time (%)**

NB: robotically assisted cases before v2021 were derived from free text entries. “Other” responses were coded as “Not tech. assisted” unless they specifically mentioned robotic, PSI oder navigation”.
There was a recognisable overlap of computer navigated and other responses, indicating that those cases were actually robotic-assisted.

## 5.7 First revision within two years after primary partial knee arthroplasty

First revisions are revisions linked to primary PKA registered in SIRIS and occurring for the first time. Of the 35,908 PKA documented since 2012 **(Table 3.10)**, 12,874 had been performed between 01.01.2019 and 31.12.2022 and were at risk for revision in the 4-year moving window used to calculate the current 2-year revision rate. Of the implants in this cohort, 633 had been revised, accounting for a 2-year revision rate of 5.0% (CI 4.6 – 5.3%) **(Table 5.11).** Please refer also to **Chapter 3.3.5** for incidence and demography.

### 5.7.1 Reasons for revision

The main reason for revision of PKA was loosening of the tibial component (30.0%), followed by progression of OA (17.2%), loosening of the femoral component (13.3%), femorotibial instability (9.8%), pain of unclear origin (7.1%) and patella problems (7.1%). Infections were registered in 9.6% and periprosthetic tibial fractures in (7.9%). Malposition of the tibial component was registered in 5.2% and in 3.0% of the femoral component **(Table 5.12).**

Excluding infections, most of the other reasons for revision speak for technical errors or mistakes in indication when the revision had to performed within less than two years after primary PKA.

| | | | Revised | | 95% CI | |
|---|---|---|---|---|---|---|
| | | N at risk* | N | %** | lower | upper |
| Overall | | 12,874 | 633 | 5.0 | 4.6 | 5.3 |
| Gender | Women | 5,341 | 276 | 5.2 | 4.6 | 5.8 |
| | Men | 6,159 | 266 | 4.4 | 3.9 | 4.9 |
| Age group | ‹55 | 1,709 | 119 | 7.0 | 5.9 | 8.3 |
| | 55-64 | 3,989 | 207 | 5.2 | 4.6 | 6.0 |
| | 65-74 | 3,635 | 146 | 4.1 | 3.5 | 4.7 |
| | 75-84 | 1,915 | 58 | 3.1 | 2.4 | 3.9 |
| | 85+ | 252 | 12 | 4.8 | 2.8 | 8.4 |

**Table 5.11**

**First revision of primary partial knee arthroplasty within 24 months overall and according to baseline characteristics**

All diagnoses, all component fixations.

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

** Rates adjusted for effects of mortality and emigration.

| Reason for early first revision | N revised | % |
|---|---|---|
| Loosening tibia | 190 | 30.0 |
| Progression of unicomp. OA | 109 | 17.2 |
| Loosening femur | 84 | 13.3 |
| Femorotibial instability | 62 | 9.8 |
| Infection | 61 | 9.6 |
| Periprosthetic fracture tibia | 50 | 7.9 |
| Patella problems | 45 | 7.1 |
| Pain (of unclear origin)* | 45 | 7.1 |
| Component malposition tibia | 33 | 5.2 |
| Component malposition femur | 19 | 3.0 |
| Joint stiffness/arthrofibrosis | 16 | 2.5 |
| Wear of inlay | 12 | 1.9 |
| Loosening patella | 8 | 1.3 |
| Sizing femoral component | 7 | 1.1 |
| Sizing tibial component | 5 | 0.8 |
| Patellar instability | 3 | 0.5 |
| Periprosthetic fracture patella | 2 | 0.3 |
| Periprosthetic fracture femur | 0 | 0.0 |
| Other | 67 | 10.6 |
| **Total Revisions** | **633** | |

**Table 5.12**

**Reason for early first revision of primary partial knee arthroplasty**

All diagnoses, all component fixations. 4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

Early first revisions are those occurring within 2 years of the primary arthroplasty.

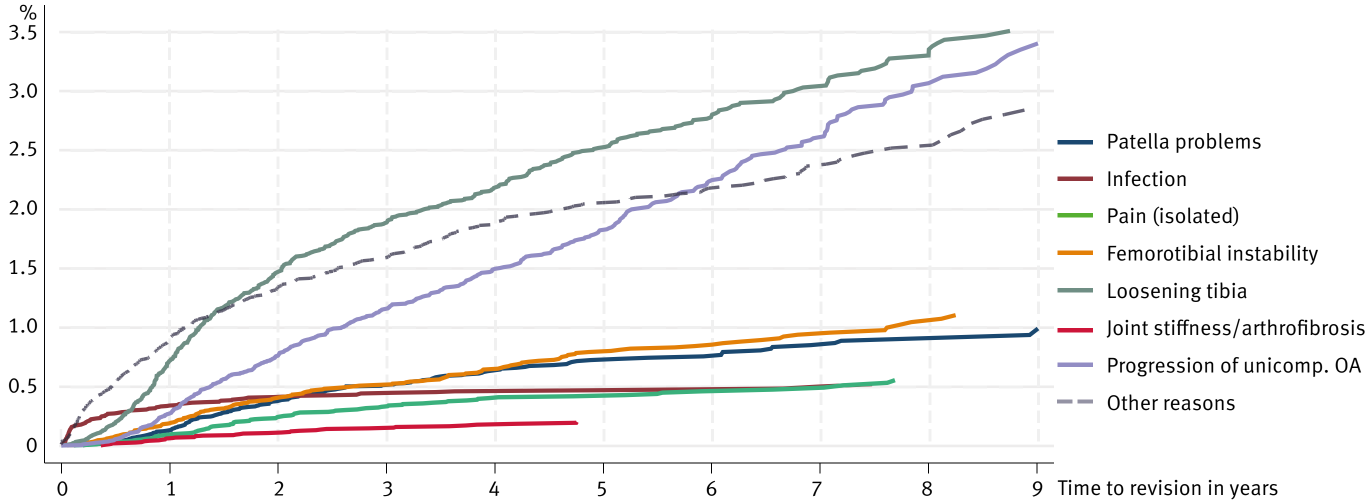
Multiple responses possible (percentages do not sum to 100)

* Pain was frequently reported alongside other reasons. The proportion of “isolated pain” was 7%.

Taking in account cumulative incidence rates for revision between 2015 and 2024, loosening of the tibial component was most prominent, followed by patella problems and “other reasons”. The curve for all the other revision reasons had a flatter pattern **(Figure 5.29).** Similarly to TKA, only periprosthetic joint infections (PJI) were revised early after the index surgery, most of the other reasons leading to a revision peak 11.8 to 14.6 months after the primary PKA. Revision for early tibial loosening had its peak 11.8 months after PKA. Early revision because of isolated pain of unknown origin was performed later at median 16.0 months **(Figure 5.30).**

## Fixation and revision

Uncemented PKA had a higher revision rate than cemented ones until 12 years of follow-up **(Figure 5.31).** A higher revision rate in uncemented PKA can be expected especially early after surgery, as uncemented implants require sufficient primary stability for osteointegration, a critical issue in some cases, particularly regarding the tibial component. After the initial failures had manifested, the revision curve of the uncemented implants remained parallel to the one observed for cemented implants. Astonishingly, the difference was getting even more pronounced from the 10th year onward **(Figure 5.31).** Of note, patients with uncemented PKA were younger than those with cemented implants. This selection bias influences the revision rate unfavourably.

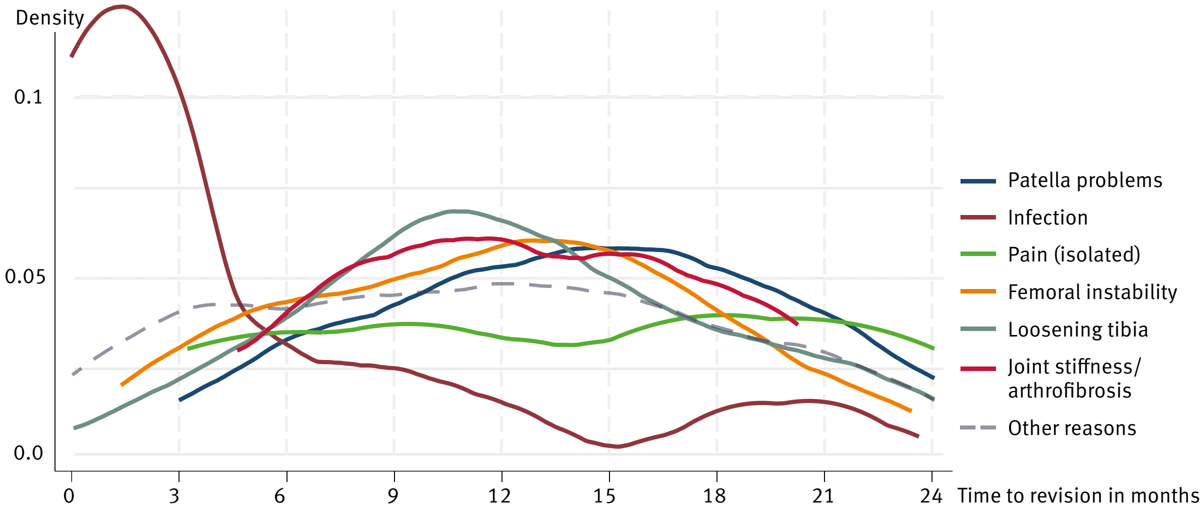


| Diagnosis for revision | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **0.1** (0.1-0.2) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.7** (0.6-0.9) | **0.8** (0.6-0.9) | **0.9** (0.8-1.1) | **1.0** (0.8-1.2) |
| Infection | **0.3** (0.3-0.4) | **0.4** (0.3-0.5) | **0.4** (0.4-0.5) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) |
| Pain (isolated) | **0.1** (0.1-0.1) | **0.2** (0.2-0.3) | **0.3** (0.3-0.4) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.6** (0.4-0.7) | **0.6** (0.4-0.7) |
| Femorotibial instability | **0.2** (0.1-0.2) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.8** (0.7-0.9) | **0.9** (0.7-1.0) | **1.0** (0.9-1.2) | **1.1** (0.9-1.3) |
| Loosening TI | **0.7** (0.6-0.8) | **1.5** (1.3-1.6) | **1.9** (1.7-2.1) | **2.5** (2.3-2.7) | **2.8** (2.6-3.1) | **3.4** (3.1-3.7) | **3.5** (3.2-3.9) |
| Joint stiffness / arthrofibrosis | **0.1** (0.0-0.1) | **0.1** (0.1-0.2) | **0.1** (0.1-0.2) | **0.2** (0.2-0.3) | **0.2** (0.2-0.3) | **0.2** (0.2-0.3) | **0.2** (0.2-0.3) |
| Progression of unicomp. OA | **0.3** (0.2-0.3) | **0.8** (0.7-0.9) | **1.2** (1.0-1.3) | **1.8** (1.6-2.0) | **2.3** (2.0-2.5) | **3.1** (2.8-3.4) | **3.4** (3.0-3.8) |
| Other reasons | **0.9** (0.8-1.0) | **1.3** (1.2-1.5) | **1.6** (1.4-1.8) | **2.1** (1.9-2.3) | **2.2** (2.0-2.4) | **2.5** (2.3-2.8) | **2.9** (2.5-3.2) |

**Figure 5.29**

**Cumulative incidence rates for different revision diagnosis of partial knee arthroplasty**

Time since operation, 2015–2024, % of implants revised. Detailed reasons for revisions available since 2015.

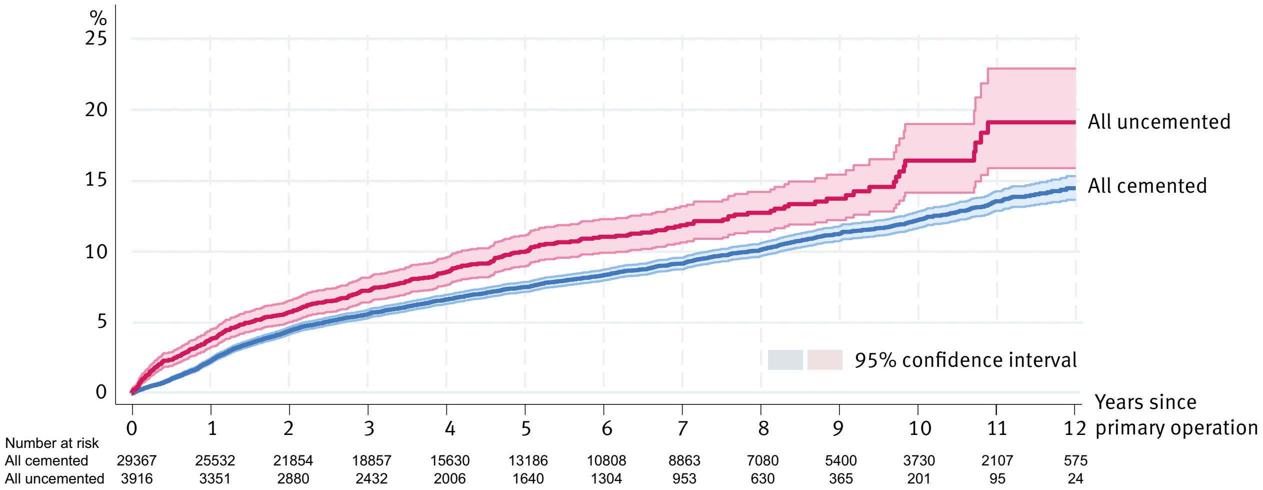


| Reason for revision | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Patella problems | 45 | 14.6 | 9.7 | 18.1 |
| Infection | 61 | 1.4 | 0.8 | 6.5 |
| Pain (isolated) | 15 | 16.0 | 5.1 | 21.1 |
| Femoral instability | 62 | 12.3 | 6.9 | 15.5 |
| Loosening tibia | 190 | 11.8 | 8.3 | 16.6 |
| Joint stiffness/arthrofibrosis | 16 | 12.2 | 8.8 | 17.5 |
| Other | 316 | 11.1 | 6.0 | 16.5 |

**Figure 5.30**

**Time interval between primary partial knee arthroplasty and first revision by reason**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024). Early first revisions are those occurring within 2 years of the primary arthroplasty. All diagnoses.



| Component fixation | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| All cemented | **2.3** (2.1-2.5) | **4.4** (4.2-4.7) | **5.6** (5.3-5.9) | **7.5** (7.2-7.9) | **8.4** (8.0-8.7) | **10.2** (9.7-10.6) | **12.3** (11.7-12.8) | **14.5** (13.7-15.3) |
| All uncemented | **3.8** (3.2-4.5) | **5.7** (5.0-6.6) | **7.3** (6.4-8.2) | **10.0** (9.0-11.1) | **11.1** (9.9-12.3) | **12.8** (11.4-14.2) | **16.4** (14.2-19.0) | **19.1** (15.9-22.9) |

**Figure 5.31**

**Estimated failure rates of primary partial knee arthroplasty for main types of component fixation**

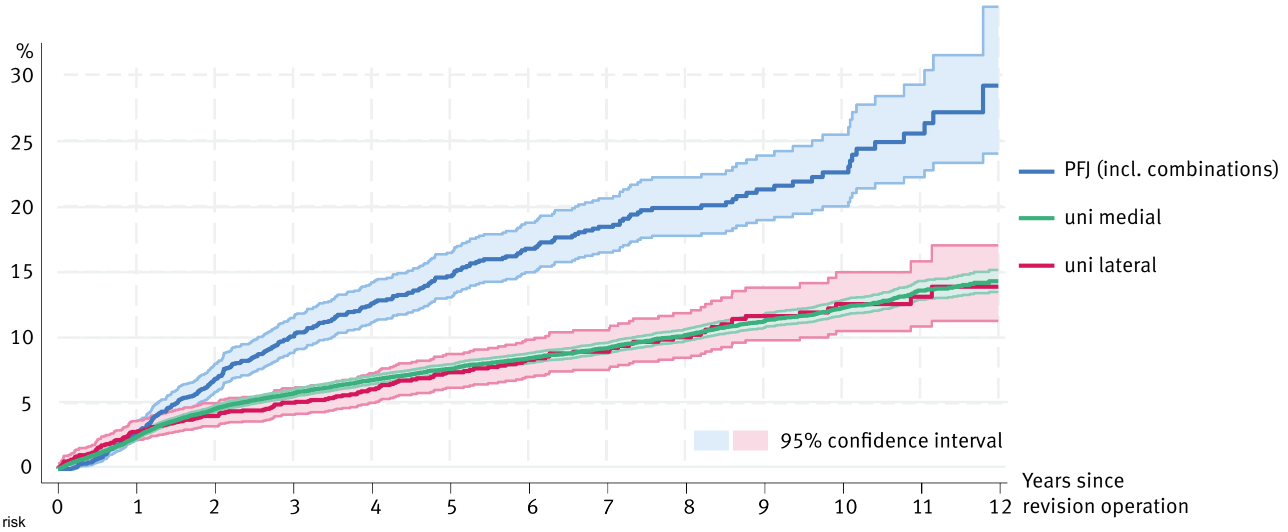
Time since operation, 2012–2024, all diagnoses.

### Type of PKA and revision

Estimated failure rates of PKA since 2012 were equal for medial and lateral PKA. PFJ performed much worse regarding revision rates, diverging already between one to two years after surgery. At 4 years of follow-up, revision rates were already twice as high as for medial or lateral PKA, maintaining a revision rate about twice as high until 12 years after primary PKA **(Figure 5.32).**

### Technical support and revision

Comparing technical support during primary PKA, PSI did not perform better than conventional technique **(Figure 5.33),** as did conventional computer navigation **(Figure 5.34).** In contrast, robotically assisted PKA was associated with less revisions from early on, although the effect seemed to flatten out from the fifth year after primary PKA **(Figure 5.34).** At 6 years,



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PFJ (incl. comb.) | 2522 | 2148 | 1755 | 1418 | 1139 | 886 | 703 | 556 | 413 | 297 | 179 | 98 | 19 |
| uni lateral | 2117 | 1844 | 1623 | 1396 | 1169 | 998 | 794 | 623 | 495 | 379 | 258 | 139 | 32 |
| uni medial | 30096 | 26081 | 22294 | 19213 | 15891 | 13334 | 10901 | 8822 | 6864 | 5071 | 3402 | 1910 | 535 |

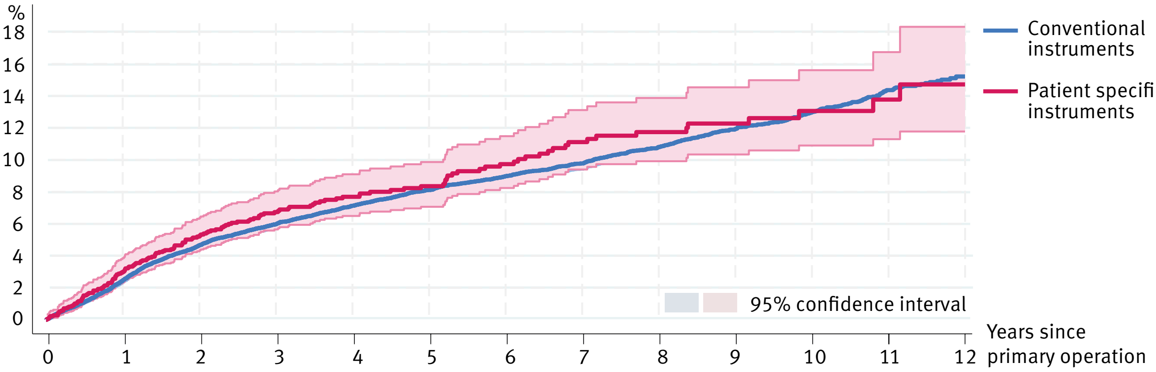
| Arthroplasty | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| uni medial | **2.4** (2.2-2.6) | **4.6** (4.3-4.8) | **5.7** (5.5-6.0) | **7.6** (7.3-8.0) | **8.4** (8.1-8.8) | **10.2** (9.7-10.6) | **12.2** (11.7-12.8) | **14.3** (13.5-15.1) |
| uni lateral | **2.8** (2.2-3.6) | **4.0** (3.2-5.0) | **5.0** (4.1-6.1) | **7.4** (6.2-8.7) | **8.3** (7.0-9.8) | **10.0** (8.5-11.9) | **12.5** (10.5-15.0) | **13.9** (11.3-17.0) |
| PFJ (incl. comb.) | **2.8** (2.2-3.5) | **6.8** (5.8-8.0) | **10.1** (8.8-11.5) | **14.7** (13.1-16.4) | **16.8** (15.0-18.7) | **19.9** (17.7-22.2) | **22.6** (20.0-25.4) | **29.2** (24.0-35.2) |

**Figure 5.32**

**Estimated failure rates of primary partial knee arthroplasty: type of arthroplasty**

Time since operation, 2012–2024, all diagnoses.

robotically assisted PKA had a revision rate of 6.8% (CI 4.1–11.3%) compared to conventional technique with 9.0% (CI 8.7–9.4%). The larger confidence intervals of robotic PKA due to smaller numbers rendered the difference non-significant. More robotic systems with varying value in supporting surgery and more surgeons with less experience could deteriorate initially promising results, as had been observed in Australia.



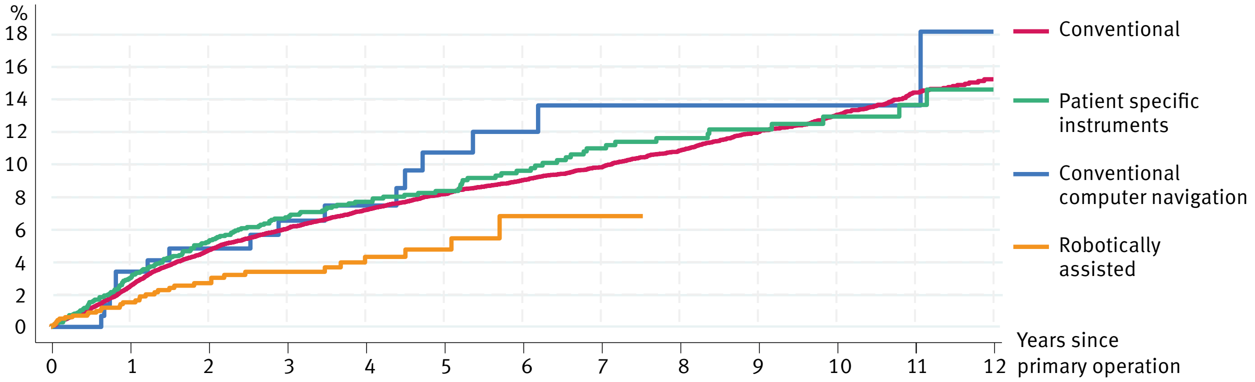
| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| conventional instrum. | 33783 | 29346 | 25130 | 21675 | 17987 | 15059 | 12286 | 9931 | 7732 | 5726 | 3877 | 2157 | 578 |
| patient specific instrum. | 2124 | 1778 | 1491 | 1175 | 905 | 734 | 580 | 454 | 361 | 284 | 170 | 107 | 33 |

| Instrumentation | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| Conventional | **2.5** (2.3-2.6) | **4.7** (4.4-4.9) | **6.0** (5.7-6.3) | **8.1** (7.8-8.5) | **9.0** (8.6-9.4) | **10.8** (10.4-11.3) | **13.0** (12.4-13.6) | **15.2** (14.4-16.1) |
| PSI | **3.0** (2.3-3.9) | **5.2** (4.3-6.3) | **6.7** (5.7-8.0) | **8.4** (7.1-9.9) | **9.7** (8.2-11.5) | **11.7** (9.9-13.9) | **13.1** (10.9-15.6) | **14.7** (11.8-18.3) |

**Figure 5.33**

## Estimated failure rates of primary partial knee arthroplasty: conventional vs. patient specific instrumentation

Time since operation, 2012–2024, all diagnoses.



| Number at risk | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conv. computer navi. | 152 | 140 | 122 | 105 | 89 | 77 | 60 | 41 | 39 | 31 | 26 | 21 | 3 |
| Conventional | 32446 | 28364 | 24422 | 21172 | 17627 | 14831 | 12198 | 9890 | 7694 | 5696 | 3852 | 2137 | 575 |
| Patient specific instr. | 2120 | 1774 | 1487 | 1172 | 902 | 731 | 579 | 453 | 360 | 283 | 169 | 106 | 33 |
| Robotically assisted | 1189 | 846 | 590 | 401 | 274 | 154 | 29 | 1 | 0 | 0 | 0 | 0 | 0 |

| Assistance | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| Conventional | **2.5** (2.3-2.7) | **4.7** (4.5-5.0) | **6.0** (5.8-6.3) | **8.2** (7.8-8.5) | **9.0** (8.7-9.4) | **10.9** (10.4-11.3) | **13.1** (12.5-13.6) | **15.3**(14.5-16.1) |
| Patient spec. instr. | **3.0** (2.3-3.9) | **5.2** (4.3-6.3) | **6.8** (5.7-8.0) | **8.4** (7.1-9.9) | **9.6** (8.1-11.4) | **11.6** (9.8-13.8) | **13.0**(10.8-15.5) | **14.6**(11.7-18.2) |
| Conv. computer navi. | **3.4** (1.4-8.0) | **4.8** (2.3-9.9) | **6.5** (3.4-12.3) | **10.7** (6.3-18.0) | **12.0** (7.2-19.8) | **13.7** (8.2-22.2) | **13.7** (8.2-22.2) | |
| Robotically assisted | **1.5** (0.9-2.5) | **2.7** (1.8-4.0) | **3.4** (2.3-4.9) | **4.8** (3.2-7.0) | **6.8** (4.1-11.3) | | | |

**Figure 5.34**

## Estimated failure rates of primary partial knee arthroplasty: technological assistance

Time since operation, 2012–2024, all diagnoses.

## 5.7.2 Type of early PKA revision

A total of 70.0% of the PKA revised were converted to TKA. Isolated liner exchange was performed in 16.7% of revisions, followed by an isolated tibial revision in 3.9% and isolated femoral revision in 1.9% **(Table 5.13).** Complete revision was performed in 2.4%, meaning conversion to TKA in many cases. These responses were reclassified as conversion if TKA components were registered at the revision. The high number of conversions to TKA in case of failed PKA is even more obvious in **Figure 5.35** depicting cumulative incidence rates of all cases since 2012. Subsequent PKA in another compartment was rare (1.9%). Component removal with spacer due to PJI was performed in only 2 of the 443 revisions performed between 01.01.2019 and 31.12.2022. For re-revision surgery after primary PKA please consult **Chapter 5.4.2.**

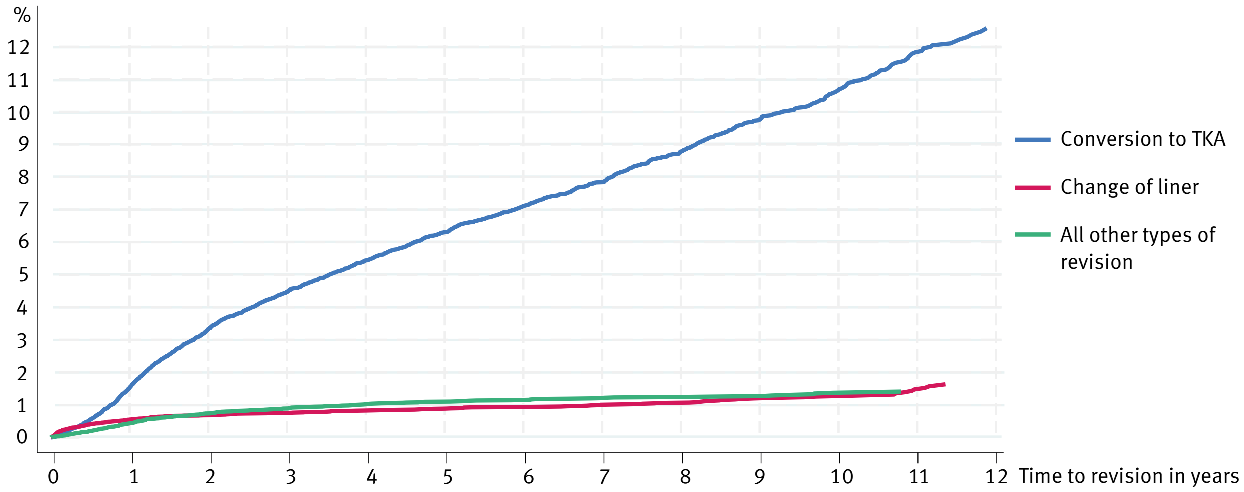
| Type of early first revision | N revised | % |
|---|---|---|
| Conversion from unicomp. to total prosthesis* | 443 | 70.0 |
| Exchange of PE liner | 106 | 16.7 |
| Tibial revision | 25 | 3.9 |
| Complete revision* | 15 | 2.4 |
| Femoral revision | 12 | 1.9 |
| Subsequent partial prosthesis, second compartment | 12 | 1.9 |
| Patella revision | 11 | 1.7 |
| Component removal with spacer implantation | 5 | 0.8 |
| Component removal without spacer implantation | 2 | 0.3 |
| Subsequent patella prosthesis | 1 | 0.2 |
| Reimplantation of prosthesis | 1 | 0.2 |
| Subsequent patella prosthesis with exchange of PE liner | 0 | 0.0 |
| Other | 0 | 0.0 |
| **Total Revisions** | **633** | **100** |

**Table 5.13**

**Type of early first revision of primary partial knee arthroplasty**

All diagnoses, all component fixations. 4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024). Early first revisions are those occurring within 2 years of the primary arthroplasty

* A large share of conversions is entered locally as “complete revisions”. Such responses have been recoded as conversions if TKA components were registered or if a TKA was indicated on the revision proforma.



| Type of revision | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 12 years |
|---|---|---|---|---|---|---|---|---|
| Conversion to TKA | **1.5** (1.4-1.7) | **3.3** (3.1-3.5) | **4.5** (4.2-4.7) | **6.3** (6.0-6.6) | **7.1** (6.8-7.4) | **8.8** (8.4-9.2) | **10.7** (10.2-11.2) | **12.6** (11.8-13.3) |
| Change of liner | **0.5** (0.5-0.6) | **0.7** (0.6-0.8) | **0.8** (0.7-0.9) | **0.9** (0.8-1.0) | **0.9** (0.8-1.1) | **1.1** (0.9-1.2) | **1.3** (1.1-1.4) | **1.6** (1.4-2.0) |
| All other types | **0.4** (0.4-0.5) | **0.7** (0.6-0.8) | **0.9** (0.8-1.0) | **1.1** (1.0-1.2) | **1.2** (1.0-1.3) | **1.2** (1.1-1.4) | **1.4** (1.2-1.6) | **1.4** (1.2-1.6) |

**Figure 5.35**

**Cumulative incidence rates for different types of revisions of partial knee arthroplasty**

Time since operation, 2012–2024, % of implants revised

## 5.8 Results of implants in unicondylar partial knee arthroplasty

The analysis is performed separately for unicondylar PKA (chapter 5.8) and for PFJ PKA **(chapter 5.9)**, as the revision rates observed largely differed.

**Table 5.14** shows Switzerland's current top ten of the most frequently used unicondylar PKA systems, representing 94% (17,588) of the PKA performed between 2019 and 2024. During this period, 1,050 implants (5.6%) belonged to the less common systems, grouped together as "other systems". The share of these is decreasing continuously over the years. Only 62 implants (0.3%) could not be classified.

| System | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|
| Balansys uni | 354 | 298 | 352 | 420 | 333 | 337 | 2,094 |
| GMK uni | 222 | 205 | 159 | 155 | 116 | 95 | 952 |
| Journey uni | 90 | 89 | 74 | 47 | 52 | 48 | 400 |
| Moto | 31 | 66 | 125 | 188 | 150 | 237 | 797 |
| Oxford cemented/hybrid | 314 | 270 | 254 | 210 | 199 | 271 | 1,518 |
| Oxford cementless | 319 | 354 | 321 | 362 | 344 | 362 | 2,062 |
| Persona partial knee | 427 | 412 | 445 | 517 | 592 | 603 | 2,996 |
| Physica ZUK | 251 | 329 | 333 | 403 | 469 | 468 | 2,253 |
| Restoris MCK | 128 | 110 | 112 | 178 | 227 | 290 | 1,045 |
| Sigma partial knee | 505 | 600 | 615 | 507 | 573 | 671 | 3,471 |
| Other systems | 245 | 175 | 198 | 182 | 140 | 110 | 1,050 |
| **Total** | **2,886** | **2,908** | **2,988** | **3,169** | **3,195** | **3,492** | **18,638** |

**Table 5.14**

**Top 10 (94%) of primary partial knee arthroplasty systems (all diagnoses, all component fixations) 2019 – 2024**

### Important information on the use of the implant performance tables below

- ● Estimated revision rate exceeds the alert boundary, but we do not identify this implant combination as an outlier because the 95% confidence interval overlaps the confidence zone of the reference group.
- ● Identified as potential outliers. Please note the statistical confidence intervals. The outlier status comes with varying degrees of statistical probability. We consider the potential outlier status „highly likely" when both the estimated revision rate and the complete confidence interval exceed the outlier alert boundary.

Please be aware that relatively rare implant combinations are frequently used in only a small number or indeed only in one hospital in Switzerland. Observed revision rates may be determined by local factors and performance may differ significantly between locations. Manufacturers of detected outlier implants and the hospitals where they were used (and revisions occurred) have been informed by SIRIS.

### 5.8.1 Two-year revision rates of unicondylar partial knee arthroplasty

The two-year revision rates of the unicondylar PKA from the current moving window is shown in **Figure 5.36,** reflecting how the implants used between 01.01.2019 and 31.12.2022, performed at a two-year follow-up by 31.12.2024. Of the 13 implant combinations used most frequently (the rest being summarised under "other systems"), none was identified as an outlier. The system reaching a definitive outlier status at the third year (Journey Uni) after PKA had only a slightly elevated revision rate at two years, remaining within the boundaries of the average. This is reflective of recent improvements with this implant. In contrast, the summary group "other systems" had the highest two-year revision rate and remained only just below the outlier-boundary (Figure 5.36). Therefore, it is advisable for surgeons using less commonly used implants to carefully review their outcomes and consider switching to brands more frequently used in Switzerland if there is any uncertainty.

| System | CCS* | Mean | at risk | Revised | |
|---|---|---|---|---|---|
| | | age | N** | N | % (95% CI)*** |
| Allegretto | 100 | 71 | 334 | 5 | 1.5 (0.6-3.6) |
| Balansys uni | 41 | 65 | 1,424 | 73 | 5.2 (4.1-6.5) |
| GMK uni | 17 | 65 | 741 | 45 | 6.1 (4.6-8.1) |
| IUni | 29 | 64 | 190 | 9 | 4.8 (2.5-9.0) |
| Journey uni | 12 | 63 | 300 | 17 | 5.7 (3.6-9.1) |
| Moto | 19 | 66 | 410 | 25 | 6.1 (4.2-8.9) |
| Oxford cemented/hybrid | 17 | 65 | 1,048 | 57 | 5.5 (4.2-7.0) |
| Oxford cementless | 14 | 64 | 1,356 | 84 | 6.2 (5.1-7.6) |
| Persona partial knee | 17 | 65 | 1,801 | 75 | 4.2 (3.4-5.2) |
| Physica ZUK | 35 | 65 | 1,316 | 70 | 5.4 (4.3-6.7) |
| Restoris MCK | 53 | 66 | 528 | 11 | 2.1 (1.2-3.7) |
| Sigma partial knee | 18 | 65 | 2,227 | 89 | 4.0 (3.3-4.9) |
| Triathlon PKR | 57 | 65 | 121 | 5 | 4.2 (1.7-9.7) |
| Other systems | | 65 | 155 | 14 | 9.0 (5.5-14.8) |
| CH average for group | | | | | 4.9 (4.5-5.3) |

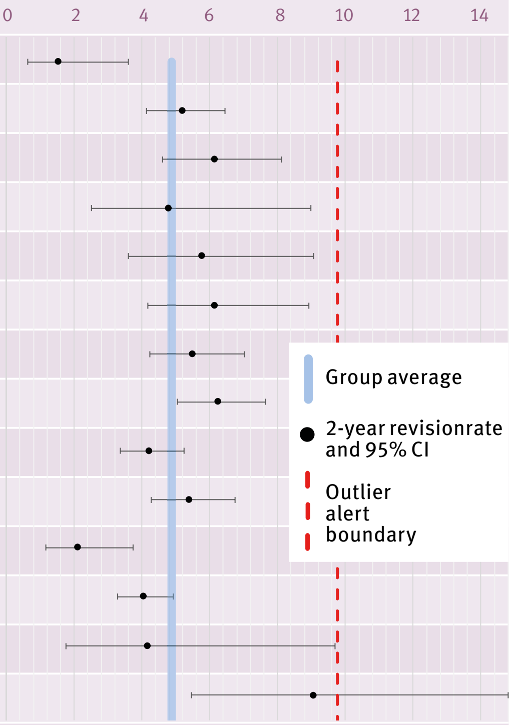


**Figure 5.36**

**2-year evaluation: Revision rates of primary partial knee arthroplasty systems within 24 months**

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

### 5.8.2 Long term survival of unicondylar partial knee arthroplasty

The long-term evaluation for all systems registered since 2012, all diagnoses, and all fixation methods is depicted in **Table 5.15**, showing results up to 12 years after surgery. The revision rate after 12 years for all systems was 14.5% (CI 13.7-15.3%), considerably higher than after TKA, where an average 12-year revision rate of 8.4% (CI 8.2–8.6%) was observed **(Table 5.9).**

Primary PKA subsystems (such as cemented or cementless) were analysed separately if numbers were sufficient and differed relevantly regarding revision rates. Different implants performed rather differently on the short, medium, and long term **(Table 5.15).** The revision rate after 12 years varied from 5.9% for the best to 25.6% for the worst system. Wider confidence intervals reflect higher variability due to small numbers in the subgroups. Please take note of the case concentration score (CCS), indicating the share of the largest providing hospital. A higher value indicates an increased likelihood of bias due to local effects, i.e. individual providers may influence results of systems not widely used. For instance, Allegretto was implanted by just one surgeon, resulting in a CCS of 100. For some brands, only five-year results were available. Until then, they performed better than the Swiss average, with one system (Restoris MCK) performing even statistically significantly better **(Table 5.15).**

| System | Total N | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Allegretto | 1,074 | 100 | 70 | **0.5** (0.2-1.1) | **1.7** (1.1-2.7) | **3.2** (2.3-4.5) | **5.9** (4.3-8.0) | **5.9** (4.3-8.0) |
| Balansys uni | 4,064 | 47 | 65 | **2.2** (1.8-2.7) | **5.6** (4.8-6.4) | **7.0** (6.1-7.9) | **11.0** (9.7-12.5) | **12.2** (10.5-14.1) |
| GMK uni | 1,852 | 21 | 66 | **3.3** (2.6-4.2) | **7.5** (6.4-8.9) | **9.4** (8.0-10.9) | **14.0** (11.8-16.5) | **15.7** (12.7-19.4) |
| Journey uni | 1,128 | 13 | 63 | **3.5** (2.6-4.8) | **8.9** (7.4-10.8) | **15.8** (13.6-18.3) | **24.5** (21.3-28.2) | **25.6** (22.1-29.5) |
| Moto | 818 | 15 | 65 | **3.4** (2.3-5.1) | **5.8** (4.2-8.0) | **6.9** (4.9-9.7) | | |
| Oxford cemented/hybrid | 4,590 | 19 | 66 | **2.5** (2.1-3.1) | **5.6** (5.0-6.4) | **7.5** (6.7-8.4) | **12.8** (11.6-14.1) | **16.0** (14.2-18.1) |
| Oxford cementless | 3,434 | 10 | 64 | **3.8** (3.2-4.5) | **6.7** (5.9-7.7) | **9.2** (8.2-10.4) | **14.6** (12.3-17.3) | **16.9** (13.3-21.3) |
| Persona partial knee | 3,441 | 14 | 65 | **2.0** (1.6-2.6) | **4.8** (4.1-5.7) | **6.6** (5.5-7.8) | | |
| Physica ZUK | 4,477 | 20 | 65 | **1.9** (1.5-2.4) | **5.5** (4.8-6.3) | **7.0** (6.2-7.9) | **11.8** (10.6-13.2) | **14.7** (12.8-16.8) |
| Restoris MCK | 1,080 | 48 | 65 | **1.2** (0.7-2.2) | **3.0** (2.0-4.5) | **4.2** (2.7-6.4) | | |
| Sigma partial knee | 6,013 | 18 | 65 | **2.2** (1.8-2.6) | **5.4** (4.8-6.0) | **6.9** (6.2-7.6) | **9.7** (8.6-10.9) | **11.2** (9.7-12.9) |
| Other systems | 1,436 | | 64 | **3.5** (2.7-4.6) | **8.0** (6.6-9.6) | **10.7** (9.0-12.7) | **19.0** (15.8-22.8) | **19.7** (16.3-23.7) |
| **CH average for group** | | | | **2.5 (2.3-2.6)** | **5.7 (5.5-6.0)** | **7.7 (7.4-8.1)** | **12.4 (11.9-13.0)** | **14.5 (13.7-15.3)** |

**Table 5.15**

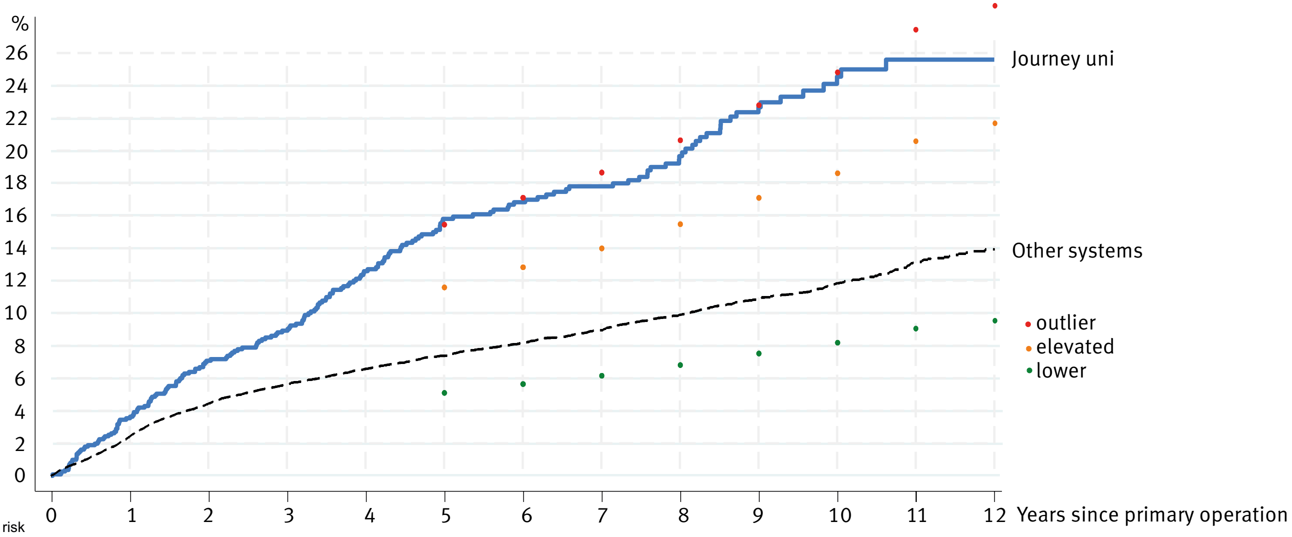
**Long term evaluation: Failure rates of primary partial knee arthroplasty systems (all diagnoses, all component fixations)**

Time since operation, 2012–2024. Please note that if reported system involves multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Younger mean age signifies that the case mix is less “usual” and potentially biased towards higher revision risk.

PKA systems grouped under the label “other systems” because of small numbers, accounting all together for 5.6% of the PKA, had an average revision rate at 12 years of 19.7% (CI 16.3 – 23.7%). This means that none of the less commonly used systems would reach a place in the midfield at twelve years of follow-up. One system (Journey Uni) **(Figure 5.37)** even had to be classified as a long-term outlier at 12 years follow-up. Interestingly, Journey Uni is from the same company as the potential outlier system and the one with “elevated” long-term revision risk identified in TKA. As usual, the potential and definitive outlier identification will result in a detailed outlier report investigating the reasons for the observed deviations from the national average. As in former years, one PKA system (Allegretto) had a significantly better survival curve than the Swiss average, but it must be underscored that it was used in just one surgical unit **(Figure 5.38).**

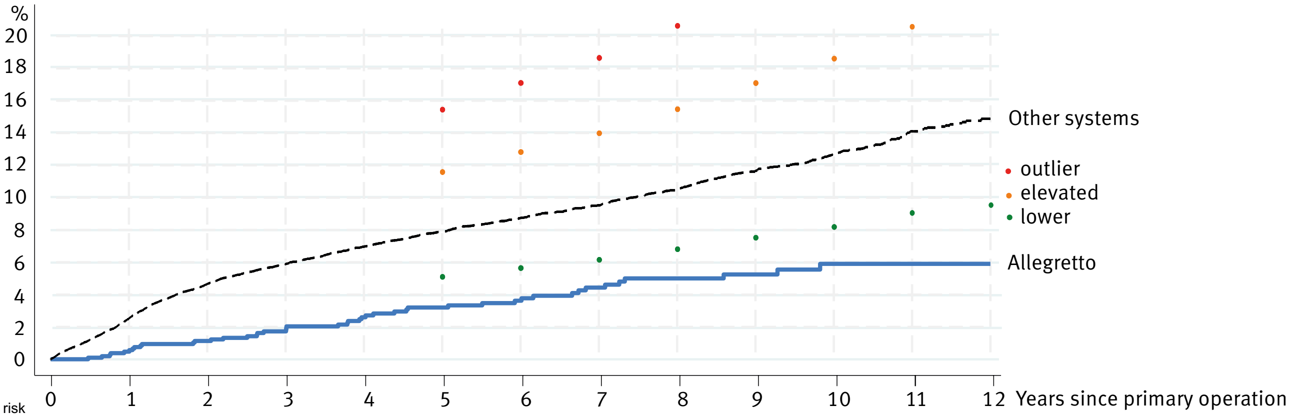


| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number at risk | | | | | | | | | | | | | |
| Journey uni | 1128 | 1031 | 935 | 861 | 725 | 619 | 539 | 461 | 351 | 255 | 171 | 89 | 18 |
| other systems | 32279 | 27921 | 23860 | 20480 | 16920 | 14164 | 11511 | 9265 | 7238 | 5384 | 3640 | 2032 | 556 |

**Figure 5.37**

**Implant combinations with long-term evaluation outlier status (all unicompartimental PKA)**

Outlier status was defined as a revision rate of twice the group average at any time between year 5 and year 12 (and lower bounds of the 95% confidence interval exceeding the upper bound of the group average; and at least 50 cases at risk at 5 years). The dots indicate upper and lower limits.



| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number at risk | | | | | | | | | | | | | |
| Allegretto | 1074 | 1058 | 1028 | 949 | 833 | 743 | 635 | 536 | 442 | 350 | 242 | 139 | 31 |
| other systems | 32333 | 27894 | 23767 | 20392 | 16812 | 14040 | 11415 | 9190 | 7147 | 5289 | 3569 | 1982 | 543 |

**Figure 5.38**

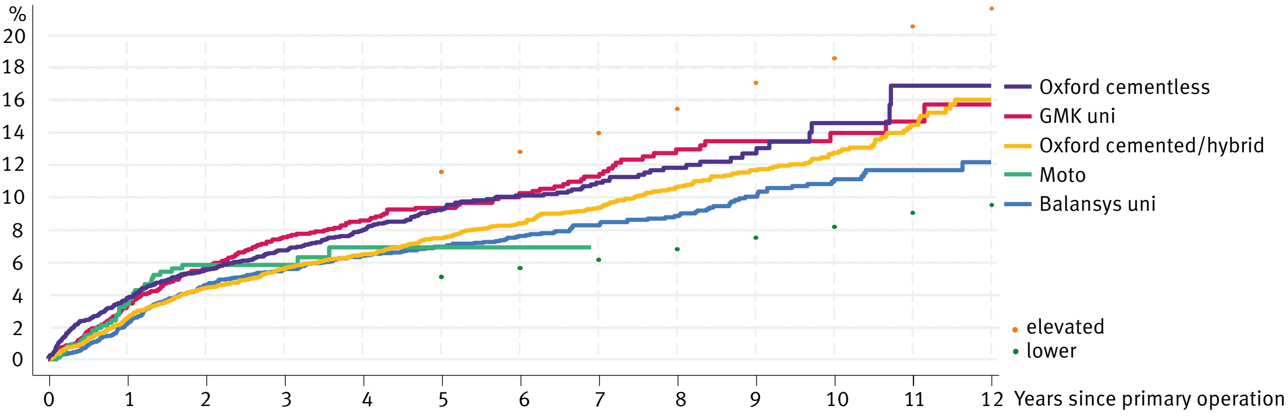
**Implant combinations with below-average long-term revision rates (unicompartimental PKA)**

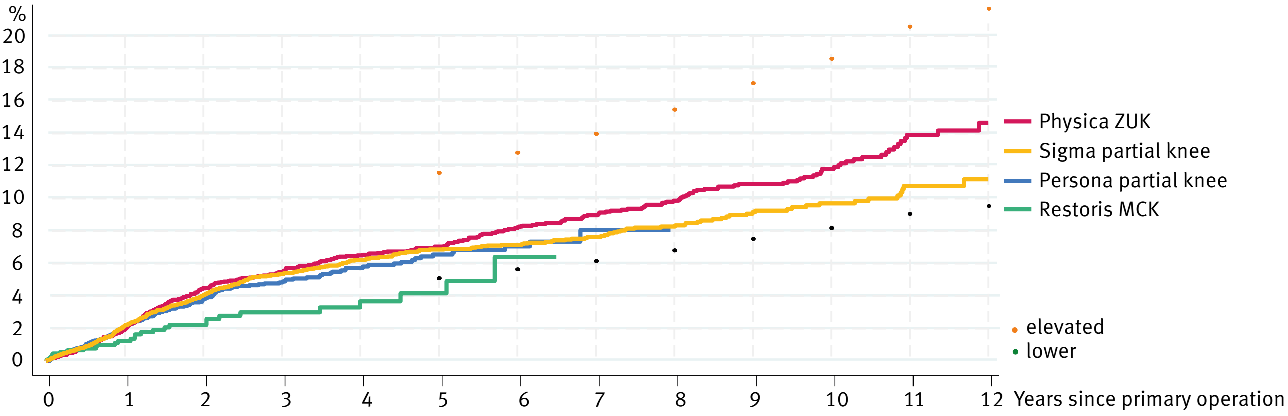
Below-average was defined as an 9-year/10-year revision rate of up to 66% of the group average (and upper bounds of the 95% confidence interval staying below the lower bound of the group average; and at least 25 cases at risk at 9 years/10-years). The dots indicate upper and lower limits.

These excellent results are most probably to be explained by the outstanding expertise of the surgeon than by the system itself. With numbers decreasing rapidly in recent years, it is expected that this system will not be used anymore in the future, either because the surgeon changed implant or is retiring. The remaining brands of PKA had revision rates within the margins of the lower and upper limits at 66% and 150% of the group average, respectively **(Figures 5.39)**.

### 5.8.3 Brands of unicondylar PKA

**Figures 5.39** show the performance of the different PKA brands up to twelve years of follow-up, with upper and lower limits of the Swiss average illustrated in dotted lines. All the systems evaluated performed at the level of the Swiss average. One older and one newer brand performed better than average, as did a system which is implanted with image-based robotic assistance, but results are limited to 6 years of follow-up. Visible steps to the worse from the fourth year after primary surgery are again related to limited numbers **(Figures 5.39)**.





**Figures 5.39**

**All remaining implant combinations with average revision risks (all PKA)**

Also showing upper and lower limits (corresponding to elevated and below-average version risk at 150% and 66% of the group average respectively).

## 5.9 Results of implants in patellofemoral joint partial knee arthroplasty

**Table 5.16** shows Switzerland's current top five of the most frequently used patellofemoral PKA systems, representing 98% (1,513) of the PFJ performed between 2019 and 2024. Only 32 implants (2.1%) in this period belonged to the less common systems, grouped as "other systems". Quite a significative share of 61 implants (3.9%) could not be identified, which is more than the 32 patellofemoral PKA summarised under "other systems".

### 5.9.1 Two-year revision rate of patellofemoral PKA

The two-year revision rates of the individual brands are shown in **Figure 5.40,** reflecting the PKA performed between 01.01.2019 and 31.12.2022, with a completed two-year follow-up by 31.12.2024. Of the five implant systems registered, including the rest summarised under "other systems", none was a definitive outlier, although one system (IBalance PFJ) was above the outlier boundary but was not classified as such due to statistical uncertainty. One system implanted with image-based robotics (Restoris

| System | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2019 – 2024 |
|---|---|---|---|---|---|---|---|
| Gender PFJ | 109 | 162 | 110 | 167 | 154 | 142 | 844 |
| Hemicap PF classic/wave (PFJ) | 24 | 33 | 40 | 48 | 28 | 29 | 202 |
| IBalance PFJ | 17 | 24 | 17 | 30 | 29 | 15 | 132 |
| Journey PFJ | 18 | 20 | 20 | 9 | 19 | 15 | 101 |
| Restoris MCK PFJ | 24 | 25 | 28 | 32 | 58 | 35 | 202 |
| Other systems | 0 | 6 | 13 | 5 | 4 | 4 | 32 |
| **Total** | **192** | **270** | **228** | **291** | **292** | **240** | **1,513** |

**Table 5.16**

Top 5 (98%) of primary patellofemoral joint systems (all diagnoses, all component fixations) 2019 – 2024

| System | CCS* | Mean age | at risk N** | N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Gender PFJ | 12 | 59 | 548 | 24 | 4.4 (3.0-6.5) |
| Hemicap PF classic/wave (PFJ) | 12 | 55 | 145 | 10 | 7.0 (3.8-12.7) |
| IBalance PFJ | 11 | 54 | 88 | 11 | 12.6 (7.2-21.7) |
| Journey PFJ | 16 | 57 | 67 | 5 | 7.6 (3.2-17.4) |
| Restoris MCK PFJ | 56 | 61 | 109 | 4 | 3.7 (1.4-9.5) |
| Other systems |  | 59 | 24 | 2 | 8.3 (2.2-29.4) |
| CH average for group |  |  |  |  | 5.8 (4.5-7.4) |

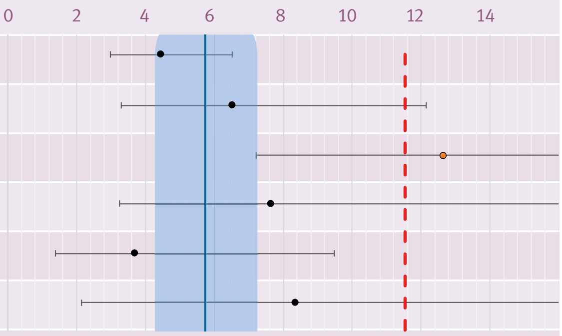


**Figure 5.40**

2-year evaluation: Revision rates of primary patellofemoral joint systems within 24 months

4-year moving average covering implants between 01.01.2019 and 31.12.2022, with two years follow-up (31.12.2024).

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration.

MCK PFJ) and the most frequently used PFJ system (Gender PFJ) had better results than the average. This is of special interest as Gender PFJ had a low case concentration score (CCS) of 12% and therefore multiple providers. This would rather be a risk for elevated revision rates due to small individual caseloads. Therefore, the results speak in favour of a reliable system. In contrast, Restoris MCK PFJ system had a CCS of 56%, thus concentrated in the hand of fewer surgeons with potentially higher expertise beside robotic assistance.

### 5.9.2 Long term survival of patellofemoral PKA

Numbers are too small to differentiate each of the five brands. Therefore, comparison was reduced to the brand used most commonly and all the rest of the implants, summarised under “other systems” **(Table 5.17).** The singular system performed significantly better than all the other systems together from the first year on, though results beyond 10 years of follow-up were not yet available. It is essential to realise that revision rates of PFJ replacements are more than three times higher than those of unicondylar PKA eleven years after surgery. At 7 years, the most frequently used and best performing PFJ system had a revision rate more than double of the unicondylar PKA average **(Table 5.17, Figure 5.30).**

| System | Total N | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 10 years (95% CI) | 12 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Gender PFJ | 1,238 | 8 | 59 | **2.2** (1.5-3.2) | **7.9** (6.3-9.8) | **11.8** (9.8-14.3) | **19.7** (15.6-24.7) | |
| Other systems | 1,212 | | 57 | **3.4** (2.5-4.6) | **12.1** (10.2-14.3) | **17.1** (14.7-19.8) | **26.1** (22.5-30.2) | **34.4** (27.0-43.2) |
| **CH average for group** | | | | **2.8 (2.2-3.5)** | **10.0 (8.7-11.4)** | **14.5 (12.9-16.3)** | **23.1 (20.3-26.1)** | **30.1 (24.4-36.8)** |

**Table 5.17**

**Long term evaluation: Failure rates of primary patellofemoral joint systems (all diagnoses, all component fixations)**

Time since operation, 2012–2024. Please note that if reported system involves multiple sub-variants, it is possible that the long-term performance of these sub-variants may be significantly different from their combined performance.

* Share of implants accounted for by main user hospital service. A higher share signifies an increased likelihood of biased figures due to local effects. A share of 50%+ would suggest that reported results are likely determined by one hospital service.

** Younger mean age signifies that the case mix is less “usual” and potentially biased towards higher revision risk.

# Patient reported outcome measures
# PROMs

# 6. Patient reported outcome measures (PROMs)

Since 2019, the core components of the new Patient-Reported Outcome Measures (PROMs) instrument have been implemented in the Canton of Zürich and selected hospitals, ahead of the nationwide registration within SIRIS scheduled for late 2025. For this report, we analysed complete pre- and post-operative data for 9,065 total hip arthroplasties (THA), 7,087 total knee arthroplasties (TKA), and 1,351 partial knee arthroplasties (PKA) performed for primary osteoarthritis. Additionally, we included 974 THA and 991 TKA cases for secondary osteoarthritis. PROMs were assessed using the Swiss Orthopaedics Minimal Dataset (SO-MDS), which comprises joint-specific pain and satisfaction evaluations via a numeric rating scale (NRS), as well as general quality of life assessment using the EQ-5D-5L score. Further details on the project and coverage rates are provided in the methods chapter. All analyses adopt an intention-to-treat (ITT) approach, meaning revised implants are included unless stated otherwise.

## 6.1 Joint-specific pain

Pain reduction is a central outcome measure for arthroplasty. Preoperative pain levels were generally similar across groups, with the exception of secondary hip osteoarthritis, which showed notably higher values. Joint-specific pain was assessed using a 0–10 numeric rating scale (NRS). Mean preoperative pain scores for primary osteoarthritis were 6.60 for total hip arthroplasty (THA), 6.64 for total knee arthroplasty (TKA), and 6.38 for partial knee arthroplasty (PKA). For secondary osteoarthritis, mean scores were 7.06 for THA and 6.42 for TKA. As illustrated in **Figure 6.1,** the distribution of preoperative pain scores was relatively consistent across most groups, with the majority of patients reporting values of seven or eight. Patients undergoing PKA experienced slightly less pain than those undergoing TKA, particularly at the higher end of the scale, while patients with secondary hip osteoarthritis reported the highest proportion of severe pain (scores of 9 or 10). Postoperatively, mean pain scores decreased substantially: to 0.86 for THA, 1.64 for TKA, and 1.73 for PKA in primary osteoarthritis, and to 1.09 for THA and 1.68 for TKA in secondary osteoarthritis. The postoperative distribution of pain scores was effectively reversed, with a significantly larger proportion of THA patients achieving complete pain remission **(Figure 6.2).**

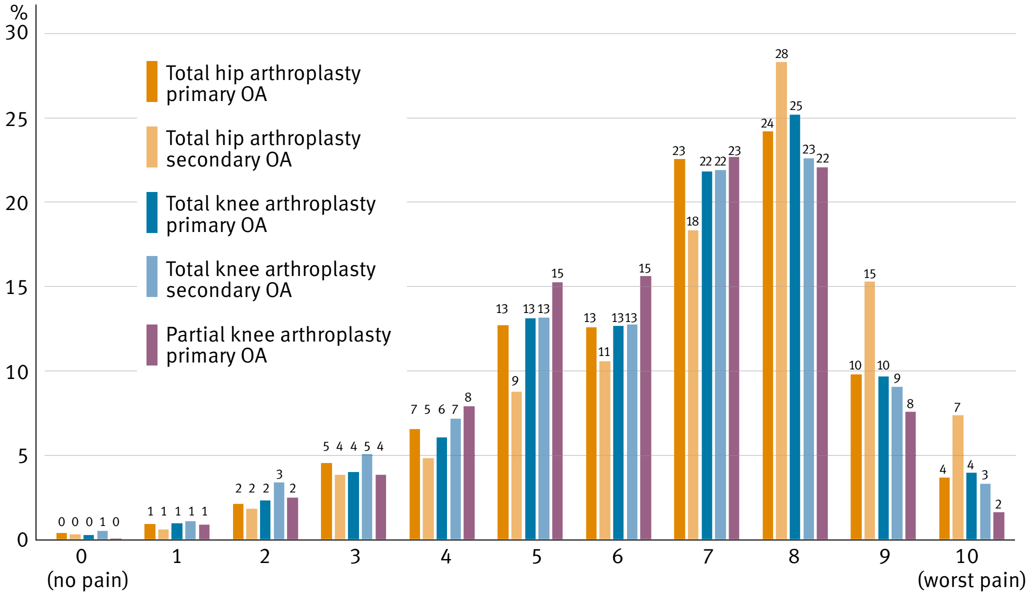


**Figure 6.1**

Preoperative pain

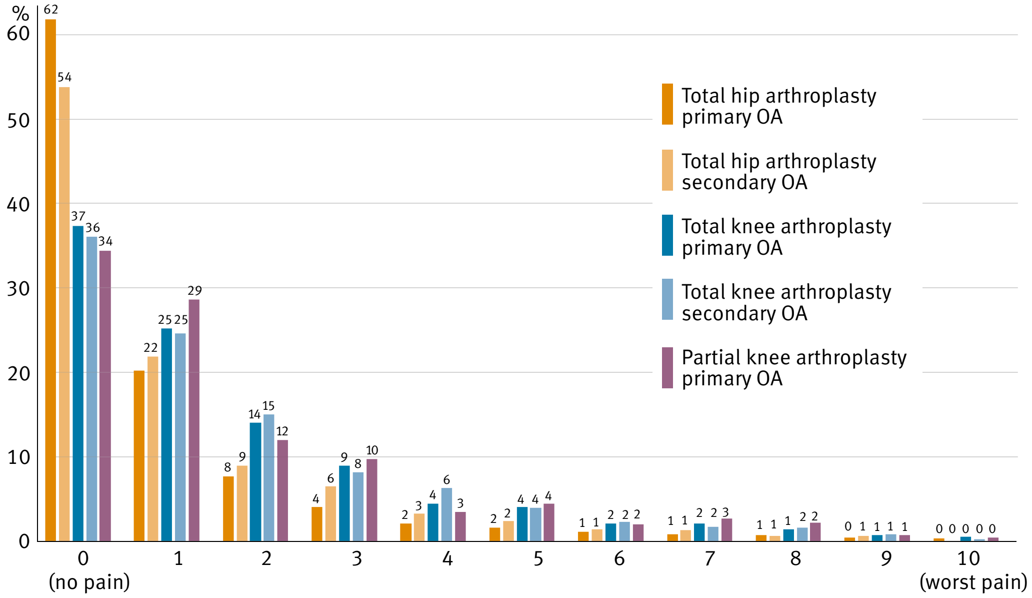


**Figure 6.2**

Postoperative pain

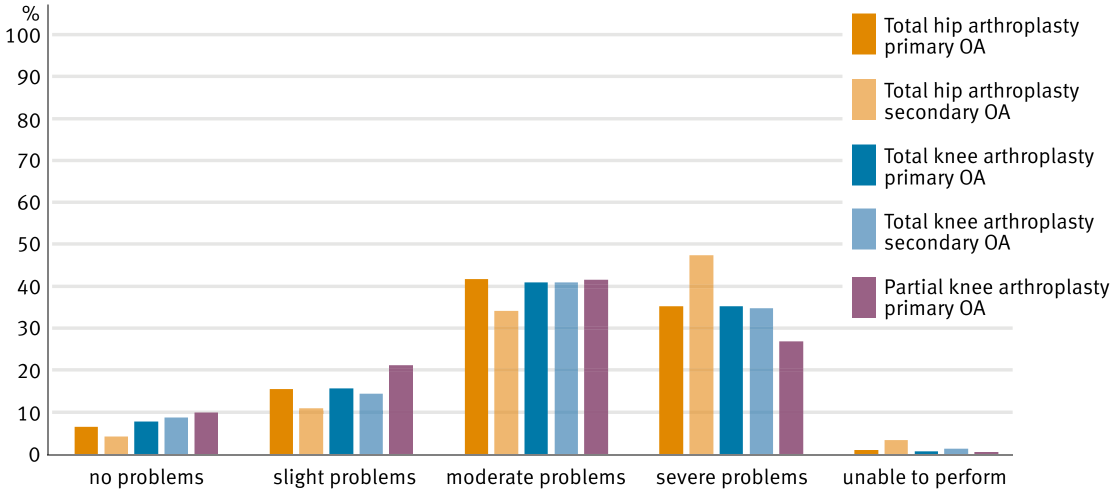
Follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective

## 6.2 Quality of life

The EQ5D-5L instrument was used to assess health-related quality of life before and after treatment across five dimensions: pain, mobility, self-care, ability to perform usual activities, and anxiety. Among these, mobility stands out as the undisputed core dimension in elective arthroplasty.

As illustrated in **Figure 6.3,** hip (THA) and knee (TKA) patients exhibited remarkably similar mobility restrictions prior to treatment. The majority reported at least moderate problems, with over a third of both THA and TKA patients experiencing severe mobility limitations. Partial knee arthroplasty (PKA) patients, on average, reported slightly fewer restrictions, while THA patients with secondary arthritis were the most likely to report severe mobility issues. Notably, a small but significant proportion of patients in each group—ranging from 4.1% to 9.8%—reported no mobility problems at all before treatment. Post-treatment, the situation improved markedly, though outcomes varied by procedure **(Figure 6.4).** 78.5% of THA patients reported no further mobility problems, compared to 60.7% of TKA and 64.0% of PKA patients. Despite TKA and PKA patients starting from a better baseline, THA patients achieved the most substantial gains in mobility following treatment.

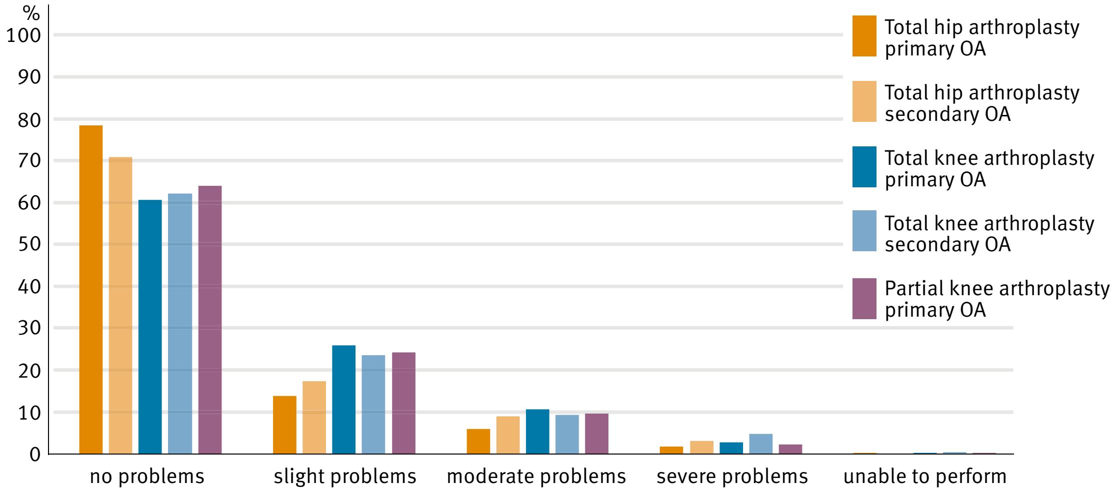
Radar charts are highly effective for visualising multidimensional concepts, such as those assessed by the EQ5D-5L. In this instrument, all items are measured on a consistent 5-point ordinal scale, ranging from “no problem” to “severe problem.” For the purposes of these visualisations, the scale was recoded so that the worst possible quality of life state is represented as 0 and the best as 4. **Figure 6.5a** presents the pre- and postoperative mean values for each EQ5D-5L dimension among THA patients with primary osteoarthritis (prim OA). At a glance, it is clear that mobility, pain/discomfort, and usual activities were the most affected areas before surgery. For instance, the mean mobility score was approximately 2.2, corresponding to the modal category of 41.9% of THA (prim OA) patients reporting moderate problems. In contrast, self-care and anxiety/depression were rarely problematic prior to treatment. Postoperatively, substantial improvements were observed not only in the three main problem areas but also, to a lesser extent, in self-care and anxiety/depression. THA patients with secondary osteoarthritis (sec OA) exhibited worse baseline



| | THA (prim OA) | | THA (sec OA) | | TKA (prim OA) | | TKA (sec OA) | | PKA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % |
| no problems | 591 | 6.5 | 40 | 4.1 | 547 | 7.7 | 87 | 8.8 | 133 | 9.8 |
| slight problems | 1,411 | 15.6 | 107 | 11.0 | 1105 | 15.6 | 143 | 14.4 | 286 | 21.2 |
| moderate problems | 3,783 | 41.7 | 333 | 34.2 | 2895 | 40.9 | 405 | 40.9 | 562 | 41.6 |
| severe problems | 3,195 | 35.3 | 461 | 47.3 | 2495 | 35.2 | 344 | 34.7 | 364 | 26.9 |
| unable to perform | 85 | 0.9 | 33 | 3.4 | 45 | 0.6 | 12 | 1.2 | 6 | 0.4 |
| **Total** | **9,065** | | **974** | | **7,087** | | **991** | | **1,351** | |

**Figure 6.3**

**Preoperative quality of life (EQ5D): mobility**



| | THA (prim OA) | | THA (sec OA) | | TKA (prim OA) | | TKA (sec OA) | | PKA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % |
| no problems | 7,116 | 78.5 | 690 | 70.8 | 4,301 | 60.7 | 615 | 62.1 | 865 | 64.0 |
| slight problems | 1,247 | 13.8 | 168 | 17.3 | 1,831 | 25.8 | 234 | 23.6 | 327 | 24.2 |
| moderate problems | 538 | 5.9 | 87 | 8.9 | 747 | 10.5 | 92 | 9.3 | 129 | 9.6 |
| severe problems | 153 | 1.7 | 29 | 3.0 | 197 | 2.8 | 47 | 4.7 | 29 | 2.2 |
| unable to perform | 11 | 0.1 | 0 | 0.0 | 11 | 0.2 | 3 | 0.3 | 1 | 0.1 |
| **Total** | **9,065** | | **974** | | **7,087** | | **991** | | **1,351** | |

**Figure 6.4**

**Postoperative quality of life (EQ5D): mobility**

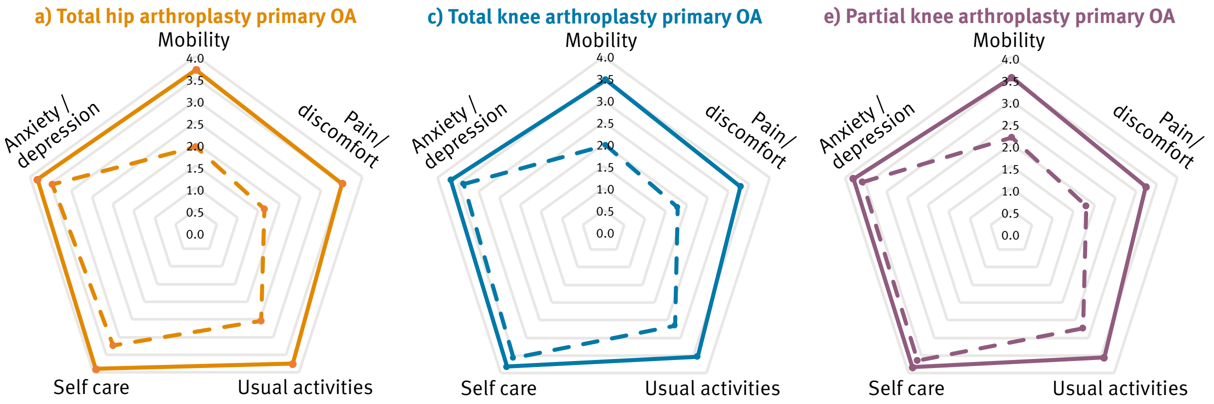
Follow-up 1 year (up to 18 months allowed), intention-to-treat perspective values and, on average, achieved less favourable outcomes **(Figure 6.5b)**. **Figures 6.5c, d, and e** depict similar patterns for knee patients (TKA and PKA), though the magnitude of improvement across all five dimensions was consistently less pronounced compared to THA patients with primary osteoarthritis.

## 6.3 Joint-specific satisfaction

Comparisons of preoperative and postoperative satisfaction ratings further corroborate the previous findings. Before surgery, hip and knee patients reported similarly high levels of dissatisfaction, with 72.5% to 84.7% stating they were very dissatisfied with their situation. One year after the operation, this picture was largely reversed. However, a clear satisfaction gap persisted between hip and knee patients. While 81.2% of hip patients with primary osteoarthritis reported being very satisfied, the corresponding figures for knee implant recipients ranged from only 60.3% to 63.8% **(Figures 6.6 and 6.7)**. Although a larger proportion of knee patients expressed dissatisfaction with their outcomes, the primary difference lay not in outright dissatisfaction but rather in the degree of satisfaction—many knee patients fell into intermediate or less conclusive categories rather than extreme dissatisfaction.

## 6.4 Treatment effects

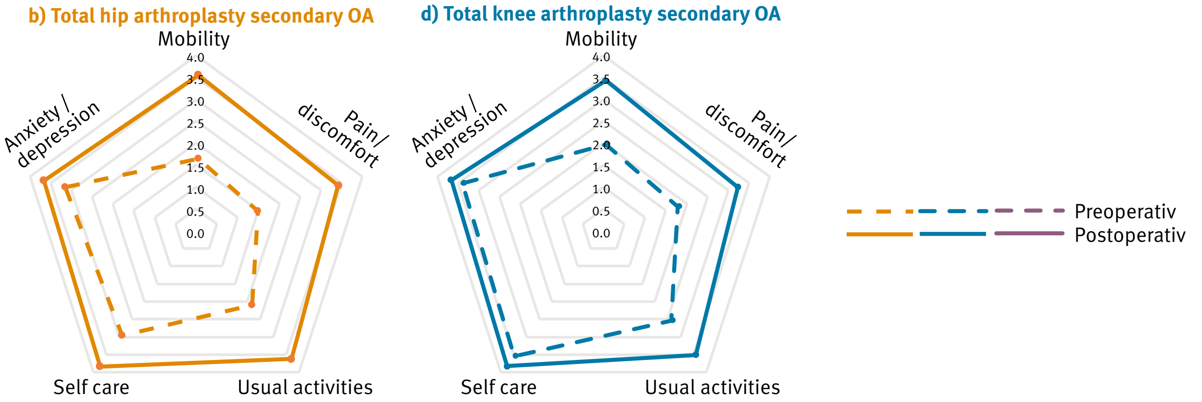
Treatment success can be directly assessed by calculating the treatment effect. **Figure 6.8** compares the distribution of pain reduction outcomes across the five patient groups, excluding the small minority who reported no preoperative pain.



a) Total hip arthroplasty primary OA

c) Total knee arthroplasty primary OA

e) Partial knee arthroplasty primary OA



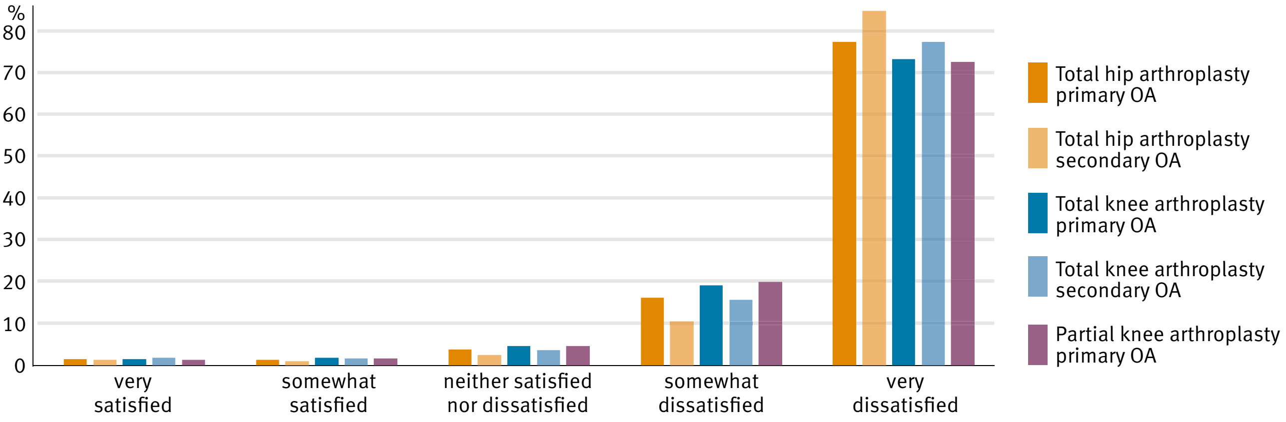
b) Total hip arthroplasty secondary OA

d) Total knee arthroplasty secondary OA

**Figure 6.5**

**Quality of life (EQ-5D-5L): overview**

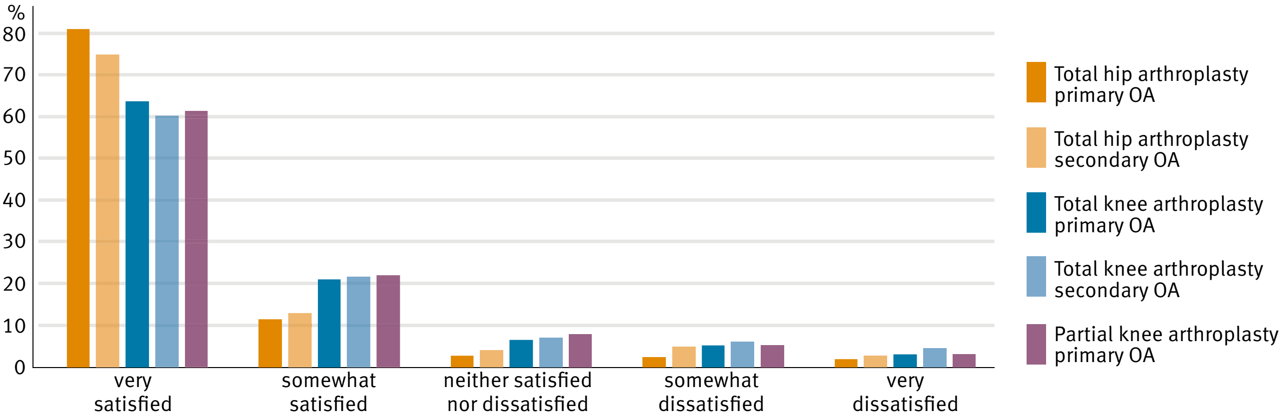
Follow-up 1 year (up to 18 months allowed), intention-to-treat perspective



| | THA (prim OA) | | THA (sec OA) | | TKA (prim OA) | | TKA (sec OA) | | PKA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % |
| very satisfied | 139 | 1.5 | 13 | 1.3 | 102 | 1.4 | 18 | 1.8 | 18 | 1.3 |
| somewhat satisfied | 116 | 1.3 | 9 | 0.9 | 122 | 1.7 | 16 | 1.6 | 21 | 1.6 |
| neither satisfied nor dissatisfied | 342 | 3.8 | 24 | 2.5 | 324 | 4.6 | 36 | 3.6 | 63 | 4.7 |
| somewhat dissatisfied | 1,456 | 16.1 | 103 | 10.6 | 1,356 | 19.1 | 155 | 15.6 | 270 | 20.0 |
| very dissatisfied | 7,012 | 77.4 | 825 | 84.7 | 5,183 | 73.1 | 766 | 77.3 | 979 | 72.5 |
| **Total** | **9,065** | | **974** | | **7,087** | | **991** | | **1,351** | |

**Figure 6.6**

**Preoperative satisfaction with current situation**

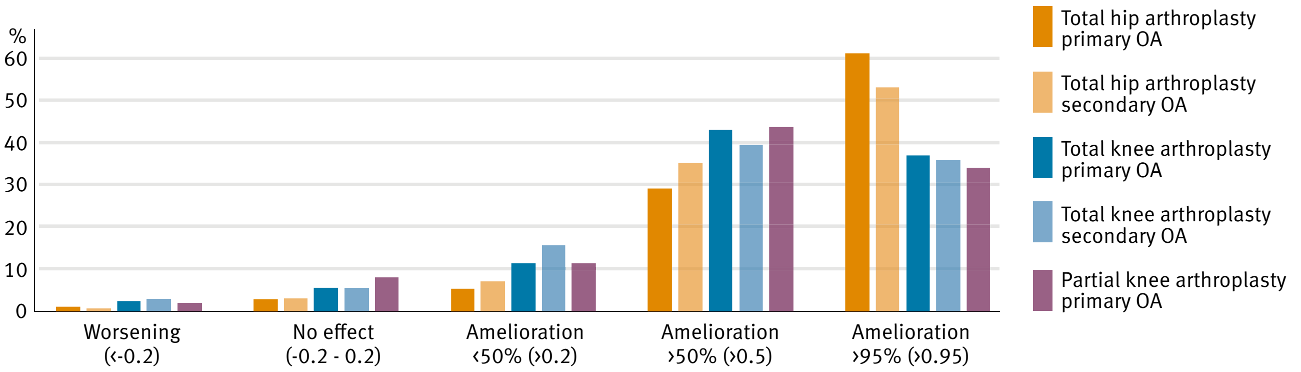


| | THA (prim OA) | | THA (sec OA) | | TKA (prim OA) | | TKA (sec OA) | | PKA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % |
| very satisfied | 7,356 | 81.2 | 730 | 75.0 | 4518 | 63.8 | 598 | 60.3 | 830 | 61.4 |
| somewhat satisfied | 1,046 | 11.5 | 127 | 13.0 | 1496 | 21.1 | 216 | 21.8 | 298 | 22.1 |
| neither satisfied nor dissatisfied | 250 | 2.8 | 41 | 4.2 | 474 | 6.7 | 71 | 7.2 | 108 | 8.0 |
| somewhat dissatisfied | 227 | 2.5 | 48 | 4.9 | 376 | 5.3 | 60 | 6.1 | 72 | 5.3 |
| very dissatisfied | 186 | 2.1 | 28 | 2.9 | 223 | 3.2 | 46 | 4.6 | 43 | 3.2 |
| **Total** | **9,065** | | **974** | | **7,087** | | **991** | | **1,351** | |

**Figure 6.7**

**Postoperative satisfaction with current situation**

Follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective

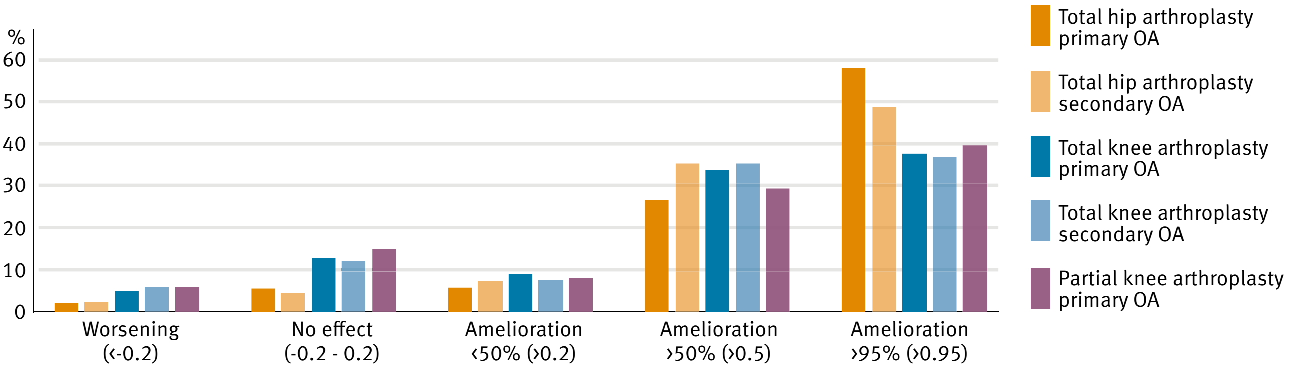


| | THA (prim OA) | | THA (sec OA) | | TKA (prim OA) | | TKA (sec OA) | | PKA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % |
| Worsening (‹-0.2) | 84 | 1.0 | 6 | 0.6 | 165 | 2.4 | 27 | 2.8 | 27 | 2.0 |
| No effect (-0.2 - 0.2) | 244 | 2.8 | 30 | 3.1 | 392 | 5.6 | 54 | 5.5 | 109 | 8.2 |
| Amelioration ‹50% (›0.2) | 476 | 5.3 | 69 | 7.2 | 802 | 11.5 | 154 | 15.8 | 152 | 11.4 |
| Amelioration ›50% (›0.5) | 2,600 | 29.3 | 340 | 35.4 | 3,026 | 43.3 | 390 | 39.9 | 588 | 44.0 |
| Amelioration ›95% (›0.95) | 5,485 | 61.7 | 513 | 53.6 | 2,603 | 37.3 | 353 | 36.1 | 460 | 34.4 |
| **Total** | **8,889** | | **958** | | **6,988** | | **978** | | **1,336** | |

**Figure 6.8**

## Treatment effect pain

Follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective . Patients without reported pain excluded as calculation of TE not possible



| | THA (prim OA) | | THA (sec OA) | | TKA (prim OA) | | TKA (sec OA) | | PKA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % |
| Worsening (‹-0.2) | 204 | 2.3 | 23 | 2.4 | 352 | 5.0 | 60 | 6.1 | 83 | 6.2 |
| No effect (-0.2 - 0.2) | 511 | 5.7 | 44 | 4.5 | 914 | 13.0 | 122 | 12.4 | 203 | 15.2 |
| Amelioration ‹50% (›0.2) | 528 | 5.9 | 73 | 7.5 | 637 | 9.1 | 77 | 7.8 | 112 | 8.4 |
| Amelioration ›50% (›0.5) | 2,439 | 27.1 | 348 | 35.9 | 2,426 | 34.6 | 354 | 36.1 | 400 | 29.9 |
| Amelioration ›95% (›0.95) | 5,335 | 59.2 | 481 | 49.6 | 2,690 | 38.3 | 369 | 37.6 | 542 | 40.5 |
| **Total** | **9,017** | | **969** | | **7,019** | | **982** | | **1,340** | |

**Figure 6.9**

## Treatment effect quality of life (EQ5D)

Follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective . Patients without reported pain excluded as calculation of TE not possible

THA patients with primary osteoarthritis achieved the most favourable results: 61.7% experienced a symptom reduction of at least 95%, effectively becoming pain-free after treatment. An additional 29.3% reported a pain reduction of more than 50%, classified as a good outcome. For example, a patient with a preoperative pain score of 8 typically reported a postoperative score of no higher than 3. Only a small fraction of THA patients had less favourable outcomes: 2.8% reported no improvement, and 1.0% experienced increased pain one year after surgery. Notably, these outcomes were observed across the full range of preoperative pain levels. For THA patients with secondary osteoarthritis, the rate of pain-free outcomes was lower (53.6%), but the proportion of patients who did not benefit at all was not higher than in the primary osteoarthritis group.

Knee patients, however, had significantly less favourable outcomes: only 34.4% to 37.3% achieved a perfect, pain-free result. While over 40% experienced a pain reduction of more than 50%, a substantial minority – 8.0% to 10.2% – reported no improvement in pain. The differences between TKA and PKA outcomes were not statistically significant, despite PKA patients generally being younger and more active, with higher expectations for both pain reduction and functional restoration.

The treatment effect on the EQ5D quality of life measure – which encompasses functional limitations – mirrored the patterns observed for pain outcomes. This analysis was based on the EQ5D-5L summary score. Overall, hip patients achieved somewhat better outcomes than knee patients, while results for TKA and PKA were largely comparable within the limits of statistical precision. However, PKA outcomes exhibited greater variability than those for TKA. Notably, the higher proportion of poor TKA results, relative to THA, was statistically significant. Furthermore, the share of patients who did not experience an improvement in overall quality of life was substantially larger than the proportion who saw no benefit in pain reduction alone. This was true for both hip and knee patients. This discrepancy may partly reflect the broader, less joint-specific nature of the EQ5D measure. Nevertheless, the proportion of poor outcomes among hip patients remained less than half that observed in knee patients **(Figure 6.9).**

## 6.5 Conclusion

In summary, patient-reported outcome measures (PROMs) offer a more comprehensive assessment of the clinical effectiveness of hip and knee arthroplasties, complementing revision rates, which capture only a single endpoint of treatment outcomes. However, the current geographical coverage of these PROMs remains limited, raising concerns about the generalisability of the findings. The data are drawn predominantly from the Canton of Zurich, and factors such as implant selection, surgical practices, and cultural influences may not be fully representative of the broader Swiss context. The planned nationwide integration of PROMs into the Swiss Implant Registry, scheduled for late 2025, is expected to address these limitations and provide a more complete and representative overview of arthroplasty outcomes across Switzerland.

# SIRIS outlier watch list – hip implants

| **Implant or implant combination** | **Risk-adjusted hazard ratios for either 2-year revision risk or overall revision risk (long-term evaluation)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Detected as outlier in report | Adjusted for age and sex **HR** | **lb95%** | **ub95%** | Adjusted for age, sex, BMI, ASA and Charnley Class (from 2015, if available) **HR** | **lb95%** | **ub95%** | |
| **Uncemented stem/cup combinations (primary osteoarthritis)** | | | | | | | | |
| **Active outlier implants** | | | | | | | | **Summary** |
| CLS Spotorno + Allofit | 2025 | 1.38 | 1.05 | 1.80 | 1.55 | 1.08 | 2.23 | The CLS Spotorno + Allofit implant combination demonstrated unremarkable revision performance between 2012 and 2019. However, an increase in early revision risk was observed starting in 2020, with relatively high rates persisting through 2021 and 2022. Given the limited number of main users during this period, the possibility of an adverse local effect cannot be ruled out. Preliminary data for 2023—following the involvement of a new main user—show no cause for concern.<br>Recommended course of action: Investigate the underlying reasons for the rise in revision risk after 2019. |
| SPS evolution + April poly | 2025 | 1.69 | 1.00 | 2.86 | 1.26 | 0.41 | 3.91 | The SPS evolution + April poly implant combination has previously avoided being classified as a potential outlier because of low statistical precision. While it exhibited unremarkable revision performance between 2012 and 2019, its usage has since declined. More recently, revision rates have risen to outlier levels.<br>Currently, this implant combination is only registered in one remaining hospital and very infrequently. |
| Twinsys + RM pressfit | 2025 | 1.97 | 1.22 | 3.17 | 2.04 | 1.02 | 4.09 | The Twinsys + RM pressfit implant combination has previously avoided being classified as a potential outlier due to low statistical precision. While it exhibited unremarkable revision performance between 2012 and 2018, its usage has since declined. More recently, revision rates have risen to outlier levels and are now very close to definitive outlier status.<br>Currently, this implant combination is only relatively infrequently registered in two remaining hospitals. |
| Nanos + R3 | 2024 | 2.25 | 1.28 | 3.97 | 2.76 | 1.24 | 6.15 | Nanos + R3 has been used in small numbers in only a few hospitals and revision performance varies between hospitals, which raises the possibility of local effects. The statistical precision of the potential outlier status is low. The R3 cup is widely used and has an excellent performance record. The Nanos stem, on the other hand, is mostly used in this particular combination. It is noteworthy that half of early revisions were due to dislocation. Recommended course of action: investigate reasons for revision, especially dislocations, and observe future performance. |
| | 2025 | 2.16 | 1.23 | 3.82 | 2.58 | 1.16 | 5.76 | |
| Accolade II + Trident II | 2023 | 2.96 | 1.54 | 5.69 | 2.60 | 1.08 | 6.26 | The Accolade II + Trident II implant combination was first registered in 2018, with significant usage beginning in 2019. Currently, the risk-adjusted 2-year revision risk for this combination exceeds the critical threshold of 2. However, statistical precision remains limited at this stage.<br>Notably, implants from the early years (2018 and 2019) exhibited a particularly high 2-year revision risk. In contrast, data for implants from 2020 onwards are, as yet, inconclusive. Infection accounted for 40% of early revisions—an unusually high proportion—suggesting that the early revision performance may have been adversely affected by random events or specific circumstances.<br>Based on the current trajectory, this implant combination is expected to lose its outlier status in the 2026 annual report, as the poorly performing implants from 2019 will no longer be included in the observation window. |
| | 2024 | 2.89 | 1.55 | 5.38 | 2.79 | 1.25 | 6.21 | |
| | 2025 | 2.66 | 1.43 | 4.94 | 2.82 | 1.26 | 6.28 | |
| Symbol + Symbol DMHA/DS evol. | 2023 | 2.62 | 1.31 | 5.23 | 2.40 | 1.19 | 4.81 | The Symbol + Symbol DMHA implant combination was initially registered in 2019, with a notable increase in registrations occurring in 2020. Importantly, only the original Symbol DMHA cups were recorded in this combination; none of the equivalent DS evolution cups were included.<br>During the most recent evaluation period, the risk-adjusted 2-year revision risk for this combination has fallen below the critical threshold of 2. However, statistical precision remains very low. It is worth noting that infections accounted for half of all early revisions—a proportion that is unusually high. This raises concerns that the observed performance may have been adversely affected by random events, particularly at one specific hospital.<br>To date, the performance of implants used in 2023 and 2024 has been unremarkable. Should this positive trend continue, the implant combination may no longer be classified as an outlier in the 2026 annual report. |
| | 2024 | 1.91 | 1.03 | 3.56 | 1.80 | 0.97 | 3.36 | |
| | 2025 | 1.72 | 1.02 | 2.91 | 1.48 | 0.86 | 2.56 | |
| SPS evolution + April ceramic | 2020 | 2.22 | 1.72 | 2.88 | 3.67 | 2.47 | 5.47 | The SPS Evolution + APRIL Ceramic implant combination has been identified as a definitive outlier based on its overall performance over multiple years, both as a combination and for its individual components, across several hospitals. The risk-adjusted hazard ratio significantly exceeds the critical value of two, including its confidence interval. This combination, which remains in active clinical use, surpasses the outlier threshold at both the 2-year and long-term (beyond 5-year) follow-up intervals.<br>While recent data indicate some improvement in early revision performance, it remains uncertain whether these changes will be sufficient to mitigate its outlier status.<br>Recommended course of action: Investigate the specific causes of above-average revision rates. Continue to monitor future performance closely. |
| | 2021 | 2.33 | 1.84 | 2.96 | 3.50 | 2.42 | 5.06 | |
| | 2022 | 2.50 | 2.01 | 3.11 | 3.50 | 2.51 | 4.88 | |
| | 2023 | 2.44 | 1.97 | 3.02 | 3.46 | 2.53 | 4.74 | |
| | 2024 | 2.49 | 2.02 | 3.05 | 3.34 | 2.44 | 4.57 | |
| | 2025 | 2.48 | 2.03 | 3.03 | 3.26 | 2.39 | 4.44 | |
| SL-plus MIA + HI (long-term evaluation) | 2025 | 1.76 | 1.36 | 2.28 | 2.39 | 1.52 | 3.75 | The SL-plus MIA + HI implant combination was first detected as a potential long-term outlier in the 2025 report because the 11-year revision rate exceeded the upper boundary. First analyses of reasons for revisions indicate relatively frequent problems with implant position/orientation as well as acetabular loosening.<br>The SL-plus MIA stem is widely used and has an excellent performance record, whilst the HI cup is more associated with the long-term upward separation of revision rates as shown in the KM curves in this report.<br>**Note that the AR2025 reported risk-adjusted hazard ratios refer to all implants with full follow-up, as the implant is now only classified as a potential long-term evaluation outlier.** |

# SIRIS outlier watch list – hip implants

| Implant or implant combination | Risk-adjusted hazard ratios for either 2-year revision risk or overall revision risk (long-term evaluation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Detected as outlier in report | Adjusted for age and sex | | | Adjusted for age, sex, BMI, ASA and Charnley Class (from 2015, if available) | | | |
| | | **HR** | **lb95%** | **ub95%** | **HR** | **lb95%** | **ub95%** | |
| **Uncemented stem/cup combinations (primary osteoarthritis)** | | | | | | | | |
| **Former outlier implants (improved)** | | | | | | | | **Summary** |
| SPS HA + April ceramic | 2021 | 2.61 | 1.44 | 4.73 | 2.85 | 1.18 | 6.87 | No longer identified as a potential outlier. Consult previous reports for details. |
| | 2022 | 2.61 | 1.44 | 4.72 | 2.84 | 1.18 | 6.85 | |
| **Former outlier implants (not in use)** | | | | | | | | **Summary** |
| Exception + Avantage | 2025 | 1.62 | 1.21 | 2.18 | 2.14 | 1.27 | 3.63 | Although detected for the first time as a potential outlier in the 2025 annual report, the last recorded use of this combination was in 2022. Revision rates were unproblematic for most of its use time, but high early revision risk of the last exemplars used prompted the outlier status in the 2019 to 2022 observation period. |
| Polarstem + EP-fit | 2020 | 1.93 | 1.30 | 2.86 | 2.52 | 1.42 | 4.45 | These combinations are not currently in active use.<br>Consult previous reports for details. |
| | 2021 | 1.89 | 1.30 | 2.74 | 2.31 | 1.39 | 3.84 | |
| | 2022 | 1.92 | 1.36 | 2.71 | 2.14 | 1.38 | 3.33 | |
| | 2023 | 1.94 | 1.40 | 2.68 | 2.11 | 1.41 | 3.16 | |
| | 2024 | 1.87 | 1.35 | 2.58 | 1.99 | 1.33 | 2.97 | |
| GTS + G7 bi-spherical | 2019 | | | | | | | |
| | 2020 | 5.27 | 3.22 | 8.62 | 3.39 | 1.52 | 7.57 | |
| | 2021 | 5.15 | 3.24 | 8.19 | 3.84 | 1.92 | 7.71 | |
| | 2022 | 5.15 | 3.28 | 8.09 | 3.96 | 2.06 | 7.63 | |
| | 2023 | 5.15 | 3.28 | 8.09 | 3.96 | 2.05 | 7.62 | |
| | 2024 | 5.33 | 3.40 | 8.37 | 4.07 | 2.11 | 7.83 | |
| Alloclassic + Fitmore | 2022 | 1.49 | 1.02 | 2.17 | 1.26 | 0.60 | 2.64 | |
| | 2023 | 1.55 | 1.07 | 2.24 | 1.24 | 0.59 | 2.61 | |
| (AMIStem + Versafitcup DM) | 2020 | 2.14 | 1.02 | 4.51 | 2.30 | 1.03 | 5.15 | |
| | 2021 | 2.00 | 0.95 | 4.21 | 2.18 | 0.98 | 4.88 | |
| Amistem-H prox coating + Versafitcup DM | 2022 | 3.11 | 1.29 | 7.49 | 3.17 | 1.31 | 7.62 | |
| | 2023 | 3.14 | 1.30 | 7.54 | 3.22 | 1.34 | 7.76 | |
| (Harmony + Gyracup) | 2020 | 3.97 | 1.98 | 7.94 | 3.55 | 1.76 | 7.13 | |
| Harmony + Symbol DMHA/DS evol. | 2022 | 3.67 | 1.83 | 7.35 | 3.20 | 1.60 | 6.42 | |
| | 2023 | 3.66 | 1.83 | 7.33 | 3.20 | 1.60 | 6.42 | |
| SPS modular + April ceramic | 2019 | | | | | | | |
| | 2020 | 2.95 | 1.94 | 4.49 | 1.61 | 0.23 | 11.50 | |
| | 2021 | 2.90 | 1.91 | 4.41 | 1.59 | 0.22 | 11.32 | |
| Stelia-stem + Ana.nova hybrid | 2019 | | | | | | | |
| | 2020 | 2.65 | 1.71 | 4.12 | 2.30 | 1.26 | 4.22 | |
| | 2021 | 2.60 | 1.68 | 4.04 | 2.20 | 1.20 | 4.01 | |
| Twinsys + Selexys PC | 2020 | 1.96 | 0.98 | 3.93 | 4.93 | 1.58 | 15.34 | |
| Exception + Exceed | 2020 | 1.53 | 0.69 | 3.40 | 1.30 | 0.33 | 5.22 | |
| | 2021 | 1.59 | 0.76 | 3.33 | 1.48 | 0.48 | 4.61 | |
| (AMIStem-H + Mpact) | 2019 | | | | | | | |
| GTS + Exceed | 2019 | | | | | | | |
| Corail + Delta motion | 2019 | | | | | | | |

# SIRIS outlier watch list – hip implants

| Implant or implant combination | Risk-adjusted hazard ratios for either 2-year revision risk or overall revision risk (long-term evaluation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Detected as outlier in report | Adjusted for age and sex | | | Adjusted for age, sex, BMI, ASA and Charnley Class (from 2015, if available) | | | |
| | | HR | lb95% | ub95% | HR | lb95% | ub95% | |
| **Hybrid fixation stem-cup combinations (primary osteoarthritis)** | | | | | | | | |
| **Active outlier implants** | | | | | | | | **Summary** |
| | | | | | | | | There are currently no active outliers in this implant category |
| **Former outlier implants (improved)** | | | | | | | | |
| CCA + RM Pressfit vitamys | 2020 | 1.83 | 0.75 | 4.45 | 1.91 | 0.60 | 6.07 | This combination is no longer identified as potential outlier. Please consult previous report for details. |
| | 2021 | 2.05 | 0.91 | 4.63 | 1.86 | 0.59 | 5.91 | |
| | 2023 | 1.94 | 0.97 | 3.88 | 1.62 | 0.61 | 4.33 | |
| Twinsys (cem) + RM pressfit | 2019 | | | | | | | |
| **Former outlier implants (not in use)** | | | | | | | | |
| PF + Fitmore | 2020 | 0.84 | 1.22 | 3.17 | 2.04 | 1.02 | 4.09 | These combinations are not currently in active use. Consult previous reports for details. |
| Weber + Alloclassic | 2019 | | | | | | | |
| | 2020 | 2.91 | 1.20 | 7.05 | 3.48 | 1.10 | 11.02 | |
| **Uncemented stem-cup combinations (fractures)** | | | | | | | | |
| **Active outlier implants** | | | | | | | | **Summary** |
| | | | | | | | | There are currently no active outliers in this implant category |
| **Former outlier implants (improved)** | | | | | | | | |
| CLS Spotorno + Allofit | 2022 | 2.18 | 1.20 | 3.95 | 2.12 | 0.94 | 4.81 | This combination is no longer identified as potential outlier. Please consult previous report for details. |
| | 2023 | 2.09 | 1.15 | 3.79 | 1.97 | 0.87 | 4.45 | |
| Fitmore + Allofit | 2022 | 1.37 | 0.77 | 2.43 | 1.87 | 0.88 | 3.98 | |
| **Cemented stem-head combinations (fractures)** | | | | | | | | |
| **Active outlier implants** | | | | | | | | **Summary** |
| | | | | | | | | There are currently no active outliers in this implant category |
| **Former outlier implants (not in use)** | | | | | | | | |
| Harmony (cemented) + OHST bipolar head | 2025 | 3.15 | 1.63 | 6.08 | 2.88 | 1.43 | 5.82 | Although detected for the first time as a potential outlier in the 2025 annual report, the last recorded use of this combination was in 2023. |
| Harmony (cemented) + Symbios bibop | 2024 | 1.75 | 1.14 | 2.68 | 1.53 | 0.79 | 2.98 | Although detected for the first time as a potential outlier in the 2024 annual report, the last recorded use of this combination was in 2020. |
| | 2025 | | | | | | | |
| Quadra-C + Medacta bipolar head | 2024 | 1.49 | 0.82 | 2.70 | 1.61 | 0.52 | 5.02 | This combination is not currently in active use. Consult previous reports for details. |

# SIRIS outlier watch list – knee implants

| **Implant or implant combination** | **Risk-adjusted hazard ratios for either 2-year revision risk or overall revision risk (long-term evaluation)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Detected as outlier in report | Adjusted for age and sex | | | Adjusted for age, sex, BMI, ASA and Charnley Class (from 2015, if available) | | | |
| | | **HR** | **lb95%** | **ub95%** | **HR** | **lb95%** | **ub95%** | |
| **Total knee systems** | | | | | | | | |
| **Active outlier implants** | | | | | | | | **Summary** |
| | | | | | | | | There are currently no active outliers in this implant category |
| **Former outlier implants (improved)** | | | | | | | | |
| Genius | 2024 | 1.93 | 1.00 | 3.71 | 2.10 | 1.00 | 4.41 | This combination is no longer identified as a potential outlier.<br>Please consult previous report for details.<br>**Update 2025:** 2-year revision rate has fallen just short of the outlier alert boundary. |
| Legion | 2024 | 1.60 | 1.36 | 1.87 | 1.35 | 1.05 | 1.73 | This combination is no longer identified as a potential outlier.<br>Please consult previous report for details.<br>**Update 2025:** 10-year revision performance just fell short of the critical threshold. Legion is now classified as showing elevated long term revision rates. |
| Journey II | 2019 | | | | | | | This combination is no longer identified as a potential outlier.<br>Please consult previous report for details. |
| | 2020 | 2.17 | 1.81 | 2.61 | 2.10 | 1.69 | 2.61 | |
| | 2021 | 2.06 | 1.74 | 2.46 | 2.00 | 1.63 | 2.45 | |
| | 2022 | 1.93 | 1.64 | 2.29 | 1.81 | 1.48 | 2.20 | |
| **Former outlier implants (not in use)** | | | | | | | | |
| Sigma PS-RP | 2024 | 1.00 | 0.77 | 1.31 | 2.42 | 1.54 | 3.80 | These combinations are not currently in active use.<br>Consult previous reports for details. |
| | 2025 | 1.00 | 0.77 | 1.31 | 2.41 | 1.53 | 3.78 | |
| Physica KR | 2019 | | | | | | | |
| | 2020 | 3.97 | 2.13 | 7.38 | 3.20 | 1.20 | 8.54 | |
| | 2021 | 3.80 | 2.04 | 7.07 | 3.06 | 1.14 | 8.17 | |
| Physica PS | 2019 | | | | | | | |
| | 2020 | 3.32 | 1.96 | 5.61 | 3.06 | 1.73 | 5.41 | |
| | 2021 | 3.11 | 1.84 | 5.25 | 2.91 | 1.65 | 5.51 | |
| Physica KR/PS | 2022 | 3.25 | 2.17 | 4.85 | 2.83 | 1.73 | 4.63 | |
| E.Motion PS | 2019 | | | | | | | |
| **Partial knee systems** | | | | | | | | |
| **Active outlier implants** | | | | | | | | **Summary** |
| Journey Uni (long-term evaluation) | 2020 | 1.82 | 1.38 | 2.39 | 1.56 | 0.96 | 2.53 | It is likely that Journey Uni was a problematic knee system at least between 2015 and 2019, but there were signs of improvement in 2020. The statistical precision within the report's main timeframe of interest (2-year revision rate) is relatively low. Whilst the system actually fell below the outlier boundary in 2022 and has so far stayed there, the development of the revision risk beyond two years follow-up strongly suggests an unusual pattern. The system was identified as an outlier in the first round of long-term-evaluation (from 5 years) in 2022 and this was confirmed in 2023 and 2024. It should also be noted that the better short-term revision position since 2022 was also due to the inclusion of poorly performing "other systems" in the evaluation and thus a right-shift of the outlier boundary. Recommended course of action: investigate reasons for revisions and observe future performance.<br>**Note that the AR2025 reported risk-adjusted hazard ratios refer to all implants with full follow-up, as the implant is now only classified as a potential long-term evaluation outlier.** |
| | 2021 | 1.81 | 1.39 | 2.35 | 1.68 | 1.10 | 2.58 | |
| | 2022 | 1.61 | 1.25 | 2.08 | 1.51 | 1.02 | 2.23 | |
| | 2023 | 1.57 | 1.23 | 2.00 | 1.40 | 0.96 | 2.03 | |
| | 2024 | 2.00 | 1.71 | 2.33 | 1.79 | 1.39 | 2.30 | |
| | 2025 | 1.94 | 1.67 | 2.24 | 1.74 | 1.37 | 2.22 | |

# List of manufacturers and distributors

## List of companies with implants registered in the SIRIS registry 2024

| Company | Headquarters Switzerland | Corporate domicile |
|---|---|---|
| **Adler Ortho** | - | Italy |
| **Amplitude Switzerland** | Genf | France |
| **Argomedical AG** | Cham | Switzerland |
| **Arthrex Swiss AG** | Belp | Germany |
| **Arthrosurface** | - | USA |
| **ATF** | - | France |
| **B. Braun Medical AG** | Sempach | Germany |
| **CeramTec** | - | Germany |
| **Conformis** | - | Germany |
| **Corin GSA GmbH** | Solothurn | United Kingdom |
| **Dedienne Santé** | - | France |
| **DePuy Synthes Johnson&Johnson** | Zuchwil/Zug | USA |
| **enovis-surgical (includes Mathys and Lima)** | Bettlach | Switzerland |
| **Exactech International Operation AG** | - | USA |
| **Heraeus Medical Schweiz AG** | Zürich | Germany |
| **Implantcast Suisse SA** | Basel | Germany |
| **Link Implants AG** | Bern | Germany |
| **Medacta International SA** | Frauenfeld | Switzerland |
| **OHST Medizintechnik AG** | - | Germany |
| **Permedica ORTHOPAEDICS (I)** | Scairolo di Collina d'Oro | Italy |
| **Peter Brehm GmbH (Schweiz)** | Dietikon | Germany |
| **PLUSOrtho Prothetik GmbH** | Oftringen | Switzerland |
| **Smith&Nephew Orthopaedics AG** | Baar | United Kingdom |
| **Stemcup Medical Products AG** | Zürich | Switzerland |
| **Stryker Osteonics SA** | Biberist | USA |
| **Swiss Synergy AG** | Baar | Switzerland |
| **Symbios Orthopédie SA** | Yverdon-les-Bains | Switzerland |
| **United Orthopedic Corporation Suisse SA** | Yverdon-les-Bains | Switzerland |
| **Zimmer Biomet** | Winterthur | USA |

# Definitions

**Acetabular component** The part of a hip prosthesis that is implanted into the acetabulum – the socket part of a ball and socket joint.

**Arthrodesis** A procedure in which a natural joint is fused together.

**Arthrofibrosis** Rigidity of the joint as a consequence of connective tissue adhesion.

**Arthrotomy** The opening of a joint during surgery.

**Articulation** The two surfaces that move together (articulate) in a total joint replacement.

**ASA score** The scoring system of the American Society of Anaesthesiologists (ASA) for grading the overall physical condition of the patient, as follows: I: fit and healthy; II: mild disease, not incapacitating; III: incapacitating systemic disease; IV: life-threatening disease.

**Benchmark** Comparing the performances at a specific hospital to the mean performances of hospitals throughout Switzerland.

**Bilateral** Replacing the same joint on both sides of the body (typically both hips or knees) by means of a prosthesis (here meaning the replacement on both sides in one session).

**Body Mass Index.** . Is obtained by dividing body weight in kilograms by height in meters squared. Interpretation: ‹18.5: underweight; 18.5–24.9: normal weight; 25–29.9: overweight; 30–34.9: obese class I; 35–39.9: obese class II; ›40: obese class III.

**Case mix** Term used to describe variation in the population, relating to factors such as diagnosis, patient age, gender and health condition.

**Cement** Material (polymethyl methacrylate) used to fix joint replacements to bone.

**Charnley score** Clinical classification system – A: one joint affected; B1: both joints affected; B2: contralateral joint with a prosthesis; C: several joints affected or a chronic disease that affects quality of life.

**Competing risks survival analysis** Method to calculate survival taking into account various outcomes, in this case revision and death.

**Cumulative incidence** Overall incidences over a specific period of an event (such as the revision of a prosthesis or death of a patient).

**Cumulative revision percentage** Overall revision percentage over a specific period.

**Femoral component** Part of a hip or knee prosthesis that is implanted into the femur (thigh bone) of the patient.

**Girdlestone** Hip revision procedure in which the hip joint or hip prosthesis is removed and no new prosthesis is implanted (usually because of a bacterial infection).

**Hybrid fixation** Fixation of a prosthesis in which one of the two parts of a prosthesis is cemented and the other one uncemented.

**Head component** Part of a hip prosthesis that is implanted on top of the femoral component of a hip prosthesis and moves inside the acetabular component of the hip joint.

**Hospital service volumes** In the tables depicting the total number arthroplasty procedures per year. Four categories of hospital service volume were used (‹100, 100–199, 200–299, 300+ procedures per year). The calculation of the annual volume was performed separately for hip and knee surgeries, using the average of all (primary and revision) procedures recorded in each hospital service in 2013–2021.

**Acetabular inlay (insert)** Intermediate component (inner layer), made usually of polyethylene (but also other materials), which is placed in the acetabular component.

**Kaplan-Meier survival analysis** Method to calculate survival, in which only one end point is possible, in this case revision.

**Kernel density plot** A variation of a histogram that uses kernel smoothing to plot values. The underlying kernel is usually Gaussian distribution. One advantage of density plots over histograms is that they are not stepped depending of the number of bins used (histogram bars), but are always smooth lines. The second advantage is that several lines can be plotted over each other and still be visible, which could be difficult with more than two overlaying histograms.

**Liner (Knee)** named alternatively inlay or insert. Intermediate component of the knee prosthesis. It is made of polyethylene and placed between the femoral and tibial component, fixed somehow to the latter.

**Lateral collateral ligament** Lateral (outer) knee ligament.

**Malalignment** Malpositioning of prosthetic components significantly deviating from physiological norms.

**Meniscectomy** Meniscus removal.

**Metallosis** Deposition of metal debris in soft tissues of the body, usually around the prosthesis.

**Osteoarthritis** Disease of the joint in which the cartilage is damaged/destroyed, and the underlying bone altered

**Osteochondral bone defect** Defect of the joint surface in which both cartilage and the underlying bone are affected

**Osteonecrosis** Cellular death of bone tissue.

**Osteosynthesis** Securing broken bone parts together with plates, pins and/or screws.

**Osteotomy** Cut of the bone with a saw or chisel in order to correct its position, to shorten or lengthen it.

**Patellar component** Part of a knee prosthesis that is implanted on the inner side of the knee cap.

**Patellofemoral prosthesis** Two-piece knee prosthesis that provides a prosthetic (knee) articulation surface between the patella and trochlea (furrow) of the thigh bone (femur).

**Primary prosthesis** The first time replacement of the original joint with a prosthesis .

**PROMs** Patient Reported Outcome Measures.

**Resurfacing hip arthroplasty** Hip prosthesis in which the cup (acetabulum) is replaced and a metal cap is implanted on top of the femoral head.

**Reverse hybrid fixation hip prosthesis** Fixation of a hip or knee prosthesis in which one component is cemented and the other uncemented.

**Revision** A revision procedure is a secondary surgical procedure of a patient's hip or knee joint whereby the complete primary implant or parts thereof are replaced by new components.

**Reoperation** All secondary procedures, where no components of the primary implantation are removed.

**Revision burden** The ratio of revision procedures to all primary and arthroplasty procedures.

**Sarcopenia** The degenerative loss of skeletal muscle mass and strength associated with aging.

**Synovectomy** Removal of inflamed mucosa in a joint.

**Tibial component** Part of a knee prosthesis that is inserted in the tibia (shin bone) of a patient.

**Total joint arthroplasty** Arthroplasty in which the entire joint of a patient is replaced.

**Unicompartimental knee arthroplasty** Replacement of half the knee (either inner or outer side) by a prosthesis.

### Abbreviations

| | |
|---|---|
| ASA | American Society of Anaesthesiologists |
| AVN | Avascular Necrosis |
| BCR | Bicruciate retaining |
| BMI | Body Mass Index |
| CCK | Constrained condylar knee |
| CI | Confidence Interval |
| CR | Cruciate retaining |
| CS | Cruciate sacrificing |
| CRF | Case Report Form |
| HA | Hemiarthroplasty of the hip |
| HR | Hazard ratio |
| IQR | Interquartile range |
| KLM | Kaplan Meier estimate |
| lb/ub | Lower, upper bound (of a convidential ratio) |
| MCL | Medical Collateral (Inner Knee) Ligament |
| OA | Osteoarthritis |
| PCR | Posterior cruciate retaining |
| PROMs | Patient Reported Outcome Measures |
| PS | Posterior stabilised |
| SD | Standard Deviation |
| SHR | Subhazard ratio |
| Sig | Significance |
| TE | Treatment effect |
| THA | Total Hip Arthroplasty |
| TKA | Total Knee Arthroplasty |
| UCOR | Ultra congruent rotating |
| UKA | Unicompartmental Knee Arthroplasty |

# Participating hospitals 2024 (144)

| | Group | Clinic |
|---|---|---|
| AG | | Kantonsspital Aarau |
| AG | | Kantonsspital Baden |
| AG | | Spital Muri |
| AG | | Spital Zofingen |
| AG | Asana Gruppe | Spital Leuggern |
| AG | Asana Gruppe | Spital Menziken |
| AG | Gesundheitszentrum Fricktal | Spital Rheinfelden |
| AG | Hirslanden Gruppe | Klinik Aarau |
| AG | Swiss Medical Network | Privatklinik Villa im Park |
| AR | | Berit Klinik AG |
| AR | Hirslanden Gruppe | Klinik Am Rosenberg AG |
| AR | Spitalverbund Appenzell (AR) | Spital Herisau |
| BE | | Klinik Hohmad |
| BE | | Spitalzentrum Biel |
| BE | Hirslanden Gruppe | Klinik Linde AG |
| BE | Hirslanden Gruppe | Salem-Spital |
| BE | Hirslanden Gruppe | Klinik Permanence |
| BE | Swiss Medical Network SA Réseau de l'Arc | Hôpital de Saint-Imier |
| BE | Swiss Medical Network SA Réseau de l'Arc | Hôpital de Moutier |
| BE | Insel Gruppe | Spital Aarberg |
| BE | Insel Gruppe | Inselspital, Unispital Bern |
| BE | Insel Gruppe | Spital Riggisberg |
| BE | Lindenhofgruppe | Lindenhofspital |
| BE | Lindenhofgruppe | Sonnenhofspital |
| BE | Spital Emmental AG | Spital Burgdorf |
| BE | Spital Emmental AG | Spital Langnau |
| BE | Spitäler fmi | Spital Frutigen |
| BE | Spitäler fmi | Spital Interlaken |
| BE | Spital Region Oberaargau SRO | Spital Langenthal |
| BE | Spital STS | Spital Thun |
| BE | Spital STS | Spital Zweisimmen |
| BE | Swiss Medical Network | Privatklinik Siloah |
| BS | | Merian Iselin Klinik für Orthopädie und Chirurgie |
| BS | Universitätsspital Basel | Standort Bethesda Spital AG |
| BS | Universitätsspital Basel | Standort Uni-Spital |
| BL | | Praxisklinik Rennbahn |
| BL | Hirslanden Gruppe | Klinik Birshof |
| BL | Kantonsspital Baselland | Bruderholz |
| BL | | Ergolz Klinik |

| | Group | Clinic |
|---|---|---|
| FL | | Liechtensteinisches Landesspital |
| FR | Hôpital fribourgeois HFR | HFR Hôpital cantonal |
| FR | Swiss Medical Network | Clinique Générale Ste-Anne |
| GE | | Hôpital de La Tour |
| GE | | Hôpitaux universitaires de Genève HUG |
| GE | Hirslanden Gruppe | Clinique La Colline SA |
| GE | Hirslanden Gruppe | Clinique des Grangettes SA |
| GE | Swiss Medical Network | Clinique Générale-Beaulieu |
| GL | | Kantonsspital Glarus |
| GR | | Flury Stiftung Spital Schiers |
| GR | | Gesundheitszentrum Unterengadin |
| GR | | Kantonsspital Graubünden |
| GR | | Regionalspital Surselva AG |
| GR | | Spital Davos |
| GR | | Spital Oberengadin |
| GR | | Spital Thusis |
| GR | Klinik Gut | Standort Fläsch |
| GR | Klinik Gut | Standort St. Moritz |
| JU | Hôpital du Jura | Site de Delémont |
| LU | Hirslanden Gruppe | Klinik St. Anna AG |
| LU | Hirslanden Gruppe | St. Anna in Meggen |
| LU | Luzerner Kantonsspital LUKS | Luzern |
| LU | Luzerner Kantonsspital LUKS | Sursee |
| LU | Luzerner Kantonsspital LUKS | Wolhusen |
| LU | | Schweizerisches Paraplegiker-Zentrum |
| NE | Réseau hospitalier neuchâtelois | La Chaux-de-Fonds |
| NE | Réseau hospitalier neuchâtelois | Pourtalès |
| NE | Swiss Medical Network | Clinique Montbrillant |
| NE | Swiss Medical Network | Hôpital de la Providence |
| NE | | Clinique Volta SA |
| NW | | Spital Nidwalden AG |
| OW | | Kantonsspital Obwalden |

|  | Group | Clinic |
|---|---|---|
| SG |  | Spital Linth |
| SG | Hirslanden Gruppe | Klinik Stephanshorn AG |
| SG | Spitalregion Fürstenland Toggenburg | Spital Wil |
| SG | Spitalregion Rheintal Werdenberg Sarganserland | Spital Altstätten |
| SG | Spitalregion Rheintal Werdenberg Sarganserland | Spital Grabs |
| SG | Kantonsspital Graubünden | Spital Walenstadt |
| SG | Kantonsspital St. Gallen | Kantonsspital St. Gallen |
| SG | Swiss Medical Network | Rosenklinik |
| SH | Spitäler Schaffhausen | Kantonsspital Schaffhausen |
| SH | Swiss Medical Network | Privatklinik Belair |
| SO | Solothurner Spitäler AG | Bürgerspital Solothurn |
| SO | Solothurner Spitäler AG | Kantonsspital Olten |
| SO | Solothurner Spitäler AG | Spital Dornach |
| SO | Swiss Medical Network | Privatklinik Obach AG |
| SZ |  | Spital Lachen |
| SZ |  | Spital Schwyz |
| SZ | AMEOS | Spital Einsiedeln |
| TG |  | Klinik Seeschau |
| TG | Spital Thurgau AG | Kantonsspital Frauenfeld |
| TG | Spital Thurgau AG | Kantonsspital Münsterlingen |
| TI | Gruppo Ospedaliero Moncucco | Clinica Moncucco |
| TI | Gruppo Ospedaliero Moncucco | Clinica Santa Chiara |
| TI | Ente Ospedaliero Cantonale | Ospedale Regionale di Bellinzona e Valli |
| TI | Ente Ospedaliero Cantonale | Ospedale Regionale di Locarno - La Carità |
| TI | Ente Ospedaliero Cantonale | Ospedale Regionale di Lugano-Civico e Italiano |
| TI | Ente Ospedaliero Cantonale | Ospedale Regionale di Mendrisio |
| TI | Swiss Medical Network | Clinica Ars Medica |
| UR |  | Kantonsspital Uri |
| VD |  | CHUV Centre hospitalier universitaire vaudois |
| VD |  | Clinique de la Source |
| VD |  | Clinique La Prairie |
| VD | Clinique CIC Suisse SA | Clinique CIC Montreux |
| VD | Ensemble Hospitalier de la Côte EHC | Hôpital de Morges |
| VD | Etablissements Hospitaliers du Nord Vaudois eHnv | Hôpital de Saint-Loup |
| VD | Etablissements Hospitaliers du Nord Vaudois eHnv | Hôpital Yverdon-les-Bains |
| VD | Groupement Hospitalier de l'Ouest Lémanique (GHOL) | Hôpital de Nyon |
| VD | Hirslanden Gruppe | Clinique Bois-Cerf |
| VD | Hôpital intercantonal de la Broye HIB | Payerne |
| VD | Hôpital Riviera-Chablais HRC | Centre hospitalier de Rennaz |
| VD | Réseau Santé Balcon du Jura RSBJ | Site des Rosiers |
| VD | Swiss Medical Network | Clinique de Genolier |
| VD | Swiss Medical Network | Clinique de Montchoisi |
| VS | Clinique CIC Valais | Clinique CIC Saxon |
| VS | Hôpital du Valais -Spital Wallis | Spital Brig |
| VS | Hôpital du Valais -Spital Wallis | Spital Visp |
| VS | Hôpital du Valais -Spital Wallis | Hôpital de Sion |
| VS | Hôpital du Valais -Spital Wallis | Hôpital de Martigny |
| VS | Swiss Medical Network | Clinique de Valère |
| ZG |  | Zuger Kantonsspital |
| ZG | Hirslanden Gruppe | AndreasKlinik Cham Zug |
| ZH |  | Kantonsspital Winterthur |
| ZH | Swiss Medical Network | Klinik Pyramide am See |
| ZH |  | Schulthess Klinik |
| ZH |  | Spital Bülach |
| ZH |  | Spital Limmattal |
| ZH |  | Spital Männedorf |
| ZH |  | Spital Uster |
| ZH |  | Spital Zollikerberg |
| ZH |  | Universitätsspital Zürich |
| ZH |  | Universitätsklinik Balgrist |
| ZH | GZO | Spital Wetzikon |
| ZH | Hirslanden Gruppe | Klinik Hirslanden |
| ZH | Hirslanden Gruppe | Klinik Im Park |
| ZH | See-Spital | Standort Horgen |
| ZH | Stadtspital Zürich | Stadtspital Zürich Triemli |
| ZH | Stadtspital Zürich | Stadtspital Zürich Waid |
| ZH | Swiss Medical Network | Privatklinik Bethanien |
| ZH | Swiss Medical Network | Privatklinik Lindberg |

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