schweizerisches implantat-register
registre suisse des implants

SIRIS

# Swiss National Joint Registry

## SIRIS Report 2012–2016

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

ano

swiss orthopaedics

UNIVERSITÉ DE GENÈVE

u b

b UNIVERSITÄT BERN

# Hip and knee replacement results

## SIRIS Report 2012–2016
## 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

ano siris swiss orthopaedics UNIVERSITÉ DE GENÈVE b UNIVERSITÄT BERN

# Preface

### Implant registry – what is it for?

More than ever before, it has become an imperative of our time to measure quality and outcome in modern health-care systems as the costs are rising continuously and regulative measures based on evidence are in demand.

To make the quality assessment as objective as possible and a base of comparison for different treatment modalities, registries are one of the tools to allow a standardized evaluation of a large number of patients. Ideally, such registry platforms are run by independent institutions like University institutes, since many currently available databases contain clinical data which are individually programmed and are based on a wide variety of validated and non-validated measurement tools, which make the data comparison difficult or impossible. Compulsory centralized registries run and evaluated by experts with an academic research background are a solution to this problem.

By collecting information about both standard (comparator) and more innovative medical methods in the registry, it is possible to make an objective assessment of the results.

Furthermore, an implant registry is also an early warning system to recognize implants that are rejected as a result of production or design faults. As this is a very rare occurrence due to the quality of modern implants, it can usually only be recognized, by means of a long-term analysis of large numbers and may finally lead to the removal of the implant from the market.

Together with its partners, SIRIS has reached an impressive level of performance within a fairly short space of time and delivers data that may help to make meaningful decisions in the future Swiss health-care environment which are supported by evidence and a broad consensus of all involved players. It is the intention of all involved parties to constantly improve this data collection and evaluation, therefore registries are part of a dynamic process and not static data collectors.

This and the recent recommendations of the Swiss Academy of Science concerning medical registry should encourage other medical disciplines to finally establish equivalent registries instead of reinventing the wheel.

**Prof. Max Aebi**
President of the Foundation for Quality Assurance in Implant Surgery, SIRIS – Swiss National Implant Registry, Hip and Knee

## Increase in content

The SIRIS implant registry is developing very well. The content of the second SIRIS report 2012–2016 proved to be even more informative than the previous report. Additional analyses have enhanced the registry data and show a nuanced picture of the hip and knee implants conducted to date.

This positive development is largely thanks to the focused dedication of the team of writers headed by Prof.Pierre Hoffmeyer and Prof.Anne Lübbeke-Wolff. Prof. Martin Beck, expert for hip implants, and Dr. Bernhard Christen, expert for knee implants, were added to the existing team, and provided substantial support in creating the report.

The annual report's increase in content in turn increases the importance of the implant registry. The professional association swiss orthopedics (SO) is promoting the active use of SIRIS data by its members, and the registry will be a major topic at the annual SO conference in June 2018. The ANQ would like to thank the team of writers, the SIRIS foundation and the professional association for their valuable support.

**Thomas Straubhaar**
President of the National Association for the Development of Quality in Swiss Hospitals and Clinics (ANQ)

# Synopsis

## Introduction

Since the start of the Swiss National Joint Registry (SIRIS) in September 2012, 86'830 total hip arthroplasties, including primary and revision operations, have been recorded. The numbers oscillate between 19'120 procedures in 2013 and 20'731 in 2016. Revisions represent 12.1% of all total hip arthroplasty procedures.

Regarding knee arthroplasties, 75'467 entries have been reported since September 2012. The number of interventions increased from 16'519 primary and revision operations performed in 2013 to 18'693 in 2016. The revision burden over the entire period was 9.8%.

## Total hip arthroplasty

With regard to primary total hip arthroplasty, 52% were performed in women, two-thirds of interventions occurred in patients aged over 65 years (the mean age of the entire cohort being 68 years), and 24% of patients were obese.

In 2016, for total hips with primary osteoarthritis, the anterior approach was used in 43% of cases, while the antero-lateral approach was used in 33% of cases, lateral in 8% and the posterior approach in 15% of cases. In patients with osteoarthritis, 86% of the primary total hip arthroplasties used were uncemented.

For all revisions of hip arthroplasties, the main causes were aseptic loosening of the femoral and/or acetabular component (41%), infection (18%), periprosthetic fracture (15%) and dislocation (12%). In 22% of cases the revision included the exchange of both the acetabular and femoral component.

Since 2012, 1.9% of patients with primary total hip arthroplasty have had revisions performed within 12 months. It is interesting to note that the main cause for these early revisions was periprosthetic fractures followed by infection and dislocation.

## Hemiarthroplasty of the hip

Hemiarthroplasties of the hip concern fractures of the femoral neck or, more rarely, intertrochanteric fractures. Compared to the 86'830 total hip arthroplasties implanted between 2012 and 2016, the number of hemiarthroplasties was much lower, accounting for 8'776 interventions. It is important to note that the patients receiving these implants were much older (a mean age of 84 years) and frailer, many having underlying conditions such as osteoporosis and sarcopenia.

In contrast to the recipients of total hip arthroplasties, the proportion of obese patients was low (8% compared to 24%). Women constituted 72% of the recipients, and the operation generally followed a low-energy fall or traumatic event.

## Knee arthroplasty

With regard to primary arthroplasties of the knee, 61% occurred in women, 69% of the interventions were performed in patients aged over 65 years (compared to the mean age of the entire cohort of 69.2 years), and 39% of patients were obese. Primary osteoarthritis was the main diagnosis in 88% of cases in 2016, and 35% of patients had had previous surgery, with arthroscopic exploration and meniscectomy accounting for 34% of all previous interventions. Twenty-four percent of the interventions were reported as being computer assisted or using patient-specific instrumentation. In more than 75% of procedures, an all-cemented component fixation was reported in 2016. Patellar components were used only in one in four cases.

Primary unicompartimental prostheses accounted for 9'709 cases between 2012 and 2016, constituting 14.3% of primary knee arthroplasties. Of the total number of operations, 51% were performed in women and the mean age at surgery was 65 years. Thirty-one percent of the patients were obese. Primary osteoarthritis was the diagnosis in 92% of cases. The data show that 40% of the patients had had previous surgery, with knee arthroscopy and meniscectomy accounting for 46% of the total. Of these operations, 87% were medial, 6% were lateral and 7% patellofemoral component replacements. In more than 80% of cases an all-cemented component fixation was used.

Among all revision knee arthroplasties, patella problems were the leading cause for revision with 21.8%, followed by loosening of the tibial component in 20.2%, and infection in 18% of the cases. In 34.2% both tibial and femoral side were revised.

Since 2012, 2.0% of patients with primary total knee arthroplasty have been revised within 24 months. Patella problems constituted the main reason for an early revision, followed by infection and pain.

## Strong commitment

The 2016 SIRIS report represents a collaborative data collection effort involving all the institutional partners of SIRIS, and including the surgeons and operating teams in 156 clinics and hospital services. Streamlining, improving and optimizing the data collection is a work in progress involving expert groups and all stakeholders, including the industrial partners.

Overall, the response rate of the hospitals and clinics for sending data has been remarkable. Although the registry officially only started in 2012, it has already enjoyed a response rate of over 96% of the involved institutions.

This demonstrates not only the strong commitment to the project by the surgeons and their teams both in public and private institutions, but also the high quality of the organization, coaching, and data collection of the SIRIS team. The report provides factual information on the state of hip and knee replacements in Switzerland and presents a wealth of new information. The report also offers important and verifiable information that the health-care community, third-party payers, and health-care regulators will find useful.

# Acknowledgements


## SIRIS Scientific Advisory Board

**Prof. Pierre Hoffmeyer, MD**
Emeritus Professor, University of Geneva

**Prof. Anne Lübbeke-Wolff, MD, DSc**
SIRIS Scientific Advisory Board leader,
Author of the scientific SIRIS-Report,
Epidemiologist, Lead Geneva Arthroplasty Registry,
Division of Orthopaedic Surgery and Traumatology,
Geneva University Hospitals

**Prof. Martin Beck, MD**
Surgeon in Chief, Orthopaedic division
Canton Hospital of Lucerne,
swiss orthopaedics, Hip Expert Group
Author of the scientific SIRIS-Report

**Dr. Bernhard Christen, MD, M.H.A.**
Christenortho AG, swiss orthopaedics,
Knee Expert Group
Author of the scientific SIRIS-Report

## SIRIS Expert Group

**Prof. Claudio Dora, MD**
Schulthess Clinic, Zurich, Senior Consultant Hip Surgery, SIRIS Board Member

**Regula Heller, MNSc, MPH**
Chair Akutsomatik ANQ
Lead and moderation SIRIS Expert Group

**Peter Liniger**
Johnson & Johnson AG, SIRIS Board Member

**Andreas Mischler**
conidea GmbH, SIRIS Administration Lead

**Jasmin Vonlanthen**
User support for SIRIS Hip and Knee, SwissRDL, ISPM, University of Berne

**Dr. Peter Wahl, MD**
Staff surgeon, Division of Orthopaedics and Traumatology, Cantonal Hospital Winterthur

**Dr. Christian Westerhoff, MD**
Chief Clinical Officer Hirslanden,
Member QA Akutsomatik ANQ

## SwissRDL, ISPM, University of Bern

**Adrian Spörri, PhD, MPH**
Head of SwissRDL, Statistical Analysis,
Data Linkage and Research, SIRIS Expert Group

**Fabio Giudici, MSc**
Statistical Analysis and Research

## Partner associations of SIRIS

**ANQ**
National Association for the Development of Quality in Swiss Hospitals and Clinics, info@anq.ch

**Hplus**
Association of the Hospitals of Switzerland
geschaeftsstelle@hplus.ch

**Swiss Medtech**
Association of the Swiss Medtech Industry
office@swiss-medtech.ch

**santésuisse**
Association of Swiss Medical Insurers
mail@santesuisse.ch

**swiss orthopaedics**
Swiss Society of Orthopaedics and Traumatology
welcome@swissorthopaedics.ch

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 2012–2016.

**Foundation for quality assurance in implant surgery – SIRIS**
c/o Conidea GmbH, 3604 Thun
info@siris-implant.ch, www.siris-implant.ch

# Contents

# 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 performance at a specific hospital to the mean performances of hospitals throughout Switzerland helps hospitals to learn from each other

**Bilaterality** Replacing the same joint on both sides of the body (typically both hips or knees) by means of a prosthesis within a specific period

**Body Mass Index** ‹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** The combined incidences over a specific period of an event (such as the revision of a prosthesis or death of a patient)

**Cumulative revision percentage** Combined 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 (often 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 or the cup of the hip joint

**Inlay (insert)** Intermediate component (inner layer), made of polyethylene, 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

**Knee insert** Intermediate component (inner layer), made of polyethylene, which is placed in the tibial component of a knee prosthesis

**Lateral collateral ligament** Lateral (outer) knee ligament

**Malalignment** Strain on a part of the body due to an abnormal position of a joint component with respect to other components

**Meniscectomy** Meniscus removal

**Metallosis** Deposition of metal debris in soft tissues of the body

**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** Incision of the bone 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 (primary) a prosthesis is implanted to replace the original joint

**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 the proximal component is cemented and the distal component is uncemented

**Revision arthroplasty** Any exchange (insertion, replacement and/or removal) of one or more components of the prosthesis

**Revision burden** Ratio of revision procedures to all (primary and revision) 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 or ankle 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** Resurfacing of half the knee (either inner or outer side) by a prosthesis

**Abbreviations**

| | |
|---|---|
| **ASA** | American Society of Anaesthesiologists |
| **BMI** | Body Mass Index |
| **CI** | Confidence Interval |
| **CRF** | Content Report Form |
| **PROMs** | Patient Reported Outcome Measures |
| **SD** | Standard Deviation |
| **THA** | Total Hip Arthroplasty |
| **TKA** | Total Knee Arthroplasty |
| **UKA** | Unicompartmental Knee Arthroplasty |

# 1. Introduction

## 1.1 Purpose of the registry

The Swiss National Implant Registry, Hip and Knee (Schweizerisches Implantat Register – Registre Suisse des Implants; SIRIS) was formally introduced and started the registration in September 2012. Participation in the activity of SIRIS became compulsory for all hospitals and clinics performing knee and hip arthroplasties and that had signed the National Quality agreement of ANQ, i.e. practically all Swiss hospitals and clinics.

SIRIS is a national registry whose goal it is to help oversee the safety and effectiveness of the various implanted arthroplasties and to detect as early as possible potential problems related to inferior implant performance. For the industrial partners, SIRIS should serve as a post-marketing surveillance instrument so as to allow the industry to track the performance of their implants over the long term. Moreover, each hospital and each surgeon can compare their own data with the complete dataset and evaluate their results against the overall results found in the registry. The aim is to use the knowledge gained from the data collected by SIRIS to improve the quality of care in Swiss hospitals and clinics.

The mission of a national joint registry needs to be clearly defined so that all stakeholders and participants strive towards a common goal. This also influences the granularity of the information contained in the registry as this will be quite a different requirement for each of the involved partners. The fact that a multi-partner association was needed to get SIRIS off the ground and flying signified that more than one point of view had to be taken into consideration if success were to be achieved. Although all the motivations pertaining to the significance of registries apply to all the partners involved, each partner tends to focus more on a particular aspect.

Patients expect their implant to provide them with a long lasting, pain-free result. The operation must be adapted to their level of activity and should be tissue sparing and complication-free, followed by rapid rehabilitation. The registry data should be presented in such a way as to be readily comprehensible, allowing patients to distinguish between fact and fiction in the «jungle» of orthopaedic arthroplasty implants.

Surgeons are primarily concerned with avoiding surgical complications and shortcomings in their individual patients. The implants must be impeccable in their manufacture, versatile and avoid problems such as early loosening, particle disease, breakage, dislocation, infection, stiffness, or chronic pain. A long, problem-free implant life with a minimum amount of wear of the bearing surfaces is the ultimate goal. The registry should identify in a relatively short time frame the problematic implants as well as the reliable ones. Surgeons are essentially motivated by their own individual clinical results to enter proper and complete information into the data collection system with minimal interference in their daily activities. Surgeons will also want to benchmark their own results as compared to the overall results for each implant, technique, and patient or disease category. A moot question is the public availability of information at the individual surgeon level. This may lead to bias entering into the system by encouraging some surgeon groups to avoid complex or complication-prone patients, who are then left to seek treatment in publicly funded institutions.

The industry's main focus is on manufacturing and sales. Designing and providing a first-rate, problem-free implant system is its primary goal. Progress and technical innovation are also powerful motivators for an industry dedicated to providing high-performance implants. The registry is seen as an essential tool for post-market surveillance and

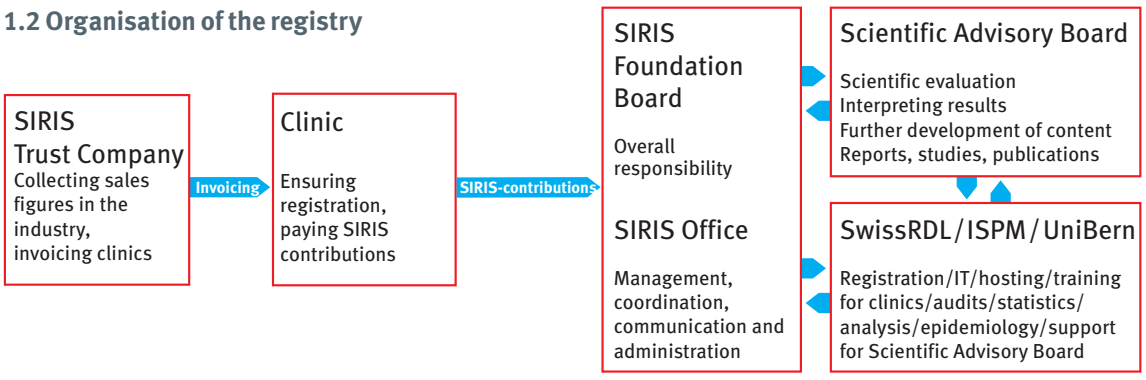
clinical control that justifies improvements in materials, design, and concepts. The down-side is that overregulation may hinder efforts at innovation, thereby missing opportunities to create better and safer products.

Hospitals aim to provide excellent and safe care, at a reasonable cost, to a large number of patients. Hospitals want to avoid the expenditures and hazards related to implant systems of uncertain reliability and value. The registry is perceived as a quality control instrument, not only of the implants used, but of the whole chain of its clinical organization, ranging from the preoperative consultation, to the procedures in the operating room and to the post-operative follow-up. Hospitals, being health-care-providing institutions in today's competitive environment, are also very keen to uphold their reputation and a registry is an invaluable tool for this purpose.

Insurers and third-party payers want minimal delays and waiting times for employed patients, short hospitalization times, no expensive re-admissions for complications, and a quick return to work. Insurers are very cost-conscious when it comes to implant pricing, medical honorarium, and hospital bills. The insurers'wish is to provide equal benefits for all their clients within the budget available to them. The registry is therefore perceived as an instrument for quality control of surgeons and institutions and also a cost-control tool.

The government is concerned with the welfare of the whole population. It therefore needs data on the overall surgical activity for public health purposes, for needs assessments, and for planning the macroeconomic policies related to health care. Government agencies are keen to ensure that the institutions under their supervision provide high-quality and complication-free health care to the overall population. The agencies will also have an interest in benchmarking hospitals and in keeping insurance and third-party payer costs down to a minimum. Health agencies also play an important role in supervising implant systems as they seek to guarantee that the industrial specifications of nationally manufactured and imported implants are safe and reliable for public usage.

### 1.2 Organisation of the registry



# 2. Methods

## 2.1 Maintenance and hosting of the registry

The Swiss National Implant Registry, Hip and Knee (SIRIS) is hosted and maintained by SwissRDL at the Institute for Social and Preventive Medicine ISPM, University of Bern. A dedicated team consisting of a project manager, data management specialists, statistician and an epidemiologist is responsible for the management and maintenance, technical support and reporting and analyses of the registry. A data monitor oversees the data entry at the hospitals and supports and trains the collaborators at the participating hospital services to ensure the smooth and efficient conduct of the registry.

SIRIS data are collected on the online documentation platform MEMdoc (accessible on www.siris- doc.ch). Clinical data on primary and revision operations as well as implant data are recorded. The current used version of the SIRIS forms for data entry can be downloaded from www.siris-implant.ch. Most participating hospital services use the online interface when documenting their operations, while a small minority sends completed paper forms to SwissRDL for processing. As a third data entry method, two large services send data exports from their hospital information system via web service client to SwissRDL.

Implants are entered into SIRIS by scanning the bar codes of the implant tags in the operation room in most participating facilities. It is also possible to enter the information manually via the web interface.

The clinical data of the SIRIS registry is stored on dedicated servers at the University of Bern. SwissRDL is able to leverage the IT infrastructure of the ISPM and the data protection resources of the University. The ISPM IT team is responsible of roughly 30 physical servers and 120 virtual servers. The clinical data of SIRIS is stored physically separated from the patient identifying information (e.g. medical record number, name and date of birth), which is stored on a specific module server. The identifying information is encrypted into a salted hash code, which allows to identify patients who receive the revision of the primary implantation at a different health facility. This is needed for the calculation of revision rates and for the constant follow-up of the implants.

SwissRDL data protection was audited recently to ensure compliance with current standards. The methodology of splitting the clinical from the patient identifying information was reviewed and approved by data protection delegates (from the canton of Bern and from the Federal Authority). Patients must provide written informed consent before data are entered into SIRIS. They have the right to withdraw, to see what is stored and to have their data deleted completely.

## 2.2 Definitions

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 other secondary procedures, where no components of the primary implantation are removed, are reoperations.

Revision burden: One measure commonly used to estimate the quality of arthroplasty surgery in a health-care system is the revision burden, defined as the ratio of revision procedures to all (primary and revision) arthroplasty procedures. In this report, we calculated the revision burden separately for total hip arthroplasties, hemiarthroplasties of the hip and total knee arthroplasties.

Kernel density estimation: The simplest form of non-parametric density estimation is the histogram. It is helpful to depict the frequency of a variable using bins (= widths of the bars). One of the drawbacks is that we can't show several histograms in one graph without messing up the bars. A solution is using non-parametric kernel density estimation. The underlying kernel can be Gaussian. Kernel density estimations are used to show the density (=degree of compactness; on y-axis) of a variable (e.g. age; on x-axis) for different subgroups (e.g. BMI) in one simple graph.

Hospital service volumes: In the tables depicting the case mix of arthroplasty populations, four categories of hospital service volume (‹100, 100–199, 200–299, 300+ procedures per year) were used. 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 2013–2016.

### 2.3 Data quality and completeness

Data for this report were exported from the database on November 1st 2017. The consistency and completeness of SIRIS data is checked through systematic software-generated validation tests of received data and a rollback in case of errors. This means that data entered in the registry is checked both for completeness and plausibility. For example, when a case of developmental hip dysplasia is entered, the system automatically checks that subsequent items on the questionnaire relevant for this pathology are completed and plausible. Error messages are displayed if the system detects missing or implausible information, and only fully completed forms can be saved and submitted to the central database.

It is not possible to distinguish between a revision of a total and an unicompartmental knee arthroplasty when the primary arthroplasty was performed before September 2012 (except when the conversion from unicompartmental to TKA was indicated as reason for revision). The same applies to hemiarthroplasties of the hip.

Two case report form (CRF) versions have been used in SIRIS. The first version was used between 2012 and 2014. Since January 2015, an updated version has been used. It includes some changes in the definition of existing variables (particularly for the arthroplasty of the knee), and some new variables were added, most notably the body mass index (BMI) and the morbidity state (ASA). The latter allows the answer "unknown", which was inconsistently used across hospital service-providers, including one service reporting unknown ASA status in almost all cases. Close monitoring of the hospitals will be set in place to reduce missing values, for example for BMI and ASA.

### 2.4 Coverage

To estimate the coverage of SIRIS, we compared the annual numbers of cases reported in the registry with those available in the Swiss hospital discharge master file of the Federal Statistical Office (FSO). This encompasses a complete survey of all annual hospital discharges in Switzerland. Each entry represents a hospital discharge of a person residing in Switzerland and includes information about socio-demographic patient characteristics, diagnosis and treatment.

In the Swiss hospital discharge master file, cases of an arthroplasty surgery are identified using the CHOP treatment classification of the FSO, which is

an ICD-9-CM-based treatment classification. For primary THA we used 81.51.1, for hip revision surgery 81.52.2, 81.52.4 and 81.52.5. For the knees we used for the primary TKA 81.54.21, 81.54.22, 81.54.23, 81.54.25 and for knee revision surgery 81.54.31, 81.54.32, 81.54.33, 81.54.35 and 81.54.4.

The overall coverage of SIRIS was 90.1% percent in 2015, and 89.4% percent in 2016 for THA and 88.0% in 2015 and 87.8% in 2016 for TKA. Note that different sources of information have been used for this estimation and the case definition for FSO and SIRIS are not identical.

# 3. Commentary on the SIRIS report 2012–2016

SIRIS, together with and thanks to all the partners, has been successful in implementing nationwide data collection on hip and knee arthroplasties. The present report covers all recorded hip and knee arthroplasties from September 2012 to December 2016. Less than 3% of the centers sent partial information. The data available currently allow us to describe quantitatively, and realistically, the epidemiology of knee and hip arthroplasties implanted in Switzerland.

Since SIRIS is now in its fifth year of data collection, it is possible to analyze early revisions, which has provided the first valuable indication of the global quality of Swiss health-care services in this area. Moreover, the initial high levels of completeness of the case-mix variables of BMI and ASA score introduced in 2015 has further increased in 2016. However, additional efforts are necessary to achieve complete coverage. This is particularly important because the registry is increasingly moving further toward comparative analyses, which will be made even more valuable with adequate and accurate case-mix adjustment.

The continuing work on the present report has enabled analysts to identify the registry's strengths and weaknesses – a step that is essential for future improvement of registry coverage, data content, structure, accuracy, completeness, analysis, and interpretation. SIRIS, in its present form, cannot answer all the queries posed by the different stakeholders. Some questions are related to medium- and long-term follow-up, whereas today the registry can only provide information from 2012 onward. The granularity and accuracy of the information is dependent on the information that the registry receives from the hospitals and clinics.

The process of gaining access to nation-wide mortality data is underway in order to calculate implant survival rates as mortality is the major risk along with implant failure. This data will be available in a future edition of the report. Ongoing modifications and improvements to the structure and content of the data-entry sheets are another important aspect. This will be an important task in the coming years, which will involve the Swiss Orthopaedics Expert Groups. Of course, input from all stakeholders is also being encouraged.

SIRIS cannot successfully answer all these challenges by its own means. As an organization it must benefit from and contribute to, the international family of registries that exist around the globe. Since December 2017, SIRIS is a full-standing member of the International Association of Arthroplasty Registries (ISAR), a global consortium of joint replacement registries throughout the world.

# 4. Overview of SIRIS

Table 1
### Total hip arthroplasty
Overall number of documented operations

| Year | Primary total | Revision total | Total |
|---|---|---|---|
| **2012** | 6652 | 863 | 7515 |
| **2013** | 16888 | 2234 | 19122 |
| **2014** | 17155 | 2463 | 19618 |
| **2015** | 17359 | 2485 | 19844 |
| **2016** | 18232 | 2499 | 20731 |
| **All** | **76286** | **10544** | **86830** |

Figure 1
### Distribution of age at surgery for total hip arthroplasty and hemiarthroplasty of the hip
All documented operations

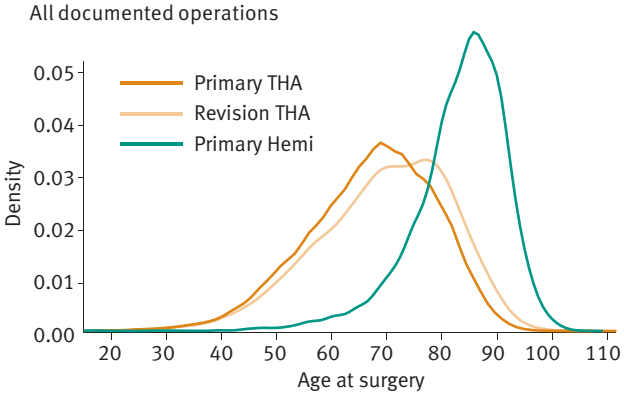



Table 2
### Hemiarthroplasty of the hip
Overall number of documented operations

| Year | Primary hemi-arthroplasty | Conversion to total hip arthroplasty | Total |
|---|---|---|---|
| **2012** | 639 | 37 | 676 |
| **2013** | 1927 | 54 | 1981 |
| **2014** | 2039 | 54 | 2093 |
| **2015** | 1964 | 60 | 2024 |
| **2016** | 1958 | 44 | 2002 |
| **All** | **8527** | **249** | **8776** |

Table 3
### Total and partial knee arthroplasty
Overall number of documented operations

| Year | Primary total | Primary partial | Revision | Total |
|---|---|---|---|---|
| **2012** | 4731 | 852 | 529 | 6112 |
| **2013** | 12927 | 2147 | 1464 | 16538 |
| **2014** | 13263 | 2091 | 1605 | 16959 |
| **2015** | 13153 | 2278 | 1734 | 17165 |
| **2016** | 14265 | 2341 | 2087 | 18693 |
| **All** | **58339** | **9709** | **7419** | **75467** |

Figure 2
### Distribution of age at surgery by total and partial knee arthroplasty
All documented operations

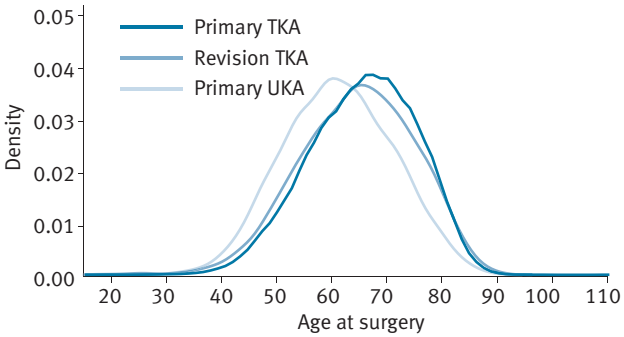


Table 4

**Number of participating hospital services (N) and maximum number of procedures per service per year (Max N)**

| | | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **Primary total hip arthroplasty** | N services | 130 | 151 | 150 | 152 | 158 |
| | Max N procedures per service | 384 | 743 | 741 | 719 | 819 |
| **Revision of total hip arthroplasty** | N services | 98 | 131 | 132 | 139 | 144 |
| | Max N procedures per service | 100 | 234 | 241 | 146 | 149 |
| **Primary hemiarthroplasty of the hip** | N services | 101 | 126 | 129 | 134 | 128 |
| | Max N procedures per service | 44 | 102 | 103 | 91 | 112 |
| **Conversion of hemiarthroplasty of the hip** | N services | 24 | 37 | 39 | 41 | 32 |
| | Max N procedures per service | 4 | 5 | 4 | 5 | 3 |
| **Primary arthroplasty of the knee** | N services | 127 | 147 | 149 | 151 | 150 |
| | Max N procedures per service | 437 | 864 | 878 | 944 | 889 |
| **Primary unicompartmental knee arthroplasty** | N services | 89 | 117 | 123 | 125 | 129 |
| | Max N procedures per service | 90 | 183 | 179 | 171 | 170 |
| **Revision arthroplasty of the knee** | N services | 88 | 123 | 127 | 126 | 131 |
| | Max N procedures per service | 51 | 112 | 121 | 100 | 122 |

Table 5

**Number of hospital services and number of procedures according to hospital service volume**

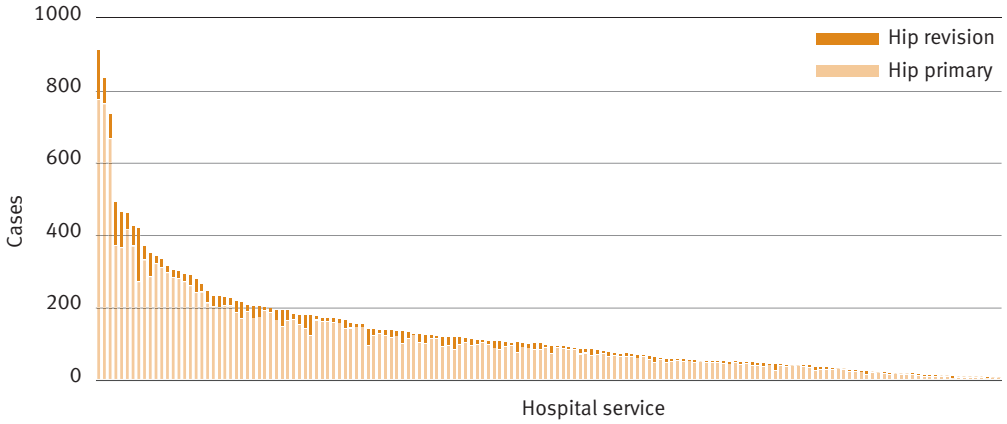
2012–2016

| | | <25 | 25–49 | 50–99 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|---|---|
| **Primary total hip arthroplasty** | N services | 38 | 28 | 35 | 47 | 13 | 11 |
| | N procedures | 1325 | 3649 | 10289 | 26592 | 13159 | 21272 |
| **Primary knee arthroplasty** | N services | 45 | 27 | 38 | 33 | 15 | 5 |
| | N procedures | 1857 | 4034 | 10900 | 17577 | 14079 | 9892 |

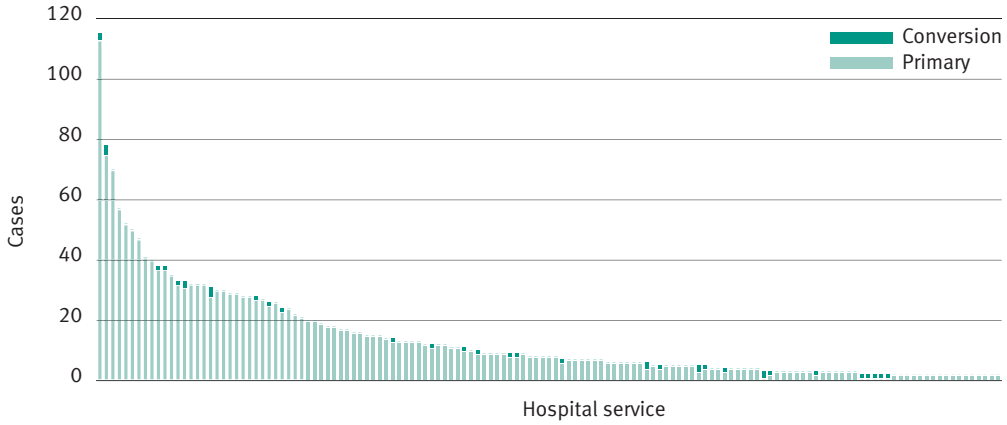
Figures 3 a, b and c

**Cases per hospital service**

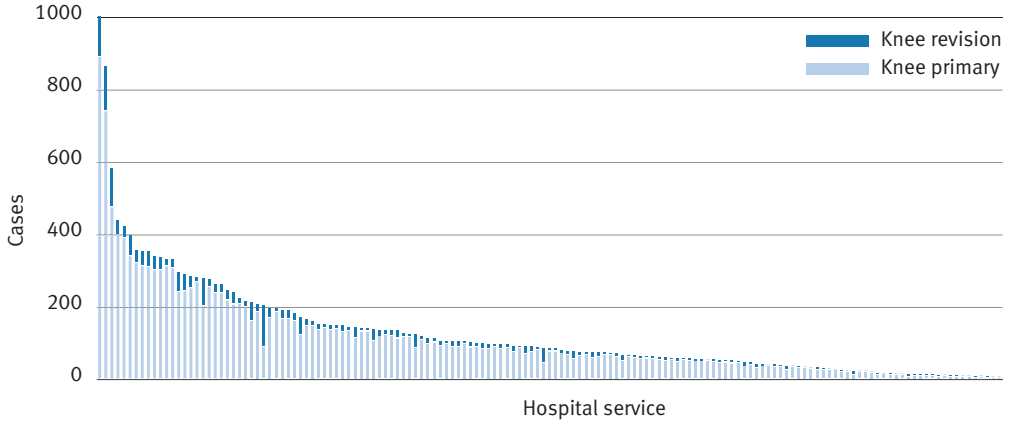
3a
Total hip arthroplasty




3b
Hemi-arthroplasty of the hip




3c
Knee arthroplasty



# 5. Hip arthroplasty

## 5.1 Primary total hip arthroplasty

The SIRIS registry has documented the implantation of 76'286 primary THAs since its start in 2012 (Table 6). Implantation is slightly more frequent in women (52.4%), and their mean age of 68.2 years is higher than in men (66.2 years).

The majority are implanted between 55 and 84 years of age. Only 6% are implanted in patients older than 85 years. Patients younger than 45 years constitute 12.4% of the recipients. The distribution among the age groups remained stable during the observation period.

Table 6

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

2012–2016. BMI and ASA class data only available from 2015 onwards

| Baseline patient characteristics | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| N | | **6652** | **16888** | **17155** | **17359** | **18232** | **76286** |
| Diagnosis (%) | Primary OA | 86 | 85.4 | 85.6 | 84.3 | 83.4 | 84.8 |
| | Secondary OA | 9 | 9 | 8.2 | 9.4 | 10.1 | 9.2 |
| | Fracture | 5 | 5.6 | 6.2 | 6.3 | 6.4 | 6.1 |
| Women (%) | | 50.5 | 52.2 | 52.5 | 52.6 | 52.9 | 52.4 |
| Mean age (SD) | All | 67.2 (12.3) | 67.9 (12.1) | 68.3 (12.2) | 68.6 (11.6) | 68.4 (11.6) | 68.2 (11.9) |
| | Women | 68.9 (12) | 69.7 (11.8) | 70 (11.9) | 70.4 (11.3) | 70.2 (11.2) | 70 (11.6) |
| | Men | 65.6 (12.3) | 65.9 (12.1) | 66.4 (12.2) | 66.6 (11.7) | 66.4 (11.6) | 66.2 (12) |
| Age group (%) | ‹45 | 3.9 | 3.3 | 3.2 | 2.6 | 2.8 | 3.1 |
| | 45–54 | 10 | 9.9 | 9.2 | 9.8 | 9.5 | 9.6 |
| | 55–64 | 23.3 | 21.9 | 21.3 | 21.3 | 21.6 | 21.7 |
| | 65–74 | 32.7 | 33.5 | 33.4 | 33.6 | 34.2 | 33.6 |
| | 75–84 | 25.2 | 25.5 | 26.6 | 26.1 | 25.7 | 25.9 |
| | 85+ | 4.9 | 5.8 | 6.2 | 6.6 | 6.3 | 6.1 |
| BMI unknown (N/%) | | | | | 4480/25.8 | 3775/20.7 | 8255 |
| BMI known (N) | | | | | 12879 | 14457 | 27336 |
| Mean BMI (SD) | | | | | 27.1 (5) | 27.2 (5.4) | 27.1 (5.3) |
| BMI (%) | ‹18.5 | | | | 1.8 | 1.8 | 1.8 |
| | 18.5–24.9 | | | | 35.1 | 34.9 | 35 |
| | 25–29.9 | | | | 38.8 | 39.3 | 39.1 |
| | 30–34.9 | | | | 17.2 | 17.4 | 17.3 |
| | 35–39.9 | | | | 5.4 | 4.9 | 5.1 |
| | 40+ | | | | 1.7 | 1.7 | 1.7 |
| ASA unknown (N/%) | | | | | 2391/13.7 | 2224/12.2 | 4615 |
| ASA known (N) | | | | | 14968 | 16008 | 30976 |
| ASA state (%) | ASA 1 | | | | 16.4 | 14.7 | 15.5 |
| | ASA 2 | | | | 58.2 | 59.5 | 58.9 |
| | ASA 3 | | | | 24.8 | 25 | 24.9 |
| | ASA 4/5 | | | | 0.6 | 0.8 | 0.7 |

Table 7

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

BMI and ASA class data only available from 2015 onwards

| Baseline patient characteristics | | Primary OA | Secondary OA | Fracture |
|---|---|---|---|---|
| N (2012-2016) | | **64670** | **7000** | **4616** |
| Women (%) | | 50.9 | 56.5 | 66.4 |
| Mean age (SD) | All | 68.3 ( 11.3) | 63.2 ( 15.5) | 73.7 ( 11.5) |
| | Women | 70.1 ( 10.9) | 65.4 ( 15.4) | 74.6 ( 11.2) |
| | Men | 66.5 ( 11.4) | 60.4 ( 15.1) | 72 ( 11.9) |
| Age group (%) | ‹45 | 2.2 | 12.1 | 1.1 |
| | 45–54 | 9.2 | 17.4 | 4.5 |
| | 55–64 | 22.3 | 20.8 | 13.9 |
| | 65–74 | 35.1 | 22.7 | 29.3 |
| | 75–84 | 26 | 20 | 33.8 |
| | 85+ | 5.2 | 7 | 17.5 |
| Diagnosis (%) | Osteoarthritis | 100 | | |
| | Inflammatory arthritis | | 5.8 | |
| | Developmental dysplasia | | 21.6 | |
| | Osteonecrosis | | 54 | |
| | Miscellaneous | | 18.6 | |
| | Fracture | | | 100 |
| N (2015-2016) | | **29781** | **3461** | **2264** |
| Unknown BMI (N/%) | | 6829/22.9 | 661/19.1 | 680/30.0 |
| Known BMI (N) | | 22952 | 2800 | 1584 |
| Mean BMI (SD) | | 27.4 (5.1) | 26.7 (6) | 24.2 (4.7) |
| BMI (%) | ‹18.5 | 1.2 | 3 | 9.3 |
| | 18.5–24.9 | 33.2 | 39.2 | 53.5 |
| | 25–29.9 | 40.3 | 35.6 | 26.8 |
| | 30–34.9 | 18.1 | 15.9 | 8.1 |
| | 35–39.9 | 5.4 | 4.5 | 2 |
| | 40+ | 1.8 | 1.8 | 0.4 |
| Unknown ASA (N/%) | | 3922/13.2 | 352/10.2 | 256/11.3 |
| Known ASA (N) | | 25859 | 3109 | 2008 |
| Morbidity state (%) | ASA 1 | 15.9 | 17.7 | 7.5 |
| | ASA 2 | 60.6 | 52.1 | 46.8 |
| | ASA 3 | 23.1 | 28.6 | 42.7 |
| | ASA 4/5 | 0.4 | 1.5 | 3 |

The BMI and morbidity state (ASA class) results are recorded since 2015. However, data for BMI is missing in 23% and for ASA class in 12% of cases, due to incomplete data reporting. The mean BMI was 27.1 kg/m$^2$. Of the total number of interventions, 39% were performed in overweight patients and 24% in obese patients. Obesity is more frequent in younger patients. Increasing BMI of the patient was associated with younger age at surgery (Figure 4). The majority of procedures are performed on healthy individuals; 25% of the implantations are performed in ASA class ≥3.

With regard to the main diagnostic groups (Table 7), women are older and more frequently treated for fractures. Overall, 80% of the patients treated for a fracture are older than 65 years and 50% of the patients are older than 75 years. There is also a much higher proportion of patients in the fracture group belonging to ASA class ≥3.

Figure 4

**Primary total hip arthroplasty: BMI in relation to age (Kernel density estimation)**

(Primary and secondary osteoarthritis patients only)

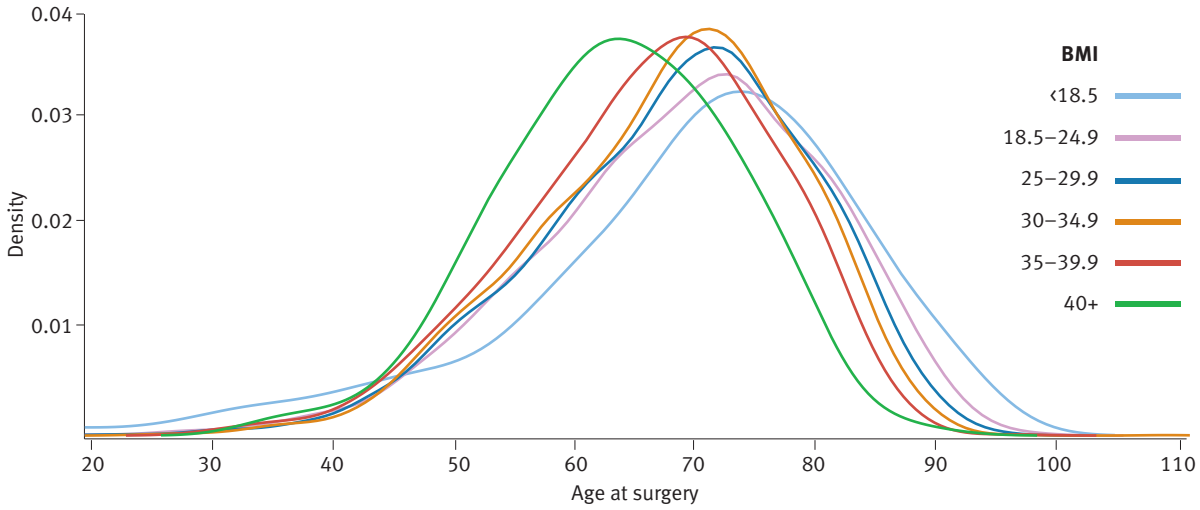


Table 8

## Baseline characteristics of primary total hip arthroplasty patients by hospital service volume

Calculations of hospital service volume based on all primary and revision hip surgeries in 2016.
BMI and ASA class data only available from 2015 onwards

| Hospital service volume | | <100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| N (2012-2016) | | **15263** | **26592** | **13159** | **21272** |
| Women (%) | | 52 | 52.6 | 52.3 | 53.7 |
| Mean age (SD) | All | 69.1 (12) | 68.2 (11.7) | 68.4 (11.5) | 67.4 (12.3) |
| | Women | 71 (11.7) | 70 (11.4) | 70.4 (10.8) | 69 (12.1) |
| | Men | 66.9 (11.9) | 66.3 (11.7) | 66.4 (11.8) | 65.5 (12.3) |
| Age group (%) | <45 | 2.5 | 2.8 | 2.4 | 4.2 |
| | 45–54 | 8.5 | 9.7 | 8.7 | 10.9 |
| | 55–64 | 20.6 | 21.9 | 21.6 | 22.2 |
| | 65–74 | 33.5 | 33.4 | 35.8 | 32.5 |
| | 75–84 | 28 | 26.1 | 26.2 | 24.1 |
| | 85+ | 7 | 6 | 5.3 | 6.2 |
| Diagnosis (%) | Primary OA | 83.8 | 85.7 | 88.9 | 81.8 |
| | Secondary OA | 9.2 | 8.2 | 7.3 | 11.6 |
| | Fracture | 7 | 6.1 | 3.9 | 6.6 |
| N (2015-2016) | | **6993** | **12695** | **6012** | **9806** |
| Unknown BMI (N/%) | | 2063/29.5 | 3047/24.0 | 1989/33.1 | 1071/10.9 |
| Known BMI (N) | | 4930 | 9648 | 4023 | 8735 |
| Mean BMI (SD) | | 27.2 (5.1) | 27.4 (5.4) | 27.1 (5.5) | 26.9 (5) |
| BMI (%) | <18.5 | 1.8 | 1.6 | 1.8 | 2.1 |
| | 18.5–24.9 | 34.6 | 33.4 | 35.5 | 36.7 |
| | 25–29.9 | 38.8 | 39.5 | 39.7 | 38.5 |
| | 30–34.9 | 17.7 | 18 | 16.8 | 16.5 |
| | 35–39.9 | 5.2 | 5.6 | 4.5 | 4.8 |
| | 40+ | 1.9 | 1.9 | 1.7 | 1.5 |
| Unknown ASA (N/%) | | 616/8.8 | 1598/12.6 | 1496/24.9 | 820/8.4 |
| Known ASA (N) | | 6377 | 11097 | 4516 | 8986 |
| Morbidity state (%) | ASA 1 | 17.6 | 17.2 | 13.5 | 13 |
| | ASA 2 | 58.8 | 58.7 | 62.9 | 57.2 |
| | ASA 3 | 22.8 | 23.5 | 23.1 | 29 |
| | ASA 4/5 | 0.8 | 0.7 | 0.5 | 0.8 |

Total hip arthroplasties constituted 99.9% of all procedures (Table 9). During the registration period, only 62 hip resurfacing procedures were documented. The surgical approach is documented since 2015 (Tables 9 and 11).

Overall, the anterior approach (DAA) was the most commonly used approach (43%), followed by the anterolateral approach used in 34% of cases, the posterior approach in 15%, and the lateral approach was used in less than 10% of the interventions. The anterior approach gained popularity and increased from 41.6% in 2015 to 43.7% in 2016.

Table 9

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

Approach data only available from 2015 onwards

| Surgery characteristics | | Primary OA | | Secondary OA | | Fracture | |
|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % |
| Previous surgery | None | | | 5607 | 80.1 | 4040 | 87.5 |
| | Internal fixation femur | | | 694 | 9.9 | 127 | 2.8 |
| | Osteotomy femur | | | 384 | 5.5 | 396 | 8.6 |
| | Internal fixation acetabulum | | | 281 | 4.0 | 37 | 0.8 |
| | Osteotomy pelvis | | | 41 | 0.6 | 38 | 0.8 |
| | Arthrodesis | | | 123 | 1.8 | 6 | 0.1 |
| | Other previous surgery | | | 4 | 0.1 | 3 | 0.1 |
| Intervention | Total hip replacement | 64622 | 99.9 | 6993 | 99.9 | 4609 | 99.8 |
| | Hip resurfacing | 48 | 0.1 | 7 | 0.1 | 7 | 0.2 |
| Approach | Anterior | 12774 | 42.9 | 1432 | 41.4 | 952 | 42.0 |
| | Anterolateral | 10017 | 33.6 | 1141 | 33.0 | 609 | 26.9 |
| | Posterior | 4492 | 15.1 | 534 | 15.4 | 378 | 16.7 |
| | Lateral | 2278 | 7.6 | 285 | 8.2 | 282 | 12.4 |
| | Other approach | 249 | 0.8 | 70 | 2.0 | 45 | 2.0 |
| Fixation | All uncemented | 55921 | 86.5 | 5464 | 78.1 | 2222 | 48.1 |
| | Hybrid* | 7371 | 11.4 | 1006 | 14.4 | 1767 | 38.3 |
| | All cemented | 841 | 1.3 | 303 | 4.3 | 450 | 9.7 |
| | Reverse hybrid** | 387 | 0.6 | 127 | 1.8 | 99 | 2.1 |
| | Reinforcement ring, femur uncemented | 81 | 0.1 | 42 | 0.6 | 31 | 0.7 |
| | Reinforcement ring, femur cemented | 69 | 0.1 | 58 | 0.8 | 47 | 1.0 |

* acetabulum uncemented, femur cemented

** acetabulum cemented, femur uncemented

Tables 10 a, b, c and Figures 5 a, b, c

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

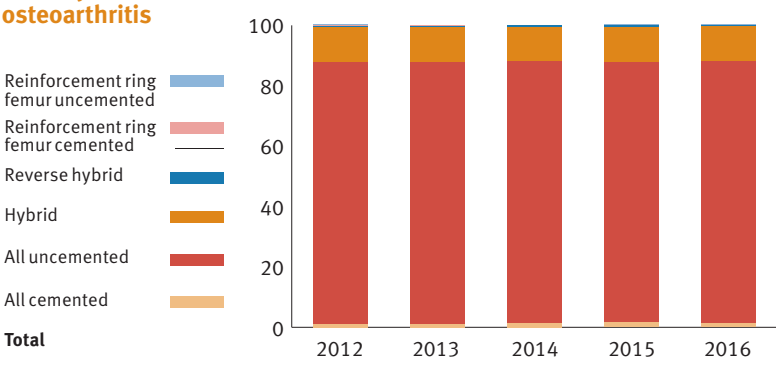
Total numbers per year

Table/Figure a

### Primary osteoarthritis

| 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| 8 | 10 | 19 | 22 | 22 |
| 13 | 16 | 16 | 10 | 14 |
| 32 | 91 | 104 | 86 | 74 |
| 682 | 1686 | 1613 | 1692 | 1698 |
| 4923 | 12454 | 12726 | 12595 | 13223 |
| 64 | 165 | 205 | 228 | 179 |
| **5722** | **14422** | **14683** | **14633** | **15210** |

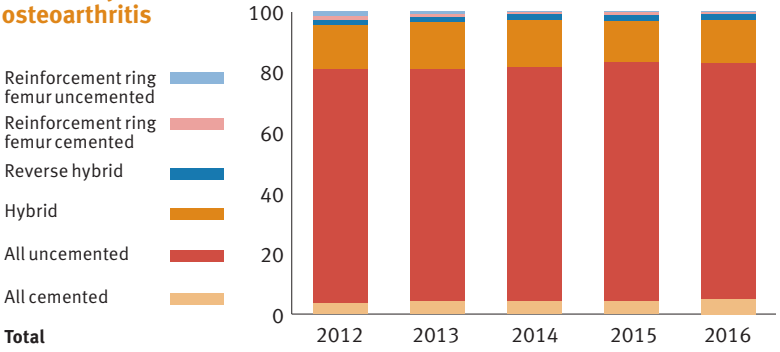
Percentage per year




Table/Figure b

### Secondary osteoarthritis

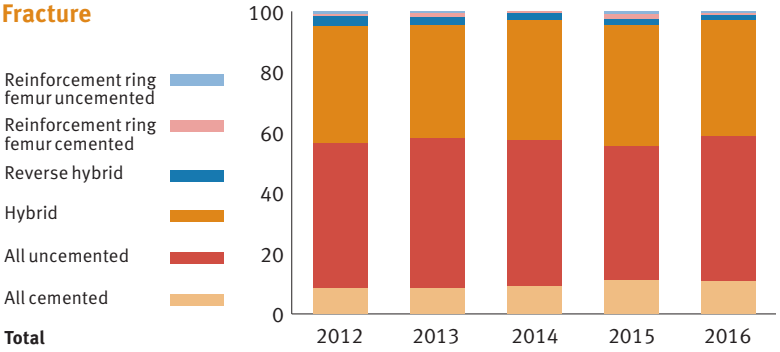
| 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| 9 | 13 | 5 | 8 | 7 |
| 8 | 16 | 9 | 12 | 13 |
| 9 | 24 | 28 | 33 | 33 |
| 89 | 233 | 210 | 213 | 261 |
| 463 | 1174 | 1091 | 1297 | 1439 |
| 21 | 62 | 57 | 69 | 94 |
| **599** | **1522** | **1400** | **1632** | **1847** |




Table/Figure c

### Fracture

| 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| 3 | 7 | 2 | 10 | 9 |
| 3 | 10 | 7 | 17 | 10 |
| 11 | 25 | 22 | 24 | 17 |
| 127 | 347 | 422 | 431 | 440 |
| 160 | 476 | 520 | 489 | 577 |
| 27 | 79 | 99 | 123 | 122 |
| **331** | **944** | **1072** | **1094** | **1175** |



All uncemented fixation was used in 87% of cases of primary osteoarthritis, 78% in secondary osteoarthritis and 48% in the fracture group (Tables 9 and 10). The acetabulum was mostly uncemented. Across all diagnostic groups, 2'207 patients (3%) received a cemented cup. 49% of the femur components were cemented in the fracture group.

Fixation techniques for primary and secondary osteoarthritis remained stable over the observation period (Figure 5). Most frequently, an uncemented fixation for both components (48%) was used, followed by a hybrid fixation in 41% of the cases.

Table 11

**Primary total hip arthroplasty: Surgical approach by year**

Approach data only available from 2015 onwards

| Surgical approach | 2015 | | 2016 | |
|---|---|---|---|---|
| | N | % | N | % |
| Anterior | 7193 | 41.6 | 7965 | 43.7 |
| Anterolateral | 5759 | 33.3 | 5976 | 32.8 |
| Lateral | 1442 | 8.3 | 1403 | 7.7 |
| Posterior | 2665 | 15.4 | 2739 | 15.0 |
| Other approach | 215 | 1.2 | 149 | 0.8 |
| **Total** | **17274** | 100 | **18232** | 100 |

## 5.2 Revision of total hip arthroplasty

Among the 10'544 THA revisions documented over the entire data collection period, 51% were performed in women (Table 12). The mean age at revision was 71 years. On average, men were three years younger than women (69 versus 72 years). The age group ‹45 years accounted for 3% and the age group between 45 and 55 for 8% of revisions. There was an increase in the proportion of revisions in the age category 85 years and older from 9% in 2012 to 12% in 2016. The mean BMI at time of revision was 27.4 kg/m$^2$ and was similar to primary THA.

Table 12

**Revision of total hip arthroplasty: Baseline patient characteristics by year**

2012–2016, BMI and ASA class data only available from 2015 onwards

| Baseline patient characteristics | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| N | | **863** | **2234** | **2463** | **2485** | **2499** | **10544** |
| Women (%) | | 47.5 | 52.1 | 52.8 | 49.8 | 52.3 | 51.4 |
| Mean age (SD) | All | 69.3 (13.5) | 70.1 (12.2) | 70.8 (12.7) | 71.3 (12.1) | 71 (12) | 70.7 (12.4) |
| | Women | 70.4 (13.6) | 71.5 (12.2) | 72.5 (12.7) | 73.5 (12.1) | 72.3 (12) | 72.3 (12.4) |
| | Men | 68.3 (13.4) | 68.6 (12.1) | 69 (12.4) | 69.2 (11.9) | 69.6 (11.9) | 69 (12.2) |
| Age group (%) | ‹45 | 3.6 | 2.9 | 2.5 | 2.8 | 2.2 | 2.7 |
| | 45–55 | 8.8 | 7.5 | 8.3 | 6.9 | 7.9 | 7.8 |
| | 55–65 | 18.5 | 19.6 | 18 | 17.3 | 17.4 | 18.1 |
| | 65–75 | 30 | 30.8 | 26.9 | 29.2 | 30.3 | 29.3 |
| | 75–85 | 30 | 29.4 | 32.2 | 31.4 | 30 | 30.7 |
| | 85+ | 9 | 9.9 | 12.2 | 12.5 | 12 | 11.5 |
| BMI unknown (N/%) | | | | | 772/31.1 | 547/21.9 | 1319 |
| BMI known (N) | | | | | 1713 | 1952 | 3665 |
| Mean BMI (SD) | | | | | 27.2 (5.3) | 27.5 (5.4) | 27.4 (5.4) |
| BMI (%) | ‹18.5 | | | | 2.6 | 2.1 | 2.3 |
| | 18.5–24.9 | | | | 34.9 | 32.4 | 33.6 |
| | 25–29.9 | | | | 37.7 | 38.5 | 38.1 |
| | 30–34.9 | | | | 16.2 | 17.9 | 17.1 |
| | 35–39.9 | | | | 6.8 | 6.9 | 6.9 |
| | 40+ | | | | 1.8 | 2.2 | 2 |
| ASA unknown (N/%) | | | | | 393/15.8 | 335/13.4 | 728 |
| ASA known (N) | | | | | 2092 | 2164 | 4256 |
| Morbidity state (%) | ASA 1 | | | | 8.8 | 7.3 | 8.1 |
| | ASA 2 | | | | 47.5 | 48.8 | 48.2 |
| | ASA 3 | | | | 40.8 | 41.4 | 41.1 |
| | ASA 4/5 | | | | 2.9 | 2.4 | 2.7 |

While data on the type of revision has been available since the start of the registry in 2012, the current listing of the reasons for revisions and the information on approach have only been recorded since 2015. Aseptic loosening of the femoral component was the most common reason for revision, followed by aseptic loosening of the acetabular component, infection, periprosthetic fracture, and dislocation (Table 13).

Table 13

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

Multiple reasons are possible per patient. The reasons for revisions categories as listed below are only available from 2015 onwards.

| Reason for revision | 2015–2016 | |
|---|---|---|
| | N | % |
| Loosening femoral | 1067 | 21.6 |
| Loosening acetabular | 936 | 18.9 |
| Infection | 890 | 18.0 |
| Periprosthetic fracture | 734 | 14.9 |
| Dislocation | 576 | 11.7 |
| Wear | 288 | 5.8 |
| Metallosis | 244 | 4.9 |
| Acetabular osteolysis | 182 | 3.7 |
| Femoral osteolysis | 167 | 3.4 |
| Position/Orientation of cup | 159 | 3.2 |
| Trochanter pathology | 110 | 2.2 |
| Status after spacer | 103 | 2.1 |
| Implant failure/breakage | 100 | 2.0 |
| Blood ion level | 98 | 2.0 |
| Position/Orientation of stem | 90 | 1.8 |
| Impingement | 82 | 1.7 |
| Acetabular protrusion | 54 | 1.1 |
| Squeaking | 33 | 0.7 |
| Other | 1142 | 23.1 |
| **Total 2015–2016** | **7055** | **142.8** |

The revision of both acetabular and femoral components was the most common type of revision. Looking at acetabular and femoral revisions separately, the acetabulum was revised in 55% of all cases, and the femoral stem in 49% of all cases (Table 14).

In contrast to primary hip arthroplasty, where anterior and anterolateral approaches are the most commonly used approaches, over 58% of the revisions are performed through a posterior or lateral approach (Table 15), and 33% through an anterior or anterolateral approach.

Table 14
**Type of revision of total hip arthroplasty**
2012–2016

| Type of revision | 2012–2016 | |
|---|---|---|
| | N | % |
| Exchange acetabular and femoral components | 2294 | 21.8 |
| Exchange acetabular component and head | 2106 | 20.0 |
| Exchange femoral component | 1787 | 16.9 |
| Exchange head and inlay | 920 | 8.7 |
| Exchange acetabular component | 840 | 8.0 |
| Component reimplantation (after spacer or Girdlestone) | 583 | 5.5 |
| Exchange head | 485 | 4.6 |
| Exchange femoral component and inlay | 388 | 3.7 |
| Component removal, spacer implantation | 251 | 2.4 |
| Girdlestone | 208 | 2.0 |
| Exchange inlay | 108 | 1.0 |
| Exchange femoral component, inlay and osteosynthesis | 80 | 0.8 |
| Osteosynthesis | 66 | 0.6 |
| Prosthesis preserving revision | 65 | 0.6 |
| Other intervention | 363 | 3.4 |
| **Total 2012–2016** | **10544** | **100.0** |

Table 15
**Approach of revision of total hip arthroplasty**
Data only available from 2015 onwards

| Approach of revision | 2015–2016 | |
|---|---|---|
| | N | % |
| Posterior | 1646 | 33.3 |
| Lateral | 1227 | 24.8 |
| Anterolateral | 868 | 17.6 |
| Anterior | 744 | 15.1 |
| Transfemoral | 250 | 5.1 |
| Other approach | 208 | 4.2 |

Component fixation techniques changed slightly during the entire period of data acquisition (Figure 6, Table 16). There was a steady increase in the use of all uncemented component fixation but also in all cemented fixation until 2015, followed by a slight decrease in 2016.

Figure 6

**Revision of total hip arthroplasty: Component fixation by year**

Percentage per year

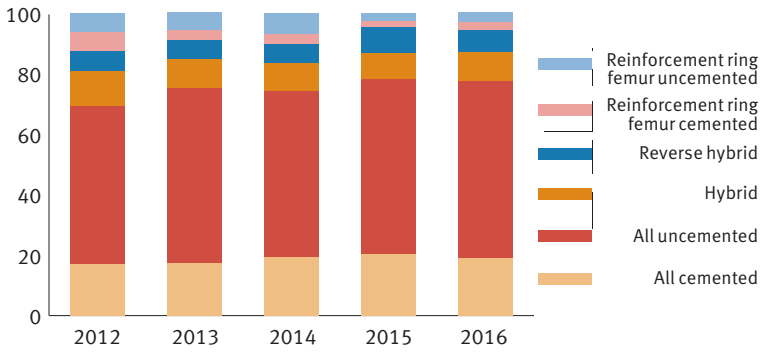



Table 16

**Revision of total hip arthroplasty: Component fixation by year**

2012–2016

| Component fixation | 2012 | 2013 | 2014 | 2015 | 2016 | 2012–2016 | |
|---|---|---|---|---|---|---|---|
| | N | N | N | N | N | N | % |
| Reinforcement ring femur uncemented | 39 | 100 | 132 | 57 | 69 | 397 | 4.8 |
| Reinforcement ring femur cemented | 38 | 53 | 65 | 36 | 51 | 243 | 2.9 |
| Reverse hybrid* | 45 | 115 | 129 | 162 | 144 | 595 | 7.2 |
| Hybrid** | 73 | 166 | 176 | 163 | 191 | 769 | 9.3 |
| All uncemented | 337 | 1011 | 1062 | 1123 | 1160 | 4693 | 56.9 |
| All cemented | 106 | 305 | 369 | 394 | 377 | 1551 | 18.9 |
| **Total** | **638** | **1750** | **1933** | **1935** | **1992** | **8248** | 100 |

* acetabulum cemented, femur uncemented

** acetabulum uncemented, femur cemented

## 5.3 First revision of primary total hip arthroplasty

This chapter reports on the revisions of those primary THAs that were implanted since the start of the registry in September 2012. Of the 76'286 primary THAs documented in the registry, 1'767 (2.3%) were revised by the end of 2016 (Table 17). Of all the revisions carried out, 92% were performed by the same provider that performed the primary implantation. The risk of revision was higher in hips with secondary osteoarthritis (3.2%) and even higher in hips treated for a fracture (4.2%). Revisions were slightly more frequent in men. The BMI had a substantial impact on the risk of revision. Revision rates increased with increasing BMI from 1.3% in normal weight patients to 2.0% in obese class I (30–34.9 kg/m$^2$)

Table 17
**First revision of primary total hip arthroplasty overall and according to baseline patient characteristics**

| Baseline patient characteristics | | Primary | Revised | | Revised same service | |
|---|---|---|---|---|---|---|
| | | N | N | % | N | % |
| Overall (2012-2016) | | 76286 | 1767 | 2.3 | 1626 | 92.0 |
| Diagnosis | Primary OA | 64670 | 1353 | 2.1 | 1247 | 92.2 |
| | Secondary | 7000 | 222 | 3.2 | 207 | 93.2 |
| | Fracture | 4616 | 192 | 4.2 | 172 | 89.6 |
| Overall Primary OA (2012–2016) | | 64670 | 1353 | 2.1 | 1247 | 92.2 |
| Gender | Women | 32943 | 669 | 2.0 | 621 | 92.8 |
| | Men | 31727 | 684 | 2.2 | 626 | 91.5 |
| Age group | ‹55 | 7370 | 161 | 2.2 | 146 | 90.7 |
| | 55–64 | 14430 | 297 | 2.1 | 270 | 90.9 |
| | 65–74 | 22690 | 451 | 2.0 | 421 | 93.3 |
| | 75–84 | 16807 | 372 | 2.2 | 344 | 92.5 |
| | 85+ | 3373 | 72 | 2.1 | 66 | 91.7 |
| Overall Primary OA (2015–2016) | | 29781 | 564 | 1.9 | 509 | 90.2 |
| BMI group | ‹18.5 | 272 | 3 | 1.1 | 3 | 100.0 |
| | 18.5–24.9 | 7613 | 98 | 1.3 | 83 | 84.7 |
| | 25–29.9 | 9259 | 158 | 1.7 | 145 | 91.8 |
| | 30–34.9 | 4150 | 85 | 2.0 | 80 | 94.1 |
| | 35–39.9 | 1241 | 49 | 3.9 | 44 | 89.8 |
| | 40+ | 417 | 26 | 6.2 | 25 | 96.2 |
| | Unknown | 6829 | 145 | 2.1 | 129 | 89.0 |
| Morbidity state | ASA 1 | 4106 | 66 | 1.6 | 57 | 86.4 |
| | ASA 2 | 15678 | 257 | 1.6 | 234 | 91.1 |
| | ASA 3 | 5961 | 155 | 2.6 | 139 | 89.7 |
| | ASA 4 / 5 | 114 | 4 | 3.5 | 4 | 100.0 |
| | Unknown | 3922 | 82 | 2.1 | 75 | 91.5 |

patients, 3.9% in obese class II (35–39.9 kg/m²) patients, and 6.2% in obese class III (BMI >40 kg/m2) patients. Compared to ASA class 1 and 2 patients, those categorized as ASA class 3 had an increase in the revision rate to 2.6%, which further increased to 3.5% in ASA class 4/5. Across all groups, the majority of revisions occurred during the first tree months (Figure 7a) and reached 1.9% at 12 months, (Table 18). Only an additional 0.3% were revised during the subsequent 12 months, adding up to a revision rate of 2.2% at 24 months. The revision rate was identical for men and women during the first 12 months. Thereafter, it increased more for men. Patients with a BMI >35 kg/m² were likely to have revisions performed in the first 12 months, thereafter only very few revisions were recorded for this patient group.

Table 18

**First revision of primary total hip arthroplasty within 12 months and within 24 months overall and according to baseline characteristics**

| Baseline patient characteristics | | Primary | Revised within 12 months | | | | Revised within 24 months | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | | Revised | | 95% CI | |
| | | N | N | % | lower | upper | N | % | lower | upper |
| Overall (2012–2016) | | 76286 | 1477 | 1.9 | 1.8 | 2.0 | 1685 | 2.2 | 2.1 | 2.3 |
| Diagnosis | Primary OA | 64670 | 1122 | 1.7 | 1.6 | 1.8 | 1291 | 2.0 | 1.9 | 2.1 |
| | Secondary OA | 7000 | 191 | 2.7 | 2.3 | 3.1 | 214 | 3.1 | 2.7 | 3.5 |
| | Fracture | 4616 | 164 | 3.6 | 3.0 | 4.1 | 180 | 3.9 | 3.3 | 4.5 |
| Overall Primary OA (2012–2016) | | 64670 | 1122 | 1.7 | 1.6 | 1.8 | 1291 | 2.0 | 1.9 | 2.1 |
| Gender | Women | 32943 | 572 | 1.7 | 1.6 | 1.9 | 637 | 1.9 | 1.8 | 2.1 |
| | Men | 31727 | 550 | 1.7 | 1.6 | 1.9 | 654 | 2.1 | 1.9 | 2.2 |
| Age group | <55 | 7370 | 112 | 1.5 | 1.2 | 1.8 | 147 | 2.0 | 1.7 | 2.3 |
| | 55–64 | 14430 | 236 | 1.6 | 1.4 | 1.8 | 279 | 1.9 | 1.7 | 2.2 |
| | 65–74 | 22690 | 385 | 1.7 | 1.5 | 1.9 | 438 | 1.9 | 1.8 | 2.1 |
| | 75–84 | 16807 | 323 | 1.9 | 1.7 | 2.1 | 355 | 2.1 | 1.9 | 2.3 |
| | 85+ | 3373 | 66 | 2.0 | 1.5 | 2.4 | 72 | 2.1 | 1.6 | 2.6 |
| Overall Primary OA (2015–2016) | | 29781 | 530 | 1.8 | 1.6 | 1.9 | 564 | 1.9 | 1.7 | 2.0 |
| BMI group | <18.5 | 272 | 3 | 1.1 | -0.1 | 2.3 | 3 | 1.1 | -0.1 | 2.3 |
| | 18.5–24.9 | 7613 | 90 | 1.2 | 0.9 | 1.4 | 98 | 1.3 | 1.0 | 1.5 |
| | 25–29.9 | 9259 | 149 | 1.6 | 1.4 | 1.9 | 158 | 1.7 | 1.4 | 2.0 |
| | 30–34.9 | 4150 | 82 | 2.0 | 1.6 | 2.4 | 85 | 2.0 | 1.6 | 2.5 |
| | 35–39.9 | 1241 | 47 | 3.8 | 2.7 | 4.8 | 49 | 3.9 | 2.9 | 5.0 |
| | 40+ | 417 | 26 | 6.2 | 3.9 | 8.6 | 26 | 6.2 | 3.9 | 8.6 |
| | Unknown | 6829 | 133 | 1.9 | 1.6 | 2.3 | 145 | 2.1 | 1.8 | 2.5 |
| Morbidity state | ASA 1 | 4106 | 57 | 1.4 | 1.0 | 1.7 | 66 | 1.6 | 1.2 | 2.0 |
| | ASA 2 | 15678 | 238 | 1.5 | 1.3 | 1.7 | 257 | 1.6 | 1.4 | 1.8 |
| | ASA 3 | 5961 | 153 | 2.6 | 2.2 | 3.0 | 155 | 2.6 | 2.2 | 3.0 |
| | ASA 4/5 | 114 | 4 | 3.5 | 0.1 | 6.9 | 4 | 3.5 | 0.1 | 6.9 |
| | Unknown | 3922 | 78 | 2.0 | 1.6 | 2.4 | 82 | 2.1 | 1.6 | 2.5 |

The most popular approach in Switzerland is the anterior approach, which has a revision rate of 1.8% during the first 12 months, compared to the anterolateral approach with 1.6%. The revision rate for these two approaches leveled out after 24 months. The highest revision rate was reported for the posterior approach (2.4%). The lateral approach had the lowest revision rate with 1.1%.

Within the first 24 months of implantation, the most frequent reasons for revision were infection in 23.4% of cases, followed by periprosthetic fractures in 21.4% of cases, dislocation in 20.4% of cases

Table 19

**First revision of primary total hip arthroplasty according to component fixation and approach**

2012–2016

| | Primary | Revised within 12 months | | | | Revised within 24 months | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Revised | | 95% CI | | Revised | | 95% CI | |
| | N | N | % | lower | upper | N | % | lower | upper |
| Overall Primary OA | 64670 | 1122 | 1.7 | 1.6 | 1.8 | 1291 | 2.0 | 1.9 | 2.1 |
| **Stem fixation** | | | | | | | | | |
| Uncemented | 56389 | 991 | 1.8 | 1.6 | 1.9 | 1144 | 2.0 | 1.9 | 2.1 |
| Cemented | 8281 | 131 | 1.6 | 1.3 | 1.9 | 147 | 1.8 | 1.5 | 2.1 |
| Overall Primary OA | 29810 | 531 | 1.8 | 1.6 | 1.9 | 565 | 1.9 | 1.7 | 2.1 |
| **Approach** | | | | | | | | | |
| Anterior | 12774 | 231 | 1.8 | 1.6 | 2.0 | 240 | 1.9 | 1.6 | 2.1 |
| Anterolateral | 10017 | 160 | 1.6 | 1.4 | 1.8 | 180 | 1.8 | 1.5 | 2.1 |
| Lateral | 2278 | 24 | 1.1 | 0.6 | 1.5 | 26 | 1.1 | 0.7 | 1.6 |
| Posterior | 4492 | 110 | 2.4 | 2.0 | 2.9 | 113 | 2.5 | 2.1 | 3.0 |
| Other approach | 249 | 6 | 2.4 | 0.5 | 4.3 | 6 | 2.4 | 0.5 | 4.3 |

and loosening of the femoral component in 10.9% of cases (Table 20, Figure 7 a,b,c). On average, most revisions occurred in the first three months. With regard to all revisions, infection and dislocation were the most frequent and earliest reasons for revisions. When stratifying the results by stem fixation, the most frequent and earliest reasons for revision after the use of uncemented stems were periprosthetic fractures (22%), followed by infection (19%) and dislocation (18%). In cemented stems, the most frequent and earliest reason for revision was dislocation (26%), followed by infection (30%). Periprosthetic fractures (10%) occurred less frequently and at a later stage.

Table 20

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

Multiple reasons are possible per patient. The reasons for revisions categories as listed below are only available from 2015 onwards.

| Reason for early first revision | 2015–2016 | |
|---|---|---|
| | N | % |
| Infection | 175 | 23.4 |
| Periprosthetic fracture | 160 | 21.4 |
| Dislocation | 153 | 20.4 |
| Loosening femoral | 82 | 10.9 |
| Loosening acetabular | 58 | 7.7 |
| Position/orientation of stem | 32 | 4.3 |
| Position/orientation of cup | 26 | 3.5 |
| Impingement | 12 | 1.6 |
| Trochanter pathology | 8 | 1.1 |
| Acetabular protrusion | 7 | 0.9 |
| Implant breakage | 6 | 0.8 |
| Status after spacer | 5 | 0.7 |
| Squeaking | 3 | 0.4 |
| Wear | 1 | 0.1 |
| Metallosis | 1 | 0.1 |
| Other | 141 | 18.8 |

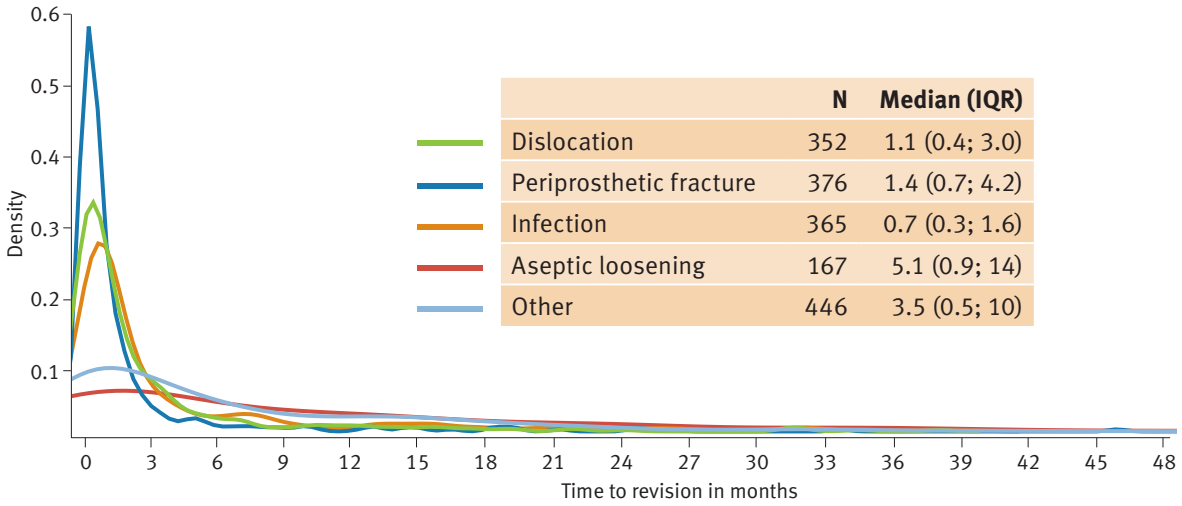
Figure 7 a, b and c

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

Figure a

**All revisions**

**(N= 1767)**

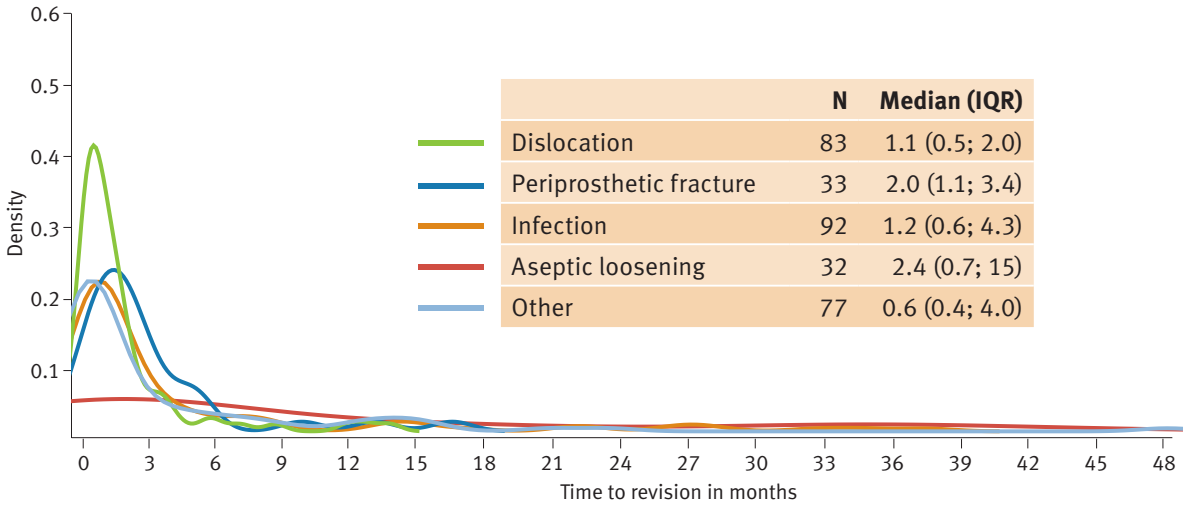



| | N | Median (IQR) |
|---|---|---|
| Dislocation | 352 | 1.1 (0.4; 3.0) |
| Periprosthetic fracture | 376 | 1.4 (0.7; 4.2) |
| Infection | 365 | 0.7 (0.3; 1.6) |
| Aseptic loosening | 167 | 5.1 (0.9; 14) |
| Other | 446 | 3.5 (0.5; 10) |

Figure b

**Revisions femur cemented only**

**(N= 310)**

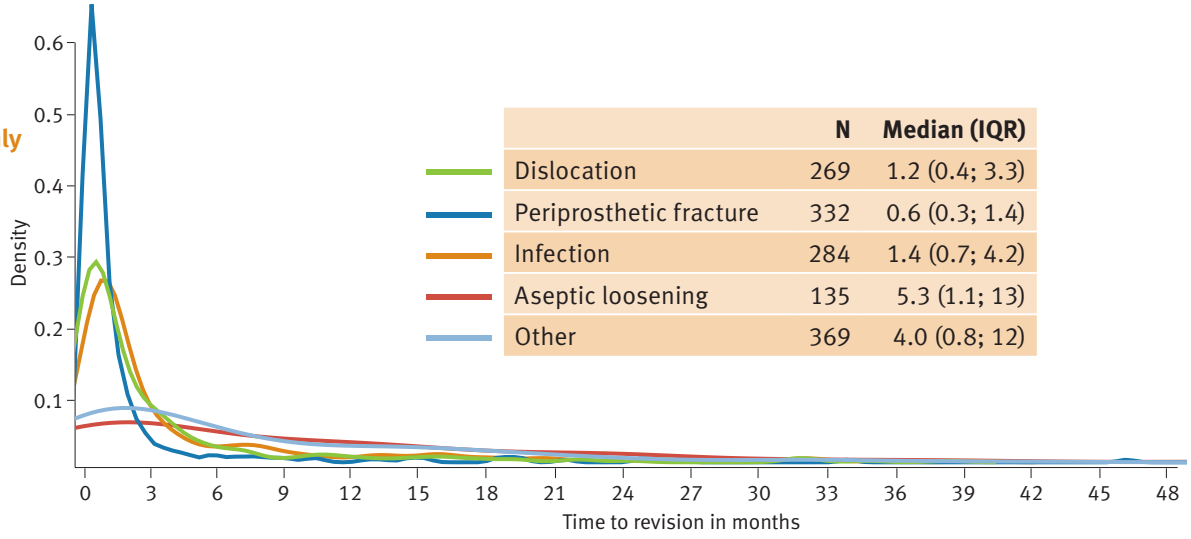



| | N | Median (IQR) |
|---|---|---|
| Dislocation | 83 | 1.1 (0.5; 2.0) |
| Periprosthetic fracture | 33 | 2.0 (1.1; 3.4) |
| Infection | 92 | 1.2 (0.6; 4.3) |
| Aseptic loosening | 32 | 2.4 (0.7; 15) |
| Other | 77 | 0.6 (0.4; 4.0) |

Figure c

**Revisions femur uncemented only**

**(N= 1457)**




| | N | Median (IQR) |
|---|---|---|
| Dislocation | 269 | 1.2 (0.4; 3.3) |
| Periprosthetic fracture | 332 | 0.6 (0.3; 1.4) |
| Infection | 284 | 1.4 (0.7; 4.2) |
| Aseptic loosening | 135 | 5.3 (1.1; 13) |
| Other | 369 | 4.0 (0.8; 12) |

# 6. Hemiarthroplasty of the hip

## 6.1 Primary hemiarthroplasty of the hip

Patients with a femoral neck fracture that is treated with a hemiarthroplasty are a special group of patients, with much lower functional needs and expected life span than patients undergoing THA. For this reason the data of this cohort of patients is recorded and analyzed in this separate chapter of the SIRIS report.

More than 56% of the patients belong to the age group 85 years and older (Table 21). The second largest group are patients aged 75 to 84 years (32%). The BMI is rather low and is on average 23.8 kg/m$^2$. Women are affected more frequently and account for 72% of all patients who have undergone hemiarthroplasty. As expected the majority of patients are grouped in the ASA 3 class (58%).

Table 21
**Primary hemiarthroplasty: Baseline patient characteristics by year**
2012–2016. BMI and ASA class data only available from 2015 onwards

| Baseline patient characteristics | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| N | | **639** | **1927** | **2039** | **1964** | **1958** | **8527** |
| Women (%) | | 71.7 | 74 | 73.4 | 71.8 | 70.5 | 72.4 |
| Mean age (SD) | All | 83.2 (11) | 83.7 (10.3) | 84.1 (9.6) | 84.3 (9.2) | 84.5 (8.6) | 84.1 (9.6) |
| | Women | 83.9 (10.2) | 84.3 (9.8) | 84.7 (8.6) | 84.8 (8.7) | 84.9 (8.2) | 84.6 (8.9) |
| | Men | 81.5 (12.8) | 82.1 (11.6) | 82.4 (11.6) | 83.2 (10.4) | 83.4 (9.4) | 82.7 (10.9) |
| Age group (%) | ‹45 | 0.8 | 0.6 | 0.4 | 0.4 | 0.2 | 0.4 |
| | 45–54 | 1.4 | 0.7 | 0.6 | 0.7 | 0.3 | 0.6 |
| | 55–64 | 3 | 2.6 | 1.9 | 2.1 | 2 | 2.2 |
| | 65–74 | 8.1 | 8.5 | 7.9 | 8.4 | 8.5 | 8.3 |
| | 75–84 | 33 | 32.2 | 33.1 | 31 | 33 | 32.4 |
| | 85+ | 53.7 | 55.5 | 56 | 57.6 | 55.9 | 56.1 |
| BMI unknown (N/%) | | | | | 769/39.2 | 631/32.2 | 1400 |
| BMI known (N) | | | | | 1195 | 1327 | 2522 |
| Mean BMI (SD) | | | | | 23.8 (4.7) | 23.8 (4.6) | 23.8 (4.6) |
| BMI [%] | ‹18.5 | | | | 10.3 | 9.8 | 10 |
| | 18.5–24.9 | | | | 55.1 | 53.7 | 54.4 |
| | 25–29.9 | | | | 27.3 | 28.6 | 28 |
| | 30–34.9 | | | | 5.4 | 6 | 5.7 |
| | 35–39.9 | | | | 1.4 | 1.5 | 1.5 |
| | 40+ | | | | 0.5 | 0.5 | 0.5 |
| ASA unknown (N/%) | | | | | 226/11.5 | 145/7.4 | 371 |
| ASA known (N) | | | | | 1738 | 1813 | 3551 |
| Morbidity state (%) | ASA 1 | | | | 2.2 | 1.4 | 1.8 |
| | ASA 2 | | | | 26.5 | 25 | 25.7 |
| | ASA 3 | | | | 63.4 | 64 | 63.7 |
| | ASA 4/5 | | | | 7.9 | 9.5 | 8.8 |

Table 22

## Baseline patient characteristics of primary hemiarthroplasty patients

Calculation of hospital services were based on all THA and hemiarthroplasty primary and revision hip surgeries in 2016. BMI data are only available from 2015 onwards

| Hospital service volume | | <100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| N (2012–2016) | | **3497** | **2824** | **794** | **1412** |
| Women (%) | | 73.4 | 72.2 | 71.4 | 70.5 |
| Mean age (SD) | All | 83.8 (9.7) | 83.7 (9.7) | 83.6 (10.5) | 85.6 (8.3) |
| | Women | 84.3 (9.2) | 84.3 (8.9) | 84.4 (9.7) | 86.1 (7.7) |
| | Men | 82.4 (10.9) | 82.4 (11.3) | 81.7 (12.1) | 84.4 (9.4) |
| Age group (%) | <45 | 0.5 | 0.4 | 0.6 | 0.2 |
| | 45–54 | 0.4 | 0.9 | 0.8 | 0.6 |
| | 55–64 | 2.2 | 2.3 | 3.1 | 1.4 |
| | 65–74 | 9.2 | 8.7 | 8.4 | 5.3 |
| | 75–84 | 33.6 | 33.5 | 31 | 28 |
| | 85+ | 54.2 | 54.2 | 56 | 64.4 |
| N (2015-2016) | | **1610** | **1331** | **312** | **645** |
| Unknown BMI (N/%) | | 640/39.8 | 475/35.7 | 149/47.8 | 112/17.4 |
| Known BMI (N) | | 970 | 856 | 163 | 533 |
| Mean BMI (SD) | | 24 (4.9) | 23.8 (4.6) | 23.6 (3.9) | 23.4 (4.4) |
| BMI [%] | <18.5 | 9.2 | 10 | 10.4 | 11.4 |
| | 18.5–24.9 | 53.9 | 53.4 | 49.1 | 58.3 |
| | 25–29.9 | 28.7 | 28.6 | 35 | 23.6 |
| | 30–34.9 | 5.8 | 6 | 4.9 | 5.3 |
| | 35–39.9 | 1.8 | 1.6 | 0.6 | 0.9 |
| | 40+ | 0.7 | 0.4 | 0.4 | |
| Unknown ASA (N/%) | | 98/6.1 | 168/12.6 | 33/10.6 | 48/7.4 |
| Known ASA (N) | | 1512 | 1163 | 279 | 597 |
| Morbidity state (%) | ASA 1 | 2.2 | 1.5 | 1.4 | 1.5 |
| | ASA 2 | 26.9 | 27.3 | 23.7 | 20.9 |
| | ASA 3 | 63.4 | 61.7 | 64.2 | 68.3 |
| | ASA 4/5 | 7.6 | 9.5 | 10.8 | 9.2 |

More than one third of patients (37%) are treated in hospitals performing fewer than 100 hip replacement surgeries per year and one fourth (27%) in hospitals treating between 100 and 199 patients per year (Table 22). High-volume hospitals each provide treatment for 18% of the cases.

Table 23

**Surgery characteristics of primary hemiarthroplasty**

Approach data are only available from 2015 onwards

| Surgery characteristics | | N | % |
|---|---|---|---|
| Previous surgery | None | 8209 | 96.3 |
| | Internal fixation femur | 141 | 1.7 |
| | Osteotomy femur | 18 | 0.2 |
| | Osteotomy pelvis | 3 | 0.0 |
| | Arthrodesis | 3 | 0.0 |
| | Internal fixation acetabulum | 1 | 0.0 |
| | Other previous surgery | 155 | 1.8 |
| Intervention | Femoral head prosthesis | 6253 | 73.3 |
| | Bipolar prosthesis | 2254 | 26.4 |
| | Hemi-surface replacement | 20 | 0.2 |
| Approach | Anterior | 1186 | 30.4 |
| | Anterolateral | 1145 | 29.4 |
| | Lateral | 796 | 20.4 |
| | Posterior | 698 | 17.9 |
| | Other approach | 75 | 1.9 |
| Stem fixation | Cemented | 7090 | 83.2 |
| | Uncemented | 1437 | 16.9 |

Table24

## Conversion of hemiarthroplasty: Baseline patient characteristics by year

2012–2016. BMI and ASA class data are only available from 2015 onwards

| Baseline patient characteristics | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| N | | **37** | **54** | **54** | **60** | **44** | **249** |
| Women (%) | | 78.4 | 70.4 | 74.1 | 75 | 70.5 | 73.5 |
| Mean age (SD) | All | 79.9 (7.1) | 78.4 (11.5) | 75.6 (12.2) | 74.6 (10.9) | 75.3 (11.3) | 76.6 (11) |
| | Women | 79.2 (7.7) | 80.2 (10.9) | 78.5 (7.9) | 75.5 (10.5) | 76.3 (11) | 77.9 (9.8) |
| | Men | 82.5 (3.1) | 74.1 (12.1) | 67.2 (17.7) | 71.7 (11.9) | 72.9 (12.3) | 72.9 (13.2) |
| Age group (%) | <45 | 1.9 | 3.7 | 2.3 | | | 1.6 |
| | 45–55 | 3.7 | 1.9 | 6.7 | 2.3 | | 3.2 |
| | 55–65 | 5.4 | 5.6 | 7.4 | 10 | 9.1 | 7.6 |
| | 65–75 | 18.9 | 16.7 | 24.1 | 21.7 | 27.3 | 21.7 |
| | 75–85 | 51.4 | 38.9 | 42.6 | 40 | 43.2 | 42.6 |
| | 85+ | 24.3 | 33.3 | 20.4 | 21.7 | 15.9 | 23.3 |
| BMI unknown (N/%) | | | | | 10/16.7 | 3/6.8 | 13 |
| BMI known (N) | | | | | 50 | 41 | 91 |
| Mean BMI (SD) | | | | | 24.2 (3.9) | 25.1 (4.7) | 24.6 (4.3) |
| BMI (%) | <18.5 | | | | 4 | 4.9 | 4.4 |
| | 18.5–24.9 | | | | 56 | 48.8 | 52.7 |
| | 25–29.9 | | | | 32 | 31.7 | 31.9 |
| | 30–34.9 | | | | 8 | 9.8 | 8.8 |
| | 35–39.9 | | | | 4.9 | 0 | 2.2 |
| ASA unknown (N/%) | | | | | 3/5.0 | 5/11.4 | 8 |
| ASA known (N) | | | | | 57 | 39 | 96 |
| Morbidity state (%) | ASA 1 | | | | 3.5 | 5.1 | 4.2 |
| | ASA 2 | | | | 54.4 | 48.7 | 52.1 |
| | ASA 3 | | | | 42.1 | 43.6 | 42.7 |
| | ASA 4/5 | | | | 2.6 | 0 | 1 |

## 6.2 Conversion of hemiarthroplasty to total hip arthroplasty

During the entire registry period, 249 hemiarthroplasties were revised to a total hip arthroplasty (Table 24). Based on the total number of 8'776 hemiarthroplasties, the conversion burden is 2.8%. As in the baseline demographics, women are more often affected. Of the total number of revisions, 66% were performed in patients over the age of 75 years. Reasons for revision are available from 2015 onwards (Table 25).

The most frequent reason for conversion was femoral loosening in 20% of cases, followed by acetabular protrusion in 14% and dislocation in 13% of cases.

Table 25

**Reason for conversion of hemiarthroplasty**

Multiple reasons are possible per patient. The reasons for conversion categories as listed below are only available from 2015 onwards.

| Reason for conversion | 2015–2016 | |
|---|---|---|
| | N | % |
| Loosening femoral | 21 | 20.2 |
| Acetabular protrusion | 14 | 13.5 |
| Dislocation | 13 | 12.5 |
| Wear | 9 | 8.7 |
| Periprosthetic fracture | 8 | 7.7 |
| Infection | 6 | 5.8 |
| Trochanter pathology | 4 | 3.8 |
| Position/Orientation of stem | 3 | 2.9 |
| Impingement | 2 | 1.9 |
| Metallosis | 1 | 1.0 |
| Other | 52 | 50.0 |

Table 26

**Approach for conversion of hemiarthroplasty**

Approach data only available from 2015 onward

| Approach for conversion | 2015–2016 | |
|---|---|---|
| | N | % |
| Posterior | 36 | 34.3 |
| Lateral | 28 | 26.7 |
| Anterolateral | 22 | 21.0 |
| Anterior | 14 | 13.3 |
| Transfemoral | 3 | 2.9 |
| Other approach | 2 | 1.9 |

Table 27

**Component fixation of conversion of hemiarthroplasty to THA**

| Component fixation | 2012–2016 | |
|---|---|---|
| | N | % |
| Uncemented | 145 | 58.2 |
| Hybrid* | 55 | 22.1 |
| Cemented | 35 | 14.1 |
| Reverse hybrid** | 7 | 2.8 |
| Reinforcement ring, femur cemented | 6 | 2.4 |
| Reinforcement ring, femur uncemented | 1 | 0.4 |

* acetabulum uncemented, femur cemented

** acetabulum cemented, femur uncemented

# 7. Knee arthroplasty

## 7.1 Primary total knee arthroplasty

Among the 58'339 primary TKAs documented over the past five years, 61% were performed in women (Table 28, see next page). The mean age of 69 years at surgery was constant during the documented period. In the age group 55–64 years, 23.3% of TKAs were performed and 36.9% in patients aged between 65 and 74 years.

The number of TKAs in younger patients (younger than 45 and in the age group 45–54 years old) and patients older than 85 years has remained consistently low over the past 5 years.

Morbidity state (ASA classification) and body mass index (BMI) were only recorded from 2015. The proportion of missing BMIs decreased from 24.8% in 2015 to 20.5% in 2016 and needs to be further improved. Among those with a known value, the mean BMI was 29.4 kg/m$^2$. Obese patients (BMI ≥ 30 kg/m$^2$) constituted 39.2% of the total knee arthroplasty patients in Switzerland. The age, at which total knee arthroplasty was undertaken, decreased with increasing BMI category (Figure 8).

Patients receiving a TKA had an ASA classification 1 or 2 in 72.7% of the cases. In 10.7%, the morbidity state was not specified. This proportion was somewhat lower than in 2015 and further reductions needs to be achieved.

Figure 8
**Primary total knee arthroplasty: BMI according to age**

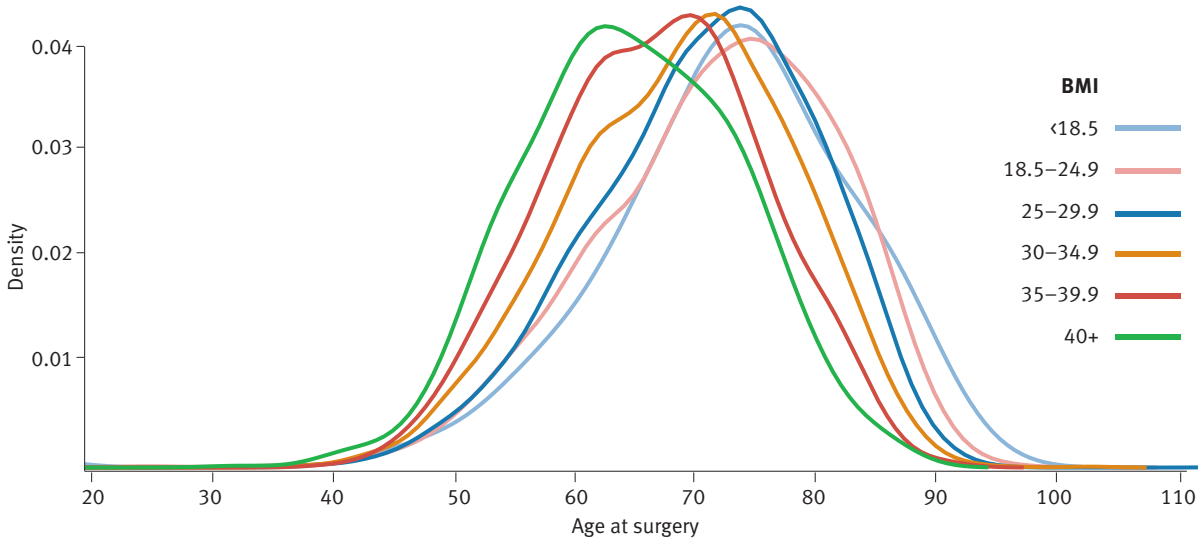


Table 28

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

BMI and ASA class data areonly available from 2015 onwards

| Baseline patient characteristics | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| N | | **4731** | **12927** | **13263** | **13153** | **14265** | **58339** |
| Diagnosis (%) | Primary OA | 95.9 | 96.4 | 96.7 | 88 | 88.3 | 92.5 |
| | Secondary OA | 4.1 | 3.6 | 3.3 | 12 | 11.7 | 7.5 |
| | Inflammatory origin | 1.1 | 0.9 | 0.9 | 1.2 | 1.1 | 1 |
| | Fracture | 0.6 | 0.4 | 0.5 | 2.3 | 2 | 1.3 |
| | Lesion of ligament | | | | 4.7 | 5.1 | 2.3 |
| | Infection | | | | 0.2 | 0.2 | 0.1 |
| | Osteonecrosis | 1.8 | 1.7 | 1.4 | 2.2 | 1.8 | 1.8 |
| | Other | 0.6 | 0.6 | 0.5 | 1.4 | 1.4 | 1 |
| Women (%) | | 59.4 | 61.1 | 60.7 | 61.3 | 61.2 | 60.9 |
| Mean age (SD) | All | 68.8 (10.4) | 69.2 (10.7) | 69.2 (10.4) | 69.4 (10) | 69.3 (9.7) | 69.2 (10.2) |
| | Women | 69.5 (10.4) | 70 (10.6) | 69.8 (10.7) | 70.1 (10) | 70 (9.7) | 69.9 (10.2) |
| | Men | 67.7 (10.3) | 67.9 (10.6) | 68.2 (10) | 68.3 (9.8) | 68.3 (9.6) | 68.2 (10) |
| Age group (%) | ‹45 | 1.1 | 1.2 | 0.9 | 0.7 | 0.6 | 0.9 |
| | 45–54 | 7 | 6.4 | 6.5 | 6.6 | 6.6 | 6.6 |
| | 55–64 | 24 | 23 | 23.2 | 23.4 | 23.5 | 23.3 |
| | 65–74 | 36.5 | 36.3 | 37 | 36.7 | 37.4 | 36.9 |
| | 75–84 | 27.3 | 28.4 | 28 | 28 | 27.7 | 27.9 |
| | 85+ | 4.1 | 4.7 | 4.4 | 4.6 | 4.2 | 4.4 |
| BMI unknown (N/%) | | | | | 3258/24.8 | 2886/20.2 | 6144 |
| BMI known (N) | | | | | 9895 | 11379 | 21274 |
| Mean BMI (SD) | | | | | 29.4 (6.1) | 29.5 (5.6) | 29.4 (5.9) |
| BMI (%) | ‹18.5 | | | | 0.5 | 0.4 | 0.4 |
| | 18.5–24.9 | | | | 21.1 | 21.1 | 21.1 |
| | 25–29.9 | | | | 39.6 | 38.9 | 39.2 |
| | 30–34.9 | | | | 24.2 | 24.5 | 24.4 |
| | 35–39.9 | | | | 10.1 | 10.5 | 10.3 |
| | 40+ | | | | 4.5 | 4.6 | 4.5 |
| ASA unknown (N/%) | | | | | 1701/12.9 | 1541/10.8 | 3242 |
| ASA known (N) | | | | | 11452 | 12724 | 24176 |
| Morbidity state (%) | ASA 1 | | | | 11.8 | 9.7 | 10.7 |
| | ASA 2 | | | | 61.5 | 62.5 | 62 |
| | ASA 3 | | | | 26.4 | 27.4 | 26.9 |
| | ASA 4/5 | | | | 0.3 | 0.3 | 0.3 |

Table 29

## Baseline patient characteristics of primary total knee arthroplasties by hospital service volume

Calculations of hospital service volumes based on all primary and revision knee surgeries in 2016.
BMI and ASA class data are only available from 2015 onwards

| Baseline patient characteristics | | <100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| N 2012–2016 | | **16791** | **17577** | **14079** | **9892** |
| Women (%) | | 60.9 | 60.3 | 60.9 | 62.2 |
| Mean age (SD) | All | 69.5 (10.5) | 69.4 (10) | 68.8 (10.4) | 69 (9.7) |
| | Women | 70 (10.5) | 70.2 (10) | 69.5 (10.5) | 69.7 (9.7) |
| | Men | 68.6 (10.3) | 68.2 (9.9) | 67.7 (10.2) | 67.9 (9.6) |
| Age group (%) | <45 | 0.9 | 0.7 | 1 | 0.8 |
| | 45–54 | 6.3 | 6.3 | 6.7 | 7.3 |
| | 55–64 | 22.6 | 23.3 | 24.5 | 23 |
| | 65–74 | 36.5 | 36.6 | 37.3 | 37.4 |
| | 75–84 | 29 | 28.4 | 26.4 | 27.6 |
| | 85+ | 4.7 | 4.7 | 4.1 | 3.9 |
| Diagnosis [%] | Primary OA | 88.6 | 88.5 | 89.2 | 86.6 |
| | Secondary OA | 11.4 | 11.5 | 10.8 | 13.4 |
| N 2015–2016 | | **7536** | **8384** | **6699** | **4721** |
| BMI unknown (N/%) | | 1962/26.0 | 1874/22.4 | 1775/26.5 | 455/9.6 |
| BMI known (N) | | 5574 | 6510 | 4924 | 4266 |
| Mean BMI (SD) | | 29.6 (5.9) | 29.6 (5.8) | 29.5 (6.1) | 28.9 (5.6) |
| BMI (%) | <18.5 | 0.4 | 0.3 | 0.5 | 0.7 |
| | 18.5–24.9 | 20.2 | 20.8 | 20.7 | 23.2 |
| | 25–29.9 | 38.6 | 37.9 | 39.5 | 41.8 |
| | 30–34.9 | 25 | 25.3 | 24.6 | 22.1 |
| | 35–39.9 | 11 | 10.9 | 10.5 | 8.4 |
| | 40+ | 4.9 | 4.9 | 4.3 | 3.9 |
| ASA unknown (N/%) | | 776/10.3 | 1101/13.1 | 1169/17.5 | 118/2.5 |
| ASA known (N) | | 6760 | 7283 | 5530 | 4603 |
| ASA state (%) | ASA 1 | 12.6 | 11.8 | 9 | 8.3 |
| | ASA 2 | 62.9 | 62.8 | 63.9 | 57.2 |
| | ASA 3 | 24.1 | 25.1 | 26.8 | 34.2 |
| | ASA 4/5 | 0.4 | 0.3 | 0.3 | 0.3 |

Table 30

**Primary total knee arthroplasty: Surgery characteristics**

| Surgery characteristics | | 2012–2014 | | 2015–2016 | |
|---|---|---|---|---|---|
| | | N | % | N | % |
| Previous surgery | None | 20898 | 67.4 | 17721 | 64.8 |
| | Knee arthroscopy | 6635 | 21.4 | 4841 | 17.7 |
| | Meniscectomy | | | 4500 | 16.5 |
| | ACL reconstruction | | | 1063 | 3.9 |
| | Osteotomy tibia close to knee | 852 | 2.7 | 907 | 3.3 |
| | Osteosynthesis tibia close to knee | 481 | 1.6 | 347 | 1.3 |
| | Surgery for patella stabilization | 440 | 1.4 | 354 | 1.3 |
| | Synovectomy | | | 215 | 0.8 |
| | Osteotomy femur close to knee | 163 | 0.5 | 148 | 0.5 |
| | Osteosynthesis femur close to knee | 157 | 0.5 | 124 | 0.5 |
| | Surgery for treating infection | 92 | 0.3 | 44 | 0.2 |
| | Surgery for tumor | | | 5 | 0.0 |
| | Ligament reconstruction | 1213 | 3.9 | | |
| | Other | 1921 | 6.2 | 903 | 3.3 |
| Intervention | CS (cruciate sacrificing) / UCOR | | | 9501 | 34.8 |
| | Unlinked posterior stabilized | 8327 | 26.9 | 7854 | 28.7 |
| | PCR (posterior cruciate retaining) | | | 7075 | 25.9 |
| | CCK (constrained condylar knee)* | 1706 | 5.5 | 610 | 2.2 |
| | BCR (bicruciate retaining) | | | 485 | 1.8 |
| | Hinge type | 608 | 2.0 | 388 | 1.4 |
| | Unlinked cruciate retaining | 7098 | 22.9 | | |
| | Unlinked meniscal | 3115 | 10.0 | | |
| | Unlinked rotating | 9211 | 29.7 | | |
| | Other | 934 | 3.0 | 1427 | 5.2 |
| Technology | Conventional | 22781 | 73.5 | 19791 | 72.4 |
| | Computer assisted | 3769 | 12.2 | 3460 | 12.7 |
| | Patient specific instrumentation | 2649 | 8.5 | 3197 | 11.7 |
| | Minimal invasive | 2559 | 8.3 | 1756 | 6.4 |
| | Other | | | 245 | 0.9 |

* Includes «unlinked semi-constrained»

Of the total number of TKA patients, 65% had never undergone knee surgery before (Table 30). Previous knee arthroscopy was mentioned in 17.7% of cases, and meniscectomy in 16.5% of cases. 3.9% of patients had had a previous ACL reconstruction, wile 3.3% of patients had had a tibial- and 0.5% a femoral osteotomy, respectively. Posttraumatic osteoarthritis following tibial or femoral fractures close to the knee was documented in 1.8% of the primary TKAs.

In primary TKAs, there was a clear trend towards all – cemented fixation (71% in 2016) during the past five years (Table 31, Figure 9), whereas the use of cementless TKA (0.9% in 2016) and hybrid fixation (28.1% in 2016) decreased. In three quarters of the primary cases, the patella was not resurfaced (Table 32).

Table 31

**Primary total knee arthroplasty: Component fixation**

Total numbers per year

| Component fixation | N | % | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|
| Femur uncemented – Tibia uncemented | 4027 | 6.9 | 475 | 1240 | 993 | 694 | 625 |
| Femur cemented – Tibia uncemented | 529 | 0.9 | 31 | 82 | 96 | 247 | 73 |
| Femur uncemented – Tibia cemented | 12367 | 21.2 | 1310 | 3337 | 2970 | 2377 | 2373 |
| Femur cemented – Tibia cemented | 41416 | 71.0 | 2915 | 8268 | 9204 | 9835 | 11194 |
| **Total** | **58339** | **100** | **4731** | **12927** | **13263** | **13153** | **14265** |

Figure 9

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

Percentage per year

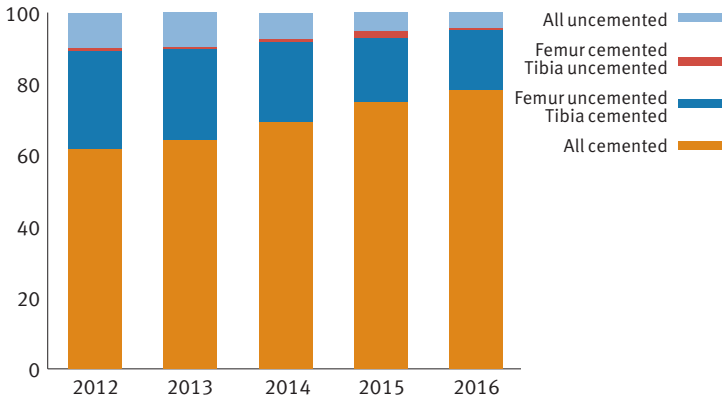



Table 32

**Primary total knee arthroplasty: Patellar component**

| | N | % |
|---|---|---|
| No | 43721 | 74.9 |
| Yes | 14603 | 25.0 |
| Status after patellectomy | 15 | 0.1 |

## 7.2 Primary partial knee arthroplasty

Of all primary knee arthroplasties, 14.3% were partial knee replacements (Table 3). The proportion has remained constant over the past five years and is with over 14% the highest in the international community, including the United Kingdom (about 9% in 2015).

Of the total number of procedures, 51% were performed in women. Mean age at surgery was almost 65 years (Table 33). In the younger age groups partial knee replacement was performed in 2% of patients younger than 45 years and 13.8% in the group between 45 to 54 years old. Elderly patients constituted 18% of the partial knee replacements performed – 16% belonged to the group aged 75–84 years and 2.1% to the group aged 85 years and older. The mean BMI was 28.3 kg/m$^2$ in the partial knee replacement group. The BMI was not recorded in 26.5% of cases. Of the total number of patients, 86% had an ASA classification of 1 or 2. In 11.2% of patients the morbidity state was not recorded.

In total, 80% of partial knee replacements were performed in hospitals that carry out more than 100 interventions per year (Table 34).

Table 33

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

2012–2016. BMI and ASA class data are only available from 2015 onwards

| Baseline patient characteristics by year | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| **N** | | **852** | **2147** | **2091** | **2278** | **2341** | **9709** |
| Diagnosis (%) | Primary OA | 93.1 | 93.7 | 94.4 | 89.5 | 91.4 | 92.2 |
| | Secondary OA | 6.9 | 6.3 | 5.6 | 10.5 | 8.6 | 7.8 |
| | Inflammatory origin | 0.2 | 0.1 | 0.1 | 0.4 | 0 | 0.2 |
| | Fracture | 0.5 | 0.2 | 0.1 | 0.7 | 0.6 | 0.4 |
| | Lesion of ligament | | | | 1.4 | 1.4 | 0.7 |
| | Infection | | | | 0.1 | 0 | 0 |
| | Osteonecrosis | 5.6 | 5.6 | 5.2 | 5.8 | 4.9 | 5.4 |
| | Other | 0.6 | 0.3 | 0.1 | 2.1 | 1.6 | 1 |
| Women (%) | | 50.8 | 50.5 | 50.5 | 52 | 49.2 | 50.6 |
| Mean age (SD) | All | 64.6 (10.9) | 65.1 (10.1) | 65.1 (10.2) | 64.7 (10.5) | 64.3 (10) | 64.8 (10.3) |
| | Women | 64.3 (11.7) | 65.8 (10) | 65.4 (10.6) | 64.5 (11.1) | 64 (10.4) | 64.8 (10.6) |
| | Men | 65 ( 9.9) | 64.4 (10.2) | 64.8 (9.7) | 64.9 (9.9) | 64.6 (9.7) | 64.7 (9.9) |
| Age group (%) | ‹45 | 2.5 | 1.4 | 1.7 | 2.5 | 2.1 | 2 |
| | 45–54 | 12.8 | 12.7 | 13.6 | 14 | 15.1 | 13.8 |
| | 55–64 | 35.6 | 33.7 | 32.2 | 32.4 | 34.6 | 33.4 |
| | 65–74 | 31.6 | 33.6 | 34.4 | 32.5 | 30.8 | 32.7 |
| | 75–84 | 15.3 | 16.4 | 16.1 | 16.3 | 15.5 | 16 |
| | 85+ | 2.3 | 2.1 | 2 | 2.2 | 2 | 2.1 |
| BMI unknown (N/%) | | | | | 676/29.7 | 542/23.2 | 1218 |
| BMI known (N) | | | | | 1602 | 1799 | 3401 |
| Mean BMI (SD) | | | | | 28.2 (4.8) | 28.4 (4.7) | 28.3 (4.7) |
| BMI (%) | ‹18.5 | | | | 0.9 | 0.4 | 0.7 |
| | 18.5–24.9 | | | | 26.7 | 25 | 25.8 |
| | 25–29.9 | | | | 42.4 | 42.4 | 42.4 |
| | 30–34.9 | | | | 20.8 | 23.3 | 22.2 |
| | 35–39.9 | | | | 7.4 | 7.1 | 7.2 |
| | 40+ | | | | 1.7 | 1.8 | 1.7 |
| ASA unknown (N/%) | | | | | 291/12.8 | 257/11.0 | 548 |
| ASA known (N) | | | | | 1987 | 2084 | 4071 |
| ASA state (%) | ASA 1 | | | | 21.8 | 20.4 | 21.1 |
| | ASA 2 | | | | 64.1 | 64.9 | 64.5 |
| | ASA 3 | | | | 14 | 14.6 | 14.3 |
| | ASA 4/5 | | | | 0.2 | 0.1 | 0.1 |

Table 34

## Primary unicompartmental knee arthroplasty: Baseline patient characteristics by hospital service volume

Calculations of hospital service volumes based on all primary and revision knee surgeries in 2016. BMI data class are only available from 2015 onwards

| Baseline patient characteristics | | <100 | 100–199 | 200–299 | 300+ |
|---|---|---|---|---|---|
| N 2012–2016 | | **2410** | **2218** | **2632** | **2449** |
| Women (%) | | 53.6 | 49 | 49.7 | 49.9 |
| Mean age (SD) | All | 64.7 (10.6) | 64.5 (9.8) | 64.5 (10.4) | 65.4 (10.1) |
| | Women | 64.5 (11) | 64.9 (10.1) | 64.5 (10.7) | 65.5 (10.5) |
| | Men | 64.9 (10.1) | 64.1 (9.4) | 64.5 (10.1) | 65.3 (9.7) |
| Age group (%) | <45 | 2.1 | 1.6 | 2.1 | 2.1 |
| | 45–54 | 14.2 | 14 | 14.4 | 12.6 |
| | 55–64 | 33.3 | 36.2 | 33 | 31.6 |
| | 65–74 | 31.7 | 32.5 | 32.8 | 33.7 |
| | 75–84 | 16.4 | 13.8 | 15.8 | 17.8 |
| | 85+ | 2.3 | 1.9 | 1.9 | 2.2 |
| Diagnosis [%] | Primary OA | 92.3 | 93 | 90.7 | 93.2 |
| | Secondary OA | 7.7 | 7 | 9.3 | 6.8 |
| N 2015–2016 | | **1173** | **1034** | **1343** | **1067** |
| BMI unknown (N/%) | | 415/35.4 | 289/27.9 | 300/22.3 | 212/19.9 |
| BMI known (N) | | 758 | 745 | 1043 | 855 |
| Mean BMI (SD) | | 28.7 (4.9) | 28.2 (4.5) | 28.4 (4.9) | 27.9 (4.6) |
| BMI (%) | <18.5 | 0.4 | 0.8 | 0.8 | 0.7 |
| | 18.5–24.9 | 23.7 | 25.2 | 25.3 | 28.8 |
| | 25–29.9 | 42 | 44.8 | 42.1 | 40.9 |
| | 30–34.9 | 23.4 | 20.8 | 22.4 | 22 |
| | 35–39.9 | 8.4 | 7 | 7.7 | 5.8 |
| | 40+ | 2.1 | 1.3 | 1.7 | 1.8 |
| ASA unknown (N/%) | | 147/12.5 | 136/13.2 | 221/16.5 | 42/3.9 |
| ASA known (N) | | 1026 | 898 | 1122 | 1025 |
| ASA state (%) | ASA 1 | 21.1 | 27.1 | 20 | 17.1 |
| | ASA 2 | 67 | 60.8 | 62.6 | 67.3 |
| | ASA 3 | 11.7 | 12.1 | 17.3 | 15.6 |
| | ASA 4/5 | 0.3 | 0.2 | | |

Table 35

## Primary unicompartmental knee arthroplasty: Surgery characteristics

| Surgery characteristics | 2012–2014 | | 2015–2016 | |
|---|---|---|---|---|
| | N | % | N | % |
| **Previous surgery** | | | | |
| None | 3184 | 62.5 | 2767 | 59.9 |
| Knee arthroscopy | 1614 | 31.7 | 1077 | 23.3 |
| Meniscectomy | | | 1035 | 22.4 |
| Osteotomy tibia close to knee | 71 | 1.4 | 66 | 1.4 |
| ACL reconstruction | | | 56 | 1.2 |
| Surgery for patella stabilization | 11 | 0.2 | 56 | 1.2 |
| Synovectomy | | | 17 | 0.4 |
| Osteosynthesis tibia close to knee | 32 | 0.6 | 16 | 0.3 |
| Osteotomy femur close to knee | 9 | 0.2 | 9 | 0.2 |
| Osteosynthesis femur close to knee | 4 | 0.1 | 9 | 0.2 |
| Surgery for treating infection | 4 | 0.1 | 4 | 0.1 |
| Surgery for tumor | | | 1 | 0.0 |
| Ligament reconstruction | 83 | 1.6 | | |
| Other | 232 | 4.6 | 113 | 2.4 |
| **Intervention** | 232 | 4.6 | 113 | 2.4 |
| Unicompartment medial | 4744 | 93.2 | 3997 | 86.6 |
| Femoropatellar | | | 339 | 7.3 |
| Unicompartment lateral | 348 | 6.8 | 281 | 6.1 |
| **Technology** | | | | |
| Conventional | 3295 | 64.7 | 3112 | 67.4 |
| Minimal invasive | 1572 | 30.9 | 1287 | 27.9 |
| Patient specific instrumentation | 236 | 4.6 | 218 | 4.7 |
| Computer assisted | 30 | 0.6 | 14 | 0.3 |
| Other | | | 14 | 0.3 |

Almost 60% of the patients had not undergone any form of surgery before partial knee replacement surgery, 23.3% had had previous arthroscopy of the knee, 22.4% a meniscectomy, 1.2% previous ACL reconstruction, and 1.4% had undergone an osteotomy close to the knee (Table 35).

Medial unicompartmental replacement was performed in 86.6% of cases, lateral in 6.1% of cases, and patello-femoral replacement in 7.3% of cases.

Over the past 5 years the use of cementless fixation has continually increased from 2.8% in 2012 to 14.8% in 2016. Hybrid fixation was used in 1.1% of cases. In total, 91% of partial knee replacements were fully cemented (Table 36, Figure 10).

Table 36

**Primary unicompartmental knee arthroplasty: Component fixation**

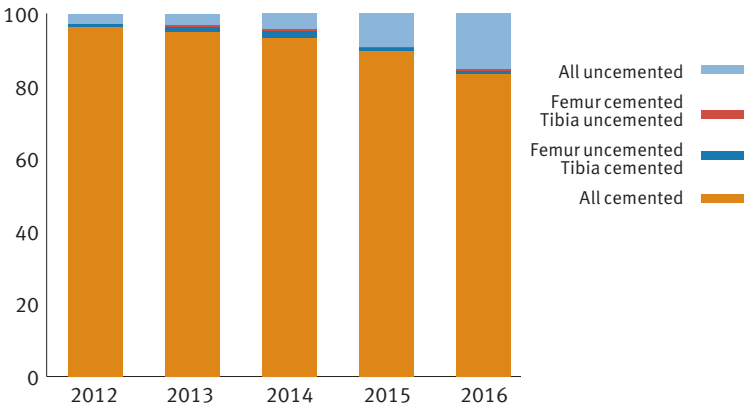
Total numbers by year

| Component fixation | N | % | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|
| Femur uncemented – Tibia uncemented | 700 | 7.5 | 24 | 72 | 90 | 193 | 321 |
| Femur cemented – Tibia uncemented | 37 | 0.4 | 2 | 9 | 9 | 7 | 10 |
| Femur uncemented – Tibia cemented | 105 | 1.1 | 6 | 28 | 39 | 15 | 17 |
| Femur cemented – Tibia cemented | 8528 | 91.0 | 820 | 2038 | 1953 | 1897 | 1820 |
| **Total** | **9370** | **100** | **852** | **2147** | **2091** | **2112** | **2168** |

Figure 10

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

Percentage by year



## 7.3 Revision of knee arthroplasty

Of the 74'567 knee arthroplasty procedures recorded in SIRIS between September 2012 and December 2016, 7'419 were revisions of total or partial knee arthroplasties. This corresponds to a revision burden of 9.9% (Table 3). Of those revisions, 59% were performed in women. Mean age at revision surgery was 68.2 years (Table 37). Similar to primary total knee arthroplasty, revision was infrequent in younger and older patients (1.5% in patients younger than 45 years old; 8.2% in the age group 45–54 years; 4.8% in patients older than 85 years, respectively). The mean BMI was at 29.6 kg/m$^2$. The proportion of missing data was 29.6%. The morbidity state was rated ASA class 1 or 2 in 62.2% of cases where this information was provided. In 13.5% of cases morbidity state was not recorded.

Table 37
**Revision knee arthroplasty: Baseline patient characteristics by year**
2012–2015, BMI and ASA class data only available from 2015 onwards

| Baseline patient characteristics | | 2012 | 2013 | 2014 | 2015 | 2016 | All |
|---|---|---|---|---|---|---|---|
| **N** | | **529** | **1464** | **1605** | **1734** | **2087** | **7419** |
| Women (%) | | 59.5 | 60.9 | 57.4 | 58.8 | 59 | 59 |
| Mean age (SD) | All | 68.5 (9.9) | 68.2 (10.7) | 67.5 (11.4) | 68.3 (10.9) | 68.5 (10.4) | 68.2 (10.8) |
| | Women | 69.2 (10.1) | 68.6 (11.1) | 68.2 (12) | 68.8 (11) | 69.3 (10.5) | 68.8 (11) |
| | Men | 67.5 (9.5) | 67.5 (10.1) | 66.7 (10.5) | 67.7 (10.6) | 67.3 (10.3) | 67.3 (10.3) |
| Age group (%) | ‹45 | 0.8 | 1.6 | 2.1 | 1.6 | 1.2 | 1.5 |
| | 45–54 | 7.2 | 8 | 9.1 | 8.6 | 7.8 | 8.2 |
| | 55–64 | 25 | 25.1 | 25.9 | 24.8 | 25.8 | 25.4 |
| | 65–74 | 38.9 | 35.8 | 34 | 35.1 | 35.9 | 35.5 |
| | 75–84 | 25.1 | 25.3 | 24.2 | 25 | 23.8 | 24.5 |
| | 85+ | 3 | 4.2 | 4.7 | 5 | 5.5 | 4.8 |
| BMI unknown (N/%) | | | | | 484/27.9 | 590/28.3 | 1074 |
| BMI known (N) | | | | | 1250 | 1497 | 2747 |
| Mean BMI (SD) | | | | | 29.4 (5.7) | 29.8 (7.2) | 29.6 (6.6) |
| BMI (%) | ‹18.5 | | | | 0.9 | 1.1 | 1 |
| | 18.5–24.9 | | | | 22.2 | 18.5 | 20.2 |
| | 25–29.9 | | | | 36.2 | 38 | 37.2 |
| | 30–34.9 | | | | 25.8 | 26.4 | 26.1 |
| | 35–39.9 | | | | 10.8 | 11.2 | 11 |
| | 40+ | | | | 4.1 | 4.9 | 4.5 |
| ASA unknown (N/%) | | | | | 260/15.0 | 281/13.5 | 541 |
| ASA known (N) | | | | | 1474 | 1806 | 3280 |
| ASA state (%) | ASA 1 | | | | 9.2 | 7.8 | 8.4 |
| | ASA 2 | | | | 53.1 | 54.4 | 53.8 |
| | ASA 3 | | | | 36.5 | 36.3 | 36.4 |
| | ASA 4/5 | | | | 1.3 | 1.5 | 1.4 |

Patella problems were the leading cause for revision knee arthroplasty with 21.8%, followed by loosening of the tibial component in 20.2% of cases, and infection in 18% of cases (Table 38). Grouping together patella problems, patellar instability and loosening, femoropatellar problems were responsible for 25% of revisions. Femorotibial instability of the primary TKA was the reason for revision in 14.5% of cases, and loosening of the femur in 12.7%. 12.1% of knees were revised because of painful TKA. Wear of the inlay was only recorded in 5.9% of the revisions. In 34.2% of cases, the revision was complete, in 15.4% only an inlay exchange was performed (Table 48). In 13.2% of patients a secondary resurfacing of the patella was performed, in a further 3.6% this was combined with an exchange of the tibial insert. Including 3.6% of patellar revisions without resurfacing, patellar revisions were performed in 20% of revisions. Of these revisions, 8% were conversions from a partial to a total knee arthroplasty. In 83.8% of cases fully cemented versions were used; hybrid fixation was performed in 9.2% of cases, and uncemented fixation in 6.5% of cases (Table 39).

Table 38

**Reason for revision of knee arthroplasty**

Multiple reasons are possible per patient. The reasons for revision categories as listed below are only available from 2015 onwards

| Reason for revision | 2015–2016 | |
|---|---|---|
| | N | % |
| Patella problems | 832 | 21.8 |
| Loosening tibia | 769 | 20.2 |
| Infection | 687 | 18.0 |
| Femorotibial instability | 552 | 14.5 |
| Loosening femur | 483 | 12.7 |
| Pain | 463 | 12.1 |
| Wear of inlay | 226 | 5.9 |
| Joint stiffness/arthrofibrosis | 213 | 5.6 |
| Progression of unicomp. OA | 188 | 4.9 |
| Component malposition femur | 174 | 4.6 |
| Component malposition tibia | 162 | 4.2 |
| Patellar instability | 72 | 1.9 |
| Loosening patella | 71 | 1.9 |
| Periprosthetic fracture femur | 69 | 1.8 |
| Sizing femoral component | 44 | 1.2 |
| Periprosthetic fracture tibia | 33 | 0.9 |
| Sizing tibial component | 22 | 0.6 |
| Periprosthetic fracture patella | 9 | 0.2 |
| Other | 393 | 10.3 |

Table 39

## Surgery characteristics of revision of knee arthroplasty

| Surgery characteristics | 2012–2014 | | 2015–2016 | |
|---|---|---|---|---|
| **Intervention type** | **N** | **%** | **N** | **%** |
| Complete revision | 1724 | 47.8 | 1302 | 34.2 |
| Exchange of PE | 502 | 13.9 | 588 | 15.4 |
| Subsequent patella replacement | 353 | 9.8 | 505 | 13.2 |
| Conversion from unicompartimental to TKA | | | 304 | 8.0 |
| Tibial revision | 261 | 7.2 | 221 | 5.8 |
| Reimplantation of prosthesis | 190 | 5.3 | 213 | 5.6 |
| Subsequent patella prosthesis with exchange of PE | | | 137 | 3.6 |
| Patella revision | 189 | 5.2 | 122 | 3.2 |
| Component removal with spacer implantation | 124 | 3.4 | 118 | 3.1 |
| Femoral revision | 103 | 2.9 | 97 | 2.5 |
| Prosthesis preserving revision | | | 37 | 1.0 |
| Component removal without spacer implantation | | | 16 | 0.4 |
| Osteosynthesis | | | 16 | 0.4 |
| Arthrodesis | 1 | 0.0 | 8 | 0.2 |
| Other | 160 | 4.4 | 128 | 3.4 |
| **Type of arthroplasty** | | | | |
| Unlinked posterior stabilised | 896 | 27.0 | 537 | 25.1 |
| Hinge type | 520 | 15.7 | 366 | 17.1 |
| CS (cruciate sacrificing) / UCOR | | | 312 | 14.6 |
| CCK constrained condylar knee* | 519 | 15.6 | 597 | 27.9 |
| PCR (posterior cruciate retaining) | | | 188 | 8.8 |
| Unicompartment medial | 74 | 2.2 | 27 | 1.3 |
| BCR (bicruciate retaining) | | | 20 | 0.9 |
| Patellofemoral | | | 6 | 0.3 |
| Unicompartment lateral | 6 | 0.2 | | |
| Unlinked rotating | 541 | 16.3 | | |
| Unlinked cruciate retaining | 368 | 11.1 | | |
| Unlinked meniscal | 187 | 5.6 | | |
| Other | 211 | 6.4 | 87 | 4.1 |
| **Technology** | 3043 | 84.4 | 3205 | 84.1 |
| Conventional | 113 | 3.1 | 133 | 3.5 |
| Computer assisted | 152 | 4.2 | 129 | 3.4 |
| Minimal invasive | 31 | 0.9 | 52 | 1.4 |
| Patient specific instrumentation | | | 15 | 0.4 |
| Other | | | 14 | 0.4 |

* Includes «unlinked semi-constrained»

Table 40

## Revision of knee arthroplasty: Component fixation

Percentage by year. Status after revision

| Component fixation | N | % | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|
| Femur uncemented – Tibia uncemented | 354 | 6.5 | 48 | 92 | 151 | 30 | 33 |
| Femur cemented – Tibia uncemented | 78 | 1.5 | 6 | 22 | 22 | 14 | 14 |
| Femur uncemented – Tibia cemented | 450 | 8.2 | 46 | 144 | 142 | 66 | 52 |
| Femur cemented – Tibia cemented | 4574 | 83.8 | 393 | 1094 | 1153 | 873 | 1061 |
| **Total** | **5456** | **100** | **493** | **1352** | **1468** | **983** | **1160** |

Figure 11

## Component fixation in revision knee arthroplasty by year

Component fixation only applicable when new components were implanted. Percentage by year

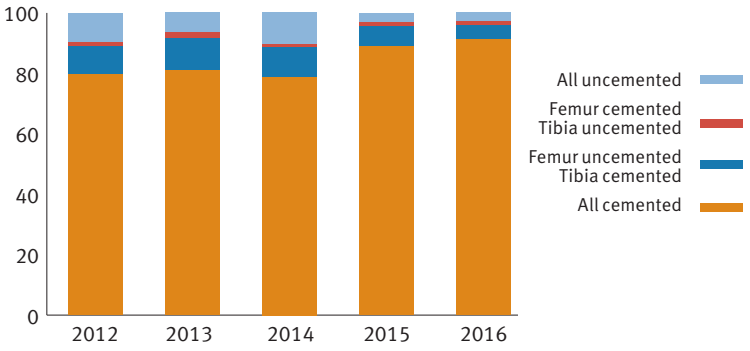



Table 41

## Revision of knee arthroplasty: Patellar component

Status after revision

| Patellar components | N | % |
|---|---|---|
| Without patellar replacement | 3148 | 50.6 |
| With patellar replacement | 3067 | 49.2 |
| Status after patellectomy | 11 | 0.2 |

## 7.4 First revision of a primary total knee arthroplasty

Documented since 2012. Table 42 includes all first revisions of primary TKAs registered since the implementation of the registry in September 2012. Overall, 1'327 of the 58'339 primary TKAs had to be revised, corresponding to a 2-year revision rate of 2.3%. These revisions were performed to 88% at the same institution as the primary implantation.

712 primary TKAs (61.1%) were revised within the first year after the index surgery, 453 TKAs (38.9%) during the second year, resulting in 1'165 revisions

Table 42
**First revision of primary total knee arthroplasty: Baseline patient characteristics**

| Baseline patient characteristics | | Primary | Revised | | Revised in same service | |
|---|---|---|---|---|---|---|
| | | N | N | % | N | % |
| **Overall 2012–2016** | | **58339** | **1327** | **2.3** | **1168** | **88.0** |
| Diagnosis | Primary OA | 53977 | 1241 | 2.3 | 1096 | 88.3 |
| | Secondary OA | 4362 | 86 | 2.0 | 72 | 83.7 |
| Overall Primary OA 2012–2016 | | 53977 | 1241 | 2.3 | 1097 | 88.4 |
| Gender | Women | 33243 | 728 | 2.2 | 648 | 89.0 |
| | Men | 20734 | 513 | 2.5 | 448 | 87.3 |
| Age group | ‹55 | 3606 | 138 | 3.8 | 124 | 89.9 |
| | 55–64 | 12343 | 371 | 3.0 | 314 | 84.6 |
| | 65–74 | 20246 | 426 | 2.1 | 384 | 90.1 |
| | 75–84 | 15378 | 273 | 1.8 | 244 | 89.4 |
| | 85+ | 2404 | 33 | 1.4 | 30 | 90.9 |
| Overall primary OA (2015–2016) | | 24092 | 382 | 1.6 | 326 | 85.3 |
| BMI group | ‹18.5 | 75 | 0 | 0.0 | 0 | |
| | 18.5–24.9 | 3770 | 58 | 1.5 | 45 | 77.6 |
| | 25–29.9 | 7281 | 119 | 1.6 | 106 | 89.1 |
| | 30–34.9 | 4612 | 70 | 1.5 | 59 | 84.3 |
| | 35–39.9 | 2027 | 35 | 1.7 | 32 | 91.4 |
| | 40+ | 902 | 17 | 1.9 | 14 | 82.4 |
| | BMI unknown | 5425 | 83 | 1.5 | 70 | 84.3 |
| ASA state | ASA 1 | 2143 | 41 | 1.9 | 34 | 82.9 |
| | ASA 2 | 13210 | 187 | 1.4 | 162 | 86.6 |
| | ASA 3 | 5810 | 114 | 2.0 | 99 | 86.8 |
| | ASA 4/5 | 73 | 3 | 4.1 | 3 | 100.0 |
| | ASA unknown | 2856 | 37 | 1.3 | 28 | 75.7 |

or a 2% revision rate within 24 months (Table 43). The risk of revision clearly depended on the patient's age and BMI and was higher for younger and/or heavier patients, even more so at 24 than at 12 months.

Patella problems constituted the main reason for an early revision (Table 45). Together with patellar instability and patella loosening, the patella led to 37% of early revisions within 24 months after index surgery. They were followed by periprosthetic infection, pain, femoro-tibial instability, and early

Table 43

**First revision of primary total knee arthroplasty within 12 months and 24 months: Baseline patient characteristics**

| Baseline patient characteristics | | Primary | Revised within 12 months | | | | Revised within 24 months | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Revised | | 95% CI | | Revised | | 95% CI | |
| | | N | N | % | lower | upper | N | % | lower | upper |
| **Overall 2012–2016** | | **58339** | **712** | **1.2** | **1.1** | **1.3** | **1165** | **2.0** | **1.9** | **2.1** |
| Diagnosis | Primary OA | 53977 | 653 | 1.2 | 1.1 | 1.3 | 1086 | 2.0 | 1.9 | 2.1 |
| | Secondary OA | 4362 | 59 | 1.4 | 1.0 | 1.7 | 79 | 1.8 | 1.4 | 2.2 |
| Overall Primary OA 2012–2016 | | 53977 | 653 | 1.2 | 1.1 | 1.3 | 1086 | 2.0 | 1.9 | 2.1 |
| Gender | Women | 33243 | 376 | 1.1 | 1.0 | 1.2 | 623 | 1.9 | 1.7 | 2.0 |
| | Men | 20734 | 277 | 1.3 | 1.2 | 1.5 | 463 | 2.2 | 2.0 | 2.4 |
| Age group [%] | ‹55 | 3606 | 65 | 1.8 | 1.4 | 2.2 | 115 | 3.2 | 2.6 | 3.8 |
| | 55–64 | 12343 | 181 | 1.5 | 1.3 | 1.7 | 320 | 2.6 | 2.3 | 2.9 |
| | 65–74 | 20246 | 202 | 1.0 | 0.9 | 1.1 | 367 | 1.8 | 1.6 | 2.0 |
| | 75–84 | 15378 | 179 | 1.2 | 1.0 | 1.3 | 253 | 1.6 | 1.4 | 1.8 |
| | 85+ | 2404 | 26 | 1.1 | 0.7 | 1.5 | 31 | 1.3 | 0.8 | 1.7 |
| Overall Primary OA 2015–2016 | | 24092 | 279 | 1.2 | 1.0 | 1.3 | 382 | 1.6 | 1.4 | 1.7 |
| BMI group | ‹18.5 | 75 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0.0 |
| | 18.5–24.9 | 3770 | 40 | 1.1 | 0.7 | 1.4 | 58 | 1.5 | 1.1 | 1.9 |
| | 25–29.9 | 7281 | 89 | 1.2 | 1.0 | 1.5 | 119 | 1.6 | 1.3 | 1.9 |
| | 30–34.9 | 4612 | 49 | 1.1 | 0.8 | 1.4 | 70 | 1.5 | 1.2 | 1.9 |
| | 35–39.9 | 2027 | 28 | 1.4 | 0.9 | 1.9 | 35 | 1.7 | 1.2 | 2.3 |
| | 40+ | 902 | 14 | 1.6 | 0.7 | 2.4 | 17 | 1.9 | 1.0 | 2.8 |
| | BMI unknown | 5425 | 59 | 1.1 | 0.8 | 1.4 | 83 | 1.5 | 1.2 | 1.9 |
| Morbidity state | ASA 1 | 2143 | 30 | 1.4 | 0.9 | 1.9 | 41 | 1.9 | 1.3 | 2.5 |
| | ASA 2 | 13210 | 133 | 1.0 | 0.8 | 1.2 | 187 | 1.4 | 1.2 | 1.6 |
| | ASA 3 | 5810 | 87 | 1.5 | 1.2 | 1.8 | 114 | 2.0 | 1.6 | 2.3 |
| | ASA 4/5 | 73 | 2 | 2.7 | -1.0 | 6.5 | 3 | 4.1 | -0.4 | 8.7 |
| | ASA unknown | 2856 | 27 | 0.9 | 0.6 | 1.3 | 37 | 1.3 | 0.9 | 1.7 |

Table 44

## First revision of primary total knee arthroplasty within 12 months and 24 months overall and according to component fixation

| Component fixation | Primary TKA | Revised within 12 months | | | | Revised within 24 months | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Revised | | 95% CI | | Revised | | 95% CI | |
| | N | N | % | lower | upper | N | % | lower | upper |
| Overall | 53977 | 653 | 1.2 | 1.1 | 1.3 | 1086 | 2.0 | 1.9 | 2.1 |
| **Component fixation** | | | | | | | | | |
| Femur and tibia cemented | 38092 | 462 | 1.2 | 1.1 | 1.3 | 751 | 2.0 | 1.8 | 2.1 |
| Femur and tibia uncemented | 3808 | 52 | 1.4 | 1.0 | 1.7 | 93 | 2.4 | 2.0 | 2.9 |
| Femur cemented, tibia uncemented | 475 | 11 | 2.3 | 1.0 | 3.7 | 16 | 3.4 | 1.7 | 5.0 |
| Femur uncemented, tibia cemented | 11602 | 128 | 1.1 | 0.9 | 1.3 | 226 | 1.9 | 1.7 | 2.2 |
| **Patellar replacement** | | | | | | | | | |
| With patellar replacement | 13489 | 145 | 1.1 | 0.9 | 1.2 | 215 | 1.6 | 1.4 | 1.8 |
| Without patellar replacement | 40477 | 508 | 1.3 | 1.1 | 1.4 | 871 | 2.2 | 2.0 | 2.3 |
| Status after patellectomy | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 45

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

Multiple reasons are possible per patient. The reasons for revision categories as listed below only are available from 2015 onwards

| Reason for early first revision | 2015–2016 | |
|---|---|---|
| | N | % |
| Patella problems | 288 | 33.7 |
| Infection | 143 | 16.7 |
| Pain | 114 | 13.3 |
| Femorotibial instability | 110 | 12.9 |
| Loosening tibia | 91 | 10.6 |
| Joint stiffness/arthrofibrosis | 68 | 8.0 |
| Loosening femur | 27 | 3.2 |
| Patellar instability | 23 | 2.7 |
| Component malposition tibia | 22 | 2.6 |
| Component malposition femur | 19 | 2.2 |
| Wear of inlay | 11 | 1.3 |
| Loosening patella | 8 | 0.9 |
| Sizing femoral component | 8 | 0.9 |
| Progression of unicomp. OA | 7 | 0.8 |
| Periprosthetic fracture femur | 6 | 0.7 |
| Periprosthetic fracture tibia | 5 | 0.6 |
| Periprosthetic fracture patella | 5 | 0.6 |
| Sizing tibial component | 3 | 0.4 |
| Other | 111 | 13.0 |

loosening of the tibia. Of the total number of revision reasons, 13% were classified as "other", which may cause underestimation and possibly distortion of the main reasons. Moreover, periprosthetic fractures may be underreported, as many of the institutions only register this complication when associated with revision of a prosthetic component.

Figure 12 shows that prosthesis infection was detected and revised early after primary TKA, followed by stiffness, which was revised on average after 6–9 months, whereas patella problems were revised on average after one year, similar to pain and early loosening of the tibia.

Figure 12

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

N= 1327

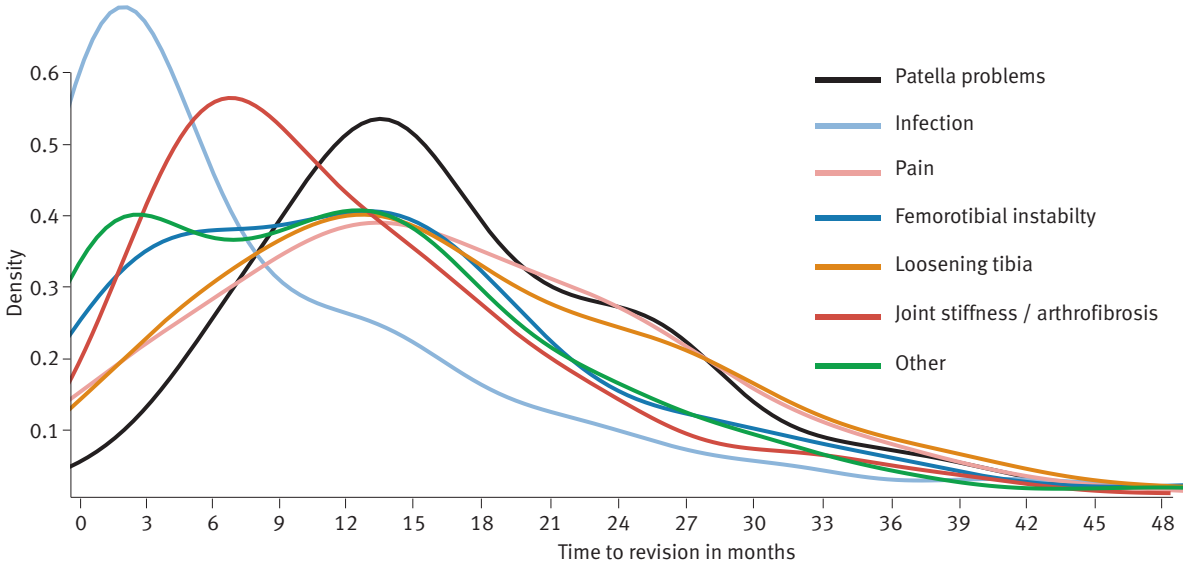



Table 46

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

| Reason for early first revision | N | Median (IQR) |
|---|---|---|
| Patella problems | 288 | 15 ( 11; 22) |
| Infection | 248 | 4.1 (1.1; 13) |
| Pain | 114 | 15 (8.9; 22) |
| Femoral instability | 176 | 12 (5.1; 18) |
| Loosening tibia | 142 | 14 (8.8; 22) |
| Joint stiffness/arthrofibrosis | 117 | 9.4 (5.4; 16) |
| Other | 569 | 11 (3.9; 17) |

## 7.5 First revision of a primary partial knee arthroplasty

Documented since 2012, primary partial knee arthroplasty led to an early revision rate (major revision including the exchange of one or more components) in 3% of cases (Table 47).

Of the total number of revisions, 87.8% were performed in the same institution. Patients younger than 65 years of age at the time of surgery underwent revision more often than those over 65 years of age.

Table 47

**First revision of primary partial knee arthroplasty: Overall and according to baseline characteristics**

| Baseline patient characteristics | | | Revised | | Revised same service | | Revised within 12 months | | | | Revised within 24 months | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Revised | | 95% CI | | Revised | | 95% CI | |
| | | N | N | % | N | % | N | % | lower | upper | N | % | lower | upper |
| **Overall** | | **9709** | 294 | 3.0 | 258 | 87.8 | **151** | **1.6** | **1.3** | **1.8** | **240** | **2.5** | **2.2** | **2.8** |
| Gender | Women | 4911 | 144 | 2.9 | 123 | 85.4 | 73 | 1.5 | 1.1 | 1.8 | 122 | 2.5 | 2.0 | 2.9 |
| | Men | 4798 | 150 | 3.1 | 135 | 90.0 | 78 | 1.6 | 1.3 | 2.0 | 118 | 2.5 | 2.0 | 2.9 |
| Age group | <55 | 1533 | 67 | 4.4 | 61 | 91.0 | 29 | 1.9 | 1.2 | 2.6 | 50 | 3.3 | 2.4 | 4.2 |
| | 55–64 | 3246 | 119 | 3.7 | 101 | 84.9 | 69 | 2.1 | 1.6 | 2.6 | 100 | 3.1 | 2.5 | 3.7 |
| | 65–74 | 3172 | 71 | 2.2 | 62 | 87.3 | 35 | 1.1 | 0.7 | 1.5 | 60 | 1.9 | 1.4 | 2.4 |
| | 75–84 | 1554 | 35 | 2.3 | 33 | 94.3 | 18 | 1.2 | 0.6 | 1.7 | 28 | 1.8 | 1.1 | 2.5 |
| | 85+ | 204 | 2 | 1.0 | 1 | 50.0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 1.0 | 0.0 | 2.3 |

Early loosening of the tibia and the femur were responsible for 47% of the revisions within 24 months after index surgery (Table 48). Pain was the second most common reason for revision in 18.9% of cases. Compared to total knee arthroplasty, revision for prosthetic infection was less common in partial knee arthroplasty (8.6% versus 16.7%).

Table 48

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

Multiple reasons are possible per patient. The reasons for revision categories as listed below are only available from 2015 onwards.

| | 2015–2016 | |
|---|---|---|
| | N | % |
| Loosening tibia | 54 | 30.9 |
| Pain | 33 | 18.9 |
| Loosening femur | 28 | 16 |
| Progression of unicomp. OA | 24 | 13.7 |
| Infection | 15 | 8.6 |
| Femorotibial instability | 13 | 7.4 |
| Patella problems | 8 | 4.6 |
| Periprosthetic fracture tibia | 6 | 3.4 |
| Wear of inlay | 6 | 3.4 |
| Component malposition tibia | 6 | 3.4 |
| Joint stiffness/Arthrofibrosis | 3 | 1.7 |
| Loosening patella | 2 | 1.1 |
| Component malposition femur | 1 | 0.6 |
| Sizing tibial component | 1 | 0.6 |
| Sizing femoral component | 1 | 0.6 |
| Other | 28 | 16 |

# 8. Participating hospitals

Asana Gruppe AG, Spital Menziken
Asana Gruppe, Spital Leuggern
Berit Klinik, Speicher
Center da Sandà, Engiadina Bassa CSEB, Scuol
Centre Hospitalier Universitaire Vaudois CHUV, Lausanne
CIC Groupe Santé SA, Clinique CIC Riviera Centre, Clarens
CIC Groupe Santé SA, Valais, Saxon
Clinica Luganese SA, Lugano
Clinica Santa Chiara SA, Locarno
Clinique de la Source, Lausanne
Clinique des Grangettes SA, Chêne-Bougeries
Clinique Générale Beaulieu, Genève
EHC, Hôpital de Morges
eHnv, Hôpital St-Loup, Pompaples
eHnv, Hôpital Yverdon-les-Bains
EOC, Ospedale regionale di Bellinzona (San Giovanni)
EOC, Ospedale regionale di Locarno (La Carità)
EOC, Ospedale regionale di Lugano (Civico e Italiano)
EOC, Ospedale regionale di Mendrisio (Beata Vergine)
Flury Stiftung, Spital Schiers
Gesundheitszentrum Fricktal AG, Spital Laufenburg
Gesundheitszentrum Fricktal AG, Spital Rheinfelden
Groupement Hospitalier de l'Ouest Lémanique GHOL, Nyon
GZO AG Spital Wetzikon
Hirslanden AndreasKlinik Cham, Zug
Hirslanden Bern AG, Klinik Beau-Site, Bern
Hirslanden Bern AG, Klinik Permanence, Bern
Hirslanden Bern AG, Klinik Salem, Bern
Hirslanden Clinique La Colline SA, Genève
Hirslanden Klinik Aarau
Hirslanden Klinik am Rosenberg, Heiden
Hirslanden Klinik Belair, Schaffhausen
Hirslanden Klinik im Park, Zürich
Hirslanden Klinik St. Anna AG, Luzern
Hirslanden Klinik St. Anna AG, Meggen
Hirslanden Klinik Stephanshorn, St. Gallen
Hirslanden Lausanne SA, Clinique Bois-Cerf, Lausanne
Hirslanden Klinik Birshof AG, Münchenstein
Hôpital du Jura bernois SA, Site de Moutier
Hôpital du Jura bernois SA, Site de Saint-Imier
Hôpital du Jura, Site de Delémont
Hôpital du Pays-d'Enhaut, Château-d'Oex
Hôpital du Valais (RSV), Martigny (no Data until now)
Hôpital du Valais (RSV), Sion (no Data until now)
Hôpital du Valais SZO, Spital Brig
Hôpital du Valais SZO, Spital Visp
Hôpital fribourgeois HFR, Hôpital cantonal, Fribourg
Hôpital fribourgeois HFR, Site de Riaz
Hôpital fribourgeois HFR, Site de Tafers
Hôpital intercantonal de la Broye HIB, Payerne
Hôpital neuchâtelois HNE, Site de la Chaux-de-Fonds
Hôpital neuchâtelois HNE, Site de Pourtalès, Neuchâtel
Hôpital Riviera Chablais, Site de Monthey
Hôpital Riviera Chablais, Site de Montreux
Hôpital Riviera Chablais, Site de Vevey
Hôpitaux Universitaires de Genève (HUG)
Insel Gruppe AG, Inselspital, Bern
Inselgruppe AG, Spital Aarberg
Inselgruppe AG, Spital Münsingen
Inselgruppe AG, Spital Riggisberg
Inselgruppe AG, Spital Tiefenau, Bern
Kantonales Spital und Pflegeheim Appenzell
Kantonsspital Aarau AG
Kantonsspital Baden AG
Kantonsspital Baselland, Standort Bruderholz
Kantonsspital Baselland, Standort Laufen
Kantonsspital Baselland, Standort Liestal
Kantonsspital Glarus AG
Kantonsspital Graubünden, Chur
Kantonsspital Nidwalden, Stans
Kantonsspital Obwalden, Sarnen
Kantonsspital St. Gallen, Spital Flawil
Kantonsspital St. Gallen, Spital Rorschach
Kantonsspital St. Gallen, Standort St. Gallen
Kantonsspital Uri, Altdorf
Kantonsspital Winterthur
Klinik Gut, Fläsch
Klinik Gut, St. Moritz
Klinik Hirslanden Zürich
Klinik Hohmad, Thun
Klinik Pyramide am See AG, Zürich
Klinik Seeschau AG, Kreuzlingen

Klinik Siloah AG, Gümligen
Klinik St.Georg Goldach AG
La Tour Réseau de Soins SA, Hôpital de la Tour, Meyrin
Lindenhofgruppe, Klinik Sonnenhof, Bern
Lindenhofgruppe, Lindenhofspital Bern
Luzerner Kantonsspital LUKS, Luzern
Luzerner Kantonsspital LUKS, Sursee
Luzerner Kantonsspital LUKS, Wolhusen
Merian Iselin Klinik, Basel
Nouvelle Clinique Vert-Pré SA, Conches-Genève
Praxisklinik Rennbahn AG, Muttenz
Hirslanden Klinik Linde AG, Biel
Regionalspital Surselva AG, Ilanz
Réseau Santé Balcon du Jura RSBJ, St. Croix
Rosenklinik, Rapperswil
Schulthess Klinik, Zürich
See-Spital, Horgen
See-Spital, Kilchberg
SMN SA, Clinica Ars Medica, Gravesano
SMN SA, Clinique de Genolier
SMN SA, Clinique de Montchoisi, Lausanne
SMN SA, Clinique de Valère, Sion
SMN SA, Clinique Générale Ste-Anne SA, Fribourg
SMN SA, Clinique Montbrillant, La Chaux-de-Fonds
SMN SA, Hôpital de la Providence, Neuchâtel
SMN SA, Klinik Villa im Park AG, Rothrist
SMN SA, Privatklinik Bethanien, Zürich
SMN SA, Privatklinik Lindberg, Winterthur
SMN SA, Privatklinik Obach AG, Solothurn
Solothurner Spitäler AG, Bürgerspital Solothurn
Solothurner Spitäler AG, Kantonsspital Olten
Solothurner Spitäler AG, Spital Dornach
Spital Affoltern, Affoltern a. A.
Spital Bülach
Spital Davos AG
Spital Einsiedeln
Spital Emmental AG, Burgdorf
Spital Emmental AG, Langnau
Spital Lachen AG
Spital Limmattal, Schlieren
Spital Linth, Uznach
Spital Männedorf AG
Spital Muri
Spital Oberengadin, Samedan
Spital Schwyz
Spital STS AG, Spital Thun
Spital Thurgau AG, Kantonsspital Frauenfeld
Spital Thurgau AG, Kantonsspital Münsterlingen
Spital Thusis
Spital Uster
Spital Zofingen
Spital Zollikerberg
Spitäler fmi AG, Spital Frutigen
Spitäler fmi AG, Spital Interlaken
Spitäler Schaffhausen. Kantonsspital
Spitalregion Fürstenland Toggenburg, Spital Wattwil
Spitalregion Fürstenland Toggenburg, Spital Wil
Spitalregion Rheintal Werdenberg Sarganserland, Spital Grabs
Spitalregion Rheintal Werdenberg Sarganserland, Spital Walenstad
Spitalregion Rheintal, Werdenberg, Sarganserland, Spital Altstätten
Spitalverbund Appenzell Ausserrhoden, Heiden
Spitalverbund Appenzell Ausserrhoden, Herisau
Spitalzentrum Biel AG
SRO AG, Spital Langenthal
St. Claraspital AG, Basel
Stadtspital Triemli, Zürich
Stadtspital Waid, Zürich
Universitätsklinik Balgrist, Zürich
Universitätsspital Basel USB
UniversitätsSpital Zürich
Zuger Kantonsspital AG, Baar

**Foundation for quality assurance**
**in implant surgery – SIRIS**

c/o conidea GmbH
Waldheimstrasse 22
3604 Thun

info@siris-implant.ch
siris-implant.ch