schweizerisches implantat-register
registre suisse des implants

SIRIS

# Swiss National Hip & Knee Joint Registry

# Report 2024

Annual Report of the SIRIS Registry Hip & Knee, 2012 – 2023

ano

swiss orthopaedics

UNIVERSITÄT BERN

# Hip and knee replacement results 2012–2023

**SIRIS Report 2024**
**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

**After more than a decade of SIRIS it is time to step back and look at what has been achieved, what has changed, and what are current opportunities and challenges.**

**Achievements**

It is paramount to keep in mind that what goes into a registry in terms of data content and data quality determines the value of what comes out of a registry.
The goal of a national hip and knee arthroplasty registry is to achieve to cover all procedures performed in the country. A proportion of 95% or higher is considered high quality. The first SIRIS report mentioned a completeness of procedure registration of 88% for the year 2013. This year's report indicates a completeness of procedure registration of 98.5% for the year 2022, an excellent result. Due to the longer follow-up available the ability to link the primary operation to the revision if one occurred has substantially increased from 19% in the first report to 54% in the current. This is important because only cases with documentation of the primary operation and the subsequent revision - if occurring during the observation period - allow to study the influence of patient-, implant-, technique-, and provider-related factors on revision rates. For the latter a high degree of completeness of the various factors is also crucial. In this regard, it should be noted positively that the proportion of missing data regarding BMI and ASA grade has steadily decreased, from 25% and 14%, respectively in 2015, when they were introduced, to 5% and 2%, respectively today. Together with age and sex they are important case-mix factors to consider in benchmarking, e.g. when comparing revision rates by provider.

Another major prerequisite for a high-quality arthroplasty registry is to obtain precise, detailed information on the implants and their attributes. SIRIS has successfully achieved this. It is illustrated by the fact that the reporting of revision rates has become much more granular, and that SIRIS now provides revision rates for implants/implant combinations overall as well as stratified by clinically relevant attributes (e.g. cumulative risk of failure at a given point in time for an implant-combination stratified by bearing surface used).

Building on this solid basis and informed by the practice in other national registries SIRIS is now monitoring and comparing implant performance up to 11 years after surgery. Moreover, since several years the registry identifies implant outliers using a well-known methodology and publicly reports them. This is most valuable information for surgeons and their patients as well as for manufacturers, notified bodies and regulators nationally and internationally.

Another important part of the activity of SIRIS is benchmarking by provider using the cumulative risk of failure 2-years after surgery, a metric based on well-established statistical methodology. The information allows hospitals and individual surgeons to acknowledge their results and work on improving it. The registry has developed a way of interacting and collaborating with providers, which was presented with concrete, impressive examples at the annual Swiss Orthopedics meeting 2024.

A good sign for a vibrant and connected registry including team and stakeholders is evolving registry production. Since 2016 the annual report content starting with 63 pages has continuously been developed further thanks to the scientific advisory board to now include over 200 pages. New analyses are regularly added, e.g. the case concentration score (CCS) in 2022, which allows the reader to appreciate whether the failure rate of a specific implant is based on data from few or from many hospitals. This years' report has a new chapter entitled "Epidemiology". It starts with general information on the Swiss health service and insurance systems, which helps international readers of the annual report to better put it into context. The chapter then goes on to present valuable epidemiological information nationwide (e.g. trends in hip and knee arthroplasty incidence, seasonal patterns), by canton, and by type of hospital. The highlight of the chapter are the cumulative postoperative revision rates by 2-year time periods, which show a trend towards decreasing revision rates after hip and knee arthroplasty for the recent years. It is thanks to the registry that positive developments like this can be documented, analyzed and reported, and it might well be thanks to the interaction of the registry stakeholders with the registry that they happen.

Regarding research and international collaborations, SIRIS is full member of the International Society of Arthroplasty Registries (ISAR) since 2017 and actively involved in working group projects. The registry has also become a valued partner in multi-registry research projects. These are usually based on aggregate data (results) rather than individual data. Moreover, SIRIS encourages the use of its data for national research projects having resulted in scientific presentations and the first publications.

Finally, the registry has notably expanded production, communication (e.g. Website) and stakeholder interaction. The now established SIRIS session at the Swiss Orthopedics annual meeting took place for the first time in Montreux in 2018. The SIRIS team has grown and with this the ability to increase efforts in training, coaching and auditing of the member hospitals among other activities.

**Changing landscape**

SIRIS has evolved - and will have to do so in the future - in a changing landscape of regulatory, ethical and legal frameworks. The EU medical device regulation (EU-MDR) adopted by Switzerland came into force in 2021. In this document registries are mentioned, for the first time in EU medical device legislation, as source for the independent evaluation of long-term safety and performance of medical devices. In particular, the new regulation requires that both manufacturers and notified bodies take registry data into account in the mandatory post-market clinical follow-up. This is good news. Another very important change in legislation is the entry into force of Switzerland‘s Federal Act on Data Protection (FADP) in September 2023. To navigate safely in this complex landscape is increasingly resource-consuming for the registry team and the participating hospitals.

**Mission accomplished, what next?**

Over the past twelve years SIRIS - together with its associated partners - has established a registry that provides high-quality nation-wide post-market surveillance of hip and knee arthroplasties, delivers important epidemiologic information as well as reports and communication tailored to different stakeholder’s needs, successfully endeavors to improve quality, and increasingly contributes to national and international research efforts. In a little bit more than a decade SIRIS has shown its clinical and public health utility - within the country and beyond.

Current opportunities and challenges include the integration of shoulder arthroplasties into SIRIS starting next year as well as the nation-wide collection of patient-reported outcomes (PROs). PRO evaluations are already part of last and this year’s annual reports. This is a welcome development and allows to consider the benefit - or the lack of it – of a hip or knee arthroplasty intervention in addition to the risk, traditionally measured using the outcome revision. It will pose, however, new challenges in terms of data collection, analysis, interpretation, and implementation. And it will be an opportunity and necessity to integrate patients views on benefit and risk and what is a tolerable risk-benefit-ratio.

Certainly, as important as ever, and the main mission of the registry, is to improve the outcomes of patients receiving joint replacement surgery through surveillance of long-term safety and performance. To refine and speed up early safety signal and outlier detection remains a priority in which SIRIS is actively involved. Progress is not linear, and even the best intentioned and thought-through innovation, reform or change can give rise to new unexpected problems. The orthopedic community has experienced this in the past. Therefore, there is need to continuously be vigilant and curious at the same time. SIRIS - with the invaluable support from the associated partners - seems perfectly suited for this.

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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 2024 and all previous reports.

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# Content

# 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. 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 so well that they forget their treated joint during daily living (the forgotten joint concept). Hence, 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 will only be implemented in 2025, but data from the pilot project of the Canton of Zurich already provides a solid basis for the development of reporting standards of PROMs and delivers 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 a long-lasting, pain-free, and maximised functional joint replacement. 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.

**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 10-years to the report further improves the function of the registry as quality assessment tool.

**The hospital's perspective.** It is in hospitals that 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 even 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 (https://www.anq.ch/de/fachbereiche/akutsomatik/messergebnisse-akutsomatik/step2/measure/20/) and are updated with every new report.

**The healthcare insurers'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 revision surgeries cause significant additional and potentially avoidable costs, the focus of insurers remains the same as for patients and surgeons: obtaining a long-lasting, pain-free function after prosthetic joint replacement.

**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 dodged 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 Liechtenstein governments, as well as to the general public.

## 1.2 Strong commitment

The annual report 2024 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 (150 units) or knee (145 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 cases can be used in the analysis, as open cases may experience later modification. As a benchmark, we use data from the hospital quality report published by the Swiss Federal Health Authorities (BAG) for the period from 2017 to 2022, as the data for 2023 are not yet available. These data are public and can be considered in relation to SIRIS data, although some details regarding coding and filtering definitions may vary. In 2022, 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 2024 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.

Table 1.1
**Variables collected by the SIRIS registry**

| 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 |

# 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 anonymization. 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 annual-

ly 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. Patients registered after April 2023 were deemed alive and at risk for the remainder of 2023. 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 2024. 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. The latter procedure, established in its current form in 2019, has already shown great potential for improving data quality.

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 its first organisational survey in 2023. Hospitals were surveyed on several issues including data entry mode, local responsibilities, coverage and availability of PROMs. In the future, this survey will be conducted annually and contents will be rotated as needed. A noteworthy finding of the first survey 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.

## 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 of a person residing in Switzerland 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 2024 annual report, only figures up to 31.12.2022 were available. These figures are published online, but only with a considerable time lag (detailed information provided at www.bag.admin.ch). Figures from 2017 to 2022 were therefore re-estimated. As shown in **Table 2.1,** primary coverage peaked at 98.5% in 2022, which includes the best value ever for hip arthroplasties and the second 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 recognised, 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.

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.

Table 2.1
**Retrospective coverage analysis 2017–2022 based on National Office of Public Health figures (BAG)**
All SIRIS figures excluding Liechtenstein

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| **Primary hip prostheses** | | | | | | |
| BAG | 22,970 | 23,160 | 23,619 | 23,310 | 24,834 | 26'435 |
| SIRIS* | 20,992 | 21,739 | 22,462 | 22,747 | 24,344 | 26066 |
| Primary coverage (%) | 91.4 | 93.9 | 95.1 | 97.6 | 98.0 | 98.6 |
| **Primary knee prostheses** | | | | | | |
| BAG | 18,558 | 18,325 | 19,181 | 18,837 | 20,280 | 23'070 |
| SIRIS** | 17,108 | 17,440 | 18,546 | 18,588 | 19850 | 22'686 |
| Primary coverage (%) | 92.2 | 95.2 | 96.7 | 98.7 | 98.0 | 98.3 |
| **All primary hip and knee prostheses** | | | | | | |
| BAG | 41,528 | 41,485 | 42,800 | 42,147 | 45,114 | 49'505 |
| SIRIS | 38,100 | 39,179 | 41,008 | 41,335 | 44,194 | 48'752 |
| Primary coverage (%) | 91.7 | 94.4 | 95.8 | 98.1 | 98.0 | 98.5 |

* I.1.8.F/I.1.9.F/I.1.10.F (all first hip prostheses, all diagnoses)
** I.1.15.F/I.1.16.F (all first knee prostheses, all diagnoses)

## 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 midterm 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 1.1.2018 and 31.12.2021). 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 mid-term 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 SO-MDS at its core, are planned for 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 year, we reported both PROMs pilot studies for hip and knee results separately. In this report, we 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. The SO-MDS forms, limited for the present analysis to primary osteoarthritis, currently provide data with follow-up at 1 year from 6,528 THA and 4,967 TKA. They also provide data with complete 1-year follow-up for 918 PKA.

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:

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

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.

[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 Pro¬spective, 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

## 3.1 Total hip arthroplasty

Since the introduction of SIRIS in 2012, a total of 226,042 primary THA were performed. Between 2018 and 2023 129,981 primary THA were implanted and build the base of the current report **(Table 3.1).** The registry discriminates between operations performed for primary OA (82.0%), the largest group, for secondary OA (9.1%), which includes post-traumatic hip joint degeneration, OA due to inflammatory diseases, avascular necrosis, and sequels of childhood diseases such as dysplasia of the hip or Perthes' disease, and for fractures of the hip (8.9%). The proportion of primary OA declined between 2018 and 2023 from 84.4% to 80.9%, while the proportions of secondary OA and fractures increased.

Table 3.1
**Primary total hip arthroplasty: Baseline patient characteristics by year**

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| N | | **19,516** | **20,173** | **20,329** | **21,982** | **23,465** | **24,516** | **129,981** |
| Diagnosis [%]* | Primary OA | 84.4 | 83.6 | 82.1 | 81.0 | 80.7 | 80.9 | 82.0 |
| | Secondary OA | 8.5 | 8.5 | 9.1 | 9.4 | 9.6 | 9.4 | 9.1 |
| | Fracture | 7.1 | 7.9 | 8.8 | 9.6 | 9.7 | 9.6 | 8.9 |
| Women [%] | | 53.5 | 53.1 | 52.3 | 53.8 | 53.3 | 53.6 | 53.3 |
| Mean age (SD) | All | 68.9 (11.5) | 69.1 (11.5) | 69.0 (11.6) | 69.2 (11.7) | 69.4 (11.5) | 69.4 (11.4) | 69.2 (11.5) |
| | Women | 70.6 (11.2) | 70.8 (11.2) | 70.6 (11.4) | 70.8 (11.5) | 71.0 (11.2) | 70.8 (11.0) | 70.8 (11.2) |
| | Men | 66.9 (11.5) | 67.1 (11.6) | 67.1 (11.6) | 67.4 (11.7) | 67.7 (11.6) | 67.6 (11.5) | 67.3 (11.6) |
| Age group [%] | ‹45 | 2.3 | 2.5 | 2.5 | 2.7 | 2.4 | 2.4 | 2.5 |
| | 45–54 | 9.3 | 8.6 | 8.9 | 8.6 | 7.9 | 7.4 | 8.4 |
| | 55–64 | 21.6 | 21.6 | 21.9 | 21.3 | 22.0 | 22.2 | 21.8 |
| | 65–74 | 32.8 | 32.3 | 31.6 | 30.9 | 30.6 | 31.4 | 31.6 |
| | 75–84 | 27.1 | 27.8 | 27.8 | 28.7 | 29.5 | 29.0 | 28.4 |
| | 85+ | 7.0 | 7.3 | 7.3 | 7.8 | 7.7 | 7.5 | 7.4 |
| N unknown BMI (%) | | 3,047 (16) | 2,924 (14) | 2,510 (12) | 1,960 (9) | 1,329 (6) | 1,251 (5) | 13,021 (10) |
| N known BMI | | 16,469 | 17,249 | 17,819 | 20,022 | 22,136 | 23,265 | 116,960 |
| Mean BMI (SD) | | 27.2 (5.2) | 27.0 (5.0) | 26.9 (5.1) | 26.9 (5.2) | 26.9 (5.2) | 26.9 (5.2) | 27.0 (5.1) |
| BMI [%] | ‹18.5 | 2.1 | 2.1 | 2.3 | 2.2 | 2.2 | 2.2 | 2.2 |
| | 18.5–24.9 | 35.0 | 35.5 | 36.5 | 36.2 | 36.5 | 36.5 | 36.1 |
| | 25–29.9 | 38.1 | 39.1 | 38.1 | 37.5 | 36.8 | 37.4 | 37.8 |
| | 30–34.9 | 17.5 | 16.6 | 16.6 | 17.3 | 17.6 | 16.9 | 17.1 |
| | 35–39.9 | 5.4 | 5.2 | 4.8 | 5.0 | 5.2 | 5.2 | 5.1 |
| | 40+ | 2.0 | 1.5 | 1.7 | 1.8 | 1.7 | 1.8 | 1.8 |
| N unknown ASA (%) | | 1,704 (9) | 1,496 (7) | 1,237 (6) | 735 (3) | 382 (2) | 372 (2) | 5,926 (5) |
| N known ASA | | 17,812 | 18,677 | 19,092 | 21,247 | 23,083 | 24,144 | 124,055 |
| Morbidity | ASA 1 | 12.0 | 12.1 | 11.7 | 11.2 | 9.9 | 9.6 | 11.0 |
| state [%] | ASA 2 | 59.5 | 59.1 | 59.0 | 57.9 | 58.9 | 59.3 | 59.0 |
| | ASA 3 | 27.6 | 27.9 | 28.3 | 29.7 | 29.9 | 30.0 | 29.0 |
| | ASA 4/5 | 0.9 | 0.8 | 1.0 | 1.2 | 1.3 | 1.1 | 1.1 |

*A diagnostic category could not be determined in 240 cases (0.18%). Percentages shown are of N = 129,741 THAs with valid diagnostic group.

### Gender and age

The male/female ratio remainded remained stable since 2018 for primary THA, whereby there was a slight increase in age at implantation of approximately half an year. Women represented 53.3% of the THA registered, and their mean age of 70.8 years was higher than for men (67.3 years).

Overall, 67.1% of THAs were performed in patients older than 65 years of age. Patients aged over 85 years represented 7.2% while patients aged ‹55 years constituted 11.2% of the recipients. The distribution among the age groups showed minimal changes in the last 6 years. The implantations in patients ‹45 years of age remained constant at about 2.5%, representing 3,224 patients. In contrast, the largest group were patients between 65 and 74 years of age, which covered 31.6% or 41,010 patients **(Table 3.1, Figure 3.1).**

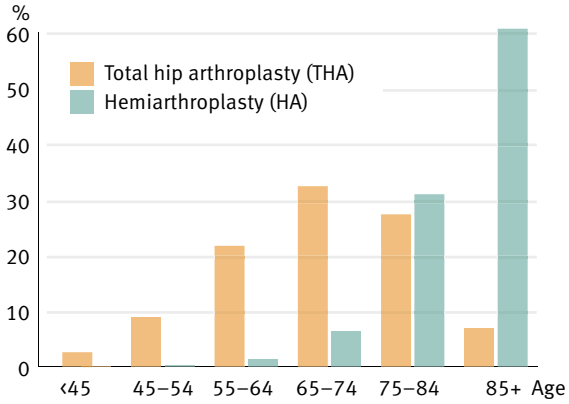
### BMI and ASA score

BMI and ASA scores are recorded since 2015. Data collection is still improving. Pleasingly, the share of unknown BMI did decrease continuously from 16% in 2018 to 5% in 2023.

The mean BMI was 27.0 kg/m² for all THA, whereby 37.8% were performed in overweight patients (BMI 25–29.9 kg/m²) and 24.0% in obese patients (BMI ›30 kg/m²) **(Table 3.1).** Younger patients were observed to have higher BMI, and this observation could be made in both male and female patients

Figure 3.1

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




**Age distribution at surgery of revision/reoperation of total hip arthroplasty and hemiarthroplasty**

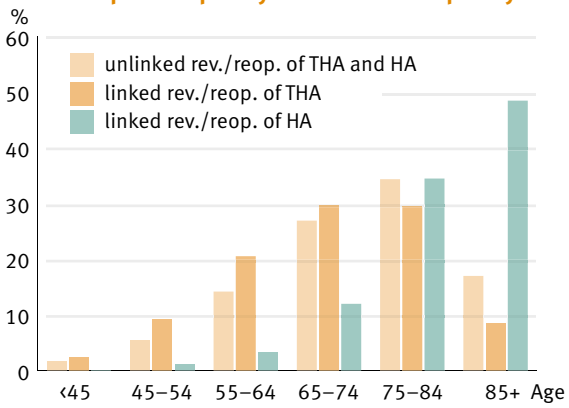
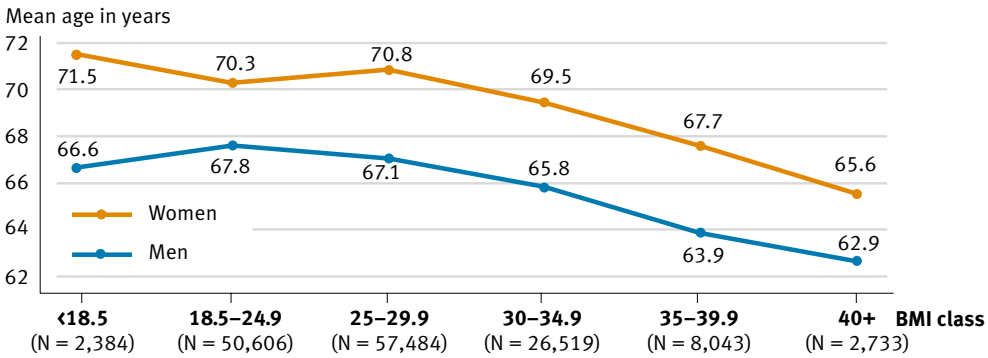



Figure 3.2

**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.



**(Figure 3.2).** Moreover, the distribution of BMI remained constant during the observation period between 01.01.2018 and 31.12.2021 with two years follow-up until 31.12.2023.

Most procedures were performed on healthy individuals (ASA class 1 and 2), but 30.1% of the THA were implanted on ASA class ≥ 3 patients. The tendency of decreasing proportions of ASA 1 classified patients continued. Concurrently, the number of patients with ASA ≥ 3 increased.

### Underlying diagnosis

Patients treated for secondary OA were on average 5.2 years younger than those treated for primary OA. The proportion of developmental dysplasia of the hip among all THA performed for secondary OA increased from 20.5% in 2015 to 26.2% in 2023, while 56.2% were treated for avascular necrosis. Compared to the other main diagnostic groups, there were more young patients treated for secondary OA (10.8% were younger than 45 years of age) **(Table 3.2).**

Among the patients treated for fractures, there were considerably more women than men, representing close to two-thirds (63.9%). The average age of these women was 75.9 years compared to 73.1 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.

Table 3.2

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

| | | Primary OA | Secondary OA | Fracture |
|---|---|---|---|---|
| N (2018–2023)* | | **106,390** | **11,834** | **11,517** |
| Women [%] | | 51.7 | 57.4 | 63.4 |
| Mean age (SD) | All | 69.1 (10.8) | 63.9 (15.3) | 74.9 (10.9) |
| | Women | 70.7 (10.4) | 65.6 (15.2) | 75.9 (10.4) |
| | Men | 67.4 (10.9) | 61.6 (15.2) | 73.1 (11.5) |
| Age group [%] | <45 | 1.8 | 10.8 | 0.7 |
| | 45–54 | 8.0 | 16.6 | 3.6 |
| | 55–64 | 22.6 | 21.9 | 13.5 |
| | 65–74 | 33.2 | 22.2 | 26.1 |
| | 75–84 | 28.3 | 20.9 | 36.7 |
| | 85+ | 6.1 | 7.6 | 19.5 |
| Diagnosis [%] | Osteoarthritis | 100.0 | 0.0 | 0.0 |
| | Inflammatory arthritis | 0.0 | 4.3 | 0.0 |
| | Developmental dysplasia | 0.0 | 26.2 | 0.0 |
| | Osteonecrosis | 0.0 | 56.5 | 0.0 |
| | Miscellaneous** | 0.0 | 13.0 | 2.3 |
| | Fracture | 0.0 | 0.0 | 97.7 |
| N unknown BMI (%) | | 10,285 (10) | 933 (8) | 1,777 (15) |
| N known BMI | | 96,105 | 10,901 | 9,740 |
| Mean BMI (SD) | | 27.3 (5.1) | 26.7 (5.4) | 24.2 (4.6) |
| BMI [%] | <18.5 | 1.6 | 2.8 | 7.5 |
| | 18.5–24.9 | 33.8 | 39 | 55.1 |
| | 25–29.9 | 39.0 | 35.0 | 28.2 |
| | 30–34.9 | 18.2 | 15.9 | 7.1 |
| | 35–39.9 | 5.5 | 4.9 | 1.5 |
| | 40+ | 1.8 | 2.2 | 0.6 |
| N unknown ASA | | 4,953 (5) | 422 (4) | 536 (5) |
| N known ASA | | 101,437 | 11,412 | 10,981 |
| Morbidity state [%] | ASA 1 | 11.3 | 12.6 | 6.2 |
| | ASA 2 | 61.5 | 52.8 | 41.9 |
| | ASA 3 | 26.6 | 33.0 | 47.3 |
| | ASA 4/5 | 0.6 | 1.6 | 4.6 |

* Number of cases with clear diagnostic information (in 0.18% of cases we cannot determine the diagnosis)

** 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.

## 3.2 Hip fractures (THA and HA)

Fractures of the hip may be treated by internal fixation, hemiarthroplasty (HA) or THA. The treatment choice depends on the pathology, functional requirements, the feasibility, as well as the experience of the treating surgeon. Additionally, patients' age, activity level and comorbidities also influence the choice of treatment. Only arthroplasties are recorded in SIRIS. While HA treatment is the preferred option in fragile, low-demand patients, THA is more commonly performed in healthier and more active patients.

**Gender and age**

Women represented the majority of the patients treated for fractures, comprising 67.3% of the cases. The vast majority of patients was aged 65 years and older (91.2%), while the age group above 85 accounted for 43.3% of the hip arthroplasties

Table 3.3
**Fracture of the hip: Baseline patient characteristics by year**

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| N | | **3,554** | **3,867** | **4,136** | **4,469** | **4,849** | **4,867** | **25,742** |
| Treatment with THA* [%] | | 39.0 | 41.1 | 43.1 | 47.4 | 47.0 | 48.4 | 44.7 |
| Treatment with HA** [%] | | 61.0 | 58.9 | 56.9 | 52.6 | 53.0 | 51.6 | 55.3 |
| Women [%] | | 68.2 | 69.1 | 67.1 | 67.0 | 66.9 | 65.9 | 67.3 |
| Mean age (SD) | All | 81.1 (10.5) | 81.0 (10.7) | 81.1 (10.7) | 80.9 (10.7) | 80.8 (10.7) | 80.6 (10.7) | 80.9 (10.7) |
| | Women | 82.1 (10.0) | 81.7 (10.1) | 82.3 (10.0) | 81.8 (10.3) | 81.9 (10.0) | 81.6 (10.1) | 81.9 (10.1) |
| | Men | 78.8 (11.2) | 79.4 (11.7) | 78.8 (11.6) | 79.2 (11.4) | 78.6 (11.7) | 78.7 (11.5) | 78.9 (11.5) |
| Age group [%] | ‹45 | 0.3 | 0.4 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 |
| | 45–54 | 1.7 | 1.8 | 1.9 | 1.6 | 1.8 | 1.9 | 1.8 |
| | 55–64 | 6.2 | 6.1 | 6.9 | 6.8 | 7.0 | 6.7 | 6.7 |
| | 65–74 | 14.4 | 15.3 | 14.7 | 14.7 | 13.9 | 15.0 | 14.7 |
| | 75–84 | 33.4 | 32.2 | 32.1 | 32.8 | 34.2 | 34.5 | 33.3 |
| | 85+ | 44.0 | 44.1 | 44.2 | 43.7 | 42.7 | 41.5 | 43.3 |
| N unknown BMI (%) | | 930 (26) | 893 (23) | 779 (19) | 716 (16) | 608 (13) | 534 (11) | 4,460 (17) |
| N known BMI | | 2,624 | 2,974 | 3,357 | 3,753 | 4,241 | 4,333 | 21,282 |
| Mean BMI (SD) | | 23.8 (4.4) | 23.7 (4.3) | 23.6 (4.4) | 23.8 (4.3) | 23.6 (4.2) | 23.8 (4.6) | 23.7 (4.4) |
| BMI [%] | ‹18.5 | 8.9 | 9.0 | 10.1 | 8.7 | 9.5 | 9.1 | 9.2 |
| | 18.5–24.9 | 57.8 | 57.3 | 56.8 | 56.7 | 56.5 | 57.2 | 57.0 |
| | 25–29.9 | 25.5 | 26.4 | 25.9 | 26.7 | 26.8 | 25.7 | 26.2 |
| | 30–34.9 | 6.5 | 5.5 | 5.6 | 6.4 | 6.2 | 5.9 | 6.0 |
| | 35–39.9 | 0.8 | 1.4 | 1.3 | 1.2 | 0.9 | 1.4 | 1.2 |
| | 40+ | 0.5 | 0.3 | 0.3 | 0.3 | 0.2 | 0.7 | 0.4 |
| N unknown ASA (%) | | 220 (6) | 277 (7) | 247 (6) | 202 (5) | 135 (3) | 131 (3) | 1,212 (5) |
| N known ASA | | 3,334 | 3,590 | 3,889 | 4,267 | 4,714 | 4,736 | 24,530 |
| Morbidity state | ASA 1 | 3.1 | 3.3 | 3.8 | 3.1 | 3.4 | 2.6 | 3.2 |
| [%] | ASA 2 | 31.6 | 30.7 | 28.9 | 28.1 | 27.5 | 28.6 | 29.1 |
| | ASA 3 | 58.7 | 58.4 | 60.0 | 60.2 | 60.4 | 60.3 | 59.8 |
| | ASA 4/5 | 6.6 | 7.6 | 7.4 | 8.6 | 8.8 | 8.6 | 8.0 |

*THA= Total Hip Arthroplasty. **HA= Hemiarthroplasty

**(Table 3.3).** On the other hand, only 2.1% of the patients were younger than 55 years, 6.7% were aged between 55 and 64 years.

Patients treated with HA were on average 11 years older than those treated with THA **(Table 3.4),** and as discussed above, younger patients were more likely to receive THA. Overall, there were more HA than THA. A total of 459 patients younger than 55 years of age were treated for hip fractures and, 90% of these (n = 415) were treated with THA. Interestingly, 44 patients younger than 55 received HA, while 62.5% of HA were performed in patients aged 85 years and older. However, 20% of the patients over 85 years of age received THA, the other 80% being treated with HA **(Table 3.4).**

### BMI and ASA score

Most patients had a normal BMI, between 18.5 and 25 kg/m². 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 in this group **(Table 3.4).**

Table 3.4

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

| | | THA | HA |
|---|---|---|---|
| **N (2018–2023)** | | **11,517** | **14,225** |
| Women [%] | | 63.4 | 70.4 |
| Mean age (SD) | All | 74.9 (10.9) | 85.8 (7.5) |
| | Women | 75.9 (10.4) | 86.3 (7.2) |
| | Men | 73.1 (11.5) | 84.7 (8.1) |
| Age group [%] | ‹45 | 0.7 | 0.0 |
| | 45–54 | 3.6 | 0.3 |
| | 55–64 | 13.5 | 1.2 |
| | 65–74 | 26.1 | 5.4 |
| | 75–84 | 36.7 | 30.5 |
| | 85+ | 19.5 | 62.5 |
| N unknown BMI (%) | | 1,777 (15) | 2,683 (19) |
| N known BMI | | 9,740 | 11,542 |
| Mean BMI (SD) | | 24.2 (4.6) | 23.3 (4.2) |
| BMI [%] | ‹18.5 | 7.5 | 10.7 |
| | 18.5–24.9 | 55.1 | 59 |
| | 25–29.9 | 28.2 | 24.5 |
| | 30–34.9 | 7.1 | 5.0 |
| | 35–39.9 | 1.5 | 0.9 |
| | 40+ | 0.6 | 0.2 |
| N unknown ASA | | 536 (5) | 676 (5) |
| N known ASA | | 10,981 | 13,549 |
| Morbidity state [%] | ASA 1 | 6.2 | 0.7 |
| | ASA 2 | 41.9 | 18.6 |
| | ASA 3 | 47.3 | 69.9 |
| | ASA 4/5 | 4.6 | 10.7 |

## 3.3 Total knee arthroplasty

In 2023, the total number of primary TKA registered in SIRIS reached 175,003 cases. Between 2018 and 2023 102,136 pimary TKA were performed

**Gender and age**

The share of women (59.4%) and the mean age of the patients (69.7 years) remained constant between 2018 and 2023. The proportion of younger patients (0.5% younger than 45 years of age and 5.6% aged 45–54 years) and of patients older than 85 years (4.6%) did not change significantly in recent years **(Table 3.5 and Figure 3.3).** On average, women were older than men when TKA was performed **(Figure 3.5).**

**BMI and ASA score**

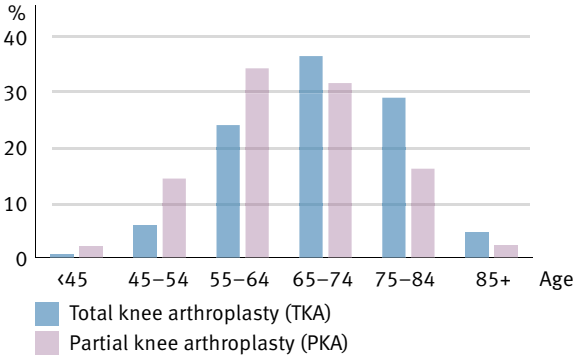
The share of unknown BMI constantly decreased from 15% in 2018 to 6% in 2023. It seems that almost all participating institutions have realised the importance of BMI for risk adjustments, as missing values may lead to overestimation of revision rates. These data allow for a risk adjustment most often favourable to the provider. Between 2018 and 2023, the BMI remained constant at mean 29.3 kg/m$^2$. The distribution among the BMI subgroups did not change relevantly over time **(Table 3.5).**

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/m$^2$ **(Figure 3.5).** 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/m$^2$, whereas patients with a BMI of more than 40 kg/m$^2$ had surgery performed between 5 and 6 years earlier **(Figure 3.5).** In posttraumatic (secondary) OA, the mean BMI was significantly

Figure 3.3

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

All documented operations




**Age distribution at surgery of revision/reoperation of total and partial knee arthroplasty**

All documented operations

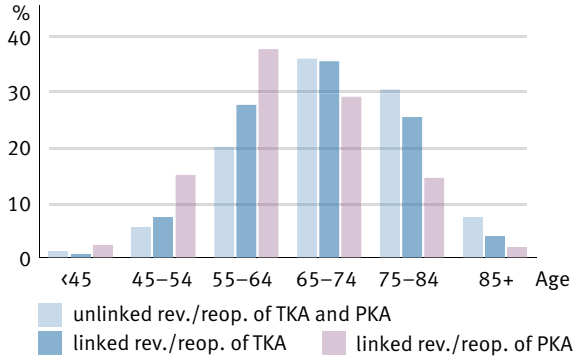


Table 3.5

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

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| **N** | | **14,717** | **15,528** | **15,439** | **16,683** | **19,274** | **20,495** | **102,136** |
| Diagnosis [%] | Primary OA* | 89.3 | 88.9 | 88.6 | 87.0 | 86.9 | 87.2 | 87.9 |
| | Secondary OA | 10.7 | 11.1 | 11.4 | 13.0 | 13.1 | 12.8 | 12.1 |
| | Inflammatory origin | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 |
| | Fracture | 2.1 | 2.2 | 2.2 | 2.4 | 2.3 | 2.3 | 2.3 |
| | Lesion of ligament | 4.8 | 5.2 | 5.7 | 5.9 | 5.9 | 5.6 | 5.5 |
| | Infection | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Osteonecrosis | 1.7 | 1.5 | 1.4 | 1.9 | 1.9 | 1.8 | 1.7 |
| | Other** | 1.3 | 1.4 | 1.2 | 1.7 | 1.8 | 1.8 | 1.6 |
| Women [%] | | 60.5 | 59.7 | 58.4 | 59.9 | 59.1 | 58.7 | 59.4 |
| Mean age (SD) | All | 69.4 (9.7) | 69.8 (9.5) | 69.5 (9.4) | 69.6 (9.5) | 69.8 (9.5) | 69.9 (9.4) | 69.7 (9.5) |
| | Women | 69.9 (9.7) | 70.5 (9.6) | 70.1 (9.6) | 70.1 (9.6) | 70.4 (9.6) | 70.3 (9.4) | 70.2 (9.6) |
| | Men | 68.6 (9.6) | 68.9 (9.3) | 68.8 (9.2) | 68.8 (9.3) | 69.0 (9.2) | 69.4 (9.2) | 68.9 (9.3) |
| Age group [%] | <45 | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| | 45–54 | 6.3 | 6.0 | 5.7 | 5.7 | 5.4 | 4.7 | 5.6 |
| | 55–64 | 24.3 | 23.0 | 24.6 | 24.6 | 24.5 | 24.6 | 24.3 |
| | 65–74 | 36.3 | 36.2 | 36.0 | 35.4 | 35.3 | 35.3 | 35.7 |
| | 75–84 | 27.8 | 29.3 | 28.9 | 29.5 | 29.8 | 30.6 | 29.4 |
| | 85+ | 4.8 | 5.1 | 4.2 | 4.4 | 4.6 | 4.3 | 4.6 |
| N unknown BMI (%) | | 2,261 (15) | 2,290 (15) | 1,923 (12) | 1,523 (9) | 1,332 (7) | 1,136 (6) | 10,465 (10) |
| N known BMI | | 12,456 | 13,238 | 13,516 | 15,160 | 17,942 | 19,359 | 91,671 |
| Mean BMI (SD) | | 29.5 (5.5) | 29.5 (5.6) | 29.2 (5.5) | 29.2 (5.6) | 29.2 (5.5) | 29.2 (5.6) | 29.3 (5.6) |
| BMI [%] | <18.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 |
| | 18.5–24.9 | 20.6 | 20.8 | 22.2 | 22.0 | 22.3 | 22.1 | 21.8 |
| | 25–29.9 | 38.5 | 38.8 | 38.1 | 38.0 | 37.8 | 38.2 | 38.2 |
| | 30–34.9 | 25.4 | 24.9 | 24.6 | 24.8 | 24.8 | 24.6 | 24.8 |
| | 35–39.9 | 10.6 | 10.2 | 10.1 | 9.9 | 10.5 | 10.4 | 10.3 |
| | 40+ | 4.5 | 4.8 | 4.3 | 4.6 | 4.2 | 4.3 | 4.4 |
| N unknown ASA (%) | | 1,187 (8) | 1,160 (7) | 1,016 (7) | 574 (3) | 441 (2) | 420 (2) | 4,798 (5) |
| N known ASA | | 13,530 | 14,368 | 14,423 | 16,109 | 18,833 | 20,075 | 97,338 |
| Morbidity state [%] | ASA 1 | 8.2 | 8.1 | 7.9 | 6.9 | 6.9 | 6.3 | 7.3 |
| | ASA 2 | 63.1 | 61.5 | 62.1 | 61.9 | 63.0 | 63.5 | 62.6 |
| | ASA 3 | 28.2 | 29.9 | 29.6 | 30.8 | 29.5 | 29.8 | 29.7 |
| | ASA 4/5 | 0.4 | 0.5 | 0.4 | 0.4 | 0.5 | 0.4 | 0.4 |

* As of SIRIS version 2021, and pending further review, this category includes the newly introduced 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 newly added cases with „secondary OA caused by patellar instability“ were added to this category.

Figure 3.5

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

All diagnoses. Please note that group sizes vary considerably.

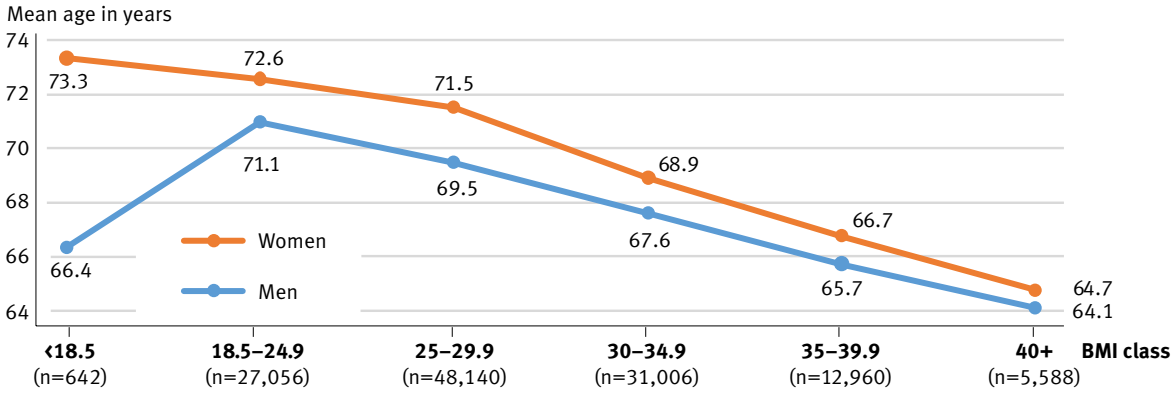



Table 3.6

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

Based on 102,036 cases with diagnostic information**

| | | Primary OA* | Secondary OA |
|---|---|---|---|
| **N** (2018–2023) | | **89,677** | **12,359** |
| Women [%] | | 61.0 | 47.7 |
| Mean age (SD) | All | 70.3 (9.1) | 65.2 (10.6) |
| | Women | 70.6 (9.3) | 66.5 (11.3) |
| | Men | 69.9 (8.9) | 63.9 (9.8) |
| Age group [%] | ‹45 | 0.2 | 2.1 |
| | 45–54 | 4.6 | 12.9 |
| | 55–64 | 22.8 | 35.0 |
| | 65–74 | 36.7 | 28.8 |
| | 75–84 | 31.0 | 18.2 |
| | 85+ | 4.8 | 2.9 |
| N unknown BMI (%) | | 9,347 (10) | 1,097 (9) |
| N known BMI | | 80,330 | 11,262 |
| Mean BMI (SD) | | 29.5 (5.6) | 28.2 (5.1) |
| BMI [%] | ‹18.5 | 0.5 | 0.8 |
| | 18.5–24.9 | 21.1 | 27 |
| | 25–29.9 | 37.9 | 40.3 |
| | 30–34.9 | 25.1 | 22.7 |
| | 35–39.9 | 10.8 | 7.0 |
| | 40+ | 4.7 | 2.5 |
| N unknown ASA (%) | | 4,353 (5) | 435 (4) |
| N known ASA | | 85,324 | 11,924 |
| ASA state [%] | ASA 1 | 6.7 | 11.8 |
| | ASA 2 | 62.6 | 62.5 |
| | ASA 3 | 30.3 | 25.2 |
| | ASA 4/5 | 0.4 | 0.5 |

* Including „arthritis after meniscus surgery“
** Number of cases with clear diagnostic information (in 0.1% of cases we cannot determine the diagnosis)

lower overall and in all BMI subgroups **(Table 3.6).** As with the BMI, the share of unknown ASA score decreased continuously from 8% in 2018 to 2% in 2023. This score is another important factor for risk adjustments. The distribution of the ASA score also remained constant over the past 6 years.

**Underlying diagnosis**

The most frequent indication for TKA was classified as primary OA, representing 87.9% of the cases in the period from 2018 to 2023 **(Table 3.5),** although additional reasons (such as ligament lesions or infection) were introduced in 2015 as possible underlying diagnosis for secondary OA, and even though the awareness of risk factors for knee OA has steadily increased in recent decades. Therefore, there seems to have been an issue of underreporting the reality. One reason could be that primary OA is the first item to appear in the selection menu and the choice of secondary OA opens another dropdown menu, which both could prevent users from selecting these items.

Secondary OA had a share of 12.1% between 2018 and 2023, not varying significantly over time. Ligament lesions formed the most frequent subgroup, followed by sequels to fractures and osteonecrosis, representing 5.5%, 2.3% and 1.7% respectively, of all TKA. All other conditions were rare, the proportion of inflammatory disease as reason for TKA was 1.0%, while the category "other" represented 1.6%.

Patients with secondary OA were significantly younger (mean age 65.2 years) than those with primary OA (mean age 70.3 years) when receiving TKA. In addition, the share of men was higher in secondary OA with 52.3% than for women (47.7%) **(Table 3.6).** 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 (see Chapters 6.3 and 6.4).

Other factors like BMI and ASA classification did not differ between the two groups. Of note, there were considerable differences in distribution of diagnosis in high-volume hospitals (please refer to chapter 4 Epidemiology for the detailed discussion).

## 3.4 Partial knee arthroplasty

A total of 32,079 primary PKA were registered since inception of SIRIS in 2012. The proportion of PKA was 15.5% over the past 11 years. In 2023, 20,494 TKA and 3,407 PKA were registered, resulting in a slightly lower share of PKA of 14.2%. This proportion remained about equal over the past 5 years and is among the highest in the western world, although clearly less than in Denmark, where the share of PKA was 30.6% in 2023. Hospitals with more than 100 arthroplasties per year performed 87.5% of the PKA between 2018 and 2023 **(Table 3.7).**

Table 3.7

**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 (2018–2023).

| Hospital service volume* | | <100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| **N (2018–2023)** | | **2,561** | **4,416** | **4,222** | **7,737** |
| Women [%] | | 47.2 | 45.4 | 47.3 | 47.7 |
| Mean age (SD) | All | 64.2 (10.3) | 64.6 (10.1) | 65.1 (10.1) | 65.0 (10.1) |
| | Women | 64.0 (11.1) | 64.3 (10.6) | 64.6 (10.4) | 64.9 (10.6) |
| | Men | 64.3 (9.5) | 64.7 (9.6) | 65.5 (9.9) | 65.1 (9.7) |
| Age group [%] | <45 | 2.1 | 1.9 | 1.9 | 1.9 |
| | 45–54 | 15.8 | 14.4 | 13.2 | 13.6 |
| | 55–64 | 34.9 | 35.5 | 33.2 | 34.0 |
| | 65–74 | 30.0 | 29.7 | 32.7 | 31.7 |
| | 75–84 | 14.6 | 16.5 | 16.5 | 16.7 |
| | 85+ | 2.5 | 2.0 | 2.3 | 2.2 |
| Diagnosis [%] | Primary OA | 91.3 | 90.7 | 89.7 | 89.0 |
| | Secondary OA | 8.7 | 9.3 | 10.3 | 11.0 |
| N unknown BMI (%) | | 426 (17) | 488 (11) | 222 (5) | 857 (11) |
| N known BMI | | 2,135 | 3,928 | 4,000 | 6,880 |
| Mean BMI (SD) | | 28.5 (4.7) | 28.8 (5.0) | 28.3 (4.9) | 28.0 (4.8) |
| BMI [%] | <18.5 | 0.4 | 0.3 | 0.3 | 0.5 |
| | 18.5–24.9 | 22.4 | 22.7 | 25.1 | 27.4 |
| | 25–29.9 | 43.7 | 40.6 | 42.5 | 41.8 |
| | 30–34.9 | 24.6 | 25.6 | 23.5 | 22.5 |
| | 35–39.9 | 7.5 | 8.4 | 6.9 | 6.2 |
| | 40+ | 1.5 | 2.4 | 1.7 | 1.7 |
| N unknown ASA (%) | | 133 (5) | 165 (4) | 231 (5) | 181 (2) |
| N known ASA | | 2,428 | 4,251 | 3,991 | 7,556 |
| ASA state [%] | ASA 1 | 16.0 | 15.2 | 12.8 | 14.0 |
| | ASA 2 | 67.3 | 66.0 | 67.7 | 66.4 |
| | ASA 3 | 16.4 | 18.7 | 19.2 | 19.5 |
| | ASA 4/5 | 0.3 | 0.2 | 0.3 | 0.2 |

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

Table 3.8

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

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| **N** | | **2,723** | **3,054** | **3,142** | **3,189** | **3,420** | **3,408** | **18,936** |
| Diagnosis [%] | Primary OA* | 91.1 | 90.6 | 91.2 | 88.9 | 88.8 | 89.2 | 89.9 |
| | Secondary OA | 8.9 | 9.4 | 8.8 | 11.1 | 11.2 | 10.8 | 10.1 |
| | Inflammatory origin | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.3 | 0.2 |
| | Fracture | 1.0 | 0.6 | 0.8 | 0.8 | 0.9 | 0.9 | 0.8 |
| | Lesion of ligament | 1.6 | 2.1 | 2.1 | 2.4 | 2.1 | 2.0 | 2.1 |
| | Infection | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| | Osteonecrosis | 5.0 | 5.5 | 4.5 | 5.6 | 5.2 | 5.2 | 5.2 |
| | Other** | 1.5 | 1.5 | 1.5 | 2.2 | 2.7 | 2.4 | 2.0 |
| Women [%] | | 47.9 | 48.7 | 47.8 | 46.6 | 45.0 | 46.4 | 47.0 |
| Mean age (SD) | All | 64.8 (10.3) | 64.7 (10.3) | 64.6 (10.2) | 64.5 (10.0) | 65.1 (9.9) | 65.0 (10.0) | 64.8 (10.1) |
| | Women | 64.8 (10.8) | 64.6 (10.8) | 64.3 (11.0) | 64.3 (10.1) | 64.7 (10.4) | 64.9 (10.6) | 64.6 (10.6) |
| | Men | 64.8 (9.9) | 64.8 (9.8) | 64.9 (9.5) | 64.7 (10.0) | 65.3 (9.5) | 65.2 (9.6) | 65.0 (9.7) |
| Age group [%] | ‹45 | 2.2 | 2.1 | 2.2 | 1.9 | 1.5 | 1.7 | 1.9 |
| | 45–54 | 14.1 | 14.5 | 14.2 | 14.5 | 13.2 | 13.5 | 14.0 |
| | 55–64 | 32.7 | 34.1 | 34.2 | 34.6 | 35.4 | 34.6 | 34.3 |
| | 65–74 | 32.1 | 30.6 | 31.2 | 31.7 | 30.9 | 31.0 | 31.2 |
| | 75–84 | 16.4 | 16.4 | 16.0 | 15.2 | 16.8 | 17.1 | 16.3 |
| | 85+ | 2.5 | 2.4 | 2.2 | 2.0 | 2.2 | 2.2 | 2.2 |
| N unknown BMI (%) | | 449 (16) | 441 (14) | 344 (11) | 297 (9) | 257 (8) | 205 (6) | 1,993 (11) |
| N known BMI | | 2,274 | 2,613 | 2,798 | 2,892 | 3,163 | 3,203 | 16,943 |
| Mean BMI (SD) | | 28.3 (4.6) | 28.4 (5.0) | 28.5 (4.9) | 28.4 (5.0) | 28.2 (4.7) | 28.3 (4.9) | 28.3 (4.8) |
| BMI [%] | ‹18.5 | 0.5 | 0.5 | 0.5 | 0.3 | 0.2 | 0.3 | 0.4 |
| | 18.5–24.9 | 24.1 | 25.0 | 24.7 | 25.7 | 26.0 | 24.9 | 25.1 |
| | 25–29.9 | 43.8 | 41.7 | 40.9 | 40.0 | 42.5 | 42.7 | 41.9 |
| | 30–34.9 | 24.3 | 23.0 | 24.8 | 23.9 | 23.1 | 23.4 | 23.7 |
| | 35–39.9 | 5.7 | 8.1 | 7.4 | 8.0 | 6.6 | 6.4 | 7.0 |
| | 40+ | 1.6 | 1.8 | 1.8 | 1.9 | 1.5 | 2.3 | 1.8 |
| N unknown ASA (%) | | 175 (6) | 165 (5) | 150 (5) | 58 (2) | 81 (2) | 81 (2) | 710 (4) |
| N known ASA | | 2,548 | 2,889 | 2,92 | 3,131 | 3,339 | 3,327 | 18,226 |
| Morbidity | ASA 1 | 17.1 | 16.9 | 14.5 | 14.8 | 12.3 | 11.0 | 14.3 |
| state [%] | ASA 2 | 66.1 | 65.1 | 68.5 | 65.9 | 66.7 | 67.6 | 66.7 |
| | ASA 3 | 16.7 | 17.8 | 16.7 | 19.0 | 20.8 | 21.1 | 18.8 |
| | ASA 4/5 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 |

* As of SIRIS version 2021, and pending further review, this category includes the newly introduced 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 newly added cases with „secondary OA caused by patellar instability“ were added to this category.

**Gender 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 3.5 and 3.8).** In 15.9% patients were younger than 54 years of age, whereas patients older than 85 years accounted for 2.2%. Elderly patients are of special interest as surgical risks can be reduced remarkably by PKA compared to TKA. Underlying diagnosis, gender, age distribution, BMI or ASA score did not vary relevantly over the past six years **(Table 3.8).**

**BMI and ASA score**

The BMI was not recorded in 11% between 2018 and 2023. The mean BMI was 28.3 kg/m². The ASA score was not reported in 4% of the cases registered between 2018 and 2023. Over the whole period, patients with an ASA score of 3 and 4 represented 20.0%, while it was significantly higher in TKA with 30.1% **(Table 3.5).** Recipients of PKA were not only healthier but also significantly younger than in TKA cohort (64.8 versus 69.7 years) **(Table 3.8).**

**Underlying diagnosis**

Between 2018 and 2023, 89.9% of the OA were classified as primary, the remaining 10.1% being secondary. In 5.2% of the latter an osteonecrosis was registered, in 2.1% a ligament lesion and 2.0% were classified as "other reason". Fractures were rare (0.8%). In 0.2% only a PKA was performed when an inflammatory arthritis was present **(Table 3.8).**

# 4. Epidemiology

Switzerland has a complicated and probably unique health care system. Beside a national health service each canton has full responsability for its own health service. In fact, the state of Switzerland acts in a subsidiarity for questions of nationwide importance as it was the case for instance during the COVID-19 epidemic. But even university hospitals belong not to the responsibility of the nationwide Health care system but are owned by certain cantons. In addition, beside a public health service ruled by the cantons a strong part of the market is organised privately. Most of the private hospitals have though a public mandate of the cantons and take a share of the public health service of the cantons.

The insurance system is as complicated as the organisation of the health service. Till now three classes of health insurance exist, public, private and semi-private in between. Each inhabitant must pay fees for health insurance. In case of a hospital stay, costs are paid in a small part by the patient whereas the bigger part is shared between insurance company and canton, depending on the insurance model. Only in case of an accident a Swiss wide insurance system exists which covers all costs including work incapacity or if necessary, pension.

Traditionally the French speaking, western part of Switzerland has close contacts to France as has Canton Ticino to northern Italy or the German speaking part to Germany and Austria. These contacts and the fact that Switzerland as a small country traditionally negotiated with the whole world, created a melting pot of different concepts and principles in orthopaedic surgery and hip and knee arthroplasty. This might explain why we can report about almost any existing arthroplasty brand and technology existing, although limited in numbers. In that context it is pure fortune that the Swiss joint registry is organised nationwide and holds a participation rate of 98.5% by its compulsory contribution.

Because of the above mentioned fragmentation, the chapter epidemiology will highlight results nationwide, by canton or region and then by hospitals.

## 4.1 Hip arthroplasty

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

**Incidence of THA and HA**

Since 2012, 226,042 primary THA and 25,297 primary HA were registered in SIRIS, as well as 30,216 revision arthroplasties of the hip. A total of 39.6% of the revisions could be linked to arthroplasties registered in SIRIS since 2012. The proportion of linked revisions increased from 13.1% in 2012 to 53.7% in 2023. There are still 46.3% unlinked revisions, either because the index arthroplasty was performed prior to implementation of SIRIS in 2012, or if the index arthroplasty was not recorded **(Table 4.1).**

Table 4.1
**Total and partial hip arthroplasty (THA and HA), primary and revisions/reoperations**
All documented operations

| Year | Primary THA | Primary HA | Primary others or type unclear | Primary total | Annual growth rate primary | Linked Rev./ Reop. of THA[2] | Linked Rev./Reop. of HA[2] | Unlinked Rev./ Reop.[3] | Rev./Reop. total[4] | % Linked Rev./ Reop. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2012**[1] | 6,705 | 637 | 3 | 7345 | | 113 | 6 | 792 | 911 | 13.1 |
| **2013** | 16,898 | 1,935 | 4 | 18,837 | | 406 | 39 | 1,872 | 2,317 | 19.2 |
| **2014** | 17,181 | 2,029 | 1 | 19,211 | 2.0% | 570 | 60 | 1,902 | 2,532 | 24.9 |
| **2015** | 17,687 | 1,982 | 5 | 19,674 | 2.4% | 723 | 65 | 1,814 | 2,602 | 30.3 |
| **2016** | 18,703 | 1,999 | 4 | 20,706 | 5.2% | 843 | 85 | 1,715 | 2,643 | 35.1 |
| **2017** | 18,887 | 2,094 | 9 | 20,990 | 1.4% | 866 | 78 | 1,677 | 2,621 | 36.0 |
| **2018** | 19,516 | 2,255 | 5 | 21,776 | 3.7% | 968 | 101 | 1,566 | 2,635 | 40.6 |
| **2019** | 20,173 | 2,356 | 7 | 22,536 | 3.5% | 1,107 | 105 | 1,515 | 2,727 | 44.4 |
| **2020** | 20,329 | 2,424 | 5 | 22,758 | 1.0% | 1,241 | 107 | 1,447 | 2,795 | 48.2 |
| **2021** | 21,982 | 2,398 | 7 | 24,387 | 7.2% | 1,326 | 116 | 1,314 | 2,756 | 52.3 |
| **2022** | 23,465 | 2,622 | 1 | 26,088 | 7.0% | 1,331 | 136 | 1,306 | 2,773 | 52.9 |
| **2023** | 24,516 | 2,566 | 5 | 27,087 | 3.8% | 1,436 | 124 | 1,344 | 2,904 | 53.7 |
| **All** | **226,042** | **25,297** | **56** | **251,395** | | **10,930** | **1,022** | **18,264** | **30,216** | **39.6** |

[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

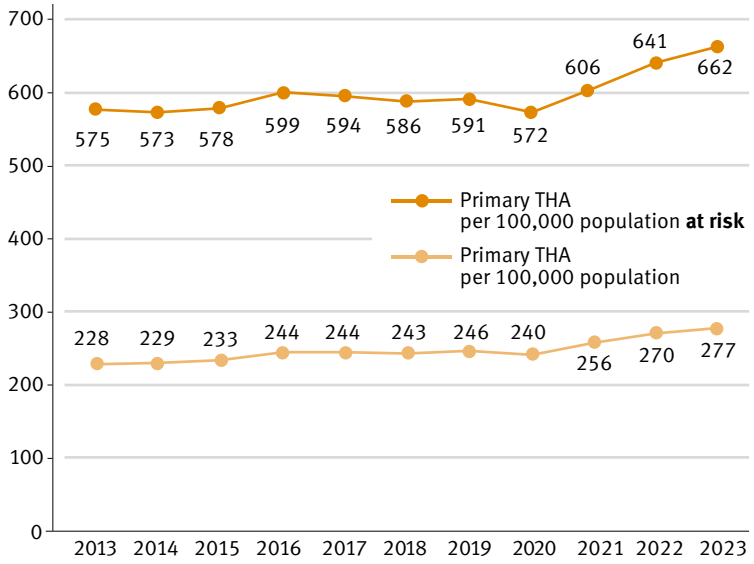
The number of THA has steadily increased over the past years from 228 per 100'000 inhabitants in 2013 to 277 per 100'000 inhabitants in 2023. Looking specifically at the population at risk – the age group between 50 to 89 years, accounting for 98% of the recipients of THA – the incidence of THA was 662 per 100,000 inhabitants at risk in 2023 **(Figure 4.1).**

In 2020, a significant drop occurred, due to restrictions linked to the COVID-19 pandemic. Before 2020, the average annual increase was approximately 0.5% per year. The growth rate increased to 5.9% in 2021 and 5.8% and 2022 respectively, decreasing to 3.3% in 2023. Large parts of the peak in 2021 and 2022 seem to be a rebound effect after the COVID-19 pandemic. The reasons for the recent increase are most probably multifactorial and may include demographic growth, increased patient expectation about quality of life, and availability of such procedures. In 2023, the curve flattened again, and future development has to be observed.

Figure 4.1

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

Per 100'000 residents and per 100'000 residents at risk*




*Age group 50–89 years accounts for 93% of all recipients of THA

Adjusted for estimated coverage. SIRIS figures excluding Liechtenstein.
Coverage rates 2013–2016 estimated at 91%; 2017–2022 based on federal health office data; 2023 estimated at 98.6%

### Seasonality

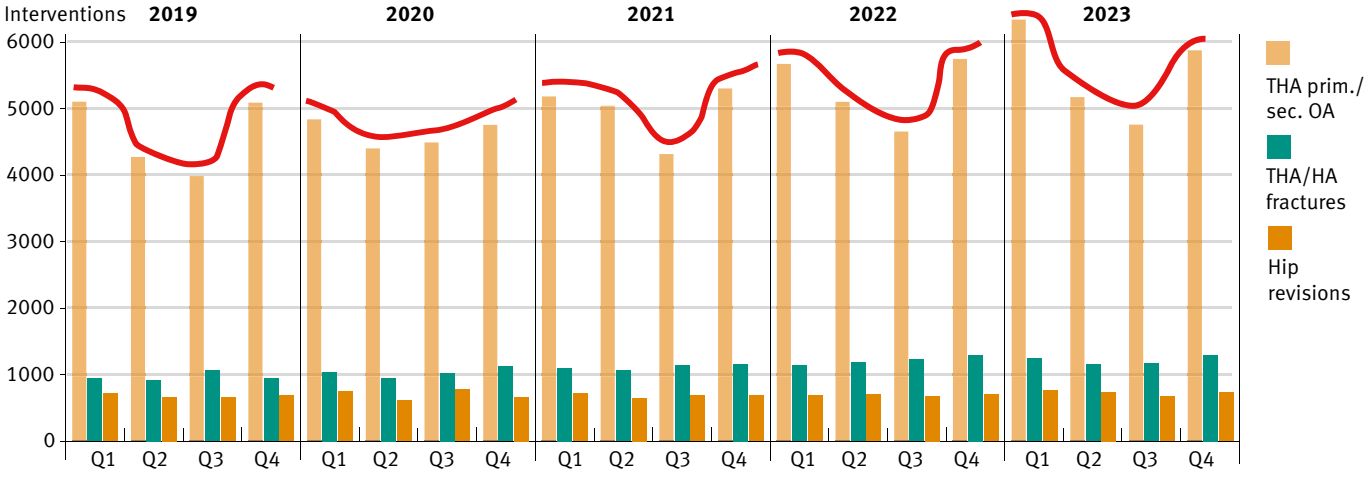
In general, primary arthroplasties follow a seasonal pattern, with more implantations performed in Q1 and Q4, and a dip in Q3, due to reduced demand and supply during summer vacations **(Figure 4.2).** During the COVID-19 pandemic, the seasonal pattern was interrupted, while in 2021 it was partially restored. In 2022, the seasonal pattern was regained again. The treatment of fractures and revision arthroplasties did not follow a seasonal pattern.

### Revision rates

Revision rates increase over time. At 2 years, the average revision rate for all THA was 2.8% (CI 2.7–2.9) and 3.4% (CI 3.2–3.7) for HA, while the 11-year revision rates were 5.3% (CI 5.1–5.4) and 6.9% (CI 6.0–8.0), respectively **(Figure 4.3).** Particularly, the results for HA have slightly improved compared to the previous periods. The comparison of different periods since 2015 shows a trend of decreasing revision rates in more recent years **(Figure 4.4).** This is one of the desired effects of a registry.

Figure 4.2

**Seasonal pattern of SIRIS submissions 2019–2023**



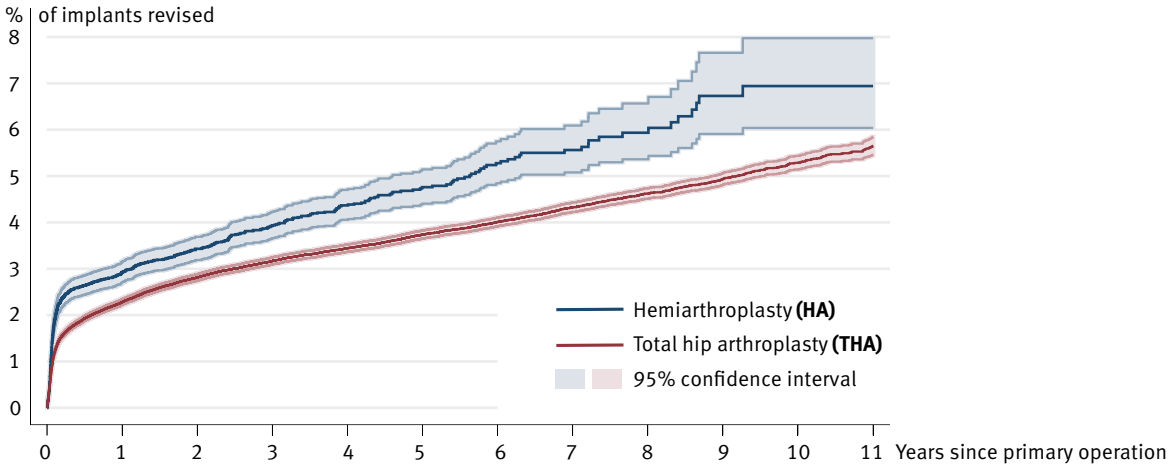

| | 2019 | | | | 2020 | | | | 2021 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| THA primary/secondary OA | 5,106 | 4,275 | 3,987 | 5,091 | 4,840 | 4,403 | 4,493 | 4,757 | 5,185 | 5,045 | 4,318 | 5,305 |
| THA/HA fractures | 940 | 918 | 1,058 | 944 | 1,040 | 949 | 1,024 | 1,118 | 1,102 | 1,064 | 1,135 | 1,159 |
| Hip revisions | 721 | 663 | 659 | 683 | 746 | 610 | 776 | 663 | 717 | 651 | 689 | 691 |

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| THA primary/secondary OA | 5,674 | 5,104 | 4,657 | 5,749 | 6,341 | 5,175 | 4,761 | 5,879 |
| THA/HA fractures | 1,142 | 1,181 | 1,228 | 1,298 | 1,243 | 1,156 | 1,173 | 1,295 |
| Hip revisions | 689 | 703 | 681 | 705 | 766 | 740 | 669 | 729 |

Figure 4.3

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

Time since operation, 2012–2023, all services, all diagnoses



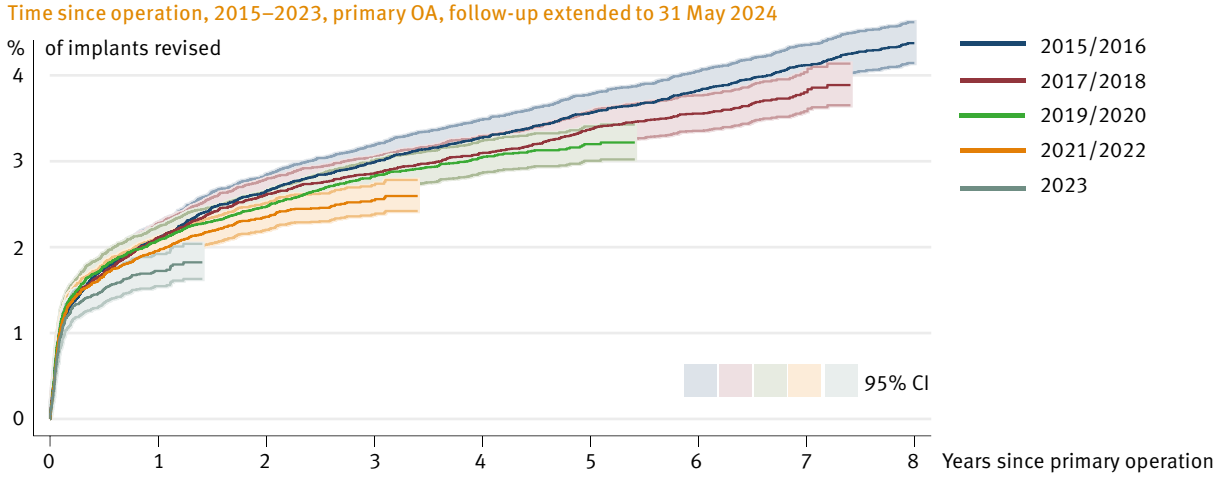

| Failure rate | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| HA | **2.9** (2.7-3.1) | **3.4** (3.2-3.7) | **3.9** (3.7-4.2) | **4.8** (4.4-5.1) | **5.3** (4.8-5.7) | **5.9** (5.4-6.6) | **6.7** (5.9-7.7) | **6.9** (6.0-8.0) | **6.9** (6.0-8.0) |
| THA | **2.3** (2.2-2.3) | **2.8** (2.7-2.9) | **3.2** (3.1-3.2) | **3.7** (3.7-3.8) | **4.0** (3.9-4.1) | **4.6** (4.5-4.7) | **4.9** (4.8-5.1) | **5.3** (5.1-5.4) | **5.7** (5.5-5.8) |

| N at risk | 0 year | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|---|
| HA | 25,297 | 15,730 | 11,288 | 8,149 | 3,537 | 2,316 | 907 | 510 | 251 | 50 |
| THA | 226,042 | 193,137 | 164,457 | 140,776 | 95,025 | 76,299 | 42,951 | 28,771 | 16,019 | 4,459 |

Figure 4.4

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

Time since operation, 2015–2023, primary OA, follow-up extended to 31 May 2024




| Failure rate | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|---|---|
| 2015/2016 | **2.1** (1.9-2.3) | **2.7** (2.5-2.8) | **3.0** (2.8-3.2) | **3.3** (3.1-3.5) | **3.6** (3.4-3.8) | **3.8** (3.6-4.0) | **4.1** (3.9-4.4) | **4.4** (4.1-4.6) | **4.6** (4.3-4.8) |
| 2017/2018 | **2.1** (2.0-2.3) | **2.6** (2.4-2.8) | **2.9** (2.7-3.0) | **3.1** (2.9-3.3) | **3.4** (3.2-3.6) | **3.6** (3.4-3.8) | **3.8** (3.6-4.0) | | |
| 2019/2020 | **2.1** (1.9-2.2) | **2.5** (2.3-2.6) | **2.8** (2.6-3.0) | **3.0** (2.9-3.2) | **3.2** (3.0-3.4) | | | | |
| 2021/2022 | **2.0** (1.8-2.1) | **2.4** (2.2-2.5) | **2.5** (2.4-2.7) | | | | | | |
| 2023 | **1.7** (1.5-1.9) | | | | | | | | |

### 4.1.2 Data by hospitals

In 2023, 147 hospital units performed primary THA, with a yearly average load of 132 THA per unit. The number of units varied since 2018 from year to year but was declining overall. There was a shift towards larger units and the number of smaller units were declining. However, these numbers also may reflect administrative measures, including mergers. At the same time, the number of THA implanted per unit was increasing **(Table 4.2).** The number of services performing less than 100 primary THAs per year remained stable at 56 units. At the same time, services with volumes ›300 continue to increase in numbers and cases. There is a case concentration in the large centres **(Table 4.3)**

Table 4.2
**Number of participating hospital services (N) and median procedures (M) per unit per year**

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Primary total hip arthroplasty | N services | 154 | 152 | 153 | 149 | 150 | 147 |
| | M per service | 86 | 87 | 94 | 117 | 122 | 132 |
| Primary hemiarthroplasty of the hip | N services | 125 | 126 | 125 | 105 | 110 | 105 |
| | M per service | 10 | 10 | 10 | 16 | 17 | 16 |
| Revision arthroplasty (THA or HA) | N services | 127 | 137 | 134 | 140 | 142 | 131 |
| | M per service | 9 | 10 | 12 | 12 | 11 | 12 |

Table 4.3
**Number of hospital services and number of primary total hip arthroplasty according to hospital volume**

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| ‹100 | N procedures/% | 3,040/**15.7** | 2,236/**12.1** | 2,829/**14.0** | 2,355/**10.9** | 2,431/**10.4** | 2,439/**9.9** |
| | N services | 74 | 64 | 73 | 61 | 56 | 56 |
| 100–199 | N procedures/% | 5,742/**29.7** | 6,669/**33.3** | 5,551/**27.5** | 6,097/**27.9** | 6,675/**28.6** | 4,887/**19.9** |
| | N services | 44 | 51 | 43 | 46 | 50 | 37 |
| 200–299 | N procedures/% | 4,242/**21.9** | 4,424/**22.1** | 4,995/**24.8** | 5,185/**23.8** | 5,751/**24.6** | 7,473/**30.5** |
| | N services | 19 | 20 | 22 | 24 | 26 | 34 |
| ›300 | N procedures/% | 6,303/**32.6** | 6,522/**32.5** | 6,800/**33.7** | 8,178/**37.4** | 8,509/**36.4** | 9,717/**39.6** |
| | N services | 15 | 15 | 15 | 18 | 18 | 20 |

Figure 4.5
**Cases per hospital sevice 2023: Total hip arthroplasty (THA) and hemiarthroplasty of the hip (HA)**

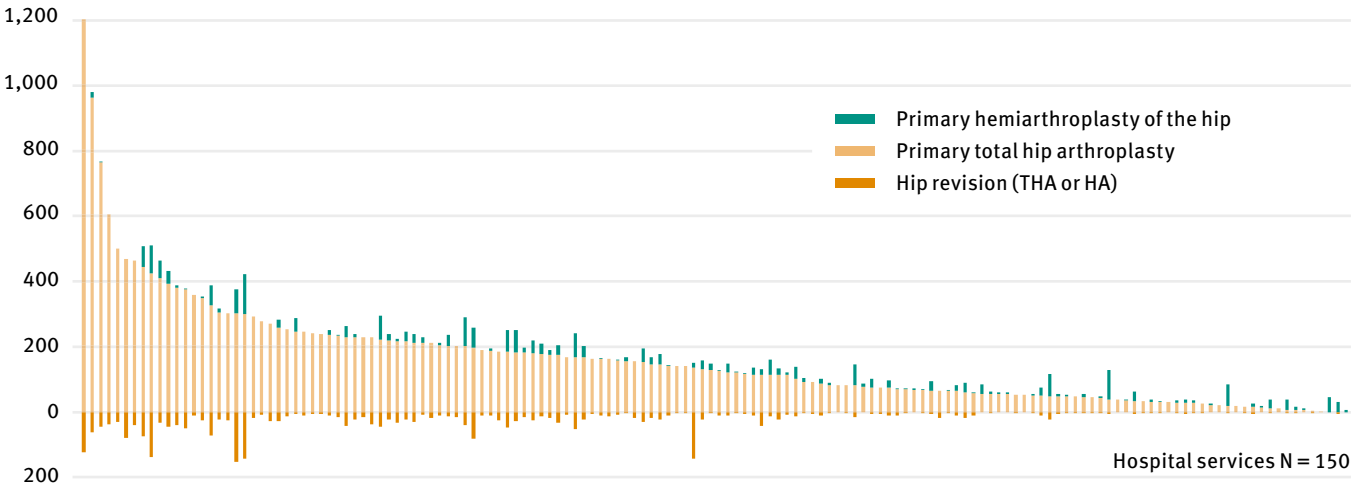


**Figure 4.5** illustrates the distribution of the workload among the 150 units participating in 2023, included three units performing only HA and no THA. The largest unit performed 1,277 primary THA, while the smallest performed only two primary THA. Hip revisions were performed in 109 units. However, 45 of them did less than 10 revisions per year **(Figure 4.5).**

A total of 15,192 hips (12.5%) were implanted in units performing fewer than 100 procedures per year. In 2023, 36% (n=47,299) of the primary THAs were implanted in the 20 services performing more than 300 procedures per year. In these larger units, arthroplasties for secondary OA were performed more frequently, and the share of young patients was higher. **(Table 4.4).**

Table 4.4

**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 (2018–2023).

| Hospital service volume | | <100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| N (2018–2023) | | **15,192** | **34,676** | **32,814** | **47,299** |
| Women [%] | | 52.8 | 53.9 | 52.4 | 53.6 |
| Mean age (SD) | All | 70.2 (11.2) | 69.8 (11.2) | 69.4 (11.3) | 68.3 (12.0) |
| | Women | 71.7 (11.0) | 71.5 (10.8) | 70.9 (11.1) | 69.9 (11.7) |
| | Men | 68.5 (11.1) | 67.8 (11.4) | 67.7 (11.3) | 66.4 (12.0) |
| Age group [%] | <45 | 1.7 | 1.9 | 2.1 | 3.4 |
| | 45–54 | 7.6 | 7.8 | 8.1 | 9.3 |
| | 55–64 | 20.2 | 21.1 | 21.9 | 22.7 |
| | 65–74 | 31.6 | 32.0 | 31.9 | 31.0 |
| | 75–84 | 30.0 | 29.4 | 28.5 | 27.1 |
| | 85+ | 8.9 | 7.9 | 7.5 | 6.6 |
| Diagnosis [%] | Primary OA | 80.1 | 81.6 | 84.1 | 81.4 |
| | Secondary OA | 7.8 | 7.6 | 7.3 | 11.9 |
| | Fracture | 12.1 | 10.8 | 8.6 | 6.7 |
| N unknown BMI (%) | | 2,473 (16) | 4,042 (12) | 2,957 (9) | 3,549 (8) |
| N known BMI | | 12,719 | 30,634 | 29,857 | 43,750 |
| Mean BMI (SD) | | 26.9 (5.0) | 27.1 (5.2) | 27.1 (5.2) | 26.8 (5.1) |
| BMI [%] | <18.5 | 2.3 | 2.2 | 2.0 | 2.2 |
| | 18.5–24.9 | 36.3 | 35.3 | 35.5 | 37.0 |
| | 25–29.9 | 37.6 | 37.7 | 37.6 | 38.0 |
| | 30–34.9 | 17.7 | 17.5 | 17.4 | 16.4 |
| | 35–39.9 | 4.7 | 5.5 | 5.5 | 4.8 |
| | 40+ | 1.5 | 1.8 | 2.0 | 1.6 |
| N unknown ASA (%) | | 404 (3) | 1,832 (5) | 1,449 (4) | 2,241 (5) |
| N known ASA | | 14,788 | 32,844 | 31,365 | 45,058 |
| Morbidity state [%] | ASA 1 | 11.3 | 10.4 | 10.6 | 11.6 |
| | ASA 2 | 59.0 | 58.9 | 59.7 | 58.5 |
| | ASA 3 | 28.4 | 29.5 | 28.8 | 29.0 |
| | ASA 4/5 | 1.3 | 1.2 | 0.9 | 1.0 |

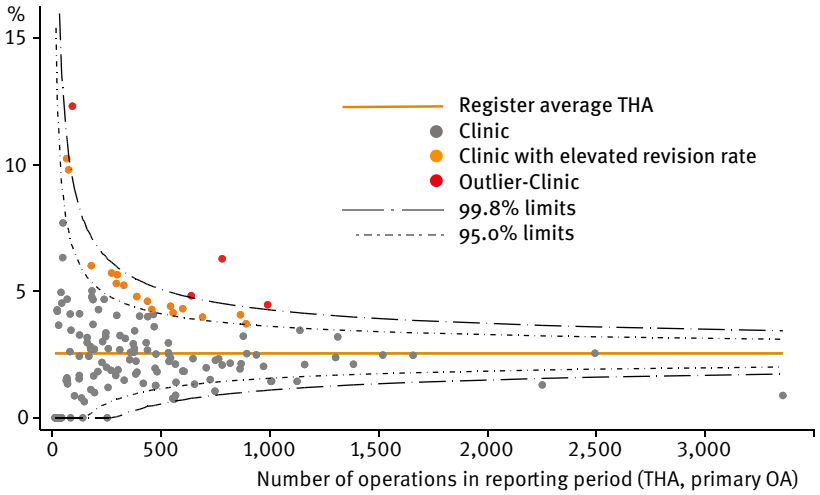
**Reporting of prostheses-related revision rates by hospitals**

The national average revision rate at 2 years for THA for primary OA of 2.5% (CI 2.4–2.7%), served as reference for calculating the outlier status of individual hospitals, implants and surgeons. The results for all participating units (hospitals) are shown in funnel plots **(Figure 4.6).** Results were risk-adjusted for age, sex, BMI, ASA, and Charnley scores, if available, and restricted to arthroplasties 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 outer limits. Although the spread of outcomes in Switzerland was relatively homogeneous, there were some exceptions. For THA, there were four units, one more than in 2022, that were detected as outliers and 16 institutions with an elevated revision risk, two more than 2022.

HA were analysed separately based on primary implantation of a HA. In 2023 there were two outliers, of which one was exactly at the boundary, and three services with an elevated revision risk, one more than 2022.

Figures 4.6

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




* Number of operations in the reporting period 01/2018–12/2021 (4-year moving average, follow-up to 12/2023).

THA results restricted to patients with primary osteoarthritis (prim OA).
Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available.

**Interpretation of funnel plots**

- The blue 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 performing better 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).

## 4.2 Hip fractures

Between 2018 and 2023, the registry recorded a total of 25,742 primary hip arthroplasties performed for fractures, with an annual increase of 7–8% per year. However, between 2022 and 2023, no more growth was observed, disregarding an irrelevant increase of only 18 cases **(Table 3.3).** Among these patients, 44.7% were treated with THA and 55.3% with HA. There was a clear trend towards treatment with THA, proportions increasing from 38.5% in 2017 to 48.8% in 2023.

**Hospitals**

One-third (31%) of all patients with a fracture were treated in a hospital with a volume of 100–199 primary arthroplasties per year **(Table 4.5),** while 21% were treated in institutions that performed fewer

Table 4.5

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

Calculations of hospital service volume based om primary hip surgeries in each included year (2018–2023).

| | | ‹100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| **N (2018–2023)** | | **5,347** | **7,899** | **6,189** | **6,307** |
| Treatment [%] | Total Hip Arthroplasty (THA) | 34.4 | 47.2 | 45.3 | 49.9 |
| | Hemiarthroplasty (HA) | 65.6 | 52.8 | 54.7 | 50.1 |
| Women [%] | | 69.0 | 68.2 | 66.2 | 65.7 |
| Mean age (SD) | All | 81.8 (9.9) | 80.7 (10.7) | 80.8 (10.7) | 80.5 (11.2) |
| | Women | 82.5 (9.5) | 81.7 (10.1) | 81.9 (10.1) | 81.7 (10.4) |
| | Men | 80.2 (10.6) | 78.6 (11.5) | 78.8 (11.5) | 78.3 (12.2) |
| Age group [%] | ‹45 | 0.2 | 0.3 | 0.3 | 0.6 |
| | 45–54 | 1.3 | 1.7 | 1.8 | 2.3 |
| | 55–64 | 5.2 | 7.1 | 6.9 | 7.2 |
| | 65–74 | 14.0 | 15.1 | 15.1 | 14.3 |
| | 75–84 | 33.6 | 33.7 | 32.9 | 32.9 |
| | 85+ | 45.8 | 42.1 | 43.1 | 42.8 |
| N unknown BMI (%) | | 1,363 (25) | 1,494 (19) | 850 (14) | 753 (12) |
| N known BMI | | 3,984 | 6,405 | 5,339 | 5,554 |
| Mean BMI (SD) | | 23.7 (4.3) | 23.7 (4.4) | 23.8 (4.4) | 23.7 (4.3) |
| BMI [%] | ‹18.5 | 8.8 | 9.3 | 9.0 | 9.7 |
| | 18.5–24.9 | 56.9 | 57.4 | 56.8 | 56.8 |
| | 25–29.9 | 26.5 | 26.0 | 26.5 | 25.9 |
| | 30–34.9 | 6.4 | 5.6 | 6.0 | 6.2 |
| | 35–39.9 | 1.1 | 1.3 | 1.1 | 1.1 |
| | 40+ | 0.3 | 0.4 | 0.6 | 0.3 |
| N unknown ASA (%) | | 205 (4) | 570 (7) | 257 (4) | 180 (3) |
| N known ASA | | 5,142 | 7,329 | 5,932 | 6,127 |
| Morbidity state [%] | ASA 1 | 3.5 | 3.1 | 3.2 | 3.0 |
| | ASA 2 | 28.8 | 30.1 | 29.2 | 27.9 |
| | ASA 3 | 58.8 | 58.8 | 60.1 | 61.5 |
| | ASA 4/5 | 8.9 | 8.0 | 7.5 | 7.7 |

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

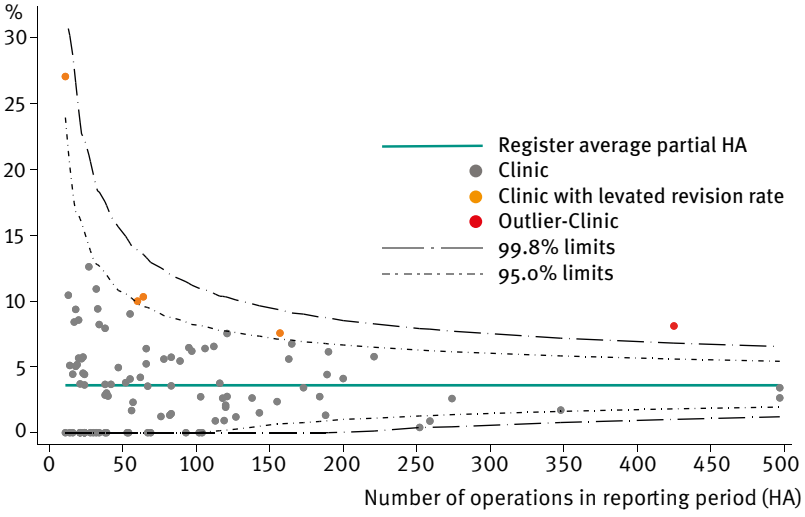
than 100 primary arthroplasties per year. The age distribution in the four categories (‹100 cases/year, 100–199, 200–299, ›300) was comparable, with an average age between 80.5 and 81.8 years. Hospitals with smaller caseloads (‹100 per year) treated more octogenarians and it is interesting to note that the percentage of patients treated by HA in the low-volume institutions was significantly higher (65.6% compared to the national average of 52.6%) **(Table 4.5).** This may indicate under-treatment, whereby the reason for this is unclear. One explanation may be that surgeons not trained to perform THA participated in the treatment of hip fractures in these smaller institutions.

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

The national average revision rate at 2 years for HA of 3.4% (CI 3.2–3.7) **(Figure 4.3),** 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 4.7).** For HA, there was one outlier unit and four services had an elevated revision risk, one more than 2022.

Figure 4.7

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




* Number of operations in the reporting period 01/2018–12/2021 (4-year moving average, follow-up to 12/2023).

**Interpretation of funnel plots**

- The blue 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 performing better 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).

## 4.3 Knee arthroplasty

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

**Incidence of TKA and PKA**

Since 2012, 207,177 primary knee arthroplasties were registered in SIRIS, of which 175,003 were TKA and 32,079 were PKA **(Table 4.6 and Figure 4.8).** The incidence of TKA and PKA has steadily increased over the past years, growing from 169 per 100'000 inhabitants in 2013 to 233 per 100'000 inhabitants in 2023. Considering only the population at risk – the age group between 50 to 89 years, accounting for 98% of the recipients of TKA – the incidence of TKA was 581 per 100,000 inhabitants at risk in 2023 **(Figure 4.9).** This incidence is one of the highest for TKA in Europe as well as worldwide. Initially, this increase could mainly be explained by an improving coverage rate, as the number of participating services and the data completeness both increased over time. In the annual report of 2023, a growth rate of 13.8% was reported for 2022, which was in fact even 14.2% after later data consolidation. The annual increase in 2023 was comparatively much lower, with 5.3%. and even lower than the 6.5% observed in 2019 **(Table 4.6, Figure 4.9).** As postulated last year, the peak

Table 4.6
**Total and partial knee arthroplasty (TKA, PKA), primary and revisions/reoperations**
All documented operations

| Year | Primary TKA | Primary PKA | Primary others or type uncl. | Primary Total | Annual growth rate primary | Linked Rev./Reop. of TKA[2] | Linked Rev./Reop. of PKA[2] | Unlinked Rev./Reop. can be of TKA or PKA | Rev./Reop. Total[3] | % Linked Rev./Reop. |
|---|---|---|---|---|---|---|---|---|---|---|
| **2012**[1] | 4,655 | 938 | 5 | 5,598 | | 19 | 2 | 510 | 531 | 4.0 |
| **2013** | 12,665 | 2,402 | 12 | 15,079 | | 181 | 51 | 1,251 | 1,486 | 15.6 |
| **2014** | 13,042 | 2,338 | 11 | 15,391 | 2.1% | 396 | 110 | 1,118 | 1,624 | 31.2 |
| **2015** | 13,437 | 2,391 | 6 | 15,834 | 2.9% | 594 | 124 | 1,071 | 1,790 | 40.1 |
| **2016** | 14,600 | 2,456 | 8 | 17,064 | 7.8% | 837 | 195 | 1,135 | 2,171 | 47.5 |
| **2017** | 14,469 | 2,619 | 15 | 17,103 | 0.2% | 945 | 264 | 1,089 | 2,303 | 52.5 |
| **2018** | 14,717 | 2,723 | 11 | 17,451 | 2.0% | 1,037 | 288 | 1,088 | 2,418 | 54.8 |
| **2019** | 15,528 | 3,054 | 6 | 18,588 | 6.5% | 1,199 | 298 | 1,057 | 2,556 | 58.6 |
| **2020** | 15,439 | 3,142 | 5 | 18,586 | 0.0% | 1,316 | 401 | 1,051 | 2,770 | 62.0 |
| **2021** | 16,683 | 3,189 | 3 | 19,875 | 6.9% | 1,348 | 404 | 1,013 | 2,772 | 63.2 |
| **2022** | 19,274 | 3,420 | 3 | 22,697 | 14.2% | 1,552 | 452 | 934 | 2,944 | 68.1 |
| **2023** | 20,494 | 3,407 | 10 | 23,911 | 5.3% | 1,641 | 469 | 1,021 | 3,134 | 67.3 |
| **All** | **175,003** | **32,079** | **95** | **207,177** | | **11,065** | **3,058** | **12,338** | **26,499** | **53.3** |

[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 in SIRIS
[3] including linked revisions/reoperations of procedures that were classified as „primary others" or of unclear type

in 2022 seems to be explainable in large parts by a considerable rebound effect after the restrictions on elective surgery during the COVID-19 pandemic. In the meantime, the increase of incidence of knee arthroplasties may have reached a more moderate level, although the rate is still higher than the increase of the population at risk, which reached 1.5% in 2023 **(Table 4.9).** Further development will be monitored in the coming years.

The proportion of PKA among all primary knee arthroplasties was 15.5% over the past 11 years. In 2023, 20,494 TKA and 3,407 PKA were performed, resulting in a slightly sinking share of PKA of 14.2% whereas in 2020 it was at 16.9% **(Table 4.6).**

Figure 4.8

**Case number growth 2021–2023 by Canton**

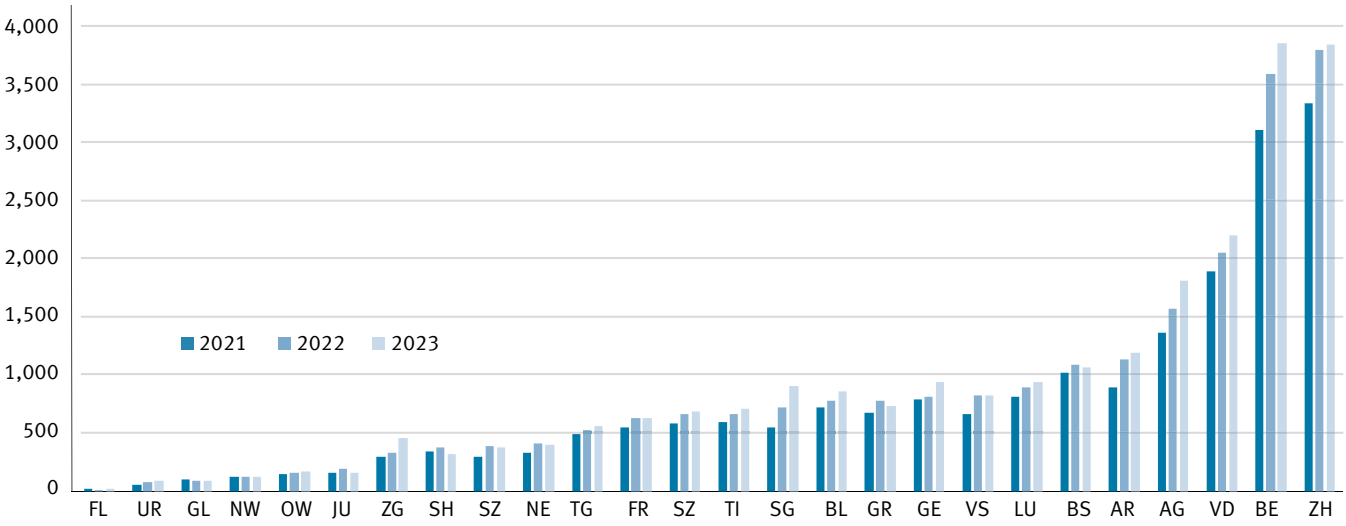
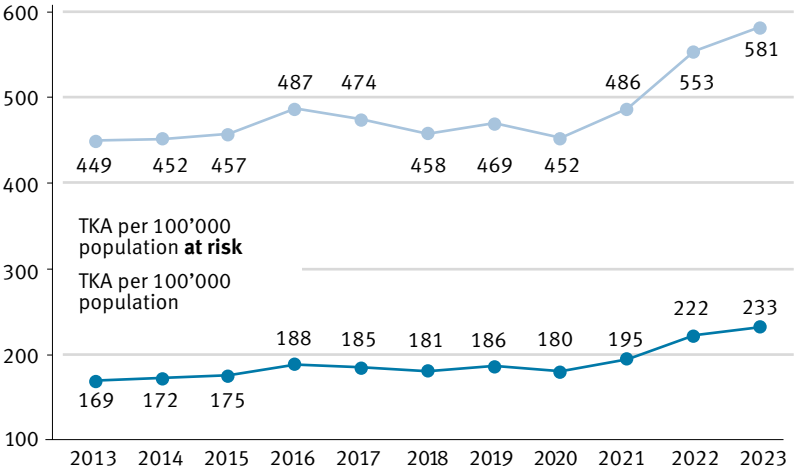



Figure 4.9

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

Per 100,000 residents and per 100,000 residents at-risk*.




*Age group 50–89 years accounts for 98% of all recipients of TKA. Adjusted for estimated coverage. SIRIS figures excluding Liechtenstein. Coverage rates 2013–2016 estimated at 92%; 2017–2022 based on federal health office data; 2023 estimated at 98.3%

### Seasonality

TKA has a clear seasonal pattern in Switzerland, with highest numbers in Q1 and Q4 and lowest activity in Q3. This pattern only changed in 2020 and 2021 due to the restrictions associated with the COVID-19 pandemic, and recurred in 2022. The seasonal influence is less marked for PKA than for TKA. Whereas revision arthroplasty of the knee seems to be performed more or less uniformly over the whole year **(Figure 4.10).**

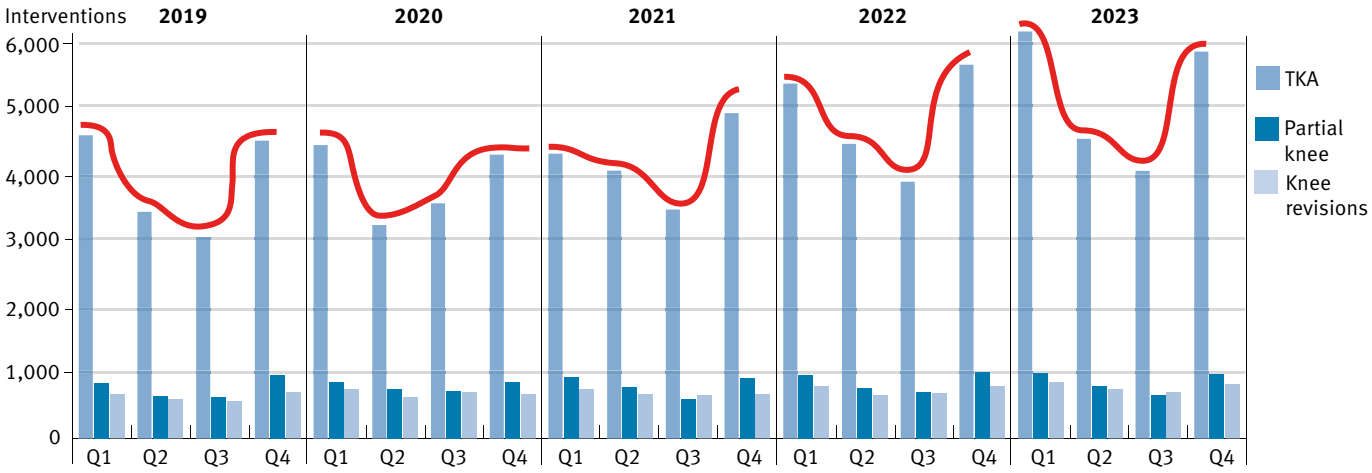
### Revision rates

Comparing the revision rates over different time periods using Kaplan-Meier estimates, there is a trend towards a progressive improvement since 2019, although the differences are not yet statistically significant **(Figure 4.11).** Such improvements over time would be one of the main goals of an implant registry.

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 4.12).** At 11 years, revision rate for TKA was 8.0% (7.8-8.2%), whereas it was 14.1% (13.4-14.9%) for PKA.

Figure 4.10

**Seasonal pattern of SIRIS submissions 2019–2023**



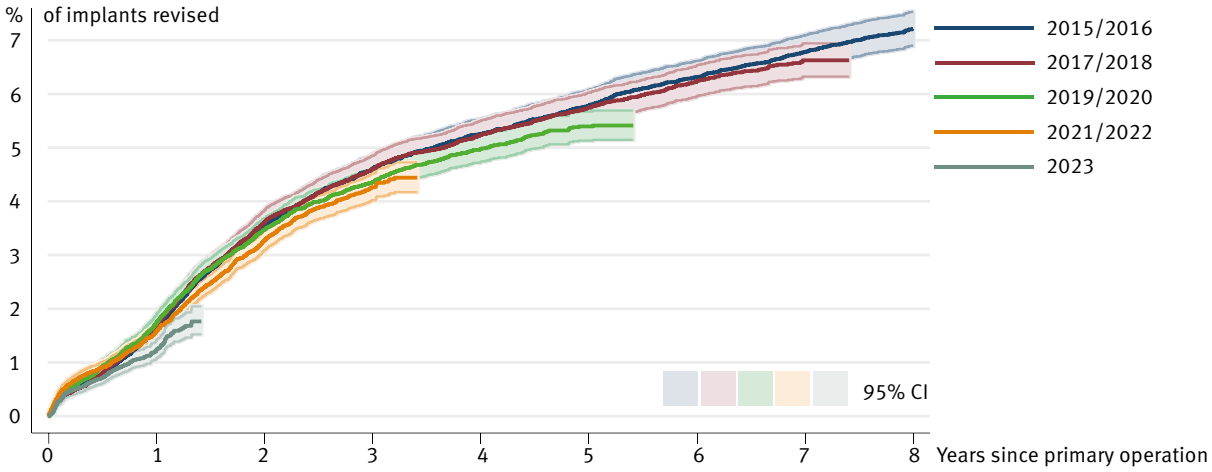

| | 2019 | | | | 2020 | | | | 2021 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| TKA | 4,566 | 3,415 | 3,028 | 4,485 | 4,419 | 3,216 | 3,543 | 4,274 | 4,289 | 4,034 | 3,449 | 4,899 |
| Partial knee | 840 | 636 | 623 | 955 | 843 | 741 | 708 | 854 | 918 | 773 | 593 | 905 |
| Knee revisions | 679 | 600 | 563 | 706 | 756 | 626 | 704 | 669 | 753 | 670 | 659 | 676 |

| | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| TKA | 5,343 | 4,437 | 3,867 | 5,627 | 6,127 | 4,513 | 4,031 | 5,824 |
| Partial knee | 955 | 760 | 699 | 1006 | 989 | 789 | 659 | 971 |
| Knee revisions | 797 | 665 | 682 | 800 | 861 | 745 | 707 | 821 |

Figure 4.11

## Kaplan Meier estimate of cumulative postoperative revision risk after total knee arthroplasty by time period

Time since operation, 2015–2023, all services, all diagnoses, follow-up extended to 31 May 2024

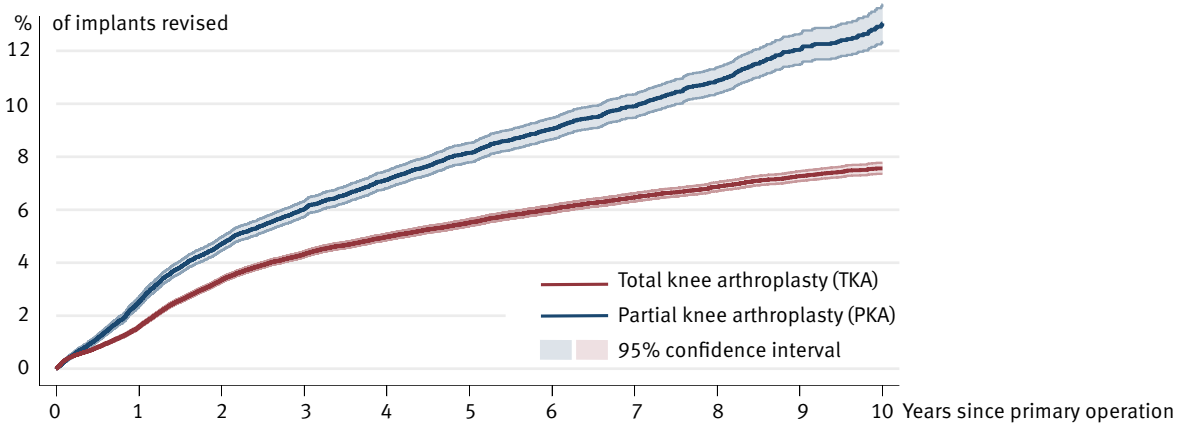



| Failure rate | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|---|---|
| 2015/2016 | **1.6** (1.5-1.8) | **3.5** (3.3-3.8) | **4.6** (4.4-4.9) | **5.3** (5.0-5.6) | **5.8** (5.5-6.1) | **6.3** (6.0-6.6) | **6.8** (6.5-7.1) | **7.2** (6.9-7.6) | **7.7** (7.4-8.1) |
| 2017/2018 | **1.7** (1.6-1.9) | **3.6** (3.4-3.9) | **4.6** (4.4-4.9) | **5.3** (5.0-5.5) | **5.8** (5.5-6.1) | **6.3** (6.0-6.6) | **6.6** (6.3-6.9) | | |
| 2019/2020 | **1.8** (1.6-1.9) | **3.5** (3.3-3.7) | **4.3** (4.1-4.6) | **4.9** (4.6-5.2) | **5.4** (5.1-5.7) | | | | |
| 2021/2022 | **1.6** (1.4-1.7) | **3.1** (2.9-3.4) | **4.3** (4.0-4.5) | | | | | | |
| 2023 | **1.2** (1.1-1.4) | | | | | | | | |

Figure 4.12

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

Time since operation, 2012–2023, all services, all diagnoses




| Failure rate | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| TKA | **1.6** (1.5-1.6) | **3.3** (3.2-3.4) | **4.3** (4.2-4.4) | **5.5** (5.4-5.6) | **6.0** (5.9-6.1) | **6.8** (6.7-7.0) | **7.3** (7.1-7.4) | **7.6** (7.4-7.8) | **8.0** (7.8-8.2) |
| PKA | **2.5** (2.3-2.7) | **4.7** (4.4-4.9) | **6.0** (5.7-6.3) | **8.1** (7.7-8.4) | **8.9** (8.6-9.3) | **10.8** (10.3-11.2) | **11.9** (11.4-12.4) | **12.9** (12.3-13.5) | **14.1** (13.4-14.9) |

| N at risk | 0 year | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|---|
| TKA | 182,927 | 159,115 | 133,451 | 113,347 | 78,242 | 63,350 | 37,286 | 25,611 | 15,743 | 6,715 |
| PKA | 33,459 | 29,176 | 24,726 | 21,223 | 14,299 | 11,645 | 7,034 | 5,008 | 3,161 | 1,364 |

### 4.3.2 Regional data, Cantons and Principality of Liechtenstein

The numbers of knee arthroplasties increased in most cantons, including the Principality of Liechtenstein, between 2021 to 2022, but there were considerable regional differences. Whereas in Geneva the growth rate was only 2.9%, TKA in Schwyz did increase by 30.5%. As cantons with larger populations like Zurich (13.5%) and Bern (15.7%) had considerable growth, this had an effect nationwide. Only Glarus and the Principality of Liechtenstein observed a decrease in numbers of knee arthroplasty **(Figure 4.8).**

It is interesting to note that no particular increase in TKA incidence is observed in Zurich, despite minimal case numbers being introduced in 2018, as such a measure may lead to less stringent application of indications. Indirect signs of widening indications for knee arthroplasty, such as increasing numbers in particularly young or particularly old patients, as had been observed in the USA, could also not be detected in the SIRIS dataset. The share of these extreme age groups did not change since 2018 **(Table 3.5).**

**Type of knee systems**

Of note is the fact that the knee replacement systems used varied significantly between hospitals and cantons, respectively regions. Traditionally, posterior stabilized (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 in Switzerland but seemed to be preferred in specific hospitals. **Figure 4.13** illustrates the variability of the different types of TKA used in Switzerland, and changes between the periods spanning 2018–2020 and 2021–2023, respectively.

**Bearing type**

The proportion of mobile-bearing polyethylene (PE) liner did rapidly decrease over the past six years, from 39.4% in 2018 to 18.7% in 2023 **(Figure 4.14).** However, the bearing type showed again a high regional variability **(Figure 4.15).** The reduction in the use of mobile-bearing implants also is not a general effect but differs considerably by region. In some cantons, the share of mobile bearings even increased (e.g., Uri, Jura, Ticino), comparing the periods 2018-2020 and 2021-2023 **(Figure 4.15).**

Figure 4.13

**Relative share of TKA procedures using CR, CS, PS, MP by Swiss Canton and Principality of Liechtenstein: comparing 2018–2020 with 2021–2023**

NB: 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.

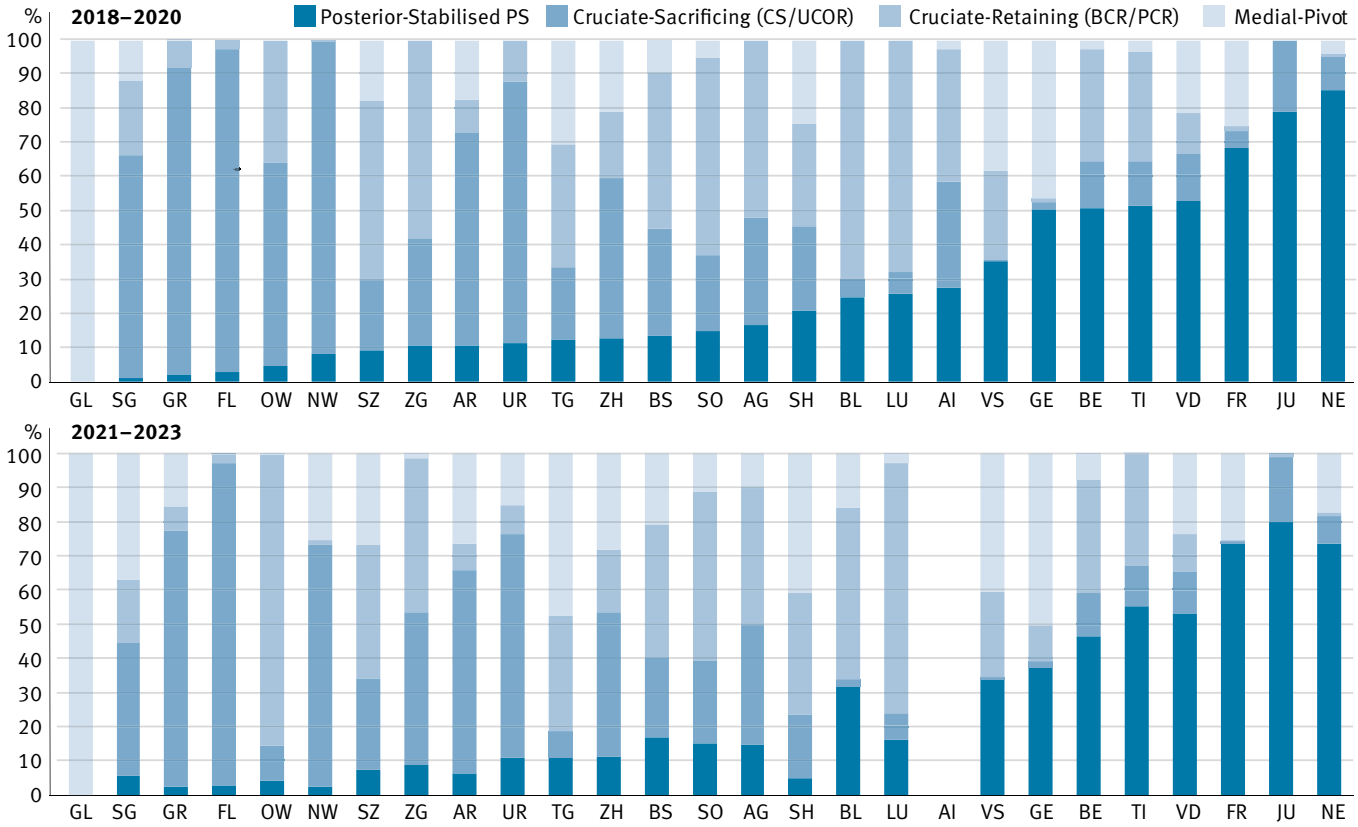
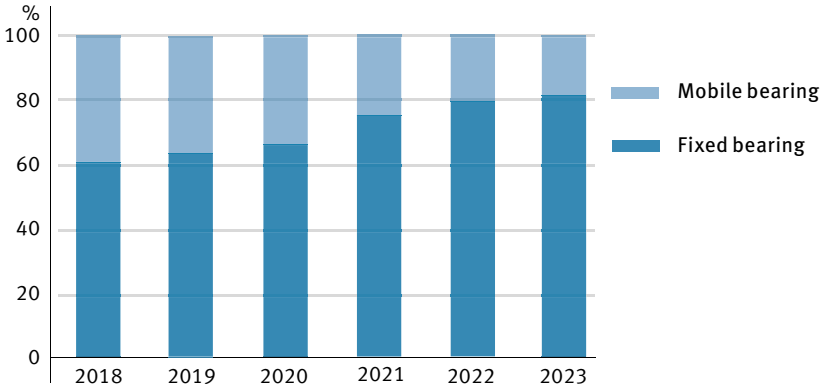



Figure 4.14

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

Percentage per year, all diagnoses.




| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| N | 13,138 | 13,691 | 13,505 | 16,211 | 18,888 | 20,074 | 95,507 |
| Mobile bearing | 39.4 | 36.5 | 34.0 | 25.1 | 20.9 | 18.7 | 27.8 |
| Fixed bearing | 60.6 | 63.5 | 66.0 | 74.9 | 79.1 | 81.3 | 72.2 |

**Patella resurfacing**

The patella was not resurfaced in 65.5% of the primary TKA performed between 2018 and 2023 **(Figure 4.16).** However, the resurfacing rate increased continuously since 2018, from 29.9% to 39.3% in 2023. As for the type of knee system or regarding the selection between fixed and mobile bearings, there were considerable differences between the cantons **(Figure 4.17).** As an example, patella resurfacing never occurred in Glarus since 2018. Some of these differences can be explained by the use of PS TKA, traditionally more popular

Figures 4.15

**Share of TKA procedures with mobile bearing by Swiss Canton and Principality of Liechtenstein: Comparing 2018–2020 with 2021–2023**

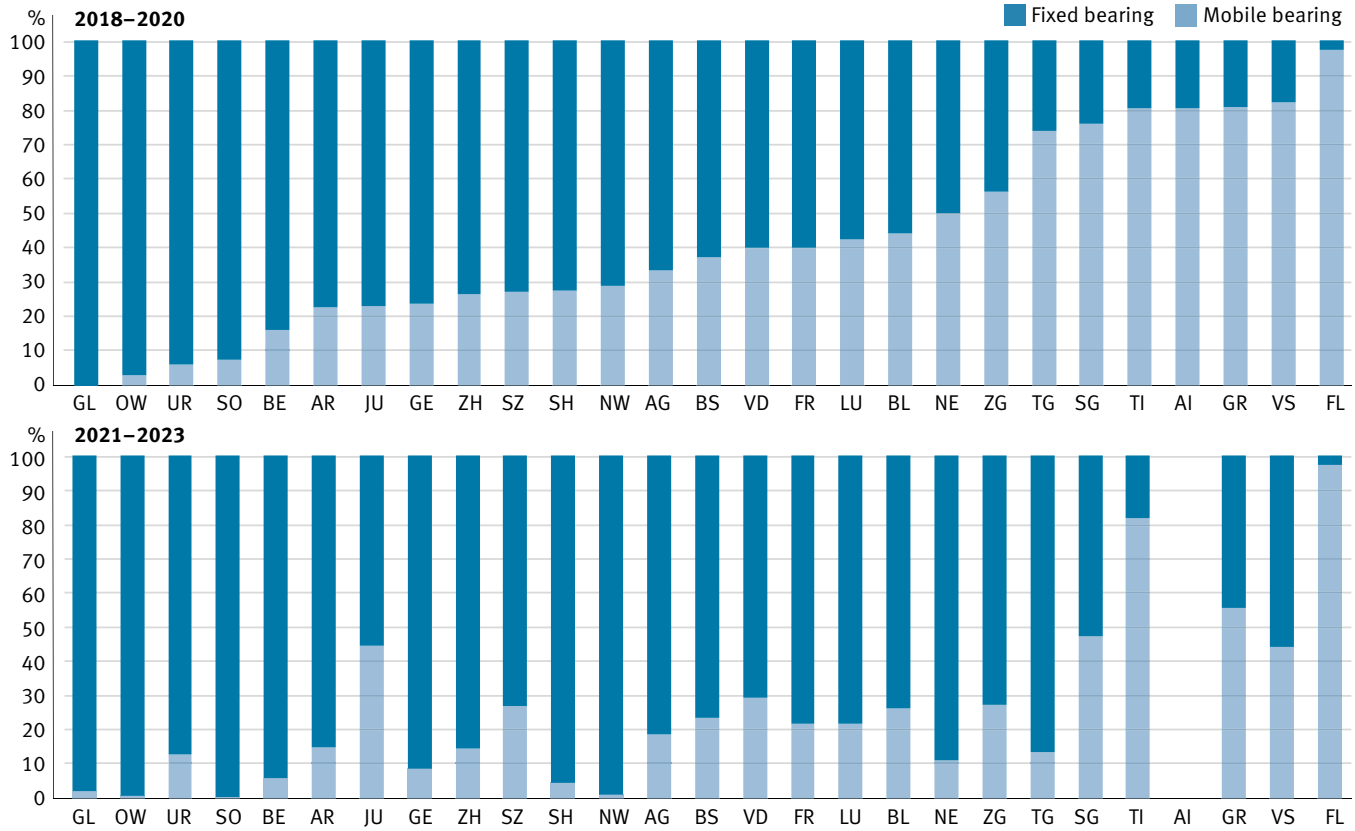
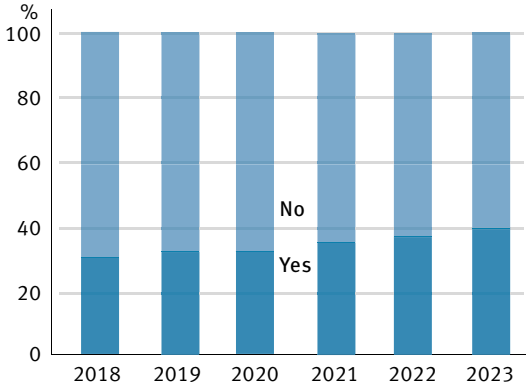



Figure 4.16

**Primary total knee arthroplasty: Patellar component**

Percentage per year, all diagnoses.

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| N | 14,707 | 15,521 | 15,437 | 16,681 | 19,273 | 20,495 | 102,114 |
| No | 70.0 | 67.9 | 68.2 | 65.0 | 63.2 | 60.7 | 65.5 |
| Yes | 29.9 | 32.0 | 31.8 | 35.0 | 36.7 | 39.3 | 34.5 |
| Status after patellectomy | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |

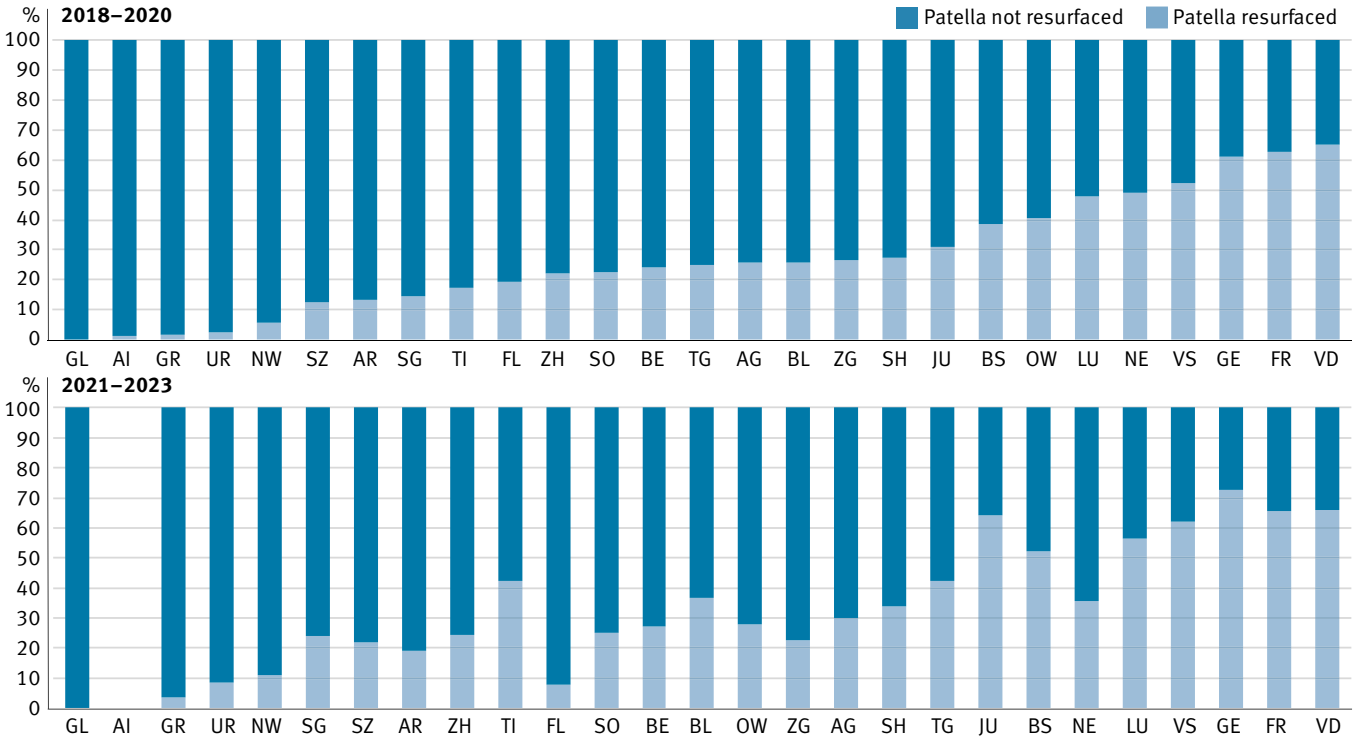


in the western, French-speaking part of Switzerland as well as in some specific centres, where primary resurfacing of the patella is recommended more often than in other designs. The continuous increase in primary patella resurfacing is thus not homogenous but underlies regional differences, correlated with the TKA system used and surgeon preferences. In many cantons, the resurfacing rate increased significantly from the period 2018–2020 to 2021–2023. Only in the Principality of Liechtenstein, the resurfacing rate decreased in the same period **(Figure 4.17).**

### 4.3.3 Data by hospitals

In 2023, 145 hospitals registered TKA, 127 PKA, and 135 revision arthroplasties of the knee. SIRIS has achieved a 100% participation rate since 2018 for primary TKA and PKA, as well as revision arthroplasty of the knee for institutions with relevant numbers. As SIRIS is highly dependent on data quality, such a deed merits congratulations of the participating surgeons. The median procedure figures per hospital **(Table 4.7)** showed ini-

Figure 4.17
**Share of TKA procedures with patella resurfacing by Swiss Canton and Principality of Liechtenstein: Comparing 2018–2020 with 2021–2023**



tially a relatively stable pattern between 2017 and 2021, but jumped upwards considerably in 2022 and maintained that growth rate in 2023.

**Table 4.8** highlights the distribution of case numbers within service size categories. The numbers of knee arthroplasties performed in Switzerland in the different services characterised by volume (yearly numbers of procedures ‹100, 100–199, 200–300, ›300) are illustrated in Table 4.1_G. The median annual number of primary TKA per hospital increased from 67 in 2015 to 111 in 2023, a clear increase in volume per unit. Simplifying the classification into centres with less than 200 and more than 200 interventions per year shows a concentration over time towards larger centres **(Figures 4.19).** This reflects not only a real caseload increase over time but may be induced by hospital mergers. In revision arthroplasty, the effect was less clear until 2017, perhaps because of smaller numbers.

Table 4.7

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

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| Primary arthroplasty of the knee (TKA) | N services | 151 | 148 | 146 | 145 | 145 | 144 |
| | M per service | 78 | 77 | 77 | 86 | 106 | 111 |
| Primary partial arthroplasty of the knee | N services | 129 | 127 | 128 | 127 | 127 | 126 |
| | M per service | 11 | 12 | 12 | 13 | 14 | 14.5 |
| Revision arthroplasty of the knee | N services | 134 | 133 | 130 | 134 | 135 | 135 |
| (TKA or partial) | M per service | 9 | 9 | 13 | 12 | 13 | 16 |

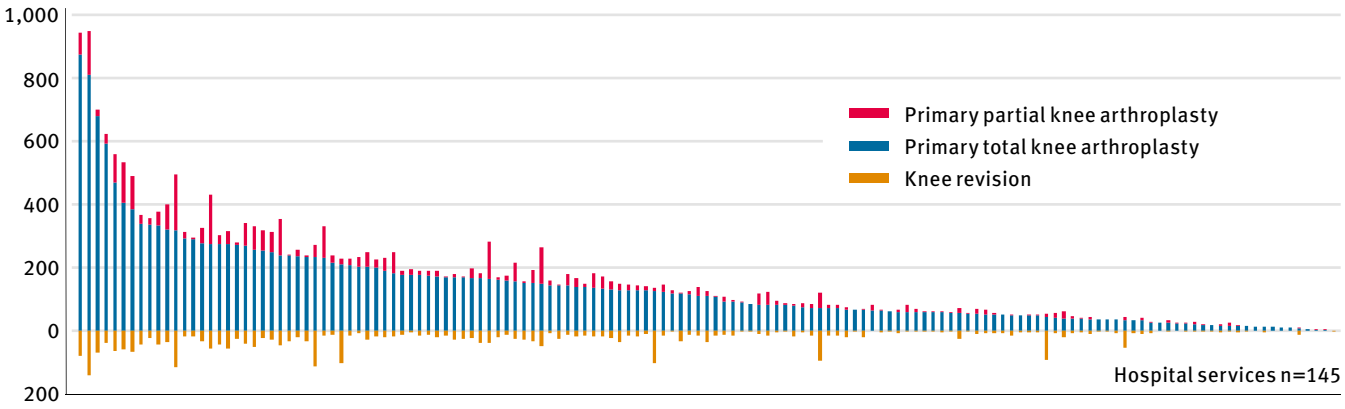
Table 4.8

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

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| ‹100 | N procedures/% | 3,590/**24.5** | 3,184/**20.5** | 2,721/**17.7** | 2,551/**15.4** | 2,699/**14.1** | 2,904/**14.2** |
| | N services | 90 | 81 | 78 | 72 | 65 | 66 |
| 100–199 | N procedures/% | 4,327/**29.5** | 4,523/**29.1** | 4,698/**30.5** | 4,778/**28.9** | 5,551/**28.9** | 5,235/**25.5** |
| | N services | 35 | 37 | 39 | 40 | 42 | 38 |
| 200–299 | N procedures/% | 3,273/**22.3** | 3,461/**22.3** | 3,240/**21.0** | 4,041/**24.4** | 3,452/**18.0** | 3,590/**17.5** |
| | N services | 16 | 17 | 16 | 19 | 18 | 17 |
| ›300 | N procedures/% | 3,480/**23.7** | 4,352/**28.0** | 4,754/**30.8** | 5,185/**31.3** | 7,493/**39.0** | 8,766/**42.8** |
| | N services | 9 | 12 | 13 | 14 | 20 | 23 |

Figure 4.18

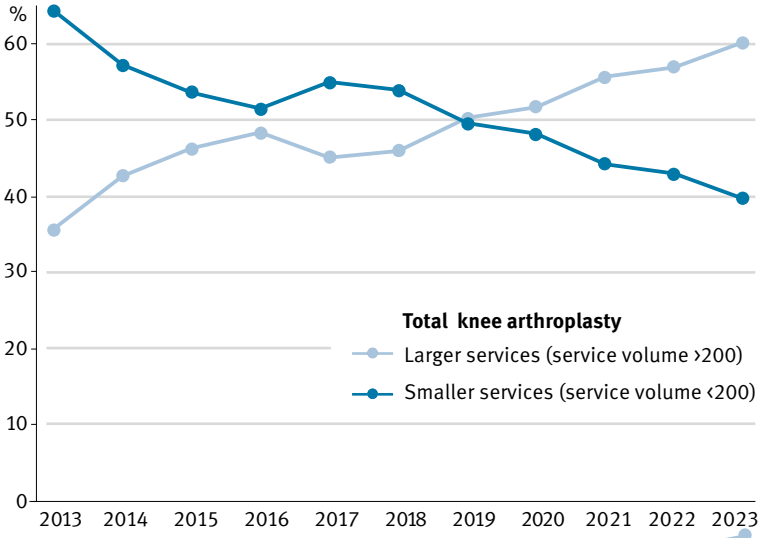
**Cases per hospital service 2023: Total and partial knee arthroplasty**

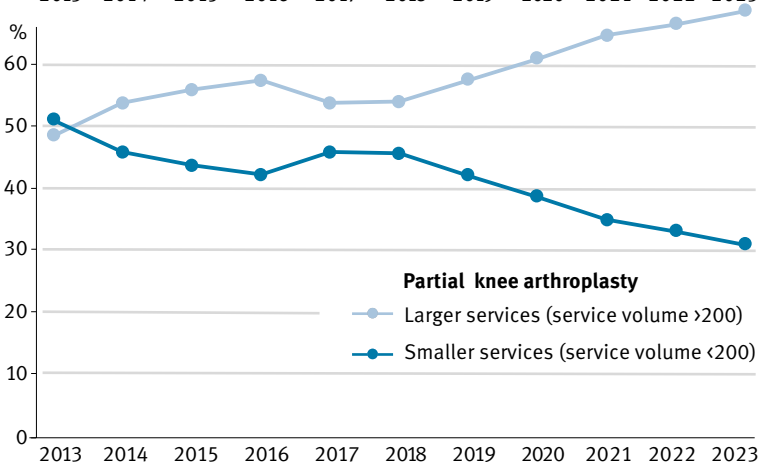


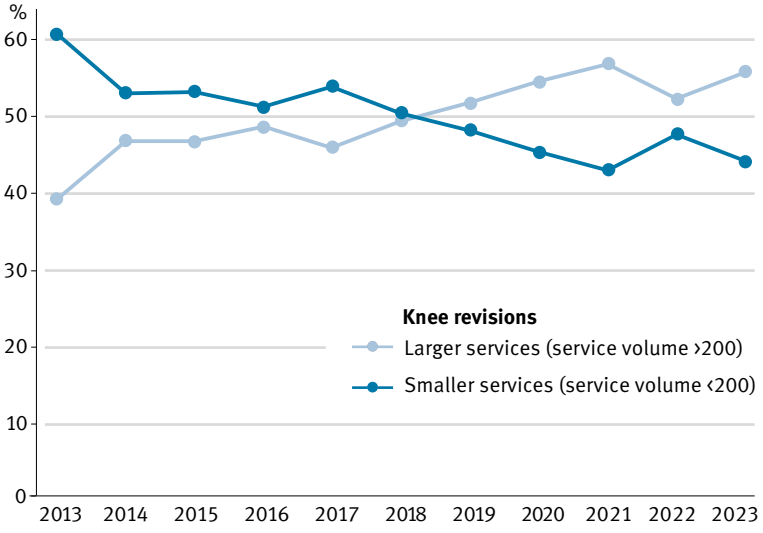
Figures 4.19

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

Service volume is defined as the sum of primary procedures per year




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 4.18).** Hospitals with more than 100 knee arthroplasties of all types per year performed 87.5% of the PKA between 2018 and 2023 **(Table 3.7).**

**Demography, type of OA**

Gender, 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 4.9).**

The most frequent indication for TKA had been classified as primary OA, representing 87.9% of the cases in the period 2018-2023 **(Table 3.5).** 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 52% and up to over 94% of the cases, indicating varying practice in coding of diagnosis **(Figure 4.20).** In units with a high share of secondary OA, a meniscectomy was indicated most frequently

Table 4.9

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

Calculations of hospital service volume based on primary hip surgeries in each included year (2018–2023).

| Hospital service volume | | ‹100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| **N** (2018–2023) | | **17,341** | **28,818** | **21,507** | **34,470** |
| Women [%] | | 59.7 | 59.1 | 60.2 | 58.9 |
| Mean age (SD) | All | 70.0 (9.7) | 70.0 (9.4) | 69.8 (9.5) | 69.3 (9.4) |
| | Women | 70.5 (9.7) | 70.6 (9.6) | 70.1 (9.6) | 69.8 (9.6) |
| | Men | 69.3 (9.6) | 69.1 (9.2) | 69.2 (9.4) | 68.5 (9.2) |
| Age group [%] | ‹45 | 0.5 | 0.4 | 0.5 | 0.5 |
| | 45–54 | 5.9 | 5.1 | 5.4 | 5.9 |
| | 55–64 | 22.8 | 24.0 | 24.0 | 25.5 |
| | 65–74 | 35.1 | 35.5 | 36.2 | 35.9 |
| | 75–84 | 30.5 | 30.2 | 29.2 | 28.3 |
| | 85+ | 5.2 | 4.8 | 4.8 | 3.9 |
| Diagnosis [%] | Primary OA | 88.6 | 88.9 | 88.5 | 86.3 |
| | Secondary OA | 11.4 | 11.1 | 11.5 | 13.7 |
| N unknown BMI (%) | | 2,576 (15) | 2,371 (8) | 1,702 (8) | 3,816 (11) |
| N known BMI | | 14,765 | 26,447 | 19,805 | 30,654 |
| Mean BMI (SD) | | 29.3 (5.6) | 29.6 (5.6) | 29.4 (5.6) | 29.0 (5.5) |
| BMI [%] | ‹18.5 | 0.6 | 0.5 | 0.6 | 0.5 |
| | 18.5–24.9 | 21.4 | 20.4 | 21.3 | 23.4 |
| | 25–29.9 | 38.4 | 37.7 | 37.6 | 39.0 |
| | 30–34.9 | 24.6 | 25.6 | 25.6 | 23.7 |
| | 35–39.9 | 10.7 | 11.0 | 10.2 | 9.5 |
| | 40+ | 4.4 | 4.8 | 4.7 | 3.9 |
| N unknown ASA (%) | | 785 (5) | 1,052 (4) | 963 (4) | 1,998 (6) |
| N known ASA | | 16,556 | 27,766 | 20,544 | 32,472 |
| ASA state [%] | ASA 1 | 7.3 | 7.0 | 6.4 | 8.1 |
| | ASA 2 | 61.6 | 63.7 | 62.0 | 62.5 |
| | ASA 3 | 30.5 | 28.9 | 31.0 | 29.0 |
| | ASA 4/5 | 0.6 | 0.5 | 0.5 | 0.3 |

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. The increasing share of secondary OA in some hospitals can partially be explained by the introduction of more coding options with the 2015 version of the CRF. Rates of secondary OA due to other causes also greatly varied among the high-volume centres, similar to proportions of post meniscectomy OA. A technical bias towards primary OA is possible, as this diagnosis is on top in the selection menu and thus possibly decreases the probability of selecting other alternatives mentioned below, 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 influencing revision rates, a benchmark established solely on arthroplasties performed for primary OA. A selection bias would lead to underestimation of revision rates, as secondary OA is known to be associated with higher revision rates, corresponding to more complex cases or cases with particular risks.

**Two-year revision rates**

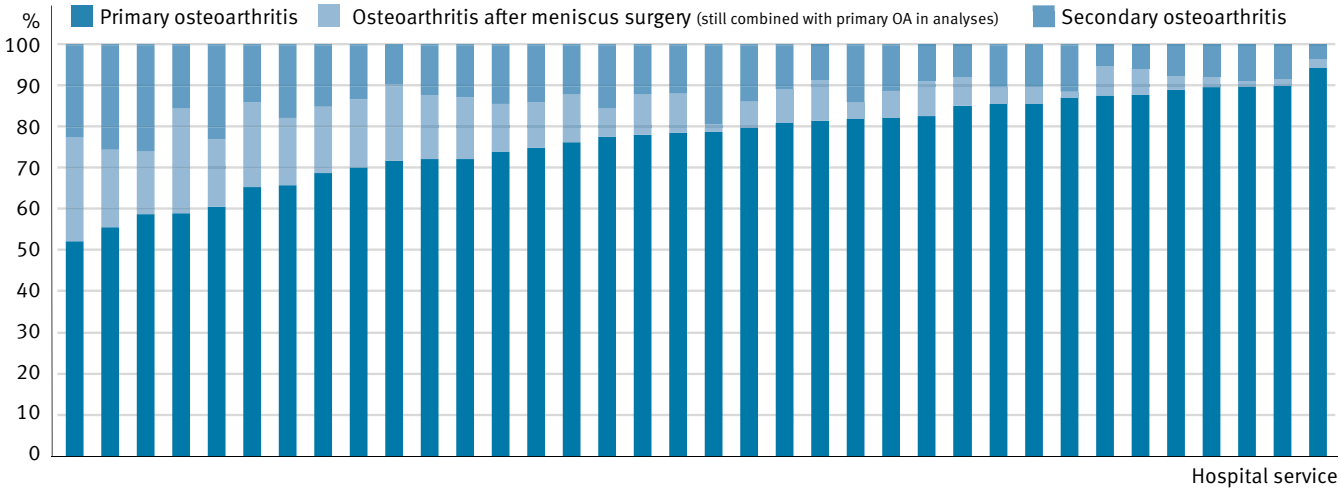
**Figures 4.21** shows funnel plots of risk-adjusted early revision rates, considering age, sex, BMI, ASA, and Charnley scores, if available, for TKA and PKA and revision TKA excluding isolated patella resurfacing alone. An additional implant, such as a secondary patella resurfacing or an additional PKA, also counts as a revision, by definition. Each dot represents a hospital service.

As revision rates improve with time **(Figure 4.11),** not only will the register average decrease but also the confidence interval will narrow. 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) can be identified for TKA than for PKA, which could not be expected as the early revision rate of PKA is clearly higher than for TKA and small errors end more often in early failures in PKA due to smaller implants exposed to higher stress forces.

When isolated secondary patella resurfacing is excluded, the spread of results becomes less pronounced, especially because of the reduced number of outliers. This implies that secondary patella resurfacing still played a prominent role as early revision after primary TKA **(Figure 4.21).**

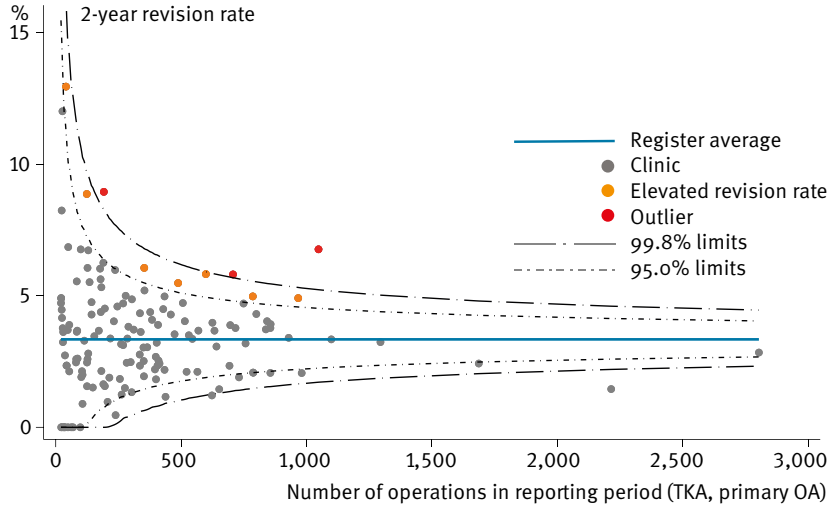
Figure 4.20

**Distributions of different diagnoses in hospitals >200 cases (2023)**

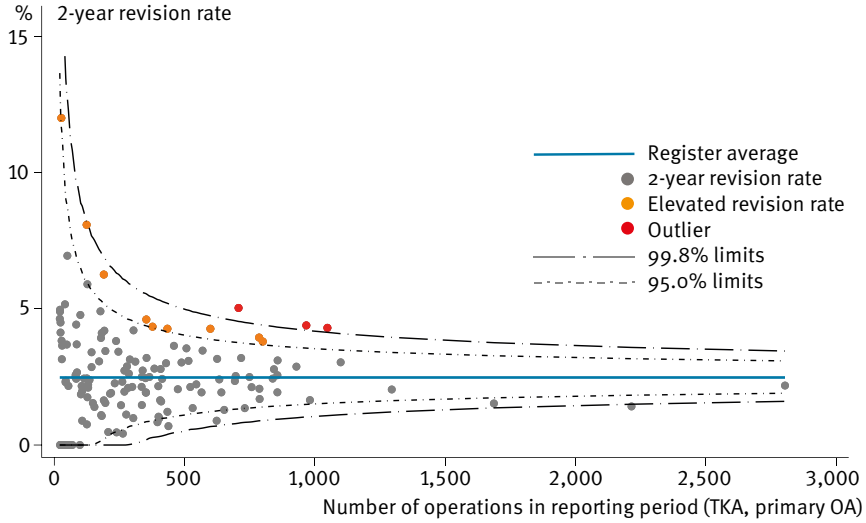


Figures 4.21

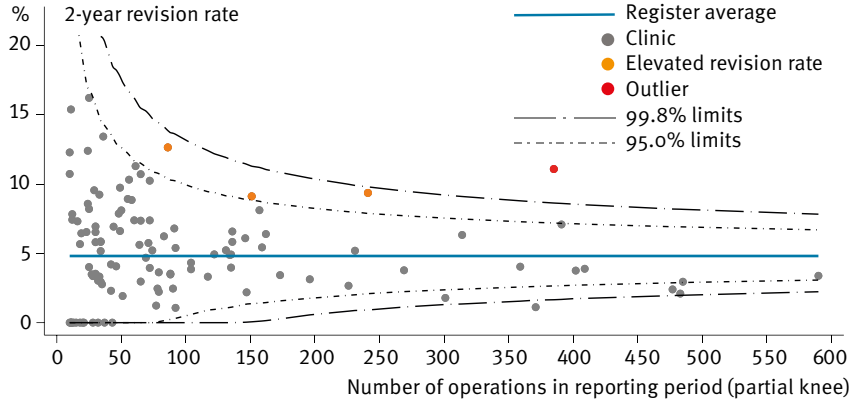
## Two-year revision rate of primary total knee arthroplasty by service*




## Total knee arthroplasty without isolated secondary patella resurfacing




## Two-year revision rate of partial knee arthroplasty by service*




### Interpretation of funnel plots

- The blue 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 performing better than the average
- Clinics above the 95% limit and below the 99.8% limit (orange dots) haveelevated 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).

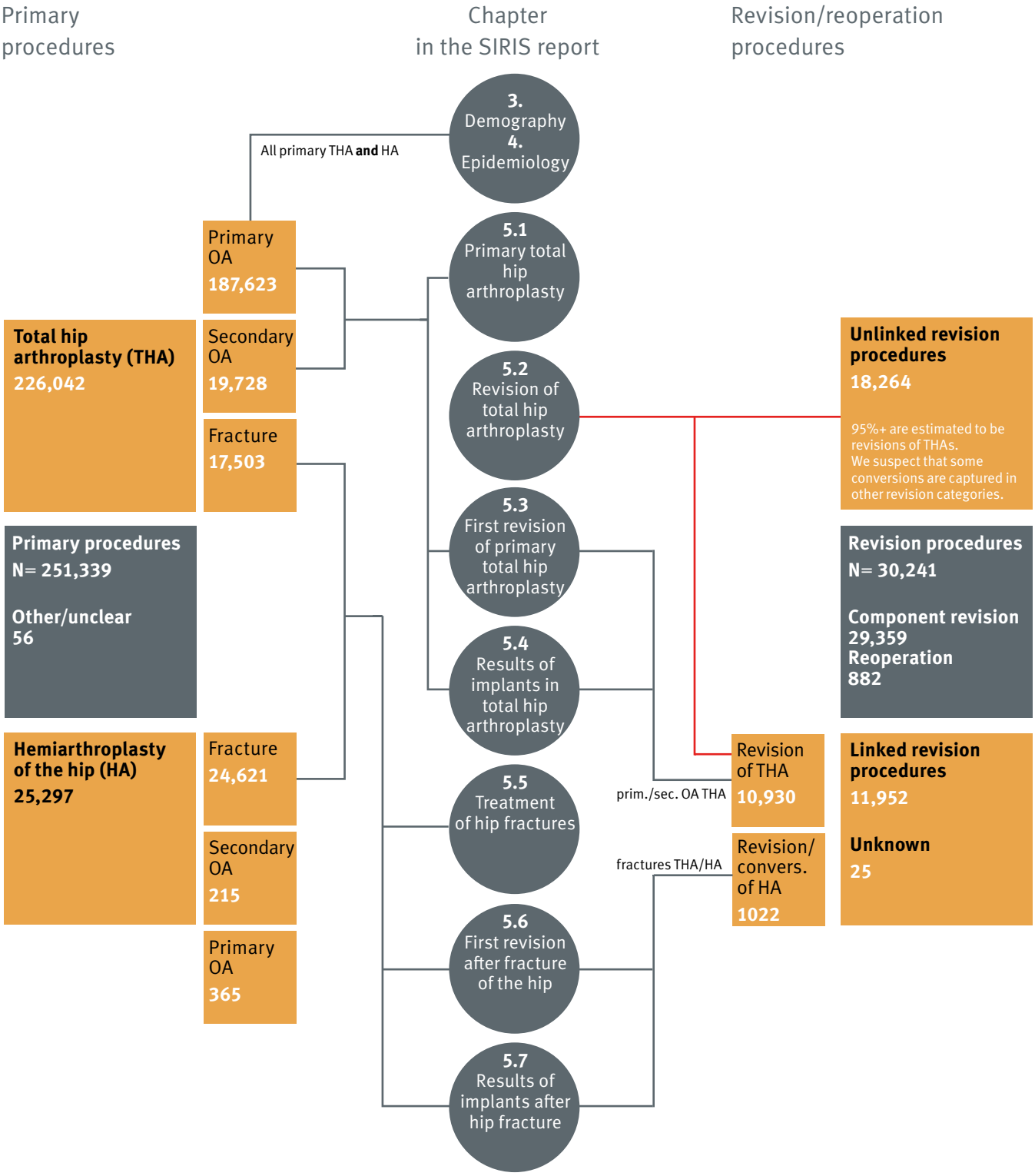
*Number of operations in the reporting period 01/2018–12/2021 (4-year moving average, follow-up to 12/2023)

TKA results restricted to patients with primary osteoarthritis (prim OA). Results are risk-adjusted for age, sex and BMI, ASA, Charnley Score if available

# Hip arthroplasty

# 5. Hip arthroplasty

## Overview of data structure



## Overview of types of analyses for determining revision rates

| Types of analysis / Report section | **Kaplan-Meier estimates** 2012–2023<br>**Adjusted for censoring events** | **2-year revision rates** (implants 2018–2021 with completed 2-year follow-up)<br>**Adjusted for censoring events** | **Funnel plots of 2-year hospital revision rates** (implants 2018–2021 with completed 2-year follow-up)<br>**Risk-adjusted and adjusted for censoring events** |
|---|---|---|---|
| **Hip overview** | All total hip arthroplasties (THA)<br><br>All hemi arthroplasties (HA) | | THA after primary osteo-arthritis (primary OA). **ANQ online reporting, above 99.8%= outlier status**<br><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><br>THA after fracture of the hip | HA for various subgroups<br><br>THA for various subgroups | |
| **Hip implants** (minimal number in group) | Uncemented stem-cup combinations, THA after primary OA (500+)<br><br>Hybrid fixation stem-cup combinations, THA after primary OA (500+)<br><br>Uncemented stem-cup combinations, THA after **secondary** OA (500+)<br><br>**Long-term evaluation 5–10 years: elevated revision rate or outlier** | Uncemented stem-cup combinations, THA after primary OA (50+)<br><br>Hybrid fixation stem-cup combinations, THA after primary OA (50+)<br><br>Uncemented stem-cup combinations, THA after **secondary** OA (50+)<br><br>Uncemented stem-cup combinations, THA after fracture OA (50+)<br><br>Hybrid fixation stem-cup combinations, THA after fracture (50+)<br><br>Cemented stem-head combinations, HA after fracture (50+)<br><br>**2-year evaluation (two times group average= outlier status)** | |

Online appendix for implants

## 5.1 Primary total hip arthroplasty

Until 31.12.2023, the total number of primary THA registered in SIRIS reached 226,042 cases **(Table 4.1).** The current 4-year moving window includes 129,981 implantations. The share of women (53.3%) and the mean age of the patients (69.2 years) remained constant throughout the current period of observation from 2018 to 2023.

Please consult Chapters 3 Demography and Chapter 4 Epidemiology for further details regarding incidence and demographic characteristics.

### Main diagnostic groups

The register categorises primary THA into three groups: THA for primary OA, for secondary OA and for the treatment of fractures, as the revisions rates differ significantly between the groups **(Table 5.1).** The latter group, behaving relevantly differently from the other groups, is considered more in detail in the section 5.8 Fractures of the hip.

### Type of hip prosthesis

In over 99% of cases a conventional THA was implanted in all three main diagnostic groups. Resurfacing of the hip has largely been abandoned in Switzerland, only 26 cases were treated this way in the past 5 years **(Table 5.1)**.

Table 5.1

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

| Main diagnostic group | | Primary OA | | Secondary OA | | Fracture | |
|---|---|---|---|---|---|---|---|
| N (2018–2023) | | N | % | N | % | N | % |
| Previous surgery | None | 103,067 | 96.9 | 10,031 | 84.8 | 10,321 | 89.6 |
| | Internal fixation femur | | | 702 | 5.9 | 901 | 7.8 |
| | Osteotomy femur | | | 454 | 3.8 | 49 | 0.4 |
| | Internal fixation acetabulum | | | 83 | 0.7 | 106 | 0.9 |
| | Osteotomy pelvis | | | 278 | 2.3 | 7 | 0.1 |
| | Arthrodesis | | | 6 | 0.1 | 3 | 0.0 |
| | Other previous surgery | 3,323 | 3.1 | 377 | 3.2 | 171 | 1.5 |
| Intervention | Total hip replacement (as entered on SIRIS form) | 106,191 | 99.8 | 11,778 | 99.5 | 11,429 | 99.2 |
| | Hip resurfacing | 24 | 0.0 | 2 | 0.0 | 0 | 0.0 |
| | Other (other cat. and free text entr. recog. as THA)*** | 175 | 0.2 | 54 | 0.5 | 88 | 0.8 |
| Approach | Anterior | 57,161 | 53.7 | 5,586 | 47.2 | 6,486 | 56.3 |
| | Anterolateral | 31491 | 29.6 | 3,808 | 32.2 | 2,800 | 24.3 |
| | Posterior | 13,746 | 12.9 | 1,581 | 13.4 | 1,383 | 12.0 |
| | Lateral | 3,546 | 3.3 | 613 | 5.2 | 641 | 5.6 |
| | Other approach | 446 | 0.4 | 246 | 2.1 | 207 | 1.8 |
| Fixation | All uncemented | 92,982 | 87.4 | 9,566 | 80.8 | 5,793 | 50.3 |
| | Hybrid* | 11758 | 11.1 | 1,563 | 13.2 | 4,667 | 40.5 |
| | All cemented | 1,004 | 0.9 | 355 | 3.0 | 661 | 5.7 |
| | Reverse hybrid** | 417 | 0.4 | 181 | 1.5 | 206 | 1.8 |
| | Reinforcement ring, femur uncemented | 82 | 0.1 | 65 | 0.5 | 50 | 0.4 |
| | Reinforcement ring, femur cemented | 147 | 0.1 | 104 | 0.9 | 140 | 1.2 |

| Main diagnostic group | | Primary OA | | Secondary OA | | Fracture | |
|---|---|---|---|---|---|---|---|
| N (2021–2023) | | N | % | N | % | N | % |
| Technology | Conventional | 36,792 | 65.8 | 4,113 | 63.1 | 3,877 | 57.9 |
| | Computer assisted cup | | | 76 | 1.2 | 32 | 0.5 |
| | Computer assisted stem | | | 84 | 1.3 | 16 | 0.2 |
| | Robotic assisted (image guided, CT based) | | | 54 | 0.8 | 10 | 0.1 |
| | Patient specific cutting blocks | | | 25 | 0.4 | 5 | 0.1 |
| | Intraoperative fluoroscopy/radiography | | | 2290 | 35.1 | 2,783 | 41.6 |
| Add. intervention | None | 53,914 | 96.4 | 5,729 | 87.9 | 5,813 | 86.8 |
| | Acetabular roof reconstruction | 641 | 1.1 | 177 | 2.7 | 73 | 1.1 |
| | Central osseous reconstruction | 474 | 0.8 | 147 | 2.2 | 127 | 1.9 |
| | Proximal femur osteotomy | 9 | 0.0 | 20 | 0.3 | 19 | 0.3 |
| | ORIF/CRIF acetabulum | 26 | 0.0 | 15 | 0.2 | 108 | 1.6 |
| | Cerclage femur | 378 | 0.7 | 170 | 2.6 | 357 | 5.3 |
| | ORIF/CRIF femur | 40 | 0.1 | 24 | 0.4 | 87 | 1.3 |
| | Augments | 11 | 0.0 | 13 | 0.2 | 9 | 0.1 |
| | Other | 587 | 1.0 | 346 | 5.3 | 303 | 4.5 |
| | **Total THA (multiple responses)** | **55,937** | | **6,520** | | **6,694** | |

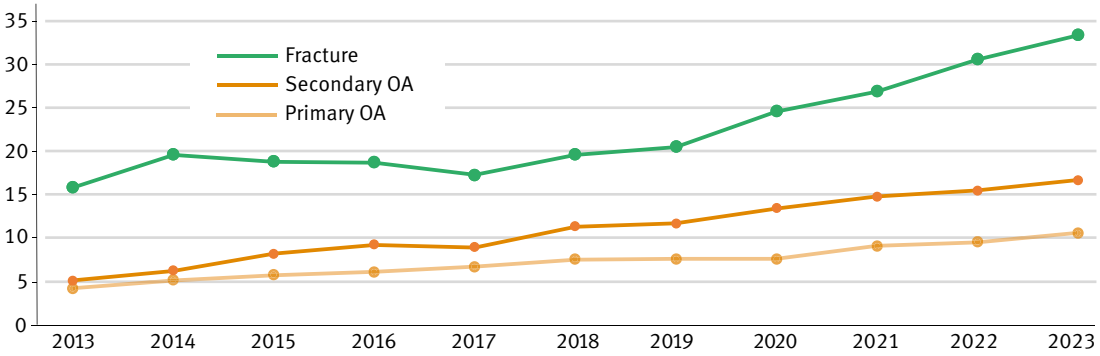
* acetabulum uncemented, femur cemented

** acetabulum cemented, femur uncemented

*** 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.

Figure 5.1

## Share of dual-mobility cups over time by main pathology

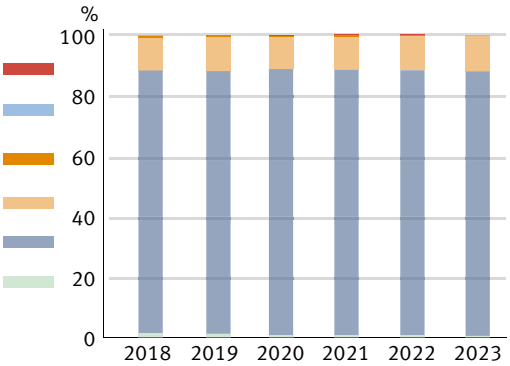



Tables 5.2

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

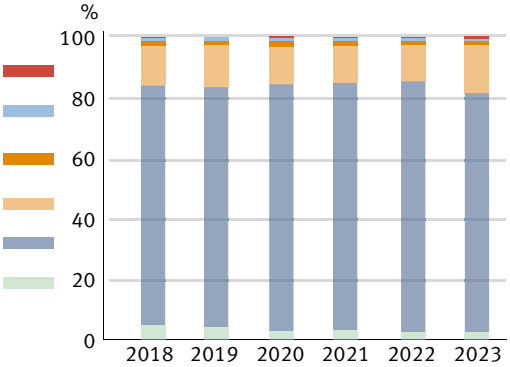
### Primary osteoarthritis

| 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | |
|---|---|---|---|---|---|---|
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | Reinforcement ring femur uncemented |
| 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | Reinforcement ring femur cemented |
| 0.5 | 0.4 | 0.4 | 0.5 | 0.3 | 0.2 | Reverse hybrid |
| 10.9 | 11.3 | 10.4 | 10.8 | 11.2 | 11.6 | Hybrid |
| 86.8 | 86.8 | 88.0 | 87.6 | 87.7 | 87.4 | All uncemented |
| 1.5 | 1.3 | 0.8 | 0.9 | 0.7 | 0.6 | All cemented |
| **16,369** | **16,802** | **16,643** | **17,802** | **18,930** | **19,844** | N |



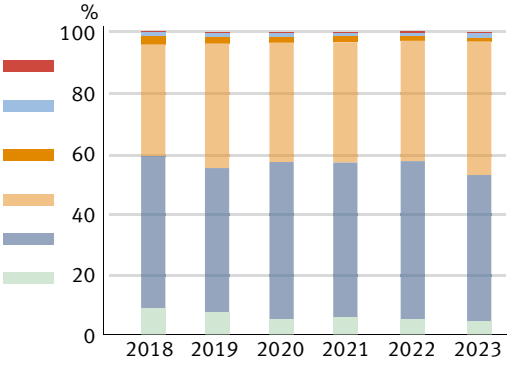

### Secondary osteoarthritis

| 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | |
|---|---|---|---|---|---|---|
| 0.6 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | Reinforcement ring femur uncemented |
| 0.7 | 1.0 | 1.2 | 0.8 | 0.8 | 0.9 | Reinforcement ring femur cemented |
| 1.9 | 1.6 | 1.7 | 1.7 | 1.3 | 1.2 | Reverse hybrid |
| 12.8 | 13.7 | 12.4 | 12.1 | 12.0 | 15.9 | Hybrid |
| 79.5 | 79.5 | 81.5 | 81.8 | 83.1 | 79.2 | All uncemented |
| 4.5 | 3.9 | 2.8 | 3.0 | 2.2 | 2.2 | All cemented |
| **1,650** | **1,715** | **1,844** | **2,059** | **2,254** | **2,312** | N |




### Fracture

| 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | |
|---|---|---|---|---|---|---|
| 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.4 | Reinforcement ring femur uncemented |
| 1.2 | 1.3 | 1.2 | 1.1 | 1.0 | 1.5 | Reinforcement ring femur cemented |
| 2.7 | 2.1 | 1.9 | 1.9 | 1.5 | 1.1 | Reverse hybrid |
| 37.1 | 41.2 | 39.5 | 39.8 | 39.8 | 44.2 | Hybrid |
| 50.1 | 47.6 | 52.1 | 51.1 | 52.3 | 48.3 | All uncemented |
| 8.7 | 7.4 | 4.9 | 5.7 | 5.0 | 4.4 | All cemented |
| **1,386** | **1,591** | **1,782** | **2,119** | **2,281** | **2,358** | N |



The use of dual mobility cups (DMC) has increased over the last 10 years, particularly in the fracture group, where 1/3 of the THA performed in 2023 were made using a DMC. The use of DMC also increased in primary and secondary OA, however at a much lower level **(Figure 5.1)**.

Fixation of the stem differed significantly among the main diagnostic groups but did not change significantly since 2018 **(Tables 5.2).** 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. 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 of the acetabulum needing advanced reconstruction techniques.

## 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 56.8% in 2022 plateauing at 56.3% in 2023. The anterolateral approach also has gained popularity, reaching 28.5% in 2023, while the lateral approach became less popular. The share of the posterior approach remained constant at approximately 13% **(Table 5.3).** However, there was a high variability of the distribution of approaches between the different geographic areas, as shown in **Figure 5.2.**

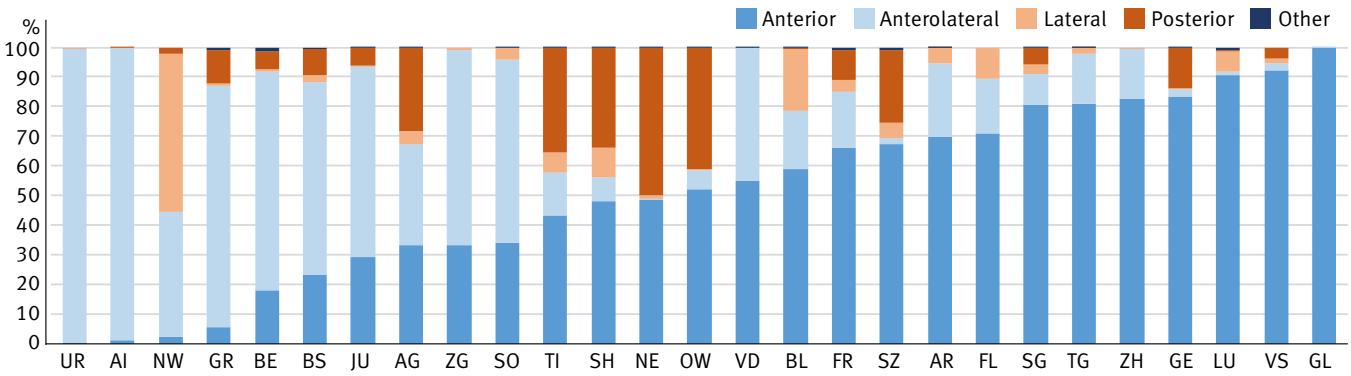
Table 5.3

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

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| Anterior | 49.1 | 50.5 | 52.8 | 55.7 | 56.8 | 56.3 | 53.7 |
| Anterolateral | 32.0 | 31.4 | 30.7 | 27.8 | 27.8 | 28.5 | 29.6 |
| Lateral | 4.9 | 4.6 | 3.7 | 2.9 | 2.5 | 1.9 | 3.3 |
| Posterior | 13.3 | 12.8 | 12.4 | 13.3 | 12.6 | 13.1 | 12.9 |
| Other approach | 0.6 | 0.7 | 0.5 | 0.3 | 0.2 | 0.2 | 0.4 |
| **Total [N]** | **16,369** | **16,802** | **16,643** | **17,802** | **18,930** | **19,844** | **106,390** |

Figure 5.2

**Relative share of total hip arthroplasty procedures using different surgical approaches by Swiss Canton and Principality of Liechtenstein (2018–2023)**



## Bearing

The bearing is one of the most important factors for wear and consequently implant survival. Improvement of bearing materials has led to a decrease in osteolysis and loosening, with decreasing requirements for revision consecutive. 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 2023, this combination was chosen in 67.3% of all primary THA for primary OA **(Table 5.4).** Metal on conventional PE (MoCPE) continued to have a very low share, essentially unchanged around 1.6% over the years. Ceramised metal (CM) heads were used in 6.9%, most frequently in combination with XLPE. Interestingly its use was independent of age. Probably because it is used only by few centers. The second most used bearing was CoC, accounting for 14.0% of the primary THA in 2023. However, its use was slowly declining over the years. It was used most often in patients ‹45 years of age, where it was chosen in 25.08% **(Table 5.5).** However, even in patients ›85 years of age 69.8% received XLPE cups, more often combined with a ceramic head.

**Correction of polyethylene classification 2024**

The classification of polyethylene in the previous reports had attempted to separate highly cross-linked polyethylene from all other variants, thereby leaving certain materials that were described by the manufacturers as moderately cross-linked grouped with conventional UHMWPE. However, this distinction, which relies on inconsistent definitions of the degree and nature of cross-linking, cannot be justified any longer and therefore SIRIS now classifies all polyethylene liners as either “conventional polyethylene” (CPE) or “cross-linked polyethylene” (XLPE). The definition follows other registries (e.g. AOANJRR: “XLPE is classified as ultra-high-molecular-weight polyethylene that has been irradiated with high-dose (≥ 50 kGy) gamma or electron beam radiation.”The abbreviation XLPE is used generically, despite also having been branded for a specific product by one manufacturer (Smith&Nephew). While the definition may be perceived as confusing, it is in fact very simple, as irradiation doses below 50 kGy are used solely for sterilisation purposes, not for cross-linking.

Table 5.4

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

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| Metal on conventional polyethylene (MoCPE) | 1.9 | 1.7 | 1.5 | 1.9 | 1.3 | 1.5 | 1.6 |
| Ceramic on conventional polyethylene (CoCPE) | 4.5 | 4.2 | 3.9 | 4.6 | 4.8 | 5.7 | 4.6 |
| Metal on cross-linked polyethylene (MoXLPE) | 11.9 | 11.2 | 9.6 | 8.8 | 7.7 | 6.7 | 9.2 |
| Ceramic on cross-linked polyethylene (CoXLPE) | 60.0 | 60.4 | 62.7 | 64.1 | 66.6 | 67.3 | 63.7 |
| Metal on metal (MoM) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ceramic on ceramic (CoC) | 14.8 | 15.2 | 14.9 | 14.2 | 12.9 | 12.2 | 14.0 |
| Ceramicised metal on conventional polyethylene (CMoCPE) | 0.3 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Ceramicised metal on cross-linked polyethylene (CMoXLPE) | 6.7 | 6.8 | 7.1 | 6.2 | 6.4 | 6.3 | 6.6 |
| Other | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| N (bearing surface known) | 16,098 | 16,410 | 16,371 | 17,512 | 18,538 | 19,109 | 104,038 |
| N (bearing surface unknown) | 271 | 392 | 272 | 290 | 392 | 735 | 2,352 |

* Femoral heads and acetabular inserts/monobloc cups

Table 5.5

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

| | <45 | 45–54 | 55–64 | 65–74 | 75–84 | 85+ | All |
|---|---|---|---|---|---|---|---|
| Metal on conventional polyethylene (MoCPE) | 0.0 | 0.2 | 0.3 | 0.8 | 2.9 | 7.5 | 1.6 |
| Ceramic on conventional polyethylene (CoCPE) | 1.3 | 1.3 | 2.0 | 4.1 | 7.5 | 10.1 | 4.6 |
| Metal on cross-linked polyethylene (MoXLPE) | 5.2 | 5.9 | 6.6 | 8.5 | 11.6 | 17.2 | 9.2 |
| Ceramic on cross-linked polyethylene (CoXLPE) | 62.8 | 63.7 | 66.4 | 65.3 | 62.0 | 52.6 | 63.7 |
| Metal on metal (MoM) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ceramic on ceramic (CoC) | 25.08 | 21.66 | 17.43 | 13.90 | 9.79 | 7.26 | 13.96 |
| Ceramicised metal on conventional polyethylene (CMoCPE) | 0.00 | 0.04 | 0.08 | 0.16 | 0.54 | 1.04 | 0.29 |
| Ceramicised metal on cross-linked polyethylene (CMoXLPE) | 5.58 | 7.17 | 7.21 | 7.19 | 5.74 | 4.29 | 6.58 |
| Other | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| N (bearing surface known) | 1,810 | 8,379 | 23,584 | 34,65 | 29,424 | 6,277 | 104,039 |
| N (bearing surface unknown)** | 55 | 136 | 510 | 730 | 721 | 199 | 2,351 |

* Femoral heads and acetabular inserts/monobloc cups ** Please note that age is missing in 6 cases

## 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 still received cementless implants in 58.5% **(Table 5.6).** Female patients received significantly more often cemented stems than male patients **(Table 5.7).**

Table 5.6
**Primary total hip arthroplasty: Fixation methods in primary osteoarthritis by age* (in %)**

| | <45 | 45–54 | 55–64 | 65–74 | 75–84 | 85+ | All |
|---|---|---|---|---|---|---|---|
| All cemented | 0.3 | 0.2 | 0.2 | 0.6 | 1.5 | 4.2 | 0.9 |
| All uncemented | 97.0 | 97.4 | 96.2 | 91.2 | 78.6 | 58.5 | 87.4 |
| Hybrid** | 1.7 | 1.9 | 3.1 | 7.8 | 19.1 | 35.6 | 11.1 |
| Reverse hybrid*** | 0.9 | 0.3 | 0.3 | 0.3 | 0.5 | 1.1 | 0.4 |
| Reinforcement ring, femur cemented | 0.00 | 0.09 | 0.10 | 0.08 | 0.19 | 0.48 | 0.14 |
| Reinforcement ring, femur uncemented | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 |
| N | 1,865 | 8,515 | 24,094 | 35,295 | 30,145 | 6,476 | 106,390 |

* Please note that age is missing in 6 cases
** acetabulum uncemented, femur cemented
*** acetabulum cemented, femur uncemented

Table 5.7
**Primary total hip arthroplasty: Fixation methods in primary osteoarthritis by gender (in %)**

| | Women | Men | All |
|---|---|---|---|
| All cemented | 1.3 | 0.6 | 0.9 |
| All uncemented | 82.6 | 92.5 | 87.4 |
| Hybrid* | 15.3 | 6.5 | 11.1 |
| Reverse hybrid** | 0.5 | 0.2 | 0.4 |
| Reinforcement ring, femur cemented | 0.20 | 0.07 | 0.14 |
| Reinforcement ring, femur uncemented | 0.1 | 0.1 | 0.1 |
| N | 55,017 | 51,373 | 106,390 |

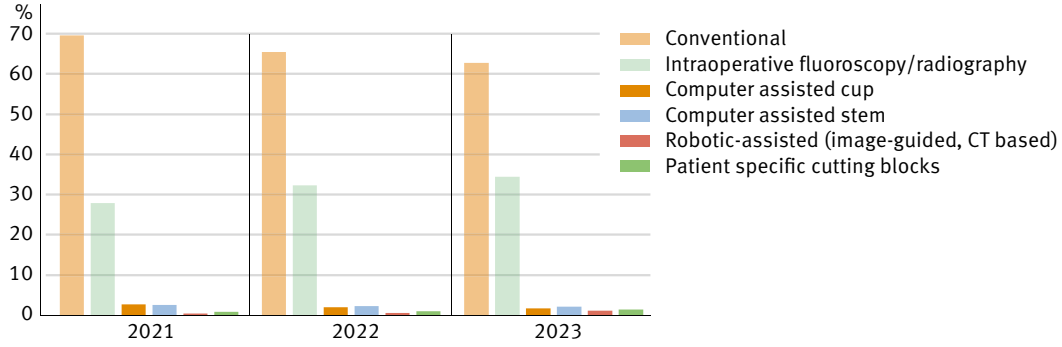
* acetabulum uncemented, femur cemented
** acetabulum cemented, femur uncemented

## Technology

Navigation, robotics or patient specific instruments (PSI) are not widely used in THA what is observed in Switzerland, contrary to knee arthroplasty. Such aids were used in about 6% of all cases only. On the other hand, intraoperative fluoroscopy was reported to be used in about one third of all cases. The use of fluoroscopy was slightly increasing over the last three years **(Figure 5.3).**

Figure 5.3

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




| Technology [%] | 2021 | 2022 | 2023 | 2021–2023 |
|---|---|---|---|---|
| Conventional | 69.6 | 65.5 | 62.7 | 65.8 |
| Intraoperative fluoroscopy/radiography | 27.9 | 32.2 | 34.4 | 31.7 |
| Computer assisted cup | 2.6 | 2.0 | 1.7 | 2.1 |
| Computer assisted stem | 2.6 | 2.2 | 2.1 | 2.3 |
| Robotic-assisted (image guided, CT based) | 0.4 | 0.6 | 1.1 | 0.7 |
| Patient specific cutting blocks | 0.8 | 1.0 | 1.4 | 1.1 |
| N | 17,163 | 18,930 | 19,844 | 55,937 |

Multiple responses possible (percentages do not sum to 100)

## 5.2 Revision of total hip arthroplasty, implanted before 2012

SIRIS has been recording all revision procedures since 2012, irrespective of whether it was the first or any subsequent revision. Unlinked revisions are procedures where the primary intervention is not documented in SIRIS. This includes hip arthroplasties performed before implementation of the registry in 2012, as well as revisions of later arthroplasties not registered within SIRIS. The share of unlinked revisions steadily decreased from 80.8% in 2013 to 46.3% **(Table 4.1, p.32).** In 2023, a total of 2,904 revisions were carried out, of which 1,306 were unlinked **(Table 5.8).** The overall revision burden in 2023 was approximately 11%.

Table 5.8
**Revision* of total hip arthroplasty (unlinked): Baseline patient characteristics by year**

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| N | | **1,534** | **1,488** | **1,411** | **1,273** | **1,269** | **1,306** | **8,281** |
| Women [%] | | 49.5 | 50.8 | 45.8 | 51.6 | 49.6 | 47.7 | 49.2 |
| Mean age (SD) | All | 74.0 (11.5) | 74.4 (10.8) | 73.9 (11.8) | 75.1 (11.5) | 76.3 (11.2) | 76.6 (11.0) | 75.0 (11.3) |
| | Women | 75.2 (11.7) | 75.5 (10.5) | 76.2 (11.1) | 75.9 (11.6) | 77.5 (10.8) | 78.1 (10.7) | 76.3 (11.1) |
| | Men | 72.8 (11.1) | 73.2 (10.9) | 71.9 (11.9) | 74.2 (11.3) | 75.2 (11.5) | 75.2 (11.0) | 73.7 (11.4) |
| Age group [%] | ‹45 | 0.9 | 0.9 | 1.8 | 1.2 | 1.1 | 0.5 | 1.1 |
| | 45–55 | 5.8 | 4.0 | 4.7 | 4.7 | 3.5 | 4.0 | 4.5 |
| | 55–65 | 13.0 | 14.2 | 13.1 | 11.0 | 10.1 | 10.3 | 12.1 |
| | 65–75 | 27.8 | 26.3 | 26.1 | 25.5 | 21.0 | 21.2 | 24.8 |
| | 75–85 | 34.8 | 36.4 | 36.1 | 35.9 | 38.9 | 38.3 | 36.7 |
| | 85+ | 17.6 | 18.2 | 18.1 | 21.7 | 25.5 | 25.7 | 20.9 |
| N unknown BMI (%) | | 289 (19) | 291 (20) | 210 (15) | 133 (10) | 107 (8) | 111 (8) | 1,141 (14) |
| N known BMI | | 1,245 | 1,197 | 1,201 | 1,140 | 1,162 | 1,195 | 7,140 |
| Mean BMI (SD) | | 26.7 (5.2) | 26.8 (5.4) | 26.9 (5.4) | 26.6 (5.5) | 26.2 (5.1) | 26.6 (5.6) | 26.6 (5.4) |
| BMI [%] | ‹18.5 | 2.4 | 2.4 | 2.4 | 2.5 | 2.8 | 3.6 | 2.7 |
| | 18.5–24.9 | 37.8 | 41.0 | 37.6 | 42.3 | 42.1 | 39.6 | 40.0 |
| | 25–29.9 | 38.2 | 34.1 | 36.9 | 32.8 | 36.3 | 33.7 | 35.4 |
| | 30–34.9 | 14.4 | 14.6 | 16.0 | 14.8 | 12.9 | 15.8 | 14.8 |
| | 35–39.9 | 5.2 | 5.8 | 5.0 | 5.5 | 4.5 | 5.2 | 5.2 |
| | 40+ | 1.9 | 2.0 | 2.1 | 2.0 | 1.4 | 2.1 | 1.9 |
| N unknown ASA (%) | | 150 (10) | 156 (10) | 120 (9) | 53 (4) | 39 (3) | 30 (2) | 548 (7) |
| N known ASA | | 1,384 | 1,332 | 1,291 | 1,220 | 1,230 | 1,276 | 7,733 |
| Morbidity state | ASA 1 | 6.2 | 3.7 | 3.6 | 3.9 | 2.4 | 2.5 | 3.7 |
| [%] | ASA 2 | 43.3 | 42.7 | 44.1 | 39.0 | 36.3 | 35.9 | 40.3 |
| | ASA 3 | 47.9 | 49.0 | 48.3 | 52.0 | 54.6 | 54.1 | 50.9 |
| | ASA 4/5 | 2.6 | 4.6 | 4.0 | 5.2 | 6.7 | 7.5 | 5.1 |

* includes a small proportion of reoperations that are not counted as component revisions in the evaluative parts of this report

## 5.3 First revision of primary total hip arthroplasty within two years

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 11 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 01.01.2018 and 31.12.2021. For long-term outcomes, cumulative revision rates were calculated using KM survival estimations.

### Incidence and demography

The current 4-year moving window included 82,000 documented primary THA, of which 67,616 had been made for primary OA, 7,268 for secondary OA, and 6,878 for the treatment of fractures. A total of 2,346 of these THA were revised within 2 years, corresponding to an overall revision rate of 2.9% (CI 2.8 – 3.0%). For primary OA, the 2-year revision rate was 2.5% (CI 2.4 – 2.7%), whereas for secondary OA it was 3.9% (CI 3.5 – 4.4%) and for fractures 5.2% (CI 4.7 – 5.7%), each significantly different from the others **(Table 5.9).**

The lowest 2-year revision rate (2.1%) was observed in the age group 55-64 years old. The highest revision rates were observed in patients ‹55 and in patients ›75 years of age.

Table 5.9

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| | | Primary | Revised within 24 months | | | |
|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | |
| | | N at risk* | N | %** | lower | upper |
| Overall (moving average) | | 82,000 | 2346 | 2.9 | 2.8 | 3.0 |
| Diagnosis | Primary OA | 67,616 | 1708 | 2.5 | 2.4 | 2.7 |
| | Secondary OA | 7,268 | 282 | 3.9 | 3.5 | 4.4 |
| | Fracture | 6,878 | 340 | 5.2 | 4.7 | 5.7 |
| Overall Primary OA | | 67,616 | 1708 | 2.5 | 2.4 | 2.7 |
| Gender | Women | 34,886 | 890 | 2.6 | 2.4 | 2.7 |
| | Men | 32,730 | 818 | 2.5 | 2.4 | 2.7 |
| Age group | ‹55 | 6,908 | 199 | 2.9 | 2.5 | 3.3 |
| | 55–64 | 15,115 | 320 | 2.1 | 1.9 | 2.4 |
| | 65–74 | 22,610 | 544 | 2.4 | 2.2 | 2.6 |
| | 75–84 | 18,846 | 528 | 2.8 | 2.6 | 3.1 |
| | 85+ | 4,137 | 117 | 2.9 | 2.4 | 3.4 |
| BMI group | ‹18.5 | 937 | 16 | 1.7 | 1.1 | 2.8 |
| | 18.5–24.9 | 19,956 | 399 | 2.0 | 1.8 | 2.2 |
| | 25–29.9 | 23,338 | 534 | 2.3 | 2.1 | 2.5 |
| | 30–34.9 | 10,719 | 327 | 3.1 | 2.8 | 3.4 |
| | 35–39.9 | 3,239 | 139 | 4.3 | 3.7 | 5.1 |
| | 40+ | 1,076 | 58 | 5.4 | 4.2 | 7.0 |
| | Unknown | 8,351 | 235 | 2.8 | 2.5 | 3.2 |
| Morbidity | ASA 1 | 7,626 | 127 | 1.7 | 1.4 | 2.0 |
| state | ASA 2 | 38,679 | 888 | 2.3 | 2.2 | 2.5 |
| | ASA 3 | 16,566 | 561 | 3.4 | 3.2 | 3.7 |
| | ASA 4/5 | 396 | 8 | 2.0 | 1.0 | 4.0 |
| | Unknown | 4,349 | 124 | 2.9 | 2.4 | 3.4 |

* 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

The most frequent cause of early first revision of primary THA for primary OA was infection (27.9%), followed by periprosthetic fracture (18.9%), dislocation (16.7%), and femoral loosening (16.5%) **(Table 5.10).** Approximately one-sixth of all revisions (15%) were undertaken for malposition of either acetabular or femoral components.

## Type of revision surgery

During the moving period of interest, there were in total 1,708 first revisions. The spectrum reached from exchange of the head or the inlay only to complete exchange of all components (13.0%) **(Table 5.11).** The most frequently performed operation was the exchange of the femoral component only (23.8%). The exchange of the acetabular component as isolated procedure was performed in 14.7%. There were 42 (2.5%) component reimplantations after Girdlestone or spacer implantation registered as first revision, despite no previous component removal being registered. Obviously,

Table 5.10

### Reason for early first revision* of primary total hip arthroplasty

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

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

| | N | % |
|---|---|---|
| Infection | 477 | 27.9 |
| Periprosthetic fracture | 322 | 18.9 |
| Dislocation | 286 | 16.7 |
| Loosening femoral | 282 | 16.5 |
| Position/orientation of cup | 139 | 8.1 |
| Loosening acetabular | 131 | 7.7 |
| Position/orientation of stem | 118 | 6.9 |
| Spacer | 16 | 0.9 |
| Implant failure | 13 | 0.8 |
| Impingement | 13 | 0.8 |
| Wear | 12 | 0.7 |
| Trochanter pathology | 11 | 0.6 |
| Acetabular protrusion | 10 | 0.6 |
| Osteolysis FE | 8 | 0.5 |
| Osteolysis AC | 4 | 0.2 |
| Squeaking | 1 | 0.1 |
| Other | 197 | 11.5 |
| **Total 2018–2023** | **2,040** | |

* Early first revisions are those occurring within 2 years of the primary arthroplasty

Table 5.11

### Type of early first revision* of total hip arthroplasty

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| | N | % |
|---|---|---|
| Exchange acetabular and femoral components | 222 | 13.0 |
| Exchange acetabular component and head | 251 | 14.7 |
| Exchange femoral component | 407 | 23.8 |
| Exchange head and inlay | 269 | 15.7 |
| Exchange acetabular component | 80 | 4.7 |
| Exchange femoral component and inlay | 106 | 6.2 |
| Component reimplantation (after spacer or Girdlestone) | 42 | 2.5 |
| Exchange head | 178 | 10.4 |
| Component removal, spacer implantation | 34 | 2.0 |
| Girdlestone | 16 | 0.9 |
| Exchange femoral component, inlay and osteosynthesis | 26 | 1.5 |
| Exchange inlay | 22 | 1.3 |
| Other intervention | 55 | 3.2 |
| **Total 2018–2023** | **1,708** | **100.0** |

* Early first revisions are those occurring within 2 years of the primary arthroplasty

these were not first revisions but appeared as first revisions because the first revision after THA (spacer implantation, Girdlestone) was not documented. The registry does not correct this faulty entry, as it documents at least that there was a revision performed. Surgeons are invited to document all the revisions performed, and to carefully chose among the options available during data entry to avoid such mistakes.

### Implants and fixation

Three different situations of early first revision were analysed more in detail, considering the type of fixation and whether primary or revision implants were used in relation to age at revision. Revision of both the acetabular and the femoral implants, femoral revision only, and component reimplantation after spacer/Girdlestone procedures. The distribution of implants used differed among these three revision situations **(Table 5.12)**. Overall, primary uncemented stems (including uncemented short stems) were used in 40% of all revisions, cemented primary stems in 26% and uncemented revision stems in 32%. Cementless stems were used in younger patients, the share of cemented stems increasing with age. The use of cemented revision stems was exceptional. **Table 5.13** gives an overview of the brands used at revision.

For acetabular revisions, standard uncemented acetabular cups were used in 77%, while cemented cups without cages were used in 11%. Reconstruction cages were used in 10%. Specific revision cups were used only rarely. An overview of the implants used is provided in **Table 5.13.**

Table 5.12

## Early first revision of primary OA THA: Main components used by age at revision (2018-2023)

All registered component revisions of four main types 2018–2023 with at least one FE/AC revision component with a known e-class

| | Category of implant | Age at revision | | | | | | N |
|---|---|---|---|---|---|---|---|---|
| | | <45 | 45-54 | 55-64 | 65-74 | 75-84 | 85+ | |
| **Type of revision of femoral components** | | % | % | % | % | % | % | |
| AC + FE revision | cem. primary stems | 0.0 | 15.8 | 14.1 | 23.5 | 25.3 | 38.9 | 68 |
| | uncem. primary stems | 50.0 | 57.9 | 49.3 | 36.3 | 33.7 | 33.3 | 132 |
| | short stems | 12.5 | 2.6 | 7.0 | 8.8 | 9.6 | 5.6 | 25 |
| | cem. revision stems | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 | 1 |
| | uncem. revision stems | 37.5 | 23.7 | 28.2 | 31.4 | 31.3 | 22.2 | 94 |
| | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **320** |
| FE revision (with or without inlay) | cem. primary stems | 10.0 | 20.4 | 23.1 | 31.4 | 26.0 | 46.3 | 209 |
| | uncem. primary stems | 90.0 | 57.1 | 35.1 | 25.2 | 22.7 | 11.1 | 209 |
| | short stems | 0.0 | 10.2 | 14.2 | 6.6 | 9.9 | 5.6 | 69 |
| | cem. revision stems | 0.0 | 0.0 | 0.7 | 0.9 | 2.2 | 0.0 | 9 |
| | uncem. revision stems | 0.0 | 12.2 | 26.9 | 35.8 | 39.2 | 37.0 | 250 |
| | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **746** |
| Component reimplantation (after spacer) | cem. primary stems | 0.0 | 0.0 | 10.0 | 20.8 | 38.5 | 33.3 | 12 |
| | uncem. primary stems | 100.0 | 100.0 | 40.0 | 54.2 | 15.4 | 33.3 | 22 |
| | short stems | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 1 |
| | cem. revision stems | | | | | | | 0 |
| | uncem. revision stems | 0.0 | 0.0 | 50.0 | 20.8 | 46.2 | 33.3 | 17 |
| | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **52** |
| **Type of revison of acetabular components** | | | | | | | | |
| AC + FE revision | cem. primary cups | 0.0 | 0.0 | 5.9 | 10.9 | 11.1 | 18.8 | 27 |
| | uncem. primary cups | 100.0 | 97.3 | 88.2 | 83.2 | 79.0 | 68.8 | 262 |
| | revision cups | 0.0 | 0.0 | 0.0 | 1.0 | 2.5 | 0.0 | 3 |
| | AC roof ring or cage | 0.0 | 2.7 | 5.9 | 5.0 | 7.4 | 12.5 | 18 |
| | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **310** |
| AC revision (with or without head) | cem. primary cups | 7.7 | 12.9 | 7.8 | 7.0 | 17.9 | 17.6 | 49 |
| | uncem. primary cups | 92.3 | 80.6 | 78.9 | 76.7 | 59.3 | 58.8 | 300 |
| | revision cups | 0.0 | 0.0 | 4.4 | 3.1 | 0.8 | 0.0 | 9 |
| | AC roof ring or cage | 0.0 | 6.5 | 8.9 | 13.2 | 22.0 | 23.5 | 62 |
| | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **420** |
| Component reimplantation (after spacer) | cem. primary cups | 0.0 | 0.0 | 0.0 | 8.3 | 27.3 | 0.0 | 5 |
| | uncem. primary cups | 100.0 | 100.0 | 72.7 | 79.2 | 72.7 | 100.0 | 40 |
| | revision cups | 0.0 | 0.0 | 9.1 | 8.3 | 0.0 | 0.0 | 3 |
| | AC roof ring or cage | 0.0 | 0.0 | 18.2 | 4.2 | 0.0 | 0.0 | 3 |
| | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **51** |

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.

Table 5.13

## Early first revision of primary OA THA: Main brands used (2018–2023)

| Femoral components | N |
|---|---|
| **Cem. primary stems** (10+) | |
| Twinsys | 54 |
| SPII Lubinus | 41 |
| Corail | 36 |
| Quadra-C | 34 |
| Weber | 22 |
| Centris | 19 |
| Avenir | 17 |
| Quadra-P (cem) | 17 |
| MS-30 | 12 |
| Other stems | 62 |
| **Uncem. primary stems** (10+) | |
| Corail collared | 77 |
| Avenir | 52 |
| Quadra-H | 48 |
| Polarstem | 43 |
| Corail | 36 |
| Twinsys | 33 |
| CLS Spotorno | 23 |
| Quadra-P | 21 |
| Stellaris | 14 |
| Other stems | 50 |
| **Short stems*** (10+) | |
| Optimys | 32 |
| Amistem-C | 27 |
| Fitmore | 23 |
| Other stems | 22 |
| **Cem. revision stems** (10+) | |
| Arcad L XL | 11 |
| Other stems | 2 |
| **Uncem. revision stems** (10+) | |
| Corail collared | 120 |
| Revitan | 53 |
| Wagner SL | 33 |
| Quadra-R | 32 |
| Mathys modular revision | 26 |
| MRP-titan | 24 |
| Lima revision | 23 |
| Alloclassic SLL | 21 |
| Redapt | 15 |
| Restoration modular | 15 |
| M-Vizion | 10 |
| Other stems | 20 |

| Acetabular components | N |
|---|---|
| **Cem. primary cups** (10+) | |
| Polarcup | 27 |
| DS evolution (cem) | 19 |
| Versacem | 17 |
| Avantage | 11 |
| Other cups | 16 |
| Centris | 19 |
| Avenir | 17 |
| Quadra-P (cem) | 17 |
| MS-30 | 12 |
| Other stems | 62 |
| **Uncem. primary cups** (10+) | |
| Pinnacle | 72 |
| RM pressfit vitamys | 65 |
| Allofit | 53 |
| Polarcup | 49 |
| Versafitcup DM | 48 |
| Versafitcup trio/ccl. | 42 |
| Bi-Mentum | 36 |
| Symbol DMHA | 31 |
| Avantage | 22 |
| Fitmore | 22 |
| TM | 21 |
| DS evolution | 17 |
| G7 DM hemispherical | 17 |
| Mpact | 17 |
| R3 | 14 |
| Gyros | 12 |
| Liberty | 12 |
| Delta TT DM | 11 |
| Other cups | 92 |
| **Revision cups** (8+) | |
| Pinnacle | 8 |
| Other cups | 7 |
| **AC roof ring or cage** (10+) | |
| ZB reinforcement rings | 56 |
| Burch-Schneider cage | 18 |
| Other cages | 12 |

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.
* Please note that both Fitmore and Amistem are originally classified as a regular primary stems. We reclassified them as short stems.

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

**Table 5.14** gives an overview of the revision rates depending on implant fixation, bearing and surgical approach, whereby the 2-year revision rate was 2.5% (1,708 of 67,616 primary THA) on average. The parameters that were associated with above average revision rates included all cemented fixation (3.0%), MoCPE bearings (3.6%), and the use of a posterior approach (3.4%). CoXLPE (2.3%) and anterior or anterolateral approaches were associated with below average revision rates.

## Timing of revision

**Figures 5.4** shows the cause and frequency distribution (Kernel density estimation) of revision overall and separately for cemented and uncemented femoral implants. Most revisions occurred during the first 3 months after primary THA, including high and early peaks of periprosthetic fractures and dislocations as reasons for revision. Although infection and aseptic loosing were more frequent complications, their curves were flatter and remained elevated over a longer period. In cemented 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.

Table 5.14

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| | | Revised | | 95% CI | |
|---|---|---|---|---|---|
| | N at risk* | N | %** | lower | upper |
| Overall (moving average) | 67,616 | 1,708 | 2.5 | 2.4 | 2.7 |
| **Fixation** | | | | | |
| All cemented | 754 | 22 | 3.0 | 2.0 | 4.5 |
| All uncemented | 59,042 | 1,471 | 2.5 | 2.4 | 2.6 |
| Hybrid | 7,652 | 204 | 2.7 | 2.4 | 3.1 |
| **Articulation** | | | | | |
| Metal on conventional polyethylene (MoCPE) | 1,173 | 42 | 3.6 | 2.7 | 4.9 |
| Ceramic on conventional polyethylene (CoCPE) | 2,841 | 105 | 3.7 | 3.1 | 4.5 |
| Metal on cross-linked polyethylene (MoXLPE) | 6,866 | 210 | 3.1 | 2.7 | 3.5 |
| Ceramic on cross-linked polyethylene (CoXLPE) | 41,059 | 978 | 2.4 | 2.3 | 2.5 |
| Ceramic on ceramic (CoC) | 9,798 | 260 | 2.7 | 2.4 | 3.0 |
| Ceramicised metal on conventional polyethylene (CMoCPE) | 199 | 8 | 4.1 | 2.1 | 8.0 |
| Ceramicised metal on cross-linked polyethylene (CMoXLPE) | 4,455 | 72 | 1.6 | 1.3 | 2.0 |
| **Approach** | | | | | |
| Anterior | 35,230 | 842 | 2.4 | 2.3 | 2.6 |
| Anterolateral | 20,570 | 490 | 2.4 | 2.2 | 2.6 |
| Lateral | 2,698 | 68 | 2.6 | 2.0 | 3.2 |
| Posterior | 8,762 | 292 | 3.4 | 3.0 | 3.8 |
| Other approach | 356 | 16 | 4.6 | 2.9 | 7.4 |

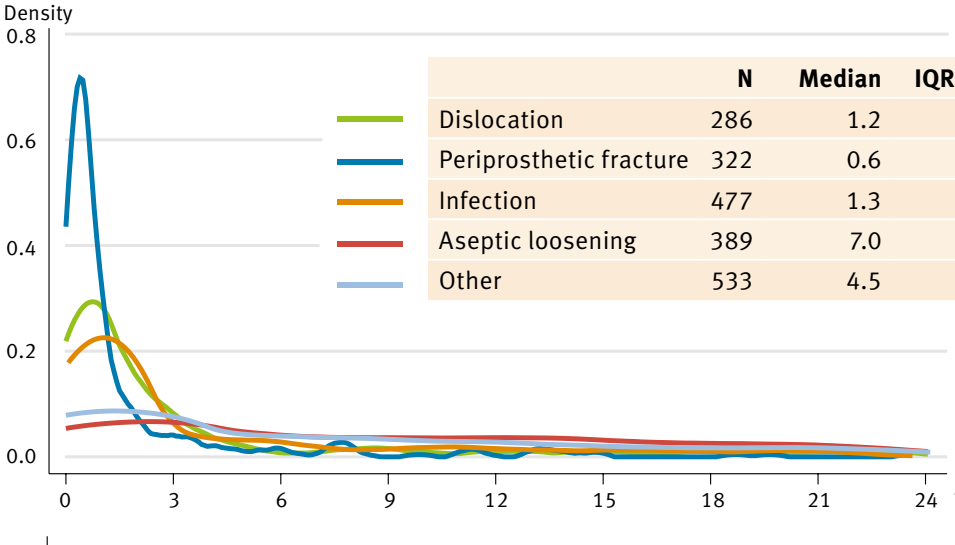
* Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).
** Rates adjusted for effects of mortality and emigration.

Figures 5.4

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

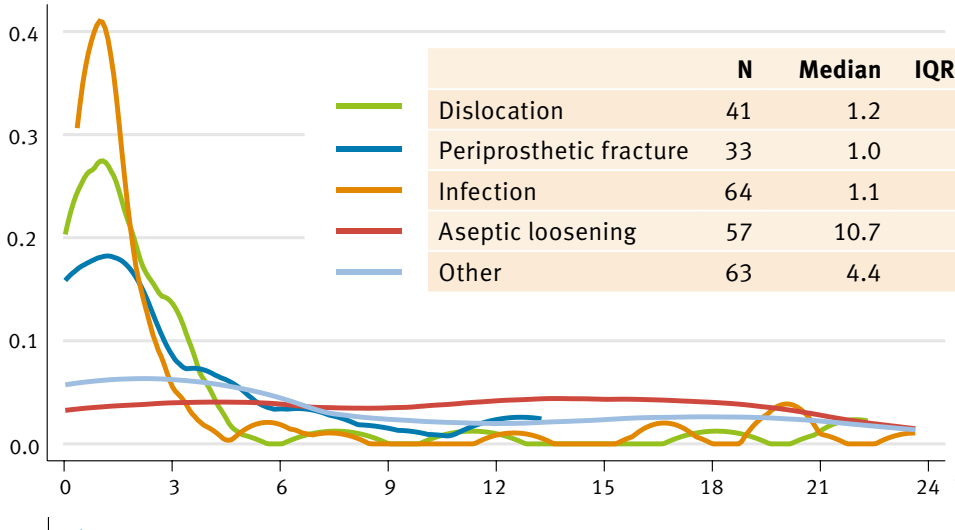
4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).
Early first revisions are those occurring within 2 years of the primary arthroplasty.

**All revisions (N= 1,708)**



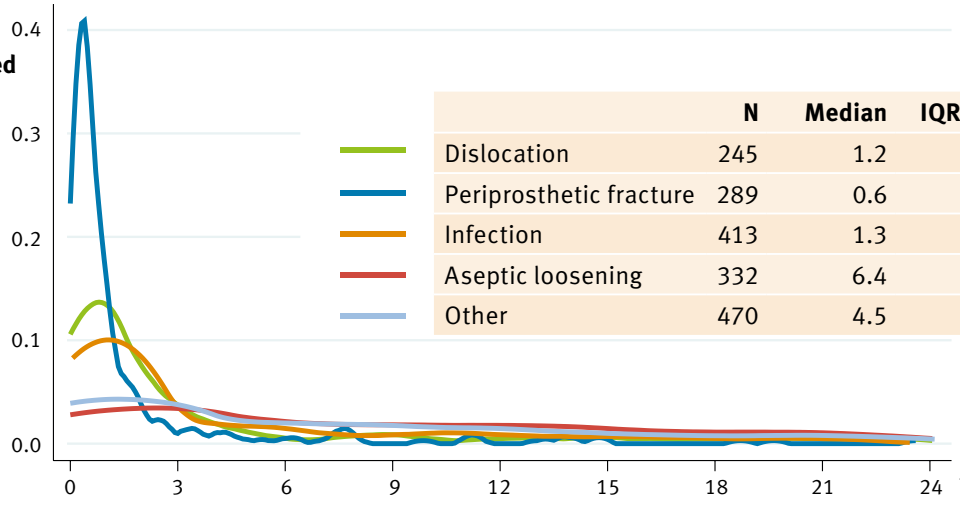

| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Dislocation | 286 | 1.2 | 0.5 | 3.2 |
| Periprosthetic fracture | 322 | 0.6 | 0.3 | 1.4 |
| Infection | 477 | 1.3 | 0.7 | 5.4 |
| Aseptic loosening | 389 | 7.0 | 1.9 | 13.9 |
| Other | 533 | 4.5 | 0.7 | 11.3 |

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




| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Dislocation | 41 | 1.2 | 0.7 | 2.8 |
| Periprosthetic fracture | 33 | 1.0 | 0.6 | 3.8 |
| Infection | 64 | 1.1 | 0.7 | 2.4 |
| Aseptic loosening | 57 | 10.7 | 3.2 | 16.0 |
| Other | 63 | 4.4 | 0.6 | 15.1 |

**Revisions femur uncemented (N= 1,493)**




| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Dislocation | 245 | 1.2 | 0.5 | 3.5 |
| Periprosthetic fracture | 289 | 0.6 | 0.3 | 1.2 |
| Infection | 413 | 1.3 | 0.7 | 5.8 |
| Aseptic loosening | 332 | 6.4 | 1.8 | 13.3 |
| Other | 470 | 4.5 | 0.7 | 11.1 |

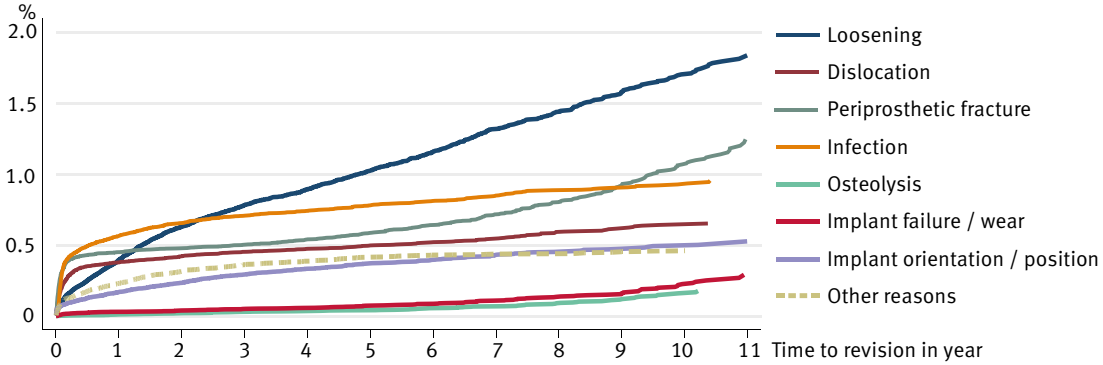
The cumulative incidence rates show the long-term behaviour of implants. **Figures 5.5** presents the cumulative incidence rates up to 11 years postoperatively for all primary THA performed for primary OA, overall and separately for cemented and uncemented femoral components, illustrating the proportion of implants having experienced at least one revision due for the frequent reasons for revision. Loosening and periprosthetic fractures were the dominant reasons for revisions over the whole observation period. Cumulative revision rates for infection, dislocation and osteolysis did not differ between cemented and uncemented stems, whereas periprosthetic fractures occurredmore frequent with uncemented stems, both on the short term as up to eleven years postoperatively **(Figures 5.5).**

Figures 5.5 – Part one

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

Time since operation, 2012–2023, all services, % of implants revised

all fixation techniques



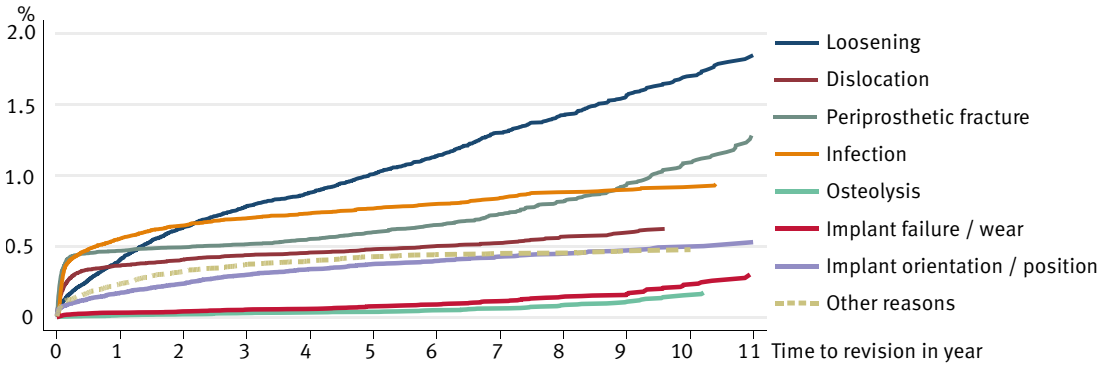

| | 1 year | 2 years | 3 years | 5 years | 7 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Loosening | **0.4** (0.4-0.4) | **0.6** (0.6-0.7) | **0.8** (0.7-0.8) | **1.0** (1.0-1.1) | **1.3** (1.3-1.4) | **1.6** (1.5-1.7) | **1.7** (1.6-1.8) | **1.8** (1.7-2.0) |
| Dislocation | **0.4** (0.4-0.4) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.5-0.5) | **0.5** (0.5-0.6) | **0.6** (0.6-0.7) | **0.6** (0.6-0.7) | **0.7** (0.6-0.7) |
| Periprosthetic fracture | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.5-0.5) | **0.6** (0.6-0.6) | **0.7** (0.7-0.8) | **0.9** (0.9-1.0) | **1.1** (1.0-1.2) | **1.2** (1.1-1.4) |
| Infection | **0.6** (0.5-0.6) | **0.7** (0.6-0.7) | **0.7** (0.7-0.7) | **0.8** (0.7-0.8) | **0.8** (0.8-0.9) | **0.9** (0.9-1.0) | **0.9** (0.9-1.0) | **1.0** (0.9-1.0) |
| 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** (0.1-0.1) | **0.2** (0.1-0.2) | **0.2** (0.1-0.2) |
| 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) | **0.1** (0.1-0.1) | **0.2** (0.1-0.2) | **0.2** (0.2-0.3) | **0.3** (0.2-0.4) |
| Implant orientation / position | **0.2** (0.2-0.2) | **0.2** (0.2-0.3) | **0.3** (0.3-0.3) | **0.4** (0.3-0.4) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) | **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) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) |

Figures 5.5 – Part two

## Cumulative incidence rates for different revision diagnoses (primary osteoarthritis THA)

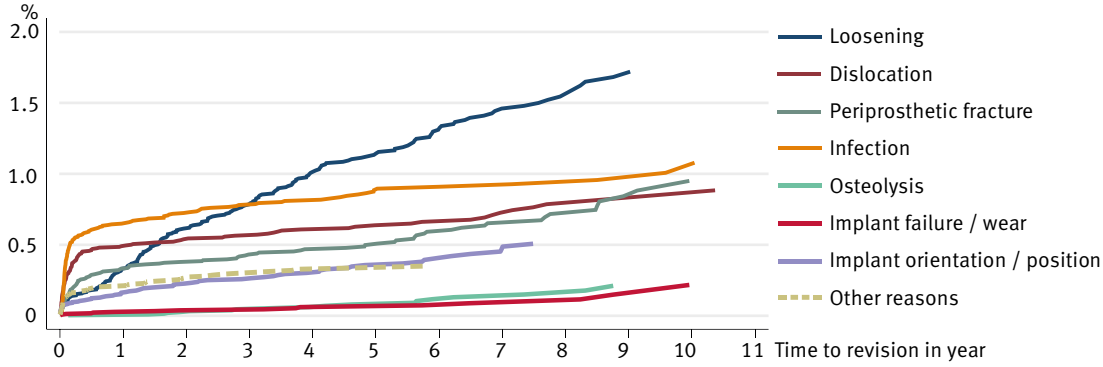
Time since operation, 2012–2023, all services, % of implants revised

uncemented femur




| | 1 year | 2 years | 3 years | 5 years | 7 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Loosening | **0.4** (0.4-0.4) | **0.6** (0.6-0.7) | **0.8** (0.7-0.8) | **1.0** (1.0-1.1) | **1.3** (1.2-1.4) | **1.6** (1.5-1.7) | **1.7** (1.6-1.8) | **1.8** (1.7-2.0) |
| 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) | **0.5** (0.5-0.6) | **0.6** (0.5-0.6) | **0.6** (0.6-0.7) | **0.6** (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) | **0.7** (0.7-0.8) | **0.9** (0.9-1.0) | **1.1** (1.0-1.2) | **1.3** (1.1-1.4) |
| Infection | **0.6** (0.5-0.6) | **0.6** (0.6-0.7) | **0.7** (0.7-0.7) | **0.8** (0.7-0.8) | **0.8** (0.8-0.9) | **0.9** (0.8-1.0) | **0.9** (0.9-1.0) | **0.9** (0.9-1.0) |
| Osteolysis | **0.0** (0.0-0.0) | **0.0** (0.0-0.0) | **0.0** (0.0-0.0) | **0.0** (0.0-0.0) | **0.1** (0.0-0.1) | **0.1** (0.1-0.1) | **0.2** (0.1-0.2) | **0.2** (0.1-0.2) |
| 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) | **0.1** (0.1-0.1) | **0.2** (0.1-0.2) | **0.2** (0.2-0.3) | **0.3** (0.2-0.4) |
| Implant orientation / position | **0.2** (0.2-0.2) | **0.2** (0.2-0.3) | **0.3** (0.3-0.3) | **0.4** (0.3-0.4) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.5-0.6) |
| Other reasons | **0.2** (0.2-0.3) | **0.3** (0.3-0.4) | **0.4** (0.3-0.4) | **0.4** (0.4-0.5) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.5) |

cemented femur




| | 1 year | 2 years | 3 years | 5 years | 7 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Loosening | **0.3** (0.3-0.4) | **0.6** (0.5-0.7) | **0.8** (0.7-0.9) | **1.1** (1.0-1.3) | **1.5** (1.3-1.7) | **1.7** (1.4-2.0) | **1.7** (1.5-2.0) | **1.7** (1.5-2.0) |
| 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) | **0.7** (0.6-0.9) | **0.8** (0.7-0.9) | **0.8** (0.7-0.9) | **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) | **0.7** (0.5-0.8) | **0.8** (0.7-1.1) | **1.0** (0.7-1.2) | **1.0** (0.7-1.2) |
| Infection | **0.6** (0.6-0.8) | **0.7** (0.6-0.8) | **0.8** (0.7-0.9) | **0.9** (0.8-1.0) | **0.9** (0.8-1.1) | **1.0** (0.8-1.1) | **1.0** (0.8-1.2) | **1.1** (0.9-1.3) |
| Osteolysis | **0.0** (0.0-0.0) | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.1** (0.0-0.1) | **0.1** (0.1-0.2) | **0.2** (0.1-0.4) | **0.2** (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) | **0.1** (0.0-0.2) | **0.1** (0.1-0.3) | **0.2** (0.1-0.5) | **0.2** (0.1-0.5) |
| Implant orientation / position | **0.2** (0.1-0.2) | **0.2** (0.2-0.3) | **0.3** (0.2-0.3) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.5** (0.4-0.7) | **0.5** (0.4-0.7) | **0.5** (0.4-0.7) |
| Other reasons | **0.2** (0.2-0.3) | **0.3** (0.2-0.4) | **0.3** (0.2-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) | **0.3** (0.3-0.4) |

## Bearings and head sizes

The 2-year revision rate for the current 4-year moving window was lowest for CMoXLPE (1.6%) and CoXLPE (2.3%), followed by CoC and MoXLPE (2.8%) **(Table 5.14).** At 11 years, the estimated cumulative revision rate for CMoXLPE had the lowest revision rate of 2.9% (CI 2.4-3.6%)and CoXLPE had a revision rate of 4.7% (CI 4.5 – 5.0%). In contrast, the highest cumulative revision rate was observed for CMoCPE (9.9% (CI 4.7 – 16.7%), followed bx MoCPE with a rate of 8.5% (CI 6.7–10.7) **(Figure 5.6).** However, for both bearings this observation has to be taken with care, considering small numbers with wide confidence intervals.

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, particularly with CPE. Heads with a diameter ≥40 mm had an excessively high revision rate of 12.1% at 11 years **(Figure 5.7).** However, these were used mostly in CoC bearings. Bearings with diameter 32 or 36 mm had an identical revision rate throughout the entire observation period. At 11 years follow-up, their revision rate was 4.9% and 5.0%, respectively. Heads diameter 28 mm were associated with a slightly higher revision rate at 11 years of 5.7%.

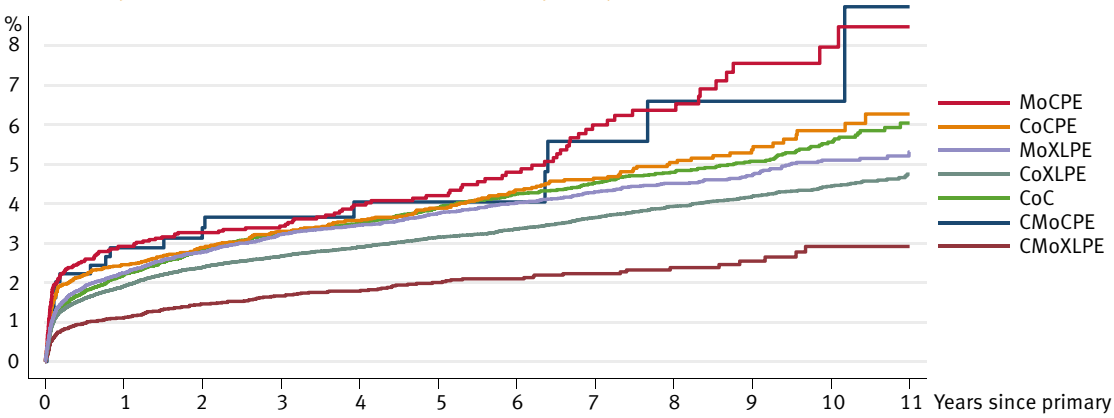
The relationship between head size and bearing type was further analysed. whereby results were broken down between head sizes of 28, 32, and 36 mm and the bearings MoCPE, CoCPE, MoXLPE, CoXLPE, MCoXLPE, and CoC. The results are presented in **Table 5.15.**

Although CMoXLPE has the lowest cumulated revision rate at eleven years, this result should be interpreted with caution. It is used with a limited

Figure 5.6

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

Time since operation, 2012–2023, all services, diagnosis primary OA

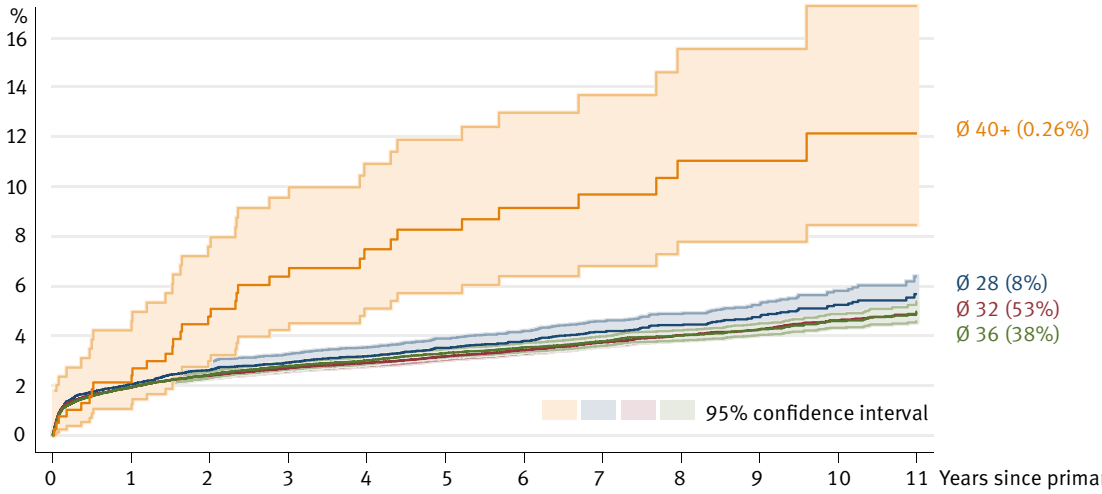



| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| MoCPE | **2.9** (2.4-3.6) | **3.3** (2.7-3.9) | **3.4** (2.9-4.1) | **4.2** (3.5-5.0) | **4.8** (4.0-5.7) | **6.4** (5.3-7.6) | **7.6** (6.2-9.2) | **8.0** (6.4-9.8) | **8.5** (6.7-10.7) |
| CoCPE | **2.5** (2.2-2.8) | **2.9** (2.6-3.3) | **3.3** (2.9-3.7) | **3.9** (3.5-4.3) | **4.3** (3.9-4.9) | **5.0** (4.5-5.7) | **5.4** (4.8-6.1) | **5.8** (5.1-6.7) | **6.3** (5.4-7.3) |
| MoXLPE | **2.2** (2.1-2.4) | **2.8** (2.6-3.0) | **3.2** (3.0-3.5) | **3.8** (3.5-4.0) | **4.0** (3.8-4.3) | **4.5** (4.2-4.8) | **4.7** (4.4-5.1) | **5.1** (4.7-5.5) | **5.3** (4.9-5.8) |
| CoXLPE | **1.9** (1.8-2.0) | **2.4** (2.3-2.5) | **2.7** (2.6-2.8) | **3.1** (3.0-3.3) | **3.4** (3.2-3.5) | **3.9** (3.8-4.1) | **4.2** (4.0-4.4) | **4.4** (4.2-4.6) | **4.7** (4.5-5.0) |
| CoC | **2.2** (2.0-2.4) | **2.8** (2.6-3.0) | **3.2** (3.0-3.5) | **3.9** (3.6-4.2) | **4.2** (4.0-4.5) | **4.8** (4.5-5.1) | **5.1** (4.7-5.4) | **5.6** (5.2-6.0) | **6.0** (5.5-6.6) |
| CMoCPE | **2.9** (1.7-4.8) | **3.4** (2.1-5.5) | **3.7** (2.3-5.8) | **4.0** (2.5-6.4) | **4.0** (2.5-6.4) | **6.6** (3.9-11.0) | **6.6** (3.9-11.0) | **6.6** (3.9-11.0) | **9.0** (4.7-16.7) |
| CMoXLPE | **1.1** (0.9-1.3) | **1.5** (1.2-1.7) | **1.7** (1.4-1.9) | **2.0** (1.7-2.3) | **2.1** (1.8-2.4) | **2.4** (2.0-2.8) | **2.5** (2.1-3.0) | **2.9** (2.4-3.6) | **2.9** (2.4-3.6) |

Figure 5.7

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

Time since operation, 2012–2023, all services, diagnosis primary OA




| Ø | 1 year | 2 years | 3 years | 5 years | 6 years | 7 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| 28 (8%) | **2.1** (1.8-2.4) | **2.6** (2.3-2.9) | **2.9** (2.6-3.3) | **3.5** (3.2-3.9) | **3.8** (3.4-4.2) | **4.4** (4.0-4.9) | **4.8** (4.3-5.2) | **5.2** (4.7-5.8) | **5.7** (5.0-6.4) |
| 32 (53%) | **1.9** (1.8-2.0) | **2.4** (2.3-2.5) | **2.7** (2.6-2.8) | **3.2** (3.1-3.3) | **3.4** (3.3-3.6) | **4.0** (3.9-4.2) | **4.3** (4.1-4.5) | **4.6** (4.4-4.9) | **4.9** (4.6-5.1) |
| 36 (38%) | **1.9** (1.8-2.1) | **2.4** (2.3-2.6) | **2.8** (2.7-2.9) | **3.3** (3.1-3.5) | **3.5** (3.4-3.7) | **4.0** (3.8-4.2) | **4.3** (4.0-4.5) | **4.6** (4.3-4.9) | **5.0** (4.6-5.4) |
| 40+ (0.26%) | **2.1** (1.1-4.2) | **4.8** (3.0-7.6) | **6.4** (4.2-9.5) | **8.3** (5.7-11.9) | **9.1** (6.4-13.0) | **11.0** (7.8-15.5) | **11.0** (7.8-15.5) | **12.1** (8.5-17.2) | **12.1** (8.5-17.2) |

Table 5.15

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

Time since operation, 2012–2023, all services, diagnosis primary OA. Only showing combinations with 500+ cases.

| Ø / bearing surface | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| 28 / CoCPE | **2.7** (1.8-4.0) | **2.8** (1.9-4.2) | **3.3** (2.3-4.8) | **3.9** (2.8-5.4) | **4.0** (2.9-5.6) | **4.6** (3.3-6.3) | **4.6** (3.3-6.3) | **5.2** (3.6-7.5) |
| 28 / MoXLPE | **2.3** (1.8-3.0) | **2.7** (2.1-3.4) | **3.2** (2.5-4.0) | **3.6** (2.9-4.5) | **4.0** (3.3-4.9) | **4.6** (3.8-5.6) | **5.7** (4.6-6.9) | **5.7** (4.6-6.9) |
| 28 / CoXLPE | **1.8** (1.5-2.2) | **2.5** (2.1-2.9) | **2.6** (2.2-3.0) | **3.3** (2.8-3.8) | **3.5** (3.0-4.0) | **4.2** (3.6-4.8) | **4.9** (4.2-5.6) | **5.6** (4.6-6.7) |
| 28 / CoC | **2.1** (1.3-3.4) | **2.9** (1.9-4.4) | **3.3** (2.3-4.9) | **4.0** (2.8-5.8) | **4.5** (3.2-6.3) | **4.7** (3.3-6.6) | **5.2** (3.6-7.5) | **5.2** (3.6-7.5) |
| 32 / MoCPE | **4.6** (3.0-6.8) | **5.0** (3.4-7.4) | **5.0** (3.4-7.4) | **5.9** (4.1-8.5) | **6.7** (4.6-9.5) | **9.4** (6.6-13.4) | **10.4** (7.2-15.1) | |
| 32 / CoCPE | **2.8** (2.2-3.7) | **3.2** (2.5-4.1) | **3.7** (2.9-4.6) | **4.3** (3.5-5.3) | **4.7** (3.8-5.8) | **5.5** (4.4-6.8) | **7.8** (6.0-10.0) | **8.7** (6.4-11.9) |
| 32 / MoXLPE | **2.6** (2.3-3.0) | **3.2** (2.9-3.6) | **3.7** (3.3-4.1) | **4.3** (3.9-4.8) | **4.6** (4.1-5.0) | **5.1** (4.6-5.6) | **5.6** (5.1-6.2) | **5.7** (5.1-6.4) |
| 32 / CoXLPE | **1.8** (1.7-1.9) | **2.3** (2.2-2.4) | **2.5** (2.4-2.7) | **3.0** (2.8-3.1) | **3.2** (3.0-3.3) | **3.8** (3.6-4.0) | **4.3** (4.0-4.6) | **4.5** (4.1-4.8) |
| 32 / CoC | **2.0** (1.7-2.3) | **2.6** (2.2-2.9) | **2.9** (2.6-3.3) | **3.6** (3.1-4.0) | **3.9** (3.5-4.4) | **4.4** (3.9-5.0) | **5.1** (4.5-5.9) | **5.7** (4.9-6.7) |
| 32 / CMoXLPE | **0.9** (0.7-1.2) | **1.3** (1.0-1.6) | **1.4** (1.1-1.8) | **1.8** (1.4-2.2) | **1.9** (1.5-2.4) | **2.3** (1.8-2.9) | **2.6** (1.9-3.5) | **2.6** (1.9-3.5) |
| 36 / MoXLPE | **1.8** (1.5-2.2) | **2.4** (2.0-2.9) | **2.8** (2.4-3.3) | **3.3** (2.8-3.8) | **3.5** (3.0-4.1) | **3.9** (3.3-4.6) | **4.5** (3.8-5.3) | **5.1** (3.8-6.8) |
| 36 / CoXLPE | **2.0** (1.8-2.1) | **2.4** (2.3-2.6) | **2.7** (2.6-2.9) | **3.2** (3.0-3.4) | **3.4** (3.1-3.6) | **3.8** (3.6-4.1) | **4.3** (3.9-4.6) | **4.5** (4.1-5.0) |
| 36 / CoC | **2.2** (1.9-2.4) | **2.8** (2.5-3.0) | **3.2** (2.9-3.5) | **3.9** (3.5-4.2) | **4.2** (3.8-4.6) | **4.7** (4.3-5.1) | **5.5** (4.9-6.0) | **6.0** (5.3-6.8) |
| 36 / CMoXLPE | **0.9** (0.6-1.3) | **1.2** (0.9-1.7) | **1.5** (1.1-2.0) | **1.8** (1.4-2.4) | **1.8** (1.4-2.4) | **1.9** (1.4-2.6) | **2.8** (1.9-4.0) | **2.8** (1.9-4.0) |

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.

MoCPE was used only in combination with 32 mm heads and appeared to have the highest revision rate at 10 years of 10.4% (CI 7.1–15.1). MoCPE with 28mm heads were mainly used in fractures, cemented stems and in dual mobility cups. These groups were not part of this analysis and were therefore excluded.

For the head diameters 32 and 36 mm, CMoXLPE had the lowest revision rates with 2.6% and 2.8% respectively at eleven years. CoXLPE had a revision rate of 4.5%. For MoXLPE, CoCPE, and CoC the long-term results varied depending on the head size.

## Fixation

Component fixation also affected the revision rate **(Figure 5.8).** Hybrid fixation showed slightly better revision rates at 11 years with 4.7% (CI 4.3–5.3%) than uncemented fixation with 5.1% (CI 4.9–5.3%) or all cemented with 5.4% (CI4.1–7.1%). 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 5.9).**

## BMI

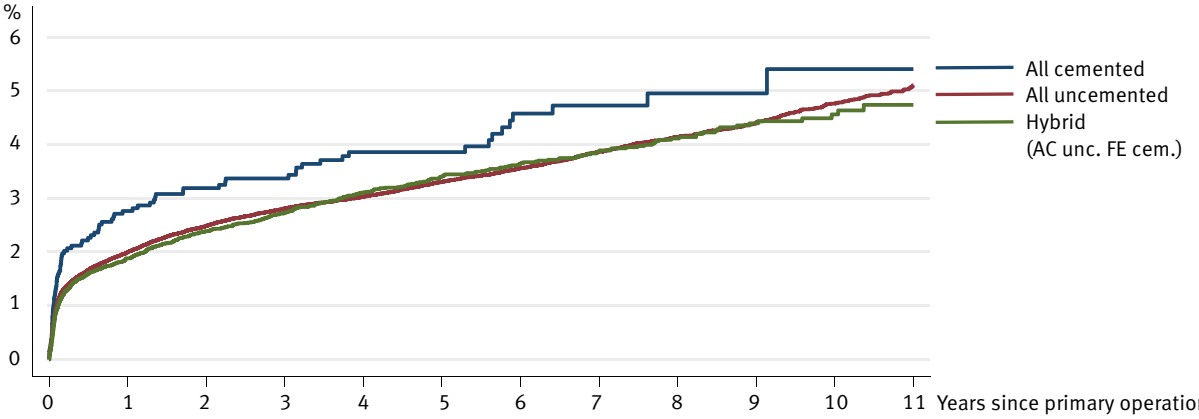
Data on BMI is collected since 2015, the observation time therefore is limited to eight years. BMI had a high impact on the risk of revision **(Figure 5.10),** with a positive correlation (meaning increasing risk with increasing BMI).

The 2-year revision rate for patients with BMI ›40 kg/m² was 6.2% (CI 5.3–7.3%), 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

Figure 5.8

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

Time since operation, 2012–2023, all services, diagnosis primary OA.



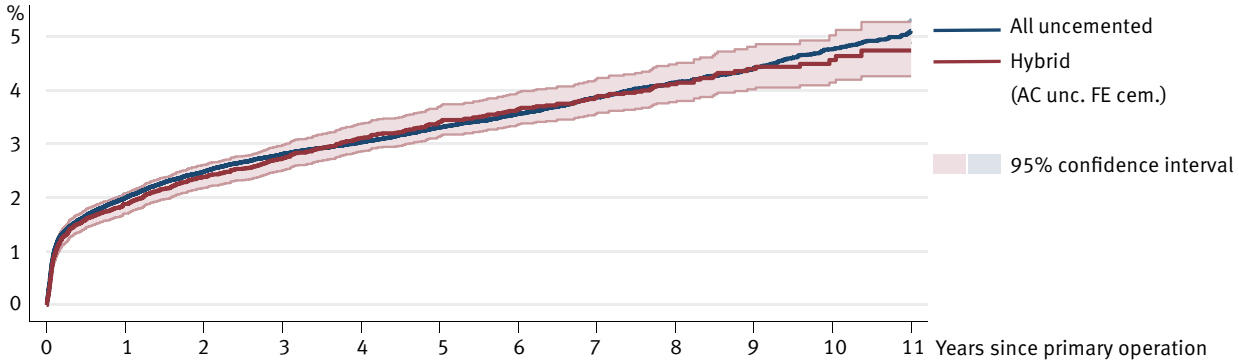

| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| All cem. | **2.8** (2.1-3.6) | **3.2** (2.5-4.0) | **3.4** (2.7-4.2) | **3.9** (3.1-4.8) | **4.6** (3.7-5.7) | **5.0** (3.9-6.2) | **5.0** (3.9-6.2) | **5.4** (4.1-7.1) | **5.4** (4.1-7.1) |
| All uncem. | **2.0** (1.9-2.1) | **2.5** (2.4-2.6) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **3.6** (3.5-3.7) | **4.1** (4.0-4.3) | **4.4** (4.3-4.5) | **4.8** (4.6-4.9) | **5.1** (4.9-5.3) |
| Hybrid | **1.9** (1.7-2.1) | **2.4** (2.2-2.6) | **2.7** (2.5-3.0) | **3.4** (3.1-3.7) | **3.6** (3.4-4.0) | **4.1** (3.8-4.5) | **4.4** (4.0-4.8) | **4.6** (4.1-5.0) | **4.7** (4.3-5.3) |

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.

Figure 5.9

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

Time since operation, 2012–2023, all services, diagnosis primary OA

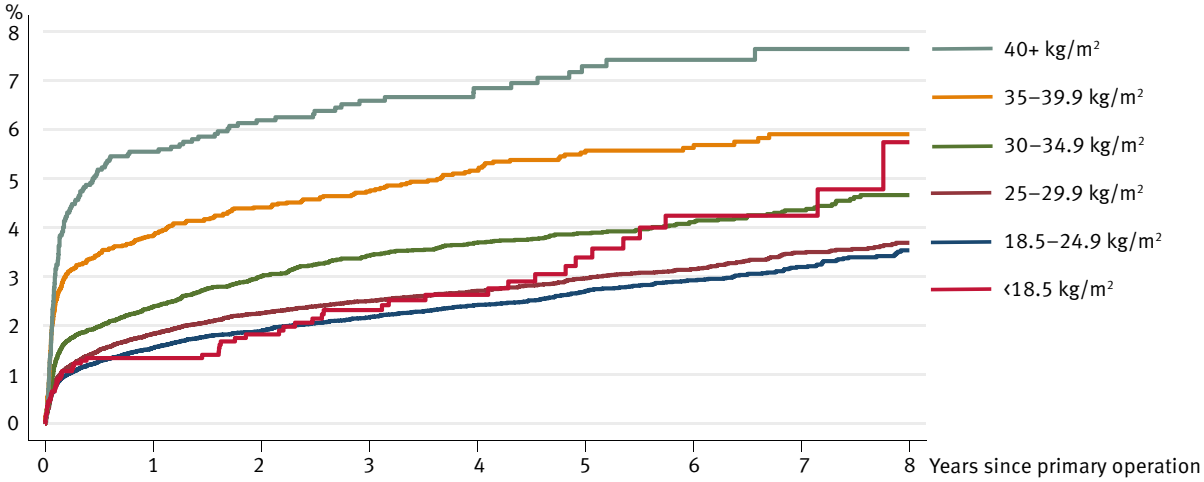



| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| All uncem. | **2.0** (1.9-2.1) | **2.5** (2.4-2.6) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **3.6** (3.5-3.7) | **4.1** (4.0-4.3) | **4.4** (4.3-4.5) | **4.8** (4.6-4.9) | **5.1** (4.9-5.3) |
| Hybrid | **1.9** (1.7-2.1) | **2.4** (2.2-2.6) | **2.7** (2.5-3.0) | **3.4** (3.1-3.7) | **3.6** (3.4-4.0) | **4.1** (3.8-4.5) | **4.4** (4.0-4.8) | **4.6** (4.1-5.0) | **4.7** (4.3-5.3) |

Figure 5.10

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

Time since operation, 2015–2023, all services, diagnosis primary OA.




| kg/m² | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| ‹18.5 | **1.3** (0.9-2.0) | **1.8** (1.3-2.6) | **2.3** (1.7-3.2) | **2.6** (1.9-3.6) | **3.4** (2.5-4.6) | **4.2** (3.1-5.8) | **4.2** (3.1-5.8) | **5.7** (3.7-8.9) |
| 18.5–24.9 | **1.5** (1.4-1.7) | **1.9** (1.8-2.0) | **2.2** (2.0-2.3) | **2.4** (2.3-2.6) | **2.7** (2.5-2.9) | **2.9** (2.7-3.1) | **3.2** (3.0-3.4) | **3.5** (3.3-3.8) |
| 25–29.9 | **1.8** (1.7-2.0) | **2.3** (2.1-2.4) | **2.5** (2.4-2.7) | **2.7** (2.6-2.9) | **3.0** (2.8-3.1) | **3.2** (3.0-3.3) | **3.5** (3.3-3.7) | **3.7** (3.5-3.9) |
| 30–34.9 | **2.4** (2.2-2.6) | **3.0** (2.8-3.2) | **3.4** (3.2-3.7) | **3.7** (3.4-4.0) | **3.9** (3.6-4.2) | **4.1** (3.8-4.4) | **4.4** (4.0-4.7) | **4.7** (4.3-5.1) |
| 35–39.9 | **3.8** (3.4-4.3) | **4.4** (4.0-4.9) | **4.7** (4.3-5.3) | **5.2** (4.6-5.7) | **5.5** (5.0-6.2) | **5.6** (5.1-6.3) | **5.9** (5.3-6.6) | **5.9** (5.3-6.6) |
| 40+ | **5.6** (4.7-6.6) | **6.2** (5.3-7.3) | **6.6** (5.6-7.7) | **6.8** (5.9-8.0) | **7.3** (6.2-8.5) | **7.4** (6.3-8.7) | **7.6** (6.5-9.0) | **7.6** (6.5-9.0) |

While underweight patients initially had a lower revision risk, the revision rate started to rise at 5 years, and at 8 years the revision rates were comparable to those patients with a BMI of between 35 and 39.9 kg/m². **Figure 5.11** shows the estimated failure rates with confidence intervals for the different groups.

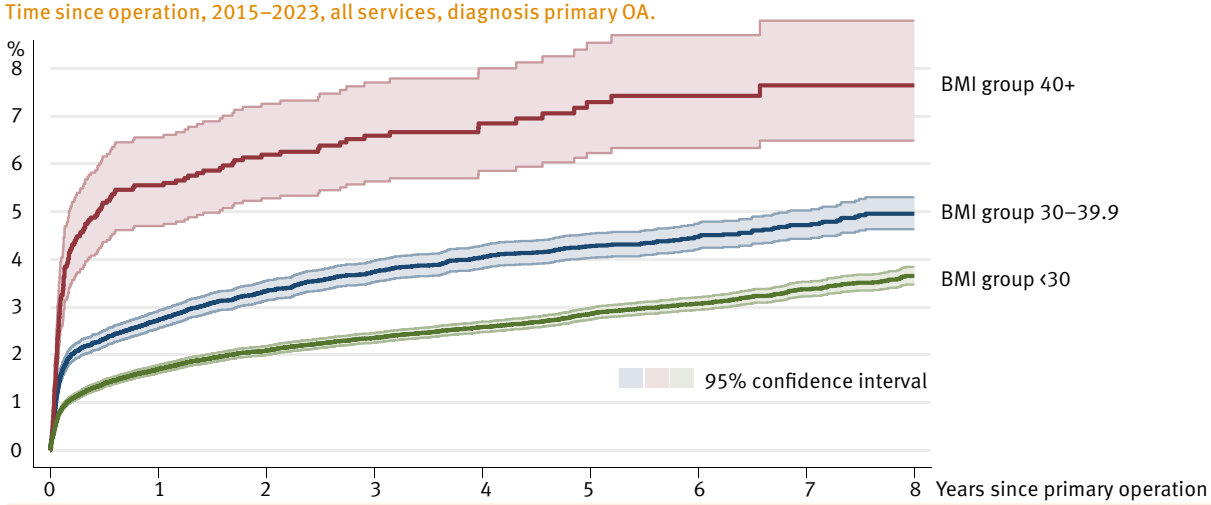
## Dual mobility cups

Dual mobility cups (DMC) were increasingly used both for primary THA **(Figure 5.1)** as well as in revisions. The main indication is to reduce the risk of dislocation, respectively the risk for revision for instability. The exact role of DMC is still debated, and several questions concerning their use are not

Figure 5.11

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

Time since operation, 2015–2023, all services, diagnosis primary OA.



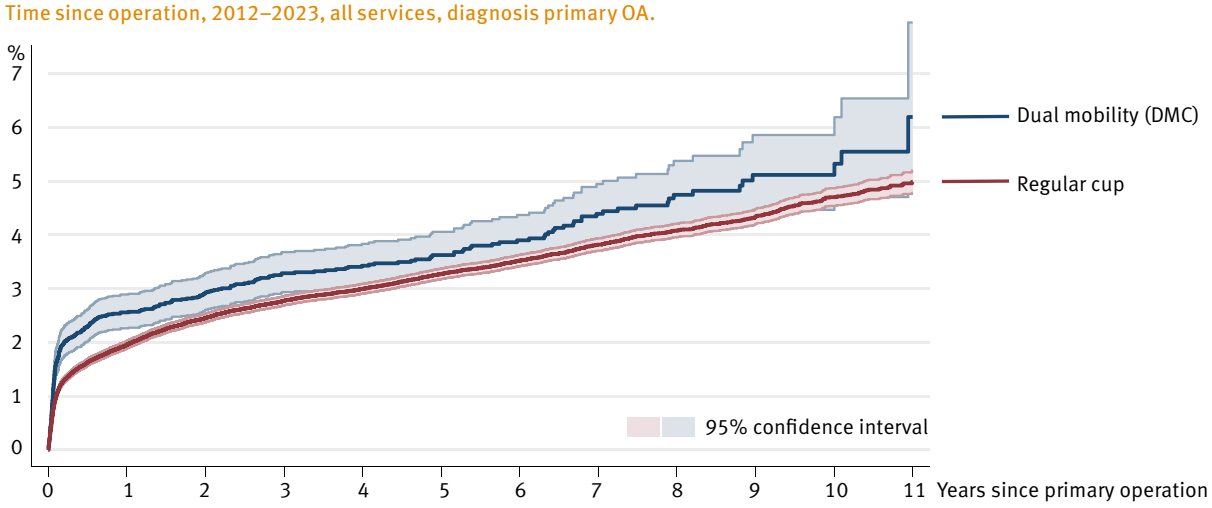

| BMI | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| 30–39.9 | **2.7** (2.6-2.9) | **3.3** (3.1-3.5) | **3.7** (3.5-4.0) | **4.0** (3.8-4.3) | **4.3** (4.0-4.5) | **4.5** (4.2-4.7) | **4.7** (4.4-5.0) | **5.0** (4.6-5.3) |
| 40+ | **5.6** (4.7-6.6) | **6.2** (5.3-7.3) | **6.6** (5.6-7.7) | **6.8** (5.9-8.0) | **7.3** (6.2-8.5) | **7.4** (6.3-8.7) | **7.6** (6.5-9.0) | **7.6** (6.5-9.0) |
| <30 | **1.7** (1.6-1.8) | **2.1** (2.0-2.2) | **2.3** (2.3-2.5) | **2.6** (2.5-2.7) | **2.9** (2.7-3.0) | **3.1** (2.9-3.2) | **3.4** (3.2-3.5) | **3.7** (3.5-3.8) |

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 5.12),** albeit without statistical significance. 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 5.13).**

Figure 5.12

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

Time since operation, 2012–2023, all services, diagnosis primary OA.

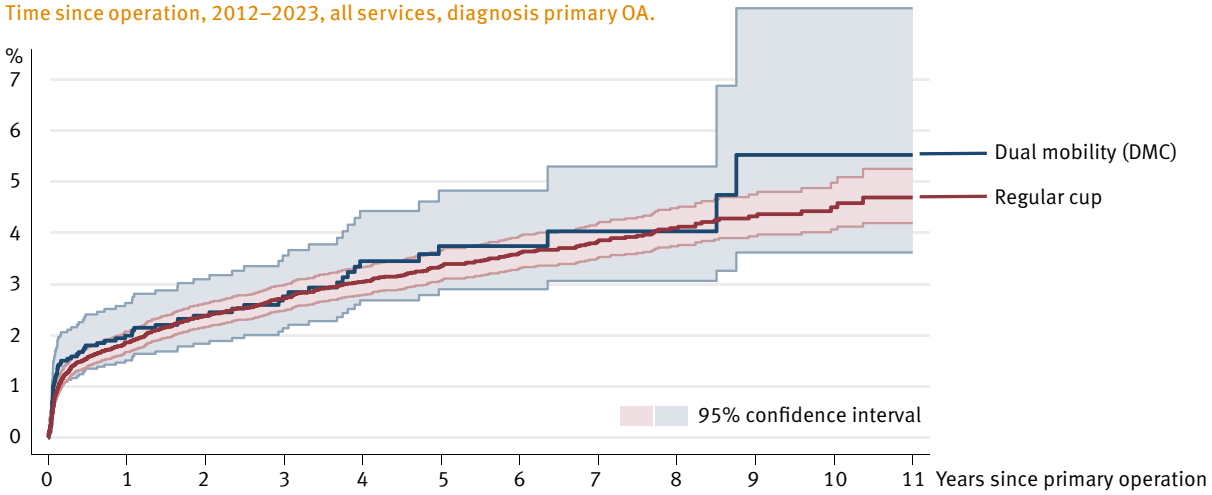



| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| Reg. cup | **2.0** (1.9-2.0) | **2.5** (2.4-2.5) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **3.5** (3.4-3.6) | **4.1** (4.0-4.2) | **4.3** (4.2-4.5) | **4.7** (4.5-4.9) | **5.0** (4.8-5.2) |
| DMC | **2.6** (2.3-2.9) | **2.9** (2.6-3.3) | **3.3** (2.9-3.7) | **3.6** (3.2-4.1) | **3.9** (3.5-4.4) | **4.7** (4.2-5.4) | **5.1** (4.5-5.9) | **5.1** (4.5-5.9) | **6.2** (4.8-8.0) |

Figure 5.13

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

Time since operation, 2012–2023, all services, diagnosis primary OA.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| Reg. cup | **1.9** (1.7-2.1) | **2.4** (2.2-2.6) | **2.7** (2.5-3.0) | **3.3** (3.1-3.6) | **3.6** (3.3-3.9) | **4.1** (3.7-4.5) | **4.3** (3.9-4.7) | **4.5** (4.1-5.0) | **4.7** (4.2-5.2) |
| DMC | **2.0** (1.5-2.6) | **2.4** (1.8-3.1) | **2.8** (2.1-3.6) | **3.7** (2.9-4.8) | **3.7** (2.9-4.8) | **4.0** (3.1-5.3) | **5.5** (3.6-8.4) | **5.5** (3.6-8.4) | **5.5** (3.6-8.4) |

DMC are provided in three different design philosophies: hemispherical, spherico-cylindrical, and superior extended coverage. Comparison of these three types is possible until 8 years of follow-up. Uncemented dual mobility cups with superior extended coverage had the lowest revision rate with 4.5% (CI 3.9 – 5.2%) at eight years. and increased to 6.0% (CI 4.6–7.8%) at eleven years. Details regarding the DMC models currently used figure in **Figure 5.14.**

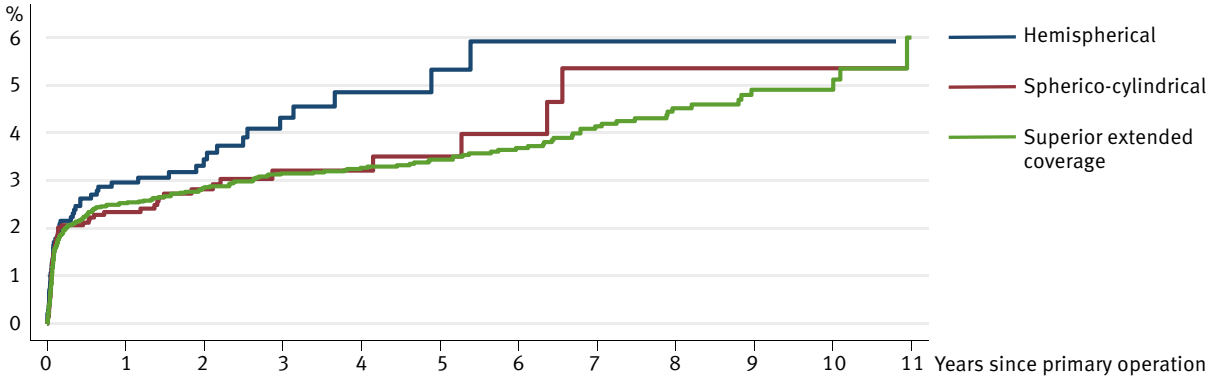
## Short stems

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[1]. This classification separates short stems into five types, depending on the zone of fixation: cephalic (type 1), isolated cervical (type 2), calcar femorale (type 3), metaphyseal (type 4), and conventional metaphyseal-dia-

Figure 5.14

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

Time since operation, 2012–2023, all services, diagnosis primary OA.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| Hemispherical | **3.0** (2.2-4.0) | **3.4** (2.6-4.6) | **4.3** (3.2-5.8) | **5.3** (3.8-7.4) | **5.9** (4.2-8.4) | **5.9** (4.2-8.4) | | | |
| Spherico-cylindrical | **2.3** (1.8-3.1) | **2.8** (2.2-3.7) | **3.2** (2.4-4.2) | **3.5** (2.6-4.7) | **4.0** (2.8-5.6) | **5.4** (3.4-8.3) | **5.4** (3.4-8.3) | | |
| Sup. extended cov. | **2.5** (2.2-2.9) | **2.8** (2.5-3.3) | **3.1** (2.7-3.6) | **3.4** (3.0-3.9) | **3.7** (3.2-4.2) | **4.5** (3.9-5.2) | **4.9** (4.2-5.7) | **4.9** (4.2-5.7) | **6.0** (4.6-7.8) |

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

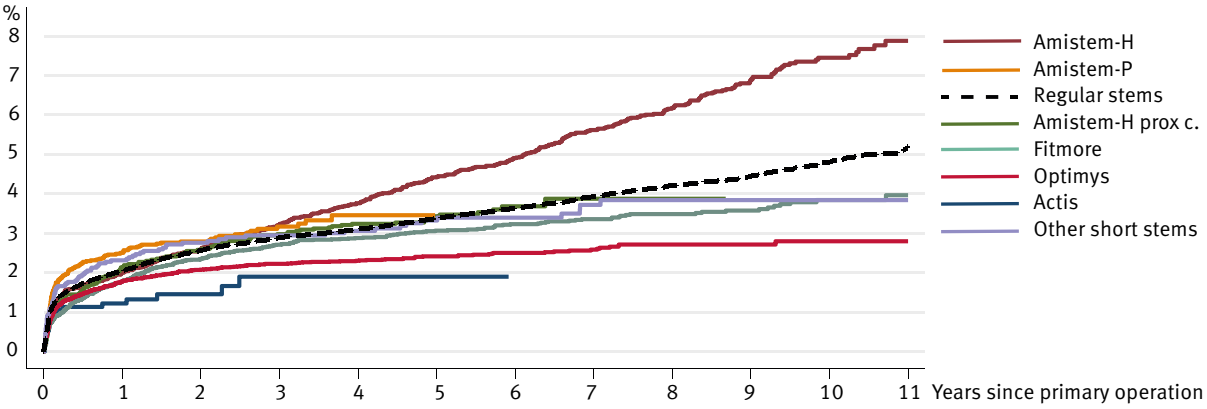
[1] Erivan R et al. French Hip & Knee Society classification of short-stem hip prostheses: Inter- and intra-observer reproducibility. Orthop Traumatol Surg Res. 2022, 108(1):103126.

physeal shortened stems (type 5). The classification of a wide variety of implants is provided in the publication. There are currently 24 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". Compared to the standard uncemented stems, the short stems showed a wider range of revision rates **(Figure 5.15),** 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, of 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.

Figure 5.15

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

Time since operation, 2012–2023, all services, diagnosis primary OA




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Actis | **1.2** (0.8-1.9) | **1.5** (0.9-2.3) | **1.9** (1.2-3.0) | **1.9** (1.2-3.0) | | | | |
| Amistem-H | **2.0** (1.7-2.3) | **2.6** (2.2-3.0) | **3.2** (2.8-3.6) | **4.4** (4.0-4.9) | **4.9** (4.4-5.4) | **6.2** (5.6-6.8) | **7.5** (6.8-8.2) | **7.9** (7.1-8.7) |
| Amistem-H prox c. | **2.1** (1.7-2.7) | **2.6** (2.1-3.1) | **3.0** (2.5-3.6) | **3.4** (2.9-4.1) | **3.7** (3.1-4.4) | | | |
| Amistem-P | **2.5** (2.1-2.9) | **2.8** (2.4-3.3) | **3.2** (2.7-3.7) | | | | | |
| Fitmore | **1.8** (1.6-2.0) | **2.3** (2.1-2.6) | **2.7** (2.4-3.0) | **3.1** (2.8-3.4) | **3.2** (2.9-3.6) | **3.5** (3.2-3.8) | **3.8** (3.4-4.3) | **4.0** (3.5-4.5) |
| Optimys | **1.8** (1.6-2.0) | **2.1** (1.9-2.3) | **2.2** (2.0-2.4) | **2.4** (2.2-2.6) | **2.5** (2.3-2.7) | **2.7** (2.5-3.0) | **2.8** (2.5-3.1) | **2.8** (2.5-3.1) |
| Other short stems | **2.3** (1.8-2.9) | **2.8** (2.2-3.4) | **2.9** (2.4-3.7) | **3.3** (2.7-4.1) | **3.4** (2.7-4.2) | **3.8** (3.1-4.8) | **3.8** (3.1-4.8) | **3.8** (3.1-4.8) |
| 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) | **4.8** (4.6-5.0) | **5.2** (4.9-5.5) |

## 5.4 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. For this reason, the following tables present results of implant combinations used at least 50 times for primary OA within the current moving 4-year window. 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.

Since the launch of the registry, SIRIS has documented a total of 171 different brands of stem (including all currently identified sub-variants), of which 33 were implanted less than 10 times, while another 40 were used in 10 to 49 cases only. There were 131 different brands of cups, of which 24 were implanted less than 10 times and another 25 were

Table 5.16
**Top 75% of primary total hip arthroplasty uncemented combinations (primary OA) 2018-2023**

| Stem component | Cup component | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 28 | 119 | 185 | 221 | 405 | 534 | **1,492** |
| Amistem-H prox coating | Versafitcup trio/ccl. | 1,278 | 857 | 49 | 28 | 0 | 0 | **2,212** |
| Amistem-P | Versafitcup trio/ccl. | 1 | 383 | 1,182 | 1,226 | 1,208 | 1,136 | **5,136** |
| Avenir | Allofit | 1,161 | 1,139 | 1,037 | 713 | 619 | 514 | **5,183** |
| Avenir | Fitmore | 300 | 280 | 257 | 186 | 119 | 67 | **1,209** |
| Corail | Pinnacle | 1,141 | 1,147 | 1,236 | 1,251 | 1,067 | 976 | **6,818** |
| Corail collared | Novae TH/Bi-Mentum | 25 | 45 | 97 | 330 | 337 | 482 | **1,316** |
| Corail collared | Pinnacle | 1,278 | 1,398 | 1,569 | 1,882 | 2,156 | 2,197 | **10,480** |
| Fitmore | Allofit | 508 | 527 | 561 | 617 | 682 | 847 | **3,742** |
| Fitmore | Fitmore | 594 | 620 | 623 | 577 | 608 | 541 | **3,563** |
| Optimys | RM pressfit vitamys | 1,750 | 1,830 | 2,107 | 2,489 | 3,044 | 3,422 | **14,642** |
| Polarstem | Polarcup | 217 | 189 | 209 | 173 | 217 | 204 | **1,209** |
| Polarstem | R3 | 649 | 684 | 764 | 805 | 936 | 1,005 | **4,843** |
| Quadra-H | Versafitcup trio/ccl. | 1,055 | 977 | 742 | 474 | 182 | 14 | **3,444** |
| Quadra-P | Versafitcup trio/ccl. | 0 | 33 | 241 | 544 | 866 | 1,036 | **2,720** |
| Twinsys | RM pressfit vitamys | 402 | 407 | 394 | 415 | 424 | 451 | **2,493** |
| other combinations | | 3,651 | 3,713 | 3,241 | 3,508 | 3,534 | 3,594 | **21,241** |
| Total | | **14,038** | **14,348** | **14,494** | **15,439** | **16,404** | **17,020** | **91,743** |

used in 10 to 49 cases. This resulted in 1,297 different stem/cup combinations, of which only 248 were used in more than 50 cases. It is noteworthy that almost half of all recognised combinations were registered less than 5 times. Yet, this remarkable diversity accounted for less than 1% of all registered THA.

The current 4-year moving window covers 108 combinations with more than 50 cases.

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.

## 5.4.1 Eleven-year revision rates

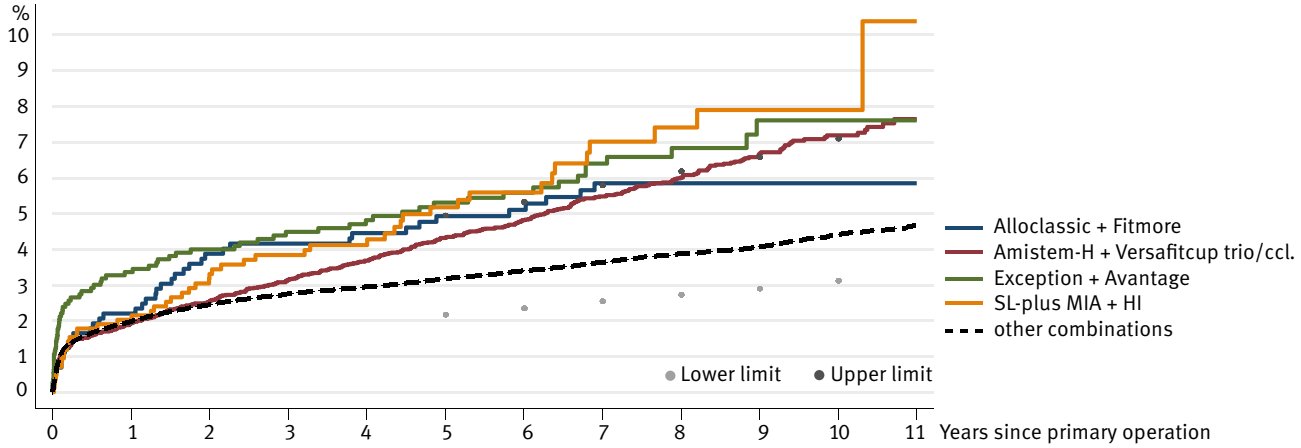
### Uncemented combinations for primary OA

The register now can provide an overview of the 11-year performance of implant combinations. The revision rates are shown for 1, 3-, 5-, 7- and 11-years follow-up. **Table 5.16** shows the stem/cup combinations used in 75% of the THA performed for primary OA and their evolution between 2018 and 2023. Two stems (Amistem-H proximal coating and Quadra-H) were still used in large numbers in 2017. Their use declined gradually since then, as they were replaced by the next generation Amistem-P and Quadra-P. **Table 5.17** shows the revision rates for the period since 2012 for implantations carried out for primary OA, whereby only stem/cup combinations with n› 500 were presented. At 11 years, the average revision rate for all uncemented stem/cup combinations was 5.1% (CI 4.9–5.3).

Four implant combinations with an elevated revision rate were detected. The corresponding KM estimates are illustrated in **Figure 5.16.** Exception/Avantage and SL Plus MIA/HI already appeared in 2022 as implant combinations with elevated revision rates. Polarstem/EP-fit and Quadra-H/Versafitcup trio/ccl, which appeared as outliers

Figure 5.16

**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 10 (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.

Table 5.17

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

Time since operation, 2012–2023

| Stem component | Cup component | Total N | CCS* | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 1,492 | 30 | **1.3** (0.8-2.0) | **1.7** (1.1-2.8) | **1.7** (1.1-2.8) | | |
| Alloclassic | Fitmore | 728 | 67 | **2.2** (1.4-3.6) | **4.2** (2.9-5.9) | **4.9** (3.6-6.8) | **5.9** (4.3-7.9) | **5.9** (4.3-7.9) |
| Amistem-H | Versafitcup trio/ccl. | 7,315 | 15 | **1.9** (1.6-2.3) | **3.1** (2.8-3.6) | **4.3** (3.9-4.8) | **5.5** (5.0-6.1) | **7.7** (6.9-8.5) |
| Amistem-H collared | Versafitcup trio/ccl. | 554 | 100 | **0.9** (0.4-2.2) | **1.8** (1.0-3.4) | **1.8** (1.0-3.4) | **2.6** (1.4-4.7) | |
| Amistem-H prox coating | Versafitcup trio/ccl. | 3,243 | 12 | **2.1** (1.7-2.7) | **2.9** (2.4-3.5) | **3.3** (2.7-4.0) | **3.8** (3.1-4.7) | |
| Amistem-P | Versafitcup trio/ccl. | 5,137 | 15 | **2.5** (2.1-3.0) | **3.1** (2.6-3.7) | | | |
| Avenir | Alloclassic | 591 | 68 | **1.9** (1.0-3.3) | **2.4** (1.4-4.0) | **2.8** (1.7-4.5) | **3.2** (2.0-5.0) | **3.9** (2.5-6.2) |
| Avenir | Allofit | 10,800 | 11 | **1.9** (1.7-2.2) | **2.6** (2.3-3.0) | **3.0** (2.7-3.4) | **3.5** (3.1-3.9) | **4.0** (3.5-4.5) |
| Avenir | Fitmore | 2,740 | 16 | **3.2** (2.6-3.9) | **4.0** (3.3-4.8) | **4.3** (3.6-5.1) | **4.5** (3.7-5.4) | **4.5** (3.7-5.4) |
| CLS Spotorno | Allofit | 1,514 | 33 | **2.6** (1.9-3.5) | **3.9** (3.1-5.1) | **4.3** (3.4-5.5) | **4.6** (3.6-5.8) | **5.5** (4.3-7.1) |
| CLS Spotorno | Fitmore | 1,852 | 24 | **1.7** (1.2-2.4) | **2.3** (1.7-3.1) | **2.9** (2.2-3.8) | **3.0** (2.2-3.9) | **3.6** (2.6-4.9) |
| Corail | Pinnacle | 13,157 | 11 | **2.1** (1.9-2.4) | **3.0** (2.8-3.4) | **3.6** (3.3-4.0) | **4.2** (3.8-4.6) | **6.0** (5.2-6.9) |
| Corail collared | Gyros | 956 | 65 | **2.1** (1.4-3.2) | **2.7** (1.9-4.0) | **2.7** (1.9-4.0) | **3.6** (2.5-5.3) | **4.0** (2.7-5.9) |
| Corail collared | Novae TH/Bi-Mentum | 1,336 | 29 | **1.6** (1.1-2.5) | **2.6** (1.6-4.4) | **2.6** (1.6-4.4) | | |
| Corail collared | Pinnacle | 13,934 | 21 | **1.4** (1.3-1.7) | **2.0** (1.8-2.3) | **2.4** (2.1-2.7) | **2.7** (2.4-3.1) | **3.4** (2.7-4.2) |
| Exception | Avantage | 1,135 | 78 | **3.4** (2.5-4.6) | **4.5** (3.4-5.9) | **5.3** (4.1-6.8) | **6.4** (5.0-8.2) | **7.6** (5.9-9.9) |
| Fitmore | Allofit | 7,631 | 66 | **1.8** (1.5-2.1) | **2.7** (2.4-3.2) | **3.1** (2.7-3.5) | **3.5** (3.0-4.0) | **4.1** (3.5-4.8) |
| Fitmore | Fitmore | 5,953 | 27 | **1.9** (1.5-2.2) | **2.7** (2.3-3.2) | **3.2** (2.8-3.7) | **3.4** (2.9-4.0) | **3.9** (3.3-4.6) |
| Fitmore | RM pressfit vitamys | 1,542 | 83 | **1.3** (0.9-2.0) | **2.1** (1.5-3.0) | **2.3** (1.6-3.3) | **2.3** (1.6-3.3) | |
| Individual/custom hip | April ceramic | 1,264 | 21 | **1.8** (1.2-2.7) | **2.8** (2.0-4.0) | **3.4** (2.4-4.9) | **3.7** (2.6-5.3) | **6.7** (2.8-15.6) |
| Optimys | Anexys | 519 | 28 | **1.6** (0.8-3.2) | **2.1** (1.1-3.8) | **2.1** (1.1-3.8) | **2.9** (1.4-5.7) | |
| Optimys | RM pressfit | 726 | 18 | **2.7** (1.7-4.2) | **2.8** (1.8-4.4) | **3.4** (2.2-5.1) | **3.8** (2.4-5.8) | |
| Optimys | RM pressfit vitamys | 20,711 | 9 | **1.8** (1.6-1.9) | **2.2** (2.0-2.4) | **2.4** (2.2-2.6) | **2.5** (2.3-2.8) | **2.7** (2.3-3.0) |
| Polarstem | EP-fit | 820 | 53 | **3.8** (2.7-5.4) | **4.6** (3.3-6.3) | **4.9** (3.6-6.7) | **5.2** (3.8-7.1) | **6.6** (4.7-9.4) |
| Polarstem | Polarcup | 2,317 | 76 | **2.0** (1.5-2.7) | **2.2** (1.7-2.9) | **2.2** (1.7-2.9) | **2.4** (1.8-3.2) | **4.6** (2.3-9.2) |
| Polarstem | R3 | 7,703 | 63 | **1.1** (0.9-1.3) | **1.6** (1.3-1.9) | **1.7** (1.4-2.1) | **2.0** (1.7-2.4) | **2.5** (2.0-3.1) |
| Quadra-H | Mpact | 535 | 43 | **2.2** (1.3-3.9) | **2.9** (1.7-4.7) | **2.9** (1.7-4.7) | | |
| Quadra-H | Versafitcup trio/ccl. | 7,173 | 18 | **2.0** (1.7-2.4) | **3.0** (2.6-3.4) | **3.7** (3.3-4.2) | **5.1** (4.5-5.7) | **7.4** (6.2-8.7) |
| Quadra-P | Mpact | 547 | 66 | **1.6** (0.8-3.1) | **2.0** (1.0-4.0) | | | |
| Quadra-P | Versafitcup trio/ccl. | 2,720 | 23 | **1.2** (0.8-1.7) | **1.5** (1.0-2.3) | | | |
| SBG | R3 | 1,640 | 43 | **1.3** (0.9-2.0) | **1.9** (1.3-2.7) | **2.4** (1.7-3.3) | **2.6** (1.8-3.6) | |
| SL-plus MIA | EP-fit | 1,252 | 29 | **1.9** (1.3-2.9) | **2.2** (1.5-3.2) | **2.5** (1.8-3.6) | **2.5** (1.8-3.6) | **2.8** (1.9-4.0) |
| SL-plus MIA | HI | 848 | 45 | 2.0 (1.3-3.2) | **3.8** (2.7-5.4) | **5.2** (3.8-7.1) | **7.0** (5.2-9.4) | **10.4** (6.2-17.2) |
| SL-plus MIA | R3 | 1,997 | 65 | **0.9** (0.6-1.4) | **1.3** (0.8-1.9) | **1.4** (0.9-2.0) | **1.5** (1.0-2.1) | **2.2** (1.4-3.4) |
| SPS evolution | April ceramic | 1,615 | 39 | **5.0** (4.0-6.1) | **6.4** (5.3-7.7) | **6.7** (5.5-8.0) | **7.0** (5.8-8.5) | **8.3** (5.9-11.4) |
| Tri-Lock | Pinnacle | 767 | 66 | **1.3** (0.7-2.4) | **2.8** (1.8-4.3) | **3.1** (2.1-4.7) | **3.5** (2.4-5.2) | **3.5** (2.4-5.2) |
| Twinsys | RM pressfit vitamys | 4,525 | 14 | **2.3** (1.9-2.8) | **2.9** (2.5-3.5) | **3.4** (2.8-4.0) | **4.0** (3.4-4.7) | **5.3** (4.3-6.6) |
| other combinations | - | 21,410 | | **2.6** (2.4-2.9) | **3.8** (3.5-4.1) | **4.6** (4.3-4.9) | **5.3** (5.0-5.7) | **6.8** (6.3-7.4) |
| **CH average for group** | | | | **2.0** (1.9-2.1) | **2.8** (2.7-2.9) | **3.3** (3.2-3.4) | **3.9** (3.7-4.0) | **5.1** (4.9-5.3) |

* 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.

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.

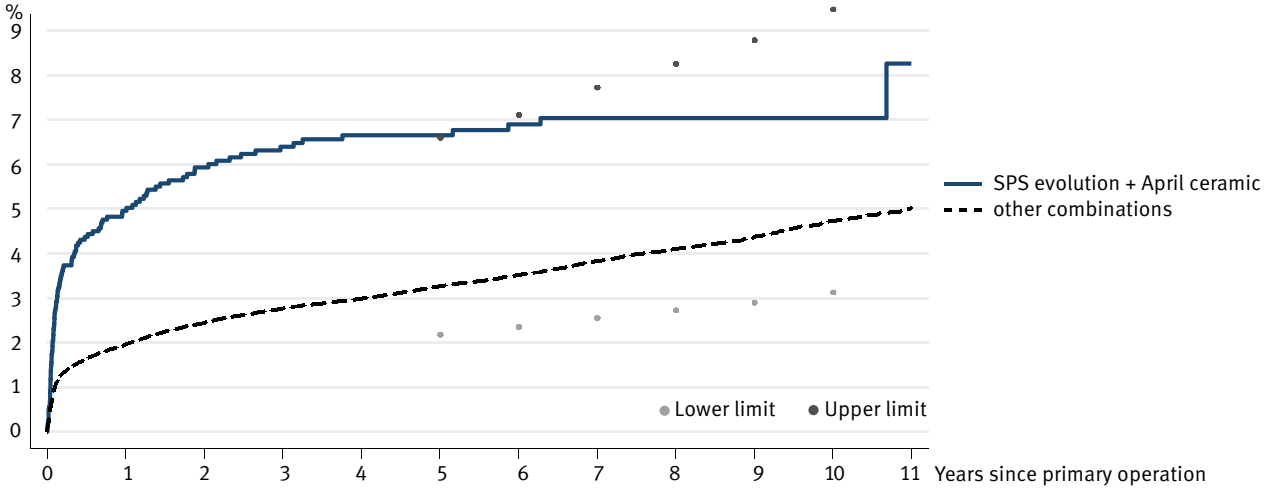
in 2023, improved and no longer had an elevated revision rate. The combination Fitmore/Allofit and Amistem-H/Versafitcup trio/ccl. reached the status of elevated revision rate in 2023. These four stem combinations represent approximately 7% of all implant combinations. None of the above was an early outlier at 2 years.

There is one outlier with increased revision rates, SPS Evolution/April ceramic, which already had outlier status at 2 years, a timepoint the revision rate already amounted to 7.7% (CI 5.7–10.2%). After a steep early rise of the revision rate, the curve flattened over the subsequent years, although the outlier boundary still exceeded at 5 years follow-up. The revision rate of this combination amounts to 8.3% (CI 5.9-11.4%) at 11 years **(Figure 5.17).** This particularly high revision rate is mainly caused by one single centre.

There are six implant combinations with a below-average revision rate in 2023, two more than in 2022 **(Figure 5.18).** The curves of these well-performing implant combinations displayed two patterns: the first with a revision rate increasing early but then an almost horizontal continuation, and the second

Figure 5.17

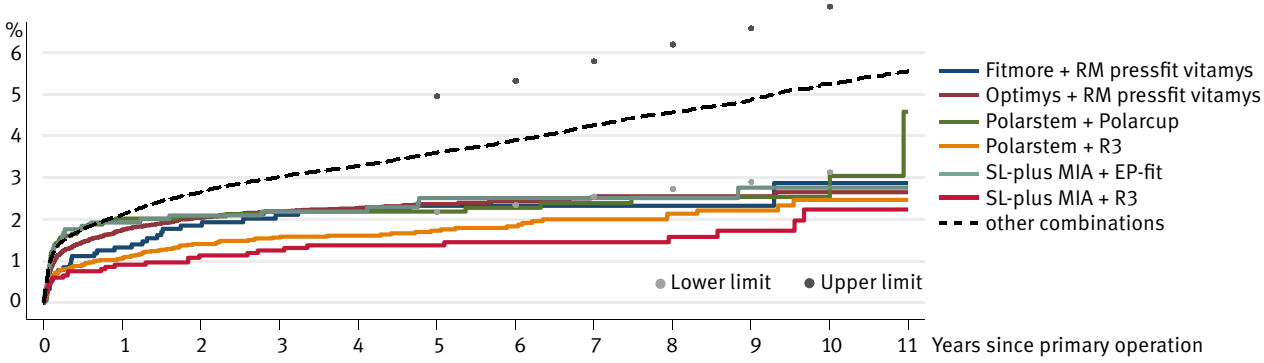
**Implant combinations with long-term evaluation outlier status (primary OA, uncemented THA)**




Outlier status was defined as a revision rate of twice the group average at any time between year 5 and year 10 (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.

Figure 5.18

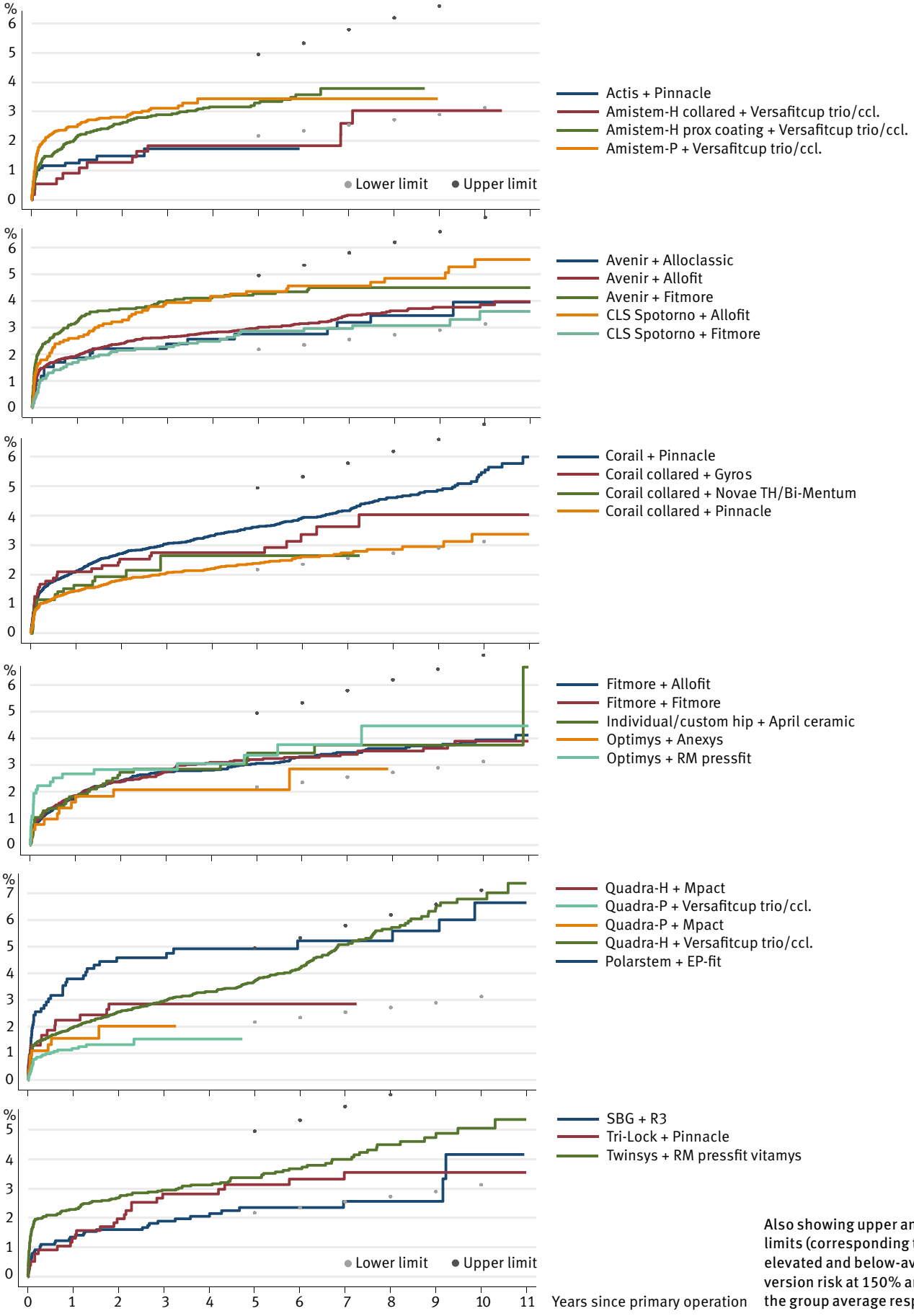
**Implant combinations with below-average long-term revision rates (primary OA, uncemented THA)**




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.

Figures 5.19

## 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).

with a very low initial revision rate followed by a flat rise. The SL Plus MIA stem, an implant with elevated revision rates when combined with the EP-Fit cup, is among the best-performing implants when combined with the R3 cup. This is a perfect example of the importance of analysing every implant combination separately.

The KM estimate of cumulative revision risk for all other uncemented implant combinations is shown in **Figures 5.19.** 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. Most cup systems are modular allowing the use of different bearings.

For the most commonly used 75% of implant combinations, the revision rate was calculated depending on the bearing surface. The results, sorted by implant combination, are shown in Table **5.18.** Although there were differences between the various bearings, these did not reach statistical significance except for Amistem-H/Versafticup trio/ccl. combined with MoXLPE, which had a significantly elevated revision rate at 11 years. This was mainly due to early revisions, after which the curves had a more parallel evolution. Overall, the pattern is not uniform as shown by examples in which CoXLPE had more revisions than MoXLPE. However, there was a trend towards slightly more revisions using CoC bearings.

Table 5.18_Part one

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

Time since operation, 2012–2023

| Stem component | Cup component | Total N | Bearing surface | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 1,019 | CoXLPE | **1.4** (0.9-2.4) | **2.2** (1.3-3.7) | **2.2** (1.3-3.7) | | |
| Alloclassic | Fitmore | 681 | CoXLPE | **1.9** (1.1-3.3) | **3.9** (2.6-5.6) | **4.7** (3.3-6.6) | **5.7** (4.1-7.8) | **5.7** (4.1-7.8) |
| Amistem-H | Versafitcup trio/ccl. | 2,410 | CoC | **1.6** (1.2-2.2) | **2.8** (2.2-3.6) | **3.7** (3.0-4.5) | **4.6** (3.8-5.6) | **6.5** (5.2-7.9) |
| Amistem-H | Versafitcup trio/ccl. | 3,137 | CoXLPE | **1.5** (1.1-2.0) | **2.8** (2.3-3.4) | **3.9** (3.3-4.6) | **4.9** (4.2-5.8) | **6.8** (5.8-8.0) |
| Amistem-H | Versafitcup trio/ccl. | 1,288 | MoXLPE | **2.8** (2.0-3.9) | **4.0** (3.1-5.2) | **5.8** (4.6-7.2) | **7.4** (6.0-9.0) | **9.2** (7.4-11.3) |
| Amistem-H collared | Versafitcup trio/ccl. | 543 | CoC | **0.9** (0.4-2.2) | **1.9** (1.0-3.5) | **1.9** (1.0-3.5) | **2.7** (1.5-4.8) | |
| Amistem-H prox coating | Versafitcup trio/ccl. | 1,389 | CoC | **1.4** (0.9-2.2) | **2.1** (1.5-3.0) | **2.5** (1.8-3.5) | **2.8** (2.0-3.8) | |
| Amistem-H prox coating | Versafitcup trio/ccl. | 1,336 | CoXLPE | **2.7** (2.0-3.7) | **3.4** (2.6-4.5) | **3.8** (2.8-4.9) | **4.6** (3.3-6.2) | |
| Amistem-P | Versafitcup trio/ccl. | 2,606 | CoC | **2.0** (1.5-2.6) | **2.5** (1.9-3.2) | | | |
| Amistem-P | Versafitcup trio/ccl. | 1,953 | CoXLPE | **2.4** (1.8-3.2) | **2.9** (2.2-3.8) | | | |
| Avenir | Allofit | 8,157 | CoXLPE | **1.7** (1.5-2.0) | **2.4** (2.1-2.7) | **2.8** (2.4-3.2) | **3.2** (2.8-3.7) | **3.9** (3.3-4.6) |
| Avenir | Allofit | 2,178 | MoXLPE | **2.4** (1.8-3.1) | **3.2** (2.5-4.0) | **3.4** (2.7-4.3) | **3.6** (2.9-4.6) | **3.8** (3.0-4.8) |
| Avenir | Fitmore | 2,059 | CoXLPE | **3.3** (2.6-4.2) | **4.0** (3.3-5.0) | **4.4** (3.6-5.4) | **4.7** (3.8-5.8) | **4.7** (3.8-5.8) |
| Avenir | Fitmore | 563 | MoXLPE | **2.7** (1.6-4.4) | **3.6** (2.3-5.5) | **3.6** (2.3-5.5) | **3.6** (2.3-5.5) | **3.6** (2.3-5.5) |
| CLS Spotorno | Allofit | 1,186 | CoXLPE | **3.0** (2.2-4.2) | **4.5** (3.4-5.8) | **4.8** (3.7-6.2) | **5.1** (3.9-6.5) | **6.4** (4.7-8.7) |
| CLS Spotorno | Fitmore | 878 | CoXLPE | **2.1** (1.3-3.3) | **2.7** (1.8-4.0) | **3.5** (2.4-5.1) | **3.7** (2.6-5.3) | **3.7** (2.6-5.3) |
| CLS Spotorno | Fitmore | 950 | MoXLPE | **1.4** (0.8-2.4) | **1.9** (1.2-3.1) | **2.4** (1.5-3.6) | **2.4** (1.5-3.6) | **3.6** (2.2-5.9) |
| Corail | Pinnacle | 1,830 | CoC | **2.1** (1.6-2.9) | **3.5** (2.7-4.4) | **4.3** (3.5-5.4) | **4.7** (3.8-5.8) | **6.8** (5.3-8.8) |

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.

Table 5.18_Part two

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

Time since operation, 2012–2023

| Stem component | Cup component | Total N | Bearing surface | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Corail | Pinnacle | 10,288 | CoXLPE | **2.1** (1.9-2.4) | **3.0** (2.7-3.3) | **3.4** (3.1-3.8) | **3.9** (3.5-4.4) | **5.7** (4.7-6.9) |
| Corail | Pinnacle | 872 | MoXLPE | **1.7** (1.1-2.9) | **2.5** (1.7-3.9) | **3.0** (2.0-4.5) | **5.2** (3.6-7.6) | **7.6** (5.0-11.4) |
| Corail collared | Gyros | 808 | CoCPE | **2.1** (1.3-3.4) | **2.9** (1.9-4.3) | **2.9** (1.9-4.3) | **3.9** (2.6-5.8) | |
| Corail collared | Novae TH/Bi-Mentum | 1,070 | CoCPE | **1.9** (1.2-3.0) | **3.1** (1.8-5.2) | **3.1** (1.8-5.2) | | |
| Corail collared | Pinnacle | 2,171 | CoC | **1.8** (1.3-2.5) | **2.5** (1.9-3.3) | **3.1** (2.4-4.1) | **3.6** (2.8-4.7) | **4.3** (2.9-6.3) |
| Corail collared | Pinnacle | 11,293 | CoXLPE | **1.4** (1.2-1.6) | **1.9** (1.6-2.2) | **2.1** (1.8-2.5) | **2.5** (2.1-2.9) | **3.0** (2.3-3.9) |
| Exception | Avantage | 903 | CoXLPE | **3.6** (2.5-5.0) | **4.5** (3.3-6.1) | **5.2** (3.9-7.0) | **6.1** (4.7-8.0) | **7.1** (5.3-9.3) |
| Fitmore | Allofit | 5,389 | CoXLPE | **1.6** (1.3-2.0) | **2.5** (2.1-2.9) | **2.7** (2.3-3.2) | **3.2** (2.7-3.8) | **3.3** (2.8-4.0) |
| Fitmore | Allofit | 2,114 | MoXLPE | **2.2** (1.6-2.9) | **3.2** (2.5-4.1) | **3.6** (2.9-4.5) | **3.8** (3.0-4.8) | **4.6** (3.6-5.8) |
| Fitmore | Fitmore | 2,885 | CoXLPE | **1.6** (1.2-2.2) | **2.3** (1.8-2.9) | **3.1** (2.5-4.0) | **3.1** (2.5-4.0) | **3.4** (2.6-4.4) |
| Fitmore | Fitmore | 3,022 | MoXLPE | **2.1** (1.6-2.6) | **3.1** (2.5-3.8) | **3.4** (2.7-4.1) | **3.6** (3.0-4.4) | **4.2** (3.4-5.3) |
| Fitmore | RM pressfit vitamys | 1,409 | CoXLPE | **1.2** (0.7-1.9) | **1.7** (1.1-2.5) | **1.8** (1.2-2.7) | **1.8** (1.2-2.7) | |
| Individual/custom hip | April ceramic | 1,239 | CoC | **1.9** (1.2-2.8) | **2.9** (2.1-4.1) | **3.5** (2.5-4.9) | **3.8** (2.7-5.4) | **6.8** (2.8-16.0) |
| Optimys | RM pressfit vitamys | 20,247 | CoXLPE | **1.8** (1.6-1.9) | **2.2** (2.0-2.4) | **2.4** (2.1-2.6) | **2.5** (2.3-2.8) | **2.7** (2.3-3.0) |
| Optimys | RM pressfit | 582 | CoCPE | **1.9** (1.1-3.5) | **2.1** (1.2-3.7) | **2.8** (1.6-4.7) | **3.2** (1.9-5.4) | |
| Polarstem | Polarcup | 1,181 | CMoXLPE | **1.8** (1.2-2.8) | **2.0** (1.3-3.0) | **2.0** (1.3-3.0) | **2.0** (1.3-3.0) | |
| Polarstem | Polarcup | 809 | CoXLPE | **2.4** (1.5-3.7) | **2.6** (1.7-4.0) | **2.6** (1.7-4.0) | **2.9** (1.9-4.4) | **5.5** (2.7-11.1) |
| Polarstem | R3 | 5,146 | CMoXLPE | **0.8** (0.6-1.1) | **1.3** (1.0-1.7) | **1.5** (1.2-2.0) | **1.8** (1.4-2.4) | |
| Polarstem | R3 | 2,370 | CoXLPE | **1.6** (1.2-2.2) | **2.0** (1.5-2.7) | **2.2** (1.6-2.9) | **2.4** (1.8-3.1) | **2.8** (2.1-3.7) |
| Quadra-H | Versafitcup trio/ccl. | 1,115 | CoC | **1.5** (1.0-2.4) | **2.3** (1.6-3.4) | **2.7** (1.9-3.9) | **3.6** (2.5-5.2) | |
| Quadra-H | Versafitcup trio/ccl. | 4,495 | CoXLPE | **2.1** (1.7-2.6) | **3.2** (2.7-3.7) | **4.0** (3.5-4.7) | **5.6** (4.8-6.5) | **8.7** (6.3-12.0) |
| Quadra-H | Versafitcup trio/ccl. | 1,413 | MoXLPE | **2.3** (1.6-3.2) | **2.9** (2.1-3.9) | **3.5** (2.6-4.7) | **4.5** (3.4-5.9) | **6.5** (4.9-8.5) |
| Quadra-P | Versafitcup trio/ccl. | 677 | CoC | **1.2** (0.6-2.4) | **1.2** (0.6-2.4) | | | |
| Quadra-P | Versafitcup trio/ccl. | 1835 | CoXLPE | **1.2** (0.8-1.8) | **1.4** (0.9-2.1) | | | |
| SBG | R3 | 776 | CMoXLPE | **1.3** (0.7-2.4) | **2.2** (1.3-3.5) | **2.9** (1.9-4.4) | **2.9** (1.9-4.4) | |
| SBG | R3 | 833 | CoC | **1.5** (0.8-2.6) | **1.7** (1.0-2.9) | **1.9** (1.2-3.2) | **2.4** (1.4-4.2) | |
| SL-plus MIA | EP-fit | 571 | CoC | **2.6** (1.6-4.3) | **2.6** (1.6-4.3) | **2.8** (1.7-4.6) | **2.8** (1.7-4.6) | **2.8** (1.7-4.6) |
| SL-plus MIA | R3 | 1,955 | CMoXLPE | **0.9** (0.5-1.4) | **1.2** (0.8-1.8) | **1.4** (0.9-2.0) | **1.4** (1.0-2.1) | **2.3** (1.4-3.5) |
| SPS evolution | April ceramic | 1,598 | CoC | **4.9** (4.0-6.1) | **6.4** (5.3-7.8) | **6.7** (5.5-8.0) | **7.1** (5.8-8.5) | **8.3** (5.9-11.5) |
| Tri-Lock | Pinnacle | 736 | CoXLPE | **1.1** (0.5-2.2) | **1.9** (1.1-3.2) | **2.3** (1.4-3.7) | **2.7** (1.7-4.3) | **2.7** (1.7-4.3) |
| Twinsys | RM pressfit vitamys | 4,406 | CoXLPE | **2.3** (1.9-2.8) | **2.9** (2.5-3.5) | **3.4** (2.8-4.0) | **4.0** (3.3-4.7) | **5.4** (4.3-6.6) |

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.

### Hybrid combinations for primary OA

There were 20 hybrid implant combinations, indicating an uncemented cup combined with a cemented stem, covering 75% of all primary THA for primary OA **(Table 5.19).** Some stems have been withdrawn meanwhile from the market, like the Centris and the use of others was declining (Weber). On the other hand, Corail and Twinsys were increasingly used. At 11 years, the average revision rate for all hybrid stem/cup combinations was 4.8 (CI 4.3–5.3%) **(Table 5.20).**

Table 5.19
**Top 75% of primary total hip arthroplasty hybrid combinations (primary OA) 2018-2023**

| Stem component | Cup component | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | Mpact | 26 | 27 | 31 | 15 | 20 | 22 | 141 |
| Amistem-C | Versafitcup DM | 23 | 27 | 29 | 26 | 24 | 44 | 173 |
| Amistem-C | Versafitcup trio/ccl. | 187 | 207 | 161 | 181 | 192 | 157 | 1,085 |
| Avenir (cem) | Allofit | 130 | 98 | 94 | 94 | 96 | 102 | 614 |
| Avenir (cem) | Fitmore | 28 | 53 | 53 | 77 | 131 | 111 | 453 |
| Centris | RM pressfit vitamys | 50 | 31 | 55 | 64 | 0 | 0 | 200 |
| Corail (cem) | Novae TH/Bi-Mentum | 1 | 1 | 14 | 37 | 73 | 95 | 221 |
| Corail (cem) | Pinnacle | 118 | 129 | 150 | 168 | 187 | 230 | 982 |
| Exeter V40 | Symbol DMHA/DS evol. | 0 | 0 | 0 | 25 | 38 | 40 | 103 |
| Harmony (cem) | Liberty | 27 | 24 | 14 | 26 | 13 | 0 | 104 |
| MS-30 | Allofit | 43 | 48 | 43 | 68 | 234 | 216 | 652 |
| MS-30 | Fitmore | 90 | 70 | 55 | 16 | 32 | 35 | 298 |
| Original Mueller | Fitmore | 37 | 30 | 20 | 19 | 5 | 16 | 127 |
| Quadra-C | Mpact DM | 20 | 29 | 24 | 21 | 1 | 2 | 97 |
| Quadra-C | Versafitcup trio/ccl. | 178 | 209 | 155 | 79 | 13 | 1 | 635 |
| Quadra-P (cem) | Versafitcup trio/ccl. | 0 | 0 | 9 | 49 | 72 | 86 | 216 |
| Twinsys (cem) | RM pressfit | 5 | 18 | 19 | 34 | 13 | 10 | 99 |
| Twinsys (cem) | RM pressfit vitamys | 157 | 196 | 198 | 284 | 318 | 416 | 1,569 |
| Twinsys (cem) | Symbol DMHA/DS evol. | 9 | 9 | 20 | 14 | 31 | 19 | 102 |
| Weber | Allofit | 77 | 48 | 38 | 31 | 30 | 29 | 253 |
| Weber | Fitmore | 195 | 180 | 162 | 148 | 104 | 39 | 828 |
| other combinations | | 458 | 491 | 404 | 474 | 505 | 622 | 2,954 |
| **Total** | | **1,859** | **1,925** | **1,748** | **1,950** | **2,132** | **2,292** | **11,906** |

There were no combinations with elevated mid-term revision rates, nor outliers, to be observed. While two implant combinations (Corail [cem]/ Pinnacle and MS-30/Allofit) had a below-average long-term revision rate **(Figure 5.20),** all remaining implants were within the upper and lower limits **(Figure 5.21).** 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 and overlapping with the reference group, due to small numbers, and therefore were not statistically different.

Table 5.20

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

Time since operation, 2012–2023

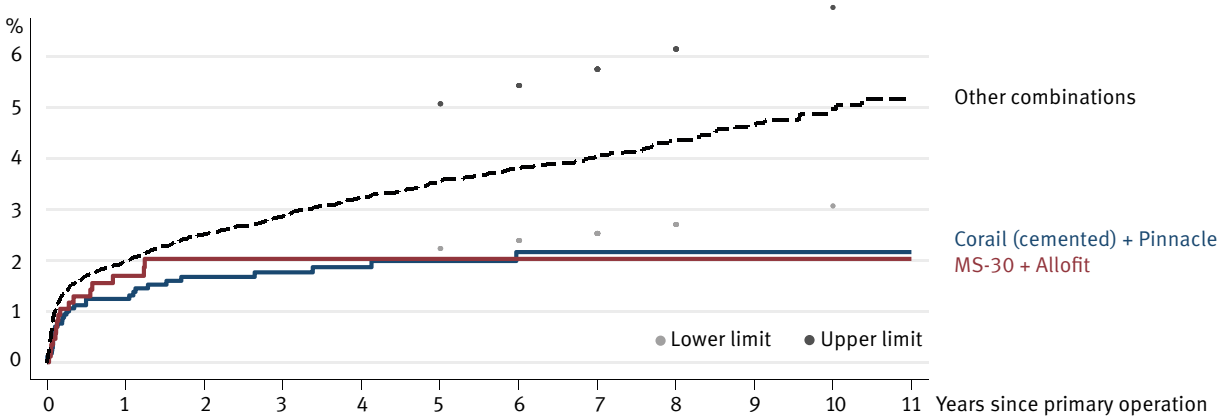
| Stem component | Cup component | Total N | CCS* | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | Versafitcup trio/ccl. | 2,337 | 23 | **2.6** (2.0-3.4) | **3.3** (2.6-4.1) | **3.9** (3.1-4.8) | **4.3** (3.4-5.3) | **5.5** (4.2-7.2) |
| Avenir (cem) | Allofit | 782 | 19 | **1.7** (1.0-3.0) | **2.4** (1.5-3.9) | **3.2** (1.9-5.1) | **3.2** (1.9-5.1) | |
| Corail (cem) | Pinnacle | 1,740 | 18 | **1.2** (0.8-1.9) | **1.8** (1.2-2.5) | **2.0** (1.4-2.9) | **2.2** (1.5-3.1) | **2.2** (1.5-3.1) |
| MS-30 | Allofit | 881 | 52 | **1.7** (1.0-2.8) | **2.0** (1.2-3.3) | **2.0** (1.2-3.3) | **2.0** (1.2-3.3) | **2.0** (1.2-3.3) |
| MS-30 | Fitmore | 843 | 53 | **1.3** (0.7-2.4) | **1.7** (1.0-2.9) | **1.9** (1.1-3.1) | **2.1** (1.3-3.5) | **3.7** (2.1-6.5) |
| Quadra-C | Versafitcup trio/ccl. | 1,038 | 32 | **2.3** (1.6-3.5) | **3.2** (2.3-4.5) | **3.8** (2.8-5.3) | **4.4** (3.2-6.2) | |
| Twinsys (cem) | RM pressfit vitamys | 1,831 | 18 | **1.1** (0.7-1.7) | **1.7** (1.1-2.5) | **2.9** (1.9-4.5) | **3.3** (2.2-5.2) | |
| Weber | Allofit | 776 | 28 | **1.8** (1.1-3.1) | **2.9** (1.9-4.4) | **3.4** (2.3-5.0) | **4.7** (3.2-6.8) | **7.3** (4.5-11.7) |
| Weber | Fitmore | 2,385 | 28 | **1.5** (1.1-2.1) | **2.5** (1.9-3.2) | **3.3** (2.6-4.1) | **4.0** (3.2-5.0) | **5.3** (3.8-7.3) |
| other combinations | - | 8,447 | | **2.2** (1.9-2.5) | **3.2** (2.8-3.6) | **3.9** (3.5-4.4) | **4.3** (3.8-4.8) | **5.1** (4.4-5.9) |
| **CH average for group** | | | | **1.9** (1.7-2.1) | **2.7** (2.5-3.0) | **3.4** (3.1-3.7) | **3.8** (3.5-4.2) | **4.8** (4.3-5.4) |

* 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.

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.

Figure 5.20

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




Below-average was defined as a 9-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). The dots indicate upper and lower limits.

### Uncemented combinations for secondary OA

**Table 5.21** shows the 19 implant combinations that cover 75% of all uncemented THA performed for secondary OA and their use over the last 5 years. The 11-year revision rates for the period since 2012 was 7.0% (CI 6.3-7.9%) **(Table 5.22).** 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. Although there were no outliers at 11 years, one combination (Quadra-H/Versafitcup Trio/ccl.) continued to have an elevated long-term revision rate **(Figure 5.22).**

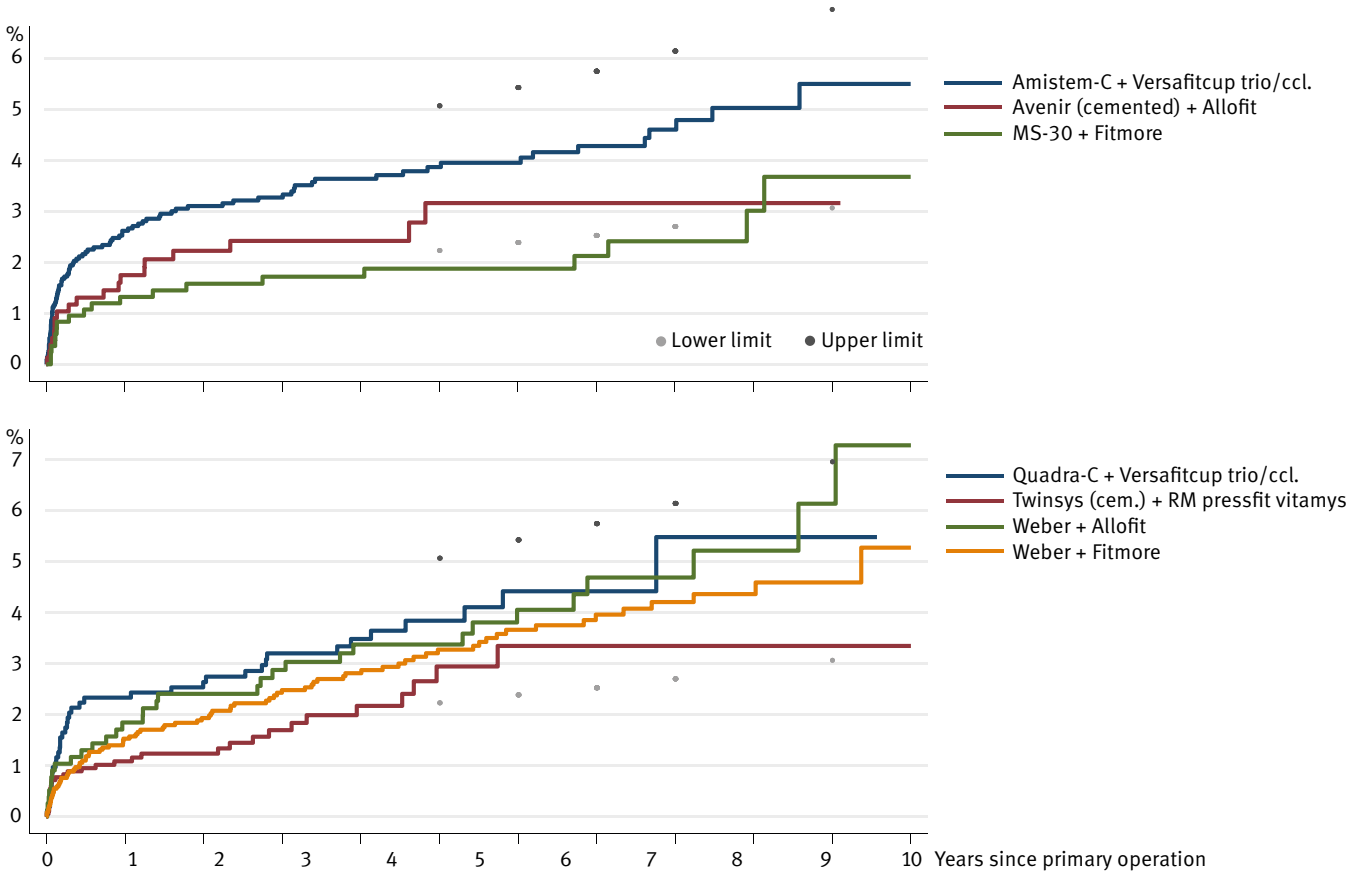
Furthermore, there were no outliers at 11 years, nor combinations with a below-average long-term revision rate **(Figures 5.23).**

### 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 THAs used to treat fractures are presented in Chapter 5.7.

Figure 5.21

**All remaining implant combinations with average revision risks (prim 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).

Table 5.21

## Top 75% of primary total hip arthroplasty uncemented combinations (secondary OA) 2018-2023

| Stem component | Cup component | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| Actis | Pinnacle | 1 | 9 | 15 | 36 | 69 | 71 | **201** |
| Amistem-H prox coating | Versafitcup trio/ccl. | 115 | 56 | 3 | 3 | 0 | 0 | **177** |
| Amistem-P | Versafitcup trio/ccl. | 1 | 41 | 111 | 117 | 99 | 78 | **447** |
| Avenir | Allofit | 90 | 90 | 101 | 54 | 67 | 61 | **463** |
| CLS Spotorno | Allofit | 30 | 35 | 23 | 9 | 5 | 6 | **108** |
| Corail | Pinnacle | 65 | 77 | 78 | 110 | 89 | 73 | **492** |
| Corail collared | Novae TH/Bi-Mentum | 5 | 6 | 16 | 37 | 32 | 54 | **150** |
| Corail collared | Pinnacle | 105 | 107 | 123 | 199 | 237 | 193 | **964** |
| Fitmore | Allofit | 121 | 123 | 131 | 173 | 179 | 163 | **890** |
| Fitmore | Fitmore | 32 | 58 | 52 | 37 | 46 | 52 | **277** |
| Fitmore | RM pressfit vitamys | 6 | 11 | 33 | 23 | 23 | 16 | **112** |
| Individual/custom hip | April ceramic | 22 | 20 | 18 | 35 | 23 | 29 | **147** |
| Optimys | RM pressfit vitamys | 149 | 145 | 179 | 218 | 266 | 294 | **1,251** |
| Polarstem | Polarcup | 2 | 19 | 30 | 29 | 46 | 37 | **163** |
| Polarstem | R3 | 61 | 73 | 89 | 89 | 91 | 98 | **501** |
| Quadra-H | Versafitcup trio/ccl. | 79 | 70 | 51 | 43 | 13 | 1 | **257** |
| Quadra-P | Versafitcup trio/ccl. | 0 | 2 | 20 | 40 | 100 | 128 | **290** |
| Twinsys | RM pressfit vitamys | 33 | 26 | 33 | 40 | 37 | 39 | **208** |
| other combinations | | 366 | 376 | 375 | 373 | 427 | 397 | **2,314** |
| **Total** | | **1,283** | **1,344** | **1,481** | **1,665** | **1,849** | **1,790** | **9,412** |

Table 5.22

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

Time since operation, 2012–2023

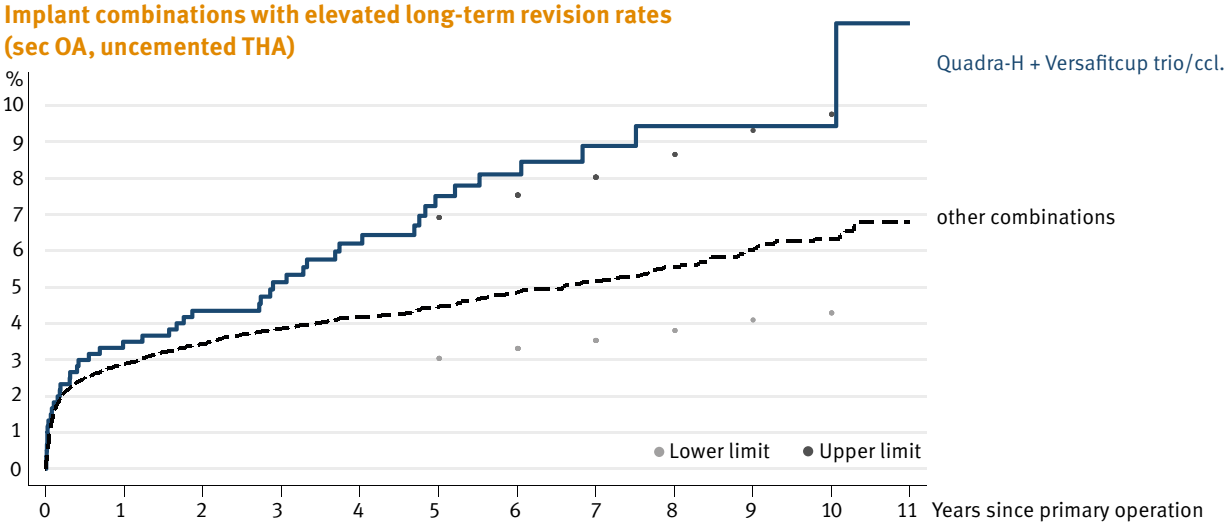
| Stem component | Cup component | Total N | CCS* | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Amistem-H | Versafitcup trio/ccl. | 556 | 14 | **1.8** (1.0-3.3) | **2.6** (1.5-4.3) | **3.8** (2.5-5.8) | **4.9** (3.3-7.2) | **10.2** (6.9-15.1) |
| Avenir | Allofit | 809 | 14 | **3.5** (2.4-5.1) | **4.6** (3.3-6.4) | **5.0** (3.6-6.9) | **5.6** (4.1-7.7) | **5.6** (4.1-7.7) |
| Corail | Pinnacle | 984 | 10 | **2.8** (1.9-4.0) | **3.7** (2.7-5.2) | **4.4** (3.2-6.1) | **4.9** (3.6-6.7) | **7.5** (4.9-11.2) |
| Corail collared | Pinnacle | 1,343 | 29 | **2.2** (1.5-3.1) | **3.1** (2.2-4.3) | **3.8** (2.8-5.2) | **3.8** (2.8-5.2) | **4.6** (3.0-7.1) |
| Fitmore | Allofit | 1,504 | 89 | **1.5** (1.0-2.3) | **2.6** (1.9-3.7) | **2.7** (2.0-3.8) | **2.9** (2.1-4.0) | **4.1** (2.8-6.2) |
| Optimys | RM pressfit vitamys | 1,688 | 18 | **2.6** (2.0-3.5) | **3.2** (2.4-4.2) | **3.7** (2.8-4.9) | **4.4** (3.3-6.0) | |
| Polarstem | R3 | 799 | 79 | **2.2** (1.4-3.5) | **3.0** (2.0-4.6) | **3.3** (2.2-5.0) | **3.6** (2.4-5.5) | **4.2** (2.7-6.4) |
| Quadra-H | Versafitcup trio/ccl. | 603 | 26 | **3.5** (2.3-5.3) | **5.1** (3.6-7.3) | **7.5** (5.5-10.2) | **8.9** (6.6-11.9) | **12.3** (7.4-20.0) |
| other combinations | - | 7,237 | | **3.4** (3.0-3.9) | **4.5** (4.0-5.1) | **5.2** (4.6-5.8) | **6.1** (5.5-6.8) | **7.1** (6.2-8.1) |
| **CH average for group** | | | | **2.9** (2.6-3.2) | **3.9** (3.6-4.3) | **4.6** (4.3-5.0) | **5.4** (4.9-5.8) | **7.0** (6.3-7.9) |

* 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.

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.

Figure 5.22

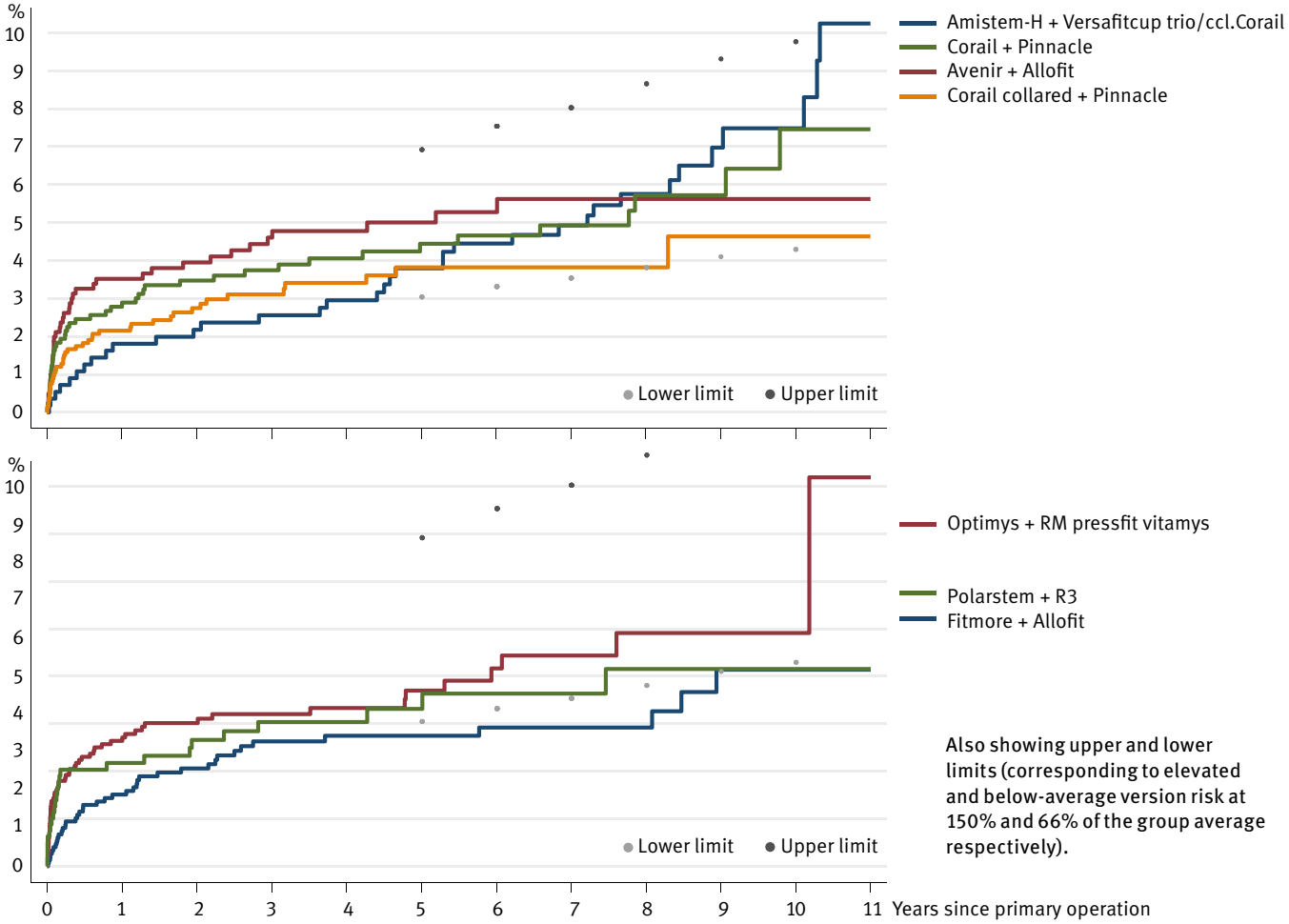
**Implant combinations with elevated long-term revision rates (sec OA, uncemented THA)**




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 10 (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.

Figures 5.23

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



## 5.4.2 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 **(Figure 5.4, Figure 5.5 see Page 74).** The average revision rate is calculated for the moving 4-year window period from 01.01.2018 to 31.12.2021. 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 58,299 uncemented THA had been performed during the period of interest for primary OA. The average revision rate was 2.5% (CI 2.4–2.6%). **Table 5.23** shows the 2-year revision rates of all uncemented implant combinations for primary OA with n›50, representing 96% of all combinations. Overall, 2,334 implant combinations were used in less than 50 cases during the 4-year observation period. Six 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. GTS/G7 bispherical, Polarstem/EP-fit and SPS Evolution/April ceramic turned out to be outliers three years in a row. However, GTS/G7 bispherical is no longer in use. Polarstem/EP-fit is still used but improving. SPS Evolution/April ceramic remains in use, but the results are worsening. The combination Nanos/R3 is a first-time outlier. A detailed assessment of the outliers is presented in the outlier watch list at **page 183.**

**Figure 5.24** 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.

### 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.

Table 5.23_ Part one

## 2-year revision rates of uncemented primary total hip arthroplasty combinations (primary OA)

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Stem component | Cup component | CSS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Accolade II | Trident II | 35 | 101 | 8 | 8.0 (4.1-15.3) |
| Actis | Pinnacle | 39 | 553 | 7 | 1.3 (0.6-2.6) |
| Alloclassic | Alloclassic | 97 | 63 | 1 | 1.6 (0.2-10.9) |
| Alloclassic | Allofit | 82 | 114 | 2 | 1.8 (0.4-7.0) |
| Alloclassic | Fitmore | 86 | 92 | 1 | 1.1 (0.2-7.5) |
| Amistem-H | Versafitcup trio/ccl. | 42 | 124 | 1 | 0.8 (0.1-5.6) |
| Amistem-H collared | Versafitcup trio/ccl. | 100 | 153 | 1 | 0.7 (0.1-4.6) |
| Amistem-H prox coating | Mpact | 30 | 243 | 5 | 2.1 (0.9-4.9) |
| Amistem-H prox coating | Versafitcup trio/ccl. | 14 | 2,212 | 63 | 2.9 (2.2-3.7) |
| Amistem-P | Mpact | 38 | 273 | 9 | 3.3 (1.8-6.3) |
| Amistem-P | Versafitcup DM | 33 | 67 | 2 | 3.0 (0.8-11.5) |
| Amistem-P | Versafitcup trio/ccl. | 15 | 2,792 | 76 | 2.7 (2.2-3.4) |
| Ana.Nova alpha proxy | Ana.Nova alpha | 96 | 158 | 2 | 1.3 (0.3-5.0) |
| Avenir | Ades DM | 94 | 63 | 1 | 1.6 (0.2-10.7) |
| Avenir | Allofit | 14 | 4,050 | 95 | 2.4 (1.9-2.9) |
| Avenir | Avantage | 22 | 74 | 2 | 2.7 (0.7-10.4) |
| Avenir | Fitmore | 26 | 1,023 | 47 | 4.6 (3.5-6.1) |
| Avenir complete | Allofit | 40 | 62 | 2 | 3.3 (0.8-12.5) |
| Brexis | Xentrax | 100 | 51 | 3 | 5.9 (1.9-17.1) |
| CLS Spotorno | Allofit | 47 | 386 | 15 | 3.9 (2.4-6.4) |
| CLS Spotorno | Fitmore | 33 | 486 | 6 | 1.2 (0.6-2.7) |
| Corail | Fitmore | 95 | 229 | 3 | 1.3 (0.4-4.0) |
| Corail | Pinnacle | 14 | 4,775 | 144 | 3.0 (2.6-3.6) |
| Corail collared | Fitmore | 82 | 51 | 1 | 2.0 (0.3-13.1) |
| Corail collared | Gyros | 53 | 442 | 13 | 3.0 (1.7-5.0) |
| Corail collared | Novae TH/Bi-Mentum | 37 | 497 | 9 | 1.8 (1.0-3.5) |
| Corail collared | Pinnacle | 24 | 6,127 | 106 | 1.7 (1.4-2.1) |
| Corehip | Plasmafit | 74 | 185 | 0 | 0.0 (.-.) |
| Exacta | Jump system/JS traser | 90 | 150 | 4 | 2.7 (1.0-7.0) |
| Exacta S | Jump system/JS traser | 53 | 174 | 5 | 2.9 (1.2-6.8) |
| Exception | Allofit | 44 | 118 | 2 | 1.7 (0.4-6.6) |
| Exception | Avantage | 65 | 328 | 13 | 4.0 (2.3-6.8) |
| Exception | Exceed | 95 | 79 | 2 | 2.5 (0.6-9.7) |
| Expersus | Primaro | 98 | 60 | 0 | . (.-.) |
| Fitmore | Allofit | 78 | 2,213 | 36 | 1.6 (1.2-2.3) |
| Fitmore | Fitmore | 36 | 2,414 | 47 | 2.0 (1.5-2.6) |
| Fitmore | RM pressfit vitamys | 89 | 547 | 10 | 1.8 (1.0-3.4) |
| GTS | G7 bispherical | 92 | 62 | 5 | 8.2 (3.5-18.5) |
| H-Max S | Delta TT | 41 | 169 | 2 | 1.2 (0.3-4.7) |
| H-Max S | Symbol DMHA/DS evol. | 74 | 121 | 4 | 3.4 (1.3-8.7) |

* 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.

Table 5.23_Part two

| Stem component | Cup component | CSS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Individual/custom hip | April ceramic | 25 | 530 | 9 | 1.7 (0.9-3.3) |
| Individual/custom hip | Pinnacle | 55 | 99 | 1 | 1.0 (0.1-7.0) |
| Link LCU | Mobilelink | 75 | 91 | 3 | 3.3 (1.1-9.9) |
| Metafix | Trinity | 65 | 158 | 7 | 4.4 (2.1-9.1) |
| Minimax | Versafitcup trio/ccl. | 36 | 116 | 4 | 3.5 (1.3-9.0) |
| Nanos | R3 | 42 | 105 | 6 | 5.8 (2.6-12.4) |
| Optimys | Anexys | 29 | 270 | 8 | 3.0 (1.5-5.9) |
| Optimys | RM pressfit | 27 | 285 | 9 | 3.2 (1.7-6.0) |
| Optimys | RM pressfit vitamys | 9 | 8,176 | 181 | 2.2 (1.9-2.6) |
| Optimys | Symbol DMHA/DS evol. | 41 | 101 | 1 | 1.0 (0.1-6.8) |
| Optimys | Trident II | 96 | 91 | 2 | 2.2 (0.6-8.5) |
| Polarstem | EP-fit | 92 | 348 | 18 | 5.2 (3.3-8.1) |
| Polarstem | HI | 97 | 64 | 0 | 0.0 (.-) |
| Polarstem | Novae TH/Bi-Mentum | 100 | 61 | 3 | 4.9 (1.6-14.5) |
| Polarstem | Polarcup | 64 | 788 | 11 | 1.4 (0.8-2.5) |
| Polarstem | R3 | 51 | 2,902 | 48 | 1.7 (1.3-2.2) |
| Quadra-H | Mpact | 47 | 453 | 12 | 2.7 (1.5-4.6) |
| Quadra-H | Versafitcup DM | 36 | 110 | 1 | 0.9 (0.1-6.3) |
| Quadra-H | Versafitcup trio/ccl. | 20 | 3,248 | 98 | 3.0 (2.5-3.7) |
| Quadra-P | Mpact | 79 | 163 | 3 | 1.8 (0.6-5.6) |
| Quadra-P | Versafitcup trio/ccl. | 35 | 818 | 10 | 1.2 (0.7-2.3) |
| SBG | R3 | 42 | 799 | 13 | 1.6 (1.0-2.8) |
| SBG | Xentrax | 100 | 82 | 1 | 1.2 (0.2-8.4) |
| SL-plus | HI | 100 | 102 | 1 | 1.0 (0.1-6.8) |
| SL-plus MIA | EP-fit | 41 | 240 | 3 | 1.3 (0.4-3.8) |
| SL-plus MIA | HI | 46 | 316 | 11 | 3.5 (2.0-6.3) |
| SL-plus MIA | R3 | 71 | 444 | 6 | 1.4 (0.6-3.0) |
| SMS | Versafitcup trio/ccl. | 61 | 135 | 5 | 3.8 (1.6-8.8) |
| SPS evolution | April ceramic | 35 | 552 | 42 | 7.7 (5.7-10.2) |
| SPS evolution | April poly | 28 | 86 | 5 | 5.9 (2.5-13.6) |
| SPS evolution | Liberty | 31 | 80 | 3 | 3.7 (1.2-11.2) |
| Stelia-Stem | BSC pressfit | 100 | 97 | 1 | 1.0 (0.1-7.1) |
| Symbol | Symbol DMHA/DS evol. | 75 | 97 | 8 | 8.3 (4.2-15.9) |
| Tri-Lock | Pinnacle | 75 | 169 | 3 | 1.8 (0.6-5.4) |
| Twinsys | Anexys | 36 | 75 | 3 | 4.0 (1.3-11.9) |
| Twinsys | RM pressfit | 39 | 76 | 4 | 5.3 (2.0-13.4) |
| Twinsys | RM pressfit vitamys | 16 | 1,618 | 39 | 2.4 (1.8-3.3) |
| Twinsys | Symbol DMHA/DS evol. | 46 | 69 | 1 | 1.4 (0.2-9.8) |
| other combinations | - | | 2,334 | 108 | 4.7 (3.9-5.6) |
| **CH average for group** | | | | | **2.5 (2.4-2.6)** |

Figure 5.24

## 2-year revision rates of uncemented primary total hip arthroplasty combinations (primary OA)

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

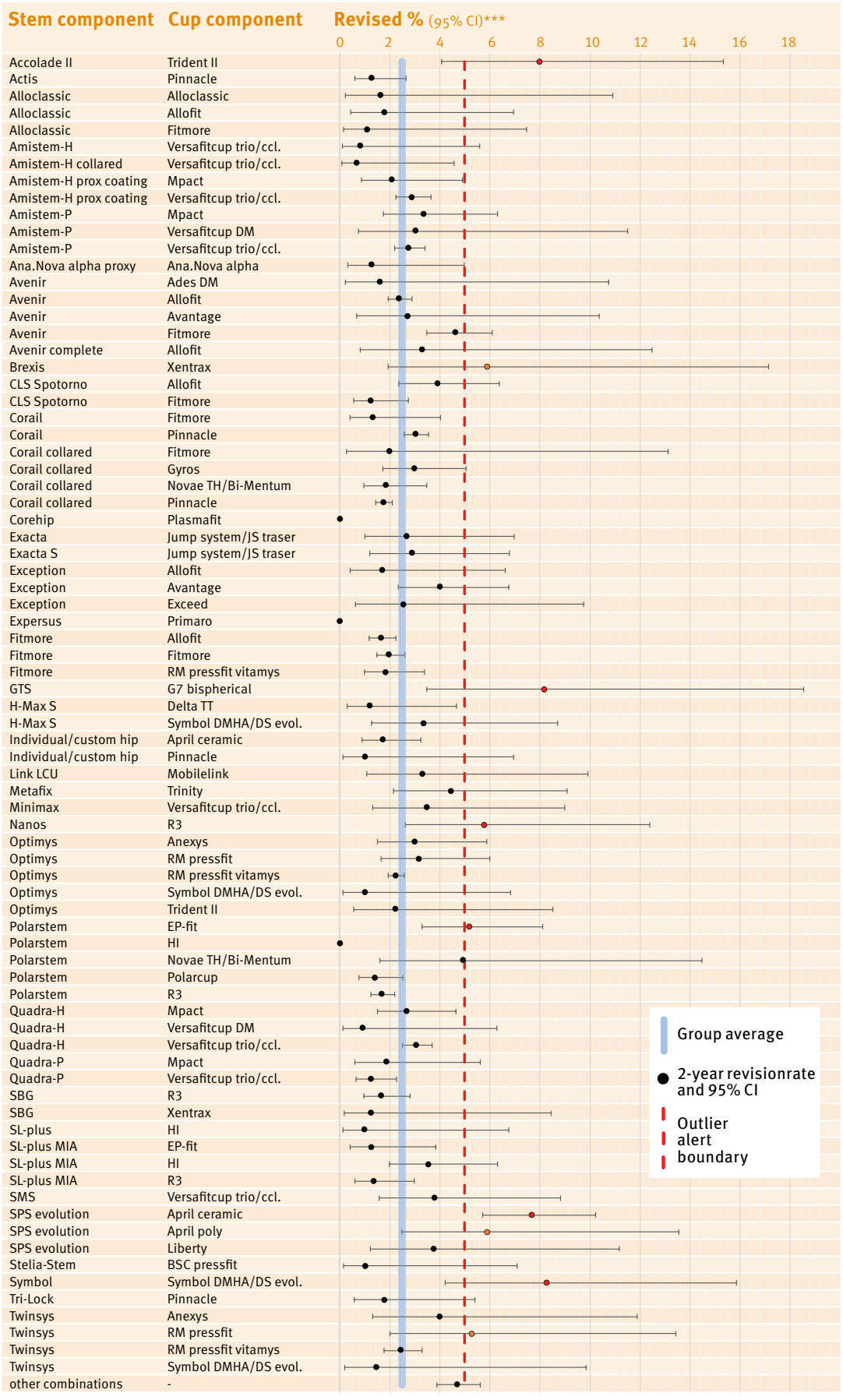
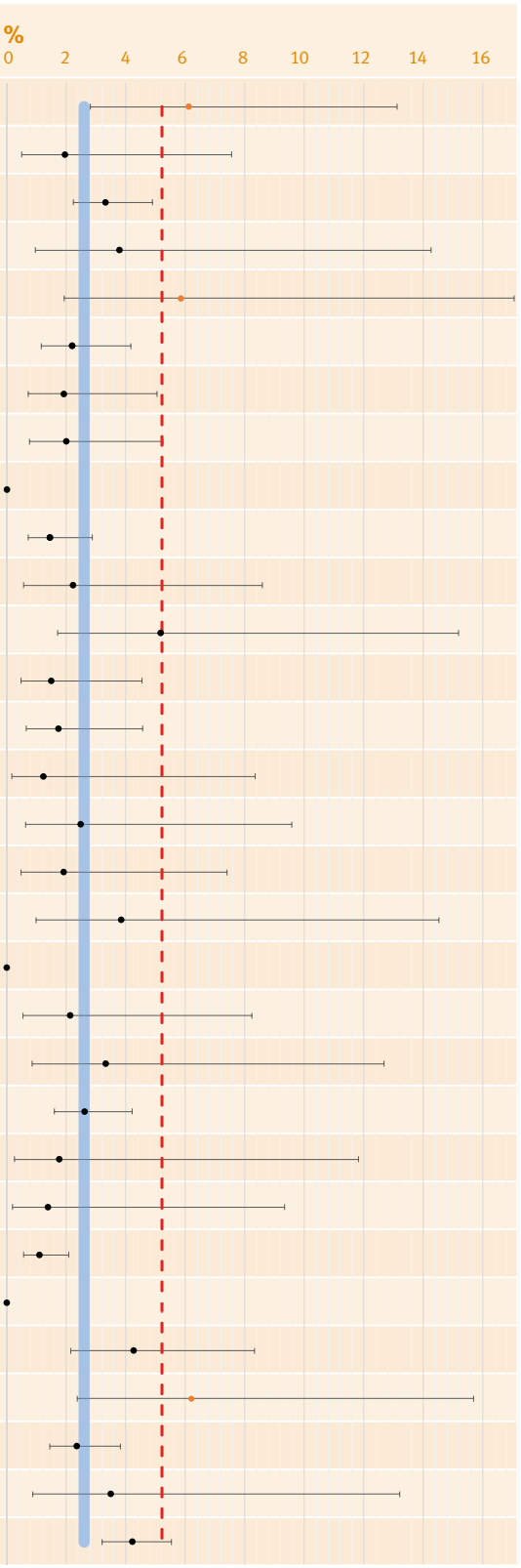


Figure 5.25

## 2-year revision rates of hybrid primary total hip arthroplasty combinations (primary OA)

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Stem component | Cup component | CSS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-C | Mpact | 35 | 99 | 6 | 6.1 (2.8-13.1) |
| Amistem-C | Versafitcup DM | 31 | 105 | 2 | 1.9 (0.5-7.5) |
| Amistem-C | Versafitcup trio/ccl. | 20 | 736 | 24 | 3.3 (2.2-4.9) |
| Arcad | April ceramic | 38 | 53 | 2 | 3.8 (1.0-14.3) |
| Arcad | Liberty | 47 | 53 | 3 | 5.8 (1.9-17.0) |
| Avenir (cem) | Allofit | 24 | 416 | 9 | 2.2 (1.1-4.2) |
| Avenir (cem) | Fitmore | 54 | 211 | 4 | 1.9 (0.7-5.0) |
| Centris | RM pressfit vitamys | 38 | 200 | 4 | 2.0 (0.8-5.2) |
| Corail (cem) | Novae TH/Bi-Mentum | 28 | 53 | 0 | 0.0 (.-.) |
| Corail (cem) | Pinnacle | 22 | 564 | 8 | 1.4 (0.7-2.9) |
| Harmony (cem) | Liberty | 41 | 91 | 2 | 2.2 (0.6-8.6) |
| Harmony (cem) | Symbol DMHA/DS evol. | 100 | 58 | 3 | 5.2 (1.7-15.2) |
| MS-30 | Allofit | 81 | 202 | 3 | 1.5 (0.5-4.5) |
| MS-30 | Fitmore | 35 | 231 | 4 | 1.7 (0.7-4.6) |
| MS-30 | Versafitcup trio/ccl. | 100 | 82 | 1 | 1.2 (0.2-8.3) |
| Original Mueller | Allofit | 47 | 81 | 2 | 2.5 (0.6-9.6) |
| Original Mueller | Fitmore | 61 | 106 | 2 | 1.9 (0.5-7.4) |
| Polarstem (cem) | Polarcup | 87 | 53 | 2 | 3.8 (1.0-14.5) |
| Quadra-C | Mpact | 48 | 52 | 0 | 0.0 (.-.) |
| Quadra-C | Mpact DM | 78 | 94 | 2 | 2.1 (0.5-8.2) |
| Quadra-C | Versafitcup DM | 42 | 60 | 2 | 3.3 (0.8-12.7) |
| Quadra-C | Versafitcup trio/ccl. | 28 | 621 | 16 | 2.6 (1.6-4.2) |
| Quadra-P (cem) | Versafitcup trio/ccl. | 40 | 58 | 1 | 1.8 (0.2-11.8) |
| Twinsys (cem) | RM pressfit | 22 | 76 | 1 | 1.4 (0.2-9.3) |
| Twinsys (cem) | RM pressfit vitamys | 25 | 835 | 9 | 1.1 (0.6-2.1) |
| Twinsys (cem) | Symbol DMHA/DS evol. | 33 | 52 | 0 | 0.0 (.-.) |
| Weber | Allofit | 35 | 194 | 8 | 4.3 (2.1-8.3) |
| Weber | Avantage | 95 | 65 | 4 | 6.2 (2.4-15.7) |
| Weber | Fitmore | 28 | 685 | 16 | 2.4 (1.4-3.8) |
| X-Acta | Versafitcup trio/ccl. | 98 | 59 | 2 | 3.5 (0.9-13.2) |
| other combinations | | | 1,183 | 49 | 4.2 (3.2-5.5) |
| **CH average for group** | | | | | **2.6 (2.3-3.0)** |




* 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.

### Hybrid combinations for primary OA

A total of 7,428 hybrid THA had been performed for primary OA within the moving 4-year window period from 01.01.2018 to 31.12.2021. The average 2-year revision rate was 2.6% (CI 2.3–3.0%) **(Figure 5.25).** There were no outliers regarding the short-term revision rates detected in the current period of observation.

### Uncemented combinations for secondary OA

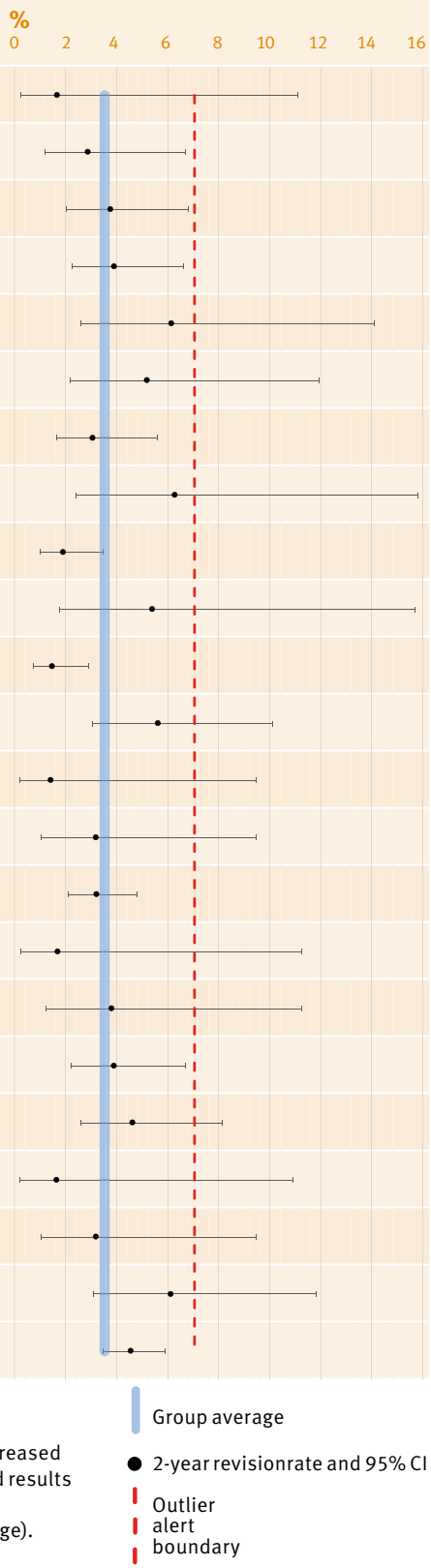
A total of 5,762 uncemented THA had been performed for secondary OA within the current moving 4-year window period. The average 2-year revision rate was 3.5% (CI 3.1–4.0%) and none of the implant combinations were considered to be outliers **(Figure 5.26).**

Figure 5.26

## 2-year revision rates of uncemented primary total hip arthroplasty combinations (secondary OA)

4-year moving average covering implants between 01.01.2017 and 31.12.2020, with two years follow-up (31.12.2022).

| Stem component | Cup component | CSS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Actis | Pinnacle | 41 | 61 | 1 | **1.6** (0.2-11.1) |
| Amistem-H prox coating | Versafitcup trio/ccl. | 19 | 177 | 5 | **2.8** (1.2-6.7) |
| Amistem-P | Versafitcup trio/ccl. | 15 | 270 | 10 | **3.7** (2.0-6.8) |
| Avenir | Allofit | 11 | 335 | 13 | **3.9** (2.3-6.6) |
| Avenir | Fitmore | 45 | 83 | 5 | **6.1** (2.6-14.1) |
| CLS Spotorno | Allofit | 57 | 97 | 5 | **5.2** (2.2-11.9) |
| Corail | Pinnacle | 12 | 330 | 10 | **3.1** (1.7-5.6) |
| Corail collared | Novae TH/Bi-Mentum | 30 | 64 | 4 | **6.3** (2.4-15.8) |
| Corail collared | Pinnacle | 39 | 534 | 10 | **1.9** (1.0-3.5) |
| Evok | Vento | 71 | 56 | 3 | **5.4** (1.8-15.7) |
| Fitmore | Allofit | 93 | 548 | 8 | **1.5** (0.7-2.9) |
| Fitmore | Fitmore | 34 | 179 | 10 | **5.6** (3.0-10.1) |
| Fitmore | RM pressfit vitamys | 100 | 73 | 1 | **1.4** (0.2-9.5) |
| Individual/custom hip | April ceramic | 18 | 95 | 3 | **3.2** (1.0-9.5) |
| Optimys | RM pressfit vitamys | 20 | 691 | 22 | **3.2** (2.1-4.8) |
| Polarstem | EP-fit | 98 | 60 | 1 | **1.7** (0.2-11.2) |
| Polarstem | Polarcup | 71 | 80 | 3 | **3.8** (1.2-11.3) |
| Polarstem | R3 | 74 | 312 | 12 | **3.9** (2.2-6.7) |
| Quadra-H | Versafitcup trio/ccl. | 31 | 243 | 11 | **4.6** (2.6-8.2) |
| Quadra-P | Versafitcup trio/ccl. | 60 | 62 | 1 | **1.6** (0.2-10.9) |
| SBG | R3 | 51 | 95 | 3 | **3.2** (1.0-9.5) |
| Twinsys | RM pressfit vitamys | 14 | 132 | 8 | **6.1** (3.1-11.8) |
| other combinations | | | 1185 | 53 | **4.5** (3.5-5.9) |
| **CH average for group** | | | | | **3.5** (3.1-4.2) |




* 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.

# Fracture of the hip

## 5.5 Treatment of hip fractures

Between 2018 and 2023, the registry recorded a total of 25,742 primary hip arthroplasties performed for fractures, of which 44.7% were THA and 55.3% HA **(Table 3.3).** Previous internal fixation was registered in 6.3% of the THA and 1.1% of the HA. However, the laps of time between internal fixation and arthroplasty is unknown, as internal fixation is not registered in any registry in Switzerland.

Most HA stems were cemented (86.1%) compared to 46.3% uncemented stems in the THA group **(Tables 5.24).** The share of cemented stems for HA remained stable since 2018. The share of uncemented stems in the THA group showed a variable course with dips in 2019 and 2023. All cemented fixation decreased from 8.7% to 4.4% between 2018 and 2023. However, the hybrid fixation showed a compensatory rise **(Figure 5.27 and Table 5.25).**

The most common approaches for both procedures were a direct anterior or an anterolateral approach, both used in over 75% of the cases. In both HA and THA, the share of the anterior approach was the highest, being used distinctly more frequently for THA. The choice of the approach changed significantly between 2018 and 2023, particularly for HA. The use of the anterior approach rose from 38% in 2018 to 52.2% in 2023. The use of the anterolateral approach declined, as did the other approaches. The development was similar for THA, however less pronounced **(Table 5.26 and Figure 5.28).**

Table 5.24
**Fracture of the hip: Surgery characteristics by main treatment group**

| | | THA | | HA | |
|---|---|---|---|---|---|
| **N (2018–2023)** | | **N revised** | **%** | **N revised** | **%** |
| Previous surgery[1] | None | 10,321 | 89.7 | 13,922 | 97.9 |
| | Internal fixation femur | 901 | 7.8 | 157 | 1.1 |
| | Osteotomy femur | 49 | 0.4 | 15 | 0.1 |
| | Internal fixation acetabulum | 106 | 0.9 | 5 | 0.0 |
| | Osteotomy pelvis | 7 | 0.1 | 1 | 0.0 |
| | Arthrodesis | 3 | 0.0 | 0 | 0.0 |
| | Other previous surgery | 177 | 1.5 | 127 | 0.9 |
| Approach | Anterior | 6,486 | 56.3 | 6,586 | 46.3 |
| | Anterolateral | 2,800 | 24.3 | 4,042 | 28.4 |
| | Posterior | 1,383 | 12.0 | 1,975 | 13.9 |
| | Lateral | 641 | 5.6 | 1,456 | 10.2 |
| | Other approach | 207 | 1.8 | 166 | 1.2 |
| Fixation | All uncemented / uncemented stem | 5,793 | 50.3 | 1,893 | 13.3 |
| | Hybrid* | 4,667 | 40.5 | | |
| | All cemented / cemented stem | 661 | 5.7 | 12,252 | 86.1 |
| | Reverse hybrid** | 206 | 1.8 | | |
| | Reinforcement ring, femur uncemented | 50 | 0.4 | | |
| | Reinforcement ring, femur cemented | 140 | 1.2 | | |

[1] multiple responses possible; does not sum to 100%
* acetabulum uncemented, femur cemented ** acetabulum cemented, femur uncemented

Figure 5.27

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

Relative distribution per year in %.

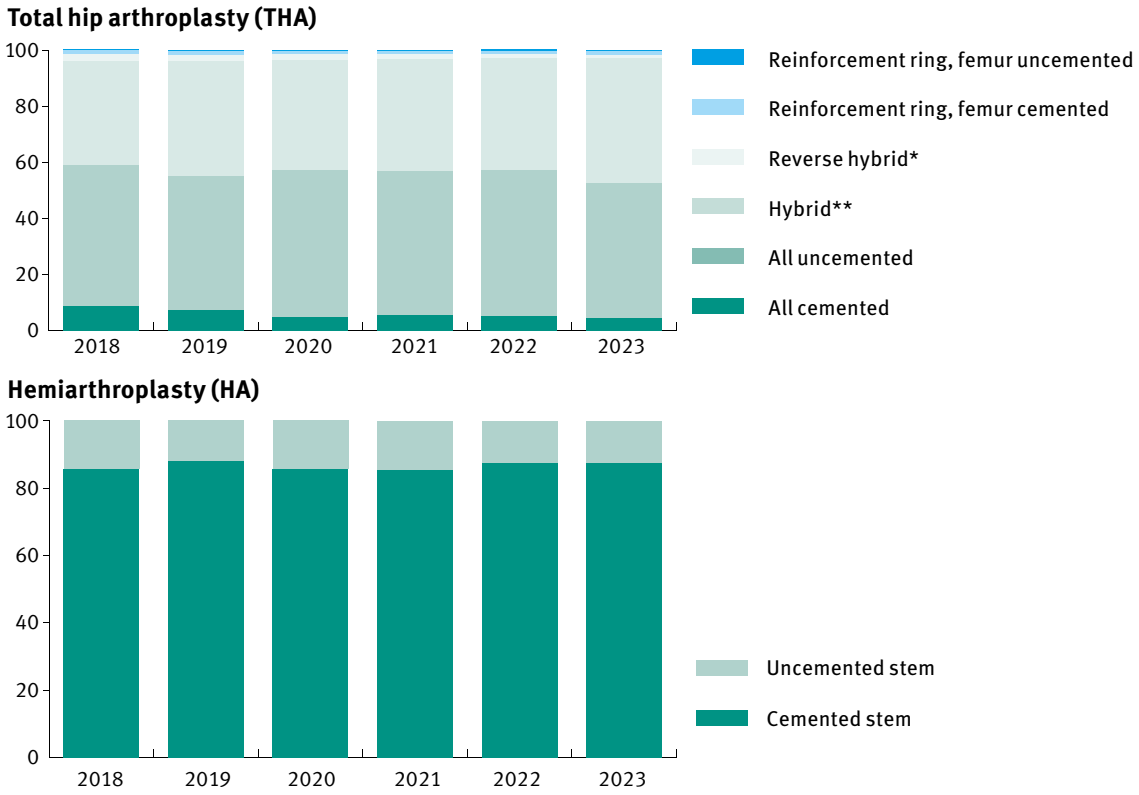



Table 5.25

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

Relative distribution per year in %.

| Total hip arthroplasty (THA) | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| Reinforcement ring, femur uncemented | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.4 |
| Reinforcement ring, femur cemented | 1.2 | 1.3 | 1.2 | 1.1 | 1.0 | 1.5 |
| Reverse hybrid* | 2.7 | 2.1 | 1.9 | 1.9 | 1.5 | 1.1 |
| Hybrid** | 37.1 | 41.2 | 39.5 | 39.8 | 39.8 | 44.2 |
| All uncemented | 50.1 | 47.6 | 52.1 | 51.1 | 52.3 | 48.3 |
| All cemented | 8.7 | 7.4 | 4.9 | 5.7 | 5.0 | 4.4 |
| **Total [N]** | **1,386** | **1,591** | **1,782** | **2,119** | **2,281** | **2,358** |

| Hemiarthroplasty (HA) | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| Uncemented stem | 14.3 | 11.9 | 14.3 | 14.7 | 12.6 | 12.6 |
| Cemented stem | 85.7 | 88.1 | 85.7 | 85.3 | 87.4 | 87.4 |
| **Total [N]** | **2,159** | **2,270** | **2,345** | **2,320** | **2,552** | **2,499** |

* acetabulum cemented, femur uncemented = Reverse hybrid
** acetabulum uncemented, femur cemented = Hybrid

Figure 5.28

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

Relative distribution per year in % .

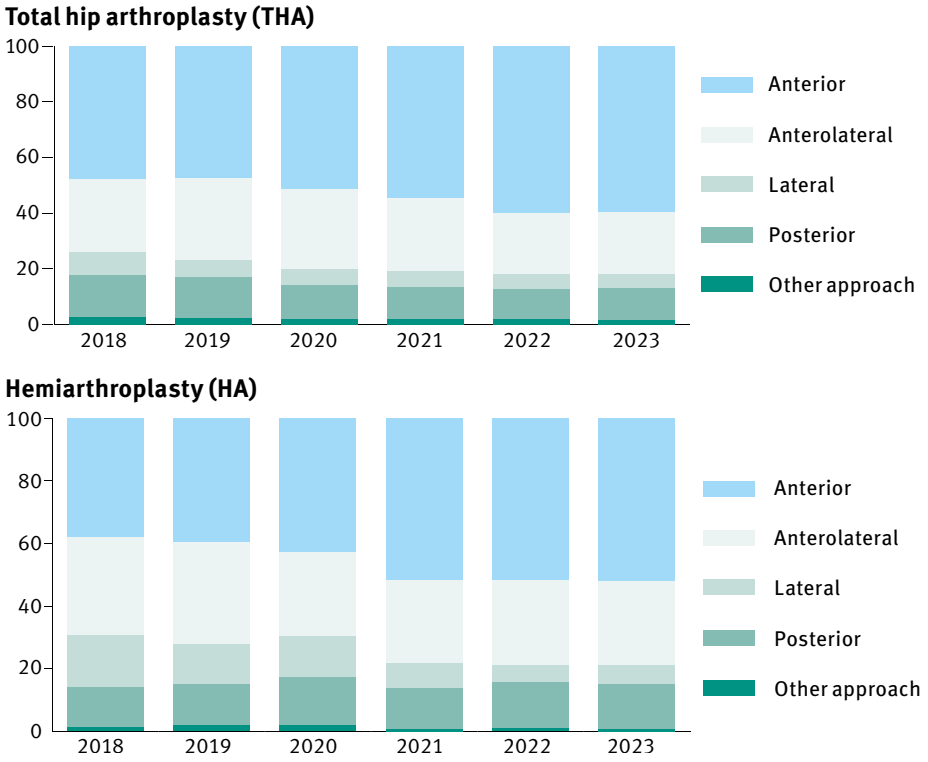



Table 5.26

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

Relative distribution per year in %.

| Total hip arthroplasty (THA) | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| Anterior | 47.5 | 51.4 | 54.7 | 59.9 | 59.8 | 59.5 |
| Anterolateral | 29.4 | 28.5 | 26.1 | 22.0 | 22.0 | 21.4 |
| Lateral | 6.1 | 6.2 | 5.9 | 5.4 | 5.3 | 5.0 |
| Posterior | 14.6 | 12.0 | 11.4 | 10.9 | 11.2 | 12.8 |
| Other approach | 2.3 | 1.9 | 1.9 | 1.8 | 1.7 | 1.4 |
| **Total [N]** | **1,386** | **1,591** | **1,782** | **2,119** | **2,281** | **2,358** |

| Hemiarthroplasty (HA) | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| Anterior | 38.0 | 39.6 | 42.9 | 51.7 | 51.8 | 52.1 |
| Anterolateral | 31.4 | 32.4 | 26.9 | 26.4 | 26.9 | 27.0 |
| Lateral | 16.6 | 13.0 | 12.9 | 8.3 | 5.7 | 6.1 |
| Posterior | 12.9 | 13.0 | 15.4 | 12.9 | 14.7 | 14.1 |
| Other approach | 1.2 | 1.9 | 1.9 | 0.6 | 0.9 | 0.6 |
| **Total [N]** | **2,168** | **2,276** | **2,354** | **2,350** | **2,568** | **2,509** |

## 5.6 Early revision after fracture of the hip

The 2-year revision rate after THA for fracture of the hip was 5.2% (CI 4.7–5.7%) and higher than in HA patients, where 3.5% (CI 3.1–4.0%) 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 (5.2% vs 2.5%).

Higher BMI were risk factors for revision, whereby the risk increase for THA already is observed at a BMI ›30 kg/m². Higher ASA scores tended to be associated with more frequent revisions in the THA group **(Table 5.27).** In the HA group, uncemented stems had an increased risk for revision caused mainly by periprosthetic fractures. A posterior approach bore a higher risk of revision for both THA and HA, whereby for THA the effect was significantly higher (7.3% vs 5.7% as shown in **Table 5.28).**

Table 5.27

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| | | 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) | | 6,878 | 340 | 5.2 | 4.7 | 5.7 | 9,148 | 280 | 3.5 | 3.1 | 4.0 |
| Gender | Women | 4,402 | 206 | 4.8 | 4.2 | 5.5 | 6,465 | 193 | 3.3 | 2.9 | 3.9 |
| | Men | 2,476 | 134 | 5.8 | 4.9 | 6.8 | 2,683 | 87 | 4.0 | 3.3 | 5.0 |
| Age group | ‹55 | 293 | 14 | 4.9 | 2.9 | 8.1 | 35 | 4 | 13.0 | 5.1 | 31.1 |
| | 55–64 | 930 | 51 | 5.6 | 4.3 | 7.3 | 120 | 7 | 6.2 | 3.0 | 12.6 |
| | 65–74 | 1,868 | 91 | 5.0 | 4.1 | 6.1 | 502 | 33 | 7.6 | 5.4 | 10.5 |
| | 75–84 | 2,458 | 123 | 5.2 | 4.4 | 6.1 | 2,769 | 97 | 3.9 | 3.2 | 4.7 |
| | 85+ | 1,329 | 61 | 5.1 | 4.0 | 6.5 | 5,722 | 139 | 2.8 | 2.4 | 3.3 |
| BMI group | ‹18.5 | 416 | 19 | 4.8 | 3.1 | 7.5 | 751 | 15 | 2.5 | 1.5 | 4.2 |
| | 18.5–24.9 | 3,069 | 124 | 4.2 | 3.5 | 5.0 | 4,185 | 97 | 2.6 | 2.2 | 3.2 |
| | 25–29.9 | 1,573 | 97 | 6.3 | 5.2 | 7.7 | 1,755 | 72 | 4.7 | 3.7 | 5.9 |
| | 30–34.9 | 410 | 33 | 8.4 | 6.1 | 11.6 | 350 | 24 | 7.4 | 5.0 | 10.9 |
| | 35–39.9 | 81 | 7 | 9.0 | 4.4 | 18.0 | 73 | 9 | 13.6 | 7.3 | 24.6 |
| | 40+ | 32 | 1 | 3.1 | 0.4 | 20.2 | 13 | 1 | 8.3 | 1.2 | 46.1 |
| | Unknown | 1,297 | 59 | 4.9 | 3.8 | 6.3 | 2,021 | 62 | 3.6 | 2.8 | 4.6 |
| Morbidity state | ASA 1 | 427 | 14 | 3.3 | 2.0 | 5.5 | 71 | 5 | 7.7 | 3.2 | 17.5 |
| | ASA 2 | 2793 | 114 | 4.1 | 3.4 | 4.9 | 1,684 | 49 | 3.1 | 2.4 | 4.1 |
| | ASA 3 | 2,977 | 172 | 6.2 | 5.3 | 7.1 | 5,980 | 189 | 3.6 | 3.1 | 4.2 |
| | ASA 4/5 | 255 | 16 | 7.1 | 4.4 | 11.4 | 893 | 17 | 2.3 | 1.5 | 3.8 |
| | Unknown | 426 | 24 | 6.0 | 4.0 | 8.8 | 520 | 20 | 4.5 | 2.9 | 6.9 |

* 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.

### 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 5.29).** However, infections were by far the most important cause of revision in the HA group, representing 35% of the registered cases, while the most frequent cause for revision in fracture THA was dislocation (25.3%), followed closely by revision for periprosthetic fracture (25.0%).

A more detailed analysis of the reasons for revision of HA analysing separately unipolar and bipolar heads showed differences. However, small numbers limit any further analysis **(Table 5.30).** 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 11 years of follow-up, the revision rates of unipolar heads and bipolar heads remained similar **(Figure 5.29).**

Table 5.28

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| | 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) | 6,878 | 340 | 5.2 | 4.7 | 5.7 | 9,148 | 280 | 3.5 | 3.1 | 4.0 |
| All cemented / cemented stem | 444 | 18 | 4.5 | 2.9 | 7.1 | 7,836 | 214 | 3.2 | 2.8 | 3.6 |
| All uncemented / uncemented stem | 3,461 | 184 | 5.5 | 4.8 | 6.3 | 1,258 | 63 | 5.5 | 4.3 | 7.0 |
| Hybrid | 2,717 | 124 | 4.8 | 4.0 | 5.7 | | | | | |
| Anterior | 3,720 | 167 | 4.7 | 4.1 | 5.5 | 3,949 | 116 | 3.4 | 2.8 | 4.0 |
| Anterolateral | 1,794 | 86 | 5.0 | 4.1 | 6.1 | 2,672 | 64 | 2.8 | 2.2 | 3.5 |
| Lateral | 402 | 17 | 4.5 | 2.8 | 7.1 | 1,155 | 33 | 3.4 | 2.4 | 4.8 |
| Posterior | 827 | 59 | 7.3 | 5.7 | 9.4 | 1,243 | 63 | 5.7 | 4.4 | 7.2 |
| Other approach | 135 | 11 | 8.8 | 5.0 | 15.3 | 129 | 4 | 3.9 | 1.5 | 10.2 |

* 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.

Table 5.29

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).

| | Total hip arthroplasty | | Hemi-arthroplasty | |
|---|---|---|---|---|
| | N | % | N | % |
| Dislocation | 86 | 25.3 | 65 | 23.2 |
| Periprosthetic fracture | 85 | 25.0 | 55 | 19.6 |
| Infection | 82 | 24.1 | 98 | 35.0 |
| Loosening femoral | 48 | 14.1 | 27 | 9.6 |
| Loosening acetabular | 33 | 9.7 | | |
| Position/Orientation of cup | 19 | 5.6 | | |
| Position/Orientation of stem | 15 | 4.4 | 8 | 2.9 |
| Implant breakage | 5 | 1.5 | 1 | 0.4 |
| Femoral osteolysis | 2 | 0.6 | 0 | 0.0 |
| Trochanter pathology | 2 | 0.6 | 0 | 0.0 |
| Acetabular protrusion | 2 | 0.6 | 6 | 2.1 |
| Wear | 1 | 0.3 | 5 | 1.8 |
| Metallosis | 1 | 0.3 | 0 | 0.0 |
| Status after spacer | 1 | 0.3 | 0 | 0.0 |
| Impingement | 1 | 0.3 | 0 | 0.0 |
| Acetabular osteolysis | 0 | 0.0 | 1 | 0.4 |
| Blood ion level | 0 | 0.0 | 0 | 0.0 |
| Squeaking | 0 | 0.0 | 0 | 0.0 |
| Other | 30 | 8.8 | 36 | 12.9 |

Table 5.30

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).

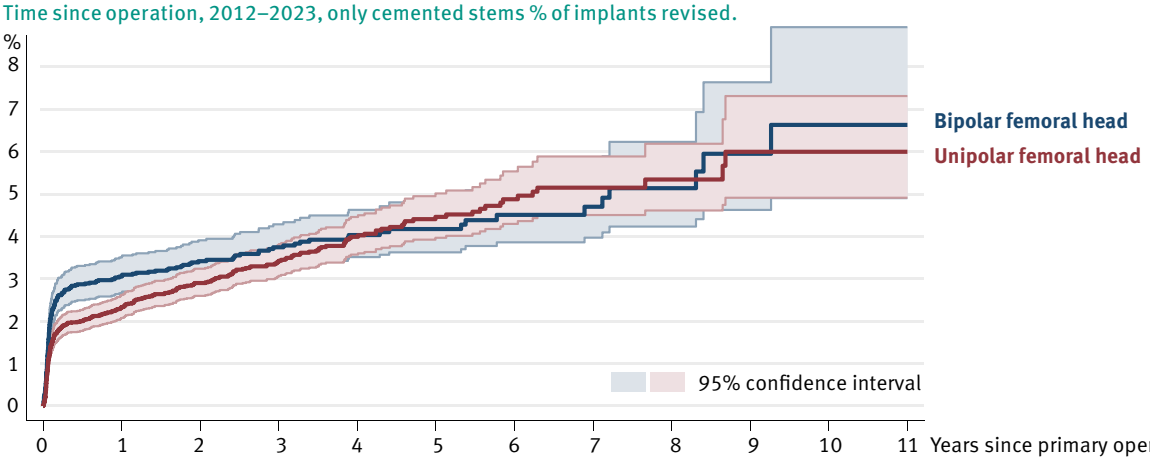
| | Unipolar heads | | Bipolar heads | |
|---|---|---|---|---|
| | N | % | N | % |
| Infection | 53 | 42.4 | 33 | 37.5 |
| Dislocation | 19 | 15.2 | 28 | 31.8 |
| Periprosthetic fracture | 17 | 13.6 | 9 | 10.2 |
| Loosening femoral | 11 | 8.8 | 11 | 12.5 |
| Impingement | 3 | 2.4 | 2 | 2.3 |
| Wear | 0 | 0.0 | 0 | 0.0 |
| Acetabular osteolysis | 0 | 0.0 | 1 | 1.1 |
| Femoral osteolysis | 0 | 0.0 | 0 | 0.0 |
| Trochanter pathology | 0 | 0.0 | 0 | 0.0 |
| Status after spacer | 0 | 0.0 | 0 | 0.0 |
| Implant breakage | 0 | 0.0 | 0 | 0.0 |
| Blood ion level | 0 | 0.0 | 0 | 0.0 |
| Position/Orientation of stem | 0 | 0.0 | 0 | 0.0 |
| Acetabular protrusion | 0 | 0.0 | 0 | 0.0 |
| Other | 22 | 17.6 | 6 | 6.8 |

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

Figure 5.29

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

Time since operation, 2012–2023, only cemented stems % of implants revised.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Unipolar femoral head | **2.3** (2.1-2.6) | **2.9** (2.6-3.2) | **3.4** (3.1-3.8) | **4.5** (4.0-5.0) | **4.9** (4.3-5.5) | **5.3** (4.6-6.2) | **6.0** (4.9-7.3) | **6.0** (4.9-7.3) |
| Bipolar femoral head | **3.1** (2.7-3.5) | **3.4** (3.0-3.9) | **3.7** (3.3-4.3) | **4.2** (3.6-4.8) | **4.5** (3.9-5.3) | **5.1** (4.2-6.2) | **6.6** (4.9-8.9) | **6.6** (4.9-8.9) |

The analysis again is limited by small numbers remaining at the end of the observation period. The higher early revision rate of bipolar heads was due to the rate of dislocation that was significantly higher. 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 5.30).** It highlights revisions for infection and for dislocation tended to occur rather early on, as indicated by a steep initial spike followed by very gradual long-term growth. 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, 302 THA revisions and 257 HA revisions were carried out during the moving observation period. The most frequent type of revision was conversion of HA to THA (almost 40% of the revisions). The second most frequent revision in the HA group was the exchange of the head **(Table 5.31).**

Table 5.31

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| | Total hip arthroplasty | | Hemi-arthroplasty | |
|---|---|---|---|---|
| | N | % | N | % |
| Exchange acetabular and femoral components | 42 | 13.9 | | |
| Exchange acetabular component | 15 | 5.0 | | |
| Exchange acetabular component and head | 55 | 18.2 | | |
| Exchange femoral component | 63 | 20.9 | 38 | 14.8 |
| Exchange femoral component and inlay | 20 | 6.6 | 6 | 2.3 |
| Exchange head | 22 | 7.3 | 60 | 23.3 |
| Exchange inlay | 2 | 0.7 | 2 | 0.8 |
| Exchange head and inlay | 48 | 15.9 | 22 | 8.6 |
| Conversion of hemi-prosthesis to THA without stem exchange | | | 58 | 22.6 |
| Conversion of hemi-prosthesis to THA with stem exchange | | | 42 | 16.3 |
| Component removal, spacer implantation | 9 | 3.0 | 3 | 1.2 |
| Component reimplantation (after spacer or Girdlestone) | 2 | 0.7 | 3 | 1.2 |
| Girdlestone | 4 | 1.3 | 3 | 1.2 |
| Exchange femoral component, inlay and osteosynthesis | 9 | 3.0 | 6 | 2.3 |
| Other intervention | 11 | 3.6 | 14 | 5.4 |
| **Total** | **302** | **100.0** | **257** | **100.0** |

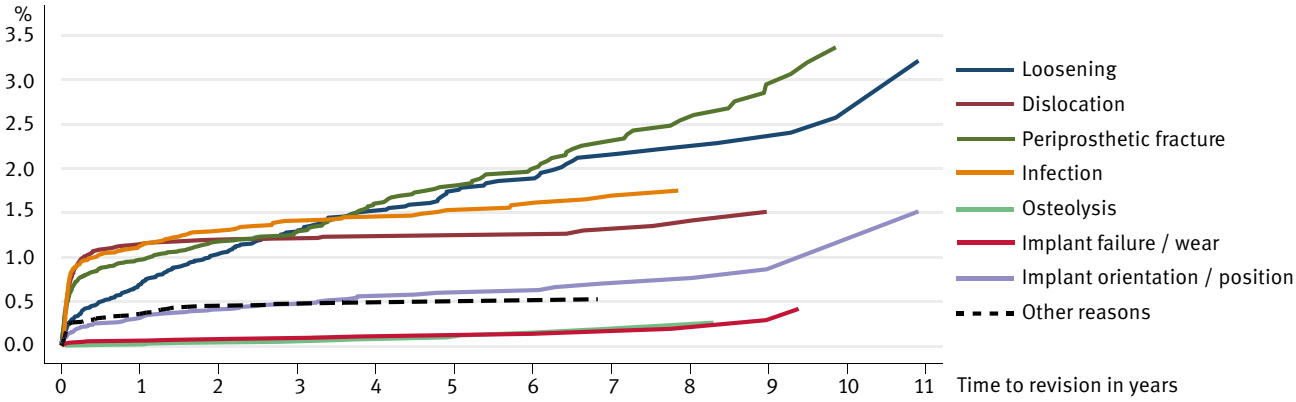
HA: in approx. 11% of cases response categories involving acetabular components were chosen. These were recoded to conversions.

Figures 5.30

## Fracture of the hip: cumulative incidence rates for different revision diagnoses

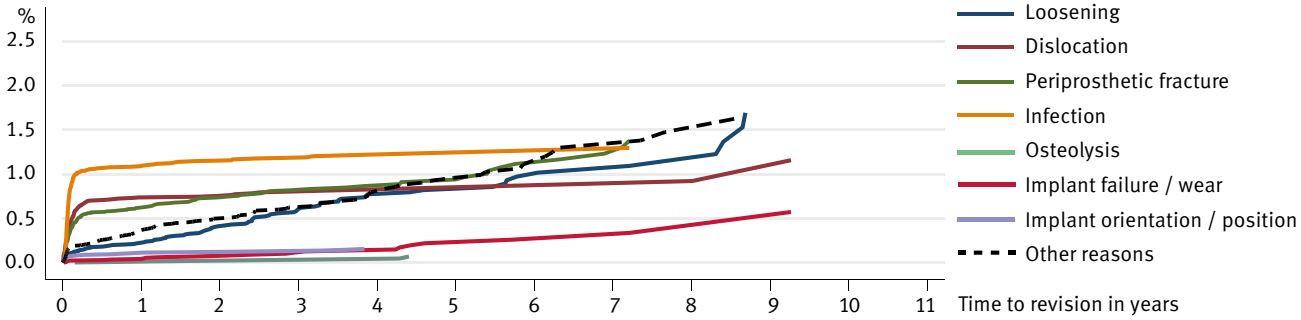
Time since operation, 2012–2023, all services, % of implants revised.

### Fracture THA




| | 1 year | 2 years | 3 years | 5 years | 7 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Loosening | **0.7** (0.6-0.8) | **1.0** (0.9-1.2) | **1.3** (1.1-1.5) | **1.7** (1.5-2.0) | **2.1** (1.8-2.5) | **2.3** (1.9-2.7) | **2.6** (2.1-3.2) | **3.2** (2.1-4.9) |
| Dislocation | **1.1** (1.0-1.3) | **1.2** (1.0-1.4) | **1.2** (1.0-1.4) | **1.2** (1.1-1.4) | **1.3** (1.1-1.5) | **1.5** (1.2-1.9) | **1.5** (1.2-1.9) | **1.5** (1.2-1.9) |
| Periprosthetic fracture | **1.0** (0.8-1.1) | **1.2** (1.0-1.4) | **1.3** (1.1-1.5) | **1.8** (1.6-2.1) | **2.3** (2.0-2.7) | **2.9** (2.5-3.5) | **3.4** (2.7-4.2) | **3.4** (2.7-4.2) |
| Infection | **1.1** (1.0-1.3) | **1.3** (1.1-1.5) | **1.4** (1.2-1.6) | **1.5** (1.3-1.8) | **1.7** (1.5-2.0) | **1.8** (1.5-2.1) | **1.8** (1.5-2.1) | **1.8** (1.5-2.1) |
| Osteolysis | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.0** (0.0-0.1) | **0.1** (0.0-0.2) | **0.2** (0.1-0.4) | **0.3** (0.1-0.5) | **0.3** (0.1-0.5) | **0.3** (0.1-0.5) |
| 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) | **0.1** (0.1-0.3) | **0.3** (0.1-0.7) | **0.4** (0.2-0.9) | **0.4** (0.2-0.9) |
| Implant orientation / position | **0.3** (0.2-0.4) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.6** (0.5-0.8) | **0.7** (0.5-0.9) | **0.9** (0.6-1.2) | **0.9** (0.6-1.2) | **1.5** (0.6-3.6) |
| Other reasons | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.7) | **0.5** (0.4-0.7) | **0.5** (0.4-0.7) | **0.5** (0.4-0.7) |

### Fracture HA




| | 1 year | 2 years | 3 years | 5 years | 7 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Loosening | **0.2** (0.2-0.3) | **0.4** (0.3-0.5) | **0.6** (0.5-0.7) | **0.8** (0.7-1.0) | **1.0** (0.8-1.3) | **1.7** (1.1-2.5) | **1.7** (1.1-2.5) | **1.7** (1.1-2.5) |
| Dislocation | **0.7** (0.6-0.9) | **0.8** (0.6-0.9) | **0.8** (0.7-0.9) | **0.8** (0.7-0.9) | **0.8** (0.7-0.9) | **0.9** (0.7-1.2) | **1.2** (0.7-1.8) | **1.2** (0.7-1.8) |
| Periprosthetic fracture | **0.6** (0.5-0.7) | **0.7** (0.6-0.9) | **0.8** (0.7-1.0) | **0.9** (0.8-1.1) | **1.2** (1.0-1.5) | **1.4** (1.1-1.8) | **1.4** (1.1-1.8) | **1.4** (1.1-1.8) |
| Infection | **1.1** (1.0-1.2) | **1.1** (1.0-1.3) | **1.2** (1.0-1.3) | **1.2** (1.1-1.4) | **1.2** (1.1-1.4) | **1.3** (1.1-1.5) | **1.3** (1.1-1.5) | **1.3** (1.1-1.5) |
| Osteolysis | **0.0** (0.0-0.0) | **0.0** (0.0-0.1) | **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) | **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** (0.2-0.4) | **0.3** (0.2-0.6) | **0.6** (0.2-1.4) | **0.6** (0.2-1.4) |
| 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) | **0.2** (0.1-0.2) |
| Other reasons | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.6** (0.5-0.8) | **1.0** (0.8-1.2) | **1.3** (1.0-1.6) | **1.6** (1.2-2.2) | **1.6** (1.2-2.2) | **1.6** (1.2-2.2) |

## 5.7 Results of implants after hip fracture
## 2-year revision rate

### Uncemented THA combinations for fractures

There were 20 uncemented stem/cup combinations, accounting for 75% of all THA performed for fracture of the hip **(Table 5.32).** The table also shows the distribution of the implants used between 2018 and 2023. The revision rates for combinations with n ›50 are shown in **Figure 5.31.** None of the implant combinations was suspicious.

Table 5.32
**Fracture of the hip: Top 75% of primary total hip arthroplasty uncemented combinations 2018–2023**

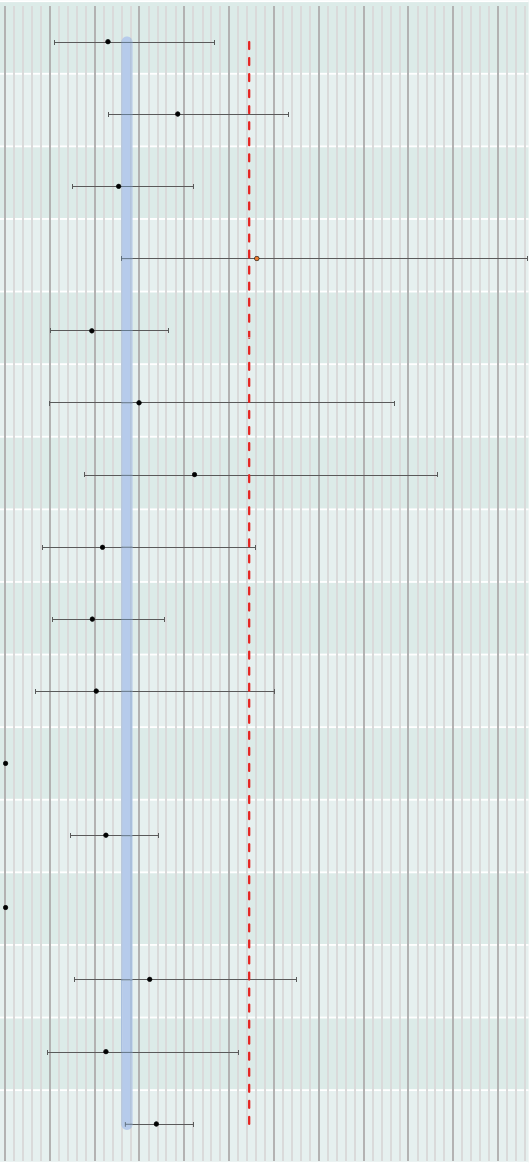
| Stem component | Cup component | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| Alloclassic | Fitmore | 12 | 14 | 5 | 13 | 9 | 7 | **60** |
| Amistem-H prox coating | Versafitcup trio/ccl. | 76 | 63 | 6 | 9 | 0 | 0 | **154** |
| Amistem-P | Versafitcup trio/ccl. | 1 | 15 | 83 | 87 | 117 | 93 | **396** |
| Avenir | Allofit | 68 | 70 | 78 | 69 | 65 | 75 | **425** |
| Avenir | Fitmore | 12 | 9 | 7 | 13 | 9 | 1 | **51** |
| CLS Spotorno | Allofit | 18 | 15 | 11 | 10 | 2 | 5 | **61** |
| Corail | Pinnacle | 35 | 61 | 68 | 76 | 66 | 57 | **363** |
| Corail collared | Bimobile | 0 | 0 | 0 | 20 | 122 | 94 | **236** |
| Corail collared | Gyros | 18 | 13 | 19 | 1 | 0 | 0 | **51** |
| Corail collared | Liberty | 1 | 0 | 13 | 53 | 4 | 1 | **72** |
| Corail collared | Novae TH/Bi-Mentum | 3 | 5 | 26 | 59 | 68 | 86 | **247** |
| Corail collared | Pinnacle | 46 | 49 | 63 | 105 | 145 | 137 | **545** |
| Fitmore | Allofit | 15 | 18 | 15 | 26 | 20 | 38 | **132** |
| Fitmore | Fitmore | 14 | 15 | 21 | 14 | 26 | 12 | **102** |
| Optimys | RM pressfit | 13 | 12 | 9 | 9 | 12 | 4 | **59** |
| Optimys | RM pressfit vitamys | 90 | 91 | 115 | 158 | 158 | 155 | **767** |
| Optimys | Symbol DMHA/DS evol. | 5 | 5 | 11 | 19 | 16 | 25 | **81** |
| Polarstem | R3 | 14 | 13 | 16 | 10 | 23 | 19 | **95** |
| Quadra-H | Versafitcup trio/ccl. | 33 | 28 | 31 | 19 | 10 | 0 | **121** |
| Quadra-P | Versafitcup trio/ccl. | 0 | 0 | 8 | 16 | 22 | 31 | **77** |
| Twinsys | RM pressfit vitamys | 29 | 24 | 26 | 34 | 31 | 36 | **180** |
| other combinations | | 170 | 205 | 257 | 241 | 249 | 246 | **1,368** |
| **Total** | | **673** | **725** | **888** | **1,061** | **1,174** | **1,122** | **5,643** |

Figure 5.31

## Two-year revision rates within 24 months of uncemented primary total hip arthroplasty combinations to treat fractures

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Stem component | Cup component | CCS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-H prox. coating | Versafitcup trio/ccl. | 23 | 154 | 7 | 4.6 (2.2-9.3) |
| Amistem-P | Versafitcup trio/ccl. | 25 | 186 | 14 | 7.7 (4.6-12.6) |
| Avenir | Allofit | 16 | 285 | 14 | 5.1 (3.0-8.4) |
| CLS Spotorno | Allofit | 57 | 54 | 6 | 11.2 (5.2-23.3) |
| Corail | Pinnacle | 11 | 240 | 9 | 3.9 (2.0-7.3) |
| Corail collared | Gyros | 39 | 51 | 3 | 6.0 (2.0-17.4) |
| Corail collared | Liberty | 87 | 67 | 5 | 8.4 (3.6-19.3) |
| Corail collared | Novae TH/Bi-Mentium | 53 | 93 | 4 | 4.3 (1.7-11.2) |
| Corail collared | Pinnacle | 13 | 263 | 10 | 3.9 (2.1-7.1) |
| Fitmore | Allofit | 69 | 74 | 3 | 4.1 (1.3-12.0) |
| Fitmore | Fitmore | 41 | 64 | 0 | 0.0 (.-.) |
| Optimys | RM pressfit vitamys | 13 | 454 | 20 | 4.5 (2.9-6.9) |
| Polarstem | R3 | 38 | 53 | 0 | 0.0 (.-.) |
| Quadra-H | Versafitcup trio/ccl. | 24 | 111 | 7 | 6.4 (3.1-13.0) |
| Twinsys | RM pressfit vitamys | 17 | 113 | 5 | 4.5 (1.9-10.4) |
| other combinations | | | 1,070 | 70 | 6.7 (5.4-8.4) |
| **CH average for group** | | | | | **5.4 (4.7-6.3)** |




* 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

### Hybrid THA combinations for fractures

There were 21 stem/cup combinations covering 75% of the hybrid THA performed for fractures of the hip treated, but 12 of these combinations were used fewer than 100 times during the observed period between 2018 and 2023 **(Table 5.33).** The revision rates for the 10 combinations with n›50 are presented in **Figure 5.32** and show that none of the implants reached potential outlier status.

Table 5.33

**Fracture of the hip: Top 75% of primary total hip arthroplasty hybrid combinations 2018–2023**

| Stem component | Cup component | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | RM pressfit vitamys | 9 | 5 | 6 | 6 | 5 | 6 | **37** |
| Amistem-C | Versafitcup DM | 25 | 16 | 12 | 9 | 6 | 18 | **86** |
| Amistem-C | Versafitcup trio/ccl. | 54 | 86 | 94 | 108 | 106 | 82 | **530** |
| Avenir (cem) | Allofit | 16 | 30 | 33 | 40 | 49 | 74 | **242** |
| Avenir (cem) | Fitmore | 19 | 26 | 37 | 65 | 58 | 45 | **250** |
| CCA | RM pressfit vitamys | 10 | 19 | 9 | 10 | 19 | 6 | **73** |
| Centris | RM pressfit | 10 | 12 | 6 | 10 | 0 | 0 | **38** |
| Centris | RM pressfit vitamys | 35 | 30 | 32 | 53 | 0 | 0 | **150** |
| Corail (cem) | Novae TH/Bi-Mentum | 0 | 2 | 8 | 28 | 52 | 68 | **158** |
| Corail (cem) | Pinnacle | 14 | 37 | 39 | 76 | 118 | 146 | **430** |
| Exacta S | Symbol DMHA/DS evol. | 0 | 0 | 0 | 5 | 24 | 38 | **67** |
| Exeter V40 | Symbol DMHA/DS evol. | 0 | 0 | 0 | 7 | 16 | 29 | **52** |
| MS-30 | Allofit | 0 | 0 | 0 | 10 | 29 | 42 | **81** |
| MS-30 | Fitmore | 21 | 9 | 10 | 1 | 0 | 0 | **41** |
| Quadra-C | Mpact | 1 | 24 | 19 | 16 | 8 | 15 | **83** |
| Quadra-C | Mpact DM | 3 | 9 | 32 | 34 | 32 | 14 | **124** |
| Quadra-C | Versafitcup trio/ccl. | 64 | 72 | 64 | 35 | 21 | 4 | **260** |
| Twinsys (cem) | RM pressfit | 6 | 5 | 6 | 6 | 12 | 5 | **40** |
| Twinsys (cem) | RM pressfit vitamys | 43 | 69 | 72 | 75 | 119 | 147 | **525** |
| Twinsys (cem) | Symbol DMHA/DS evol. | 1 | 4 | 3 | 4 | 13 | 13 | **38** |
| Weber | Allofit | 9 | 9 | 10 | 2 | 4 | 2 | **36** |
| Weber | Fitmore | 38 | 51 | 46 | 37 | 33 | 26 | **231** |
| other combinations | - | 144 | 152 | 180 | 217 | 192 | 265 | **1,150** |
| **Total** | | **522** | **667** | **718** | **854** | **916** | **1,045** | **4,722** |

### 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.

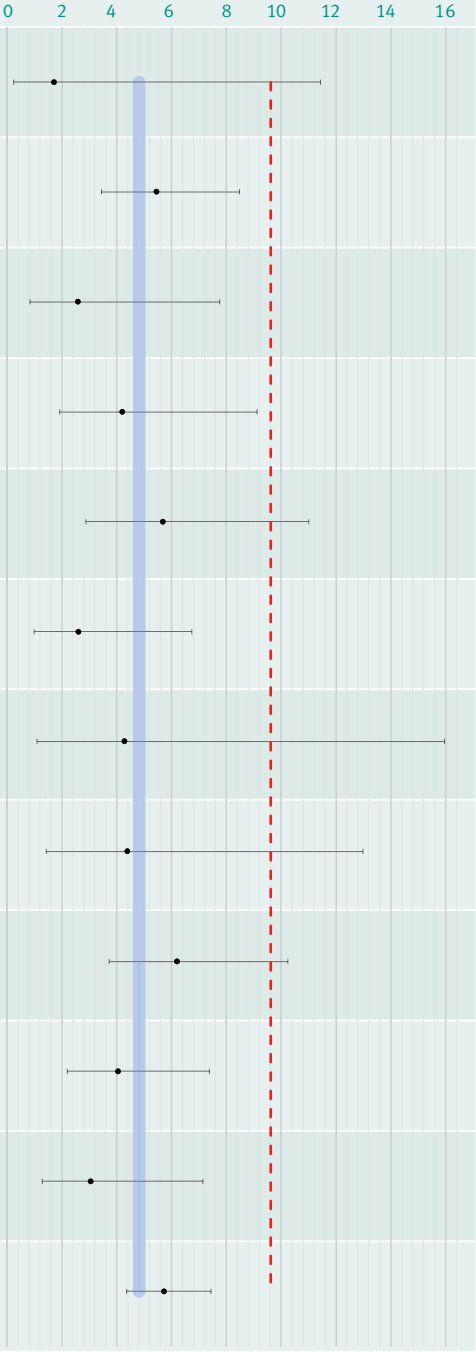
Please be aware that relatively rare implant combinations are frequently used in only a small number or indeed only in one hospital in Switzerland. Observed revision rates may be determined by local factors and performance may differ significantly between locations. Manufacturers of detected outlier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

Figure 5.32

## Two-year revision rates within 24 months of hybrid primary total hip arthroplasty combinations to treat fractures

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Stem component | Cup component | CCS* | at risk N** | Revised N | Revised % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-C | Versafitcup DM | 74 | 62 | 1 | 1.7 (0.2-11.4) |
| Amistem-C | Versafitcup trio/ccl. | 25 | 342 | 18 | 5.4 (3.5-8.5) |
| Avenir (cem) | Allofit | 56 | 119 | 3 | 2.6 (0.8-7.8) |
| Avenir (cem) | Fitmore | 59 | 147 | 6 | 4.2 (1.9-9.1) |
| Centris | RM pressfit vitamys | 37 | 150 | 8 | 5.7 (2.9-11.0) |
| Corail (cem) | Pinnacle | 23 | 164 | 4 | 2.6 (1.0-6.7) |
| Quadra-C | Mpact | 78 | 60 | 2 | 4.3 (1.1-16.0) |
| Quadra-C | Mpact DM | 50 | 78 | 3 | 4.4 (1.4-13.0) |
| Quadra-C | Versafitcup trio/ccl. | 55 | 235 | 14 | 6.2 (3.7-10.2) |
| Twinsys (cem) | RM pressfit vitamys | 20 | 259 | 10 | 4.0 (2.2-7.4) |
| Weber | Fitmore | 46 | 172 | 5 | 3.0 (1.3-7.1) |
| other combinations | | - | 946 | 51 | 5.7 (4.4-7.4) |
| **CH average for group** | | | | | **4.8** (4.1-5.7) |




* 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

### 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 components **(Table 5.34).** These combinations were used rather frequently over the last 11 years, and it is worth noting that neither combination was used fewer than 300 times during the last 5 years. The revision rates for combinations with n›50, which are more than the above-mentioned nine combinations, are shown in **Figure 5.33.**

The average revision rate of this subgroup was 3.2% (CI 2.8-3.6%). There were two implant combinations that were detected as outliers. Among these, the combination Harmony (cem)/Symbios bibop was used in one center only, illustrating the importance of single centres on the revision rates of specific implants.as a single combination **(Table 5.33).** For the 2023 report, the analysis of the Harmony-related data could be split up into three different head types, of which one has a rather high revision rate, while none of the implants reached potential outlier status.

Table 5.34

**Fracture of the hip: Top 75% stem/head combinations used in hemiarthroplasty (HA) 2018–2023**

| Stem component | Cup component | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| Amistem-C | Medacta bipolar head | 95 | 92 | 114 | 151 | 170 | 189 | **811** |
| Amistem-C | Medacta endohead | 289 | 281 | 329 | 377 | 415 | 375 | **2,066** |
| Avenir (cem) | ZB bipolar head | 60 | 79 | 99 | 69 | 100 | 106 | **513** |
| Avenir (cem) | ZB unipolar head | 14 | 28 | 44 | 72 | 69 | 67 | **294** |
| CCA | Hemihead SS | 430 | 438 | 395 | 350 | 289 | 184 | **2,086** |
| Centris | Hemihead SS | 113 | 109 | 103 | 113 | 0 | 0 | **438** |
| Corail (cem) | J&J modular head carthcart | 42 | 85 | 105 | 173 | 257 | 270 | **932** |
| Twinsys (cem) | Hemihead SS | 71 | 97 | 124 | 121 | 236 | 327 | **976** |
| Weber | ZB unipolar head | 252 | 225 | 168 | 140 | 151 | 103 | **1,039** |
| other combinations | | 494 | 586 | 531 | 440 | 547 | 533 | **3,131** |
| **Total** | | **1,860** | **2,020** | **2,012** | **2,006** | **2,234** | **2,154** | **12,286** |

### 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.

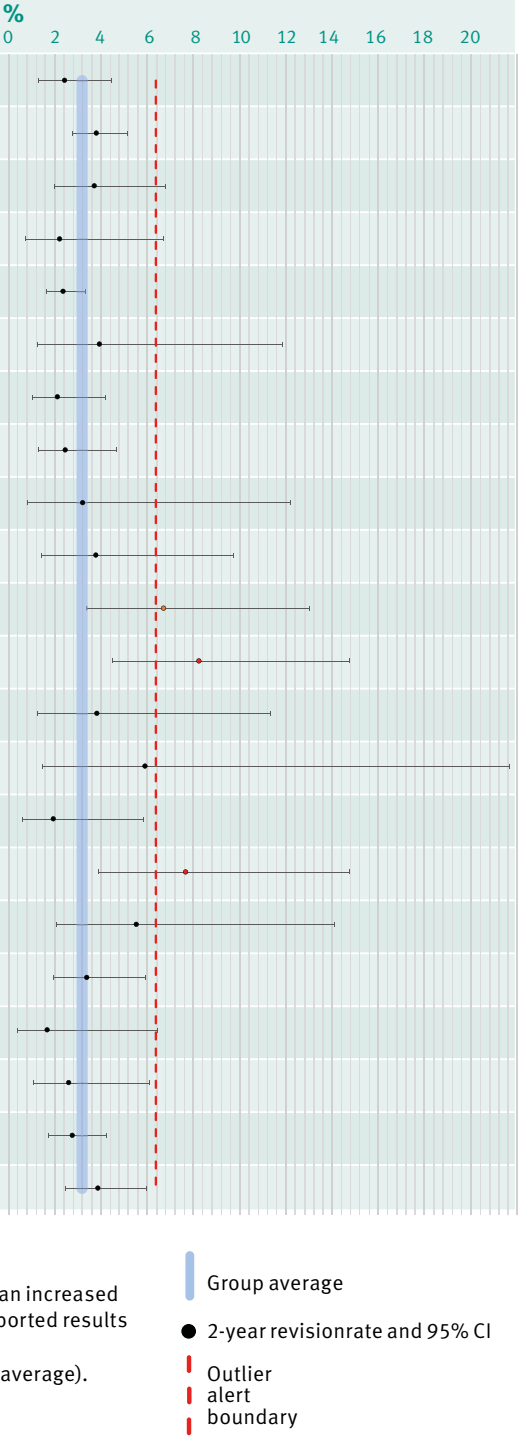
Please be aware that relatively rare implant combinations are frequently used in only a small number or indeed only in one hospital in Switzerland. Observed revision rates may be determined by local factors and performance may differ significantly between locations. Manufacturers of detected outlier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

Figure 5.33

## Two-year revision rates of cemented primary HA components

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Stem component | Cup component | CCS* | at risk N** | Revised N | % (95% CI)*** |
|---|---|---|---|---|---|
| Amistem-C | Medacta bipolar head | 29 | 452 | 10 | 2.4 (1.3-4.5) |
| Amistem-C | Medacta endohead | 34 | 1276 | 40 | 3.8 (2.8-5.1) |
| Avenir (cem) | ZB bipolar head | 29 | 307 | 10 | 3.7 (2.0-6.8) |
| Avenir (cem) | ZB unipolar head | 23 | 158 | 3 | 2.2 (0.7-6.7) |
| CCA | Hemihead SS | 31 | 1613 | 31 | 2.3 (1.6-3.3) |
| CCA | Mathys bipolar steel head | 26 | 99 | 3 | 3.9 (1.3-11.8) |
| Centris | Hemihead SS | 41 | 438 | 8 | 2.1 (1.1-4.2) |
| Corail (cem) | J&J modular head carthcart | 18 | 405 | 9 | 2.5 (1.3-4.7) |
| Corail (cem) | S&N bipolar ballhead | 100 | 65 | 2 | 3.2 (0.8-12.2) |
| Harmony (cem) | Acropole bipolar head | 98 | 124 | 4 | 3.8 (1.4-9.7) |
| Harmony (cem) | OHST bipolar head | 86 | 141 | 8 | 6.7 (3.4-13.0) |
| Harmony (cem) | Symbios bibop | 100 | 138 | 10 | 8.2 (4.5-14.8) |
| MS-30 | ZB bipolar head | 62 | 86 | 3 | 3.8 (1.2-11.4) |
| Original Mueller | ZB bipolar head | 34 | 59 | 2 | 5.9 (1.5-21.7) |
| Original Mueller | ZB unipolar head | 36 | 194 | 3 | 1.9 (0.6-5.9) |
| Quadra-C | Medacta bipolar head | 37 | 111 | 8 | 7.7 (3.9-14.8) |
| Quadra-C | Medacta endohead | 39 | 85 | 4 | 5.5 (2.1-14.1) |
| Twinsys (cem) | Hemihead SS | 30 | 413 | 12 | 3.4 (1.9-5.9) |
| Twinsys (cem) | Mathys bipolar steel head | 30 | 138 | 2 | 1.6 (0.4-6.4) |
| Weber | ZB bipolar head | 50 | 213 | 5 | 2.6 (1.1-6.1) |
| Weber | ZB unipolar head | 30 | 785 | 19 | 2.7 (1.7-4.3) |
| other combinations | | | 568 | 19 | 3.9 (2.5-6.0) |
| CH average for group | | | 804 | 23 | 3.2 (2.8-3.6) |




* 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.

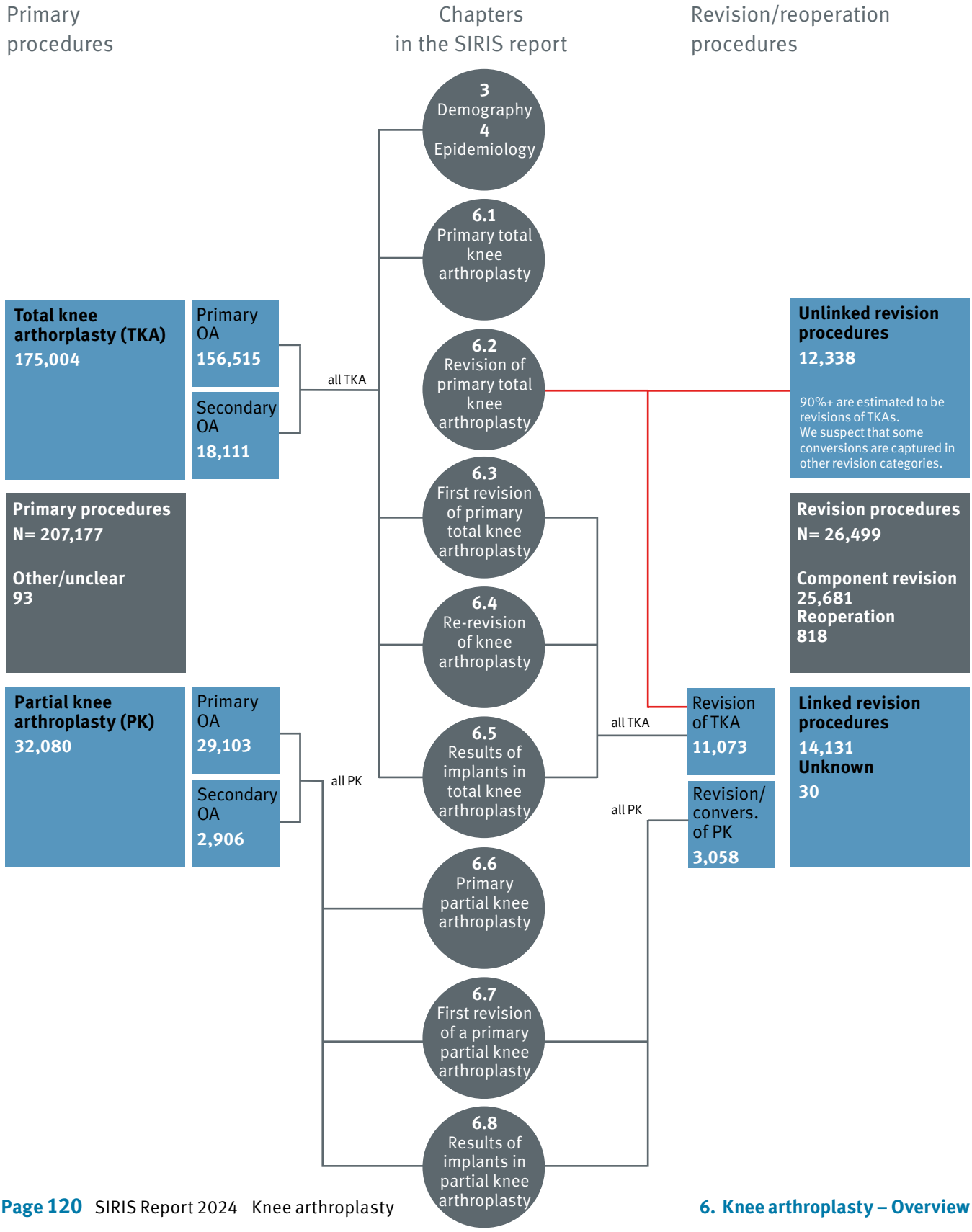
** Number of patients with at least two years follow-up (i.e. primary prosthesis in moving average).

*** Rates adjusted for effects of mortality and emigration

# Knee arthroplasty

# 6. Knee arthroplasty

## Overview of data structure (annual report 2024)



## Overview of of types of analyses for determining revision rates (annual report 2024)

| Types of analysis / Report section | **Kaplan-Meier estimates** 2012–2023<br>**Adjusted for censoring events** | **2-year revision rates** (implants 2018–2021 with completed 2-year follow-up)<br>**Adjusted for censoring events** | **Funnel plots of 2-year hospital revision rates** (implants 2018–2021 with completed 2-year follow-up)<br>**Risk-adjusted and adjusted for censoring events** |
|---|---|---|---|
| **Knee overview** | All total knee arthroplasties (TKA)<br><br>All partial knee arthroplasties (PK) | | TKA after primary osteoarthritis (primary OA). **ANQ online reporting, above 99.8%= outlier status**<br><br>All partial knee arthroplasties (PK)<br><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 PK** | PK for various subgroups | PK for various subgroups | |
| **Re-revision after revision of TKA/PK** | Re-revision after revised TKA for various subgroups<br><br>Re-revision after conversion from PK to TKA | | |
| **Knee implants** (minimal number in group) | Bicondylar total knee systems, all diagnoses (500+)<br><br>Unicondylar partial knee systems, all diagnoses (500+)<br><br>Patellofemoral joint systems, all diagnoses (500+)<br><br>**Long-term evaluation 5–10 years: elevated revision rate or outlier** | Bicondylar total knee systems, all diagnoses (50+)<br><br>Unicondylar partial knee systems, all diagnoses (50+)<br><br>Patellofemoral joint systems, all diagnoses (50+)<br><br>**2-year evaluation (two times group average= outlier status)** | |

## Online appendix for implants

## 6.1 Primary total knee arthroplasty

The total number of primary TKA registered in SIRIS at the end of 2023 reached 175,003 cases **(Table 4.6, Page 41).** The share of women (59.4%) and the mean age of the patients (69.7 years) remained constant throughout the entire registration period. Please consult also chapters 3 Demography and 4 Epidemiology for further details regarding incidence and demographic characteristics.

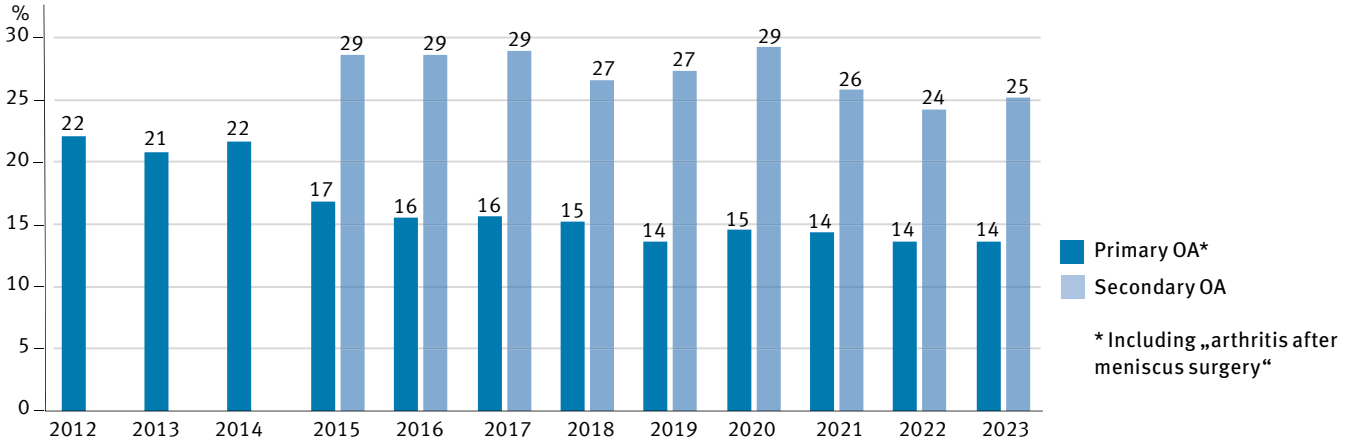
### Previous surgery

Between 2018 and 2023, no previous surgery was recorded in 67.8% of the TKA registered, while 17.9% had former meniscectomy and 15.6% arthroscopy. Assuming a meniscectomy was performed at every arthroscopy, one could estimate open meniscectomy having been performed in 2.3% of the cases. Preceding ACL reconstruction was registered in 5.2%, and osteotomy at tibial level in 1.4%, but at the femur only in 0.4%. All other conditions were rare, in 2.1% "other" former surgeries were reported **(Table 6.1).** The rate of previous arthroscopies preceding TKA in primary OA was constantly decreasing since 2012, with the share being much higher in secondary OA **(Figure 6.1).**

### 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 2018 and 2023, the share of cruciate-sacrificing/ultracongruent systems (CS/UCOR) was 24.8%, for posterior stabilized (PS) it was 27.4% and posterior cruciate-retaining (PCR/CR) it was 25.4%. A medial pivot (MP) was used in 17.3%, whereas semi-constrained/constrained condylar knees (SC/CCK) or hinged implants were used only in 1.3% and 2.8% of the cases, respectively. Bicruciate-retaining knees (BCR) were rarely used (1.0%) as well **(Table 6.1).** The share of MP implants seemed to increase nationwide and replace more traditional designs such as PS, PCR/CR and CS/UCOR. The proportion of SC/CCK TKA was approximately 1.6% in primary and approximately 3.3% in secondary OA. For hinged systems, the share almost tripled in secondary OA (approx. 4.4% versus approx. 1.6% in primary OA). Of note, the knee replacement systems used varied significantly between cantons, regions, and hospitals (see chapter 4 Epidemiology).

Figure 6.1
**Share of TKA patients who had knee arthroscopy prior to arthroplasty (%)**
Secondary OA categories were different before 2015 and therefore cannot be compared



### Type of bearing

The rate of mobile bearing polyethylene (PE) liners did rapidly decrease over the past six years, from 39.4% in 2018 to 18.7% in 2023 **(Figure 4.14, page 46).** However, one must note that the choice of bearing type showed again a high variability among the different cantons of Switzerland, including the Principality of Liechtenstein (see chapter 4 Epidemiology). The type of PE (CPE vs XLPE) was not analysed so far in TKA.

Table 6.1
**Primary total knee arthroplasty: Surgery characteristics**
all diagnoses

| **N** (2018–2023) | **N** | **%** |
|---|---|---|
| **Previous surgery** | | |
| None | 69,297 | 67.8 |
| Knee arthroscopy | 15,897 | 15.6 |
| Meniscectomy | 18,248 | 17.9 |
| ACL reconstruction | 5,304 | 5.2 |
| Osteotomy tibia close to knee | 2,585 | 2.5 |
| Osteosynthesis tibia close to knee | 1,457 | 1.4 |
| Surgery for patella stabilization | 1,276 | 1.2 |
| Synovectomy | 802 | 0.8 |
| Osteotomy femur close to knee | 438 | 0.4 |
| Osteosynthesis femur close to knee | 529 | 0.5 |
| Surgery for treating infection | 182 | 0.2 |
| Surgery for tumor | 43 | 0.0 |
| Other | 2,143 | 2.1 |
| **Intervention** | | |
| CS (cruciate sacrificing) / UCOR | 25,310 | 24.8 |
| PS (posterior stabilized) | 28,036 | 27.4 |
| PCR (posterior cruciate retaining) | 25,961 | 25.4 |
| BCR (bicruciate retaining) | 978 | 1.0 |
| Hinge type | 1,992 | 2.0 |
| SC/ CCK (semi-constrained/constrained) | 1,372 | 1.3 |
| Other (Medial-Pivot)[1] | 17,708 | 17.3 |
| Other | 711 | 0.7 |
| **Technology** | | |
| Conventional | 71,463 | 70.0 |
| Computer assisted / navigation | 10,162 | 9.9 |
| Patient specific instrumentation | 17,514 | 17.1 |
| Robotic-assisted (v2021) | 3,589 | 3.5 |
| Other | 1,586 | 1.6 |

| **N** (2021–2023) | **N** | **%** |
|---|---|---|
| **Additional Intervention** | | |
| None | 53,254 | 95.4 |
| Osteosynthesis FE | 67 | 0.1 |
| Osteosynthesis TI | 47 | 0.1 |
| Osteosynthesis PAT | 4 | 0.0 |
| Removal of metalwork | 746 | 1.3 |
| Operation extensors | 352 | 0.6 |
| Reconstruction plasty | 54 | 0.1 |
| Tibial tubercle osteotomy | 816 | 1.5 |
| Other additional intervention(s) | 600 | 1.1 |
| **Total TKA (multiple responses)** | **55,794** | |
| **Additional components** | | |
| Stem FE (cemented)* | 963 | 1.7 |
| Stem FE (uncemented)** | 333 | 0.6 |
| Stem TI (cemented)*** | 3,213 | 5.7 |
| Stem TI (uncemented)**** | 538 | 1.0 |
| Sleeve FE | 34 | 0.1 |
| Sleeve TI | 104 | 0.2 |
| Augments FE | 68 | 0.1 |
| Augments TI | 120 | 0.2 |
| Augments PAT | 2 | 0.0 |
| Bone homologous | 29 | 0.1 |
| Bone autologous | 103 | 0.2 |
| Cone FE | 3 | 0.0 |
| Cone TI | 35 | 0.1 |
| **Total TKA (multiple responses)** | **55,983** | |

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

[1] 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.

### Patella resurfacing

The patella was not resurfaced in 65.5% of primary TKA during the period 2018 to 2023 ***(Figure 4.16 p. 47).*** However, the resurfacing rate increased continuously since 2018 from 29.9% to 39.3% in 2023. However, there were again considerable differences between the cantons (see chapter 4 Epidemiology). Increasing resurfacing rates may be partially due to the prosthesis type used, as resurfacing of the patella is recommended more frequently in PS knees than in other TKA types. 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 even more dependent on the surgeon's personal preference than on the knee system type or geographic region. The observed trend toward 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, independently of functional outcomes. The same effect could be observed in Australia over the past 10 years.

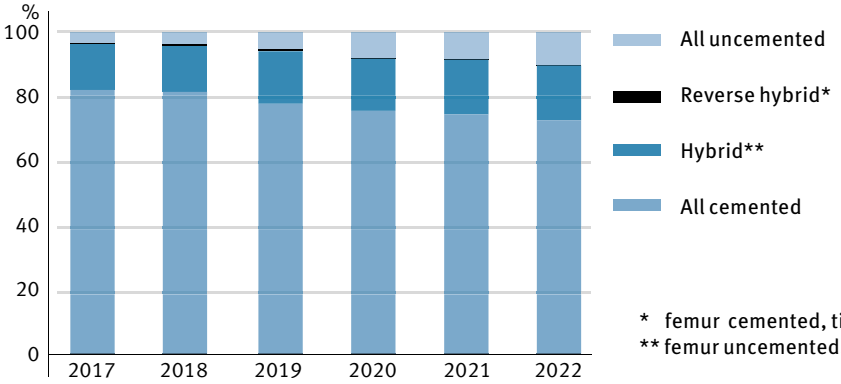
### Fixation and use of stems

Fixation of TKA mostly was fully cemented, with a proportion of 76.9 % over the past six years. Use of hybrid fixation of the components remained constant with 15.9%. Interestingly, cementless fixation represented only 3.5% of the TKA in 2018, but the share tripled within 6 years to 10.2% in 2023 **(Figure 6.2).** Stems (femoral and/or tibial) were used in 9.0% of primary TKA, mostly (in 74.3%) on the tibial side, and 82.7% were cemented **(Table 6.1).** Obesity (≥ 30 kg/m²) was not associated with use of a tibial stem, despite such recommendations from several studies. Stems were mainly associated with higher intrinsic stability of the knee system (SC/CCK or hinge type). Stems were also used more frequently in PS than in the PCR/CR, CS, or MP designs **(Figure 6.1).**

Figure 6.2

**Primary total knee arthroplasty: Component fixation by year**

Percentage per year, all diagnoses.




| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| N | 14,707 | 15,521 | 15,437 | 16,681 | 19,273 | 20,495 | 102,114 |
| All uncemented | 3.5 | 4.0 | 5.5 | 8.1 | 8.5 | 10.2 | 6.9 |
| Reverse hybrid* | 0.3 | 0.4 | 0.5 | 0.2 | 0.1 | 0.2 | 0.3 |
| Hybrid** | 14.2 | 14.2 | 16.3 | 16.2 | 17.0 | 17.0 | 15.9 |
| All cemented | 82.0 | 81.5 | 77.7 | 75.5 | 74.4 | 72.6 | 76.9 |

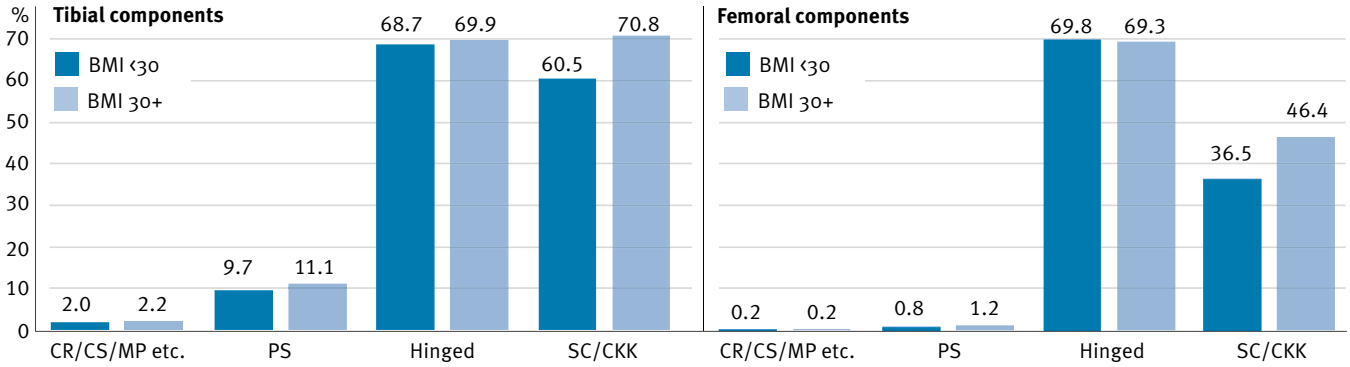
## Additional components

More information about components in primary TKA were introduced on the 2021 version of the CRF, improving registering possibilities. The most common additional components were tibial stems in 6.7% of the cases, whereby 85.7% of them were cemented. Femoral stems were used in 2.3% of the primary TKA, 74.3% being cemented. Sleeves, cones, augments, or additional homologous or autologous bone grafting were rarely necessary in primary TKA **(Table 6.1).** Most of the stems were used in hinged or primary SC/CCK TKA systems, irrespective of the underlying BMI (benchmark set at 30 kg/m2). Stems were also significantly more frequently used in PS than other knee types such as PCR/CR, CS, or MP **(Figure 6.3).** BMI ≥30 kg/m² did not lead to a more frequent use of stems on the tibial side, despite availability of corresponding recommendations in the literature since many years. Femoral and tibial stems were used more often in patients with a BMI ≥30 kg/m² only together with SC/CCK knee systems **(Figure 6.1).**

## Additional interventions

Additional interventions were rarely performed during primary TKA (4.6% of cases on average between 2018 to 2023). The removal of internal fixation devices (1.3%) and osteotomies of the tibial tubercle (1.5%) were the most common additional surgical steps, while 1.1% were reported as "other" **(Table 6.1).**

Figure 6.3
**Use of stems by BMI (%)**



## Technology

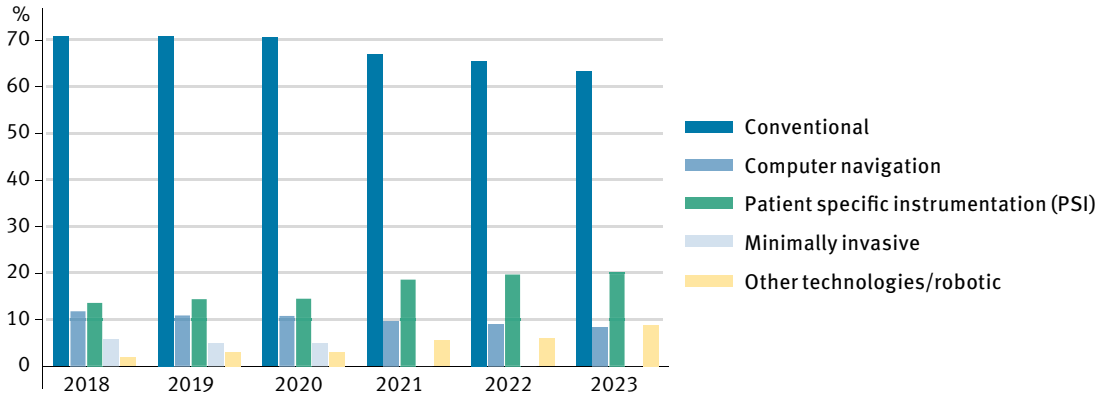
Between 2018 and 2023, 67.6% of the primary TKA in Switzerland were performed conventionally, without additional technological assistance. The share of computer navigation was 9.9% and continuously decreased from 11.8% in 2018 to 8.3% in 2023. On the other hand, the use of patient-specific instrumentation (PSI) increased from 13.6% in 2018 to 20.2% in 2023. Robotic-assisted TKA (imageless and image-based) were classified as "other" and accounted for 5.0% of surgical interventions for the whole period, increasing from 1.9% in 2018 to 8.9% in 2022 **(Figure 6.4).** Of note, the different robotic systems were not yet differentiated due to limited numbers. In summary, surgeons used technical support in 32.4% of TKA over the past 6 years.

Minimal invasive surgery is no longer a topic in Switzerland. It was removed from the CRF in 2021. Anyway, there was no uniformly accepted definition, limiting the reliability of the data.

Figure 6.4

**Primary total knee arthroplasty: Technologies used**

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




| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| N | 14,717 | 15,528 | 15,439 | 16,683 | 19,274 | 20,495 | 102,136 |
| Conventional | 70.8 | 70.9 | 70.6 | 67.0 | 65.6 | 63.3 | 67.6 |
| Computer navigation | 11.8 | 10.9 | 10.8 | 9.7 | 9.1 | 8.3 | 9.9 |
| PSI | 13.6 | 14.4 | 14.5 | 18.6 | 19.7 | 20.2 | 17.1 |
| Minimally invasive (up to 2020) | 5.7 | 4.9 | 5.0 | 0.0 | 0.0 | 0.0 | 2.3 |
| Other technologies/robotic | 1.9 | 3.1 | 3.1 | 5.5 | 6.0 | 8.9 | 5.0 |

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

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. Unlinked revisions cannot be linked to a primary knee arthroplasty registered in SIRIS. Revisions of index arthroplasties registered in SIRIS are named linked revisions (see Chapter 6.3).

The share of unlinked revisions steadily decreased from 96% in 2013 to 32.7% in 2023 (848 cases), corresponding to unlinked TKA revisions overall in 46.7% **(Table 6, p.41).** A total of 5,325 unlinked TKA revisions were performed between 2018 and 2023 **(Table 6.2).** As the primary TKA was not registered, it remains unclear if the registered revision was the first or a subsequent intervention. The rate of unlinked revision TKA falls more rapidly than in THA,

Table 6.2
**Revision* of total knee arthroplasty (unlinked): Baseline patient characteristics by year**

| | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|---|
| N | | **957** | **934** | **928** | **874** | **784** | **848** | **5,325** |
| Women [%] | | 61.5 | 58.9 | 56.6 | 62.0 | 62.0 | 60.6 | 60.2 |
| Mean age (SD) | All | 71.0 (10.3) | 71.7 (10.0) | 71.2 (10.0) | 72.6 (10.3) | 72.4 (9.9) | 72.6 (10.1) | 71.9 (10.1) |
| | Women | 71.7 (10.4) | 72.2 (10.2) | 71.8 (10.5) | 73.1 (10.2) | 72.6 (9.8) | 73.1 (10.3) | 72.4 (10.3) |
| | Men | 70.0 (10.2) | 70.8 (9.5) | 70.3 (9.3) | 71.8 (10.4) | 72.1 (10.1) | 71.8 (9.7) | 71.1 (9.9) |
| Age group [%] | <45 | 0.9 | 0.4 | 0.6 | 0.8 | 0.6 | 1.3 | 0.8 |
| | 45–54 | 5.6 | 5.4 | 4.2 | 3.0 | 4.1 | 3.4 | 4.3 |
| | 55–64 | 18.1 | 16.8 | 20.0 | 17.8 | 14.4 | 14.0 | 17.0 |
| | 65–74 | 35.8 | 37.6 | 36.4 | 32.0 | 34.2 | 33.0 | 34.9 |
| | 75–84 | 31.6 | 31.5 | 30.6 | 35.0 | 38.3 | 39.3 | 34.2 |
| | 85+ | 7.9 | 8.4 | 8.1 | 11.3 | 8.4 | 9.0 | 8.8 |
| N unknown BMI (%) | | 201 (21) | 176 (19) | 158 (17) | 111 (13) | 77 (10) | 69 (8) | 792 (15) |
| N known BMI | | 756 | 758 | 770 | 763 | 707 | 779 | 4,533 |
| Mean BMI (SD) | | 29.3 (5.7) | 29.5 (6.1) | 29.8 (5.8) | 29.8 (5.9) | 29.4 (6.0) | 29.4 (5.5) | 29.5 (5.8) |
| BMI [%] | <18.5 | 0.5 | 0.9 | 0.4 | 0.4 | 1.6 | 0.6 | 0.7 |
| | 18.5–24.9 | 22.1 | 20.6 | 19.6 | 21.2 | 19.8 | 19.9 | 20.5 |
| | 25–29.9 | 36.9 | 36.9 | 36.9 | 34.2 | 37.1 | 38.0 | 36.7 |
| | 30–34.9 | 26.1 | 25.3 | 27.3 | 26.9 | 27.6 | 26.1 | 26.5 |
| | 35–39.9 | 9.9 | 12.3 | 10.8 | 10.6 | 7.6 | 11.6 | 10.5 |
| | 40+ | 4.5 | 4.0 | 5.1 | 6.7 | 6.4 | 3.9 | 5.1 |
| N unknown ASA (%) | | 78 (8) | 87 (9) | 78 (8) | 43 (5) | 36 (5) | 23 (3) | 345 (6) |
| N known ASA | | 879 | 847 | 850 | 831 | 748 | 825 | 4,980 |
| Morbidity state [%] | ASA 1 | 5.9 | 4.0 | 2.7 | 3.4 | 4.0 | 2.8 | 3.8 |
| | ASA 2 | 48.6 | 47.1 | 49.3 | 45.0 | 44.0 | 43.9 | 46.4 |
| | ASA 3 | 43.7 | 47.0 | 45.8 | 49.1 | 49.6 | 48.2 | 47.1 |
| | ASA 4/5 | 1.8 | 1.9 | 2.2 | 2.5 | 2.4 | 5.1 | 2.7 |

* includes a small proportion of reoperations that are not counted as component revisions in the evaluative parts of this report

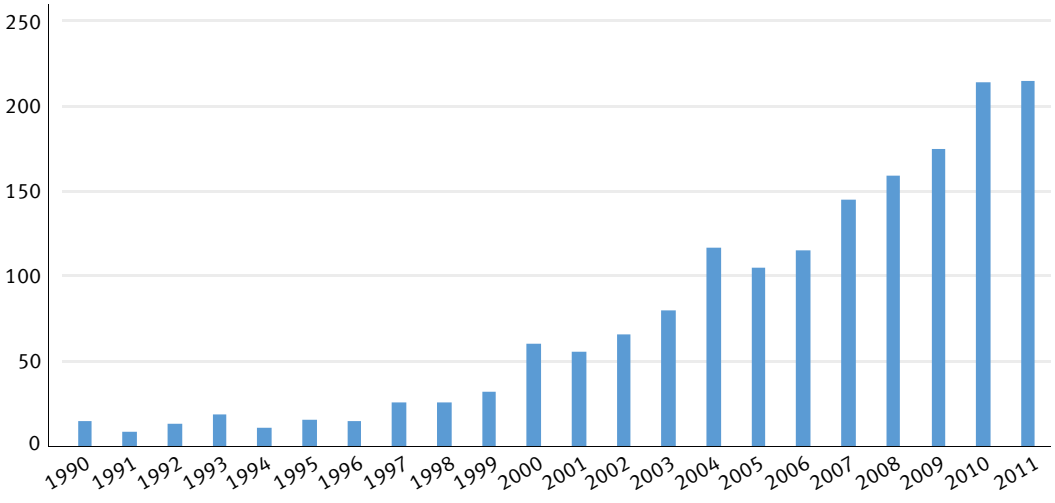
which is most probably attributable to the fact that TKA are revised earlier and more frequently than THA. Surgeons more often did not fill in the year of the primary TKA the older the implants were. That this information is missing is more pronounced than in unlinked THA. **(Figure 6.5).** Because of heterogeneity of data quality mainly in the first years of the registry and the rapidly decreasing share of unlinked revisions these older cases are of limited and continuously decreasing value and were not further analysed in this report.

## 6.3 First revision within two years after primary total knee arthroplasty

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 in OA classified as primary. 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 higher due to the underlying diagnosis.

Figure 6.5
**Number of unlinked revisions by year of primary implantation**



### 6.3.1 Incidence and demography

In the current 4-year moving window from 1.1.2028 – 31.12.21 with a complete 2-year follow-up until 31.12.2023 a total of 62,367 TKA were implanted and were at risk for an early revision within the first two years of follow-up. Of those, 2,138 were revised, resulting in a 2-year revision rate of 3.5% (CI 3.3–3.6%) **(Table 6.3).** Whereas the 2-year revision rate was 3.3% (CI 3.2–3.5%) in primary OA, the rate increased significantly to 4.5% (CI 4.0–5.0%) in secondary OA. This is partially an effect of the age difference at the index arthroplasty, which was 70.3 years on average between 2018 and 2023 for primary OA, compared to 65.2 years for secondary OA **(Table 3.6, p.26).** A second explanation could be that more complex knee systems had to be used in secondary OA more frequently at the index surgery.

Younger patients were more at risk of early revision (5.5% for the age group under 55 and 4.0% for the age group 55–64 years). 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 more tolerance for inferior results.

Women (3.2%, CI 3.0-3.4%) were revised less often than men (3.6%, CI 3.3-3.8%) although the difference was not statistically significant.

The BMI was moderately associated with short-term revision rates. Normal weight patients had the lowest early revision rate at 3.0%. With BMI values above 30 kg/m² the revision rate increased to 3.5% and above 35 kg/m² to 4.0%. The latter value represents a statistically significant difference from the normal weight reference group. The apparently increased revision rate in low BMI patients might be contributed to small numbers, as only 247 TKA patients had a BMI less than 18 kg/m².and they accounted for 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 4/5 tended to be revised more often, the difference however remaining statistically not significant **(Table 6.3).**

Table 6.3

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).

| | | Primary | Revised within 24 months | | | |
|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | |
| | | N at risk* | N | %** | lower | upper |
| Overall (moving average) | | 62,367 | 2,138 | 3.5 | 3.3 | 3.6 |
| Diagnosis | Primary OA | 55,048 | 1,816 | 3.3 | 3.2 | 3.5 |
| | Secondary OA | 7,219 | 319 | 4.5 | 4.0 | 5.0 |
| Overall Primary OA | | 55,048 | 1,816 | 3.3 | 3.2 | 3.5 |
| Gender | Women | 33,724 | 1,064 | 3.2 | 3.0 | 3.4 |
| | Men | 21,324 | 752 | 3.6 | 3.3 | 3.8 |
| Age | ‹55 | 2,777 | 151 | 5.5 | 4.7 | 6.4 |
| group [%] | 55–64 | 12,549 | 501 | 4.0 | 3.7 | 4.4 |
| | 65–74 | 20,372 | 697 | 3.5 | 3.2 | 3.7 |
| | 75–84 | 16,677 | 411 | 2.5 | 2.3 | 2.7 |
| | 85+ | 2,668 | 56 | 2.2 | 1.7 | 2.8 |
| BMI group | ‹18.5 | 247 | 11 | 4.6 | 2.6 | 8.1 |
| | 18.5–24.9 | 9,941 | 296 | 3.0 | 2.7 | 3.4 |
| | 25–29.9 | 18,227 | 558 | 3.1 | 2.9 | 3.4 |
| | 30–34.9 | 12,039 | 413 | 3.5 | 3.2 | 3.8 |
| | 35–39.9 | 5,108 | 204 | 4.0 | 3.5 | 4.6 |
| | 40+ | 2,303 | 86 | 3.8 | 3.1 | 4.7 |
| | BMI unknown | 7,183 | 248 | 3.5 | 3.1 | 4.0 |
| Morbidity | ASA 1 | 3,668 | 124 | 3.4 | 2.9 | 4.1 |
| state | ASA 2 | 31,972 | 1,037 | 3.3 | 3.1 | 3.5 |
| | ASA 3 | 15,599 | 543 | 3.5 | 3.3 | 3.8 |
| | ASA 4/5 | 209 | 8 | 4.2 | 2.1 | 8.2 |
| | ASA unknown | 3,600 | 104 | 2.9 | 2.4 | 3.5 |

## 6.3.2 Reasons for first revision

The most frequent reason for first revision were patella problems, registered in 37.3%. Additionally, an instability of the patella was reported in 3.6%. Infection (20.6%) and femorotibial instability (18.0%) were the second and third most frequent reasons. Loosening of the tibial component was indicated in 8.3% of the cases, joint stiffness in 8.2% and pain of unclear origin in 5.4%. Wear of the liner was reported rarely (0.7%) **(Table 6.4).** Periprosthetic fractures of the femur, tibia, and/or patella were rarely responsible for early revisions. However, most cases treated with internal fixation only were probably not registered. Still, 10.5% of the reasons for revision were classified as "other". This diverse group mostly consists of the same reasons as listed above, but with added details and includes numerous wound healing problems and more special reasons, such as liner dislocations. Excluding periprosthetic infections and fractures, most of the other reasons appeared to be related to surgeon's errors in technique and/or indication.

Table6.4

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023), all diagnoses.
Early first revisions are those occurring within two years of the primary arthroplasty.
Multiple responses possible (percentages do not sum to 100).

| | N | % |
|---|---|---|
| Patella problems | 798 | 37.3 |
| Infection | 440 | 20.6 |
| Femorotibial instability | 384 | 18.0 |
| Loosening tibia | 177 | 8.3 |
| Pain (of unclear origin)* | 116 | 5.4 |
| Joint stiffness/arthrofibrosis | 175 | 8.2 |
| Component malposition femur | 88 | 4.1 |
| Component malposition tibia | 94 | 4.4 |
| Loosening femur | 85 | 4.0 |
| Patellar instability | 77 | 3.6 |
| Wear of inlay | 14 | 0.7 |
| Loosening patella | 28 | 1.3 |
| Periprosthetic fracture femur | 24 | 1.1 |
| Sizing femoral component | 33 | 1.5 |
| Periprosthetic fracture tibia | 16 | 0.7 |
| Sizing tibial component | 15 | 0.7 |
| Periprosthetic fracture patella | 17 | 0.8 |
| Other | 225 | 10.5 |
| **Total** | **2,806** | |

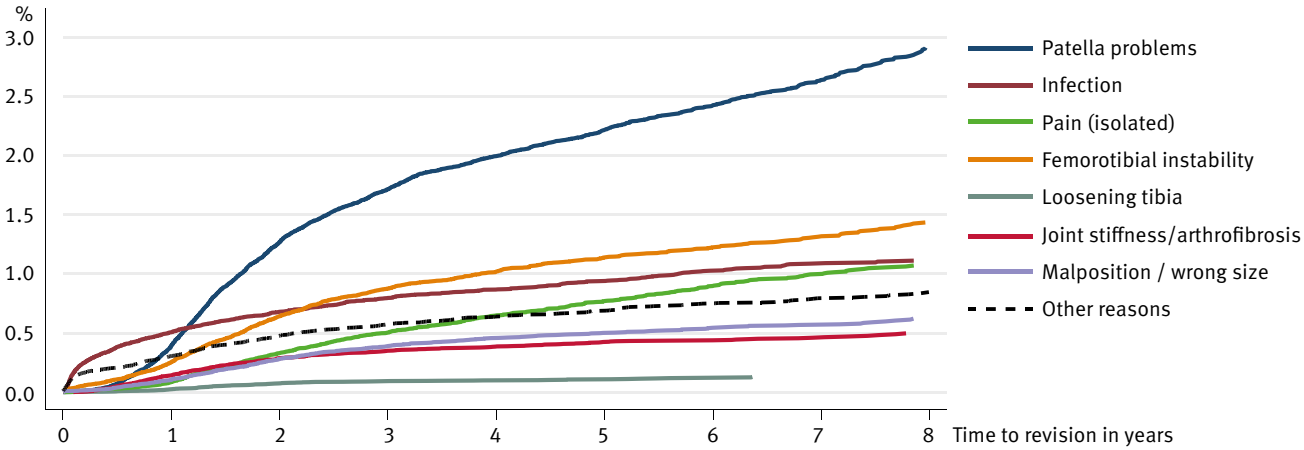
* Pain was frequently reported alongside other reasons. The proportion of „isolated pain" was 3.2%. The wording was adapted in v2021 and the share dropped accordingly in 2021.

Cumulative incidence rates show patella problems to be the most prominent reason for revision surgery within one year after TKA, and corresponding revision rates increase thereafter more rapidly than all other reasons **(Figure 6.6).** Kernel density estimation – that evaluates the frequency at a given time – depicts that only infections were revised early after primary TKA, whereas peaks for reasons linked to the patella, 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, as "wait and see" often is recommended. The bell-like pattern drives the revision rates upwards with ongoing time, in what might resemble logistic growth curves (slow increase followed by steeper growth and then a flattening out effect). Patella problems contributed to the observed pattern of revisions, causing a disproportionate number of revisions between 11.1 and 18.7 months after implantation, with the median at 14.8 months. Revision for joint stiffness showed a flatter pattern, with a maximum at 12 months **(Figure 6.7 and Table 6.5).**

Figure 6.6

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

Time since operation, 2012–2023, all services, % of implants revised. Detailed reasons for revisions available since 2015.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **0.4** (0.4-0.4) | **1.3** (1.2-1.3) | **1.7** (1.6-1.8) | **2.2** (2.1-2.3) | **2.4** (2.3-2.5) | **2.6** (2.5-2.8) | **2.9** (2.8-3.1) |
| Infection | **0.5** (0.5-0.5) | **0.7** (0.6-0.7) | **0.8** (0.7-0.8) | **0.9** (0.9-1.0) | **1.0** (1.0-1.1) | **1.1** (1.0-1.2) | **1.1** (1.0-1.2) |
| 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** (0.1-0.2) | **0.1** (0.1-0.2) |
| Femorotibial instability | **0.3** (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) | **1.3** (1.2-1.4) | **1.4** (1.3-1.5) |
| Loosening TI | **0.1** (0.1-0.1) | **0.3** (0.3-0.4) | **0.5** (0.5-0.5) | **0.8** (0.7-0.8) | **0.9** (0.8-1.0) | **1.0** (0.9-1.1) | **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) | **0.4** (0.4-0.5) | **0.5** (0.4-0.5) | **0.5** (0.4-0.6) |
| Malposition / wrong size | **0.1** (0.1-0.1) | **0.3** (0.3-0.3) | **0.4** (0.4-0.4) | **0.5** (0.5-0.5) | **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** (0.7-0.9) | **0.8** (0.8-0.9) |

Figure 6.7

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

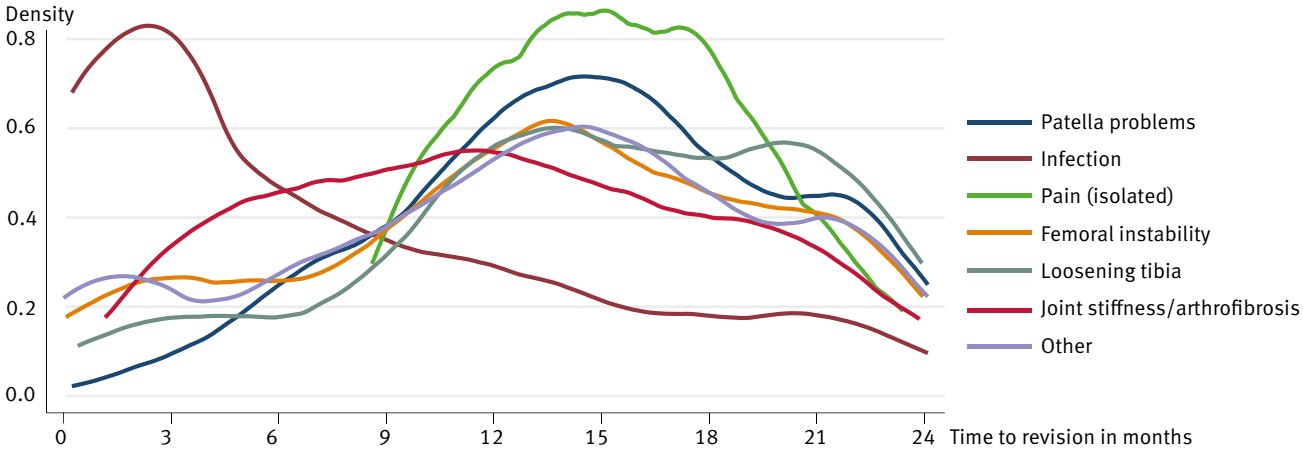



Table 6.5

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023), all diagnoses.

| | Primary TKA | Revised within 24 months | | | |
|---|---|---|---|---|---|
| | | Revised | | 95% CI | |
| | N at risk[1] | N | %[2] | lower | upper |
| Overall | 62,367 | 2138 | 3.5 | 3.3 | 3.6 |
| **Component fixation** | | | | | |
| All cemented | 49,295 | 1679 | 3.5 | 3.3 | 3.6 |
| All uncemented | 3,323 | 141 | 4.3 | 3.6 | 5.0 |
| Hybrid* | 9,513 | 306 | 3.3 | 2.9 | 3.6 |
| Reverse hybrid** | 215 | 11 | 5.1 | 2.9 | 9.1 |
| **Patellar replacement** | | | | | |
| With patellar replacement | 20,104 | 586 | 3.0 | 2.7 | 3.2 |
| Without patellar replacem. | 42,223 | 1549 | 3.7 | 3.5 | 3.9 |
| Status after patellectomy | 19 | 2 | 10.5 | 2.7 | 35.9 |

[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.

* femur uncemented, tibia cemented
** femur cemented, tibia uncemented

Table 6.6

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

all diagnoses

| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Patella problems | 798 | 14.8 | 11.1 | 18.7 |
| Infection | 440 | 5.2 | 1.3 | 11.8 |
| Pain (isolated) | 30 | 15.4 | 12.2 | 18.1 |
| Femoral instability | 384 | 13.7 | 8.6 | 18.3 |
| Loosening tibia | 177 | 14.5 | 11.1 | 19.7 |
| Joint stiffness/arthrofibrosis | 175 | 12.0 | 7.0 | 17.2 |
| Other | 1,231 | 13.7 | 8.3 | 17.9 |

* Early first revisions are those occurring within 2 years of the primary arthroplasty

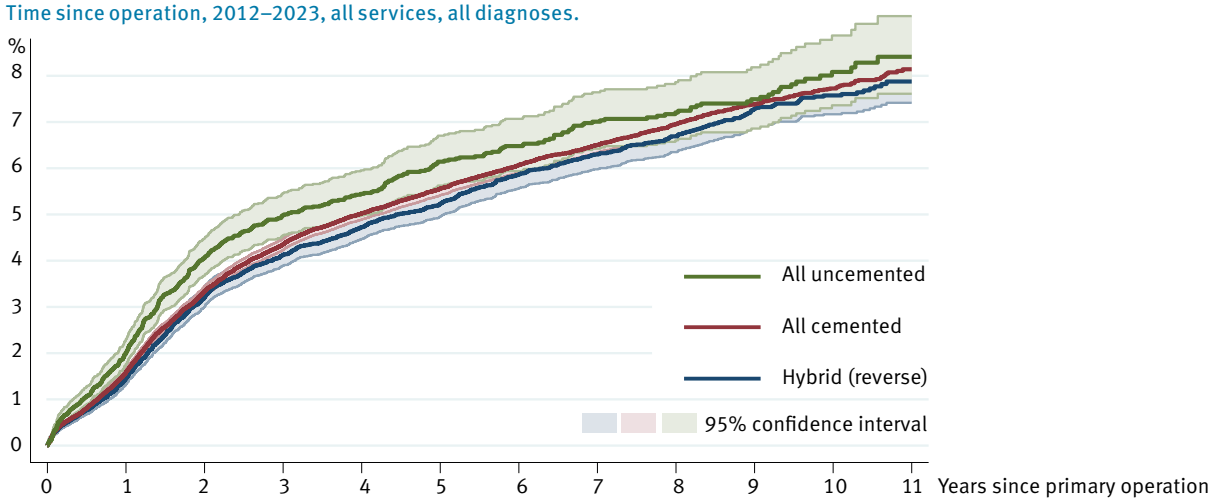
### Fixation and first revision

Uncemented TKA were revised more often (4.3%, CI 3.6–5.0%) than fully cemented TKA (3.5%, CI 3.3–3.6%) in the first two years after index surgery. Ignoring the proportionally irrelevant reverse hybrid fixation, hybrid fixation tended to perform best, with a 2-year revision rate at 3.3% (CI 2.9–3.6%). Non-cemented had a higher revision rate **(Table 6.6),** the difference however was statistically significant only the first two years after TKA **(Figure 6.8).** It seems that the higher revision rate of uncemented TKA is an increased risk for up to three years after operation, perhaps reflecting failed osteointegration or failures due to malalignment and/or insufficient bone quality. From the 4th year after index surgery, the curve is moving on a higher level than for the cemented and the hybrid fixation TKA but evolving parallel. All curves seem to converge 8 years after surgery **(Figure 6.8).** It is also important to consider that all TKA brands were included in this KM estimation of cumulative revision risk, mixing in various effects. Younger age (‹60 years) was correlated with an elevated early revision rate, independently of the fixation method (see above).

Figure 6.8

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

Time since operation, 2012–2023, all services, all diagnoses.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| All cemented | **1.6** (1.5-1.7) | **3.3** (3.2-3.4) | **4.4** (4.2-4.5) | **5.6** (5.4-5.7) | **6.1** (5.9-6.2) | **6.9** (6.8-7.1) | **7.4** (7.2-7.6) | **7.7** (7.5-8.0) | **8.1** (7.9-8.4) |
| All uncemented | **2.0** (1.8-2.3) | **4.1** (3.7-4.5) | **5.0** (4.5-5.5) | **6.1** (5.6-6.7) | **6.5** (5.9-7.1) | **7.2** (6.6-7.9) | **7.5** (6.9-8.2) | **8.1** (7.4-8.9) | **8.4** (7.6-9.3) |
| (reverse) hybrid | **1.5** (1.3-1.6) | **3.2** (3.0-3.4) | **4.1** (3.9-4.4) | **5.2** (5.0-5.5) | **5.9** (5.6-6.2) | **6.7** (6.3-7.0) | **7.3** (6.9-7.7) | **7.6** (7.2-8.0) | **7.9** (7.4-8.4) |

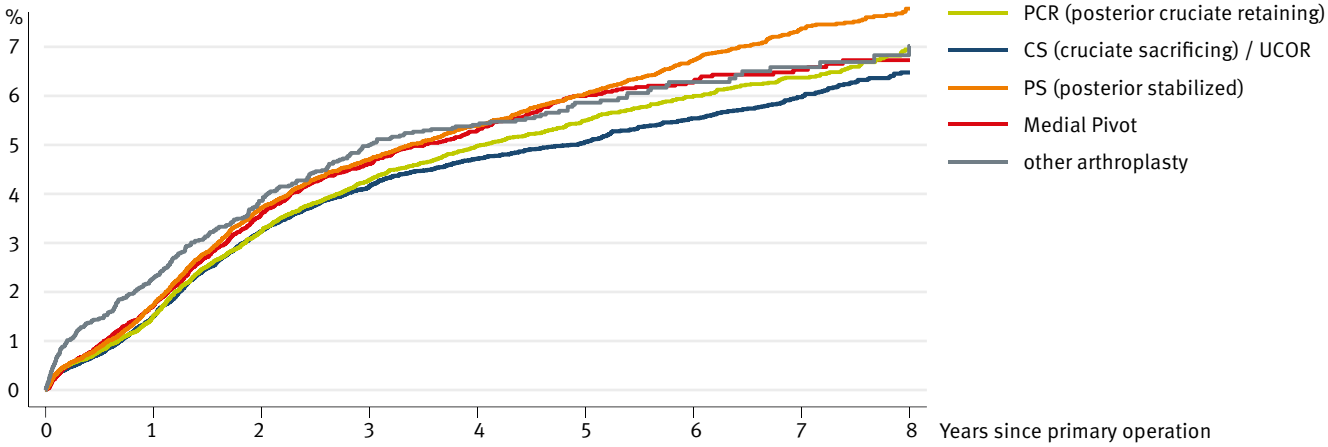
### Role of the type of knee arthroplasty and of the BMI on first revision

Two years after index TKA differences between types of arthroplasties were small, only PS showed a significantly higher revision rate (3.7%, CI 3.5-3.9%) than other types as PCR/CR, UCOR or MP. Different systems grouped as "other arthroplasty" had a higher early revision rate than the rest of the TKA systems but remaining statistically not significant due to small numbers and therefore bigger confidence intervals (3.9%, CI 3.4-4.4%). In mid-term PCR/CR seemed to perform best. PS was associated with the highest revision rate, with the difference increasing from the 6th year after primary TKA onwards **(Figure 6.9).** 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 imbalances, such as in fixed valgus OA.

Figure 6.9

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

Time since operation, 2012–2023, all services, all diagnoses.




| | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| PCR (posterior cruciate ret.) | **1.5** (1.4-1.7) | **3.2** (3.1-3.4) | **4.3** (4.1-4.5) | **5.0** (4.7-5.3) | **5.5** (5.2-5.8) | **6.0** (5.7-6.3) | **6.4** (6.0-6.7) | **6.9** (6.6-7.4) |
| CS (cruciate sacr.)/UCOR | **1.5** (1.4-1.6) | **3.2** (3.1-3.4) | **4.2** (3.9-4.4) | **4.7** (4.5-5.0) | **5.1** (4.8-5.3) | **5.5** (5.3-5.8) | **6.0** (5.7-6.3) | **6.5** (6.1-6.8) |
| PS (posterior stabilised) | **1.7** (1.6-1.9) | **3.7** (3.5-3.9) | **4.7** (4.5-4.9) | **5.4** (5.1-5.7) | **6.0** (5.8-6.3) | **6.7** (6.4-7.1) | **7.4** (7.0-7.7) | **7.8** (7.4-8.2) |
| Medial Pivot | **1.7** (1.6-1.9) | **3.6** (3.3-3.9) | **4.6** (4.3-5.0) | **5.3** (4.9-5.7) | **6.0** (5.6-6.4) | **6.3** (5.8-6.8) | **6.5** (6.0-7.1) | **6.7** (6.2-7.3) |
| other arthroplasty | **2.3** (2.0-2.7) | **3.9** (3.4-4.4) | **5.0** (4.5-5.6) | **5.4** (4.8-6.0) | **5.9** (5.2-6.5) | **6.3** (5.6-7.0) | **6.6** (5.9-7.4) | **7.0** (6.2-8.0) |

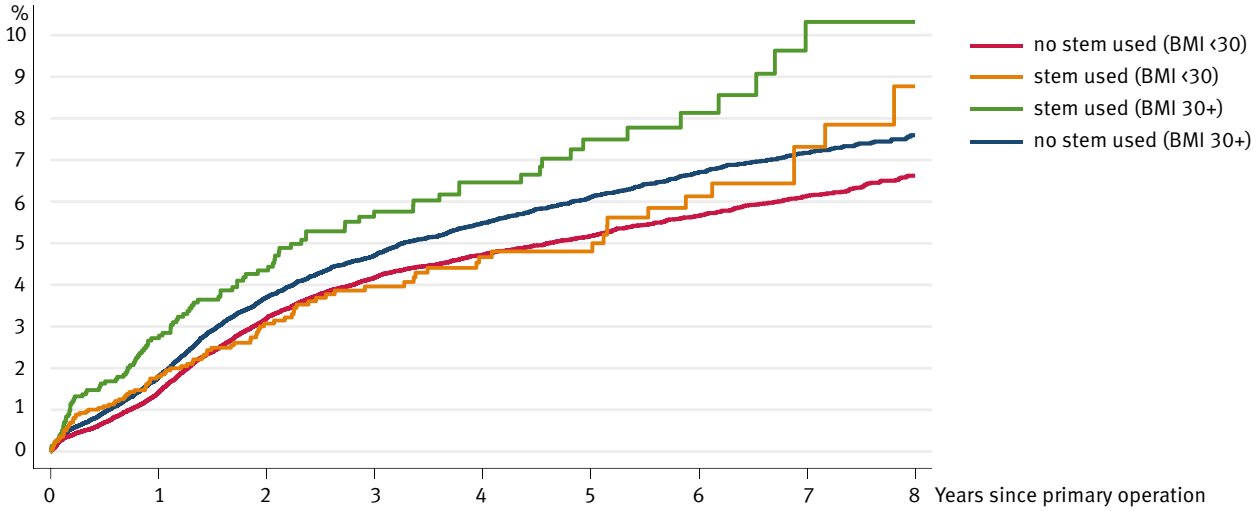
*Medial pivot was not available as a response category before SIRIS v2021. In the annual report 2020, only free text „other" responses were identified as and recoded to medial pivot. However, this missed a number of GMK Sphere total knee systems that were incorrectly registered as other types, mainly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

Concerning the use of stems in primary TKA type PCR/CR, CS, PS or MP, the revision rate did not differ with or without the 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 ended in an even higher revision rate compared to no stem use **(Figures 6.10 and 11).** 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

Figure 6.10

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

Time since operation, 2015–2023, all services, all diagnoses, only cemented tibias

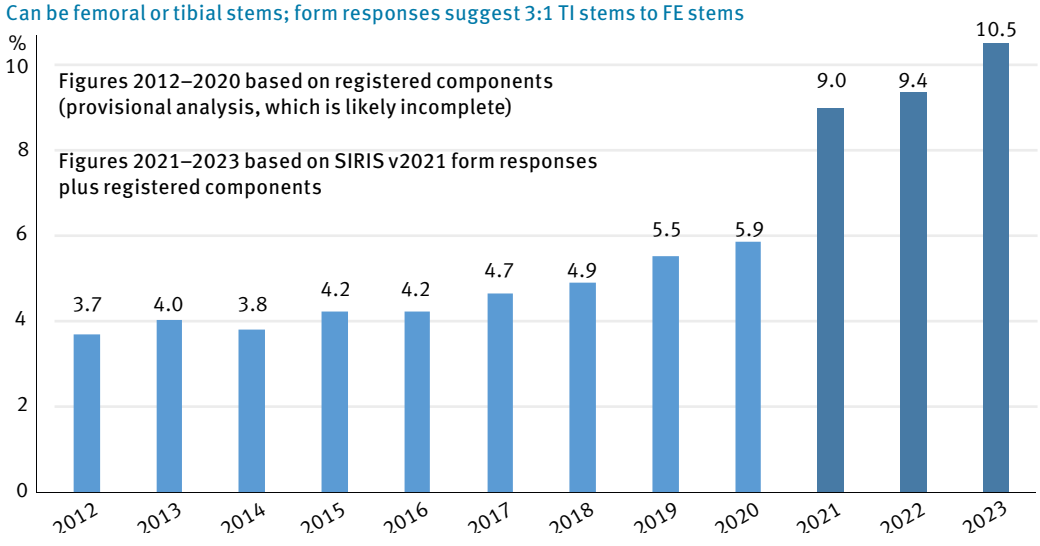



| | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| no stem used **(BMI<30)** | **1.4** (1.3-1.5) | **3.2** (3.1-3.4) | **4.2** (4.0-4.4) | **4.7** (4.5-4.9) | **5.2** (5.0-5.4) | **5.7** (5.4-5.9) | **6.1** (5.9-6.4) | **6.6** (6.3-6.9) |
| stem used **(BMI<30)** | **1.8** (1.3-2.4) | **3.1** (2.4-3.9) | **4.0** (3.2-5.0) | **4.7** (3.7-5.9) | **4.8** (3.8-6.0) | **6.1** (4.8-7.8) | **7.3** (5.5-9.6) | **8.8** (6.3-12.1) |
| stem used **(BMI 30+)** | **2.7** (2.1-3.6) | **4.3** (3.5-5.4) | **5.8** (4.7-7.1) | **6.5** (5.2-8.0) | **7.5** (6.0-9.3) | **8.1** (6.5-10.2) | **10.3** (7.9-13.5) | **10.3** (7.9-13.5) |
| no stem used **(BMI 30+)** | **1.8** (1.7-1.9) | **3.7** (3.5-3.9) | **4.7** (4.5-4.9) | **5.5** (5.2-5.8) | **6.1** (5.8-6.4) | **6.7** (6.4-7.0) | **7.2** (6.8-7.5) | **7.6** (7.2-8.0) |

Figure 6.11

**Use of stems as a percentage of primary TKAs with cemented tibias**

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



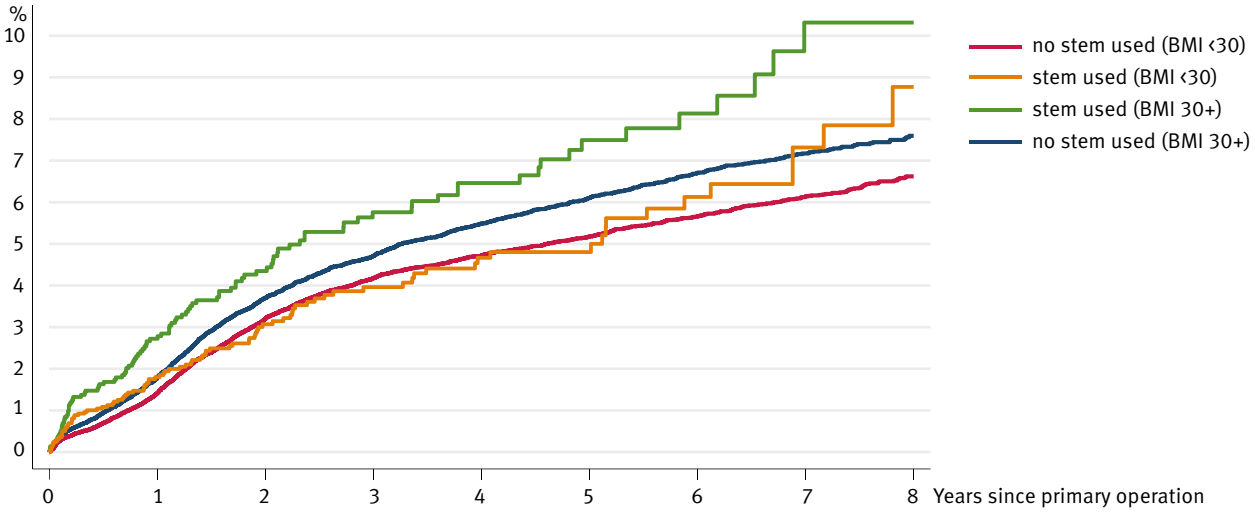
could speak for a certain selection bias with other influencing factors than BMI alone (e.g. osteoporosis). Definitive conclusions however may not be drawn, as further subgrouping would be necessary, made impossible due to small numbers. However, those differences are either not or at best borderline statistically significant.

For primary TKA with higher intrinsic stability (SC/CCK or hinge type) survival up to 8 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 being pronounced from the 4th year after index surgery **(Figure 6.12).**

Figure 6.12

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

Time since operation, 2015–2023, all services, all diagnoses, only cemented tibias




| | 1 year | 2 years | 3 years | 4 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|---|
| no stem used **(BMI‹30)** | **2.5** (1.6-3.8) | **3.6** (2.5-5.3) | **5.0** (3.6-6.9) | **5.2** (3.8-7.2) | **5.5** (4.0-7.6) | **5.5** (4.0-7.6) | **5.5** (4.0-7.6) | **5.5** (4.0-7.6) |
| stem used **(BMI‹30)** | **2.3** (1.7-3.2) | **3.8** (2.9-5.1) | **4.8** (3.7-6.3) | **5.2** (4.0-6.8) | **5.8** (4.4-7.7) | **5.8** (4.4-7.7) | **5.8** (4.4-7.7) | **5.8** (4.4-7.7) |
| stem used **(BMI 30+)** | **2.8** (1.9-4.1) | **3.9** (2.7-5.5) | **4.5** (3.2-6.3) | **6.6** (4.8-9.1) | **8.1** (5.9-11.2) | **8.1** (5.9-11.2) | **8.1** (5.9-11.2) | **9.5** (6.4-13.8) |
| no stem used **(BMI 30+)** | **1.9** (1.0-3.8) | **3.0** (1.7-5.3) | **4.2** (2.6-6.8) | **4.2** (2.6-6.8) | **4.7** (2.9-7.6) | **5.4** (3.3-8.7) | **5.4** (3.3-8.7) | **5.4** (3.3-8.7) |

### Patella resurfacing and first revision

Revision was clearly associated with a higher probability for revision when the patella was not resurfaced initially, becoming significant from the first year on and remaining significant at up to eleven years follow-up **(Figure 6.13).** Early revision rates at two years after primary TKA differed significantly from 2.8% (CI 2.7–3.0%) to 3.6% (CI 3.5–3.7%), respectively. Between 3 and 9 years after TKA, the revision rates developed in parallel for TKA without and with patella resurfacing, although the curve of TKA with patella resurfacing seemed to flatten from 8 years onwards, increasing again the gap **(Figure 6.13).** It seems that secondary resurfacing had only a narrow time window between one and three years after index surgery for the common complaint of anterior knee pain after primary TKA.

## 6.3.3 Type of revision surgery at first early revision

Complete revision of both femoral and tibial components was performed in 22.8% of the cases. In 24.6%, only the PE liner was exchanged. Secondary resurfacing of the patella alone was performed in 24.6%. A combined exchange of the PE liner with secondary patella resurfacing was conducted in 6.6% of the cases.

Technology was mostly conventional (97.5%), technical assistance was rare (2.1% for all technologies) **(Table 6.7).**

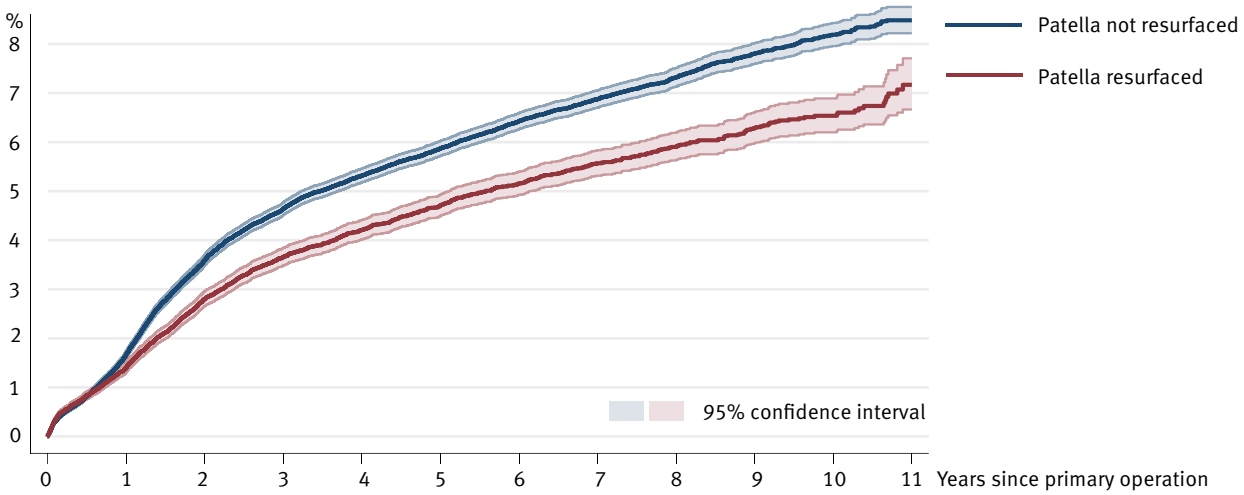
### Type of implants and fixation

With 31.0%, SC/CCK systems formed the largest group of implants used in revision TKA. PCR/CR TKA were used in 6.1% of the revisions, whereas 25.6% were PS, 8.9% were classified as CS or UCOR implants, and in 20.1% of cases, a hinge-type prosthesis was used, whereas MP was only used in 4.4% of the revisions **(Table 6.7).**

Figure 6.13

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

Time since operation, 2012–2023, all services, all diagnoses.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 9 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|---|
| Patella resurf. | **1.4** (1.3-1.5) | **2.8** (2.7-3.0) | **3.7** (3.5-3.8) | **4.7** (4.5-4.9) | **5.2** (4.9-5.4) | **5.9** (5.6-6.2) | **6.3** (6.0-6.6) | **6.5** (6.2-6.9) | **7.2** (6.7-7.7) |
| Patella not resurf. | **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** (7.1-7.5) | **7.8** (7.6-8.0) | **8.2** (8.0-8.4) | **8.5** (8.2-8.8) |

Table 6.7

## Early first revision of primary total knee arthroplasty: Surgery characteristics

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Intervention type[a] | N | % |
|---|---|---|
| Complete revision | 487 | 22.8 |
| Exchange of PE | 527 | 24.6 |
| Subsequent patella prosthesis | 527 | 24.6 |
| Tibial revision | 124 | 5.8 |
| Reimplantation of prosthesis | 38 | 1.8 |
| Subsequent patella prosthesis with exchange of PE | 141 | 6.6 |
| Patella revision | 124 | 5.8 |
| Component removal with spacer implantation | 70 | 3.3 |
| Femoral revision | 71 | 3.3 |
| Prosthesis preserving revision | 1 | 0.0 |
| Osteosynthesis | 3 | 0.1 |
| Arthrodesis | 25 | 1.2 |
| 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 |

| Type of arthroplasty | N | % |
|---|---|---|
| SC / CCK (semi-constrained / constrained) | 227 | 31.0 |
| Hinge type | 147 | 20.1 |
| PS (posterior stabilized) | 188 | 25.6 |
| CS (cruciate sacrificing) / UCOR | 65 | 8.9 |
| PCR (posterior cruciate retaining) | 45 | 6.1 |
| Medial-Pivot[b] | 32 | 4.4 |
| BCR (bicruciate retaining) | 9 | 1.2 |
| Other | 20 | 2.7 |

| Technology | N | % |
|---|---|---|
| Conventional | 1991 | 97.5 |
| Computer assisted / navigation | 24 | 1.2 |
| Patient specific instrumentation | 19 | 0.9 |
| Robotic-assisted (v2021) | 0 | 0.0 |
| Other | 16 | 0.8 |

| Additional intervention | N | % |
|---|---|---|
| None | 808 | 79.1 |
| Osteosynthesis FE | 3 | 0.3 |
| Osteosynthesis TI | 1 | 0.1 |
| Osteosynthesis PAT | 1 | 0.1 |
| Removal of metalware | 11 | 1.1 |
| Operation extensors | 40 | 3.9 |
| Reconstruction plasty | 8 | 0.8 |
| Tibial tubercle osteotomy | 85 | 8.3 |
| Other additional intervention(s) | 84 | 8.2 |
| **Total revisions** (multiple responses) | **1,021** | |

| Addtional components[c] | N | % |
|---|---|---|
| Stem FE (cemented)* | 273 | 37.4 |
| Stem FE (uncemented)** | 149 | 20.4 |
| Stem TI (cemented)*** | 322 | 44.1 |
| Stem TI (uncemented)*** | 157 | 21.5 |
| Sleeve FE | 28 | 3.8 |
| Sleeve TI | 93 | 12.7 |
| Augments FE | 218 | 29.9 |
| Augments TI | 81 | 11.1 |
| Augments PAT | 0 | 0.0 |
| Bone homologous | 9 | 1.2 |
| Bone autologous | 18 | 2.5 |
| Cone FE | 3 | 0.4 |
| Cone TI | 15 | 2.1 |
| **Total revisions** (multiple responses) | **730** | |

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

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

Fixation of the revision implants was fully cemented in the vast majority, with a mean value of 90.3% over the last 5 years, fluctuating between 87.2% and 95.3% since 2018 **(Figure 6.14).** Early revision TKA was associated with patella resurfacing in 76.7% of cases (11 percentage points higher than in primary TKA), but this includes cases where the primary patella component was left in place as the combined percentage of procedures where a patella component could have been replaced or added barely exceeds 60% of first revisions. An exact count of how many patella components were added at revision is limited by incomplete registration of the primary components.

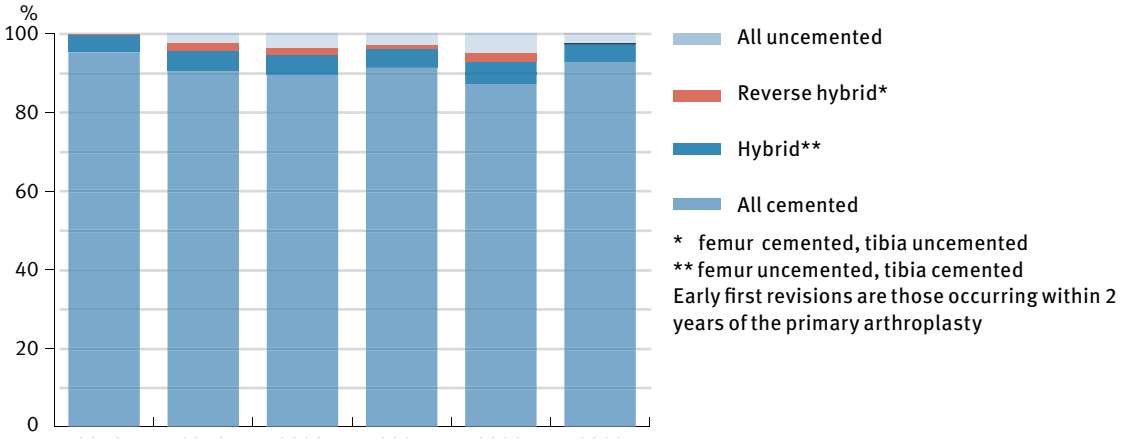
## Patella

Isolated patella resurfacing was performed in 24.6% of the first revisions. In additional 6.6%, secondary patella resurfacing was combined with an exchange of the PE liner **(Table 6.7 and Figure 6.15).** 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 important reason for re-intervention.

Figure 6.14

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

Component fixation only applicable when new components were implanted.




| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| N | 192 | 200 | 182 | 175 | 179 | 195 | 1,123 |
| All uncemented | 0.5 | 2.5 | 3.8 | 2.9 | 5.0 | 2.6 | 3.3 |
| Reverse hybrid* | 0.0 | 2.0 | 1.6 | 1.1 | 2.2 | 0.0 | 1.4 |
| Hybrid** | 4.2 | 5.0 | 4.9 | 4.6 | 5.6 | 4.6 | 4.9 |
| All cemented | 95.3 | 90.5 | 89.6 | 91.4 | 87.2 | 92.8 | 90.3 |

### Additional components

Since 2015, increasing numbers of tibial and femoral stems were used. Augments were also used more frequently, but more on the femoral side. Tibial sleeves decreased since 2021 whereas femoral ones slightly increased at the same time **(Figure 6.15).** At first revision TKA, 65.6% received a tibial and 57.8% a femoral stem, and 67.2% of the tibial and 64.7% femoral stems were cemented. Femoral augments were used in 29.9%, tibial ones in 11.1%. Reinforcement of the metaphysis by tibial sleeves was applied in 12.7%, femoral ones in 3.8%. Cones were rarely used, in 2.1% at the tibial and in 0.4% 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. Bone grafting was used in 3.7% only of the first revisions, and then autologous bone in 66.7%.

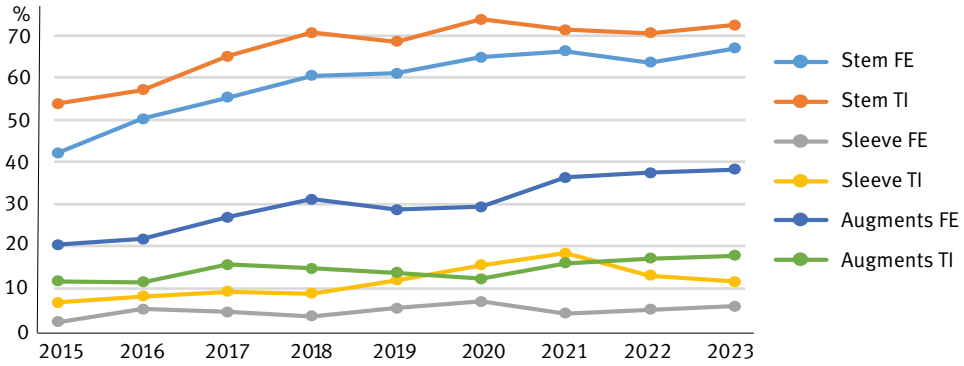
### Additional interventions

In 79.1% of first revisions, no additional intervention was necessary. Tibial tubercle osteotomy was performed in 8.3% of the cases, in 3.9% additional intervention at the extensor apparatus was performed, while a formal reconstruction plasty of the extensor apparatus was registered in 0.8%. Removal of orthopaedic or fracture fixation devices was done in combination with revision in only 1.1%. In 8.2%, "other" additional interventions were recorded **(Table 6.7).**

### Technology

As in unlinked revisions, also first revisions were performed mostly conventionally (97.5%). Computer navigation (1.2%) or PSI (0.9%) did play minor rolls. Robotic assistance would technically be possible in revision TKA but may be hindered by medicolegal constraints in some of the systems available.

Figure 6.15
**Selected additional components used in early first revisions (%)**



## 6.4 Re-Revision of knee arthroplasty

Re-revisions after revision TKA were considered when they occurred after partial or complete revisions, re-implantations or 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.

### 6.4.1 Reasons for re-revision TKA

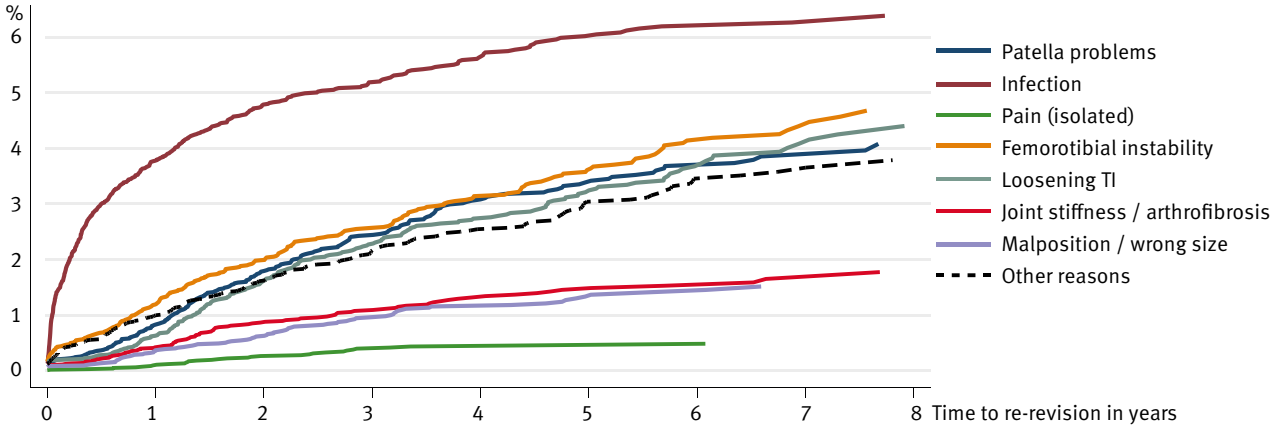
As multiple reasons for revision may be registered, individual rates do not add up. This may also lead to under- or overestimation of some topics.

Cumulative repeated revision rates after revision TKA from 2012 onwards are depicted in **Figure 6.16.** 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 unclear, as is the rate of revision for malposition or wear/loosening of patella buttons. Joint stiffness seemed to play a minor role, as did malposition or malsizing of the components. Isolated pain of unknown origin was rarely reason for a re-revision.

Figure 6.16

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

Time since revision, 2012–2023, all services, % of implants re-revised. Detailed reasons for revisions available since 2015




| | 1 year | 2 years | 3 years | 5 years | 6 years | 7 years | 8 years |
|---|---|---|---|---|---|---|---|
| Patella problems | **0.8** (0.7-1.0) | **1.8** (1.5-2.1) | **2.4** (2.1-2.8) | **3.4** (3.0-3.9) | **3.7** (3.2-4.2) | **3.9** (3.4-4.4) | **4.1** (3.5-4.7) |
| Infection | **3.8** (3.4-4.2) | **4.8** (4.4-5.2) | **5.2** (4.8-5.7) | **6.0** (5.5-6.6) | **6.2** (5.7-6.8) | **6.3** (5.7-6.8) | **6.4** (5.8-7.0) |
| Pain (isolated) | **0.1** (0.0-0.2) | **0.3** (0.2-0.4) | **0.4** (0.3-0.6) | **0.4** (0.3-0.6) | **0.4** (0.3-0.6) | **0.5** (0.3-0.7) | **0.5** (0.3-0.7) |
| Femorotibial instability | **1.2** (1.0-1.4) | **2.0** (1.7-2.3) | **2.6** (2.2-2.9) | **3.6** (3.2-4.1) | **4.1** (3.6-4.7) | **4.4** (3.8-5.0) | **4.7** (4.1-5.4) |
| Loosening TI | **0.6** (0.5-0.8) | **1.6** (1.4-1.9) | **2.3** (2.0-2.6) | **3.2** (2.8-3.7) | **3.7** (3.2-4.2) | **4.1** (3.5-4.7) | **4.4** (3.8-5.2) |
| Joint stiffness / arthrofibrosis | **0.4** (0.3-0.6) | **0.9** (0.7-1.1) | **1.1** (0.9-1.3) | **1.5** (1.2-1.8) | **1.5** (1.2-1.9) | **1.7** (1.3-2.0) | **1.8** (1.4-2.3) |
| Malposition / wrong size | **0.4** (0.3-0.5) | **0.6** (0.5-0.8) | **1.0** (0.8-1.2) | **1.3** (1.1-1.7) | **1.4** (1.1-1.7) | **1.5** (1.2-1.9) | **1.5** (1.2-1.9) |
| Other reasons | **1.0** (0.8-1.2) | **1.6** (1.4-1.9) | **2.2** (1.9-2.5) | **3.0** (2.6-3.5) | **3.5** (3.0-4.0) | **3.6** (3.1-4.1) | **3.8** (3.2-4.4) |

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

Complete revision of TKA tended to perform better from the first year onwards and up to 11 years of follow-up regarding risk of repeated revision than partial revision **(Figure 6.17).** Re-revision rate at 11 years was 24.7% (CI 21.3-28.4%) for partial and 20.7% (CI 19.1-22.5%) for complete revision, the difference not being statistically significant. This rate is almost three times higher than after primary TKA **(Figure 6.8).** Early, 2-year re-revision rates reached 8.3% (CI 7.7–9.0%) for complete and 10.8% (CI 9.6–12.2%) for partial revision respectively, whereas it was 3.5% (CI 3.3–3.6%) after revision of primary TKA **(Table 6.3).**

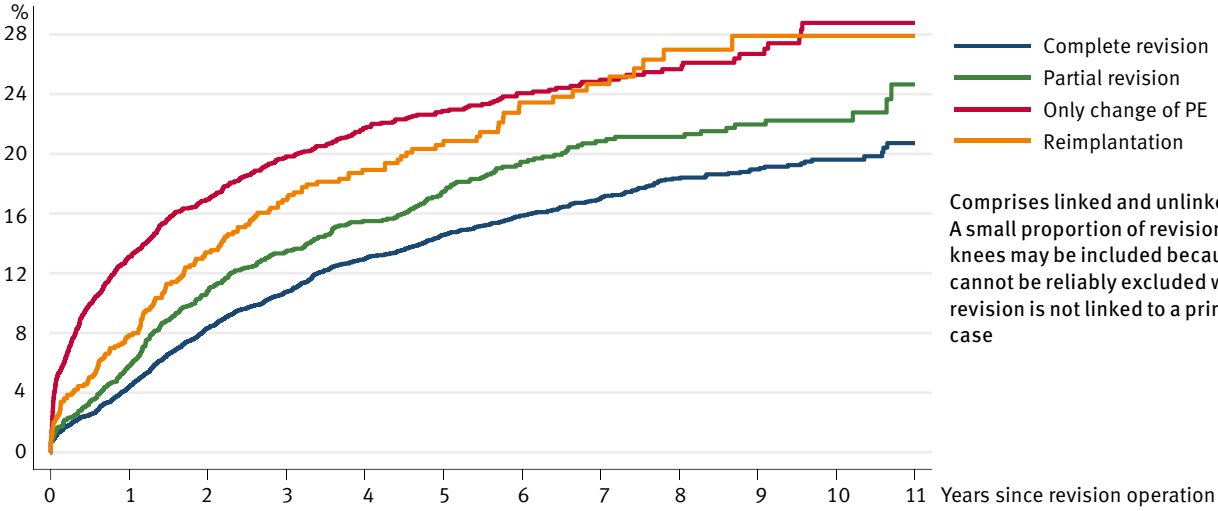
If only the liner was exchanged at revision, the early re-revision rate was 16.9% (CI 15.6–18.4%), rising to 28.8% (CI 26.1–31.7%) at eleven years. Compared to partial or complete revision exchange of PE liner had significantly higher re-revision rate at 2 years, whereas after 11 years only the difference to complete revision remained significant **(Figure 6.17).**

Component reimplantation - standing mostly for a staged revision surgery due to periprosthetic infection and temporary spacer implantation - had an early (two year) re-revision rate of 13.4% (CI 11.2–16.0%). The re-revision rate increased over time up to 27.9% (CI 23.6–32.7%) 11 years after reimplantation. Reimplantation performed even better regarding repeated revision than partial revision until six years after revision surgery and then picked up to the same level from the seventh year up to the last follow-up at 11 years **(Figure 6.17).**

Figure 6.17

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

Time since revision, 2012–2023. 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

| | 1 year | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|
| Complete revision | **4.4** (3.9-4.9) | **10.8** (10.0-11.6) | **14.6** (13.7-15.5) | **15.9** (14.9-16.9) | **18.3** (17.2-19.6) | **19.6** (18.3-21.0) | **20.7** (19.1-22.5) |
| Partial revision | **5.8** (4.9-6.8) | **13.5** (12.0-15.0) | **17.5** (15.8-19.3) | **19.5** (17.6-21.5) | **21.1** (19.1-23.3) | **22.2** (20.0-24.6) | **24.7** (21.3-28.4) |
| Only change of PE | **13.1** (11.9-14.4) | **19.8** (18.3-21.4) | **22.9** (21.2-24.7) | **24.1** (22.3-25.9) | **25.7** (23.7-27.8) | **28.8** (26.1-31.7) | **28.8** (26.1-31.7) |
| Reimplantation | **7.9** (6.2-9.9) | **16.9** (14.4-19.8) | **20.9** (17.9-24.2) | **23.4** (20.2-27.1) | **27.0** (23.0-31.5) | **27.9** (23.6-32.7) | **27.9** (23.6-32.7) |

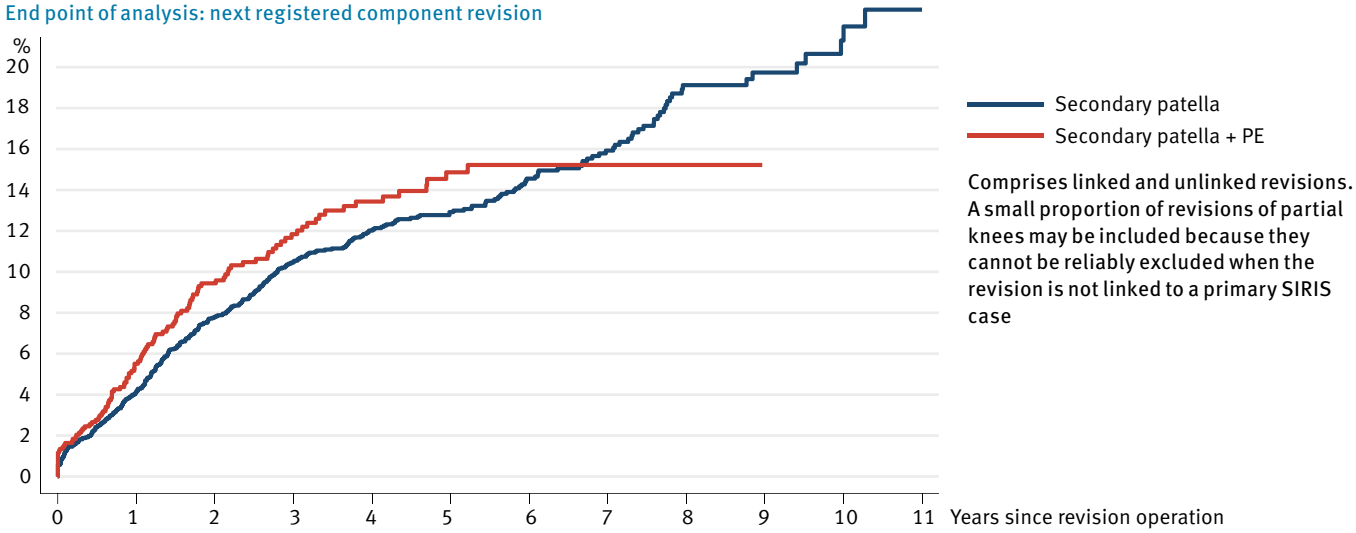
### Patella and re-revision TKA

Isolated secondary patella resurfacing was associated with an early re-revision rate of 7.8% (CI 6.9–8.9%), which is in the range of the results after complete revision. Secondary patella resurfacing combined with liner exchange led to 9.4% (CI 7.7–11.6%) of re-revisions, worse but not significantly different to isolated secondary patella resurfacing **(Figure 6.18).** Ten-years results are still lacking, but at 8 years secondary patella resurfacing in combination with liner exchange performed better than secondary resurfacing alone, also not statistically significant. This was comparable to the re-revision rates after complete TKA revision **(Figure 6.17).** It is unclear if PE wear played a role in cases of isolated patella resurfacing from 7 years after revision surgery onwards. As stated before, the type of PE (CPE vs XLPE) was not analysed so far in knee arthroplasty. The main reason for re-revision after secondary patella resurfacing, with or without PE liner exchange was femorotibial instability **(Figure 6.19).** 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 6.19).**

Figure 6.18

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

Time since revision, 2012–2023. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria. End point of analysis: next registered component revision




| | 1 year | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|
| Secondary patella | **4.1** (3.5-4.9) | **10.5** (9.4-11.7) | **12.9** (11.6-14.3) | **14.6** (13.1-16.1) | **19.1** (17.1-21.4) | **21.3** (18.6-24.3) | **22.8** (19.5-26.5) |
| Secondary patella +PE | **5.5** (4.2-7.2) | **11.8** (9.8-14.3) | **14.9** (12.4-17.8) | **15.2** (12.6-18.3) | **15.2** (12.6-18.3) | | |

## 6.4.2 Conversion of PKA to TKA and re-revision

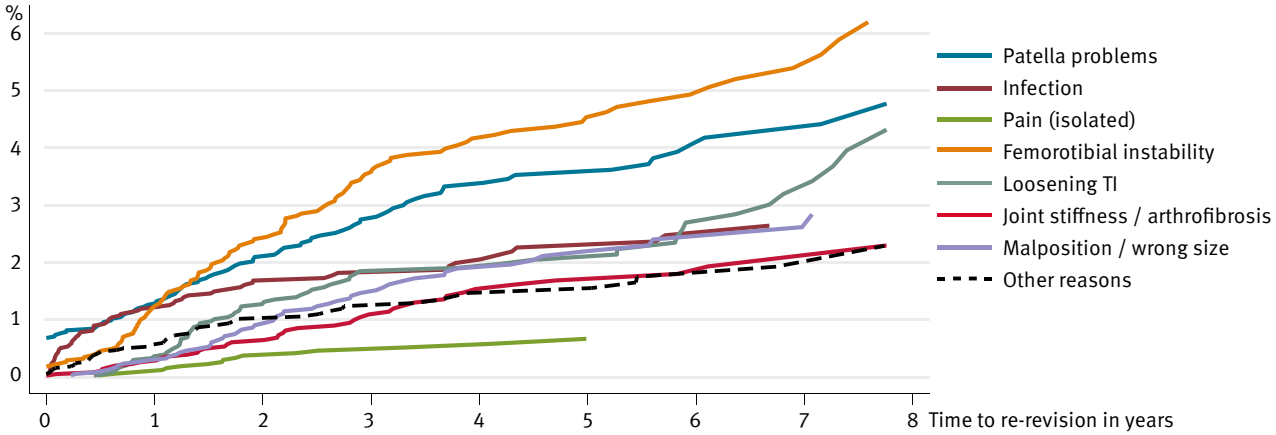
Re-revision rate after conversion of a PKA to TKA reached 10.1% (CI 8.7-11.6%) after two years and 21.6% (CI 18.5-25.0%) after 11 years, respectively **(Figure 6.20).** This is comparable to the re-revision rates after revision TKA and far worse than the re-vision rates after primary TKA (3.5% at two years (CI 3.3–3.6%), and 8.0% at 11 years (CI 7.8-8.2%)) **(Table 6.3, Figure 4.12, p.44).**

Obviously, a conversion from PKA to TKA was not equivalent to a primary TKA but remains a revi-sion with higher repeated revision rates than ob-served after primary TKA. This contradicts some surgeons' opinion that technically a conversion can be compared to primary TKA to some extent, as long no bone defect does require a revision type TKA system, including stems, augments and/or cones/sleeves. Main reasons for re-revision after conversion were femorotibial instability and tibial loosening, followed by patella problems. All other reasons were noted less frequently, isolated pain played an only limited role this time (compare first revision of PKA in chapter 6.7) **(Figure 6.21).**

Figure 6.19

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

Time since revision, 2012–2023, all services, % of implants re-revised. Detailed reasons for revisions available since 2015. Comprises of all secondary patella replacements (with or without PE replacement)

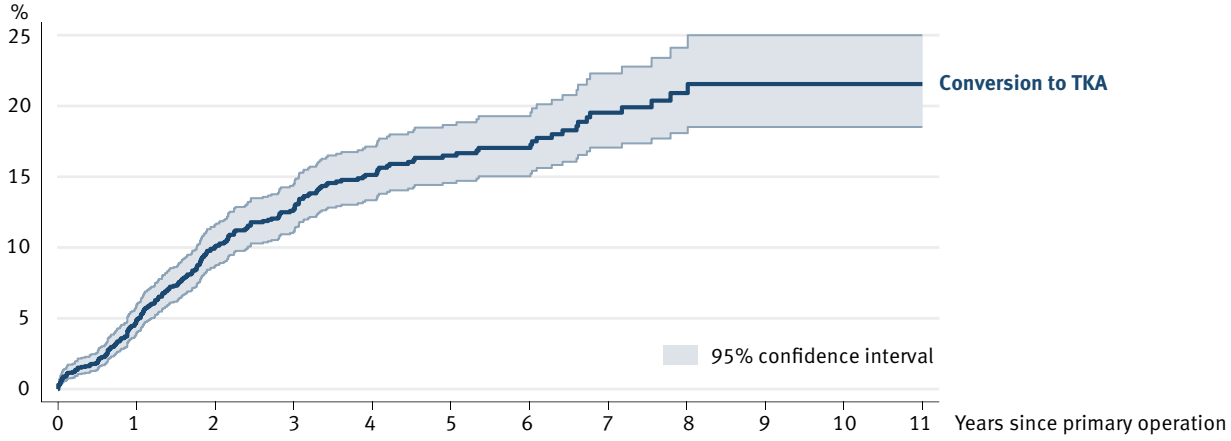



| | 1-year | 2-years | 3-years | 5-years | 6-years | 7-years | 8-years |
|---|---|---|---|---|---|---|---|
| Patella problems | **1.3** (0.9-1.7) | **2.1** (1.7-2.6) | **2.7** (2.2-3.4) | **3.5** (2.9-4.3) | **4.0** (3.3-5.0) | **4.2** (3.4-5.1) | **4.8** (3.7-6.1) |
| Infection | **1.2** (0.9-1.6) | **1.7** (1.3-2.2) | **1.8** (1.4-2.3) | **2.3** (1.8-2.9) | **2.5** (1.9-3.2) | **2.6** (2.0-3.5) | **2.6** (2.0-3.5) |
| Pain (isolated) | **0.1** (0.0-0.2) | **0.4** (0.2-0.7) | **0.5** (0.3-0.8) | **0.7** (0.4-1.1) | **0.7** (0.4-1.1) | **0.**7 (0.4-1.1) | **0.7** (0.4-1.1) |
| Femorotibial instability | **1.2** (0.9-1.7) | **2.4** (1.9-3.0) | **3.6** (2.9-4.3) | **4.5** (3.8-5.4) | **4.**9 (4.1-5.9) | **5.**4 (4.4-6.5) | **6.2** (4.9-7.7) |
| Loosening TI | **0.4** (0.2-0.6) | **1.3** (0.9-1.7) | **1.8** (1.4-2.4) | **2.0** (1.6-2.7) | **2.7** (2.0-3.6) | **3.**2 (2.4-4.3) | **4.3** (3.1-6.0) |
| Joint stiffness / arthrofibrosis | **0.3** (0.1-0.5) | **0.6** (0.4-1.0) | **1.1** (0.8-1.6) | **1.7** (1.2-2.3) | **1.8** (1.3-2.5) | **1.9** (1.4-2.7) | **2.3** (1.5-3.5) |
| Malposition / wrong size | **0.3** (0.2-0.5) | **0.9** (0.6-1.3) | **1.5** (1.1-2.0) | **2.2** (1.7-2.9) | **2.4** (1.8-3.2) | **2.6** (1.9-3.5) | **2.8** (2.1-3.9) |
| Other reasons | **0.6** (0.4-0.9) | **1.0** (0.7-1.4) | **1.2** (0.9-1.7) | **1.5** (1.1-2.0) | **1.7** (1.3-2.4) | **1.9** (1.4-2.7) | **2.3** (1.5-3.5) |

Figure 6.20

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

Time since operation, 2012–2023. Start point of analysis: first registered component revision in SIRIS that meets the inclusion criteria. End point of analysis: next registered component revision.

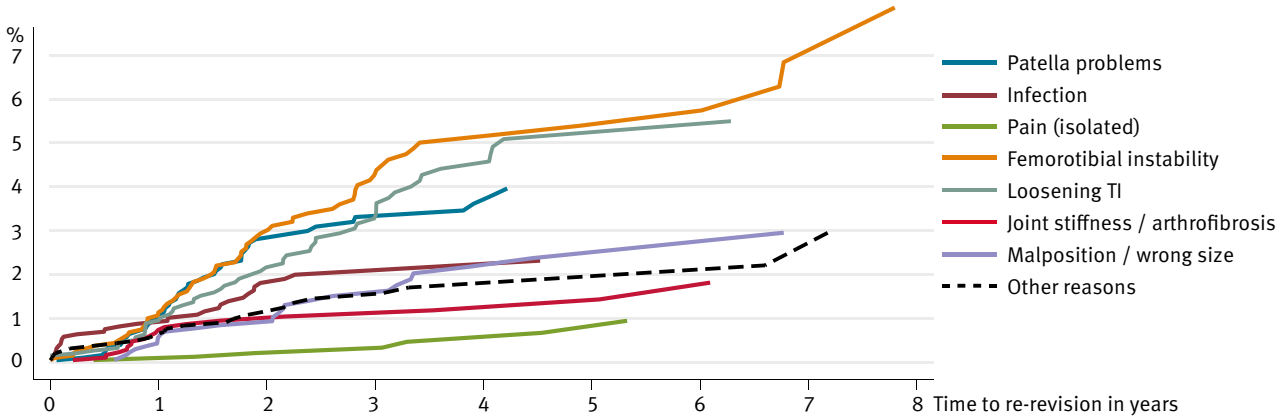



| | 1 year | 2 years | 3 years | 5 years | 6 years | 7 years | 8 years | 9 years |
|---|---|---|---|---|---|---|---|---|
| Conversion to TKA | **4.9** (4.0-6.0) | **10.1** (8.7-11.6) | **12.7** (11.1-14.5) | **16.5** (14.6-18.7) | **17.0** (15.0-19.3) | **19.5** (17.1-22.3) | **20.9** (18.1-24.1) | **21.6** (18.5-25.0) |

Figure 6.21

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

Time since revision, 2012–2023, all services, % of implants re-revised. Detailed reasons for revisions available since 2015.




| | 1-year | 2-years | 3-years | 5-years | 6-years | 7-years | 8-years |
|---|---|---|---|---|---|---|---|
| Patella problems | **1.0** (0.6-1.7) | **2.8** (2.1-3.8) | **3.3** (2.5-4.4) | **4.0** (3.0-5.3) | **4.0** (3.0-5.3) | **4.0** (3.0-5.3) | **4.0** (3.0-5.3) |
| Infection | **0.9** (0.5-1.4) | **1.8** (1.2-2.6) | **2.0** (1.4-2.9) | **2.3** (1.6-3.3) | **2.3** (1.6-3.3) | **2.3** (1.6-3.3) | **2.3** (1.6-3.3) |
| Pain (isolated) | **0.1** (0.0-0.4) | **0.2** (0.1-0.7) | **0.2** (0.1-0.7) | **0.7** (0.3-1.6) | **1.0** (0.4-2.2) | **1.0** (0.4-2.2) | **1.0** (0.4-2.2) |
| Femorotibial instability | **1.1** (0.7-1.8) | **2.9** (2.2-3.9) | **4.3** (3.3-5.5) | **5.4** (4.2-6.9) | **5.4** (4.2-6.9) | **6.8** (5.0-9.3) | **8.1** (5.4-12.0) |
| Loosening TI | **0.9** (0.5-1.5) | **2.2** (1.5-3.1) | **3.3** (2.4-4.4) | **5.1** (3.9-6.7) | **5.1** (3.9-6.7) | **5.5** (4.1-7.3) | **5.5** (4.1-7.3) |
| Joint stiffness / arthrofibrosis | **0.7** (0.4-1.3) | **1.0** (0.6-1.6) | **1.0** (0.6-1.7) | **1.2** (0.7-1.9) | **1.4** (0.8-2.4) | **1.8** (1.0-3.3) | **1.8** (1.0-3.3) |
| Malposition / wrong size | **0.6** (0.3-1.1) | **0.9** (0.5-1.5) | **1.5** (1.0-2.4) | **2.4** (1.6-3.6) | **2.4** (1.6-3.6) | **3.0** (1.8-4.9) | **3.0** (1.8-4.9) |
| Other reasons | **0.6** (0.3-1.1) | **1.2** (0.7-1.9) | **1.5** (0.9-2.2) | **1.7** (1.1-2.6) | **1.7** (1.1-2.6) | **2.2** (1.3-3.8) | **3.0** (1.6-5.6) |

## 6.5 Results of implants in total knee arthroplasty

### 6.5.1 Long-term survival

**Table 6.8** shows the TKA systems used most commonly in Switzerland, representing 75% (76,615) of the primary TKA from 2018 until 2023. The 25% less commonly used implants accounted for 24,455 cases during this period. Only 401 implant combinations (0.4%) could not be classified, similarly to the rate of missing implants observed in the annual report of 2023.

The long-term evaluation for all systems, all diagnoses, and all fixation systems since 2012 is depicted in **Table 4.5_B,** showing results up to 11 years after surgery. Primary TKA subsystems (such as PCR/CR or PS) were analysed separately if numbers were both sufficient and showed relevantly different revision rates. The 11-year revision rate for all systems was 8.0% (CI 7.8–8.3%). The various implant systems performed rather differently in the short, medium, and long term **(Table 4.5_B).** Higher 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 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.

Table 6.8
**Top 75% of primary total knee arthroplasty systems***
All diagnoses, all component fixations 2018–2023.

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| Attune CR-FB | 677 | 677 | 841 | 1,248 | 1,692 | 2,079 | 7,214 |
| Attune CR-RP | 1,043 | 1,165 | 1,335 | 1,416 | 1,602 | 1,462 | 8,023 |
| Attune PS-FB | 568 | 544 | 462 | 498 | 654 | 601 | 3,327 |
| Attune PS-RP | 984 | 837 | 745 | 744 | 1035 | 1071 | 5,416 |
| Balansys CR | 236 | 294 | 355 | 517 | 920 | 730 | 3,052 |
| Balansys PS | 548 | 663 | 599 | 623 | 570 | 610 | 3,613 |
| Balansys RP | 574 | 521 | 443 | 320 | 310 | 404 | 2,572 |
| Balansys UC | 363 | 360 | 387 | 441 | 594 | 757 | 2,902 |
| GMK sphere | 1,719 | 2,019 | 2,077 | 2,461 | 3,062 | 3,237 | 14,575 |
| LCS complete cemented/hybrid | 613 | 713 | 669 | 503 | 47 | 43 | 2,588 |
| Origin PS | 28 | 219 | 354 | 421 | 538 | 552 | 2,112 |
| Persona CR-MC | 524 | 708 | 971 | 1,246 | 1,803 | 2,153 | 7,405 |
| Persona CR-UC | 1,034 | 1,099 | 1,163 | 1,101 | 1,259 | 1,400 | 7,056 |
| Persona PS | 655 | 600 | 477 | 786 | 938 | 905 | 4,361 |
| Triathlon PS | 154 | 184 | 356 | 553 | 516 | 636 | 2,399 |
| Other systems | 4,852 | 4,699 | 4,066 | 3,643 | 3,574 | 3,621 | 24,455 |
| **Total** | **14,572** | **15,302** | **15,300** | **16,521** | **19,114** | **20,261** | **101,070** |

*Constrained/hinged systems were included if used for cases of primary OA including OA after meniscectomy

Table 6.9_Part one

## Long term evaluation: Failure rates of primary total knee arthroplasty systems

All diagnoses, all component fixations. Time since operation, 2012–20232. 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.

| | Total number | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Advance | 2,095 | 19 | 68 | **2.2** (1.6-2.9) | **5.0** (4.1-6.1) | **5.9** (4.9-7.1) | **6.9** (5.7-8.2) | **8.0** (6.5-9.9) |
| Attune CR-FB | 9,101 | 14 | 69 | **1.3** (1.0-1.5) | **3.7** (3.2-4.2) | **4.7** (4.1-5.3) | **5.7** (5.0-6.5) | |
| Attune CR-RP | 12,425 | 11 | 69 | **1.9** (1.7-2.2) | **5.3** (4.9-5.8) | **6.6** (6.1-7.2) | **7.7** (7.1-8.3) | |
| Attune PS-FB | 5,402 | 15 | 70 | **1.5** (1.2-1.8) | **4.0** (3.4-4.6) | **5.2** (4.5-5.9) | **6.7** (5.8-7.7) | |
| Attune PS-RP | 7,452 | 16 | 70 | **1.7** (1.4-2.0) | **4.8** (4.3-5.4) | **6.3** (5.7-7.0) | **7.7** (6.9-8.6) | |
| Balansys CR | 3,846 | 15 | 70 | **1.1** (0.8-1.5) | **3.2** (2.6-4.0) | **4.1** (3.4-5.1) | **5.2** (4.2-6.4) | **5.7** (4.5-7.2) |
| Balansys PS | 5,267 | 55 | 70 | **1.3** (1.0-1.6) | **3.6** (3.1-4.2) | **4.9** (4.3-5.7) | **5.9** (5.1-6.9) | **7.2** (5.9-8.8) |
| Balansys RP | 6,790 | 14 | 70 | **1.4** (1.1-1.7) | **4.2** (3.8-4.8) | **5.5** (5.0-6.1) | **6.9** (6.2-7.6) | **9.0** (8.0-10.1) |
| Balansys UC | 5,660 | 23 | 71 | **1.5** (1.2-1.9) | **4.5** (3.9-5.2) | **5.6** (4.9-6.3) | **7.4** (6.6-8.3) | **8.3** (7.2-9.4) |
| E.Motion FP/UC | 1,875 | 83 | 70 | **1.4** (1.0-2.1) | **3.7** (2.8-4.7) | **5.1** (4.1-6.4) | **6.4** (5.2-7.9) | **8.0** (6.3-10.1) |
| Evolution | 547 | 35 | 69 | **1.4** (0.6-3.4) | **5.0** (2.8-8.9) | | | |
| First/First REV | 2,764 | 37 | 70 | **1.6** (1.2-2.1) | **4.9** (4.1-5.8) | **5.9** (5.0-6.9) | **7.2** (6.2-8.4) | **8.6** (7.1-10.4) |
| GMK primary CR/UC-RP | 2,622 | 19 | 70 | **1.5** (1.1-2.1) | **4.0** (3.3-4.8) | **4.9** (4.1-5.8) | **5.6** (4.8-6.7) | **7.2** (6.1-8.6) |
| GMK primary PS | 2,136 | 23 | 71 | **1.2** (0.8-1.8) | **3.7** (3.0-4.7) | **5.2** (4.2-6.3) | **6.4** (5.3-7.6) | **8.7** (7.0-10.7) |
| GMK sphere | 18,542 | 12 | 69 | **1.7** (1.5-1.9) | **4.6** (4.2-4.9) | **6.0** (5.6-6.4) | **6.6** (6.1-7.1) | **7.6** (6.6-8.7) |
| ITotal | 2,032 | 24 | 68 | **0.8** (0.5-1.4) | **3.1** (2.3-4.0) | **3.9** (3.1-5.1) | **4.5** (3.4-6.0) | **6.1** (4.0-9.1) |
| Innex FB | 1,730 | 42 | 71 | **1.4** (0.9-2.1) | **4.3** (3.4-5.4) | **5.4** (4.4-6.6) | **6.1** (5.1-7.5) | **8.7** (7.1-10.7) |
| Innex RP | 4,807 | 17 | 69 | **1.7** (1.4-2.1) | **4.6** (4.0-5.2) | **5.6** (5.0-6.3) | **6.4** (5.7-7.2) | 8.5 (7.5-9.6) |
| Journey II | 2,562 | 28 | 67 | **3.2** (2.5-3.9) | **7.7** (6.7-8.9) | **9.5** (8.3-10.7) | **11.3**(10.0-12.9) | |
| LCS complete cemented/hybrid | 6,730 | 22 | 70 | **1.5** (1.2-1.8) | **4.8** (4.3-5.3) | **5.7** (5.2-6.3) | **6.4** (5.8-7.1) | **7.3** (6.6-8.1) |
| LCS complete cementless | 2,982 | 28 | 69 | **2.0** (1.5-2.6) | **5.4** (4.7-6.3) | **6.2** (5.3-**7.2**) | **6.7** (5.8-7.7) | 7.4 (6.4-8.6) |
| Legion | 1,901 | 17 | 67 | **2.0** (1.5-2.8) | **7.0** (5.8-8.4) | **9.2** (7.8-10.9) | **10.6**(9.0-12.5) | |
| NK flex | 1,841 | 41 | 70 | **1.3** (0.8-1.9) | **4.0** (3.2-5.0) | **5.1** (4.2-6.2) | **6.0** (4.9-7.2) | **7.6** (6.2-9.3) |
| Nexgen CR/LPS-Flex | 2,210 | 14 | 69 | **1.5** (1.1-2.1) | **3.5** (2.8-4.4) | **4.5** (3.7-5.5) | **4.9** (4.0-6.0) | **6.7** (5.5-8.1) |
| Origin PS | 2,112 | 22 | 69 | **1.8** (1.3-2.6) | **4.8** (3.7-6.1) | **7.6** (5.2-10.9) | | |
| Persona CPS | 1,023 | 16 | 72 | **1.2** (0.6-2.1) | **2.7** (1.8-4.2) | **3.6** (2.4-5.6) | **3.6** (2.4-5.6) | |
| Persona CR-MC | 7,855 | 8 | 69 | **1.2** (1.0-1.5) | **3.4** (2.9-4.0) | **4.2** (3.6-5.0) | **6.5** (4.8-8.9) | |
| Persona CR-UC | 10,058 | 38 | 70 | **0.9** (0.7-1.1) | **2.6** (2.3-3.0) | **3.5** (3.1-4.0) | **4.0** (3.5-4.6) | |
| Persona PS | 6,831 | 12 | 70 | **1.7** (1.4-2.1) | **4.1** (3.6-4.6) | **5.3** (4.7-6.0) | **6.3** (5.6-7.1) | |
| RT-plus | 1,244 | 13 | 77 | **2.7** (1.9-3.8) | **4.3** (3.2-5.7) | **5.0** (3.7-6.6) | **5.3** (4.0-7.0) | **5.3** (4.0-7.0) |
| Sigma CR-FB | 4,780 | 28 | 71 | **0.9** (0.6-1.2) | **2.4** (2.0-2.9) | **3.3** (2.8-3.9) | **3.7** (3.2-4.3) | **4.4** (3.7-5.2) |
| Sigma CR-RP | 2,257 | 40 | 68 | **2.4** (1.9-3.2) | **5.8** (4.9-6.8) | **6.6** (5.6-7.7) | **6.9** (5.9-8.1) | **8.4** (7.0-10.1) |
| Sigma PS-FB | 1,335 | 59 | 72 | **1.1** (0.6-1.8) | **3.1** (2.3-4.3) | **3.9** (3.0-5.2) | **4.5** (3.4-5.9) | **5.6** (4.2-7.3) |
| Sigma PS-RP | 1,660 | 11 | 70 | **1.6** (1.1-2.4) | **3.9** (3.0-4.9) | **4.7** (3.8-5.9) | **5.4** (4.4-6.6) | **6.1** (5.0-7.4) |

* 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

## Survival of different knee systems

Mobile bearings did perform worse in all knee systems compared to other subtypes of TKA of the same brand, except for Medacta. Interestingly, the system with mobile bearing was associated with lower long-term revision rates compared to other knee subsystems from the same manufacturer **(Table 6.9).** The revision rate after 11 years varied from 4.4% for the best to 9.0% for the worst system of the implant list.

Other systems, accounting for under 5% of the TKA and grouped together because of small numbers, had a relatively poor average revision rate at 11 years of 11.3% (CI 9.8-13.0%).

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 6.9).** Both problematic systems were identified as potential outliers. None of the knee system used in Switzerland was classified as definitive outlier anymore.

One older and one of the newer TKA systems performed significantly better at long term than the Swiss average **(Figure 6.22).** For the older system, 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.

One newer system performed significantly worse than the Swiss average. The effect started early after primary TKA, and the revision rates remained elevated up to 11 years of follow-up **(Figure 6.23).** This system was classified as a potential outlier. Another brand of the same company also showed elevated revision rates from early on and up to 11 years, but remained within the upper limit of the range defined as acceptable **(Figure 6.24).** 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 6.22, 23, 24).**

Table 6.9_Part two

### Long term evaluation: Failure rates of primary total knee arthroplasty systems

All diagnoses, all component fixations. Time since operation, 2012–20232. 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.

| | Total number | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| TC-plus primary FB | 2,714 | 32 | 69 | **1.4** (1.1-2.0) | **3.8** (3.1-4.7) | **4.8** (4.0-5.7) | **5.5** (4.6-6.6) | **7.6** (6.2-9.4) |
| TC-plus primary RP | 2,016 | 32 | 70 | **1.3** (0.9-1.9) | **3.8** (3.0-4.8) | **5.1** (4.1-6.3) | **6.6** (5.4-8.0) | **8.7** (7.1-10.8) |
| Triathlon CR/CS | 1,904 | 37 | 69 | **2.3** (1.7-3.1) | **5.6** (4.6-6.9) | **6.7** (5.6-8.1) | **7.9** (6.5-9.5) | **8.7** (7.2-10.5) |
| Triathlon PS | 3,010 | 33 | 69 | **2.2** (1.7-2.8) | **5.5** (4.5-6.5) | **6.5** (5.4-7.8) | **7.9** (6.5-9.6) | **8.5** (6.9-10.5) |
| Unity | 582 | 34 | 68 | **1.3** (0.6-2.7) | **2.9** (1.7-4.9) | **3.3** (1.9-5.6) | **8.7** (2.6-27.2) | |
| Vanguard CR | 1,197 | 30 | 67 | **1.5** (0.9-2.3) | **4.1** (3.1-5.5) | **5.5** (4.3-7.0) | **6.5** (5.1-8.2) | **7.6** (5.9-9.7) |
| Vanguard PS | 1,071 | 57 | 68 | **1.9** (1.2-2.9) | **4.8** (3.7-6.3) | **6.6** (5.2-8.3) | **7.4** (5.9-9.2) | **8.7** (6.8-11.1) |
| Other systems | 8,071 | | 71 | **2.0** (1.7-2.3) | **5.2** (4.7-5.8) | **6.8** (6.2-7.5) | **8.2** (7.5-9.0) | **11.3** (9.8-13.0) |
| **CH average for group** | | | | **1.6** (1.5-1.6) | **4.3** (4.2-4.4) | **5.5** (5.4-5.6) | **6.5** (6.3-6.6) | **8.0** (7.8-8.3) |

* 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

Figure 6.22

## 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).

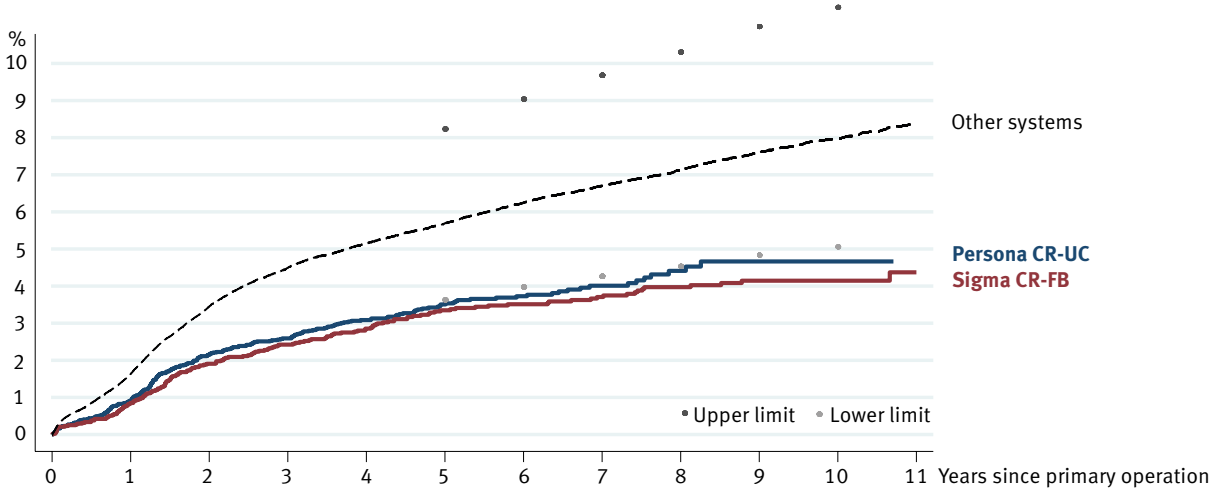



Figure 6.23

## 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 10 (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).

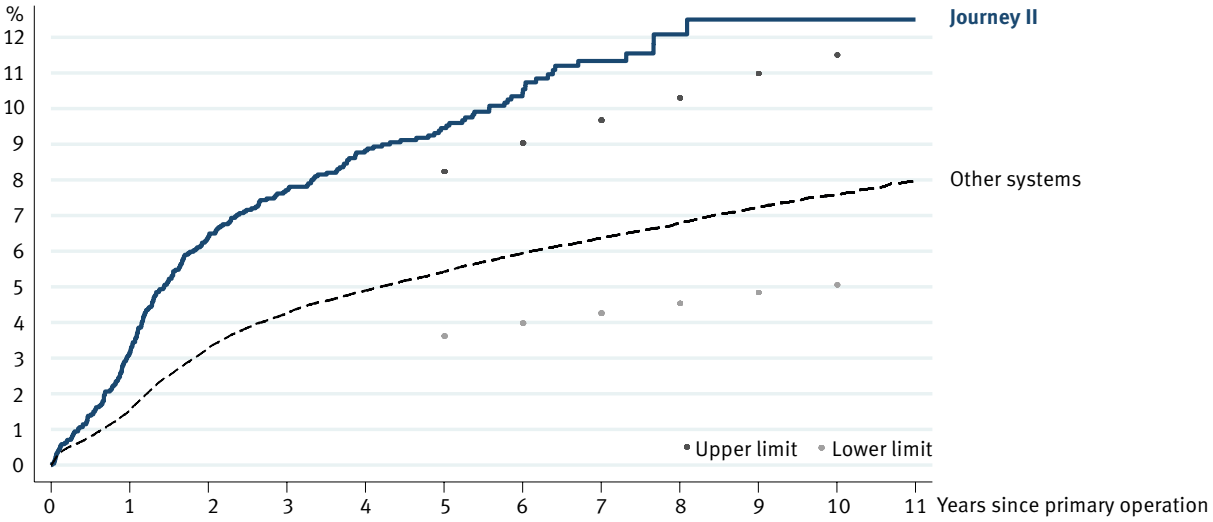
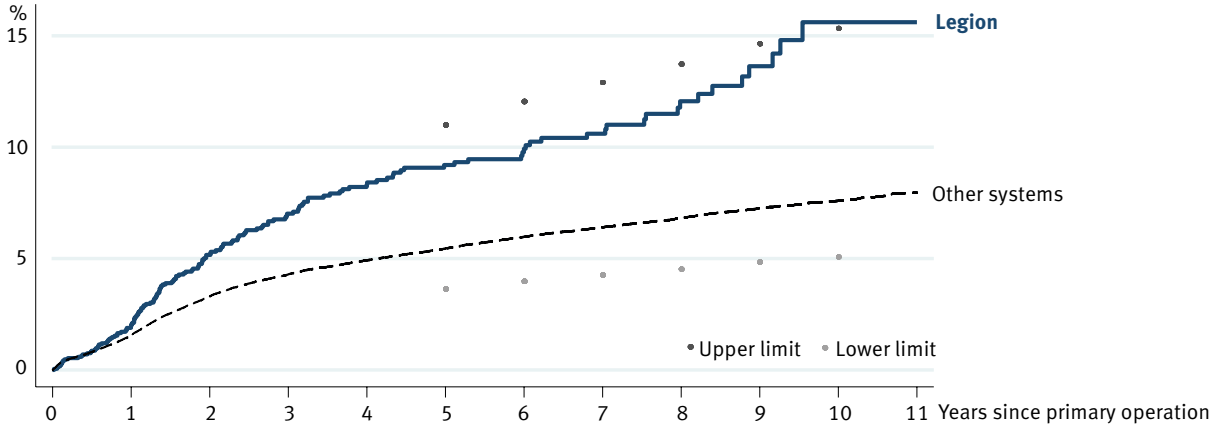



Figure 6.24

## Implant combinations with long-term evaluation outlier status (all TKA)

Outlier status was defined as a revision rate of twice the group average at any time between year 5 and year 10 (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).



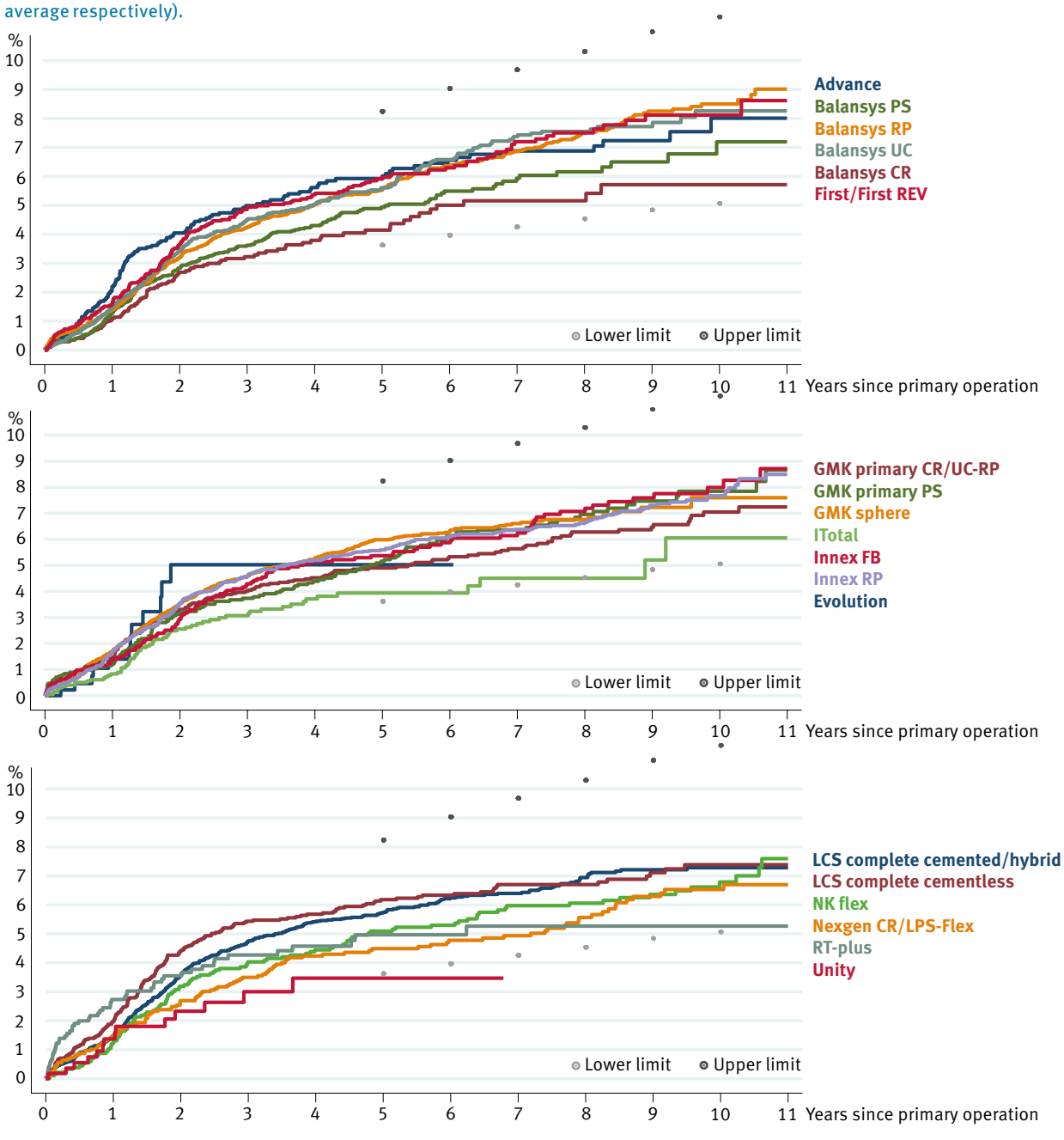
## Brands and subsystems

**Figures 6.25 and 26** show performance of the different TKA brands, including subsystems, up to eleven years after surgery. The upper and lower limits of the Swiss average are illustrated by 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 county-wide range or even better – some types of implants performed significantly worse or were even outli-

Figures 6.25

**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).

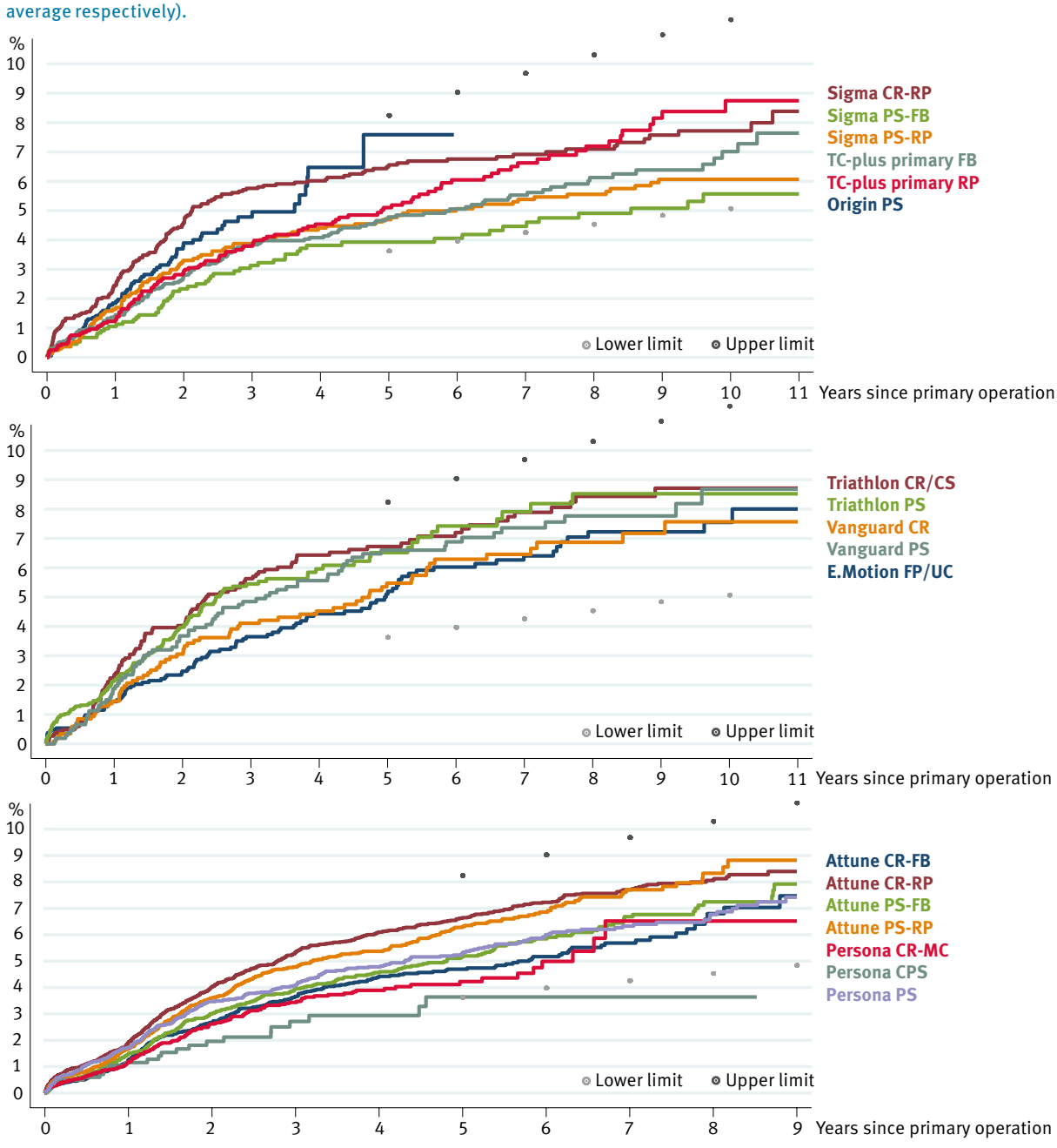


ers, the effect though hidden by the rest of the well performing variants. In Switzerland, such an example is the well-known Sigma TKA, which showed different results depending on the subsystem examined. While Sigma CR-FB had excellent results, the other variants (CR-RP, PS-FB, PS-RP) showed a spread of results in the long-term evaluation. All subsystems grouped together had revision rates within the expected range, even with a tendency toward decent 11-year results **(Figure 6.26).** However, PS-RP implantations cases from 2018 to 2021 had outlier status already in the 2-year evaluation

Figures 6.26

**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).



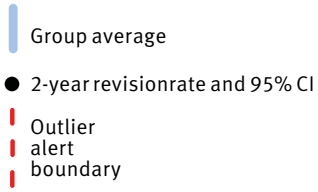
**(Figure 6.27).** It could be assumed that not only the knee system, but the surgeon does influence results significantly. Excellent outcomes of the Sigma PS-RP after 11 years speak for implant and surgery quality. The more recent bad performance at two years therefore raises the question whether the increased revision rates are attributable to less experienced surgeons.

## 6.5.2 Two-year revision rates of TKA

The two-year revision rate of the individual implants is shown in **Figure 6.27,** reflecting results from TKA performed between 01.01.2018 and 31.12.2021, providing a completed two-year follow-up by 31.12.2023. Numbers at risk were adjusted for mortality and emigration. Of the 60 implant combinations used (the rest being summarised under "other systems"), two systems 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 will result in an outlier report investigating the reasons for the observed deviations from the national average.

The first potential outlier system was used by one single surgeon (CCS 100) with small numbers reflected by higher confidence intervals. 7 early revisions of 89 TKA at risk resulted in an elevated revision rate of 7.9% (CI 3.8-15.8%). Any additional revision or prevented intervention will thus considerably influence performance of the specific TKA. The second potential outlier at two years concerns a subtype of an older implant with otherwise solid results overall and a result within the boundaries for the subtype mentioned. CCS of 32 indicates that problems in short term could be related to certain hospitals or surgeons **(Figure 6.27, Table 6.8).** "Other systems", summarising TKA with insufficient numbers to be represented individually, had a slightly better 2-year revision rate than average. As mentioned above, this group however had above-average medium- to long-term revision rates.

Of interest is that the two mentioned potential outliers in long-term (compare 6.5.1) had results with elevated revision rates but within the boundaries of the registry at two years.




* 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 6.27_Part one

## Two-year evaluation: Revision rates of primary total knee arthroplasty systems within 24 months

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Knee system | CCS* | Mean age | at risk N** | Revised N | % *** (95% CI) |
|---|---|---|---|---|---|
| 3D | 61 | 68 | 76 | 3 | 4.3 (1.4-12.8) |
| Advance | 35 | 68 | 669 | 29 | 4.4 (3.1-6.3) |
| Anatomic | 41 | 68 | 179 | 4 | 2.3 (0.9-6.0) |
| Attune CR-FB | 18 | 69 | 3,443 | 94 | 2.8 (2.3-3.4) |
| Attune CR-RP | 9 | 69 | 4,959 | 208 | 4.2 (3.7-4.8) |
| Attune CRS | 10 | 69 | 71 | 3 | 4.4 (1.4-13.0) |
| Attune PS-FB | 17 | 70 | 2,072 | 52 | 2.5 (1.9-3.3) |
| Attune PS-RP | 15 | 70 | 3,310 | 116 | 3.6 (3.0-4.2) |
| Balansys CR | 24 | 70 | 1,402 | 44 | 3.2 (2.4-4.2) |
| Balansys PS | 46 | 70 | 2,433 | 72 | 3.0 (2.4-3.8) |
| Balansys RP | 18 | 71 | 1,858 | 63 | 3.4 (2.7-4.4) |
| Balansys UC | 26 | 70 | 1,551 | 54 | 3.5 (2.7-4.6) |
| E.Motion FP/UC | 99 | 69 | 558 | 13 | 2.4 (1.4-4.1) |
| E.Motion PS | 98 | 71 | 125 | 5 | 4.0 (1.7-9.4) |
| Endo-Modell SL | 19 | 78 | 122 | 2 | 1.7 (0.4-6.7) |
| Endo-Modell rotation | 52 | 81 | 61 | 2 | 3.5 (0.9-13.1) |
| Enduro | 36 | 77 | 64 | 2 | 3.2 (0.8-12.3) |
| Evolution | 48 | 69 | 126 | 4 | 3.2 (1.2-8.3) |
| First/First REV | 34 | 71 | 915 | 47 | 5.2 (4.0-6.9) |
| GKS prime flex | 36 | 69 | 191 | 7 | 3.7 (1.8-7.5) |
| GMK hinge | 17 | 76 | 161 | 3 | 1.9 (0.6-5.7) |
| GMK primary CR/UC-FB | 49 | 70 | 78 | 3 | 3.9 (1.3-11.5) |
| GMK primary CR/UC-RP | 24 | 69 | 483 | 14 | 2.9 (1.7-4.9) |
| GMK primary PS | 27 | 71 | 308 | 14 | 4.6 (2.8-7.7) |
| GMK sphere | 13 | 69 | 8,276 | 307 | 3.8 (3.4-4.2) |
| Gemini SL | 72 | 67 | 129 | 2 | 1.6 (0.4-6.1) |
| Genus | 100 | 73 | 89 | 7 | 7.9 (3.8-15.8) |
| HLS kneetec | 82 | 68 | 76 | 2 | 2.7 (0.7-10.2) |
| ITotal | 27 | 68 | 1,027 | 28 | 2.8 (1.9-4.0) |
| Innex FB | 86 | 72 | 347 | 12 | 3.5 (2.0-6.1) |
| Innex RP | 30 | 70 | 835 | 26 | 3.2 (2.2-4.6) |
| Journey II | 23 | 68 | 1,216 | 67 | 5.6 (4.4-7.0) |
| LCS compl. cem./hybrid | 33 | 70 | 2,498 | 100 | 4.0 (3.3-4.9) |
| LCS compl. cementless | 36 | 68 | 734 | 42 | 5.8 (4.3-7.8) |
| Legion | 21 | 67 | 737 | 39 | 5.3 (3.9-7.2) |
| NK flex | 50 | 70 | 230 | 10 | 4.4 (2.4-8.0) |

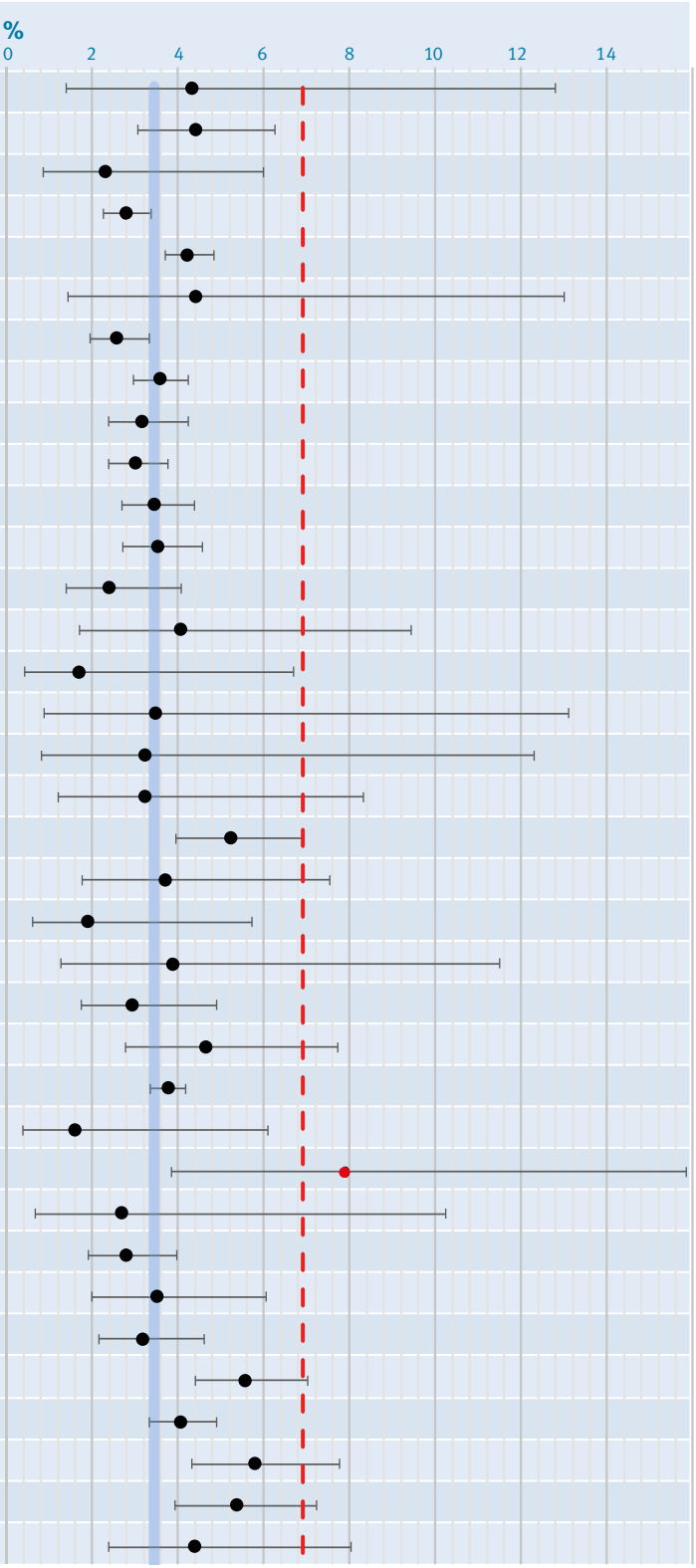
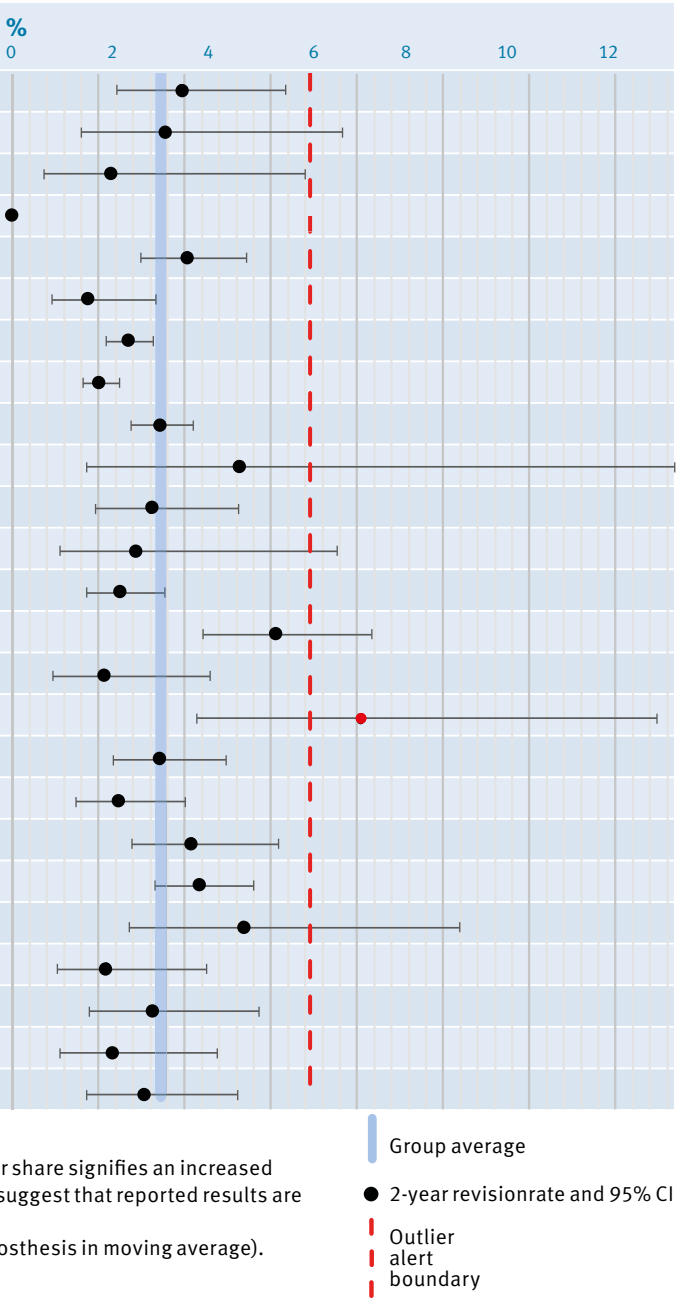


Figure 6.27_Part two

## Two-year evaluation: Revision rates of primary total knee arthroplasty systems within 24 months

4-year moving average covering implants between 01.01.2017 and 31.12.2020, with two years follow-up (31.12.2022).

| Knee system | CCS* | Mean age | at risk N** | Revised N | Revised % ***(95% CI) |
|---|---|---|---|---|---|
| Nexgen CR/LPS-Flex | 22 | 68 | 412 | 16 | 3.9 (2.4-6.3) |
| Nexgen LCCK | 19 | 71 | 176 | 6 | 3.5 (1.6-7.7) |
| Nexgen RHK | 28 | 77 | 134 | 3 | 2.2 (0.7-6.8) |
| Optetrak logic | 91 | 68 | 53 | 0 | 0.0 (.-.) |
| Origin PS | 19 | 69 | 1022 | 41 | 4.0 (3.0-5.4) |
| Persona CPS | 17 | 71 | 519 | 9 | 1.7 (0.9-3.3) |
| Persona CR-MC | 9 | 69 | 3449 | 91 | 2.7 (2.2-3.3) |
| Persona CR-UC | 41 | 70 | 4397 | 88 | 2.0 (1.6-2.5) |
| Persona PS | 14 | 70 | 2518 | 85 | 3.4 (2.8-4.2) |
| Physica KR/PS | 50 | 68 | 58 | 3 | 5.2 (1.7-15.4) |
| RT-plus | 20 | 77 | 479 | 15 | 3.2 (1.9-5.3) |
| Score | 78 | 69 | 139 | 4 | 2.9 (1.1-7.5) |
| Sigma CR-FB | 32 | 71 | 1183 | 29 | 2.5 (1.7-3.5) |
| Sigma CR-RP | 54 | 67 | 593 | 36 | 6.1 (4.4-8.4) |
| Sigma PS-FB | 83 | 71 | 293 | 6 | 2.1 (0.9-4.6) |
| Sigma PS-RP | 46 | 71 | 112 | 9 | 8.1 (4.3-15.0) |
| TC-plus primary FB | 41 | 70 | 774 | 26 | 3.4 (2.3-5.0) |
| TC-plus primary RP | 31 | 71 | 626 | 15 | 2.4 (1.5-4.0) |
| Triathlon CR/CS | 45 | 68 | 564 | 23 | 4.2 (2.8-6.2) |
| Triathlon PS | 31 | 69 | 1247 | 53 | 4.3 (3.3-5.6) |
| U2 | 91 | 69 | 150 | 8 | 5.3 (2.7-10.4) |
| Unity | 25 | 69 | 326 | 7 | 2.2 (1.0-4.5) |
| Vanguard CR | 47 | 67 | 343 | 11 | 3.2 (1.8-5.7) |
| Vanguard PS | 52 | 69 | 307 | 7 | 2.3 (1.1-4.8) |
| Other systems | | 72 | 412 | 12 | 3.0 (1.7-5.2) |
| **CH average for group** | | | | | **3.5 (3.3-3.6)** |




* 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.

# Partial knee arthroplasty

## 6.6 Primary partial knee arthroplasty

Since 2012, a total of 32,079 primary PKA were registered **(Table 4.6, p.41).** The proportion of PKA was 15.5% over the past 11 years. In 2023, 20,494 TKA and 3,407 PKA were performed, resulting in a share of PKA of 14.2%. This proportion sank continuously slightly since 2020 (16.9%) but remain among the highest in the western world, although clearly less than in Denmark, where PKA rates were 30.6% in 2023. For further details regarding incidence and demography please consult also Chapter 3 Demography and Chapter 4 Epidemiology.

### Previous surgery

Over the past six years, no previous operations were registered in 64.2% of the PKA, whereas 23.6% had a meniscectomy, and 19.9% an arthroscopy. As both these options could be selected simultaneously, one may expect that an earlier open meniscectomy was performed in 3.7%. Prior meniscal surgery declined steadily since 2012 (32%) and was registered only in 17.8% in 2023 **(Figure 6.28).** Former ACL reconstruction was noted in 1.9% of the cases, followed next by high tibial osteotomy in 1.2%. All other previous surgeries were very rare **(Table 6.10).** The rate of arthroscopy prior to PKA continuously decreased over the past 10 years, corresponding to the general decline of arthroscopy in knees with degenerative disease **(Figure 6.28).**

### Type of PKA and fixation

Medial PKA represented 83.4% of cases, lateral PKA 6.0%, and PFJ replacement 6.6%. Others, including combinations, were rare (1.2%). In 2.9%, the type was incorrectly classified as a TKA (mentioned as "other, type unknown"), but the implant data identified them as PKA **(Table 6.10).** This underscores the importance of checking properly the options available at case registration.

Most of the PKA were fully cemented during the period from 2018 to 2023. The share of cemented components continuously increased. The share of uncemented PKA continuously decreased over the same period, hybrid fixation played not an important role **(Figure 6.29).**

Table 6.10

**Primary partial knee arthroplasty: Surgery characteristics**

All diagnoses, all component fixations, 2018–2023.

| Previous surgery | N | % |
|---|---|---|
| None | 12,153 | 64.2 |
| Knee arthroscopy | 3,761 | 19.9 |
| Meniscectomy | 4,467 | 23.6 |
| ACL reconstruction | 369 | 1.9 |
| Osteotomy tibia close to knee | 220 | 1.2 |
| Osteosynthesis tibia close to knee | 91 | 0.5 |
| Surgery for patella stabilization | 203 | 1.1 |
| Synovectomy | 113 | 0.6 |
| Osteotomy femur close to knee | 24 | 0.1 |
| Osteosynthesis femur close to knee | 33 | 0.2 |
| Surgery for treating infection | 10 | 0.1 |
| Surgery for tumor | 7 | 0.0 |
| Other | 350 | 1.8 |

| Intervention | N | % |
|---|---|---|
| Unicompartment medial | 15,792 | 83.4 |
| Unicompartment lateral | 1,127 | 6.0 |
| Femoropatellar | 1,247 | 6.6 |
| Other (including combinations) | 228 | 1.2 |
| Other (type unknown)* | 542 | 2.9 |

| Technology | N | % |
|---|---|---|
| Conventional (including minimally invasive) | 16,682 | 88.1 |
| Computer assisted / navigation | 384 | 2.0 |
| Patient specific instrumentation | 1,253 | 6.6 |
| Robotic-assisted (v2021) | 565 | 3.0 |
| Other | 424 | 2.2 |

* 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.

### Technology

Between 2018 and 2023, PKA were implanted conventionally in 88.1% of the cases. Technical support in PKA was still rarely used in Switzerland, accounting for 10% of all cases between 2018 to 2023, although a slight increase could be observed since 2018 **(Figure 6.30).** Expectation would have been rather that technical support would be more frequently used in PKA to prevent surgical errors, mainly on the tibial side, responsible for elevated early revision rate of PKA compared to TKA. Conventional computer navigation was used in 2.0%, PSI in 6.6% and robotics in 3.0% **(Table 6.10).** Obviously trust in technology is much less pronounced in Switzerland than in other countries like Australia.

Figure 6.28
**Share of partial knee patients who had knee arthroscopy prior to arthroplasty (%)**

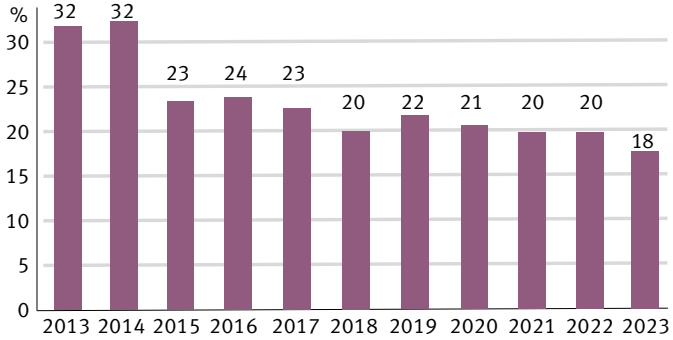
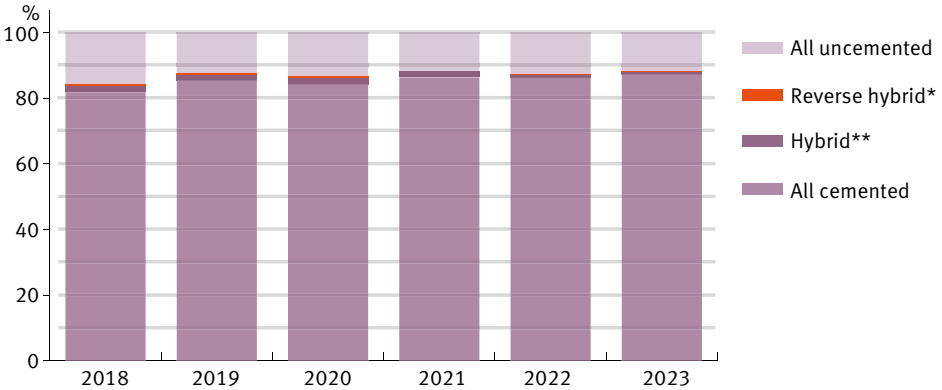



Figure 6.29
**Primary partial knee arthroplasty: Component fixation**
All diagnoses, in percent




| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| All uncemented | 15.7 | 12.4 | 13.4 | 11.7 | 12.8 | 11.8 | 12.9 |
| Reverse hybrid* | 0.7 | 0.6 | 0.4 | 0.2 | 0.2 | 0.2 | 0.4 |
| Hybrid** | 1.8 | 1.6 | 1.9 | 1.8 | 0.8 | 0.8 | 1.4 |
| All cemented | 81.8 | 85.4 | 84.2 | 86.3 | 86.2 | 87.3 | 85.3 |
| **N** | **2,546** | **2,892** | **2,916** | **2,981** | **3,175** | **3,179** | **17,689** |

* femur cemented, tibia uncemented ** femur uncemented, tibia cemented

## 6.7 First revision within two years after primary partial knee arthroplasty

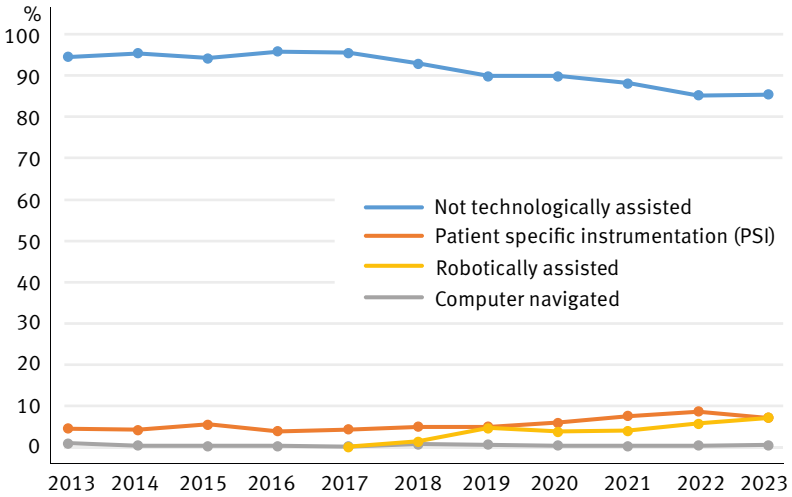
### 6.7.1 Incidence and demography

First revisions are revisions linked to primary PKA registered in SIRIS and occurring for the first time. Of the 32,079 PKA documented since 2012 **(Table 4.6. p.41),** 12,108 had been performed between 01.01.2018 and 31.12.2021, the 4-year moving window used to calculate the current 2-year revision rate. Of the implants in this cohort, 577 were revised, accounting for a 2-year revision rate of 4.8% (CI 4.4–5.2%). Younger patients had a much higher revision risk, with revision rates of 6.3% in the age group under 55 years, compared to 2.2% 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 avoidance of any additional surgery because of age and comorbidities.

The 2-year revision rates for women were 5.0% (CI 4.4-5.6%), whereas for men it was 4.2% (CI 3.7-4.8%), a difference not statistically significant **(Table 6.11).**

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 unrecognized revisions.

Figure 6.30
**Partial knee arthroplasty: Technology 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.

### 6.7.2 Reasons for revision

The main reason for revision of PKA was loosening of the tibial component (27.9%), followed by progression of OA (16.5%), loosening of the femoral component (12.3%), femorotibial instability (9.5%) and pain of unclear origin (9.5%). Infections were indicated in 8.5%. Patella problems (7.1%) were listed as often as periprosthetic tibial fractures (6.9%). In 5.2%, malposition of the tibial and in 3.3% of the femoral component were registered **(Table 6.12).** Excluding infections, most of the other reasons for revision mentioned only two years after primary PKA speak for technical errors or mistakes in indication. Taking in account cumulative incidence rates for revision, isolated pain was very prominent one year after surgery, followed by "other reasons" and progression of OA in other compartments. All other reasons played a less important role **(Figure 6.31).** Similar as in TKA only periprosthetic joint in-

Table 6.11

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

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023). All diagnoses, all component fixations.

| | | | Revised | | 95% CI | |
|---|---|---|---|---|---|---|
| | | N at risk[1] | N | %[2] | lower | upper |
| Overall | | 12,108 | 577 | 4.8 | 4.4 | 5.2 |
| Gender | Women | 5,130 | 253 | 5.0 | 4.4 | 5.6 |
| | Men | 5,731 | 239 | 4.2 | 3.7 | 4.8 |
| Age group | <55 | 1,653 | 104 | 6.3 | 5.2 | 7.6 |
| | 55–64 | 3,706 | 202 | 5.5 | 4.8 | 6.3 |
| | 65–74 | 3,467 | 137 | 4.0 | 3.4 | 4.7 |
| | 75–84 | 1,784 | 39 | 2.2 | 1.6 | 3.0 |
| | 85+ | 250 | 10 | 4.0 | 2.2 | 7.4 |

[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.

Table 6.12

**Reason for early first revision of primary partial knee arthroplasty**

all diagnoses, all component fixations. 4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).

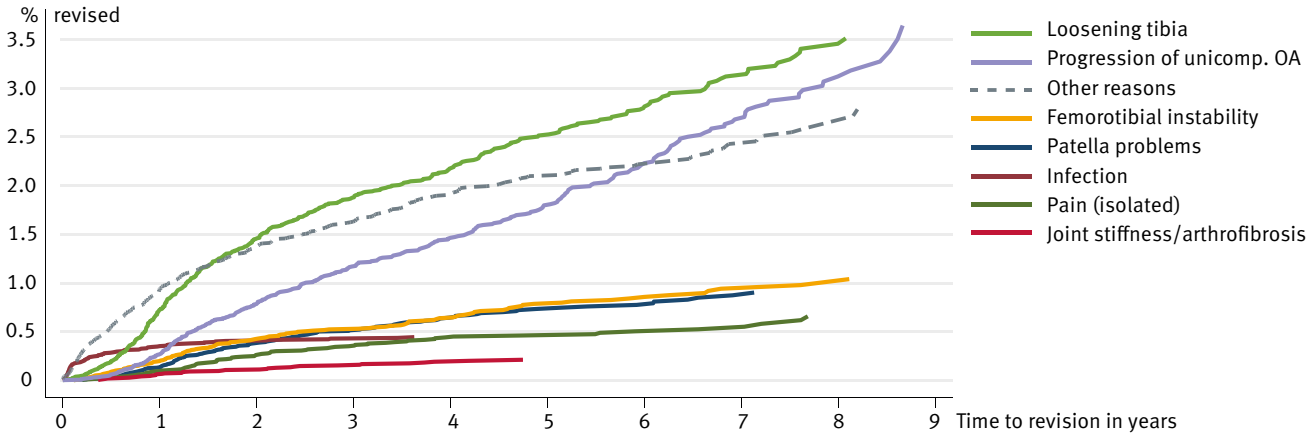
| | N | % |
|---|---|---|
| Loosening tibia | 161 | 27.9 |
| Progression of unicomp. OA | 95 | 16.5 |
| Loosening femur | 71 | 12.3 |
| Femorotibial instability | 55 | 9.5 |
| Pain (of unclear origin)* | 55 | 9.5 |
| Infection | 49 | 8.5 |
| Patella problems | 41 | 7.1 |
| Periprosthetic fracture tibia | 40 | 6.9 |
| Component malposition tibia | 30 | 5.2 |
| Component malposition femur | 19 | 3.3 |
| Joint stiffness/arthrofibrosis | 16 | 2.8 |
| Wear of inlay | 13 | 2.3 |
| Loosening patella | 8 | 1.4 |
| Patellar instability | 5 | 0.9 |
| Sizing tibial component | 5 | 0.9 |
| Sizing femoral component | 4 | 0.7 |
| Periprosthetic fracture femur | 2 | 0.3 |
| Periprosthetic fracture patella | 2 | 0.3 |
| Other | 70 | 12.1 |
| **Total** | **741** | |

* Pain was frequently reported alongside other reasons. The proportion of „isolated pain" was 7%.
Multiple responses possible (percentages do not sum to 100)

Figure 6.31

## Cumulative incidence rates for different revision diagnosis of partial knee arthroplasty

Time since operation, 2015–2023, all services, % of implants revised. Detailed reasons for revisions available since 2015.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 7 years | 8 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** (0.7-1.1) | **0.9** (0.7-1.1) |
| Infection | **0.3** (0.3-0.4) | **0.4** (0.3-0.5) | **0.4** (0.4-0.5) | **0.4** (0.4-0.5) | **0.4** (0.4-0.5) | **0.4** (0.4-0.5) | **0.4** (0.4-0.5) |
| Pain (isolated) | **0.1** (0.1-0.1) | **0.3** (0.2-0.3) | **0.4** (0.3-0.4) | **0.5** (0.4-0.6) | **0.5** (0.4-0.6) | **0.5** (0.4-0.7) | **0.7** (0.5-0.9) |
| Femorotibial instability | **0.2** (0.1-0.3) | **0.4** (0.3-0.5) | **0.5** (0.4-0.6) | **0.8** (0.7-0.9) | **0.9** (0.7-1.0) | **0.9** (0.8-1.1) | **1.0** (0.8-1.2) |
| Loosening TI | **0.7** (0.6-0.8) | **1.5** (1.3-1.6) | **1.9** (1.7-2.1) | **2.5** (2.3-2.8) | **2.8** (2.6-3.1) | **3.1** (2.8-3.4) | **3.5** (3.1-3.8) |
| Joint stiffness / arthrofibrosis | **0.1** (0.0-0.1) | **0.1** (0.1-0.2) | **0.2** (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) | **2.2** (2.0-2.5) | **2.7** (2.4-3.0) | **3.1** (2.7-3.5) |
| Other reasons | **0.9** (0.8-1.1) | **1.4** (1.2-1.5) | **1.6** (1.5-1.8) | **2.1** (1.9-2.3) | **2.2** (2.0-2.5) | **2.4** (2.2-2.7) | **2.6** (2.3-2.9) |

Figure 6.32

## Time interval between primary partial knee arthroplasty and first revision by reason

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).
Early first revisions are those occurring within 2 years of the primary arthroplasty.

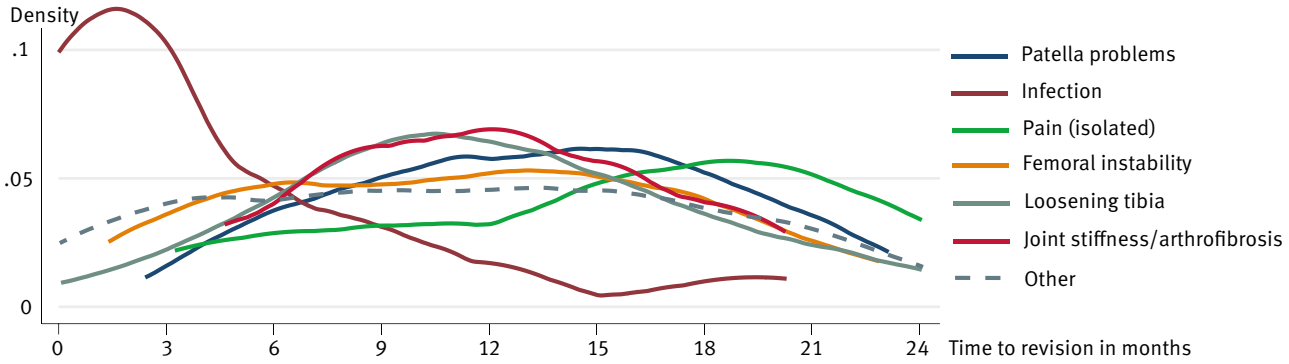



Table 6.13

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

all diagnoses

| | N | Median | IQR 25% | IQR 75% |
|---|---|---|---|---|
| Patella problems | 41 | 13.7 | 8.8 | 17.4 |
| Infection | 49 | 2.2 | 0.8 | 6.5 |
| Pain (isolated) | 23 | 16.5 | 10.2 | 20.4 |
| Femoral instability | 55 | 11.2 | 6.0 | 15.9 |
| Loosening tibia | 161 | 11.6 | 8.1 | 16.0 |
| Joint stiffness/arthrofibrosis | 16 | 11.7 | 8.8 | 15.4 |
| Other | 295 | 11.2 | 5.9 | 16.7 |

fections (PJI) were revised early after index surgery, most of the other reasons led to a revision peak one year after PKA. Revision for early loosening had its peak 11.6 months after PKA. Early revision because of isolated pain was performed later at median 16.5 months **(Figure 6.32 and Table 6.13).**

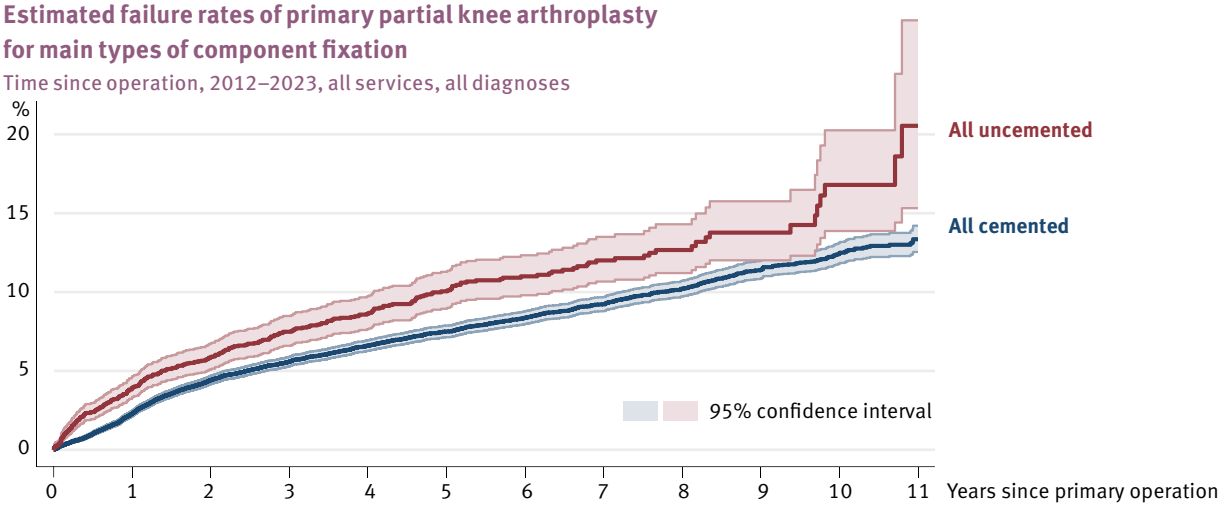
### Fixation and revision

Uncemented PKA were revised significantly more often than cemented ones until 8 years after primary PKA, the difference getting non-significant from the 9th year onward, mainly because of low numbers in uncemented PKA with consecutive widening of the confidence interval. A higher revision rate in uncemented PKA can be expected especially early after surgery as uncemented implants must osteointegrate, 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 largely parallel to the one observed for cemented implants **(Figure 6.33).** Of note, patients with uncemented PKA were younger than those with cemented implants. This selection bias also influenced the revision rate.

Figure 6.33

**Estimated failure rates of primary partial knee arthroplasty for main types of component fixation**

Time since operation, 2012–2023, all services, all diagnoses




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| All cemented | **2.3** (2.1-2.5) | **4.4** (4.2-4.7) | **5.6** (5.3-5.9) | **7.5** (7.1-7.9) | **8.4** (8.0-8.8) | **10.2** (9.7-10.7) | **12.5** (11.8-13.1) | **13.4** (12.5-14.2) |
| All uncemented | **3.9** (3.3-4.6) | **5.9** (5.1-6.7) | **7.5** (6.6-8.5) | **10.1** (8.9-11.3) | **11.0** (9.8-12.3) | **12.7** (11.2-14.3) | **16.8** (13.9-20.3) | **20.5** (15.3-27.2) |

### Type of PKA and revision

Estimated failure rates were equal for medial and lateral PKA. PFJ performed much worse regarding revision rates, diverging already one year after surgery. At 4 years of follow-up, revision rates already were twice as high as for medial or lateral PKA, with a tendency for further increase **(Table 6.14 and 15, Figure 6.34 ).**

### Technical support and revision

Comparing technical support during primary PKA, PSI and computer navigation did not perform better than conventional technique **(Figure 6.35 and 36).** In contrast, robotically assisted PKA was associated with less revisions from early on, although the effect seemed to flatten out from the 5th year after primary PKA **(Figure 6.36).** This has to be ob-

Table 6.14

**Long term evaluation: Failure rates of primary patellofemoral joint systems**

Time since operation, 2012–2023. All diagnoses, all components. 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.

| Knee system | Total number | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Gender PFJ | 1,082 | 8 | 59 | **2.2** (1.5-3.4) | **7.9** (6.2-10.0) | **12.1** (9.8-14.8) | **15.7** (12.7-19.4) | |
| Other systems | 1,101 | | 57 | **3.5** (2.5-4.8) | **12.1**(10.1-14.5) | **17.7** (15.1-20.7) | **21.6** (18.6-25.0) | **30.3** (24.5-37.1) |
| CH average for group | | | | **2.9** (2.2-3.7) | **10.1**(8.7-11.6) | **15.1** (13.3-17.1) | **18.9** (16.7-21.3) | **27.1** (22.4-32.5) |

* 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.

Table 6.15

**Long term evaluation: Failure rates of primary partial knee arthroplasty systems**

Time since operation, 2012–2023. All diagnoses, all component fixations. 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.

| Knee system | Total number | CCS* | Mean age** | 1 year (95% CI) | 3 years (95% CI) | 5 years (95% CI) | 7 years (95% CI) | 11 years (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Allegretto | 1,062 | 100 | 70 | **0.5** (0.2-1.1) | **1.6** (1.0-2.6) | **3.1** (2.2-4.5) | **4.6** (3.3-6.3) | **5.9** (4.2-8.2) |
| Balansys UNI | 3,717 | 48 | 65 | **2.2** (1.7-2.7) | **5.3** (4.6-6.1) | **6.6** (5.8-7.6) | **7.8** (6.9-8.9) | **11.6** (9.9-13.5) |
| GMK uni | 1,752 | 20 | 66 | **3.3** (2.5-4.2) | **7.3** (6.1-8.7) | **9.2** (7.8-10.9) | **11.4** (9.6-13.4) | **14.1** (11.6-17.2) |
| Journey uni | 1,074 | 12 | 63 | **3.3** (2.4-4.6) | **9.1** (7.4-11.0) | **16.2** (13.9-18.8) | **18.5** (15.9-21.3) | **25.6** (21.8-29.9) |
| Moto | 576 | 18 | 66 | **2.6** (1.5-4.5) | **5.6** (3.8-8.4) | **7.1** (4.3-11.5) | | |
| Oxford cemented/hybrid | 4,311 | 20 | 66 | **2.6** (2.2-3.2) | **5.5** (4.8-6.3) | **7.3** (6.5-8.2) | **9.2** (8.3-10.2) | **14.3** (12.6-16.3) |
| Oxford cementless | 3,062 | 10 | 64 | **3.9** (3.3-4.7) | **7.0** (6.1-8.0) | **9.2** (8.1-10.5) | **11.0** (9.6-12.6) | **18.5** (12.5-26.8) |
| Persona partial knee | 2,826 | 15 | 65 | **2.0** (1.5-2.6) | **4.8** (3.9-5.8) | **6.4** (5.2-7.8) | | |
| Physica ZUK | 4,016 | 20 | 65 | **1.9** (1.5-2.4) | **5.6** (4.8-6.4) | 7.0 (6.2-8.0) | **9.0** (8.0-10.2) | **13.3** (11.4-15.5) |
| Restoris MCK | 790 | 52 | 65 | **1.3** (0.7-2.4) | **2.9** (1.8-4.8) | **4.7** (2.5-8.7) | | |
| Sigma partial knee | 5,317 | 17 | 65 | **2.2** (1.9-2.7) | **5.4** (4.7-6.1) | **6.9** (6.1-7.7) | **7.6** (6.8-8.5) | **10.4** (8.8-12.3) |
| Other systems | 1,323 | | 64 | **3.6** (2.7-4.9) | **8.4** (6.9-10.2) | **10.9** (9.2-13.0) | **13.9** (11.7-16.4) | **20.3** (16.1-25.4) |
| CH average for group | | | | **2.5** (2.3-2.7) | **5.7** (5.5-6.0) | **7.7** (7.4-8.1) | **9.4** (8.9-9.8) | **13.5** (12.7-14.4) |

* 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.

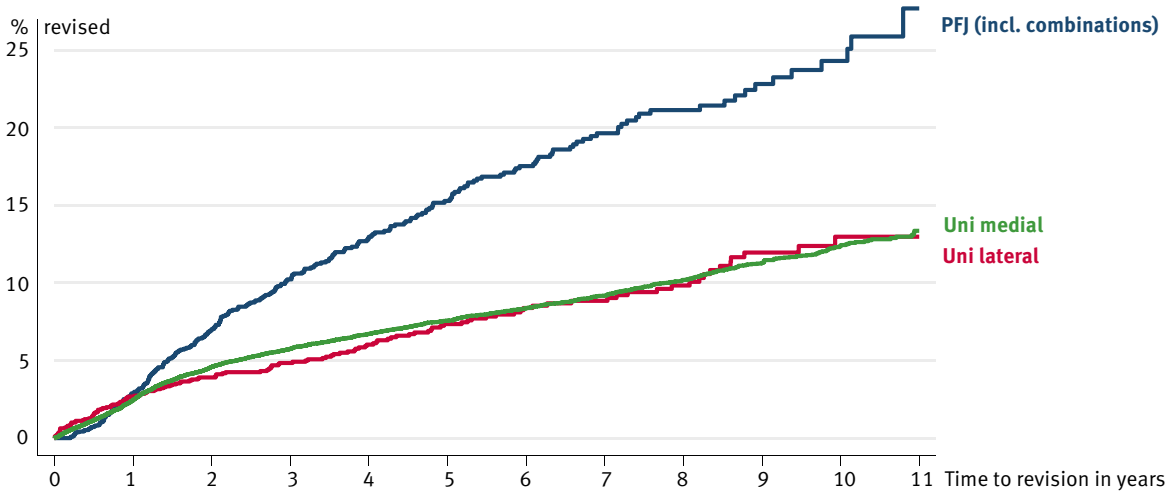
** Younger mean age signifies that the case mix is less "usual" and potentially biased towards higher revision risk.

served further in the future. 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.

Figure 6.34

**Estimated failure rates of primary partial knee arthroplasty: types of arthroplasties**

Time since operation, 2012–2023, all services, all diagnoses

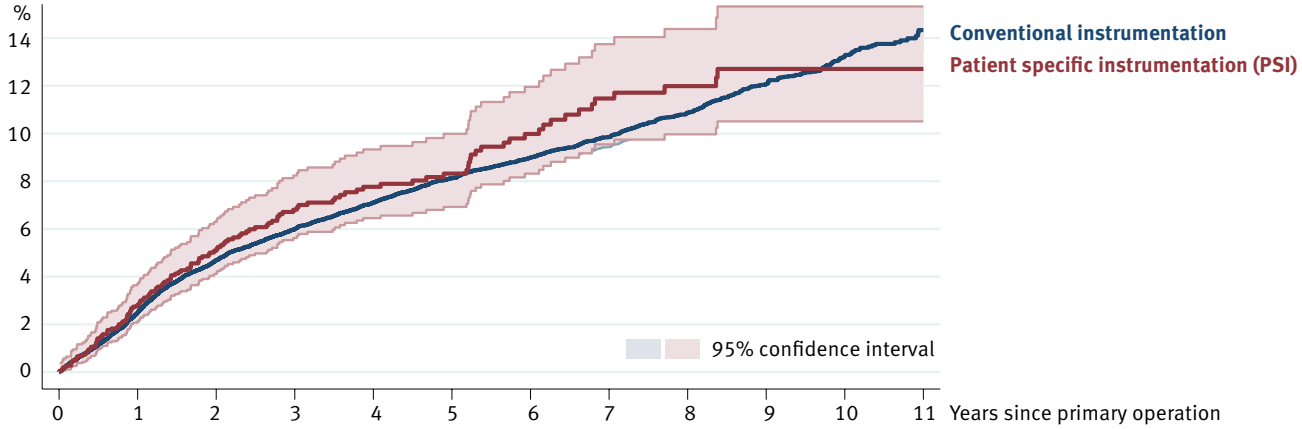



| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| uni medial | **2.4** (2.3-2.6) | **4.6** (4.3-4.9) | **5.8** (5.5-6.1) | **7.6** (7.2-7.9) | **8.4** (8.0-8.8) | **10.2** (9.7-10.7) | **12.4** (11.7-13.1) | **13.4** (12.5-14.3) |
| uni lateral | **2.7** (2.0-3.5) | **3.9** (3.1-4.9) | **4.8** (3.9-6.0) | **7.3** (6.1-8.9) | **8.4** (7.0-10.1) | **9.8** (8.2-11.8) | **13.0** (10.5-15.9) | **13.0** (10.5-15.9) |
| PFJ (incl. combinations) | **2.9** (2.2-3.7) | **7.0** (5.9-8.2) | **10.2**(8.9-11.8) | **15.3**(13.5-17.3) | **17.5**(15.5-19.7) | **21.1**(18.7-23.8) | **24.3**(21.2-27.8) | **27.7**(22.9-33.2) |

Figure 6.35

**Estimated failure rates of primary partial knee arthroplasty: conventional vs. patient specific instrumentation (PSI)**

Time since operation, 2012–2023, all services, all diagnoses.

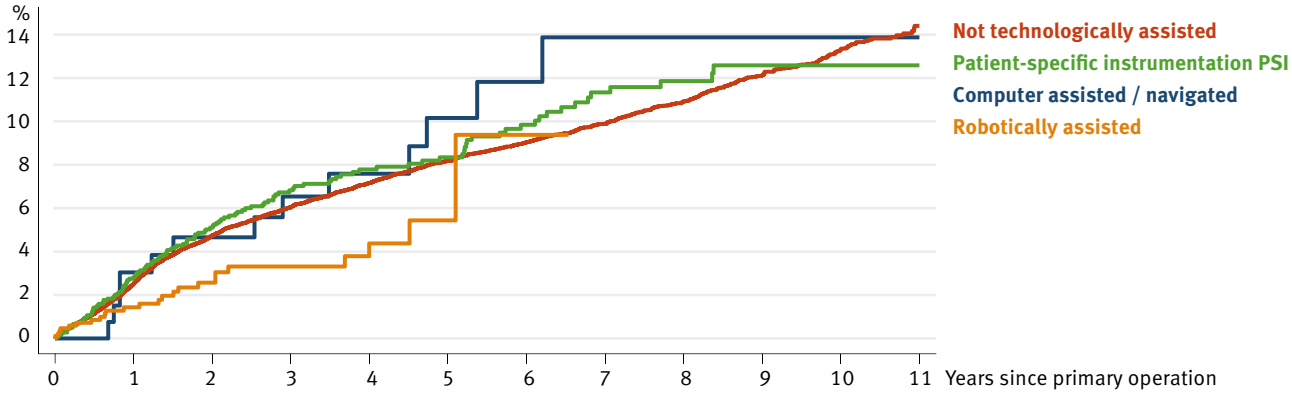



| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Conventional | **2.5** (2.3-2.7) | **4.7** (4.4-5.0) | **6.0** (5.7-6.3) | **8.1** (7.8-8.5) | **9.0** (8.6-9.4) | **10.9** (10.4-11.4) | **13.3** (12.6-13.9) | **14.3** (13.5-15.2) |
| PSI | **2.8** (2.1-3.7) | **5.1** (4.1-6.3) | **6.8** (5.6-8.2) | **8.3** (6.9-10.0) | **10.0** (8.3-12.0) | **12.0**(10.0-14.4) | **12.7** (10.5-15.3) | **12.7** (10.5-15.3) |

Figure 6.36

## Estimated failure rates of primary partial knee arthroplasty: technology assistance

Time since operation, 2012–2023, all services, all diagnoses.




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Not tech. assisted | **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** (10.4-11.4) | **13.3** (12.7-14.0) | **14.4** (13.6-15.3) |
| PSI | **2.8** (2.1-3.7) | **5.1** (4.1-6.3) | **6.8** (5.6-8.3) | **8.3** (6.9-10.0) | **9.8** (8.2-11.8) | **11.9** (9.8-14.2) | **12.6** (10.4-15.2) | **12.6** (10.4-15.2) |
| Computer navigated | **3.0** (1.2-7.9) | **4.7** (2.1-10.1) | **6.5** (3.3-12.7) | **10.2** (5.7-17.9) | **11.8** (6.7-20.4) | **13.9** (8.0-23.6) | **13.9** (8.0-23.6) | |
| Robotically assisted | **1.4** (0.8-2.6) | **2.6** (1.6-4.1) | **3.3** (2.1-5.2) | **5.4** (3.2-9.3) | | | | |

Table 6.16

## Type of early first revision of primary partial knee arthroplasty

All diagnoses, all component fixations. 4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023). Early first revisions are those occurring within two years of the primary arthroplasty.

| | N | % |
|---|---|---|
| Conversion from unicomp. to total prosthesis* | 398 | 69.2 |
| Exchange of PE | 102 | 17.7 |
| Tibial revision | 24 | 4.2 |
| Subsequent patella prosthesis | 3 | 0.5 |
| Complete revision* | 13 | 2.3 |
| Femoral revision | 11 | 1.9 |
| Patella revision | 8 | 1.4 |
| Component removal with spacer implantation | 5 | 0.9 |
| Reimplantation of prosthesis | 1 | 0.2 |
| Subsequent partial prosthesis, second compartment | 7 | 1.2 |
| Subsequent patella prosthesis with exchange of PE | 1 | 0.2 |
| Other | 2 | 0.3 |
| **Total** | **575** | |

* 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.

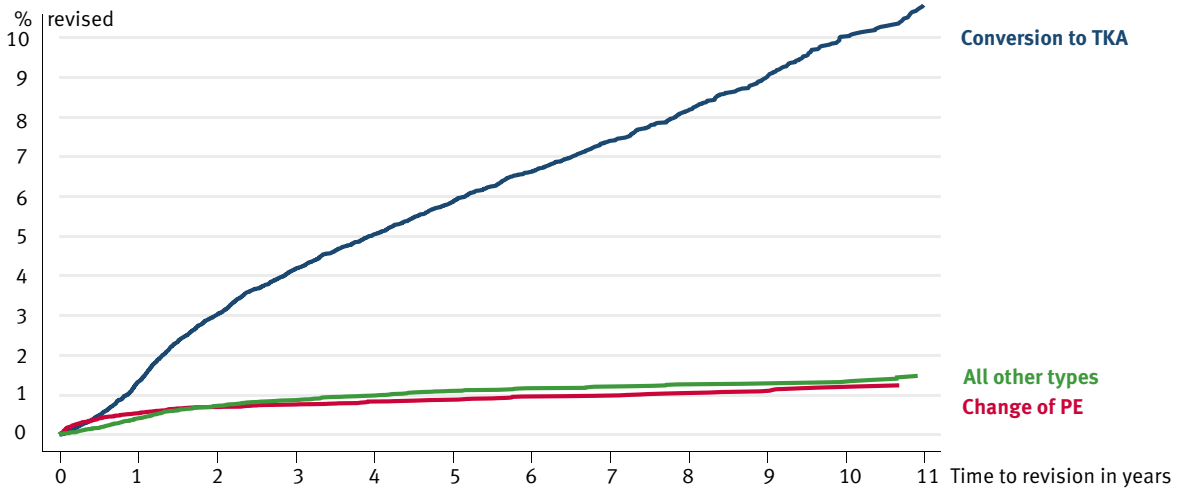
### 6.7.3 Type of early revision surgery

A total of 69.2% of the PKA revised were converted to TKA. Isolated liner exchange was performed in 17.7% of revisions, followed by an isolated tibial revision in 4.2% and isolated femoral revision in 1.9% **(Table 6.16).** The high number of conversions to TKA is even more obvious in **Figure 6.37.** Subsequent PKA in another compartment was rare (1.2%). Component removal with spacer due to PJI was performed in only 5 of the 398 revisions. A new PKA followed in only one case, in 4 cases probably a conversion to TKA was performed. For re-revision surgery after primary PKA please consult Chapter 6.4.

Figure 6.37

**Cumulative incidence rates for different types of revisions of partial knee arthroplasty**

Time since operation, 2012–2023, all services, % of implants revised




| | 1 year | 2 years | 3 years | 5 years | 6 years | 8 years | 10 years | 11 years |
|---|---|---|---|---|---|---|---|---|
| Conversion to TKA | **1.5** (1.4-1.7) | **3.3** (3.1-3.5) | **4.4** (4.2-4.7) | **6.3** (5.9-6.6) | **7.1** (6.7-7.4) | **8.8** (8.4-9.2) | **10.8** (10.2-11.4) | **11.6** (10.9-12.3) |
| Change of PE | **0.6** (0.5-0.7) | **0.7** (0.6-0.8) | **0.8** (0.7-0.9) | **0.9** (0.8-1.0) | **1.0** (0.9-1.1) | **1.1** (0.9-1.2) | **1.2** (1.1-1.4) | **1.5** (1.2-1.9) |
| All other types | **0.5** (0.4-0.5) | **0.8** (0.7-0.9) | **0.9** (0.8-1.0) | **1.1** (1.0-1.3) | **1.2** (1.0-1.3) | **1.3** (1.1-1.5) | **1.5** (1.3-1.7) | **1.6** (1.3-1.9) |

## 6.8 Results of implants in partial knee arthroplasty

The analysis is performed separately for unicondylar PKA and for PFJ PKA, as the revision rates observed largely differed.

### 6.8.1 Unicondylar partial knee arthroplasty

**Table 6.17** shows Switzerland's top ten most frequently used unicondylar PKA systems, representing 94% (16,455) of the PKA from 2018 until 2023. During this period, 1,136 implants (6%) belonged to the less common systems, grouped together as "other". Only 77 implants (0.4%) could not be classified, similarly to the rate indicated in the annual report of 2023.

#### Long term survival of unicondylar partial knee arthroplasty

The long-term evaluation since 2012 for all systems, all diagnoses, and all fixation methods is depicted in **Table 6.15,** showing results up to 11 years after surgery. The revision rate after 11 years for all systems was 13.5% (CI 12.7-14.4%), considerably higher than in TKA, where an average 11-year revision rate of 8.0% (CI 7.8–8.3%) was observed. 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 6.15).** The revision rate after 11 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, as individual providers may influence results of systems not widely used. A higher value indicates an increased likelihood of bias due to local effects. 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 as the Swiss average at 5 years, one system was slightly better **(Table 6.15).**

Table 6.17
**Top 10 (94%) of primary partial knee arthroplasty systems (all diagnoses, all component fixations) 2018–2023**

| Knee system | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| Balansys UNI | 280 | 354 | 298 | 350 | 417 | 330 | 2,029 |
| GMK uni | 196 | 222 | 205 | 158 | 155 | 116 | 1,052 |
| Journey uni | 93 | 89 | 88 | 74 | 47 | 50 | 441 |
| Moto | 21 | 31 | 66 | 123 | 189 | 146 | 576 |
| Oxford cemented/hybrid | 353 | 313 | 269 | 253 | 210 | 195 | 1,593 |
| Oxford cementless | 361 | 317 | 354 | 318 | 361 | 342 | 2,053 |
| Persona partial knee | 355 | 423 | 409 | 442 | 515 | 592 | 2,736 |
| Physica ZUK | 199 | 251 | 329 | 332 | 404 | 470 | 1,985 |
| Restoris MCK | 35 | 128 | 110 | 112 | 178 | 227 | 790 |
| Sigma partial knee | 423 | 497 | 600 | 615 | 504 | 559 | 3,198 |
| Other systems | 209 | 239 | 175 | 195 | 182 | 138 | 1,138 |
| **Total** | **2,525** | **2,864** | **2,903** | **2,972** | **3,162** | **3,165** | **17,591** |

PKA systems grouped together because of small numbers as "other", accounting for 6% of the PKA, had an average revision rate at 11 years of 20.3% (CI 16.1-25.4%). This means that none of the less commonly used systems would reach a place in the midfield at eleven years of follow-up, as it was the case for TKA. One system and the group "other systems" were classified as definitive outliers at 11 years follow-up. One variation of another uncemented system was a potential outlier. Interestingly, the PKA system identified as outlier is from the same company as the two potential outlier systems identified in TKA. As usual, the potential outlier identification will result in an outlier report investigating the reasons for the observed deviations from the national average. As in former years, one PKA system used by just one user had a significantly better survival curve than the Swiss average **(Figure 6.38)**. These excellent results are most probably to be explained by the outstanding expertise of the surgeon than by the system itself. 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 6.38 and 39).**

Figure 6.38

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

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).

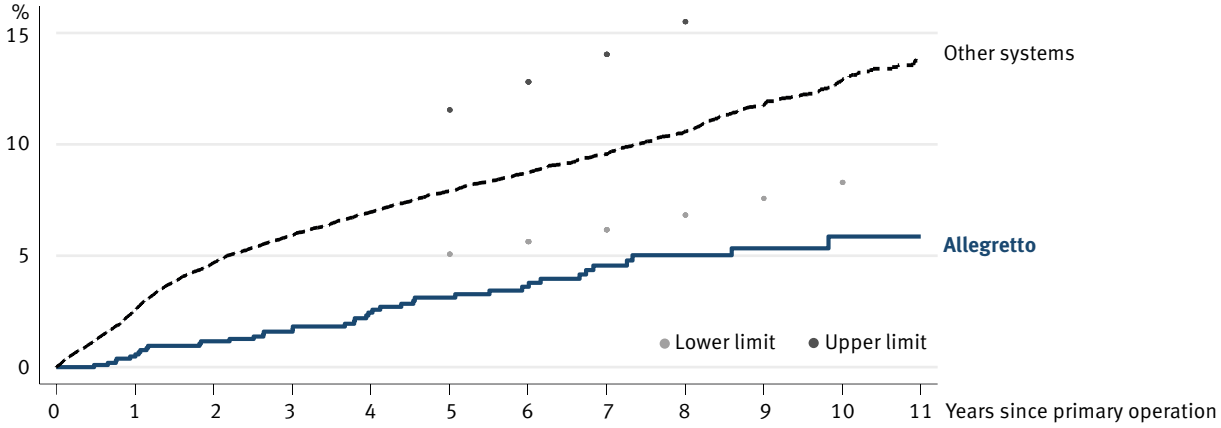
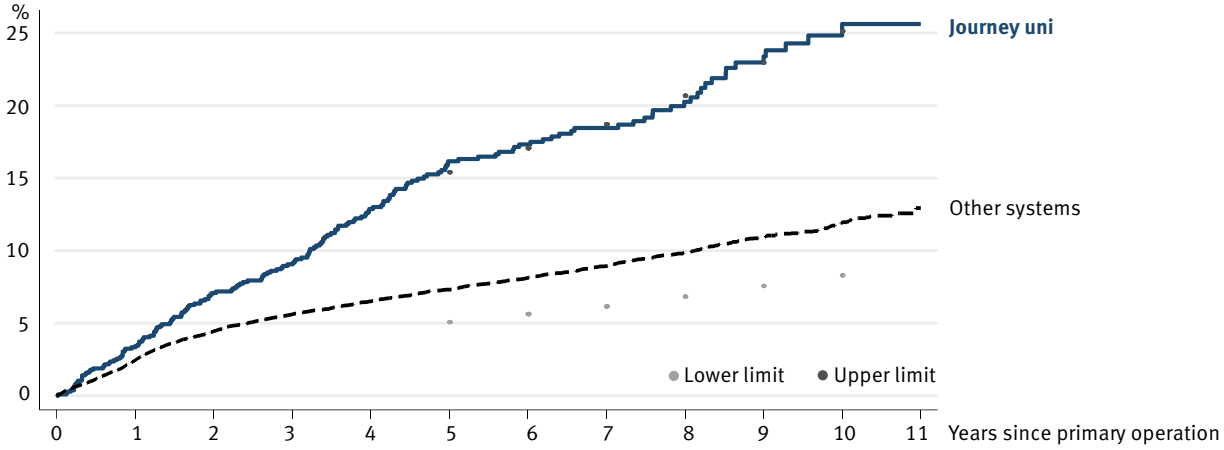



Figure 6.39

**Implant combinations with long-term evaluation outlier status (all PK)**

Outlier status was defined as a revision rate of twice the group average at any time between year 5 and year 10 (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).



**Figures 6.40** show the performance of the different PKA brands up to eleven years of follow-up, with upper and lower limits of the Swiss average illustrated in dotted lines. One brand implanted with an image-based robotic system performed at the lower margin of the Swiss average until 4 years after surgery but lost this favourable position due to mid-term revisions. The rather large steps in the KM estimate are related to relatively small numbers remaining at risk over time.

## 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 6.41,** reflecting how the implants performed between 01.01.2018 and 31.12.2021, with a completed two-year follow-up by 31.12.2023. Numbers at risk were adjusted for mortality and emigration. Of the 13 implant combinations used most frequently (the rest being summarised under "other systems"), none was identified as an outlier. The system which got to a definitive outlier from the third year after intervention onwards had elevated revision rate at

Figures 6.40

### All remaining implant combinations with average revision risks (all PK)

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

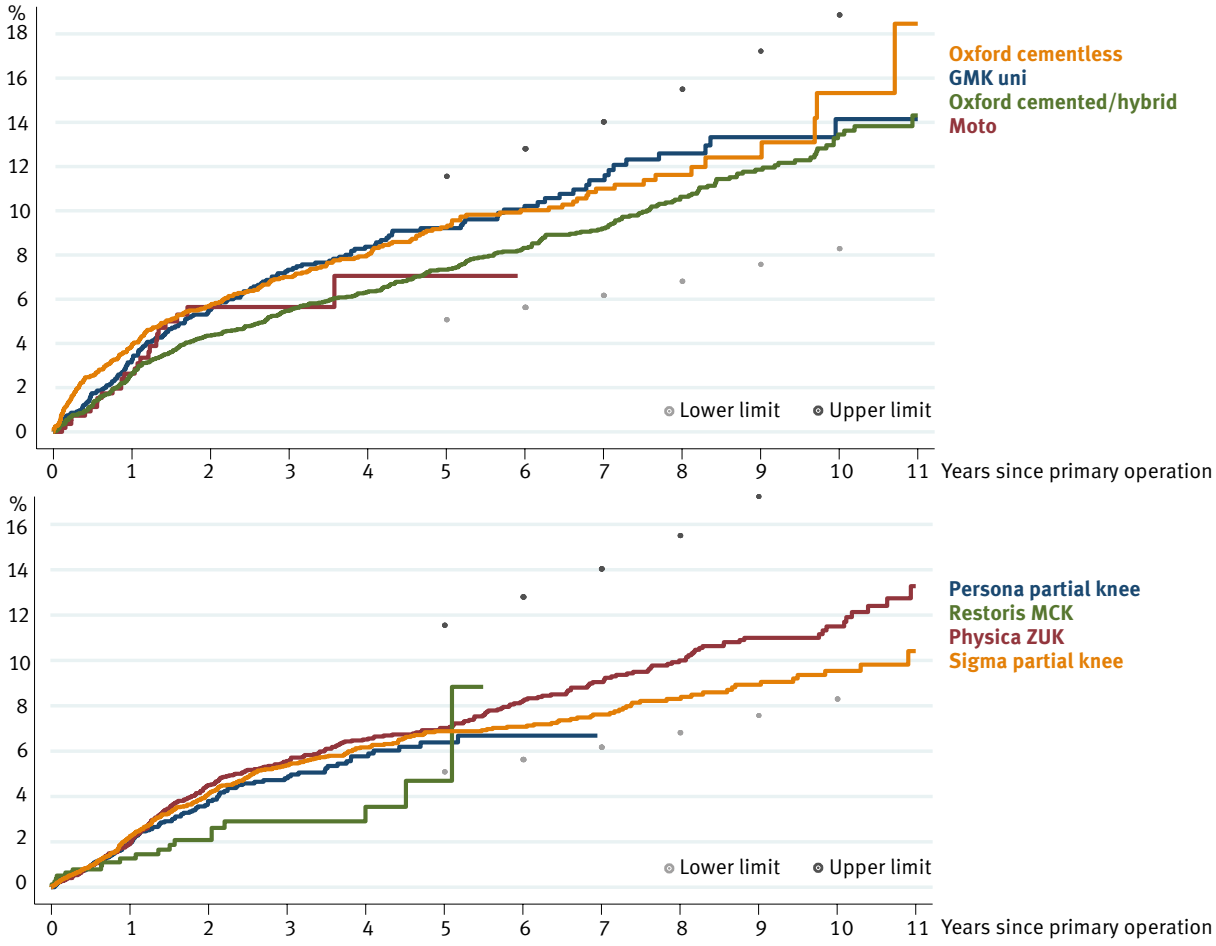
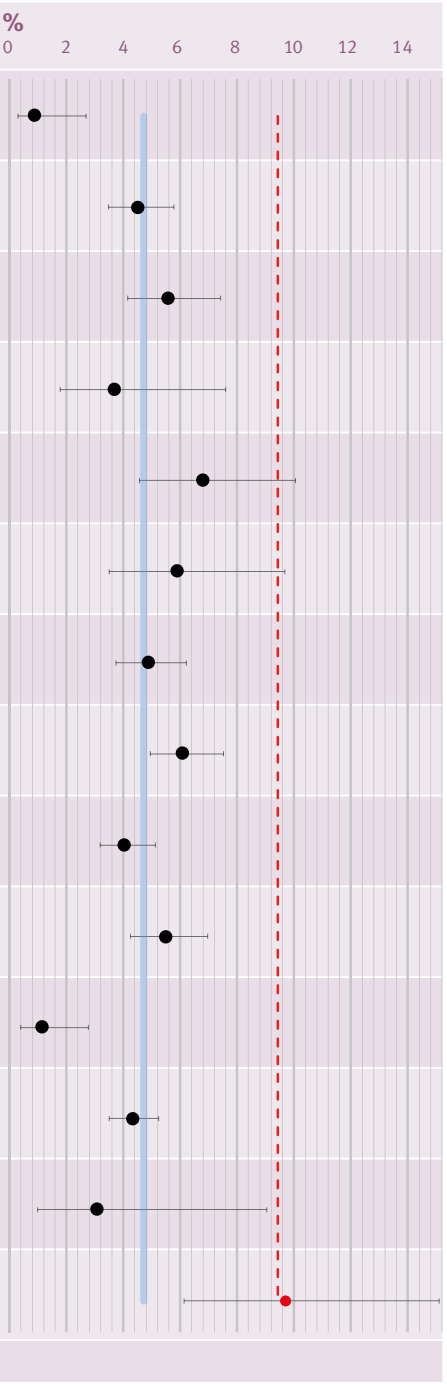


Figure 6.41

## Two-year evaluation: Revision rates of primary partial knee arthroplasty systems within 24 months

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023)

| Knee system | CCS* | Mean age | at risk N** | Revised N | Revised % ***(95% CI) |
|---|---|---|---|---|---|
| Allegretto | 100 | 71 | 347 | 3 | **0.9** (0.3-2.7) |
| Balansys UNI | 45 | 65 | 1,282 | 57 | **4.5** (3.5-5.8) |
| GMK uni | 16 | 66 | 781 | 43 | **5.6** (4.2-7.4) |
| IUni | 23 | 64 | 191 | 7 | **3.7** (1.8-7.6) |
| Journey uni | 10 | 63 | 344 | 23 | **6.8** (4.6-10.0) |
| Moto | 34 | 67 | 241 | 14 | **5.9** (3.5-9.7) |
| Oxford cemented/hybrid | 21 | 65 | 1,188 | 57 | **4.8** (3.7-6.2) |
| Oxford cementless | 14 | 64 | 1,350 | 82 | **6.1** (4.9-7.5) |
| Persona partial knee | 17 | 65 | 1,629 | 65 | **4.0** (3.2-5.1) |
| Physica ZUK | 32 | 65 | 1,111 | 60 | **5.4** (4.3-7.0) |
| Restoris MCK | 54 | 65 | 385 | 4 | **1.0** (0.4-2.8) |
| Sigma partial knee | 19 | 65 | 2,135 | 91 | **4.3** (3.5-5.2) |
| Triathlon PKR | 55 | 62 | 101 | 3 | **3.0** (1.0-9.0) |
| Other systems | | 64 | 179 | 17 | **9.7** (6.1-15.1) |
| CH average for group | | | | | **4.7** (4.3-5.1) |




* 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

two years but remaining within the boundaries of the registry. In contrast, the summary group "other systems" was within the boundaries just at one year of follow-up but turned to definitive outlier status after two years. Therefore, it should be recommended to surgeons using more exotic implants should review their own results thoroughly and switch to a brand more frequently used in Switzerland at any doubt **(Figure 6.41, Table 6.14).**

## 6.8.2 Patellofemoral joint partial knee arthroplasty

**Table 6.18** shows Switzerland's top five used patellofemoral PKA systems, representing 97% (1402) of the implants from 2018 until 2023. Only 30 implants (3%) in this period belonged to the less common systems declared as "other". Quite a significative share of 54 implants (3.6%) could not be classified, which is more than the 30 patellofemoral PKA summarised under "other systems".

### Long term survival of patellofemoral PKA

Numbers are too small to differentiate each of the 5 brands, therefore comparison was reduced to the brand which was used mostly and all the rest of the implants, summarized under "other systems" **(Table 6.14).** The singular system performed signi-

Table 6.18
**Top 5 (95%) of primary patellofemoral joint systems**
2018–2023, all diagnoses, all component fixations.

| Knee system | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2018–2023 |
|---|---|---|---|---|---|---|---|
| Gender PFJ | 103 | 102 | 160 | 108 | 166 | 153 | 792 |
| Hemicap PF classic/wave (PFJ) | 26 | 23 | 31 | 40 | 46 | 22 | 188 |
| IBalance PFJ | 30 | 17 | 24 | 17 | 30 | 29 | 147 |
| Journey PFJ | 20 | 18 | 20 | 18 | 9 | 19 | 104 |
| Restoris MCK PFJ | 4 | 24 | 25 | 28 | 32 | 58 | 171 |
| Other systems | 2 | 0 | 6 | 13 | 5 | 4 | 30 |
| **Total** | **185** | **184** | **266** | **224** | **288** | **285** | **1,432** |

ficantly better than all the other systems together from the first year on, though 11 years results 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 6.14, Figure 6.34).**

### Two-year revision rate of patellofemoral PKA

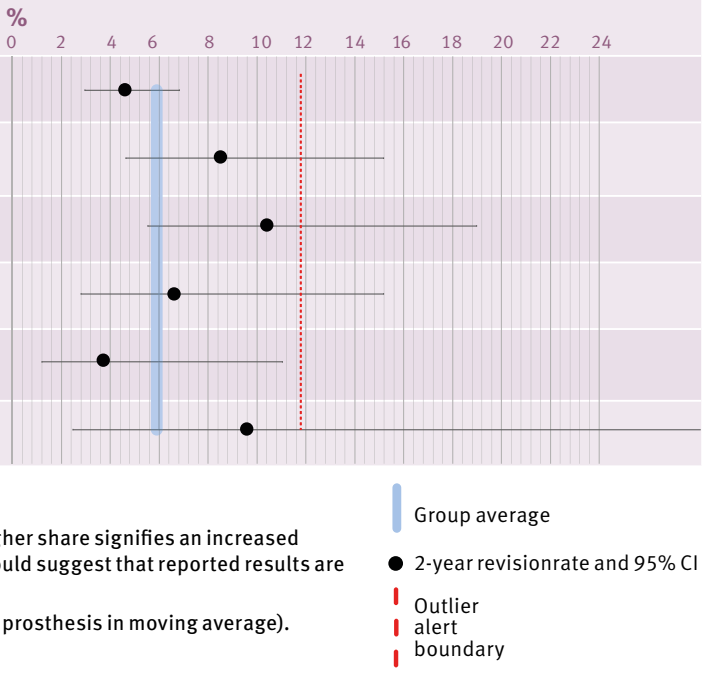
The two-year revision rates of the implants are shown in **Figure 6.42,** reflecting the implants performed between 01.01.2018 and 31.12.2021, with a completed two-year follow-up by 31.12.2023. Numbers at risk were adjusted for mortality and emigration. Of the 5 implant systems used, including the rest summarised under "other systems", none was an outlier. One system performed less good, another system where the femoral implant is conducted with image-based robotics had better results than the average.

Figure 6.42

**Two-year evaluation: Revision rates of primary patellofemoral joint systems within 24 months**

4-year moving average covering implants between 01.01.2018 and 31.12.2021, with two years follow-up (31.12.2023).

| Knee system | CCS* | Mean age | at risk N** | Revised N | % *** (95% CI) |
|---|---|---|---|---|---|
| Gender PFJ | 12 | 59 | 473 | 21 | **4.5** (3.0-6.8) |
| Hemicap PF classic/ wave (PFJ) | 13 | 55 | 120 | 10 | **8.5** (4.6-15.2) |
| IBalance PFJ | 16 | 54 | 88 | 9 | **10.4** (5.5-19.0) |
| Journey PFJ | 14 | 56 | 76 | 5 | **6.6** (2.8-15.2) |
| Restoris MCK PFJ | 51 | 60 | 81 | 3 | **3.7** (1.2-11.0) |
| Other systems | | 58 | 21 | 2 | **9.5** (2.5-33.0) |
| **CH average for group** | | | | | **5.9 (4.5-7.7)** |




* 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.

# Patient reported outcome measures (PROMs)

# 7. Patient reported outcome measures (PROMs)

While nationwide registration of PROMs within SIRIS will be introduced in 2025, the core of the new PROMs instrument has already been in use in the Canton of Zürich and some other hospitals since 2019. For this report, complete pre- and post-operative data were available for 7,243 THA, 5,552 TKA and 1,008 PKA performed only for primary osteoarthritis. Details of the project and coverage rates can be found in the methods chapter. In short, evaluation of PROMs is made using the Swiss Orthopaedics Minimal Dataset (SO-MDS), including an evaluation of joint-specific pain and joint-specific satisfaction by a numeric rating scale (NRS), and an evaluation of general quality of life using the EQ-5D-5L score. This chapter focusses on the results for hip and knee patients with a diagnosis of primary osteoarthritis only, for reasons of comparability between the three groups. Results are provided with an intention-to-treat (ITT) perspective. That is to say that revised implants are included in the analyses except if explicitly excluded.

## 7.1 Joint-specific pain

Reduction of pain is undoubtedly a core outcome for any arthroplasty. It is noteworthy that preoperative pain was quite similar in all three groups. Joint-specific pain was measured on a 0 to 10 scale. The mean pain values were 6.61 (SD 1.95) for THA, 6.65 (SD 1.92) for TKA and 6.40 (SD 1.77) for PKA. **Figure 7.1** highlights that the distribution of pain scores among the three groups resembled each other relatively closely. Most patients rated their preoperative pain with values of seven or eight on the ten-point NRS. Patients treated with PKA were visibly slightly less affected by pain than those treated with TKA, especially at the upper end of the distribution. After treatment, the mean pain values were reduced to 0.85 (SD 1.61) for THA, 1.67 (SD 2.04) for TKA and 1.78 (SD 2.17) for PKA. The distribution of values is practically reversed, but with a far larger proportion of THA patients reporting complete remission of pain **(Figure 7.2).**

Figure 7.1
**Preoperative pain**
Primary OA

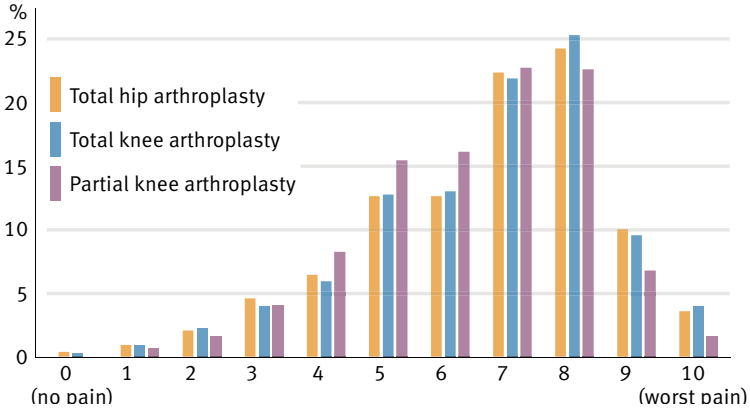
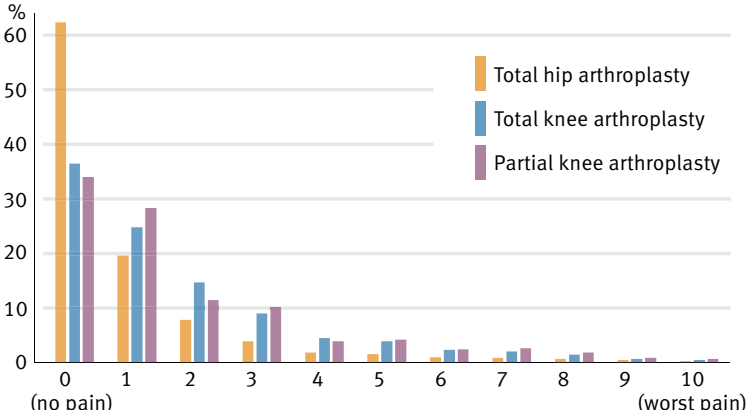



Figure 7.2
**Postoperative pain**
Primary OA, follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective

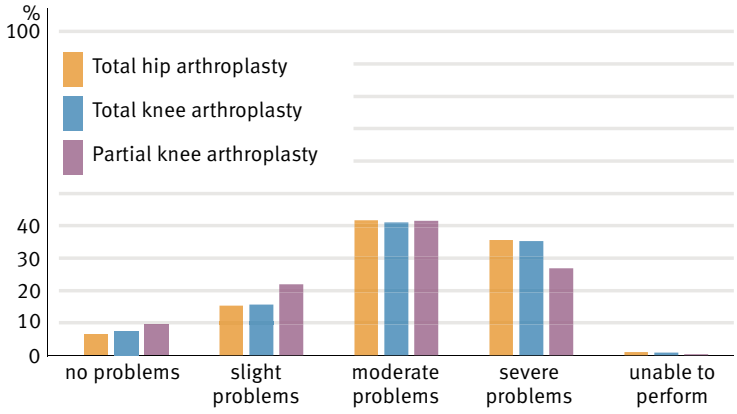


## 7.2 Quality of life

The EQ-5D-5L instrument was used to evaluate health-related quality of life before and after treatment. At its core are 5 dimensions covering pain, mobility, self-care, ability to do usual activities and anxiety. Highlighting the undisputed core dimension in elective arthroplasty, mobility, **Figure 7.3** show that once again hip and knee patients had very similar mobility restrictions before treatment. Most patients reported at least moderate problems, but over a third of THA and TKA patients also reported severe mobility problems. Again, PKA patients were on average slightly less affected. It is noteworthy that in every patient group significant minorities of between 6.5% and 9.5% reported no apparent mobility problems at all.

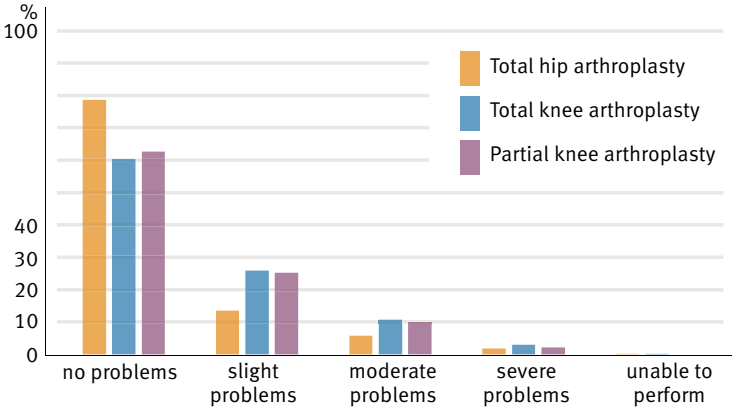
After treatment, the picture was again largely reversed. Reflecting the diverging outcomes in pain reduction, 78.7% of THA patients reported no further problems, but only 60.3% of TKA and 62.6% of PKA patients reported no problems **(Figure 7.4).** Considering that both TKA and PKA patients already were better at baseline, treatment gains were clearly superior in THA patients in this respect.

Figure 7.3
**Preoperative quality of life (EQ-5D-5L): mobility**
Primari OA




| | THA | | TKA | | PKA | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| no problems | 469 | **6.5** | 412 | **7.4** | 96 | **9.5** |
| slight problems | 1,112 | **15.4** | 867 | **15.6** | 220 | **21.8** |
| moderate problems | 3,018 | **41.7** | 2,274 | **41.0** | 419 | **41.6** |
| severe problems | 2,577 | **35.6** | 1,959 | **35.3** | 270 | **26.8** |
| unable to perform | 67 | **0.9** | 40 | **0.7** | 3 | **0.3** |
| **Total** | **7,243** | | **5,552** | | **1,008** | |

Figure 7.4
**Postoperative quality of life (EQ-5D-5L): mobility**
Primary OA, follow-up 1 year (up to 18 months allowed), intention-to-treat perspective

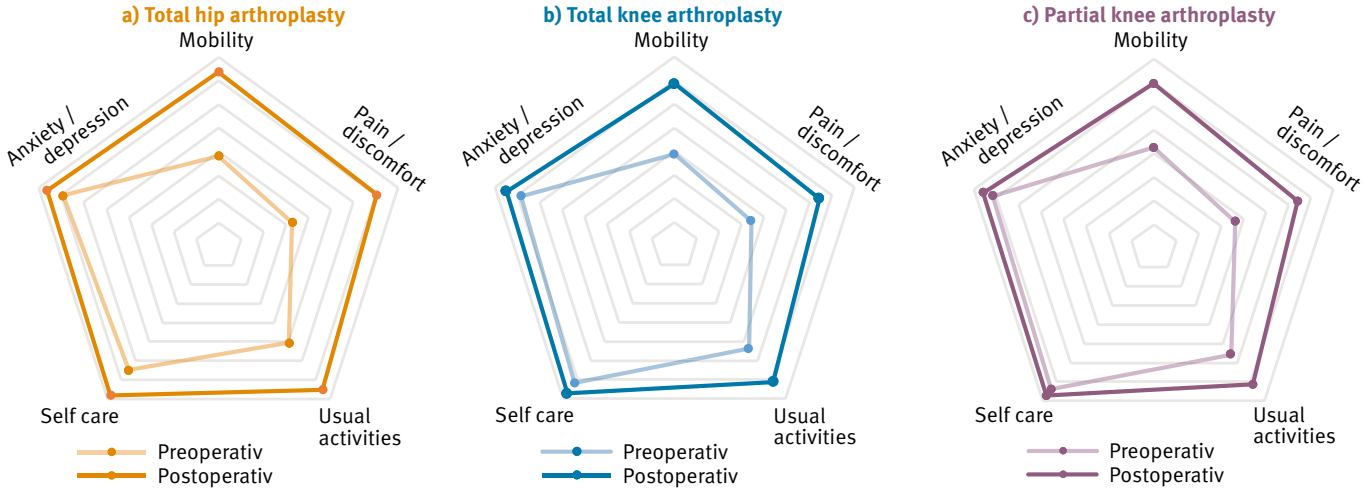



| | THA | | TKA | | PKA | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| no problems | 5,702 | **78.7** | 3,348 | **60.3** | 631 | **62.6** |
| slight problems | 983 | **13.6** | 1,438 | **25.9** | 255 | **25.3** |
| moderate problems | 421 | **5.8** | 593 | **10.7** | 100 | **9.9** |
| severe problems | 127 | **1.8** | 165 | **3.0** | 22 | **2.2** |
| unable to perform | 10 | **0.1** | 8 | **0.1** | 0 | **0.0** |
| | **7,243** | | **5,552** | | **1,008** | |

So-called radar charts are useful tools for visualising concepts that have multiple dimensions. All EQ-5D-5L items are scaled in the same way; 5-point ordinal categories ranging from no problem to severe problem. For these depictions the scales were recoded to depict the worst possible quality of life states as 0 and the best possible states as 4. **Figure 7.5a** shows the pre- and postoperative mean values of each item for THA patients. It is apparent at first glance that mobility, pain/discomfort and usual activities are the areas with most preoperative problems. For example, mobility has a value of approximately 2.2, reflecting the above shown majority category (mode) of 41.7% of THA patients with moderate problems. Self-care and anxiety/depression were rarely a problem before treatment. Nevertheless, in addition to the big gains in the three main problem areas, those areas of lesser importance also showed potential for improvement.

**Figures 7.5b and c** show the same basic picture for knee patients, but improvements were visibly less pronounced in all 5 dimensions compared to THA patients.

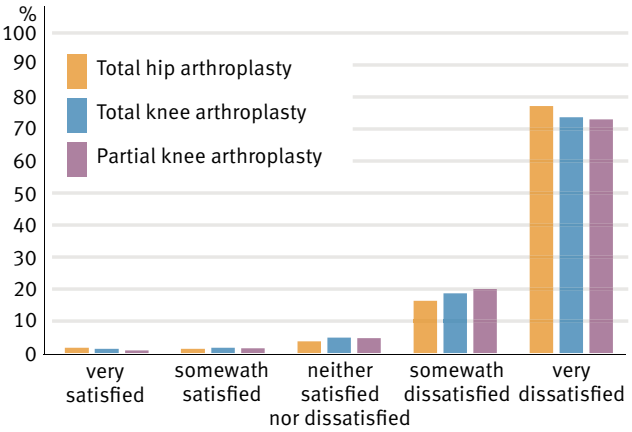
Figure 7.5
**Quality of life (EQ-5D-5L): overview**



## 7.3 Joint-specific satisfaction

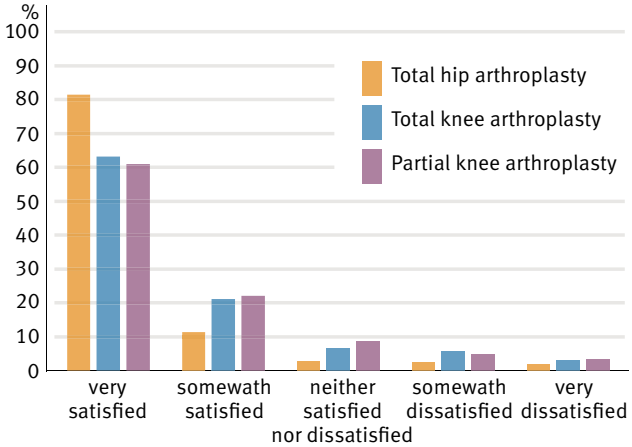
Comparisons of pre- and postoperative satisfaction ratings confirmed the above findings. Hip and knee patients were similarly dissatisfied with their situation before the operation. Between 73.0% and 77.2% of the patients stated that they were very dissatisfied. This picture was largely reversed one year after the operation. But there remains a clear satisfaction gap between hip and knee. Whilst 81.5% of hip patients were very satisfied, the corresponding values for knee implants were 60.9% and 63.2% **(Figures 7.6 and 7.7).** Although larger shares of knee patients were dissatisfied with their outcome, the main difference was one of degree of satisfaction or in-between inconclusiveness rather than dissatisfaction.

Figure 7.6
**Preoperative satisfaction with current situation**
Primari OA




| | THA | | TKA | | PKA | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| very satisfied | 114 | **1.6** | 75 | **1.4** | 8 | **0.8** |
| somewhat satisfied | 95 | **1.3** | 90 | **1.6** | 15 | **1.5** |
| neither satisfied nor dissatisfied | 258 | **3.6** | 263 | **4.7** | 47 | **4.7** |
| somewhat dissatisfied | 1,186 | **16.4** | 1,033 | **18.6** | 202 | **20.0** |
| very dissatisfied | 5,590 | **77.2** | 4,091 | **73.7** | 736 | **73.0** |
| | **7,243** | | **5,552** | | **1,008** | |

Figure 7.7
**Postoperative satisfaction with current situation**
Primary OA, follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective




| | THA | | TKA | | PKA | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| very satisfied | 5,904 | **81.5** | 3,510 | **63.2** | 614 | **60.9** |
| somewhat satisfied | 817 | **11.3** | 1175 | **21.2** | 222 | **22.0** |
| neither satisfied nor dissatisfied | 189 | **2.6** | 379 | **6.8** | 89 | **8.8** |
| somewhat dissatisfied | 188 | **2.6** | 315 | **5.7** | 49 | **4.9** |
| very dissatisfied | 145 | **2.0** | 173 | **3.1** | 34 | **3.4** |
| | **7,243** | | **5552** | | **1,008** | |

## 7.4 Treatment effects

We can evaluate treatment success more directly by calculating a quantity called the treatment effect (refer to chapter 2.5 for details). **Figure 7.8** compares the categorical distributions of the treatment effect for pain between the three groups. Small minorities of patients who did not report any preoperative pain were excluded.

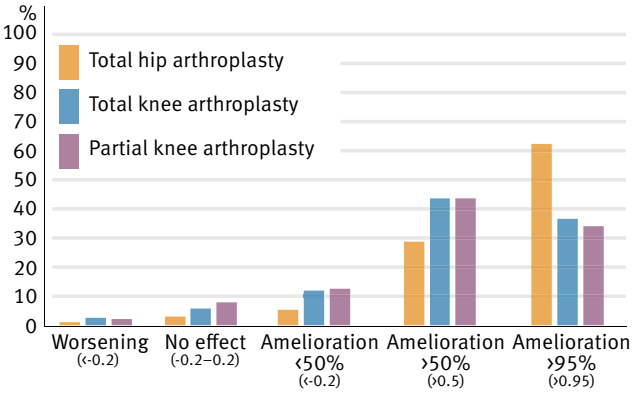
THA results were clearly best, with 62.4% of patients reporting symptom reduction of at least 95%. This means they were pain free after treatment. A further 28.7% reported good outcomes (reduction of more than 50%). A typical patient with a preoperative pain value of 8 would typically report a value no higher than 3 after treatment. Few THA patients had less favourable outcomes. However, 2.8% reported no improvement and 0.9% had more pain one year after the THA than before. It should be noted that these two categories include patients with a full spread of preoperative pain values.

In contrast, only 36.5% and 34.0% of knee patients achieved a perfect, pain free, outcome. However, over 40% had good outcomes with more than 50% pain reduction. Significant minorities of both TKA and PKA patients had less than 50% pain reduction and, most critically, between 8.1% and 9.8% of all knee patients did not benefit from the

Figure 7.8

**Treatment effect pain**

Primary OA, follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective.
Share of patients without reported pain (excluded as calculation of TE not possible)




| | THA | | TKA | | PKA | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Worsening (‹-0.2) | 66 | **0.9** | 135 | **2.5** | 21 | **2.1** |
| No effect (-0.2 - 0.2) | 196 | **2.8** | 305 | **5.6** | 76 | **7.7** |
| Amelioration ‹50% (›0.2) | 366 | **5.2** | 648 | **11.9** | 124 | **12.5** |
| Amelioration ›50% (›0.5) | 2,036 | **28.7** | 2,384 | **43.6** | 433 | **43.7** |
| Amelioration ›95% (›0.95) | 4,419 | **62.4** | 1,996 | **36.5** | 337 | **34.0** |
| **n** | **7,083** | | **5,468** | | **991** | |

surgery in terms of pain reduction. The small differences between TKA and PKA were statistically not significant. Differences between TKA and PKA patients would be expected, as the latter tend to be younger and more active than the former and thus probably expect more from a surgical treatment aiming at pain reduction and restoration of knee function.

An interesting additional perspective can be gained by comparing implants that were not revised during the observation period to those that were revised either before the PROMs follow-up or after the PROMs follow-up **(Table 7.1).**

There were 91 THAs and 46 TKAs with a recorded revision before the follow-up, and a further 33 THAs and 98 TKAs with a recorded revision after the follow-up. Timing of early revisions differs considerably between THA and TKA and this is reflected in those numbers. **Figures 7.9** show that both groups had markedly worse pain outcomes than implants that were never revised, even though there were also implants with excellent and good outcomes. Whilst 62.8% of unrevised THAs had perfect outcomes, this was only the case for 39.6% of THAs that had already been revised; and it was even lower at 33.3% for those cases that

Table 7.1

**Treatment effect pain (revised vs. unrevised implants)**

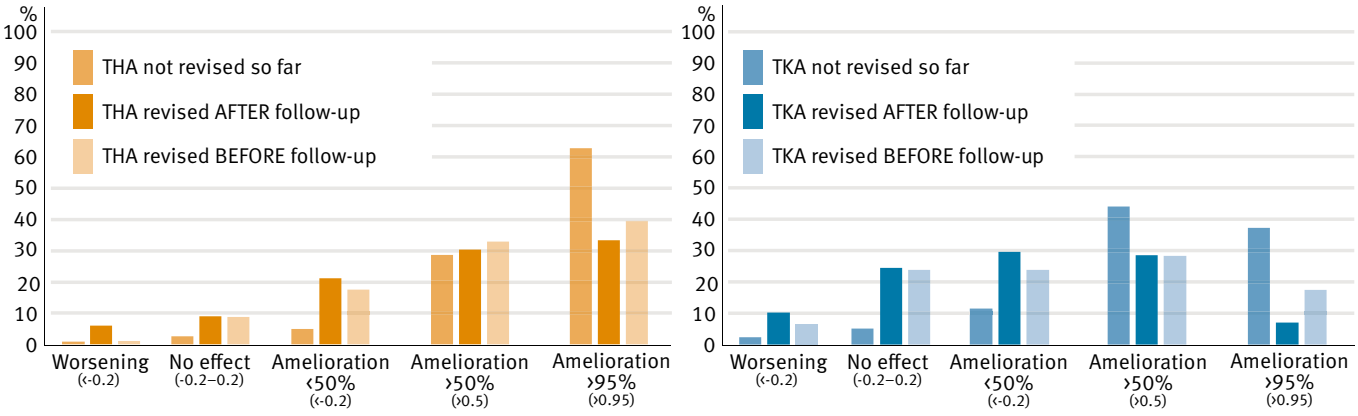
Primary OA, follow-up 1 year (9 to 18 months allowed)

| | THA not revised so far | | THA revised AFTER follow-up | | THA revised BEFORE follow-up | | TKA not revised so far | | TKA revised AFTER follow-up | | TKA revised BEFORE follow-up | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | N | % | N | % |
| Worsening (‹-0.2) | 63 | **0.9** | 2 | **6.1** | 1 | **1.1** | 122 | **2.3** | 10 | **10.2** | 3 | **6.5** |
| No effect (-0.2 - 0.2) | 185 | **2.7** | 3 | **9.1** | 8 | **8.8** | 270 | **5.1** | 24 | **24.5** | 11 | **23.9** |
| Amelioration ‹50% (›0.2) | 343 | **4.9** | 7 | **21.1** | 16 | **17.6** | 608 | **11.4** | 29 | **29.6** | 11 | **23.9** |
| Amelioration ›50% (›0.5) | 1996 | **28.7** | 10 | **30.3** | 30 | **33.0** | 2343 | **44.0** | 28 | **28.6** | 13 | **28.3** |
| Amelioration ›95% (›0.95) | 4372 | **62.8** | 11 | **33.3** | 36 | **39.6** | 1981 | **37.2** | 7 | **7.1** | 8 | **17.4** |
| **n** | **6,959** | 100% | **33** | 100% | **91** | 100% | **5,324** | 100% | **98** | 100% | **46** | 100% |

Figures 7.9

**Treatment effect pain (revised vs. unrevised implants)**

Primary OA, follow-up 1 year (9 to 18 months allowed)



would still see a revision in the available observation period of up to 5 years. However, the proportion of perfect outcomes was particularly small for TKAs that would still see a revision after the one-year follow-up (7.1%), suggesting a stronger link between poor functional outcomes and revision likelihood. But one should not lose sight of the absolute numbers in this context. There were still more than 10 times as many unrevised implants with poor functional outcomes than revised ones. Thus, failure to reduce pain is not automatically a determinant of early revision.

Treatment effect was also calculated for the EQ-5D-5L quality of life measure. The EQ-5D-5L summary score was used for that purpose. Treatment outomes in terms of quality of life resembled pain outcomes. 59.2% of THA patients and 37.8% of TKA patients reported complete restoration of their quality of life.

Hip outcomes were somewhat better than knee outcomes and TKA and PKA outcomes were largely equivalent within the limits of statistical precision, but PKA results were more polarised than TKA results. The bigger proportion of poor TKA results compared to THA was statistically significant. The share of patients that did not appear to benefit in terms of overall quality of life from their surgery is much larger than for the pain outcome alone, both for hip and knee patients. This is certainly at least partly a reflection of the less specific outcome and lack of joint-specific questions. Nevertheless, the proportion of poor hip results was less than half of that of knee results **(Figure 7.10)**.

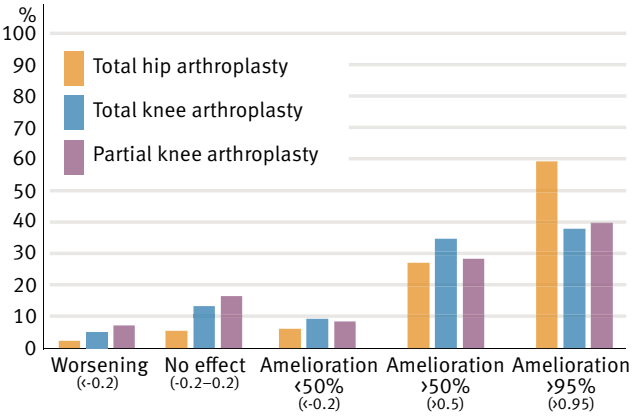
## 7.5 Conclusion

In conclusion, PROMs permit to provide a more complete picture of the clinical effectiveness of hip and knee arthroplasties, as revision rates illustrate only one aspect of outcomes. However, the geographical coverage of those PROMs is currently still very restricted, rendering generalisability questionable. Results are mostly from the Canton of Zurich. Specifically, the implant mix and some other surgical aspects may not be a reflection of Switzerland on the whole. Nationwide registration of PROMs within SIRIS is planned to be implemented in 2025 and will eventually complete the picture.

Figure 7.10

**Treatment effect quality of life (EQ-5D-5L)**

Primary OA, follow-up 1 year (9 to 18 months allowed), intention-to-treat perspective.
Share of patients without reported limitations (excluded as calculation of TE not possible)




| | THA | | TKA | | PKA | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Worsening (‹-0.2) | 160 | **2.2** | 276 | **5.0** | 72 | **7.2** |
| No effect (-0.2 - 0.2) | 396 | **5.5** | 733 | **13.3** | 164 | **16.4** |
| Amelioration ‹50% (›0.2) | 437 | **6.1** | 505 | **9.2** | 84 | **8.4** |
| Amelioration ›50% (›0.5) | 1,943 | **27.0** | 1,910 | **34.7** | 2,84 | **28.4** |
| Amelioration ›95% (›0.95) | 4,267 | **59.2** | 2,079 | **37.8** | 397 | **39.7** |
| **n** | **7,203** | | **5,503** | | **1,001** | |

# SIRIS outlier watch list – hip implants

| Implant or implant combination | Detected as outlier in report | Risk-adjusted hazard ratios for 2-year revision risk: for age and sex HR | lb95% | ub95% | for age, sex, BMI, ASA and Charnley Class (from 2015, if available) HR | lb95% | ub95% | Summary |
|---|---|---|---|---|---|---|---|---|
| **Uncemented stem/cup combinations (primary osteoarthritis)** | | | | | | | | |
| Alloclassic + Fitmore | 2022 | 1.49 | 1.02 | 2.17 | 1.26 | 0.60 | 2.64 | It is very unlikely that this combination is an actual outlier combination. The outlier detection is based on an unusual number of revisions detected in cases from 2017. In fact, few uses were registered after 2019 (down from 100+ per year before 2016). It was mainly in use in one hospital and therefore there is a high likelihood of a local effect in 2017. This hospital stopped using the combination after 2020. Performance before the 2017 peak in revisions was unremarkable and none of the registered cases since 2019 had been revised by June 2023. |
| | 2023 | 1.55 | 1.07 | 2.24 | 1.24 | 0.59 | 2.61 | |
| AMIStem + Mpact | 2019 | | | | | | | Not anymore identified as a potential outlier. The outlier status in 2019 was caused by early implants. Performance since 2017 has been average or better. |
| (AMIStem + Versafitcup DM) | 2020 | 2.14 | 1.02 | 4.51 | 2.30 | 1.03 | 5.15 | Due to the reclassification of implants in 2022, we narrowed down the stem in this combination to the Amistem-H proximal coating variant. This particular combination was mainly used in one hospital and only between 2016 and 2019. A small absolute number of revisions was recorded against a moderate number of primary procedures, but the deviation from an average 2-year-revision rate is still very marked, albeit with very limited statistical precision. It is also noteworthy that the stem and the cup observed individually are performing adequately at two years. **Combination is not currently in active use.** |
| | 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 | |
| Corail + Delta motion | 2019 | | | | | | | Not anymore identified as a potential outlier. The outlier status in 2019 was caused by early implants. **Combination is not currently in active use.** |
| Exception + Exceed | 2020 | 1.53 | 0.69 | 3.40 | 1.30 | 0.33 | 5.22 | Not anymore identified as a potential outlier because revision rate is now below threshold. We already noted in past reports that it was unlikely that this combination was a genuine outlier because current use is limited to one hospital where the performance is statistically inconclusive due to small numbers. **Combination is not currently in active use.** |
| | 2021 | 1.59 | 0.76 | 3.33 | 1.48 | 0.48 | 4.61 | |
| GTS + Exceed | 2019 | | | | | | | Not anymore identified as a potential outlier. **Combination is not currently in active use.** |
| GTS + G7 bi-spherical | 2019 | | | | | | | GTS + G7 bi-spherical is very likely a problematic stem-cup combination. It was practically in use in only one hospital and there were no further uses recorded since 2021. It is noteworthy that both stem and cup observed individually have been performing poorly. **Combination is not currently in active use.** |
| | 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 | |
| (Harmony + Gyracup) | 2020 | 3.97 | 1.98 | 7.94 | 3.55 | 1.76 | 7.13 | Due to the reclassification of implants, this combination is now correctly identified as Harmony + Symbol DMHA/DS. evolution (Gyracup being an alternative brand name not actually used in Switzerland). It was in use in only one hospital and active use ceased in 2019 after an unusual number of revisions. Only original Symbol DMHA cups (none of the equivalent DS Evolution cups) were used in this outlier combination. **Combination is not currently in active use.** |
| Harmony + Symbol DMHA/DS evolution | 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 | |
| Polarstem + EP-fit | 2020 | 1.93 | 1.30 | 2.86 | 2.52 | 1.42 | 4.45 | Polarstem and EP-FIT is a potential outlier combination, as its risk adjusted hazard ratio has exceeded the relevant threshold of two in most evaluation periods. Polarstem is a frequently used stem with an excellent performance record, whilst EP-fit cups are more average. It is noteworthy that an unusual number of infections as well as dislocations was recorded as reasons for revisions. Without the infections, the combination's performance would have been closer to the national average, but still above it. **Combination is not currently in active use.** |
| | 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 | |
| SPS evolution + April ceramic | 2020 | 2.22 | 1.72 | 2.88 | 3.67 | 2.47 | 5.47 | SPS Evolution + APRIL Ceramic is now a definitive outlier combination considering the overall performance over several years of both the combination and the separate components in more than one hospital. It is noteworthy that the risk-adjusted hazard ratio clearly exceeds the critical value of two including its confidence interval. This combination, still in active use, exceeds the outlier boundary both at 2-years and long-term beyond 5 years. Recommended course of action: investigate causes of revisions where those are higher than average and observe future performance. |
| | 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 | |
| SPS HA + April ceramic | 2021 | 2.61 | 1.44 | 4.73 | 2.85 | 1.18 | 6.87 | SPS HA + April ceramic appears to be following the same pattern as the other SPS/April ceramic combinations, although only actively used in significant numbers in two hospitals and only rarely between 2017 and 2019. Active use practically stopped in 2021 with only 2 registered uses in that year. There were fewer than 50 eligible cases in the current reporting period and therefore the combination was not anymore listed in 2023. |
| | 2022 | 2.61 | 1.44 | 4.72 | 2.84 | 1.18 | 6.85 | |

| Implant or implant combination | Detected as outlier in report | Risk-adjusted hazard ratios for 2-year revision risk | | | | | | Summary |
|---|---|---|---|---|---|---|---|---|
| | | for age and sex | | | for age, sex, BMI, ASA and Charnley Class (from 2015, if available) | | | |
| | | HR | lb95% | ub95% | HR | lb95% | ub95% | |
| SPS modular + April ceramic | 2019 | | | | | | | Not identified anymore as an outlier combination. The last registered use was in 2021. **Combination is not currently in active use.** |
| | 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 | | | | | | | Not identified anymore as an outlier combination. The last registered use was in 2019. It is still listed in the annual report with an unremarkable revision rate. This is due to the fact that years with particularly poor performance have been replaced with years with better performance in the evaluation period. **Combination is not currently in active use.** |
| | 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 | Not identified anymore as an outlier combination. The last use was registered in 2019. **Combination is not currently in active use.** |
| Accolade II + Trident II | 2023 | 2.96 | 1.54 | 5.69 | 2.60 | 1.08 | 6.26 | Accolade II + Trident II was first registered in 2018 and only from 2019 in significant numbers. The risk-adjusted 2-year revision risk exceeds the critical value of 2, but statistical precision is still low. It is noteworthy that early implants from 2018 and 2019 faced a particularly high 2-year revision risk, whereas results for implants from 2020 onwards are at least inconclusive so far. 40% of early revisions were caused by infection, which is an unusually large proportion and may indicate the possibility that the early revision performance of this combination was adversely affected by random events. Recommended course of action: investigate reasons for revision and observe future performance. |
| | **2024** | 2.89 | 1.55 | 5.38 | 2.79 | 1.25 | 6.21 | |
| Symbol + Symbol DMHA/DS evol. | 2023 | 2.62 | 1.31 | 5.23 | 2.40 | 1.19 | 4.81 | Symbol + Symbol DMHA was first registered in 2019 and only in significant numbers in 2020 (only original Symbol DMHA cups were registered in this combination and none of the equivalent DS evolution cups). The risk-adjusted 2-year revision risk has fallen below the critical value of 2 again in this evaluation period and statistical precision is very low. Half of all registered early revisions were due to infections, which is unusually high and raises the possibility that performance was adversely affected by random events in one hospital in particular. Recommended course of action: investigate reasons for revision and observe future performance. |
| | **2024** | 1.91 | 1.03 | 3.56 | 1.80 | 0.97 | 3.36 | |
| 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 dislocations. Recommended course of action: investigate reasons for revision, especially dislocations, and observe future performance. |
| **Hybrid fixation stem/cup combinations (primary osteoarthritis)** | | | | | | | | |
| CCA + RM Pressfit vitamys | 2020 | 1.83 | 0.75 | 4.45 | 1.91 | 0.60 | 6.07 | CCA + RM Pressfit vitamys was not identified as a potential outlier in AR2022 because of lack of statistical certainty. In the current reporting period, it still exceeds the outline boundary with just about sufficient precision in order to be detected as a potential outlier. This combination is still in active use, but it is clearly a borderline case in terms of statistical precision. The number of primary cases has fallen below the reporting threshold of 50. |
| | 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 | |
| PF + Fitmore | 2020 | 0.84 | 0.27 | 2.61 | 1.04 | 0.14 | 7.45 | PF Stems + Fitmore Cups was not actually an outlier combination. The potential outlier status (sitting exactly on the alert level boundary in the Annual Report 2020) was an artefact of only 3 revisions against a very small volume of operations in the reporting timeframe. **Combination is not currently in active use.** |
| Twinsys cemented + RM pressfit | 2019 | | | | | | | This combination is not identified as an outlier anymore. |
| Weber + Alloclassic | 2019 | | | | | | | Not anymore identified as a potential outlier. Active use ended in 2020. **Combination is not currently in active use.** |
| | 2020 | 2.91 | 1.20 | 7.05 | 3.48 | 1.10 | 11.02 | |
| **Uncemented stem-cup combinations (fractures)** | | | | | | | | |
| CLS Spotorno + Allofit | 2022 | 2.18 | 1.20 | 3.95 | 3.48 | 0.94 | 4.81 | This combination is in active use in only a few hospitals. Most revisions are registered by its main user, which leads to the conclusion that the outlier status is a result of a local effect. This combination is not identified as an outlier anymore. |
| | 2023 | 2.09 | 1.15 | 3.79 | 1.97 | 0.78 | 4.45 | |
| Fitmore + Allofit | 2022 | 1.37 | 0.77 | 2.43 | 1.87 | 0.88 | 3.98 | This combination is not identified as an outlier anymore. |
| **Cemented stem-head combinations (fractures)** | | | | | | | | |
| Harmony (cemented) + Symbios bibop | **2024** | 1.75 | 1.14 | 2.68 | 1.53 | 0.79 | 2.98 | The last registered use of this combination was in 2020. **Combination is not currently in active use.** |
| Quadra-C + Medacta bipolar head | **2024** | 1.49 | 0.82 | 2.70 | 1.61 | 0.52 | 5.02 | Quadra-C and Medacta bipolar heads have been in use for some time, but implants from the 2019 to 2021 period have shown unusually high early revision risk. It is noteworthy that 8 out of 11 revisions were due to dislocation. Recommended course of action: investigate reasons for revision, especially dislocations, and observe future performance. |

# SIRIS outlier watch list – knee implants

| Implant or implant combination | Detected as outlier in report | Risk-adjusted hazard ratios for 2-year revision risk: for age and sex HR | lb95% | ub95% | for age, sex, BMI, ASA and Charnley Class (from 2015, if available) HR | lb95% | ub95% | Summary |
|---|---|---|---|---|---|---|---|---|
| **Total knee systems** | | | | | | | | |
| E.motion PS | 2019 | | | | | | | Not anymore identified as a potential outlier. The outlier status in 2019 was caused by early implants. Performance has been improving over time and the last registered primary use was in 2019. **System is not currently in active use.** |
| Journey II | 2019 | | | | | | | It is likely that Journey II was a problematic system in the sense that it registered above average revision rates in several reporting periods, in particular stemming disproportionately from some hospitals and surgeons. However, it was also reported in AR2022 that the revision rates kept improving through the reporting period. This system is not identified as an outlier anymore. |
| | 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 | |
| Physica KR | 2019 | | | | | | | As of 2022, we combined Physica PS and KR into one system in our reporting. It is likely that Physica KR/PS was a problematic knee system at least in the hospital where the majority of implants have been used. The probability of a local hospital effect must be rated as rather high given the evidence. This system is not identified as an outlier anymore. |
| | 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 | |
| Genus | **2024** | 1.93 | 1.00 | 3.71 | 2.10 | 1.00 | 4.41 | The Genus total knee system has in recent years only been in use in one hospital. During the 2019 to 2021 period, when the system was introduced in this hospital, early revision rates were unusually high. The risk-adjusted early revision hazard ratio exceeds the critical value of 2, but statistical precision is very low. The likelihood of a local effect explaining the poor performance must be rated as rather high given the data. Recommended course of action: investigate reasons for revision and observe future performance. |
| Legion | **2024** | 1.60 | 1.36 | 1.87 | 1.35 | 1.05 | 1.73 | The Legion total knee system has been in use for many years and early revision risk is generally within the range of expectations. Legion was detected as a potential long-term outlier in the 2024 reporting round for the first time because the 10-year revision rate exceeded a critical threshold just narrowly (over 15%; the only system in the registry with sufficient numbers reaching this level). It is noteworthy that patella problems and subsequent (secondary) patella components are clearly dominant occurrences. Note that the reported risk-adjusted hazard ratios refer to all implants with full follow-up (not just 2Y). The results of the statistical model would suggest that after risk-adjustment, performance is not quite so elevated as seen in the unadjusted Kaplan-Meier estimates. However, the standard SIRIS model applied may also be misleading somewhat in this case due to violation of modelling assumptions. Recommended course of action: investigate reasons for late revisions and observe future performance. |
| Sigma PS-RP | **2024** | 1.00 | 0.77 | 1.31 | 2.42 | 1.54 | 3.80 | The Sigma PS-RP total knee system was in use from the inception of the SIRIS registry and was gradually phased out from 2017 onwards. Revision performance over the entire time period was almost exactly average and there was certainly no suggestion that it was an outlier system. However, the last implants used between 2018 and 2022 in only a few hospitals exhibited very high early revision rates. The discrepancy between the two risk-adjusted hazard models is an artefact of this development: earlier implants with only age and sex as risk-adjusters were unremarkable in their performance; later implants with BMI, ASA and Charnley as adjusters performed clearly worse than the average. System is not currently in active use. |
| **Partial knee system** | | | | | | | | |
| Journey Uni | 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. Note that the AR2024 reported risk-adjusted hazard ratios refer to all implants with full follow-up (not just 2Y), as the implant is now 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 | |

# List of manufacturers and distributors

**List of companies with implants registered in the SIRIS registry**
2021

| 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 |
| **Exactech International Operation AG** | - | USA |
| **Heraeus Medical Schweiz AG** | Zürich | Germany |
| **Implantcast Suisse SA** | Basel | Germany |
| **Lima Switzerland** | Rotkreuz | Italy |
| **Link Implants AG** | Bern | Germany |
| **Mathys (Schweiz) GmbH, enovis** | Bettlach | Switzerland |
| **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.

**Knee inlay (insert)** Intermediate component of the knee prosthesis. It is made of polyethylene and placed between the femoral and tibial components.

**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 |
| BMI | Body Mass Index |
| CI | Confidence Interval |
| 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 |
| PROMs | Patient Reported Outcome Measures |
| SD | Standard Deviation |
| SHR | Subhazard ratio |
| Sig | Significance |
| TE | Treatment effect |
| THA | Total Hip Arthroplasty |
| TKA | Total Knee Arthroplasty |
| 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 |
| 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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