Swedish Hip Arthroplasty Register

Annual Report 2011

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Contents

Footnote. A number of descriptive tables have been moved from our printed Annual Report and published solely on our website. This also applies to the chapter ”Environment and Technology Profile”. In previous years the Annual Report ended with a summary that is now published only on the website. The Registry’s website can found at: www.shpr.se.

Introduction

In December 2011 Swedish quality registers obtained heavily increased financial support, much to the great satisfaction of all faithful Registry workers. For the first time in the Swedish Hip Arthroplasty Register´s 30-year history the Registry is now approaching full financing. Moreover, the Registry gained a three-year contract, radically improving possibilities for necessary long-term planning of its activities. As a consequence of the state's increased investment in the Registry, a new national and hierarchical system for "leading and guiding" of the register sphere was introduced. The state's contract with the Swedish Association of Local Authorities and Regions (SALAR) covers 1.5 billion SEK during a five-year period of operations and development of the current 100 National Quality Registers. The Registry's management is of the understanding that this considerable allocation "demands" increased supervision and a more thorough "regulatory government office" for the Registry than before. However, we are completely convinced that the professions, even in the future, should initiate, analyze, interpret and research the registers. We see a risk to continuing development if the Registry becomes all too hierarchically controlled. The entire concept of the profession scrutinizing and developing its own care quality can be toppled by an all too centrally controlled system.

The Swedish Hip Arthroplasty Register is a merging of two registers: one for operations with total hip arthroplasty with osteoarthritis/arthritis as the main indication, and one for operations with a hemiarthroplasty with hip fracture as the main indication. The patient groups vary widely: a relatively healthy population with an average age just under 70 and a group of patients with an average age of 84 with pronounced medical comorbidity and short life expectancy.

The Swedish Hip Arthroplasty Register is now in its 33rd year of activities. Analyses of different types of implants and the importance of surgical techniques for reoperation frequency, both short and long term, remain a central task of the Registry. The Registry's continual feedback to the profession has brought about national adaptation of optimal technique and the use of few but well-documented implant types. This has resulted in continually improved implant survival.

The Registry's main task, however, is to analyze the entire process of arthroplasty, that is, to identify predictors for both good and poor outcomes in a multidimensional and individual-based manner. The 10-year survival of our most common and well-documented implants is currently over 95%, and the potential for improvement exists chiefly within certain patient groups. There is probably a greater possibility for outcome improvement from a patient perspective through optimizing work on indications, care processes, pre- and postoperative information, rehabilitation and implementation of non-surgical, early management of patients with osteoarthritis of the hip – in other words, to operate the right patient at the right time with the right technique.

Open reporting

The Swedish Hip Arthroplasty Register openly reports a large number of outcome variables at unit and aggregate county council levels. Five of these variables make up the national quality indicators in Regional Comparisons: 1. Patient-reported health gains (EQ-5D-index gains after 1 year), 2. Patient satisfaction one year after total hip arthroplasty, 3. Short-term complications two years after total hip arthroplasty, 4. Ten-year prosthetic survival and 5. One-year prosthetic survival for hemiarthroplasty.

Annual News

The Registry has, besides its earlier continual validation process throughout the year, also started local monitoring. The clinics are visited by the Registry's coordinators who compare register data with local patient-administrative and local medical records data. During the coming year the Registry hopes to monitor approximately 10 hospitals yearly. In our striving to map possible hidden statistics regarding secondary interventions, we have linked up with the Swedish Prescribed Drug Register and found a number of unreported cases of infection.

Since "choice of primary care" for patients is being successively introduced across the country we have thus initiated an adaptation of the Annual Report to "choice of primary care" where we have created the "the typical patient" via statistical analyses of our extensive database. Comparisons of the results of this "case-mix"-adjusted population can, in the future, facilitate pedagogy in the Annual Report regarding "free choice of care".

In-depth analyses

The Registry's continual registration and regular reports of standard results are important for maintaining the high quality of hip replacement surgery. We have, for several years, also carried out and reported a number of in-depth analyses from different perspectives. These analyses are not only intended for clinical improvement but for new development and publication of scientific reports as well. The road to scientific publication often takes years, and does not always reach all colleagues. A carefully considered alternative to both these report systems is probably the optimal way of spreading register results.

The Swedish Hip Arthroplasty Register and clinical research

National Quality Registers have long been poorly exploited for clinical research. We now see a shift within register research toward an increased interest in observational studies from the rest of the medical research world. The Registry's research activity is greater than ever before with 13 PhD students and more on their way to signing up. In order to broaden research fields and operational analyses we have, throughout the year, implemented a number of interconnecting projects with health data registers at the National Board of Health and Welfare and Statistics Sweden (Statistiska Centralbyran). During 2011 and the first half of 2012 the Registry has published 17 articles with four in press in "peer-reviewed journals". An additional four manuscripts have been submitted during this period.

International cooperation

During the year the Registry's international cooperation intensified. The Registry is a member of three international organizations linking their databases with the goal of creating common research databases, and create an international system of "early warnings" of newly introduced types of implants, and eventually poorly functioning implants. International cooperation culminated in May 2012 when the three organizations

(NARA, ISAR and ICOR, see chapter "International cooperation!) arranged the 1st International Congress for Arthroplasty Registries in Bergen with 200 participants from all over the world.

Covarage and completeness of registration

All units, public and private, that carry out total hip arthroplasty are included in the Register. All hospitals where hemiarthroplasty is carried out also report to the Register. The Swedish Hip Arthroplasty Register thus has 100% coverage for hospitals. Coverage for primary hip replacement on an individual level (completeness) has also been controlled by co-processing with the National Patient Register at the Swedish National Board of Health and Welfare, and is accounted for in detail in a later chapter. The completeness of individual registrations on a national level was 98% for total hip replacement, and 96% for hemiarthroplasty.

Patient-reported outcome measures - PROM

Patient-reported outcome measures were reported from all hospitals during 2011. The Registry now has a nationwide system to prospectively and longitudinally capture patient-reported outcomes for all patients operated with total hip replacement. The response frequency for one-year follow-ups is slightly higher than 90%.

Reporting

Most of the clinics report via the web application. Medical record copies from reoperations are sent during the year with varying delay. Reviews of journal copies and systematic central data collection is a necessity for register analysis regarding reoperations and revisions.

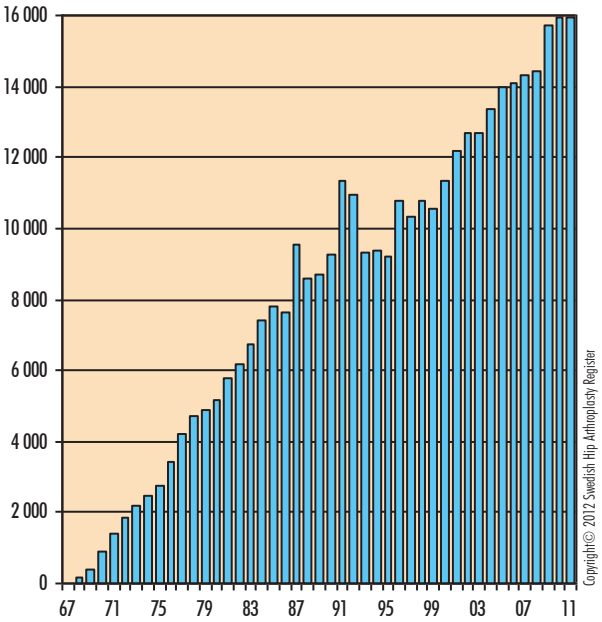
Feedback data

All publications, annual reports and scientific reports are presented on our website. The Swedish Hip Arthroplasty Register calls, in cooperation with the Swedish Knee Arthroplasty Register all clinics to a yearly user meeting in Arlanda, Stockholm. A number of "site visits" are carried out during the year.

Local activity analysis and development

The Registry has, throughout the years, worked for feedback and open accounting to stimulate participating units to local activity analyses; and that this should lead to measures for improvement. During the last years we have, in each annual report, chosen to pick out good examples of such efforts. This year we have published a unit's written report of its analytical work. We feel this example may stimulate all other units to similar efforts.

Primary total hip replacement in Sweden



The number of primary total hip arthroplasties performed in Sweden from 1967 (6 operations) to 2011 (15 945 operationer).

The year's production

During 2011 the annual production of total hip replacements was unaltered compared with 2010. Approximately 16,000 operations were carried out, which is 170/100,000 inhabitants. Even the production of hemiarthroplasties was unchanged with approximately 4,500 operations performed. The amount of reoperations was 2,200 and 330, respectively. A total of 23,000 interventions were reported to the Swedish Hip Arthroplasty Register in 2011.

Thanks to all contributors!

The Swedish Hip Arthroplasty Register is based on decentralized data capture, which is why the clinics' contact secretaries' and physician contributions are completely necessary and invaluable to the Registry's function. Many thanks for all contributions during the past year! The Registry would also like to express its thanks for the tremendous support from Western Gotaland Region and The Registry Center of Western Gotaland Region.

Goteborg October 2012

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Monitoring – a validation process

For a number of years the Registry has annually published the level of completeness that does not, however, include secondary interventions. Analyzing the completeness of primary hip replacements with the aid of The Patient Register (PAR) is relatively easy whereby all primary interventions are encompassed within five measure codes. There are, however, certain problems even with the analysis of primary interventions such as the lack of laterality in PAR and above all private clinics' poor compliance with PAR.

Completeness of secondary interventions and validation of reoperations are at present the Register's "Achilles heel". One of the reasons for this is, unfortunately, the continually poor quality of the surgeons' diagnoses: poor quality of the surgeons diagnoses (ICD-10) and specification of measure codes (KVA) for secondary interventions. We have made several efforts but the sources of error in PAR for such an analysis are currently all too numerous.

The Registry has initiated a plan of action intended to capture hidden statistics and validate clinicians' registrations. Linkage to the Swedish Prescribed Drug Register to clarify the true incidence of implant-related infections is presented elsewhere in this report. Monitoring individual clinics is also part of this action plan. Such a measure is resource-intensive both economically and in terms of staff; but as the Registry, for the first time in its more than thirty-year history approaches full financing, we have been able to begin the monitoring process this year.

How is monitoring carried out?

Following a test period we have arrived at the following logistics:

- Choice of clinic occurs by draw. The Swedish Hip Arthroplasty Register sends a letter for signature to the director of operations concerning monitoring and a request for access to the clinic's diverse computer systems used by the register's coordinators when visiting the clinic. This modus operandi has been approved by the Data Inspection Board – in other words the clinic requests monitoring by the SHPR and not vice versa. "Monitors" from the Registry then gain temporary authorization for the local patient administrative- and medical history system without violating the Patient Data Act.
- Selection: only the previous year's "settled" productions (the procedures which are included in an Annual Report)
- Aim: to check that all primary operations and reoperations are registered, to ensure correct registration, and to document clinical logistics concerning reporting to the Register.

Upon the return of the signed letter a requirement specification is sent to the clinic enabling SHPR to acquire a database prior to monitoring. All this is to facilitate our coordinator's visit to the clinic and save the clinic time as well. The database is requested in Excel, must be password-protected, and sent special delivery on a CD or memory stick to the Registry.

The database should include the following data for patients **operated during the year when monitoring was called for** (from the operation planning system) for primary total hip arthroplasty and primary partial hip replacement and reoperation following total and hemiarthroplasty and should be sorted according to operation date:

- Personal identity number (preferably 12 digits with a hyphen)
- Operation date
- Diagnosis and the respective ICD-10-code
- Side (if available)
- Operations are to be presented with measuring codes (KVA-codes NF* and QD* = searches should be performed for all NF* and QD*)

The following is checked at the visit: A production year is scrutinized in both the medical journals and local PAS-system or other administrative system checking the following:

- Operation date
- Side
- Diagnosis in the operation report and discharge report with codes according to ICD-10
- Measure (KVA) codes in the operation report
- Eventual reoperations after unreported primary operations

It is desirable during monitoring that a contact person is available during the visit as well as a contact person capable of performing searches/statistics. At the visit the Registry staff requires two workplaces with computers, preferably in the same room. Monitoring takes 1-3 days depending on the clinic's annual production.

The Registry plans to carry out 7-10 local monitorings annually.

The results from two local monitorings

During the spring of 2012 the SPHR visited Kungalv hospital and the OrthoCenter IFK-clinic in Goteborg. There were contact secretaries available at both units during the visit. The inspected data from both units were 2011's registrations.

Monitoring revealed the following:

One entry for a primary total hip replacement was missing in Kungalv. However, no primary total hip replacement entries were missing at the OrthoCenter. In Kungalv, five reoperations were found missing (3 patients).

A check of ICD-10-codes revealed two patients (1 total hip replacement + 1 hemiarthroplasty) incorrectly registered when compared with the medical history system in Kungalv. However, the data varied between the different

patient administrative systems in Kungalv (differing dictations from different physicians?). At the OrthoCenter five patients were found to have incorrect ICD-10-codes.

Two patients were found having incorrectly entered operation dates in Kungalv. Moreover, three patients were registered with three different operation dates within the different administrative systems in Kungalv. Three patients were registered at the OrthoCenter with incorrect dates. Five patients were found in Kungalv and three at the OrthoCenter with incorrect measure codes (KVA-codes).

A patient in Kungalv was registered for the wrong side. In Kungalv, the operation side was not indicated in the operation planning system, but was at the OrthoCenter. In some cases data was incorrectly entered in paper forms by personnel in the operating room, whereby the contact secretary entered the incorrect data.

In Kungalv the entries of ICD-10-codes varied between the different patient-administrative systems (manual feeding in different systems), whereby it was sometimes difficult to decide which was correct.

Discussion

The above errors may be considered small but can, in a national aggregation, influence statistical results. It is very surprising to the Registry that local, regional, and national patient administration systems (PAS) lack laterality. It is, of course, important to know which of paired organs are operated on or successively reoperated. This sad fact has been pointed out by us for many years without results! It is also surprising that a hospital has different PAS-systems that do not communicate with each other; thus there is a tremendous potential for administrative improvement!

In conclusion, we ask that, with these forthcoming monitorings, contact secretaries and physicians take up registration logistics at their clinic meetings.

Notes

Completeness of registrations

A high completeness is one of the most important factors in a register's data quality as well as the possibility of conducting qualitative improvement work and clinical research. The completeness of registrations should be noted on an individual level. The coverage regarding participating departments is an important variable, but if participating units underreport on an individual level the analyses and rereporting become misleading. All hip-arthroplasty-producing units in Sweden have, for many years, participated in reporting to the Register, so current analyses have as their chief goal to illustrate the degree of completeness on an individual level.

Method

Matching the Registry's databases with the Patient Register (PAR, National Board of Health and Welfare) (NFB 29, 39, 49, 62 and 99 for total hip arthroplasty; NFB 09 and NFB 19 for hemiarthroplasty) at an individual level (personal identification number) provides three different outcomes:

- Matching of individuals, i.e. patients recorded in both registers.
- Individuals recorded only in the Swedish Hip Arthroplasty Register.
- Individuals recorded only in the PAR.

The completeness of the Swedish Hip Arthroplasty Register is presented in the following table as the sum of outcomes 1+2 and the completeness for PAR as the sum of 1+3. We do not know whether these results reflect the true completeness since patients may have undergone hip arthroplasty without the care unit in question entering the measure in either register. The number of such cases should be very low in Sweden in 2011.

Weak points in the analysis

Laterality: In most cases the Patient Register lacks laterality, i.e. right or left is not provided as a unique variable, as is done in the Hip Arthroplasty Register. Patients operated with one-stage or two-stage bilateral hip replacement during 2010 may 'fall out' of the Patient Register with the selection criteria chosen for matching.

During 2011, 100 patients were operated on in Sweden, with bilateral hip replacement at one session. These 200 operations are registered as such in the Register but only as 100 procedures in PAR. The Registry leadership has for many years marveled at the fact that more or less all of Sweden's PAS-systems lack the laterality variable, subsequently leading to suboptimal statistical utility of these databases for illnesses involving paired organs.

Lag in registration. Certain units are 'chronic' laggards - not so seldom over the new year, which is a great disadvantage with this type of necessary quality control. Experience shows that a further 0.5% to 1.0% are reported to the Register during the subsequent year.

Administrative fusions of hospitals and the opposite, i.e. operations carried out at 'satellite hospitals'.

As described earlier both these examples of structural change in orthopaedics represent a future 'threat' to fair and open reporting. Differences in completeness may then have non-medical logistical reasons; e.g. that the hospital reports to the PAR via 'the principal hospital' and to the Registry via the unit where the operation was performed. The Swedish Hip Arthroplasty Register has always and will always state hospital affiliation to the hospital /operational environment where the actual intervention is performed. This is to enable analysis of complications.

Results

Total hip arthroplasties. The national completeness for 2011 was 97.6%. Should the analysis be repeated, the regular lag of 0.5-1.0% would probably mean that over 98-99% of all primary arthroplasties are registered in Sweden, which is very satisfying. Departments with values less than one standard deviation below the national mean value are marked in red in the table. Nine departments received this mark regarding completeness in the Register during 2011 – despite the high national average there is potential for improvement.

Just as in the latest analyses, the private departments were poor at reporting to the PAR.

Hemiarthroplasties. Hemiarthroplasties have only been registered for seven years and the completeness on a national level is relatively unchanged at 96%. Eight clinics have a similar completeness of registrations. All of 21 clinics have an underreporting to PAR.

Reoperations and revisions. A good completeness for this type of intervention register naturally includes completeness for reporting possible reoperations/revisions. The analysis of secondary interventions, however, proves to be much more difficult owing to the poor quality of coding; both for diagnosis and for reoperation measures. The Registry now maintains a strategy which includes several methods of checking incomplete registration of reoperations (please see page 48 under the heading "Underreporting").

The Swedish Hip Arthroplasty Register has always and will always state hospital affiliation to the hospital body/operational environment where the intervention in question is carried out. This to enable us to analyse complications. The Registry's goal is not to illustrate principal's productivity figures from an organizational unit.

Completeness for total arthroplasties

registrations during 2011

Hospital	No.[1]	SHAR[2]	PAR[3]
University/Regional Hospitals			
KS/Huddinge	281	100.0%	100.0%
KS/Solna	204	99.6%	98.1%
Linköping	68	98.5%	95.6%
SUS/Lund	96	100.0%	**89.6%**
SUS/Malmö	83	98.8%	97.6%
SU/Sahlgrenska + Mölndal + Östra[4]	404	95.5%	95.5%
Umeå	63	98.5%	98.5%
Uppsala	249	96.9%	98.4%
Örebro	177	99.5%	98.4%
Central hospitals			
Borås + Skene[5]	294	**94.6%**	95.9%
Danderyd	338	97.7%	96.8%
Eksjö	183	97.9%	98.4%
Eskilstuna	127	99.2%	96.9%
Falun	367	98.2%	99.8%
Gävle	194	**95.1%**	96.6%
Halmstad	225	98.2%	99.5%
Helsingborg	217	99.5%	99.1%
Hässleholm-Kristianstad	775	99.8%	99.3%
Jönköping	209	98.1%	97.2%
Kalmar	184	99.5%	97.8%
Karlskrona + Karlshamn[6]	271	**92.8%**	98.3%
Karlstad	246	95.7%	97.3%
Norrköping	245	99.2%	99.6%
S:t Göran	448	99.3%	98.7%
Skövde + Lidköping + Falköping[7]	348	97.7%	**95.2%**
Sunderby	30	**93.7%**	96.9%
Sundsvall	223	96.5%	97.4%
Södersjukhuset	336	96.3%	96.0%
Uddevalla	336	98.9%	98.3%
Varberg	241	98.8%	99.6%
Västerås	457	**91.2%**	97.6%
Växjö	145	96.6%	98.6%
Ystad	8	100.0%	**87.5%**
Östersund	277	96.5%	97.6%
Rural hospitals			
Alingsås	210	96.7%	96.7%
Arvika	184	96.3%	97.4%
Bollnäs	281	97.9%	99.7%
Enköping	288	99.6%	99.6%
Frölunda Specialistsjukhus	82	98.8%	97.6%
Gällivare	86	100.0%	100.0%
Hudiksvall	126	**96.2%**	100.0%
Karlskoga	120	99.1%	99.1%
Katrineholm	239	99.6%	99.6%
Kungälv	171	96.7%	96.1%
Lindesberg	232	100.0%	100.0%
Ljungby	165	99.4%	96.4%
Lycksele	309	98.7%	98.7%
Mora	222	96.9%	100.0%
Motala	429	**95.9%**	98.6%
Norrtälje	101	100.0%	100.0%
Nyköping	165	100.0%	97.6%
Oskarshamn	210	99.0%	99.0%
Piteå	373	99.7%	98.7%
Skellefteå	79	98.8%	97.6%
Sollefteå	125	**92.6%**	97.0%
Södertälje	118	96.0%	**95.2%**
Torsby	105	98.1%	100.0%
Trelleborg	585	99.8%	97.6%
Visby	118	96.7%	96.7%
Värnamo	146	98.0%	96.6%
Västervik	117	96.7%	98.3%
Ängelholm	217	99.5%	99.1%
Örnsköldsvik	140	97.2%	98.6%
Private hospitals			
Aleris Specialistvård Sabbatsberg	145	99.3%	99.3%
Carlanderska	156	100.0%	**0.0%**
Elisabethsjukhuset	60	100.0%	100.0%
Movement	253	**87.5%**	**12.5%**
Nacka Närsjukhus Proxima	133	96.4%	97.1%
Ortho Center Stockholm	400	97.6%	**78.0%**
OrthoCenter IFK-kliniken	150	100.0%	98.7%
Ortopediska Huset	316	96.9%	**82.5%**
Sophiahemmet	166	100.0%	**0.0%**
Spenshult	156	98.8%	**95.0%**
Nation	15.846	97.6%	**93.8%**

Red marking indicates values one standard deviation below national average.

1) Refers to the number of registrations in the Swedish Hip Arthroplasty Register.

2) Refers to the proportion of registrations in both registers or only in the Swedish Hip Arthroplasty Register.

3) Refers to proportion of registrations in both registers or only in the National Patient Register.

4) These departments are in the National Patient Register combined to 'Sahlgrenska University Hospital'.

5) These departments are in the National Patient Register combined to 'SA medical care'.

6) These departments are in the National Patient Register combined to 'Blekinge Hospital'.

7) These departments are in the National Patient Register combined to 'Skaraborg Hospital'.

Completeness for hemi arthroplasties

registrations during 2011

Hospital	No.[1]	SHAR[2]	PAR[3]
University/Regional Hospitals			
KS/Huddinge	113	100.0%	99.1%
KS/Solna	49	98.0%	100.0%
Linköping	91	95.8%	96.8%
SUS/Lund	143	97.9%	**93.2%**
SUS/Malmö	214	100.0%	96.7%
SU/Sahlgrenska + Mölndal + Östra[4]	312	96.6%	**89.8%**
Umeå	83	**91.2%**	98.9%
Uppsala	112	95.7%	96.6%
Örebro	82	98.8%	**95.2%**
Central hospitals			
Borås + Skene[5]	65	**86.7%**	**84.0%**
Danderyd	159	98.7%	**93.7%**
Eksjö	65	97.0%	100.0%
Eskilstuna	41	100.0%	**90.2%**
Falun	132	98.5%	95.5%
Gävle	124	96.1%	**94.6%**
Halmstad	62	96.9%	**93.7%**
Helsingborg	175	97.2%	97.8%
Hässleholm-Kristianstad	98	98.0%	**91.0%**
Jönköping	55	**93.2%**	**93.2%**
Kalmar	104	98.1%	95.3%
Karlskrona + Karlshamn[6]	65	**94.2%**	**91.3%**
Karlstad	72	91.1%	96.2%
Norrköping	72	98.6%	100.0%
S:t Göran	190	97.0%	97.5%
Skövde + Lidköping + Falköping[7]	119	97.5%	**90.2%**
Sunderby	161	97.5%	96.6%
Sundsvall	50	98.1%	98.1%
Södersjukhuset	260	97.0%	**94.8%**
Uddevalla	225	97.8%	96.5%
Varberg	89	95.7%	**94.6%**
Västerås	43	**86.0%**	**84.0%**
Växjö	37	**71.1%**	**88.4%**
Ystad	54	100.0%	100.0%
Östersund	93	98.9%	96.8%
Rural hospitals			
Alingsås	46	97.9%	**85.1%**
Arvika	21	100.0%	**85.7%**
Gällivare	16	100.0%	100.0%
Hudiksvall	55	98.2%	98.2%
Karlskoga	44	100.0%	97.7%
Kungälv	70	95.9%	**80.8%**
Lindesberg	18	**94.7%**	100.0%
Ljungby	25	**86.2%**	100.0%
Mora	51	100.0%	**94.1%**
Norrtälje	46	97.8%	97.8%
Nyköping	26	96.3%	100.0%
Skellefteå	38	97.5%	97.5%
Sollefteå	33	97.0%	**82.3%**
Södertälje	40	97.6%	**90.2%**
Torsby	22	95.6%	95.6%
Visby	32	100.0%	**90.6%**
Värnamo	30	100.0%	**93.3%**
Västervik	60	96.8%	98.4%
Örnsköldsvik	36	100.0%	**86.1%**
Nation	4 518	95.5%	**94.5%**

Red marking indicates values one standard deviation below national average for SHPRs values concerning total arthroplasties.

1) Refers to the number of registrations in the Swedish Hip Arthroplasty Register.

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6) These departments are in the National Patient Register combined to 'Blekinge Hospital'.

7) These departments are in the National Patient Register combined to 'Skaraborg Hospital'.

On coding

Code correctly

Giving the correct diagnosis code and the right code for the measures carried out enables better follow-up of activity, fairer and more correct compensation and reliable research databases.

That data entered into the quality and other health data registers is correct is a prerequisite for analysis results maintaining high quality and reliability.

Updated Concise Guide

The Swedish Orthopaedic Association published an updated version of its Concise Guide (Lathunden) in 2011. Older versions contained several errors now corrected. This compilation explains and clarifies the most frequent and relevant codes in arthroplasty. The Swedish Hip Arthroplasty Register (SHPR) recommends that the country's departments keep to the coding recommendations in the new Concise Guide.

Sequelae following childhood diseases of the hip

How should one code residual states following childhood diseases? Dysplastic arthritis has its own diagnosis number and sequelae following Perthes' disease (coxa plana) have likewise. We propose that other sequelae following childhood diseases should be coded with secondary arthritis followed by a Z code for other acquired musculoskeletal disorder in the patient's own medical history (Z87.3) or congenital musculoskeletal deformity/malformation in the patient's medical history (Z87.7).

Complications

Recording complications is difficult and there are no satisfactory codes. For registration in the reoperation database to be as correct as possible, it is important to clearly describe the causes of reoperations and revisions, along with details of the surgical procedure.

The most common diagnosis codes are mechanical complications (T84.0F) sometimes including implant loosening, dislocation, osteolysis, acetabular erosion and implant fracture. As a supplement, a code is required that specifies the cause where code Y83.1 is commonly used (implant complication without relation to adverse events during the procedure) but also Y79.2 (implant-related adverse events, technical error) may be appropriate. Osteolysis with evident cup wear can be an example of this.

Dislocations

A major reason for coding implant dislocation correctly is that closed reduction is not reported to SHPR. To be able to analyse the occurrence of dislocation in the future, therefore, coding reported to the Patient Register needs to be correct. An earlier version of the Concise Guide gave various combinations of codes for early and late implant dislocation, which was incorrect. Now the use of T84.0F (mechanical complication) and Y83.1 (implant complication not associated with adverse effects during measure taken) are suggested. In repeated dislocations, M24.4F (repeated dislocation) is added. Do not use S73.0, which stands for traumatic dislocation of the hip joint, not hip replacement.

Infections

Implant infection is coded T84.5F and Y83.1 and it makes no difference for diagnosis coding whether the infection occurs early or late. Typical coding for reoperation for deep implant infection where it is intended to save the implant is NFS 19 (incision/debriding in septic arthritis), NFS 49 (implantation of pharmaceutical preparation in septic arthritis), suitable codes for replacement of head, and possibly liner with addition of NFW 69 (early reoperation for deep infection).

Special codes for early reoperation

The NFW reoperation codes should always be used for early reoperation, within 30 days of original operation. For minor surgical procedures they may be used separately, but for more extensive interventions they should be used as supplementary codes. Among others this gives higher DRG points.

Extraction of implants

Irrespective of whether one intends to reimplant a prosthesis, extraction of the implant is coded NFU 09 for hemiarthroplasty and NFU 19 for total arthroplasty. If a spacer is inserted, NFC 59 should be added. Do not, therefore, use the code for excision arthroplasty, normally termed Girdlestone, in connection with implant surgery.

Periprosthetic fractures

Periprosthetic fractures must not be coded with S codes. M96.6F is used supplemented by a suitable cause code (V, W or Y number). This also applies to fractures distal to the implant, Vancouver type C, regardless of whether the implant is loose or not. If there is concurrent implant loosening, codes for this should also be given. For surgical fracture intervention, suitable codes for osteosynthesis are used in combination with codes for possible implant revision and structural graft. Accidental perioperative (or early postoperatively discovered) fractures should be coded with suitable S-codes followed by Y60.0 (unintentional injury during operation).

Diagnoses

Osteoarthritis			
Primary bilateral	M16.0		
Primary unilateral	M16.1		
Dysplastic bilateral	M16.2		
Dysplastic unilateral	M16.3		
Post-traumatic bilateral	M16.4		
Post-traumatic unilateral	M16.5		
Secondary bilateral	M16.6		
Secondary unilateral	M16.7		
Coxa plana (Perthes' sequelae)	M91.2		
Sequelae following acquired hip disorder in childhood	M16.7	Z87.3	
Sequelae of congenital hip disorder in childhood	M16.7	Z87.7	
Rheumatic arthritis			
Psoriatic arthritis (+ L40.5)	M07.3F		
RA seropositive	M05.8F		
RA juvenile	M08.0F		
RA UNS	M06.9F		
Fractures			
Cervical femur fracture	S72.00		
Trocanter femur fracture	S72.10		
Pathological fracture	M90.7F		
Tumours			
Skeletal metastases	C79.5		
Skeletal tumour, benign	D16.2		
Skeletal tumour, malign	C40.2		
Other diagnoses			
AVN, idiopathic	M87.0F		
AVN, post traumatic	M87.2F		
Complication diagnoses			
Wound infection superficial	T81.4	Y83.1	
Implant infection	T84.5F	Y83.1	
Implant dislocation	T84.0F	Y83.1	
Implant dislocation, repeated	T84.0F	M24.4F	Y83.1
Ectopic bone formation following op	M61.4	Y83.1	
Osteolysis, near to implant	M89.5	Y83.1	
Implant failure/break	T84.0F	Y79.2	
Implant loosening	T84.0F	Y83.1	
Fracture close to implant following fall	M96.6F	W-nr	
Acetabular erosion	T84.0F	M16.7	Y83.1
Pseudoarthosis, hip fracture	M84.1F	T93.1	Y86.9
AVN, post-operative fracture	M87.2F	T93.1	Y86.9
Explanation			
Mechanical complication in hip joint	T84.0F		
Implant causing failure	Y79.2		
Implant complication not linked to failure during operation	Y83.1		
Sequelae following fractured femur including hip joint	T93.1		
Late complication following other accident	Y86.9		
Unintentional injury during operation	Y60.0		

Measures

Primary hip implant operations	
NFB09	Primary hemi-arthroplasty cement-free
NFB19	Primary hemi-arthroplasty with cement
NFB29	Primary total arthroplasty cement-free
NFB39	Primary total arthroplasty hybrid technique
NFB49	Primary total arthroplasty with cement
NFB62	Primary total surface replacement implant
NFB99	Other primary hip implant op.
Revisions (secondary hip implant operations)	
Without cement	
NFC09	Secondary hemi-arthroplasty cement-free
NFC20	Secondary total arthroplasty cement-free, total revision
NFC21	Secondary total arthroplasty cement-free, cup revision
NFC22	Secondary total arthroplasty cement-free, stem revision
NFC23	Secondary total arthroplasty cement-free, other component
NFC29	Secondary total arthroplasty cement-free, other revision
Hybrid	
NFC30	Secondary total arthroplasty hybrid, total revision
NFC31	Secondary total arthroplasty hybrid, cup revision
NFC32	Secondary total arthroplasty hybrid, stem revision
NFC33	Secondary total arthroplasty hybrid, other component
NFC39	Secondary total arthroplasty hybrid, other revision
With cement	
NFC19	Secondary hemi arthroplasty with cement
NFC40	Secondary total arthroplasty with cement, total revision
NFC41	Secondary total arthroplasty with cement, cup revision
NFC42	Secondary total arthroplasty with cement, stem revision
NFC43	Secondary total arthroplasty with cement, other component
NFC49	Secondary total arthroplasty with cement, other revision
Other secondary hip-joint operations	
NFC99	Other secondary hip-implant operations
Supplementary measures	
NFN09	Autotransplantation of bone to femur
NFN19	Homotransplantation of bone to femur
NFN29	Heterotransplantation of bone to femur
NEN09	Autotransplantation of bone to pelvis
NEN19	Homotransplantation of bone to pelvis
NEN29	Heterotransplantation of bone to pelvis
TNF50	Implantation of skeleton markers
NFC59	Secondary implantation of interposition implant (spacer)
Reoperations	
NFU09	Extraction of hemi-implant
NFU19	Extraction of total implant
NFA12	Open exploration of hip joint
NFH22	Open reposition of dislocated implant
NFL49	Suture/reinsertion of tendon muscle insertion
NFS19	Incision/debriding septic arthritis
NFS49	Implant medication septic arthritis
NFT12	Open mobilisation of joint
Code for early reoperation	
NFW49	Suture of incision rupture
NFW59	Reoperation for superficial wound infection
NFW69	Reoperation for deep infection
NFW79	Reoperation for wound bleeding/haematoma
NFW89	Reoperation for deep bleeding
NFW99	Other reoperation
Fracture measures	
NFJ59	Osteosynthesis with nail
NFJ69	Osteosynthesis with plate and screws
Closed operations (not to be reported to SHAR!)	
NFH20	Closed reduction of dislocated hip prosthesis
TNF10	Arthrocentes
TNF11	Injection in hip joint
NFA10	Diagnostic arthrography

Primary total hip arthroplasty

News and results

We have begun the work of restructuring the databases in order to ease and improve future analyses. The first step is to create the basis to integrate the component database with the primary and reoperation databases. This implies that detailed information concerning the various implant component characteristics such as choice of material and size will be easier to analyze. More detailed information is now available, for example for the choice of material and cup size, liner and femoral head, which is reflected in this year's Annual Report. This project will be completed during the year.

The Registry's report is built upon a large number of analyses. For the sake of clarity they are not always presented in their entirety. The results from different regression analyses are presented as risk ratio (RR) with a 95% confidence interval (C.I.).

Demography

The number of hip implants in 2011 reached 15,945, nearly the same number as last year (15,944). The distribution of men and women was unchanged between 2010 and 2011 (58.4%). The relative proportion of women has slowly decreased since 1992, which implies that 2010 and 2011 represent the lowest recorded proportion in the last 20 years. The average for the entire period is 59.8%.

The average age for men (66.9 years; median: 67) has increased insignificantly compared with 2010 (66,8; median: 67). There has been a slight reduction for women from 69.5 to 69.2 years (median 2010 and 2011: 70). For men the proportion increases in the age groups 40-49 and 60-69 years. There has been a relative increase for women mainly in the group 60-69 years, while the groups up to 59 years of age have remained relatively constant. For both genders this change has occurred at the expense of a declining relative proportion of patients 70 years or older. For all age groups there has, however, between the two latest three-year periods, been an increase in the number of operated patients in absolute numbers except for women 80 years of age and older (Figure 1). An interesting observation is that the proportion of men under 50 has increased from 5.0% 1994-1996 to 7.0% 2009-2011, while the corresponding proportion for women has decreased from 4.4 till 4.1%.

Bilaterality

Operation with bilateral hip implants is relatively common. If an otherwise healthy patient has problems with both hip joints a simultaneous operation in one session can be discussed. Several studies speak for the fact that if this operation is carried out according to correct indications it is a cost -effective measure. The proportion of hip replacements carried out on patients with previous contralateral hip replacement was 21.8% of the total amount. This proportion has increased from 10.1% since the three-year period 1994-1996. Both operations have been registered in The Swedish Hip Arthroplasty Register's database for 40,764 patients corresponding to 81,528 hip replacements. The majority of these were performed in two sessions (96%). In 4% of the cases the operations were performed on the same day; in 12.2% the other hip was operated on within 6 months, and 17.9% 6-12 months after the first operation. The interval was longer than 1 year for the other cases (65.9%) (Figure 2).

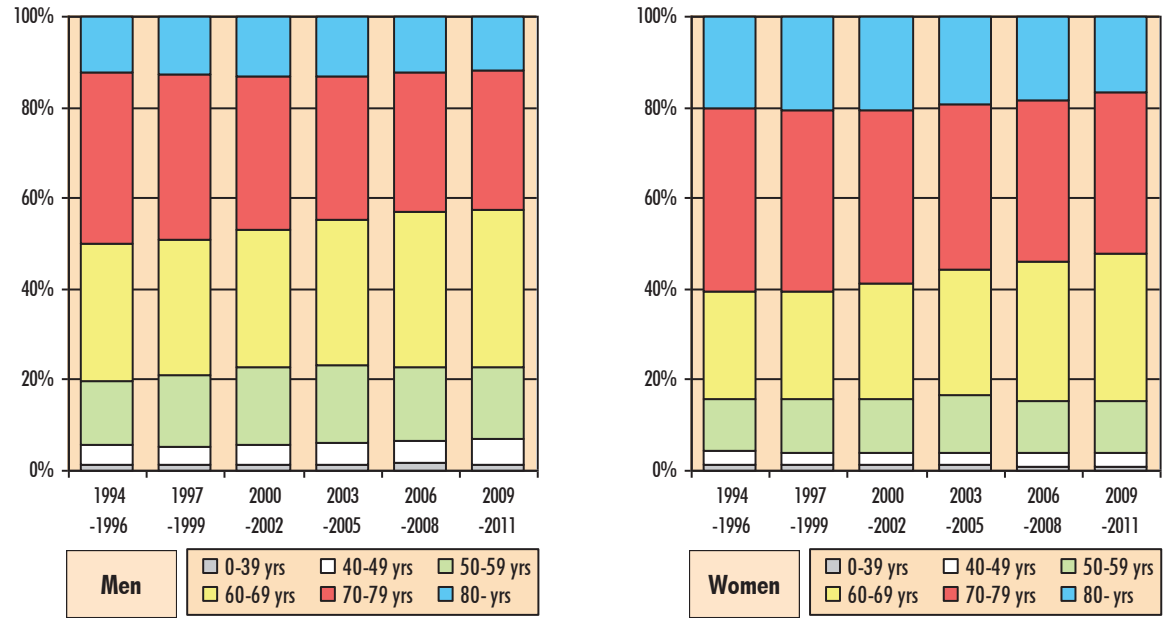


Figure 1. Grouped age distribution in men and women, respectively. In both men and women the proportion in the group 60-69 years of age increases while the relative proportion of those over 70 decreases. For men the proportion 40-49 years also increases, but not for women.

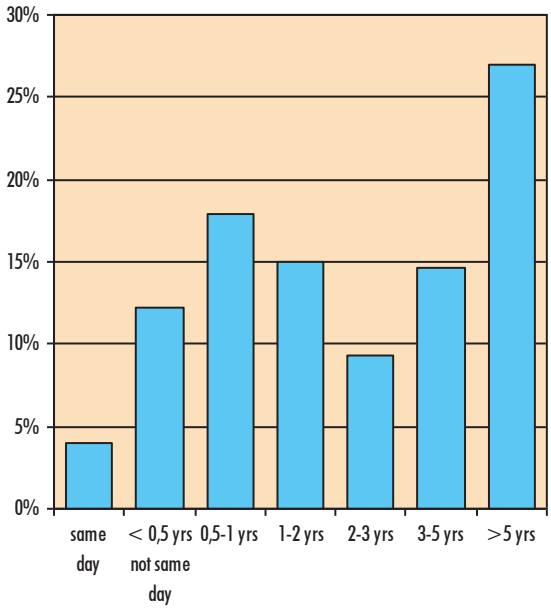


Figure 2. Time between first and second hip arthroplasty in patients operated bilaterally.

Implant selection

The long-term trend towards an increased proportion of uncemented implants continued during 2011. The increase was mainly in completely uncemented arthroplasty combined with a minimal increase of hybrids. The use of reverse -hybrid arthroplasty was largely unchanged while the proportion of resurfacing implants declined. (Figure 4).

Cup selection

During 2011 cemented cup fixation was selected in 81.3% of the cases. That is a slight reduction since 2010. The Lubinus cup dominates the Swedish market with a market share of 43-45% during the last three years. During the remainder of 2010 this cup was also introduced with highly crosslinked polyethylene. The Marathon cup has increased considerably, from 8.5% in 2009 to 17.7% 2011 and is now the second most common cup. In third place is the ZCA, which has declined somewhat (2011:14.8%). Exeter Rimfit has also increased considerably, from 1% 2010 to 9.7% during the previous year. During 2011 five cemented cups stood for 92.6% of the Swedish market.

During the last three years the Trilogy cup, with or without hydroxyapatite/calcium phosphate coating, has been the most commonly used uncemented hip cup (33.3-40.2%) followed by Trident ±HA (14.5 – 19.0%). The Pinnacle ±HA remains in third place (10.8%). The Continuum cup, introduced 2009 is now in fourth place (8.2%). Other new variations of uncemented cups with porous metal surfaces have also appeared (TMT-variation 6.1%, Regenerex 3.4%, Tritanium 3.1%, Pinnacle Gripton 0.4%). During 2011 uncemented cups with an HA/TCP coating stood for 53.6%, which is somewhat remarkable against the background of data previously presented from one of the Registry's collaborative projects (see Revision). Despite the total number of uncemented cups being considerably lower than the number of cemented cups, 13 cup designs made up (17 if different variations of these designs are included) 93.5% of the Swedish market.

Stem selection

The choice of cemented fixation has, during the last 3-year period, become even more unidirectional. Lubinus SP II, Exeter polished and MS30 are used most. During 2011 they accounted for 97.6% of all cemented stems (Lubinus SP II 55.1%, Exeter polished 30.6%, MS30 11.9%).

The uncemented stems show a similar pattern. The stems used most during 2009-2011 were Corail, CLS Spotorno and Bi-Metric followed by ABG II, Accolade and Wagner Cone in that order. They have maintained the same ranking during the period. Corail has increased from 29.3 till 43.9% whereby the collarless is used most. CLS, Bi-Metric and ABG have declined somewhat. Accolade and Wagner Cone show small changes. These six implants accounted for 93.4% of all implanted uncemented stems during 2011.

The four most common combinations of totally cemented components during 2011 were Lubinus SP II-stam/Lubinus-cup (47.3% of all totally cemented implants), Exter/Marathon XLPE (11.9%), MS30/ZCA XLPE (10.8%) and Exeter/Exeter Rim-fit (9.6%). Corresponding combinations with totally uncemented components were CLS/Trilogy

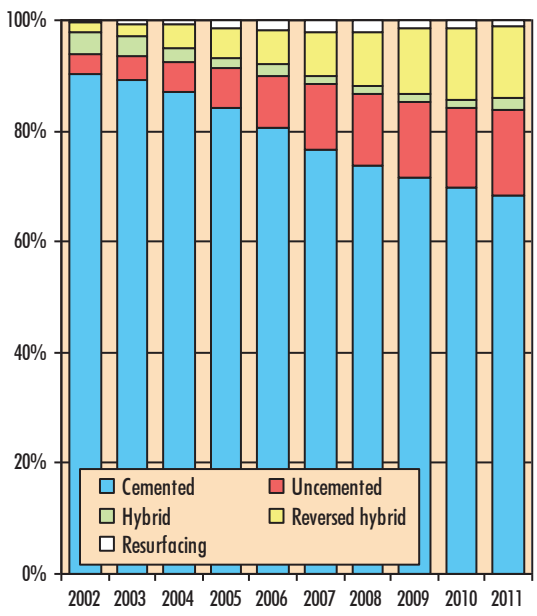


Figure 4. Distribution of prosthetic types 2002-2011. During 2011 the long term trend of frequently using uncemented prostheses continued.

(14.8%), Corail/Pinnacle (10.8%), Corail/Trilogy (9.9%) and Accolade/Trident (8.0%).

Hybrid implants with uncemented cup and cemented stem are currently sparsely performed. During 2011, 296 hybrid prosthetics were inplanted (1.9% of the total). Most common were the Exeter stem/Trident cup followed by Lubinus SP II/Trilogy. The Corail stem is often used when implanting reversed hybrid implants most often combined with the Marathon or Lubinus cup. The third most used combination was the Bi-Metric stem/Marathon cup (8.4%) followed by the Bi-Metric stem/Lubinus cup (5.2%).

During 2011, 167 resurfacing implants were set in. BHR (83,2%) was mainly used followed by Adept (15%) and Durom (1.8%).

Type of articulation

In Sweden metal/polyethylene articulations have completely dominated the choice of joint surface for hip replacements. During the period 2002-2011 this type of joint was used in at least 85.5% of all cases (exact data missing in 2.1%). Henceforth follow ceramic femoral heads that articulate with a polyethylene cup or liner (9.8%). During the 2000 decade conventional polyethylene has been successively replaced by highly crosslinked polyethylene. Up to and including 2003 this new type of polyethylene was used in less than 1% of all operations. Henceforth a successive increase has taken place. During 2011 more implants with the new polyethylene were set in than with the older type.

The trend since 2007 has been to use more and more joint sockets or liners of polyethylene. During 2011 these types of articulations accounted for 97.7% of the total. The combination with a ceramic femoral head accounted for 10.5% in 2002 and declined to 7.9% in 2005. Hereafter there has been a successive increase to 12.8% during 2011. Ceramic/ceramic joints have been sparsely used in Sweden and have until now made up less than 1% (0.1-0.8%). Since 1999 there have been 495 operations (see "Metal/metal joints).

Crosslinked polyethylene

Since 2005 the use of cemented cups with highly crosslinked polyethylene slowly increased. This was first observed for the ZCA-cup followed by Reflection. These two designs have now been used with highly crosslinked polyethylene for more than 5 years corresponding to a total of 8,499 ZCA and 1 663 Reflection cups. Up until 2007 both types were used with the older type of polyethylene. Since other cemented cups with highly crosslinked polyethylene have considerably shorter observation times this year's report is limited to these two types. Maximum follow-up time is set at 6 years adjusted for age, sex, diagnosis, design and the femoral head size (only 28 and 32 mm included). A total of 17,909 cups are included in the analysis and only the metal femoral head. At 6 years after the primary operation we find that cups made of the older polyethylene have been revised more often due to loosening (1.2 as opposed to 0.1%), but after adjustment for the factors of sex, age, femoral head size, and cup design we see no definite difference between groups (older/new polyethylene: RR 1.6 0,6 – 4.2).

Highly crosslinked polyethylene was introduced earlier for uncemented than for cemented joint sockets. The follow-up time is therefore longer, 8 years. In this year's analysis three designs are included: Trident, Allofit och Trilogy. This analysis can be said to be fairer than previous year's analyses since we now have a more detailed knowledge of the design of the joint in individual cases. All included types have, during a period in the beginning or middle of the 2000s, been used parallel to polyethylene liners of both modern (Crossfire, X3, Durasul or Longevity) and older polyethylene types. The femoral head 36 mm in diameter have only been inserted together with the new polyethylene, which is why the analysis is limited to implants with 28 and 32 mm femoral heads. Altogether 1,693 Trident, 691 Allofit and 7,487 Trilogy cups are included. The control group is relatively small due to a stricter selection compared to earlier; 73-89% of the polyethylene liners have been manufactured of modern polyethylene. In the control group 1.1% of the cups of older polyethylene have been revised within 8 years due to aseptic loosening, compared with 0.1% in the group with modern polyethylene. After adjusting for the same factors as in the previous analysis we find no difference between groups (older/new polyethylene: RR 2.1 0.9–4.7).

Highly crosslinked polyethylene has, in several studies, shown reduced wear. This feature can be expected to lead to lower frequencies of revisions after an observation time of at least 7-10 years. In our analyses of up to 6 and 8 years respectively after surgery we find very few revisions in the group with modern polyethylene due to aseptic loosening/osteolysis. We have not as yet been able to show any statistically verified improvement compared to the older polyethylene types.

Metal/metal joints

Metal/metal joints have been used conservatively in Sweden. A total of 3 410 have been reported to the Register, corresponding to 1.9% of all implanted hip replacements 1999-2011. Most cases involved total resurfacing cups (1,946, 57.1% of all metal/metal joints). In 676 operations a resurfacing cup combined with a conventional stem implant with a large head has been used. When using 581 uncemented conventional cups, the femoral head sizes 28, 36, and 38 mm have been most commonly used in while all 207 cemented cups have been combined with a 28 millimeter femoral head.

Mapping of implanted metal/metal articulations in Sweden is urgent. This type of joint has been used sporadically since the the 1930s, but was temporarily abandoned at the end of the 1970s due to uncertainty concerning risks associated with the increased levels of metals in the blood measured in some patients. The articulation regained popularity during the 1990s when it was, by means of refined technology, considered possible to produce joints that optimally distributed a thin liquid layer between components thereby greatly reducing friction. Metal/metal joints quickly became popular particularly in Anglo-Saxon countries. The Australian annual report from 2010 indicates that barely 12% of all implanted arthroplasties have a metal/metal articulation. During the period of October 2005 to and including 2006 it was estimated that roughly 35% of all implanted replacements in the USA had a metal/metal joint. The English register reported that resurfacing implants and implants with a large

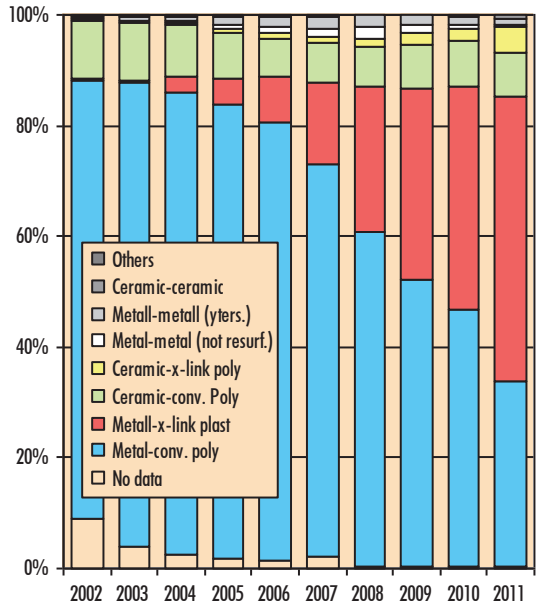


Figure 5. Type of joint inserted during the last 10-year period regardless of implant type. Highly cross-linked polyethylene is used all the more often.

femoral head articulating against a cup of resurfacing implant design made up 15% of the total production during 2006-2007 to later fall to 5% during 2010.

From all larger registers, including the Swedish, it was found that metal/metal articulations and particularly those with a femoral head larger than 28 or 32 mm are associated with increased risk for revision mainly due to loosening. Moreover, this type of articulation can lead to serious side effects, among others formation of so-called pseudo-tumors. This can if worst comes to worst and despite revision, lead to permanent handicap. The risk depends on several factors where particularly female gender, component size and position, and choice of design are important. It is therefore important that this complication is discovered in time. The Swedish Hip and Knee Society has brought forth guidelines for following up patients operated with metal/metal articulations. These guidelines have been published in the current annual report and can also be reached at http://www.ortopedi.se/pics/6/59/Ytis_riktlinjer_120516001.pdf.

Those metal/metal implants used in Sweden can be separated into four groups: conventional prostheses with cemented or uncemented cups, resurfacing cups combined with a conventional stem, and a traditional resurfacing prosthesis (Figure 6). We have compared those prostheses implanted between 1999 and 2011 with a control group consisting of conventional cemented and uncemented prostheses with a metal/polyethylene joint. In the control group (n=146,472) cups made of both older and newer polyethylene types (80.3 and 19.7%, respectively are included). The group with a resurfacing cup and conventional stem has the shortest observation time, 5 years, which is why the analysis is limited to 5 years after operation. Adjustment has been made for age, gender, and diagnosis. Conventional prostheses with metal/metal articulations show no definite increased or decreased risk for revision (cemented cup: RR=0.8 0.,3-2.,0, uncemented cup: RR=1.,2 0.8 – 2.0). On the other hand the risk for revision with use of the two alternatives where the joint socket of resurfacing design was used increased (resurfacing cup with conventional prosthesis: RR 1.8 1.2 – 2.6; traditional resurfacing prosthesis: RR 1.9 1.5-2.4).

In the group receiving the resurfacing prosthesis female gender bore twice the risk for revision (RR 2.2 1.1-4.2; Cox regression). Femoral head size was divided into five classes ($\leq$52, 54, 56, $\geq$58 mm) based on each class comprising at least 100 cases and at least 30 men and women in each class. With the use of this classification and the group $\geq$58 mm as reference we cannot with certainty show that the caput size influences the result.

Analysis of the patient group receiving a resurfacing cup with standard stem provides similar results. Female gender implies an almost tripled risk (2.9 1.1- 7.5). We cannot, in this analysis either, confirm that femoral head size comprises a risk factor.

Three types of conventional resurfacing prostheses (BHR, Durom European version and ASR) have dominated the Swedish market. Together they account for 93.2% of all implanted resurfacing prostheses. Both Durom (RR 3.3 2.0-5.6) and ASR (3.0 1.7- 5.5) have roughly a tripled risk for revision compared with BHR. In all of these analyses we have adjusted for gender, age, diagnosis, and femoral head size.

In conclusion, the use of a resurfacing cup with conventional stem and traditional resurfacing prostheses is associated

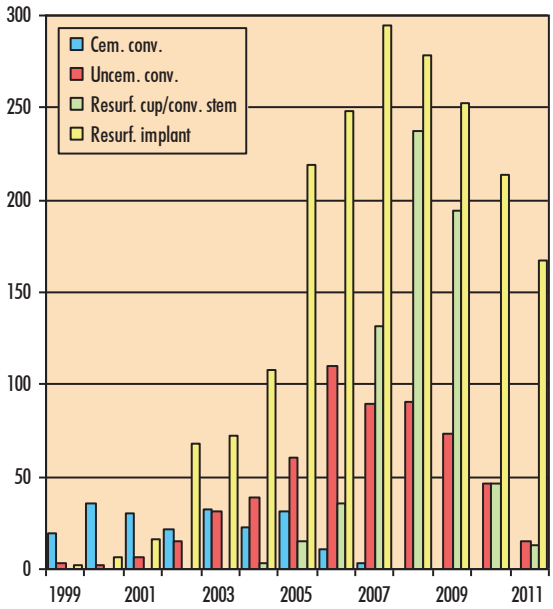


Figure 6. Number of prostheses with metal-on-metal articulation 1999 -2011. Resurfacing prosthesis is the most common followed by resurfacing cup combined with conventional stem and large joint head. After 2007 the use of metal-on-metal articulation has decreased.

	Cemented	Uncemented	Hybrid	Reversed hybrid
No.	143,336	13,372	4,219	9,503
Age (mean, *SD*)	71.4 *9.1*	56.6 *10.0*	60.4 *11.5*	62.3 *10.1*
Proportion women %	61.1	46.8	53.6	54.7
Proportion primary osteoarthritis %	80.4	84.9	76.5	85.8
Time to follow-up [1)] (mean, *SD*)	5.9 *4.1*	3.6 *3.0*	7.3 *4.3*	2.7 *2.1*

	Cemented cup	Cemented stem	Uncemented cup	Uncemented stem
No.	152,840	147,556	17,591	22,875
Age (mean, *SD*)	70.8 *9.4*	71.1 *9.3*	57.5 *10.5*	59.0 *10.4*
Proportion women %	60.7	60.9	48.4	50.1
Proportion primary osteoarthritis %	80.7	80.3	82.8	85.3
Time to follow-up [1)] (mean, *SD*)	5.3 *3.8*	5.9 *4.1*	3.4 *3.0*	3.2 *2.7*

Table 4. Base data for patients included in this year's analysis of cemented compared with uncemented fixation and of different prosthetic concepts based on selection of "modern" prostheses according to Table 5. [1)] within the 0-16-year interval.

with an increased risk for revision in Sweden. The risk increase affects chiefly women. In contrast to other national registers we find that the risk increase for hip prostheses with a traditional stem and resurfacing cup is relatively similar to that of conventional resurfacing prostheses. In an international comparison the numbers of implanted prostheses are relatively few. Even if certain conventional prostheses with metal/metal articulation, such as the BHR-prosthesis in younger men, have thus far shown about the same risk for revision as prostheses with metal/polyethylene articulation, the current advice is to avoid the use of this type of articulation (further reading: Kjaersgaard-Andersen: Global time-out may calm maelstrom of metal-on-metal THR, Orthopaedics Today: www.healio.com/orthopedics/hip/news/print/orthopaedics-today-europé/).

Dislocation, caput diameter and dual articular cup

In the previous annual report we informed that dual articular cups are used to an increasing extent to hinder dislocation. The cup consists of a metal shell that encloses a movable polyethylene hemisphere (polyethylene insert or liner). The stem component's femoral head (diameter 22 or 28 mm) is encased by the hemisphere so that it also allows rotation of the femoral head within the polyethylene sphere. The polyethylene casing can thus articulate partly against the metal casing and partly against the femoral head fixated on the stem. The concept differentiates from other types of joint-stabilising polyethylene liners ("constrained liner") used for uncemented cups. In this construction the insert is fixated to the metal shell while the liner in the dual articular cup can also articulate with the metal shell. From a biomechanical perspective this construction should have advantages compared with a joint stabilizing liner, since movements to a lesser extent load the cup component's fixation. Moreover, the construction can be expected to be more forgiving if collisions between stem component and polyethylene arise in certain positions of the joint. Positive experiences with dual articular cups have been published both after primary and revision surgery. The Avantage cup dominates the Swedish market for dual articular cups. Up until 2010 287 of these had been set in as cup components in primary prostheses, and 328 had been used in revisions of various kinds. In our analyses of dual articular cups we have used the outcome revision due to dislocation. Closed reductions of dislocation have been excluded since they are not reported to the Swedish Hip Arthroplasty Register. At the analysis we used patients operated with cups of conventional design as controls.

Dual articular cups as primary implant

78,098 hip replacements implanted in 61,743 patients between 2005 and 2010 were identified in the Swedish Hip Arthroplasty Register. The control group consisted of prosthetic types that were used in at least 1 000 operations. The inclusion criteria for the study were a joint head size of 22, 28, 32 or 36 mm or the use of a dual articular cup. The variables assumed to possibly affect the outcomes age, gender, diagnosis, choice of incision and size of femoral head were studied in a Cox-regression model to calculate the adjusted relative risk (RR) for revision due to dislocation.

174 of 287 dual articular cups had been inserted due to femur neck fracture, another 24 due to idiopathic necrosis, which means that 69% of all dual articular cups were inserted in high risk patients. Only 12% of all 28-millimeter joint heads had been used on this patient group. Following an average follow-up of roughly 3 (0-6) years, 399 (0.5%) of all examined prostheses had been revised due to dislocation whereof only one dual articular cup. The use of a 22-millimeter caput resulted in an increased risk for revision due to dislocation compared with a 28-millimeter caput (RR = 2.0 1.2-3.3, p = 0.01). There was a tendency toward diminished risk for revision due to dislocation for implants where the femoral heads diameter was 32 or 36 mm or if a dual articular cup was used, but no significant difference could be shown.

Other risk factors for revision due to dislocation were in this material male gender, patients with hip fracture or osteonecrosis (compared with primary osteoarthritis), miniinvasive and posterior incision, respectively (compared with lateral incisions). The project has taken place in cooperation

with Nils Hailer, Rudiger Weiss and André Stark. For details see: Hailer et al. Surgical approach, femoral head size and diagnosis influence the risk of early revision due to dislocation after total hip arthroplasty. An analysis of 78,098 operations in the Swedish Hip Arthroplasty Register. Acta Orthop 2012;83(6):566-71.

In summary we cannot ascertain that neither a femoral head larger than 28 mm in diameter nor dual articular cups reduce the risk for revision due to dislocation. Results are however to be seen against the background of the material containing relatively few dual articular cups. Since the observation time remains short one still cannot talk of long term results, which are strongly influenced by the risk for revision due to loosening and osteolysis. Increased wear of polyethylene from dual articular cups could lead to an increased presence of these complications in a longer perspective, wherefore the use of these cups should probably be reserved for high risk patients operated for hip fracture, idiopathic necrosis, or the presence of associated neuromuscular diseases.

Cup			
Cemented (n = 152,840)	%	Uncemented (n = 17,591)	%
Lubinus [1)]	55.0	Trilogy [2)]	46.6
Charnley Elite	8.5	Trident [2)]	12.6
Exter Duration	8.3	Allofit	9.4
Contemporary Hooded Duration	6.5	CLS Spotorno	7.0
ZCA [1)]	6.3	Pinnacle	5.0
Reflection [1)]	6.2	Ranawat/Burstein	3.7
FAL [1)]	4.1	TMT 3 varianter	3.5
Marathon XLPE	3.5	Reflection HA	3.1
Exeter X3 RimFit	0.9	TOP Pressfit HA	2.6
SHP	0.4	Continuum	1.7
Avantage	0.2	Regenerex	1.3
		Full hemisphere	1.1
		Mallory head	0.8
		Tritanium	0.8
		Exceed ABT	0.6

Stem			
Cemented (n = 147,556)	%	Uncemented (n = 22,875)	%
Lubinus SP2	64.0	CLS Spotorno	34.1
Exter polished	23.9	Corail ±krage	25.1
Spectron EF Primary	7.6	Bi-Metric	18.3
MS30 polished	3.7	ABGII HA	8.2
CPT (CoCr)	0.6	Accolade	5.8
Spectron Revision	0.1	Wagner Cone	3.5
		Symax	1.5
		CFP	1.2
		Synergy	1.0
		MP modulär	0.5
		Fitmore	0.4
		Proxima	0.3

Table 5. Prosthetic components included in the analysis of cemented and uncemented fixation of cup or stem. The selection is based on these having been used during 2011, and moreover, in at least 100 hip replacements 1992-2011.
[1)] ± highly cross-linked polyethylene.
[2)] ± hydroxylapatite/tricalciumphosphate.

Cemented – uncemented prosthesis

In the previous annual report we compared the risk for revision after operation with cemented and uncemented cups and stem, respectively. By selecting prosthetic components used during the last year and that have been implanted in at least 100 hip arthroplasties, we attempted to reflect the results based on modern prostheses. In several countries with an extended usage of cemented fixation there is a current trend to use more and more uncemented fixation. The transition to modern polyethylene with increased resistence to wear has gone slowly in Sweden, but is now accelerating and will probably lead to the complete disappearance from the market of the older types of polyethylene during 2012. We feel therefore that it is urgent to update the previous year's analysis and moreover study how the choice of fixation of the individual components play in when judging implant survival related to implant group.

In the previous year's analysis the focus was on revision due to loosening. Since complication profiles vary between cemented and uncemented prostheses we have, in this year's analysis, examined how the choice of fixation influences the risk for revision due to any cause. Demographic data and follow-up times are shown in Table 4. In this year's analysis 170,430 hip replacements are included (Table 5). In order to include reversed hybrid prostheses that have the follow-up time it has been maximized to 16 years.

Cemented and uncemented cup

Without adjusting for any differences between patients operated with cemented and uncemented cups, respectively, we find higher implant survival for cemented cups after 16 years (92.1% ±0.5 compared with 86.5%±2.6, 95% confidence interval, Figure 8). After adjusting for age, gender and diagnosis the risk for cup revision, regardless of cause, somewhat lowered with the use of cemented cups (RR cemented/uncemented cup 0,9 (0.8-0.96)). Among the three commonest causes of revision, loosening/osteolysis, dislocation and infection, we find that use of cemented cups imply a higher risk for revision due to loosening (1,3 1,1-1,5) but reduce the risk for revision due to dislocation (0.7 0.5 – 0.9) and infection (0.5 0.4-0.7). For patients over 70 the choice of cup fixation had no definite influence on the risk for revision due to loosening (0.6 0.3-1.4).

The better outcome for cemented cups with regard to dislocation could depend on the fact that an uncemented cup is more difficult to control. One can also tend more to perform revision with dislocation problems after implanting an uncemented cup, whereby it is easier to perform a revision with a liner replacement and perhaps larger femoral head compared with replacing a cemented cup. Even the increased revision risk in deep infection could be partly explained by the surgeon having a lower threshold for per-

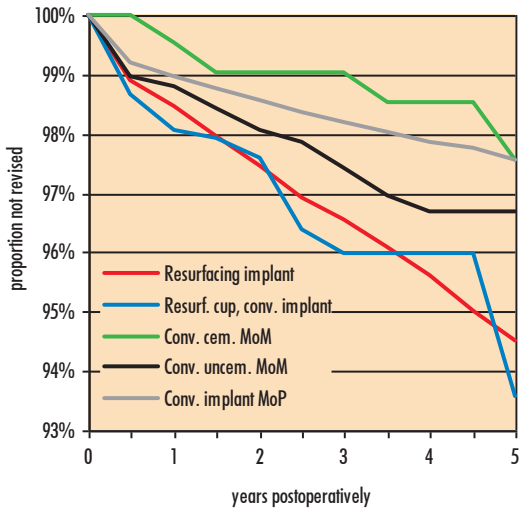


Figure 7. Unadjusted implant survival based on reoperation within 5 years (all casuses) in operations with 4 types of prostheses with metal-on-metal articulation (MoM).

forming a liner replacement than revision of a cemented cup in case of deep infection. If only femoral head replacement is performed it is not registered as a cup revision.

Cemented and uncemented stem

Comparison of the survival curves for cemented and uncemented stems shows a biphasic progression (Figure 9). During the first postoperative years uncemented stems are revised more frequently than cemented. The curves intersect after roughly 8 years. After 16 years unadjusted implant survival in the two groups was 90.8±3.0 (cemented stem) and 94.7±8.0%, respectively (uncemented stem). Since the curves intersect the analysis has been divided into two periods, 0-5 and 8-16 years. During the first interval the risk for stem revision regardless of cause was reduced by about half when using cemented fixation (0.5 0.4-0.6). A separate analysis of the four commonest reoperation causes loosening/osteolysis, infection, periprosthetic fracture and dislocation show a mixed picture. The risk for stem revision due to loosening is relatively similar (1.0 0.7-1.5). Cemented stems show an increased revision risk due to infection (1.4 1.0-1.9), but on the other hand a clearly reduced risk to suffer reoperation due to both periprosthesic fracture (0.1 0.1-0.2) and dislocation (0.4 0.3-0.6). At a separate analysis of the uncemented stems we find the risk for periprosthesic fracture three times higher for patients over 70 compared with those receiving an uncemeted stem and under 70 (2,9 2,0-4,4). The increased risk for stem reoperation due to infection need not depend on an increased infection incidence. The surgeon's attitude toward extracting a firmly situated uncemented stem and his/her attitude toward allowing the infection to heal with a remaining cemented or uncemented stem probably also plays a role. Cemented stems between 8 and 16 years show a clearly increased risk of reoperation regardless of cause. More than 80% of these revisions (482 of 597) are caused by loosening/osteolysis. The risk of being affected by this complication in the later interval is about 8 times greater for a cemented stem (7.4 2.5 – 24.8).

We find, in summary, no great differences in outcome in the form of cup revision that can with certainty be traced to the method of prosthetic fixation. The choice of uncemented fixation for younger patients with a high activity level could, since the risk for revision due to loosening is somewhat lower for this group, be advantageous. Likewise, the data speaks for the advantage of uncemented stem fixation for younger active patients with good bone quality, while uncemented stems should be used after careful selection for patients over 70. Uncemented stems should be generally avoided in cases of osteoporosis due to the risk for periprosthetic fractures.

A prerequisite for enabling future choices between cemented and uncemented fixation technique is that both are practiced and taught to future orthopedic surgeons. The trend of using all the more uncemented fixation has in some countries meant that younger physicians have, during their training, no longer contact with the cementation technique.

Totally cemented, uncemented, hybrid or reversed hybrid?

The above analysis speaks for component and fixation selection's influence on which complications can be expected. When these complications are to be treated the surgeon's strategy is influenced by the existing prosthesis' fixation and design. In the continuing review of the prosthetic concept the analysis has been limited whereby the regression model used builds on an existing proportionality between different survival curves, which is not always the case. In some cases there are insufficient observations for a meaningful analysis.

The assessment of prosthetic survival based on reoperation regardless of component(s) shows that the totally cemented

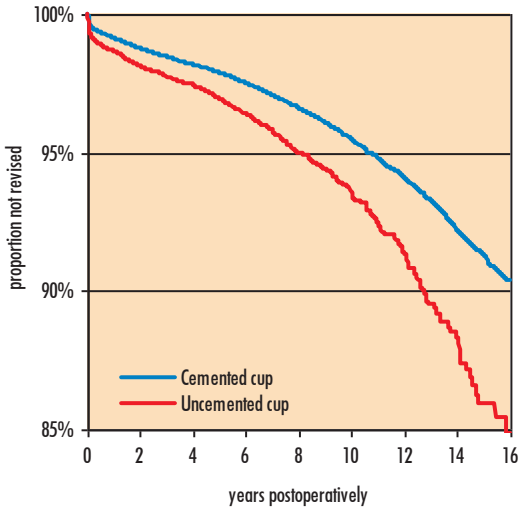


Figure 8. Unadjusted implant survival for cemented and uncemented cup based on cup revision with or witout simultaneous stem reoperation regardless of cause.

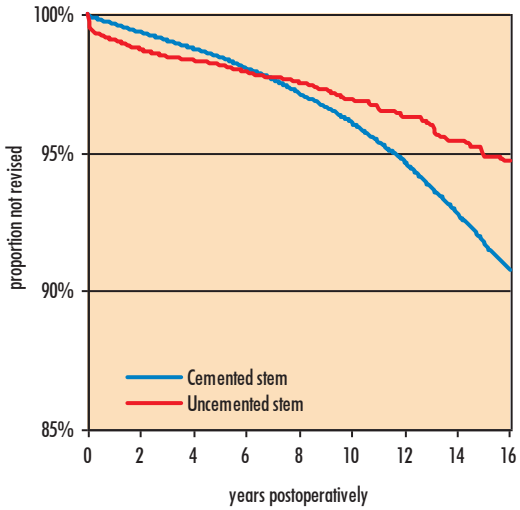


Figure 9. Unadjusted implant survival for cemented and uncemented stem based on stem revision with or without simultaneous cup revision regardless of cause.

prosthesis functions well. The unadjusted prosthetic survival for totally cemented, totally uncemented, hybrid and reversed hybrid varies between 90.4±0.5% for totally cemented prostheses and 81.0±4.2 % for hybrid prostheses. After adjusting for age, gender and diagnosis the risk for revision within 8 years is 30 to 80% higher for the other three prosthetic concepts (0 to 8 years after index operation: totally uncemented: 1.3 1.2-1.5, hybrid 1.4 1.2-1.7, reversed hybrid 1.8 1.6-2.1). After 8 years the survival curve for the prostheses with uncemented stems begins approaching totally cemented prostheses. The survival curve for hybrid prostheses shows a diverging pattern during the entire period and the increased risk for revision compared with totally cemented prostheses remains during the entire period (0 to 16 years: 1.3 1.4-1.8) (Figure 10).

The risk for revision due to loosening up to 69 years of age is relatively the same for totally cemented and hybrid prostheses up to 8 years (hybrid: 1.1 0.9-1.5). For reversed hybrid it is, during this period, somewhat higher (1.4 1.1-2.0). The totally uncemented prostheses is more seldom revised due to loosening than the totally cemented, a trend noted during the first 8 years and during the entire period (0 -16 years: 0.5 0.4-0.7). Up to 16 years the hybrid prostheses tend to be revised more often but the difference is not statistically ascertained (1.4 1.00-1.8). Reversed hybrids have not been analysed up to 16 years due to few observations, and because a regression model built on proportionality is not applicable (Figure 11). In the age group 70 and older the numbers of observations of uncemented components with a follow-up longer than 5 years are so few (≤280/group) that a statistical analysis is meaningless.

Revision due to dislocation is the next most common reason for revision during the first 16 years. The analysis has often been adjusted for incision selection. During the first three years the uncemented prosthetic concept is affected oftener. Risk increase varies between about 40 and 60% (RR between 1.5 1.1-2.0 for reversed hybrid and 1.6 1.2-2.2 for totally uncemented prostheses). After roughly 7 years the difference evens out for totally uncemented and reversed hybrid prostheses (no analysis performed). Hybrids have, during the entire interval 0 to 16 years, an increased risk for revision due to dislocation (1.6 1.0-1.9). Separate analyses within the groups lateral (supine or side position), posterior and other (mainly mini-incision) incisions show that the difference in incidence of dislocation leading to reoperation between totally cemented and reversed hybrid can be traced to the group operated on using one of the lateral incisions (Figure 12c) and the group of other incisions (data not shown). The analysis also shows that hybrids' tendency to be more often revised due to dislocation can in principle be attributed to those hybrid prostheses inserted from a posterior incision (Figure 12b).

Infection is the third most common cause of revision. The risk for revision due to this complication is increased for totally uncemented and hybrid prostheses (1.3 1.0-1.7, 1.5 1.1-2.1). The analysis of reversed hybrid prostheses up to 4 years after primary operation shows no certain difference compared to totally cemented prostheses (1.2 0.9-1.6).

In the analysis of those individual components it appears that uncemented stems are more often affected by periprosthetic fractures foremost during the first half year following the primary hip replacement. The risk diminishes after approximately 2 years. Up until 2 years the risk increase for both reverse hybrids (8.9 6.6-12.1) and totally uncemented prostheses (4.9 3.5-6.9) is higher than for totally cemented. Hybrid prostheses do not differ from the totally cemented (1.4 0.7-2.7).

In this selected sample of modern prostheses technical causes for reoperation are in fifth place. The most frequent measures for this complication are uncemented stem replacement followed by replacement of cemented cups and femoral heads,

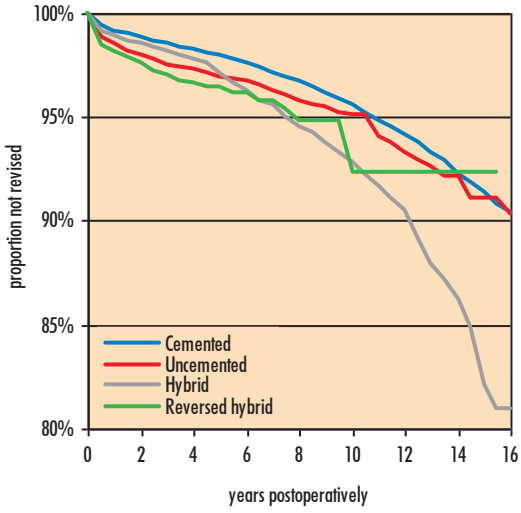


Figure 10. Unadjusted implant survival for completely cemented, completely uncemented, hybrid, and reversed hybrid prostheses based on all types of revision and all causes of revision.

which corresponds to slightly more than half of the 191 registered cases. This is an early complication that is chiefly dealt with during the first postoperative year (156 cases). Only 5 reoperations due to technical complications occur later than 3 years after the primary operation. The analysis is limited therefore to the period 0-3 years after the primary operation. Patients with uncemented stems suffer particularly from reoperation related to technical causes (totally uncemented 4.9 3.2-7.5, reversed hybrid 5.5 3.6-8.4). Hybrid prostheses do not differ from totally cemented (1.3 0.5-3.6).

Our analysis shows that the type of complications that leads to reoperation varies between the different prosthetic concepts. Up until 69 years of age the problem of loosening is lowest if a totally uncemented prosthesis is used, but this prosthetic concept is instead affected by other complications. This is possibly determined by the position of the uncemented components being more difficult to control during the process of insertion. Moreover, the stem can alter position after insertion by sinking and retroversion, which can influence the joint's stability.

The above analysis cannot alone form the background for a distinct recommendation for prosthetic selection in each individual case. The difference between the different types of prostheses are moreover relatively small, which is why the surgeons experience of different implants is many times more important than the choice of cemented or uncemented fixation. However, much of the above analyses speak for the totally cemented implant with its good results concerning all complications, as preferable for patients with expected lower activity, and particularly those with osteoporosis. Totally uncemented prostheses can be advantageous to patients expected to be engaged in high activity for a long period of time. Any disctinct advantage of using a hybrid or reversed hybrid prosthesis compared to the two other prosthetic concepts are not seen in our analysis. Finally, it should be pointed out that the analysis is also somewhat shaky since relatively few of the reversed hybrids have been followed up for an extended period of time. Many patients can also be expected to have their prosthesis way longer than 16 years.

Uncemented monoblock cups

Uncemented monoblock cups have been introduced to avoid problems chiefly in the form of wear due to movement between liner and metal-back when using uncemented fixation. In cooperation with Rudiger Weiss, Nils Hailer and André Stark, (Karolinska Institutet, Stockholm and Uppsala University) we have studied the two designs of monoblock cups used in Sweden (Morscher, TMT). 210 operations were registered 1999-2010. The Trilogy cup was used in the control group (n=1 130). Highly cross-linked polyethylene was used in about half the cases in the control group but was unavailable to the group with monoblock prostheses. The cumulative 5-year survival based on all types of revisions was 95% (91-98) for monoblock prostheses and 97% (96-98) in the control group. After adjusting for other risk factors we found no differences between groups (see: Weiss et al. Acta Orthop. 2012 June; 83(3): 214–219).

Surgical approach

The posterior approach (Moore) has long been the most frequently used approach in Sweden followed by lateral approach in lateral position (Gammer). Up until 2008 there has been a gradual swing in favor of lateral approaches. During the last 3 years the proportion operated by posterior approach stabilized at approximately 51-52% (Figure 13).

The approach's importance for various outcomes has been assessed in several studies. In general, the posterior approach bears a greater risk for dislocation. It has also been discussed

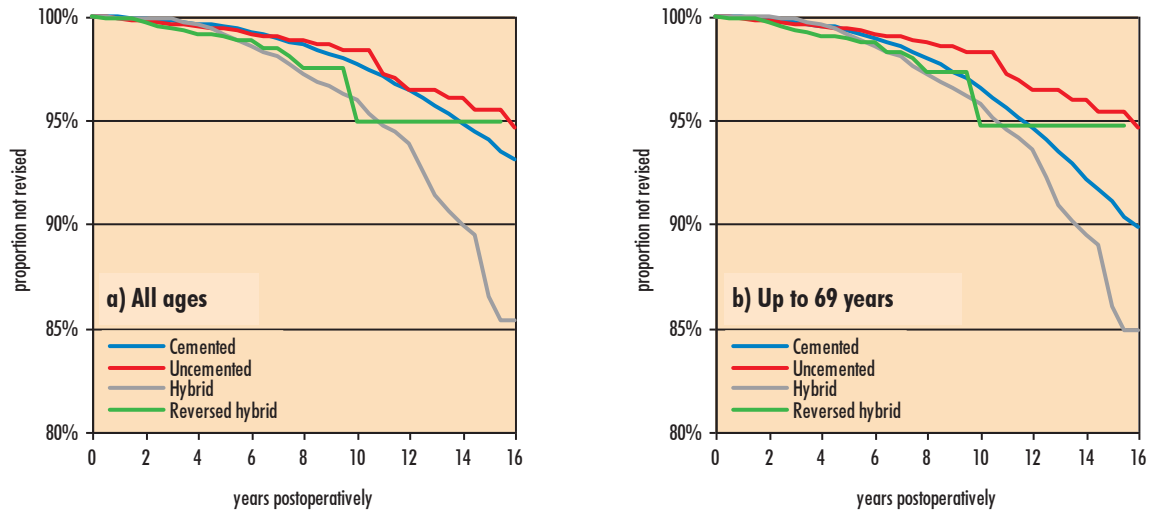


Figure 11a-b. Unadjusted implant survival for completely cemented, completely uncemented, hybrid, and reversed hybrid prostheses due to loosening/osteolysis. Primary operation regardless of age on the left, only 0-69 years on the right.

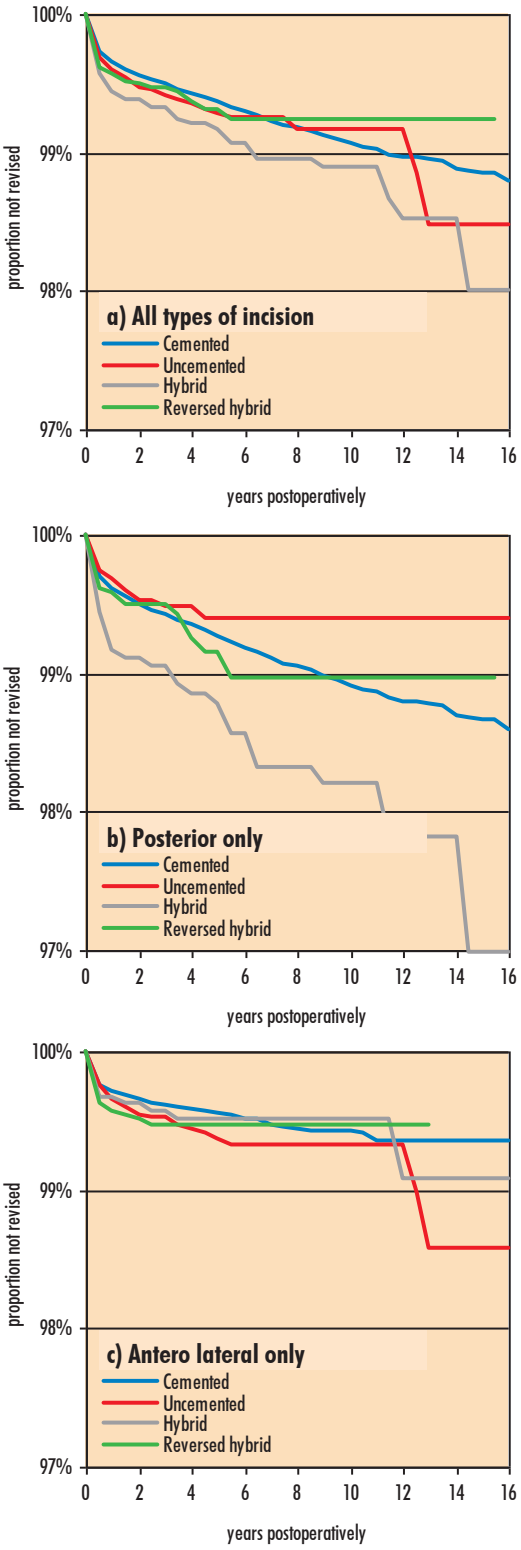


Figure 12a-c. Unadjusted implant survival for completely cemented, completely uncemented, hybrid, and reversed hybrid prostheses based on all types of revision due to dislocation. Primary operation with all types of approaches, only posterior approach, and only anterolateral approach with patient supine or in lateral position.

how the choice of approach influences the conditions for optimal positioning of the components, a problem discussed in the previous chapter. In a joint project with Viktor Lindgren and Per Wretenberg (Orthopedic clinic, Karolinska Institutet) we have studied how approach selection influences outcome in the form of risk for revision due to implant loosening and dislocation. Three prosthetic types (Exeter, Lubinus, Spectron EF Primary) were studied separately. Only operations carried out with an lateral approach in lateral position (Gammer) and posterior approach were included. Only prostheses with a 28 millimeter head were included in the study.

We found that the approach's influence on the risk for dislocation or loosening varied depending on the prosthetic design used. Lubinus and Spectron EF Primary stems inserted using an lateral approach showed, compared to a posterior approach, an increased risk for revision due to loosening. But they had a reduced risk for revision due to dislocation. In contrast to these two designs the choice of approach did not affect the risk for revision when the Exeter stem was used (for details see: Lindgren et al. Type of surgical approach influences the risk of reoperation in total hip arthroplasty. A study from the Swedish Hip Arthroplasty Register of 90,662 total hip replacements with 3 different cemented prostheses. Acta Orthop 2012;83(6):559-65.

The surgical technique's influence on the patient's experience of the results of surgery, degree of postoperative pain and function are also important to observe. We have, in an annual report, described how the posterior approach has a tendency to result in greater EQ-5D-gains, better pain reduction and higher patient satisfaction after one year. In this year's report this analysis has been repeated on those patients included in the group "modern prostheses" (Table 6).

A comparison between posterior and lateral approach in lateral position shows, for both men and women, that the posterior approach resulted in better EQ-5D-gains, better pain reduction and higher satisfaction (ANOVA with Bonferroni correction, $p < 0.0005$). After adjusting for age, diagnosis and covariation between outcome variables we find, for both genders, EQ-5D-gains and satisfaction in favor of the posterior approach, but not for pain improvement. This can be interpreted as pain improvement according to VAS, and the EQ-5D-gain partially explain the same thing, but that the EQ-5D gain does it in a better (and more extensive) way.

Corresponding comparisons between the posterior and lateral approach in the supine position in women shows a better outcome for the posterior approach for pain and satisfaction ($p < 0.0005$). In men we find only significantly higher satisfaction when using a posterior approach ($p < 0.0005$). Expanded analysis in a regression model provides similar results for men. Significance is less for women concerning differences in pain reduction while the difference in degree of satisfaction remains (detailed data not shown).

In summary, there is a relatively complex connection between approach seleletion and outcome. Against the background of the existing scientific evidence an lateral approach should be selected in those cases where an increased risk for future dislocaton problems is deemed likely.

	Posterior (Moore)		Antero lateral/patient on side (Gammer)		Antero lateral/patient on back (Hardinge)	
	median	mean *SD*	median	mean *SD*	median	mean *SD*
Women (no.)	18,096		12,096		1,313	
Gain EQ5D 0-1 year	0.34	0.39 *0.36*	0.32	0.37 *0.36*	0.34	0.37 *0.36*
Pain VAS difference 0-1 year	-52	-50 *23*	-50	-48 *24*	-50	-47 *25*
Satisfaction 1 year postop.	10	17 *20*	10	19 *23*	10	21 *23*
Men (no.)	13,132		8,342		793	
Gain EQ5D 0-1 year	0.31	0.36 *0.34*	0.27	0.33 *0.34*	0.27	0.33 *0.34*
Pain VAS difference 0-1 year	-50	-46 *23*	-49	-44 *23*	-50	-45 *23*
Satisfaction 1 year postop.	9	14 *18*	10	17 *22*	10	17 *21*

Table 6. EQ-5D improvement, difference in pain VAS and patient satisfaction 1 year after operation for the three most common approaches.

Posterior approach provides a somewhat better patient-reported outcome after one year. In the use of this approach, as in several others used more rarely in Sweden, the gluteus medius is unaffected, which should be an advantage where future revisions are to be expected. Posterior approach can also have a positive effect by reducing the risk for future loosening, but this has thus far only been shown for two types of cemented prosthetic designs. This year's analysis also hints towards approach selection as having importance for outcome after use of uncemented implants. This is an area in need of further study.

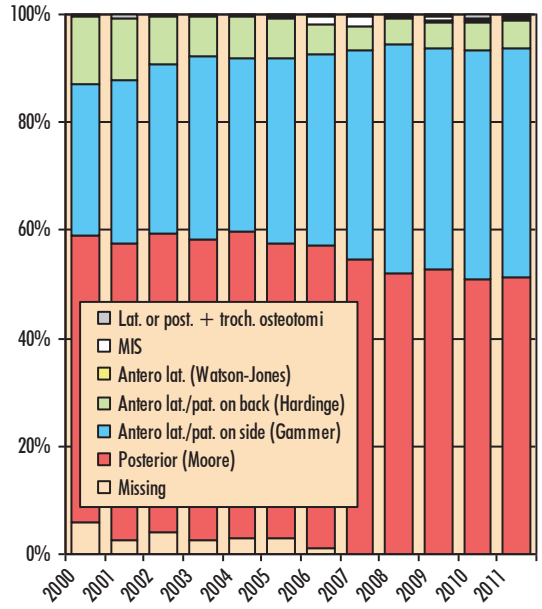


Figure 13. Relative distribution of type of approach. The relative proportion of operations performed by lateral approach increased until 2008 and has thereafter remained relatively constant (41-42%).

Notes

15 most common implants

most used during the past 10 years

Cup (Stem)	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
Lubinus All-poly (Luninus SP II)	62,099	5,269	4,917	4,943	5,166	4,345	86,739	35.3%
Contemporary Hooded Duration (Exeter Polished)	2,588	785	1,396	1,733	1,491	632	8,625	6.0%
Charnley Elite (Exeter Polished)	6,562	1,211	1,030	520	133	49	9,505	5.6%
Exeter Duration (Exeter Polished)	10,282	812	227	208	183	72	11,784	5.6%
FAL (Lubinus SP II)	4,064	448	419	438	396	266	6,031	3.8%
ZCA XLPE (MS30 Polished)	231	403	862	994	1,155	1,150	4,795	3.3%
Reflection (Spectron EF Primary)	6,941	285	160	127	29	4	7,546	3.2%
Marathon XLPE (Exeter Polished)	2	0	45	690	1,105	1,260	3,102	2.2%
Trilogy HA (CLS Spotorno)	596	347	380	379	380	372	2,454	1.7%
Charnley (Exeter Polished)	2,334	206	78	2	3	0	2,623	1.4%
ZCA XLPE (Lubinus SP II)	1	115	269	460	480	335	1,660	1.2%
Reflection XLPE (Spectron EF Primary)	10	242	460	507	220	97	1,536	1.1%
Lubinus All-poly (Corail Collarless)	19	69	170	406	401	356	1,421	1.0%
Allofit (CLS Spotorno)	563	131	294	221	140	80	1,429	1.0%
Charnley (Charnley)	55,515	3	1	0	0	0	55,519	0.9%
Others (1,375)	118,931	3,986	3,747	4,107	4,662	6,927	142,360	
Total	270,738	14,312	14,455	15,735	15,944	15,945	347,129	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

15 most common uncemented implants

most used during the past 10 years

Cup (Stem)	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
Trilogy HA (CLS Spotorno)	596	347	380	379	380	372	2,454	16.8%
Allofit (CLS Spotorno)	563	131	294	221	140	80	1,429	9.6%
Trident HA (Accolade)	236	147	164	235	201	201	1,184	8.1%
CLS Spotorno (CLS Spotorno)	902	194	69	45	36	38	1,284	5.8%
Trilogy HA (Corail Collarless)	3	47	80	155	212	159	656	4.5%
Trilogy (CLS Spotorno)	385	93	80	27	4	0	589	3.7%
Trident HA (ABG II HA)	54	107	79	107	69	83	499	3.4%
Pinnacle HA (Corail Collarless)	7	17	93	100	130	123	470	3.2%
Ranawat/Burstein (Bi-Metric HA std)	33	26	55	126	134	44	418	2.9%
Trilogy HA (Bi-Metric HA std)	72	53	70	61	68	53	377	2.6%
Trilogy HA (Wagner Cone Prosthesis)	20	9	34	71	96	70	300	2.0%
Trident HA (Symax)	85	79	45	29	3	3	244	1.7%
Trilogy HA (Versys stem)	257	0	0	0	0	0	257	1.6%
TOP Pressfit HA (CFP stem HA)	48	32	55	55	29	29	248	1.6%
Trilogy HA (Bi-Metric HA lat)	40	21	38	31	34	56	220	1.5%
Others (326)	7,380	383	311	436	752	1 196	10,458	
Total	10,681	1,686	1,847	2,078	2,288	2,507	21,087	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

15 most common hybrid implants

most used during the past 10 years

Uncemented cup (cemented stem)	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
Trilogy HA (Lubinus SP II)	972	55	66	56	47	70	1,266	26.9%
Trilogy HA (Spectron EF Primary)	1,191	24	18	8	2	2	1,245	21.7%
Trident HA (Exeter Polished)	6	2	1	15	56	82	162	5.4%
TOP Pressfit HA (Lubinus SP II)	141	4	1	9	3	1	159	4.2%
Trilogy HA (Exeter Polished)	40	13	17	28	23	7	128	3.8%
Trilogy HA (MS30 Polished)	3	18	27	19	17	15	99	3.3%
Ranawat/Burstein (Lubinus SP II)	16	9	21	16	12	18	92	3.1%
Reflection HA (Lubinus SP II)	188	2	11	3	0	1	205	2.8%
Trilogy HA (Stanmore mod)	86	8	2	1	0	0	97	2.8%
Biomex HA (Lubinus SP II)	107	0	0	0	0	0	107	2.2%
Trident HA (ABG II Cemented)	35	21	5	0	2	0	63	2.1%
Trident HA (Lubinus SP II)	20	6	3	14	6	5	54	1.8%
Allofit (MS30 Polished)	79	5	1	3	5	2	95	1.6%
Trilogy HA (CPT (CoCr))	7	3	3	6	12	15	46	1.5%
ABG II HA (Lubinus SP II)	213	0	0	0	0	0	213	0.9%
Others (256)	5,796	33	30	53	46	78	6,036	
Total	8,900	203	206	231	231	296	10,067	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

15 most common reversed hybrid implants

most used during the past 10 years

Cemented cup (uncemented stem)	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
Lubinus All-poly (Corail Collarless)	19	69	170	406	401	356	1,421	12.7%
Marathon XLPE (Corail Collarless)	0	0	15	186	382	384	967	8.6%
Contemporary Hooded Duration (ABG II HA)	151	85	100	156	123	25	640	5.7%
Charnley Elite (Corail Collarless)	60	70	147	79	60	20	436	3.9%
Lubinus All-poly (CLS Spotorno)	76	100	100	54	68	34	432	3.9%
Lubinus All-poly (Bi-Metric HA lat)	92	36	51	72	72	81	404	3.6%
Charnley Elite (CLS Spotorno)	195	90	90	19	4	3	401	3.6%
ZCA XLPE (CLS Spotorno)	20	83	64	59	60	66	352	3.1%
ZCA XLPE (Bi-Metric HA lat)	0	43	118	100	32	3	296	2.6%
ZCA XLPE (Corail Collarless)	0	6	34	68	106	51	265	2.4%
Charnley Elite (ABG II HA)	118	20	61	41	5	0	245	2.2%
Charnley Elite (ABG uncem.)	370	0	0	0	0	0	370	2.1%
Marathon XLPE (Bi-Metric HA std)	0	0	5	53	76	102	236	2.1%
Charnley (ABG II HA)	205	22	7	0	0	0	234	2.1%
Marathon XLPE (CLS Spotorno)	0	0	10	84	79	57	230	2.1%
Others (255)	1,971	518	430	458	609	913	4,899	
Total	3,277	1,142	1,402	1,835	2,077	2,095	11,828	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

15 most common resurfacing implants

most used during the past 10 years

Cup (Stem)	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
BHR Acetabular Cup (BHR Femoral Head)	424	111	111	137	137	125	1,045	53.1%
ASR Cup (ASR Head)	73	94	118	82	28	0	395	20.6%
Durom (Durom)	224	70	34	28	5	0	361	18.8%
Adept (Adept Resurfacing Head)	5	9	1	0	34	25	74	3.9%
BHR Acetabular Cup (BMHR VS)	0	0	0	2	6	11	19	1.0%
BHR Dysplasia Cup (BHR Femoral Head)	6	4	0	1	1	3	15	0.8%
Durom studiecup (Durom)	3	5	5	2	0	0	15	0.8%
ReCap Cup (ReCap Head)	1	0	6	0	2	0	9	0.5%
BHR Acetabular Cup (BMHR)	0	2	3	0	0	0	5	0.3%
ReCap HA Cup (ReCap Head)	3	0	0	0	0	0	3	0.2%
Zimmer MMC Cup (Durom)	0	0	0	0	0	3	3	0.2%
BHR Dysplasia Cup (BMHR VS)	0	0	0	0	1	0	1	0.1%
ASR Cup (BHR Femoral Head)	1	0	0	0	0	0	1	0.1%
McMinn resurf (McMinn resurf)	6	0	0	0	0	0	6	0.0%
Cormet 2000 resurf (Cormet 2000 resurf)	5	0	0	0	0	0	5	0.0%
Others (1)	2	0	0	0	0	0	2	
Total	753	295	278	252	214	167	1,959	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

15 most common cup components

most used during the past 10 years

Cup	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
Lubinus All-poly	84,614	5,550	5,309	5,561	5,842	5,004	111,880	37.4%
Charnley Elite	11,420	1,662	1,513	716	284	172	15,767	8.1%
Contemporary Hooded Duration	2,965	1,040	1,615	1,988	1,703	802	10,113	7.1%
Exeter Duration	11,123	912	243	230	189	79	12,776	6.2%
ZCA XLPE	282	778	1,682	2,000	2,120	1,913	8,775	6.1%
Trilogy HA	3,884	619	753	827	980	932	7,995	4.6%
FAL	4,150	472	441	480	447	290	6,280	4.0%
Marathon XLPE	2	0	80	1,099	1,928	2,292	5,401	3.8%
Reflection	8,468	316	182	167	44	8	9,185	3.3%
Charnley	61,135	239	88	4	3	0	61,469	2.6%
Trident HA	530	374	298	440	371	407	2,420	1.7%
Reflection XLPE	12	251	490	571	276	123	1,723	1.2%
Allofit	711	145	308	242	169	88	1,663	1.1%
Weber all-poly cup	1,425	262	18	0	0	0	1,705	1.0%
Exeter X3 RimFit	0	0	0	0	138	1,258	1,396	1.0%
Others (190)	80,017	1,692	1,435	1,410	1,450	2,577	88,581	
Total	270,738	14,312	14,455	15,735	15,944	15,945	347,129	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

15 most common stem components

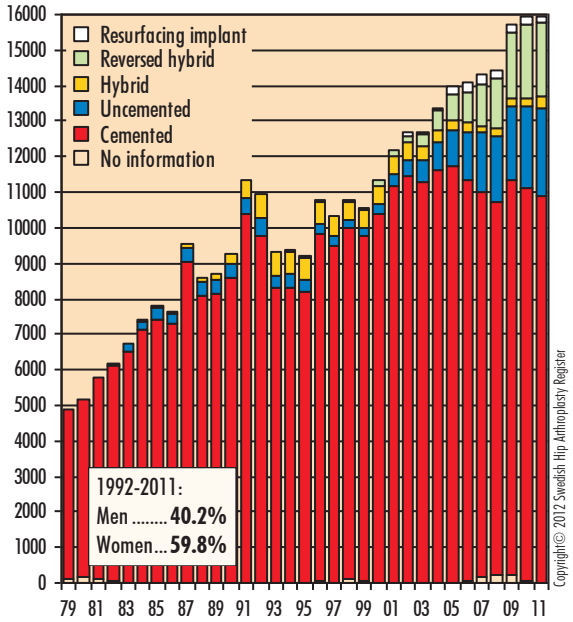
most used during the past 10 years

Stem	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1]
Lubinus SP II	73,901	6,167	5,837	6,123	6,377	6,145	104,550	43.7%
Exeter Polished	39,077	3,060	2,888	3,297	3,274	3,414	55,010	22.4%
CLS Spotorno	3,378	1,260	1,251	1,010	915	861	8,675	5.5%
Spectron EF Primary	9,128	614	742	739	319	132	11,674	5.2%
MS30 Polished	1,168	497	924	1,035	1,213	1,324	6,161	4.2%
Corail Collarless	159	259	618	1,203	1,494	1,521	5,254	3.7%
Bi-Metric HA std	417	349	386	465	442	424	2,483	1.7%
ABG II HA	709	276	277	371	369	277	2,279	1.6%
Bi-Metric HA lat	559	268	348	359	280	309	2,123	1.5%
CPT (CoCr)	807	188	102	128	115	130	1,470	1.0%
Accolade	245	148	213	258	231	252	1,347	0.9%
Charnley	56,646	4	1	0	0	0	56,651	0.9%
Straight-stem standard	1,189	256	16	0	0	0	1,461	0.8%
BHR Femoral Head	431	115	111	138	138	128	1,061	0.7%
Wagner Cone Prosthesis	435	66	87	119	165	134	1,006	0.5%
Others (191)	82,489	785	654	490	612	894	85,924	
Total	270,738	14,312	14,455	15,735	15,944	15,945	347,129	

1) Refers to the proportion of the total number of primary THRs performed during the past 10 years.

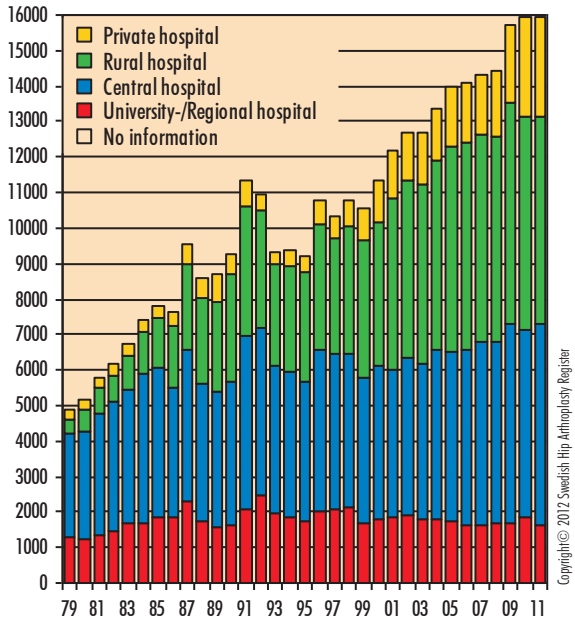
Number of primary THRs

per type of fixation, 1979-2011



Number of primary THRs

per type of hospital, 1979-2011



Number of primary THRs per hospital and year

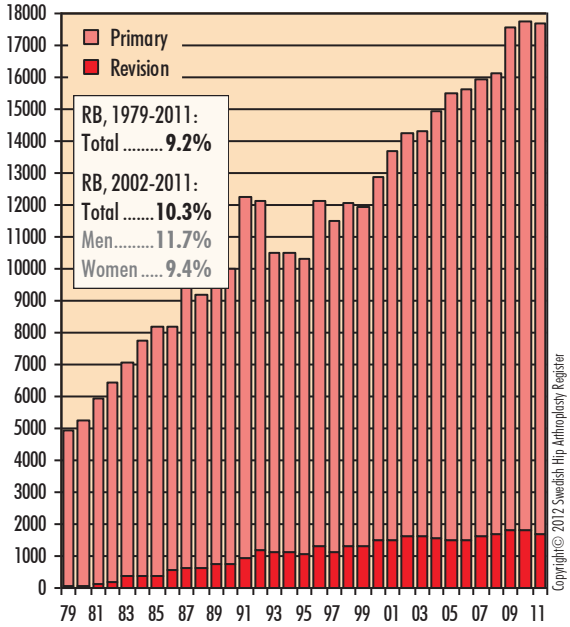
Hospital	1979-2006	2007	2008	2009	2010	2011	Total	Prop. [1)]
Aleris Ortopedi i Ängelholm	0	0	0	0	0	2	2	0.0%
Aleris Spec.vård i Motala	0	0	0	0	437	429	866	0.2%
Aleris Specialistvård Elisabethsjukhuset	598	164	143	84	70	60	1,119	0.3%
Aleris Specialistvård Nacka	72	34	13	100	121	133	473	0.1%
Aleris Specialistvård Sabbatsberg	1,517	0	0	131	150	145	1,943	0.6%
Alingsås	1,878	211	207	223	201	210	2,930	0.8%
Arvika	1,274	88	148	166	182	184	2,042	0.6%
Bollnäs	2,140	262	243	304	331	281	3,561	1.0%
Borås	5,097	214	192	202	171	188	6,064	1.7%
Capio S:t Göran	9,259	300	360	418	422	455	11,214	3.2%
Carema Ortopediska Huset	1,584	536	500	441	342	316	3,719	1.1%
Carlanderska	1,235	50	44	44	118	159	1,650	0.5%
Danderyd	6,757	418	404	377	299	338	8,593	2.5%
Eksjö	4,196	183	207	211	193	183	5,173	1.5%
Enköping	1,586	187	222	235	257	295	2,782	0.8%
Eskilstuna	3,942	76	103	110	110	128	4,469	1.3%
Falun	5,484	260	289	326	322	367	7,048	2.0%
Frölunda Specialistsjukhus	196	75	79	81	78	82	591	0.2%
Gällivare	2,258	70	102	86	105	86	2,707	0.8%
Gävle	5,073	129	136	175	164	203	5,880	1.7%
Halmstad	3,810	238	202	218	229	227	4,924	1.4%
Helsingborg	3,725	60	49	73	70	59	4,036	1.2%
Hudiksvall	2,716	139	111	138	138	128	3,370	1.0%
Hässleholm-Kristianstad	7,621	851	853	894	797	775	11,791	3.4%
Jönköping	3,993	179	204	208	210	211	5,005	1.4%
Kalmar	4,162	173	165	193	165	184	5,042	1.5%
Karlshamn	1,957	196	182	221	188	235	2,979	0.9%
Karlskoga	2,307	106	100	141	137	120	2,911	0.8%
Karlskrona	2,320	35	17	16	46	36	2,470	0.7%
Karlstad	4,306	335	243	252	287	259	5,682	1.6%
Karolinska/Huddinge	5,262	257	216	253	234	283	6,505	1.9%
Karolinska/Solna	4,290	189	255	185	208	206	5,333	1.5%
Katrineholm	2,006	201	255	234	239	239	3,174	0.9%
Kungälv	2,306	225	191	178	193	171	3,264	0.9%
Lidköping	1,969	133	134	123	123	186	2,668	0.8%
Lindesberg	2,009	147	153	208	210	234	2,961	0.9%
Linköping	5,205	51	57	70	58	68	5,509	1.6%
Ljungby	2,083	127	104	194	164	165	2,837	0.8%
Lycksele	2,483	238	230	322	330	309	3,912	1.1%
Mora	2,721	152	195	217	216	222	3,723	1.1%
Movement	217	98	190	193	256	253	1,207	0.3%
Norrköping	4,811	135	265	234	238	245	5,928	1.7%

Norrtälje	1,335	105	120	131	118	101	1,910	0.6%
Nyköping	2,568	131	177	158	184	171	3,389	1.0%
Ortho Center Stockholm	851	197	215	411	434	400	2,508	0.7%
OrthoCenter IFK-kliniken	0	18	94	103	117	150	482	0.1%
Oskarshamn	1,998	233	217	198	198	210	3,054	0.9%
Piteå	1,468	363	334	352	373	373	3,263	0.9%
Skellefteå	2,322	86	91	94	93	79	2,765	0.8%
Skene	1,013	88	78	87	105	106	1,477	0.4%
Skövde	5,285	140	98	100	134	198	5,955	1.7%
Sollefteå	1,764	98	116	116	123	125	2,342	0.7%
Sophiahemmet	4,866	190	178	172	174	166	5,746	1.7%
Spenshult	0	75	153	104	184	156	672	0.2%
SU/Mölndal	1,150	224	294	342	444	405	2,859	0.8%
SU/Sahlgrenska	4,948	6	8	4	8	4	4,978	1.4%
Sunderby (inklusive Boden)	4,679	58	45	42	38	30	4,892	1.4%
Sundsvall	5,256	136	114	215	203	229	6,153	1.8%
SUS/Lund	4,337	85	99	85	114	100	4,820	1.4%
SUS/Malmö	5,839	105	98	92	109	83	6,326	1.8%
SUS/Trelleborg	3,734	622	599	582	572	598	6,707	1.9%
Södersjukhuset	6,684	468	431	383	387	337	8,690	2.5%
Södertälje	1,137	117	107	136	118	118	1,733	0.5%
Torsby	1,354	96	79	100	105	105	1,839	0.5%
Uddevalla	5,067	326	309	364	284	337	6,687	1.9%
Umeå	4,084	84	83	107	95	63	4,516	1.3%
Uppsala	5,888	290	288	321	372	256	7,415	2.1%
Varberg	3,894	247	203	263	193	241	5,041	1.5%
Visby	2,047	120	132	139	105	118	2,661	0.8%
Värnamo	2,352	130	150	144	124	146	3,046	0.9%
Västervik	2,527	117	110	109	113	117	3,093	0.9%
Västerås	3,356	181	239	433	416	460	5,085	1.5%
Växjö	3,212	108	142	100	127	145	3,834	1.1%
Ystad	2,427	7	7	3	5	8	2,457	0.7%
Ängelholm	2,831	0	6	45	143	156	3,181	0.9%
Örebro	4,885	198	164	177	184	177	5,785	1.7%
Örnsköldsvik	2,422	188	189	166	185	140	3,290	0.9%
Östersund	4,007	193	185	237	234	278	5,134	1.5%
Others [2)]	32,726	960	740	641	220	0	35,287	10.2%
Total	270,738	14,312	14,455	15,735	15,944	15,945	347,129	

1) Proportion of the total number of primary THRs performed during 1979-2011.
2) Hospitals that are missing registrations during 2011 are included here.

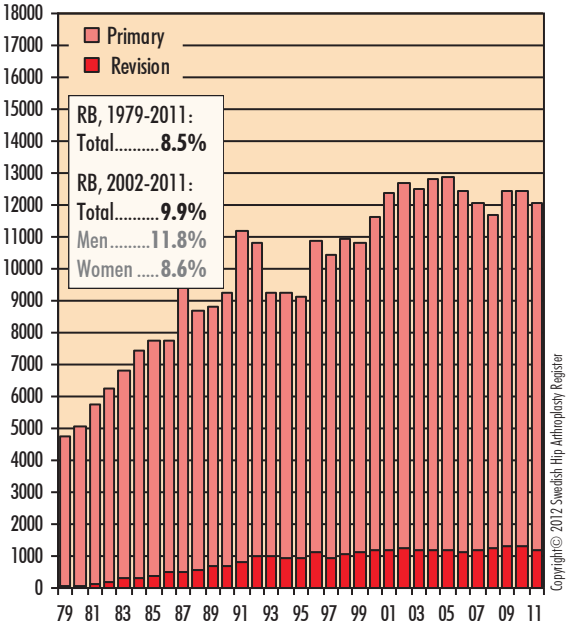
All THRs

347,129 primary THRs, 34,981 revisions, 1979-2011



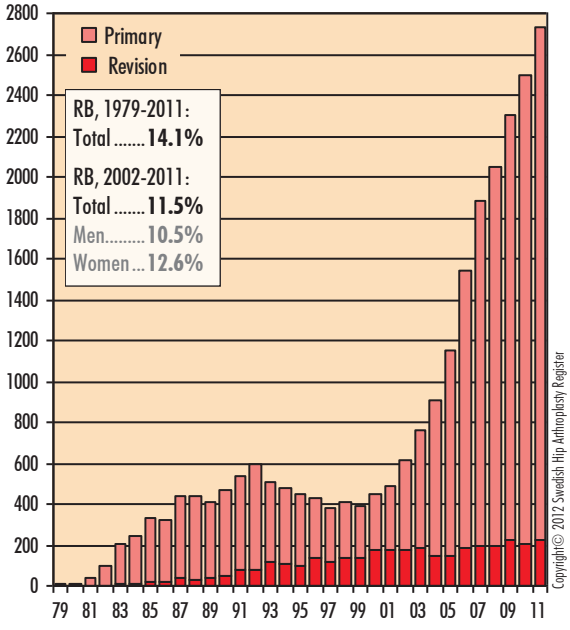
THRs with cemented implants

300,607 primary THRs, 27,900, 1979-2011



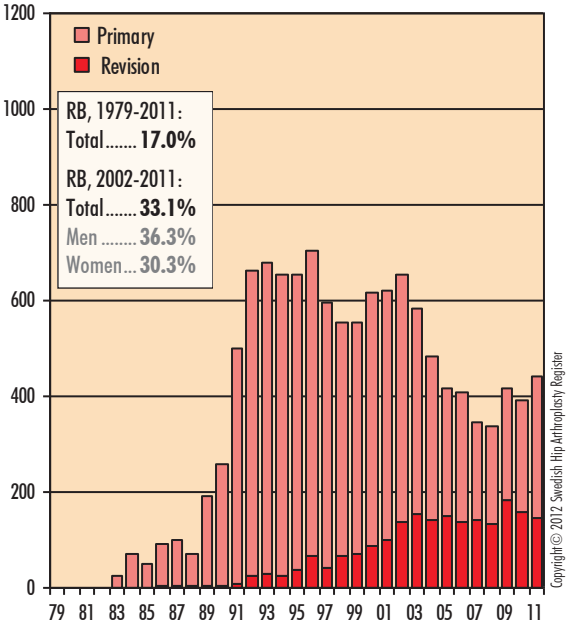
THRs with uncemented implants

21,807 primary THRs, 3,460 revisions, 1979-2011



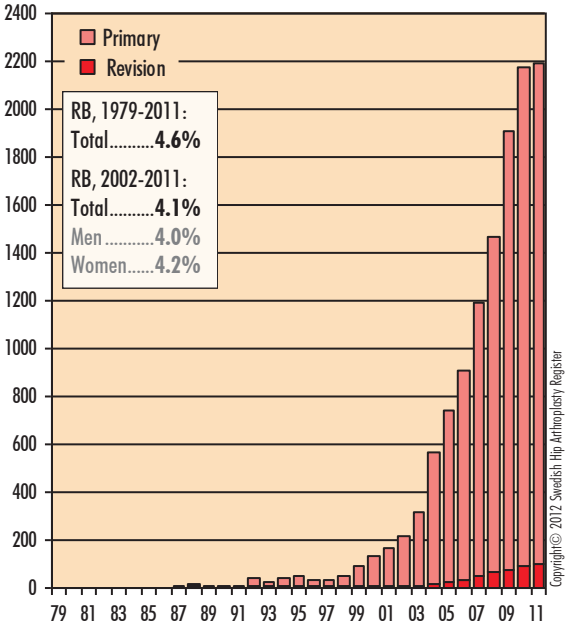
THRs with hybrid implants

10,067 primary THRs, 2,066 revisions, 1979-2011



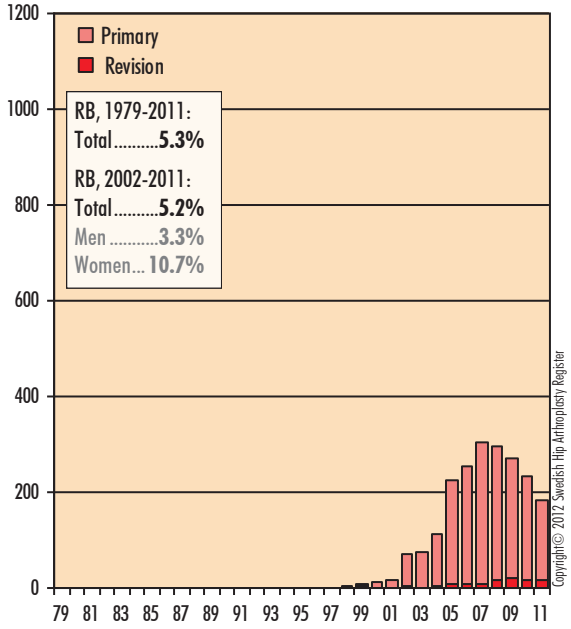
THRs with reversed hybrid implants

11,828 primary THRs, 576 revisions, 1979-2011



THRs with resurfacing implants

1,959 primary THRs, 110 revisions, 1979-2011



Number of primary THRs per diagnosis and year

Diagnosis	1992-2006	2007	2008	2009	2010	2011	Total	Prop.
Primary osteoarthritis	131,474	11,855	11,981	13,242	13,373	13,255	195,180	79.2%
Fracture	19,069	1,417	1,403	1,421	1,474	1,509	26,293	10.7%
Inflammatory arthritis	7,140	298	271	285	234	241	8,469	3.4%
Idiopathic femoral head necrosis	4,900	339	394	408	445	505	6,991	2.8%
Childhood disease	3,074	294	289	286	307	338	4,588	1.9%
Secondary osteoarthritis	1,295	1	0	4	3	2	1,305	0.5%
Tumour (malignancy)	888	88	93	78	81	74	1,302	0.5%
Secondary arthritis after trauma	420	18	22	11	26	21	518	0.2%
(missing)	1,869	2	2	0	1	0	1,874	0.8%
Total	170,129	14,312	14,455	15,735	15,944	15,945	246,520	100%

Number of primary THRs per diagnosis and age

1992-2011

Diagnosis	< 50 years		50-59 years		60-75 years		> 75 years		Total	Prop.
Primary osteoarthritis	7,201	59.4%	26,878	82.1%	107,229	84.2%	53,872	72.5%	195,180	79.2%
Fracture	343	2.8%	1,334	4.1%	10,218	8.0%	14,398	19.4%	26,293	10.7%
Inflammatory arthritis	1,526	12.6%	1,606	4.9%	4,013	3.2%	1,324	1.8%	8,469	3.4%
Idiopathic femoral head necrosis	805	6.6%	901	2.8%	2,625	2.1%	2,660	3.6%	6,991	2.8%
Childhood disease	1,835	15.1%	1,403	4.3%	1,127	0.9%	223	0.3%	4,588	1.9%
Secundary osteoarthritis	99	0.8%	112	0.3%	475	0.4%	619	0.8%	1,305	0.5%
Tumour (malignancy)	141	1.2%	257	0.8%	598	0.5%	306	0.4%	1,302	0.5%
Secondary arthritis after trauma	72	0.6%	69	0.2%	183	0.1%	194	0.3%	518	0.2%
(missing)	107	0.9%	171	0.5%	887	0.7%	709	1.0%	1,874	0.8%
Total	12,129	100%	32,731	100%	127,355	100%	74,305	100%	246,520	100%

Number of primary THRs with uncemented implants per diagnosis and age

1992-2011

Diagnosis	< 50 years		50-59 years		60-75 years		> 75 years		Total	Prop.
Primary osteoarthritis	2,773	62.0%	6,175	87.3%	5,326	91.6%	301	76.8%	14,575	82.1%
Childhood disease	843	18.8%	455	6.4%	135	2.3%	10	2.6%	1,443	8.1%
Inflammatory arthritis	368	8.2%	137	1.9%	111	1.9%	12	3.1%	628	3.5%
Idiopathic femoral head necrosis	326	7.3%	167	2.4%	102	1.8%	15	3.8%	610	3.4%
Fracture	73	1.6%	97	1.4%	120	2.1%	50	12.8%	340	1.9%
Secundary osteoarthritis	33	0.7%	7	0.1%	4	0.1%	1	0.3%	45	0.3%
Secondary arthritis after trauma	26	0.6%	5	0.1%	2	0.0%	3	0.8%	36	0.2%
Tumour (malignancy)	3	0.1%	7	0.1%	4	0.1%	0	0.0%	14	0.1%
(missing)	28	0.6%	21	0.3%	11	0.2%	0	0.0%	60	0.3%
Total	4,473	100%	7,071	100%	5,815	100%	392	100%	17,751	100%

Number of primary THRs per type of fixation and age

1992-2011

Type of fixation	< 50 years		50-59 years		60-75 years		> 75 years		Total	Prop.
Cemented	3,631	29.9%	17,693	54.1%	112,086	88.0%	71,969	96.9%	205,379	83.3%
Uncemented	4,473	36.9%	7,071	21.6%	5,815	4.6%	392	0.5%	17,751	7.2%
Reversed hybrid	1,323	10.9%	3,662	11.2%	5,608	4.4%	1,190	1.6%	11,783	4.8%
Hybrid	1,447	11.9%	3,186	9.7%	3,378	2.7%	643	0.9%	8,654	3.5%
Resurfacing implant	919	7.6%	799	2.4%	239	0.2%	2	0.0%	1,959	0.8%
(missing)	336	2.8%	320	1.0%	229	0.2%	109	0.1%	994	0.4%
Total	12,129	100%	32,731	100%	127,355	100%	74,305	100%	246,520	100%

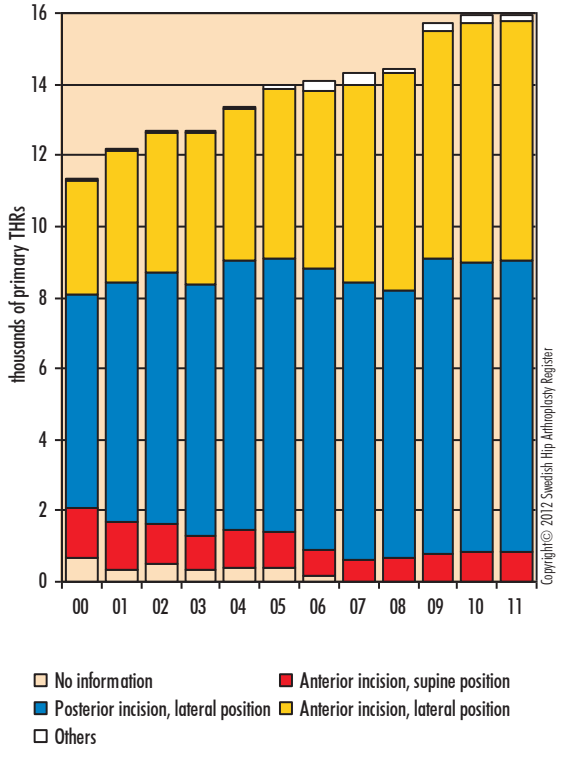
Number of primary THRs per type of incision and year

Type of incision	2000-2006	2007	2008	2009	2010	2011	Total	Prop.
Posterior incision, lateral position (Moore)	50,038	7,817	7,506	8,299	8,129	8,157	89,946	54.0%
Anterior incision, lateral position (Gammer)	29,174	5,544	6,118	6,421	6,745	6,767	60,769	36.5%
Anterior incision, supine position (Hardinge)	7,715	606	671	793	835	861	11,481	6.9%
Others	615	327	143	221	230	158	1,694	1.0%
(missing)	2,759	18	17	1	5	2	2,802	1.7%
Total	90,301	14,312	14,455	15,735	15,944	15,945	166,692	100%

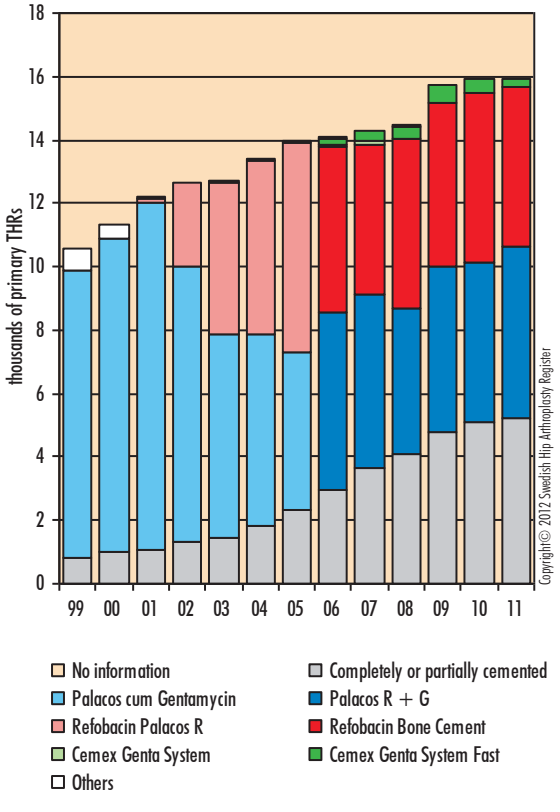
Number of primary THRs per type of cement and year

Typ av cement	1999-2006	2007	2008	2009	2010	2011	Total	Prop.
Palacos cum Gentamycin	55,991	0	0	0	0	0	55,991	31.6%
Palacos R + G	5,551	5,500	4,556	5,220	5,062	5,375	31,264	17.6%
Refobacin Palacos R	19,612	0	0	0	0	0	19,612	11.1%
Refobacin Bone Cement	5,262	4,698	5,359	5,163	5,345	5,055	30,882	17.4%
Cemex Genta System Fast	223	354	413	569	429	247	2,235	1.3%
Cemex Genta System	111	120	0	0	0	1	232	0.1%
Others	1,335	10	15	21	34	21	1,436	0.8%
(completely or partially uncemented)	12,779	3,630	4,112	4,762	5,074	5,246	35,603	20.1%
(missing)	4	0	0	0	0	0	4	0,0%
Total	100,868	14,312	14,455	15,735	15,944	15,945	177,259	100%

Type of incision
2000-2011

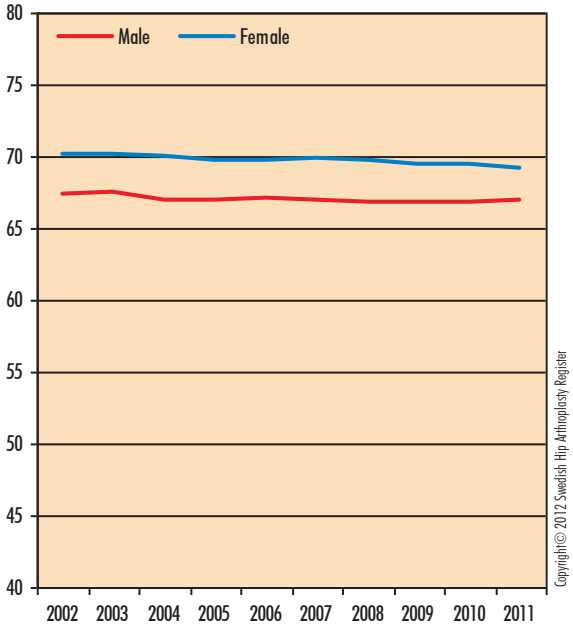


Type of cement
1999-2011



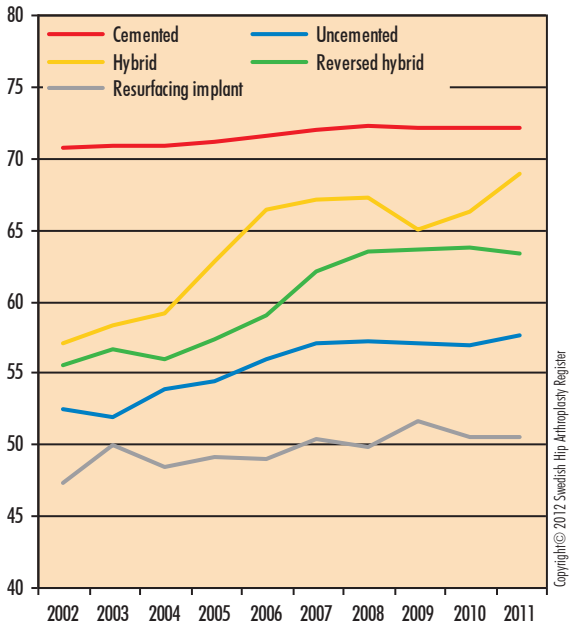
Mean age per gender

the past 10 years, 143,177 primary THRs



Mean age per type of fixation

the past 10 years, 142,420 primary THRs



Average age per diagnosis and gender

the past 10 years

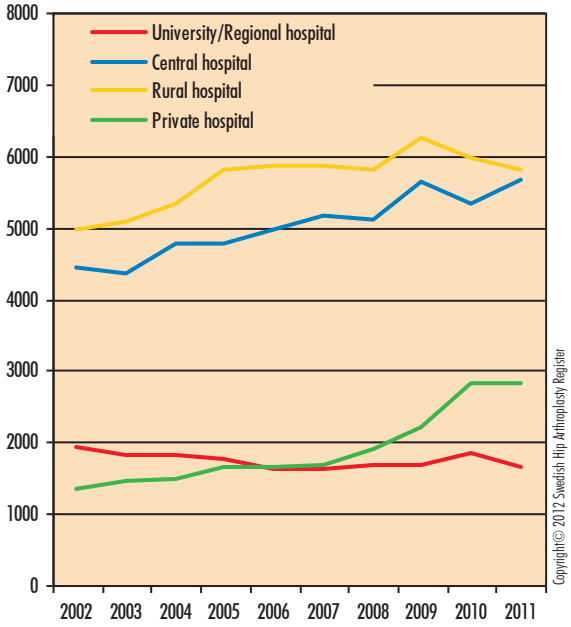
Diagnosis	Male	Female	Total
Fracture	73.2	75.2	74.6
Secondary arthritis after trauma	70.2	73.1	71.5
Primary osteoarthritis	67.1	69.6	68.5
Idiopathic femoral head necrosis	61.4	70.3	67.1
Tumour (malignancy)	70.1	63.2	66.5
Secondary osteoarthritis	64.3	66.3	65.2
Inflammatory arthritis	58.9	62.2	61.3
Childhood disease	54.1	53.2	53.6
(missing)	75.0	63.9	65.7
Total	67.0	69.7	68.6

Average age per type of hospital and gender

the past 10 years

Type of hospital	Male	Female	Total
Central hospitals	67.9	70.6	69.5
Rural hospitals	67.9	70.0	69.1
Private hospitals	65.0	68.2	66.9
University/Regional hospitals	63.6	68.0	66.3
Total	67.0	69.7	68.6

Trend in number of primary THRs
the past 10 years, by type of hospital



Effect of increased proportion private operations

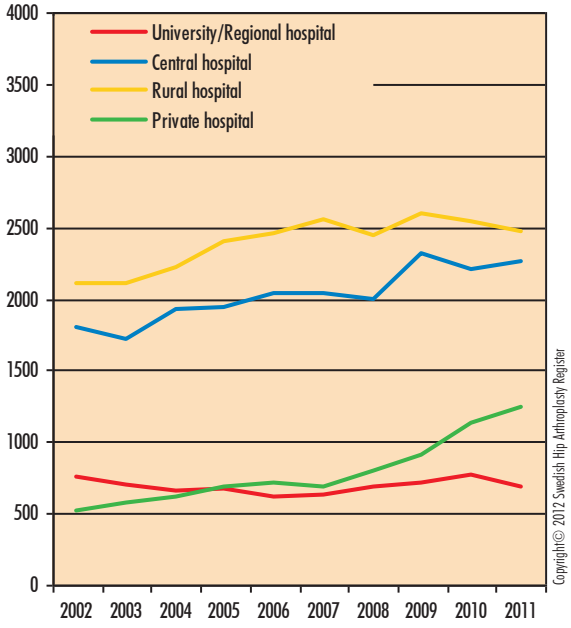
In 2009 Swedish private hospitals carried out, for the first time, more primary arthroplasties in comparison to university and regional hospitals. This difference has been further accentuated in 2010.

The fact that county and particularly private hospitals operate on ”healthier” patients, with less comorbidity and technically simpler cases, can lead to lesser accessibility for those ”sicker” patients or more difficult cases, leading to a displacement effect. Other long-term disadvantages:

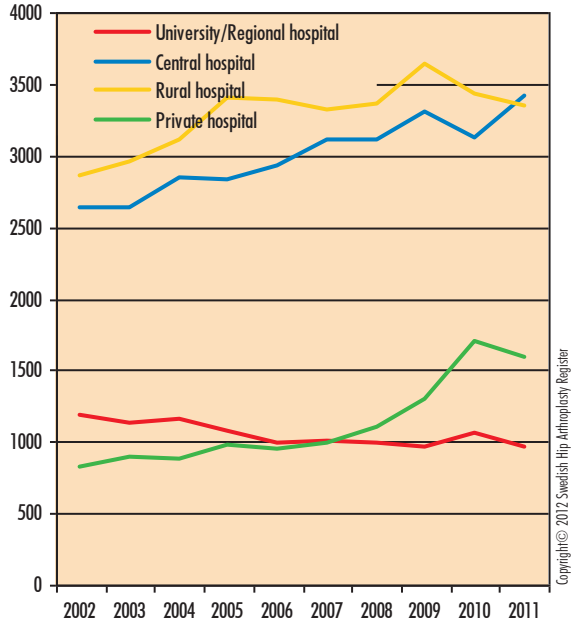
- Possibilities for continual training of physicians and operating room personnel are reduced whereby training is concentrated to university and regional hospitals.
- The basis for clinical studies in primary arthroplasties becomes dramatically reduced.

This can, in the long run, affect the possibilities for transferring competence to doctors in specialist training, and the trend should absolutely be broken. One demand is for the private sector to take educational responsibility, which can be made possible if the compensation level is raised in future public contracts.

Trend in number of primary THRs
the past 10 years - males only



Trend in number of primary THRs
the past 10 years - females only



Guidelines for follow-up of metal-on-metal

The Swedish Hip and Knee Society's guidelines for the follow-up of Metal-on-metal prostheses in Sweden

Previous annual reports have discussed outcomes after insertion of resurfacing prostheses and prostheses with large metal heads against metal cups. The Registry has previously recommended the use of resurfacing prostheses should be limited to younger men, and preferably concentrated to units with greater volumes (Annual report 2010). In our neighboring European countries and at international orthopaedic meetings these implants have been brought to attention after a marked increase of the number of reports of undesired consequences after insertion and a relatively high number of early revisions.

An unavoidable consequence of the material combination metal-on-metal is that wear and corrosion leads to the release of metal ions from the implants. This is particularly true of the heavy metals cobalt and chrome, but even other metal ions have been described as increased. In patients opererated with metal-on-metal prostheses concentrations of cobalt and chrome in the blood and urine are increased, in some cases heavily increased.

Two main causes of early revision after resurfacing prostheses and metal-on-metal, respectively has been described in Sweden and internationally:

1. Increased occurrences of **fracture of the femoral neck**, partly due to osteonecrosis. Osteonecrosis is assumed to be a consequence of negatively affected blood circulation to the femoral head and possibly also after insertion of a resurfacing prosthesis.

2. Presence of **pseudotumor** around the hip joint. Pseudotumor is unusual but important to diagnose early to facilitate treatment. Presence of pseudotumor has been associated with increased concentrations of metal ions in the tissues surrounding the implant and in the blood, but can in rare cases also appear without markedly increased concentrations of cobalt and chrome in the bloodstream. Pseudotumors can appear both in patients receiving resurfacing and operated with metal-on-metal prostheses with a large head.

The following risk groups **for revision regardless of cause** have been identified in smaller cohort studies and register data:

1. Older patients have a higher risk for revision than younger ones.

2. Women have a higher risk for revision than men.

3. Patients with small implant sizes (<50 mm on the femur) have a greater risk for revision than patients with large implants.

Pseudotumor can appear in patients not belonging to any of the above risk groups. Changes also appear in patients completely devoid of symptoms. There have, however, been risk -groups defined that run an especially high **risk of developing pseudotumor**:

1. Women run a higher risk of developing pseudotumors than men.

2. In some studies a higher risk for developing pseudotumors could be associated with steeply seated acetabulums (>50 degrees from the horizontal plane).

3. Extremely heightened concentrations of cobalt and chrome have been associated with a higher risk for developing pseudotumors. It should be emphasized that pseudotumors can also appear in the absence of extremely heightened concentrations of metal ions.

The number of reported early revisions of resurfacing prostheses and metal-on-metal prostheses with a large head caused, in 2010, the British authorities' "Medicines and Healthcare Products Regulatory Agency" to come out with a warning for continued use of these prostheses ("Medical Device Alert"). The British Orthopaedic Association (BOA) even recommended a systematic follow-up of patients with these prosthetic types, including measurement of certain metal ions (cobalt and chrome) in the blood. The Danish Orthopaedic Association sooned followed suit with the Societys´s own recommendations. The manufacturer of a particular, currently withdrawn, resurfacing prosthesis (ASR), DePuy Johnson & Johnson made, along with a user group, a flow chart for the systematic examination of patients operated with an ASR-prosthesis.

The Swedish Hip and Knee Association was, in the beginning of 2012, given the task by the Swedish Orthopaedic Association's board of directors of systematically following up patients with resurfacing prostheses and metal-on-metal prostheses with a large head, respectively. Work with these guidelines took place in cooperation with representatives of the Swedish Hip Arthroplasty Register. The knowledge of the pathophysiology behind lymphocytic pseudotumors and possible immunological reactions, the association between pseudotumors and elevated concentrations of metal ions, and the respective consequences of long term exposure to raised levels of particularly cobalt and chrome, is limited. There are very few prospective, randomised studies to turn to, and many published reports lack a control group. Thus, the following recommendations must, while awaiting an improved knowledge base, be considered preliminary.

Follow-up of patients operated with resurfacing prostheses and metal-on-metal prostheses with a large femoral head

Follow-up of all patients with implants according to the above, even in the absence of symptoms:

- Clinical examination with X-ray 2, 4 and 6 years after implant insertion. Hereafter, there is some uncertainty, due to lack of experience, whether the interval between examinations can be lengthened. We currently suggest an interval of 3-4 years, but this may be changed as we gain more experience.

- **IF** symptoms in the form of pain are present in the operated hip = > follow-up as for patients in a risk group according to the following.

- Analysis of cobalt and chrome serum concentrations at least once during the first 3 years, more seldom thereafter. We still lack grounds for recommending necessary follow-up frequencies for this examination.

- **IF** chrome and/or cobalt serum levels are > 5 microgram/L = > follow-up as for patients in a risk group according to the following:

Follow-up of patients belonging to risk groups:

According to the above, patients in risk groups are defined as:

- Women

- Patients with steep-seated acetabulums (> 50 degrees)

- Patient with cobalt and chrome concentrations > 5 microgram/L

Moreover all patients with symptoms from the operated hip joint in the form of pain must be considered risk patients.

- Renewed examination of serum concentrations of chrome and cobalt ions should be carried out within 1 year after the first examination. If there is no tendency to increase compared with earlier results, further testing is unnecessary.

- In addition to the above examinations, examination seeking out pseudotumors by MRI with a special technique for reducing implant disturbances (”MRT MARS” or similar) are to be carried out every other year during the first six years.

- **IN** case of pseudotumor = > discussion concerning revision surgery with implant replacement and tumor excision.

Details concerning lab test routines were published along with the Swedish Hip and Knee Association’s guidelines on SOF’s website (http://www.ortopedi.se/index1.asp?siteid=6&pageid=163).

"Free choice of care" perspective

During the last years a number of county councils/regions introduced so-called "Free choice of care" implying that the patient is given the possibility to choose a care unit. Traditionally, the National Quality Registries' annual reports and websites have been chiefly aimed toward professionals and decision makers. If this rereporting is to be used by patients in the future with the perspective of "free choice of care", simplification and altered pedagogics are needed. The analysis below is the Swedish Hip Arthroplasty Register's first step toward such a simplification. The results will be published next year on a unit level serving as a guide to patients.

Continual measurement and open reporting of results are an important part of health care. This information is a prerequisite for the continuous work of improvement. In Regional comparisons the results for selected parameters judged to be quantifiable per hospital unit are presented. A problem with the interpretation of the results after hip replacement surgery is that the case mix varies between different types of clinics. To facilitate future comparisons we have attempted to define a reference population corresponding to a patient group with few risk factors. For the majority of operating units this group should be sufficiently large to carry out relevant comparisons.

In the Register´s Annual Report from 2010 we began work with defining a "standard patient", with, among other things, the help of the relatively newly introduced variables ASA-level and BMI (illness level and height-weight relationship, respectively). Reporting these variables began on a larger scale 2008, thus setting limits on the size of the material. As outcome variables we have used reoperation within 2 years. Our aim is to continually update the definition of this standardised patient group based on an evaluation of risk factors.

A continual update is important whereby the base of our calculations is successively expanding. Slow changes in age and gender distribution moreover occur in the population operated with hip implants (see Demographics). Between the years 2008 and 2011 the mean BMI rose slightly for patients operated with primary hip replacement (from 27.1 to 27.4). The proportion with ASA-level 2 increased by 0.5% and those with ASA-class 3 or higher by 0.8%. This year's report shows that male gender, secondary osteoarthritis (OA), increasing ASA-levels, higher and lower BMI than normal (normal value: 18.5-24.9) increases the risk for reoperation within 2 years (see Reoperation). In last year's analysis age over 80 implied a marginal risk increase. This year's analysis shows no greater changes. In similarity with last year's analysis the Charnley-category did not influence the risk for reoperation within 2 years.

Whereby the risk increase for patients over 80 is unclear we have made separate analyses for respective gender, and moreover, examined how the age factor influences the risk for reoperation within 2 years in the entire database from 1992 with no further statistical adjustment. The analysis based on data from and including 2008 shows that women over 80 run a greater risk for early reoperation while age doesn't appear to influence the outcome for men. The analysis based on the entire database content except for resurfacing transplants is presented in Table 1. No adjustment for BMI, ASA-level and Charnley category has been made since this data is largely missing. In comparison with the age group 70-79 the risk is significantly reduced for men in the group 60-69 years and increases significantly in the group 80 and older. In the groups under 60 years the risk is lower although not significantly. For women the same pattern is seen in the age groups 60-69 and 80 and above. The risk increases significantly below the age of 55.

Age group	Male		Female		Both	
	RR	95% C.I.	RR	95% C.I.	RR	95% C .I.
0-49 years	**0.8**	0.7-1.0	**1.7**	1.4-2.2	**1.20**	1.01-1.4
50-54 years	**0.9**	0.7-1.1	**1.3**	1.06-1.7	**1.11**	0.9-1.3
55-59 years	**0.9**	0.8-1.1	**1.1**	0.9-1.3	**1.04**	0.9-1.2
60-69 years	**0.8**	0.7-0.9	**0.8**	0.7-0.9	**0.84**	0.8-0.9
70-79 years	**1**		**1**		**1**	
80- years	**1.2**	1.03-1.4	**1.2**	1.02-1.3	**1.14**	1.04-1.3

Table 1. The significance of age for suffering reoperation within 2 years. Unadjusted data based on 195 180 hip arthroplasties 1992-2011. The age group 70-79 comprises the reference population. Confidence interval over or less than 1 marked in red. The risk increases over the age of 80 and for women below 50.

Patient group with low risk for early reoperation

Gender, type of osteoarthritis (OA), BMI, ASA-level and age influence the risk for early reoperation. Based on demographics for those patients that have in fact been operated on we defined a group of patients with a small expected risk for reoperation within 2 years in the previous report.

The group should, moreover, be sufficiently large to form a basis for comparison. Patients with secondary OA were excluded since most of these diagnoses imply an increased risk. Many of these patients are referred, moreover, to a limited number of clinics since the group is relatively small.

In this year's analysis, built on a larger patient base, we have adjusted the limits somewhat, partly on the basis of previously performed risk analyses (see "Reoperation") and partly for a more distinct and manageable definition. Table 2 illustrates how the risk for reoperation within 2 years changes depending on the number of risk factors. The analysis is built on the observations from the database. No further analysis has been carried out here to illuminate how the risk can vary between patient groups with differing risk factors, or different combinations of two risk factors. In general the risk increases with increasing numbers of risk factors. An exception consists of men with three risk factors. Even if the risk is doubled the increase is not statistiscally significant, probably due to too few observations.

Collected data and the patient sample size, of course, influence the quality of risk calculations of this type. The group of patients with complete data will successively increase, enabling a more certain analysis. A more extensive data capture, based entirely on direct transfer from existing patient records would also be expedient. Based on the year's analysis, we can confirm that knowledge of BMI, ASA-level and age can be used to calculate the risk for reoperation within 2

years. The predictive value is better for women than for men, mainly depending on the age factor's greater impact on women. A suitable group to use for comparison and with an expectedly low risk for reoperation could be defined as age 55-79, BMI 18.5-29.9 (normal weight or overweight) and ASA-group 1-2.

Risk for reoperation within 2 years – operating clinic

In the previous annual report we drew attention to the fact that case-mix varies between different clinic types. We have also, in previous annual reports, drawn attention to primary OA and female gender reducing the risk for reoperation. In the current annual report we can confirm that these factors also coincide with a reduced risk for reoperation within 2 years. Within the primary OA group it is also of interest to describe how the patient group with low risk for early reoperation is distributed among the different types of hospitals.

The proportion of women is relatively equally divided between hospital types (Table 3). Nearly all patients at private and county hospitals have primary OA. County and university/regional hospitals operate more patients with other diagnoses. In the primary OA group the proportion of low risk patients varied considerably (age 55-79 years with BMI 18.5-29.9 in the ASA-group 1-2). In 2011 they comprised 32% of all primary OA patients at the university/regional hospitals. Corresponding proportions for private hospitals was 61%.

Between 2008 and 2011, 1 394 patients defined as low risk according to the above were operated at a university/regional hospital, 7 373 at county hospitals, 10 239 at rural hospitals, and 5 286 at private hospitals. If the group with the greatest number of observations (rural hospitals) is used as references, we find that the risk for reoperation is increased for private hospitals (1.5 1.1-2.1). For the two other types of hospitals the increase is not statistically confirmed (university/regional hospitals: 1.2 0.7-2.1; county hospitals: 1.3 0.9-1.7) (Figure 1).

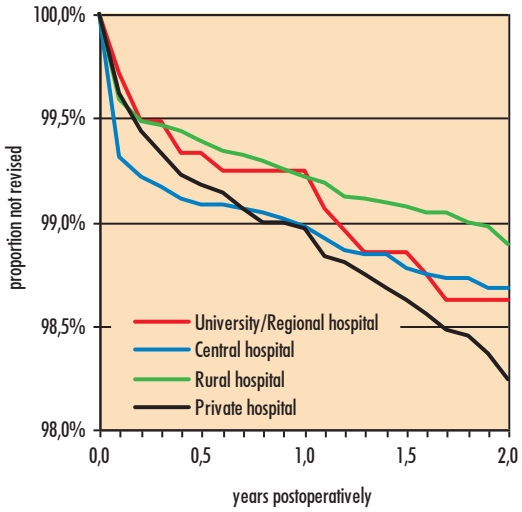


Figure 1. Unadjusted implant survival based on reoperation within 2 years (all causes) for patients med primary OA, ages 55-79, BMI 18.5-29.9 and ASA-group 1-2.

	Male			Female			Both		
Other risk factors	n	RR	95% C.I.	n	RR	95% C.I.	n	RR	95% C.I.
None	9,271	1		12,109	1		2,130	1	
1	6,297	1.4	1.1-1.9	8,403	2.0	1.5-2.5	14,700	1.7	1.4-2.0
2	2,017	2.4	1.8-3.3	2,537	2.6	1.9-3.6	4,554	2.5	2.0-3.1
3	158	1.9	0.7-5.2	246	4.0	2.0-8.3	404	2.9	1.6-5.2
None	9,271	1		12,109	1		21,380	1	
At least 1	8,472	1.7	1.4-2.1	11,186	2.1	1.7-2.7	19,658	1.9	1.6-2.2

Table 2. Calculated risk for reoperation within 2 years based on the risk factors BMI outside the interval 18.5 – 29.9, ASA-level 3 as well as 80 years of age and older. Confidence Interval (C.I.) over or under 1 marked red.

	University-/regional hospital			Central hospital			Rural hospital			Private hospital		
Prop. (%)	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
Women	57.5	57.8	58.7	58.8	57.8	60.2	58.3	57.5	58.7	58.9	60.2	56.1
Primary osteoartritis	61.4	59.7	59.9	78.8	77.8	75.5	91.7	91.5	91.4	94.0	95.1	95.0
Low risk patients [1)]	39.3	36.7	31.7	50.0	49.8	48.7	52.7	52.5	52.1	62.7	60.3	60.6

Table 3. Distribution of proportion women, patients with primary OA and proportion of the primary OA group with a low risk for complications leading to reoperation within 2 years.

[1)] Proportion patients in the group with primary OA in ages 55-79 with a BMI 18.5-29.9 and belonging to ASA-group 1-2.

Notes

Reoperation

Reoperation comprises all types of surgical intervention relating directly to an inserted hip implant. It may be that the implant is left untouched, or revised, when the entire implant or at least one of its components is changed or extracted. The proportion of reoperations in relation to the total number of completed primary hip arthroplasties plus the number of reoperations in one year has during the last years varied between 11 and 12% (Figure 1). This quotient indicates how heavily reoperations weigh on health care resources for hip arthroplasties in a country or area. The quotient is, however, unsuitable for other purposes due to its sensitivity to temporary swings in the number of completed primary operations. It is also affected by many other factors such as patient flow between health care districts, the medical profession's attitude toward revision surgery, and the time period hip arthroplasty has been practiced within a health care district.

Reoperation without implant replacement or extraction

Reoperations are divided in the Register in "minor" and "major" surgical interventions. The most common "minor" surgical interventions during the last 10 years are sore operations representing 80.9% of these interventions, followed by secondary suturing (7.4%). "Major" interventions are more varied. A third (33.5%) is made up of fracture reconstruction followed by implant, replacement or adjustment of complementary augments on cups (21.8%) for the prevention of dislocation. This intervention has, in the reoperation database, been classified as reoperation, but has, nevertheless in certain analyses, been recoded as revision.

The causes of major interventions have varied over time. Since 2002 the proportion of these interventons carried out due to dislocation decreased, which also applies to those due to fracture. As for dislocation the reduction can probably be explained by the fact that operations with cup augment (without cup replacement) have become increasingly rare. Between 2003 and 2011 the annually reported number decreased from 57 to 13 yearly. The proportion of this type of intervention due to fractrure (mainly osteosynthesis) has declined. The relative decline av these reoperations can be explained by an increase caused by infection. This increasing portion of reoperationer (minor and major) can depend on a substantial increase in the number of infections, and/or that early discovered suspicious infections are treated by rinsing and removal of synovia and devitalised soft tissue (Figure 2).

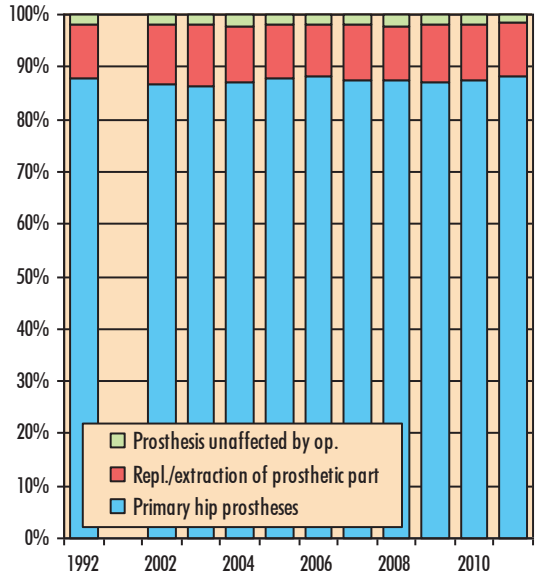


Figure 1. Proportion reoperated (green and red bar) in relation to the total number of arthroplasty-related operations 1992 and 2002-2011.

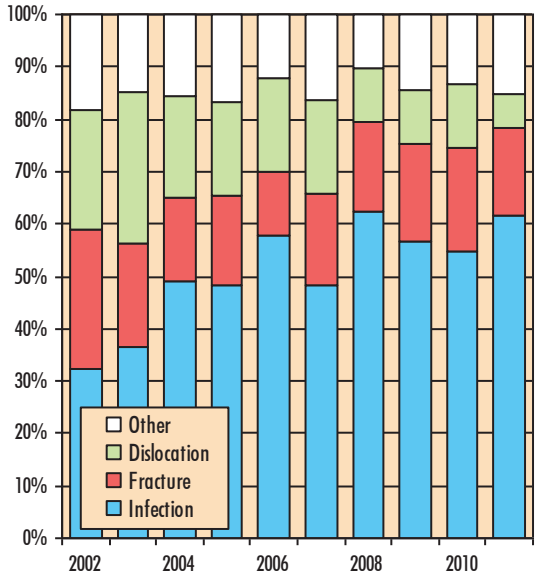


Figure 2. The three most common reasons for reoperation ("minor" and "major" intervention) without implant component replacement, entire implant or implant extraction and regardless of whether the index operation was primary or reoperation during 2002-2011. The relative proportion of interventions performed due to infection has increased.

Reoperation within 2 years – risk factors

During 1992 to 1995 primary operations were followed, in more than 3% of cases, by reoperation within 2 years of the previous intervention. In the beginning of the 2000s the incidence of these interventions decreased to fewer than 2% of the primary hip arthroplasties. Of the operations carried out during the latest period where all were observed for 3 years (2006-2008), 1.7% of the cases were reoperated within 2 years.

Reoperation within 2 years is an important quality control for each individual clinic. Since case mix varies between operating clinics the analysis of patient-related background factors influencing the risk for early reoperation is important. In the current Annual Report we have performed a new analysis since the number of patients is increasing

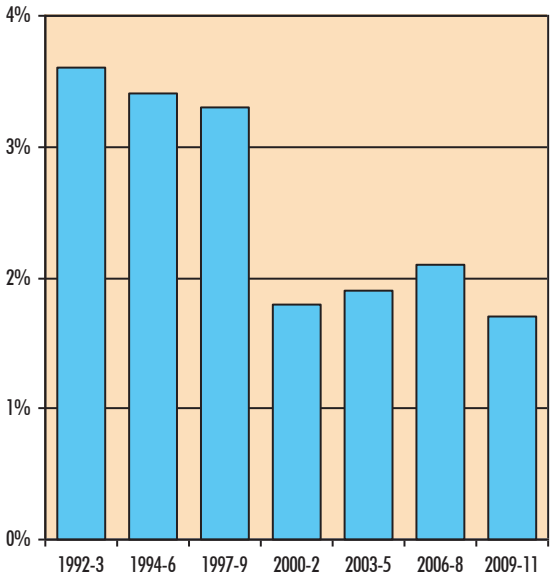


Figure 3. Incidence of reoperation within 2 years 1992-2011 in 3-year periods.

and a greater proportion have been observed during an entire period. The evaluation is based on, aside from age, gender and hip disease diagnosis, BMI and ASA-level having been registered, and that the patient has completed the dispensary protocol (to ascertain Charnley category). The variables' class division is based on previous analytical work aimed at defining distinct groups of patients that are, moreover, sufficiently large. The idea is that grouping will be able to separate low from high risk patients while being easily applicable, which is impossible without a number of compromises. Compared to last year's analysis the classification is similar except for BMI. Rather than use the average BMI for patients we in fact operated on, the reference group now consists of normal (BMI 18.5-24.9) and overweight patients (25-29.9).

Our intention is to first evaluate possible risk factors that have been registered. In the next step this information is used to identify a patient group operated on in relatively large numbers at most of the hospitals, and where the outcome measure of risk for reoperation within 2 years should be relatively equivalent on a group level. In this first step we have, aside from age, BMI, ASA-group and Charnley category also included gender and diagnosis (Table 1b). In a regression model (Cox regression), we find that the age group 80 and older have a significantly increased risk but only for primary OA. The risk for reoperation within 2 years is 40-50% higher for men and doubled for secondary OA. Underweight and obesity (BMI outside the reference group) implies an alomost equally high risk increase as for patients with secondary OA. ASA-level 3 implies increased risk regardless of OA type.

There is thus a distinct risk profile in primary OA. It is more difficult to see a distinct risk profile for secondary OA. The group with secondary OA is still relatively small. It consists moreover of several subgroups each of which with high probability, have different risk profiles. Until the base is further increased, we don't consider it meaningful to expand the analysis of this group.

Patients with primary OA have, thus, a lower risk of suffering reoperation within 2 years. The prognosis is particularly favorable for those of normal weight or overweight (BMI 18.5-29.9) in the ASA-group 1-2. Women have a better prognosis than men. Patients 80 and older have an increased risk. The risk increase is statistically significant for women but not for men (Table 1a).

	Primary osteoarthritis — men			Primary osteoarthritis — women		
	n	RR	95% C.I.	n	RR	95% C.I.
Count	17,743			23,295		
0-49 years	1,013	**0.6**	0.3-1.2	681	**1.4**	0.7-1.1
50-59 years	3,345	**1.0**	0.8-1.4	3,352	**1.3**	0.9-1.8
60-69 years	6,032	**1.0**	0.7-1.3	7,474	**0.8**	0.6-1.1
70-79 years	5,509	**1.0**		8,308	**1.0**	
80- years	1,844	**1.2**	0.8-1.7	3,480	**1.4**	1.01-1.9
Charnley cat. 1-2	11,383	**1.0**		12,818	**1.0**	
Charnley cat. 3	4,213	**1.1**	0.8-1.3	10,477	**1.0**	0.8-1.2
BMI 18.5-29.9	13,530	**1.0**		17,281	**1.0**	
BMI <18.5; ≥30	4,213	**1.9**	1.5-2.4	6,014	**1.8**	1.5-2.3
ASA 1-2	15,052	**1.0**		20,220	**1.0**	
ASA 3	2,691	**1.6**	1.2-2.4	3,075	**1.6**	1.2-2.2

Table 1a. Patient related factors and their effect on the risk for reoperation within 2 years based on five different regression analyses. Statistically significant differences (95% C.I. greater or smaller than 1 marked in red).

	Primaty osteoarthritis			Secondary osteoarthritis			Primary + secondary osteoarthritis		
	n	RR	95% C.I.	n	RR	95% C.I.	n	RR	95% C.I.
Count	41,038			3,366			44,404		
0-49 years	1,694	**0.9**	0.6-1.4	687	**0.6**	0.3-1.1	2,381	**0.8**	0.5-1.1
50-59 years	6,697	**1.1**	0.9-1.4	730	**0.8**	0.5-1.6	7,427	**1.1**	0.9-1.4
60-69 years	13,506	**0.9**	0.7-1.1	834	**1.1**	0.6-1.9	14,340	**0.9**	0.8-1.1
70-79 years	13,817	**1.0**		726	**1.0**		14,543	**1.0**	
80- years	5,324	**1.3**	1.03-1.7	389	**0.7**	0.3-1.5	5,713	**1.2**	0.97-1.6
Female	23,295	**1.0**		2,137	**1.0**		25,432	**1.0**	
Male	17,743	**1.5**	1.2-1.7	1,229			18,972	**1.4**	1.2-1.7
Primary osteoarthritis		-			-		41,038	**1.0**	
Secondary osteoarthritis		-			-		3,366	**2.0**	1.6-2.5
Charnley cat. 1-2	24,201	**1.0**		1,760	**1.0**		25,961	**1.0**	
Charnley cat. 3	16,837	**0.9**	0.9-1.2	1,606	**0.9**	0.6-1.5	18,443	**1.0**	0.9-1.2
BMI 18.5-29.9	30,811	**1.0**		2,662	**1.0**		33,473	**1.0**	
BMI <18.5; ≥ 30	10,227	**1.9**	1.6-2.1	704	**1.1**	0.7-1.9	10,931	**1.8**	1.5-2.1
ASA 1-2	35,272	**1.0**		2,680	**1.0**		37,952	**1.0**	
ASA 3	5,766	**1.6**	1.3-2.0	686	**1.7**	1.1-2.7	6,452	**1.6**	1.4-2.0

Table 1b. Patient-related factors and their effect on the risk for reoperation within 2 years based on five different regression analyses. Statistically significant differences (95% C.I. greater or smaller than 1 marked in red).

Number of reoperations per procedure and year

primary THRs performed 1979-2011

Procedure at reoperation	1979-2006	2007	2008	2009	2010	2011	Total	Prop.
Revision	27,673	1,715	1,735	1,933	1,933	1,810	36,799	84.9%
Major surgical intervention	3,296	155	159	176	157	130	4,073	9.4%
Minor surgical intervention	1,578	173	204	190	171	161	2,477	5.7%
(missing)	1	0	0	0	0	0	1	0.0%
Total	32,548	2,043	2,098	2,299	2,261	2,101	43,350	100%

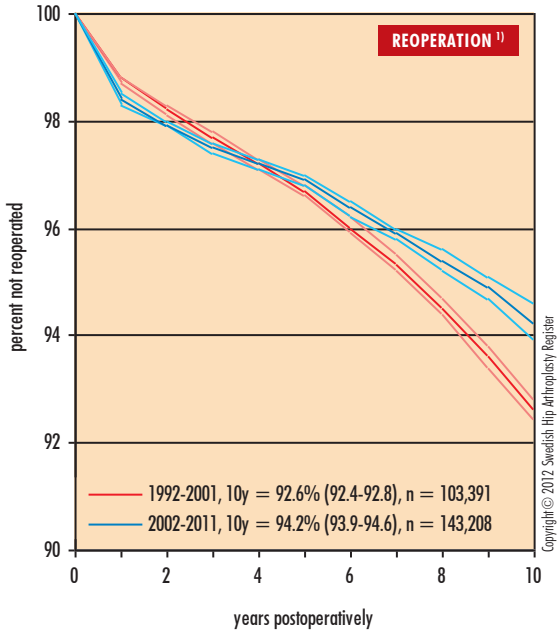
Number of reoperations per reason and year

primary THRs performed 1979-2011

Reason for reoperation	1979-2006	2007	2008	2009	2010	2011	Total	Prop.
Aseptic loosening	19,067	1,003	1,004	1,115	1,067	961	24,217	55.9%
Deep infection	3,321	324	399	427	412	436	5,319	12.3%
Dislocation	3,721	306	302	286	298	242	5,155	11.9%
Fracture	2,400	211	219	231	250	219	3,530	8.1%
2-stage procedure	1,390	83	73	95	103	96	1,840	4.2%
Technical error	915	39	43	58	61	69	1,185	2.7%
Miscellaneous	914	36	20	34	30	30	1,064	2.5%
Implant fracture	454	24	18	38	22	30	586	1.4%
Pain only	329	14	19	15	18	16	411	0.9%
Secondary infection	2	3	0	0	0	1	6	0.0%
(missing)	35	0	1	0	0	1	37	0.1%
Total	32,548	2,043	2,098	2,299	2,261	2,101	43,350	100%

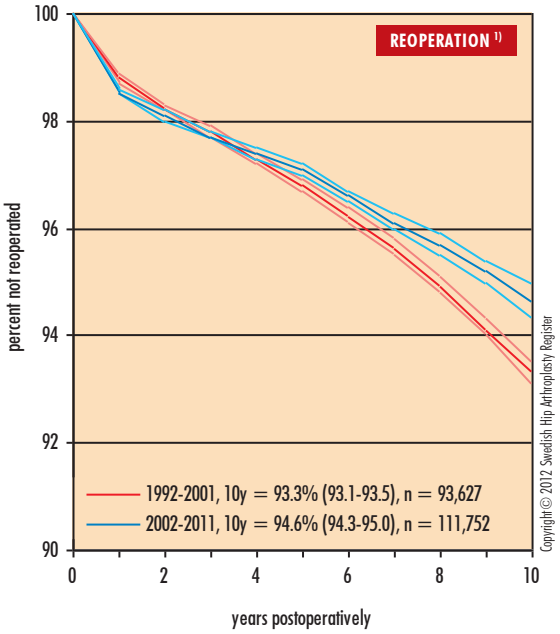
All implants

all diagnoses and all reasons



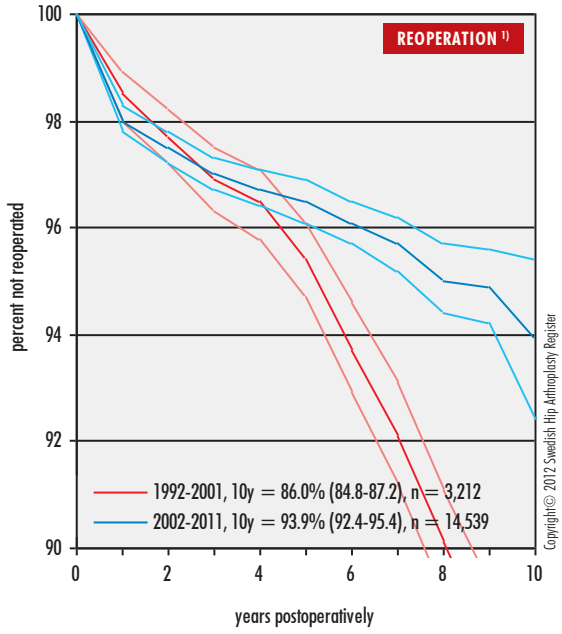
All cemented implants

all diagnoses and all reasons

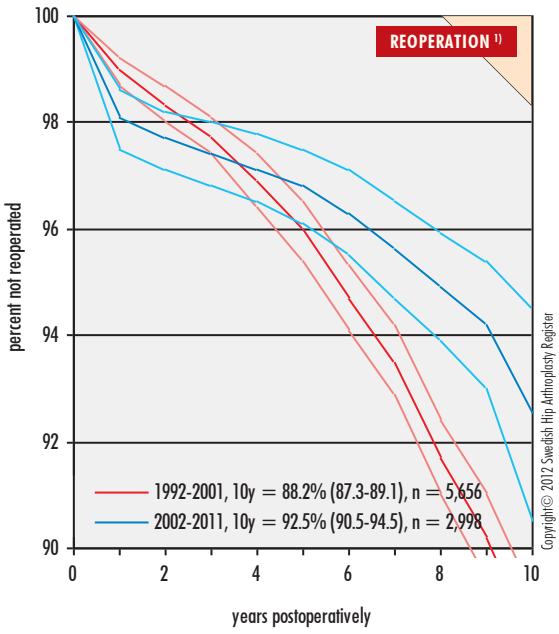


1) Survival statistics according to Kaplan-Meier with reoperation (all form of further surgery, including revision) as end-point definition.

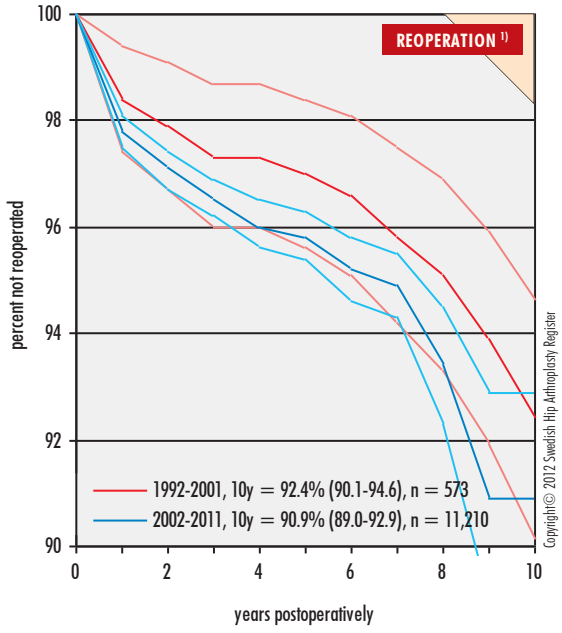
All uncemented implants
all diagnoses and all reasons



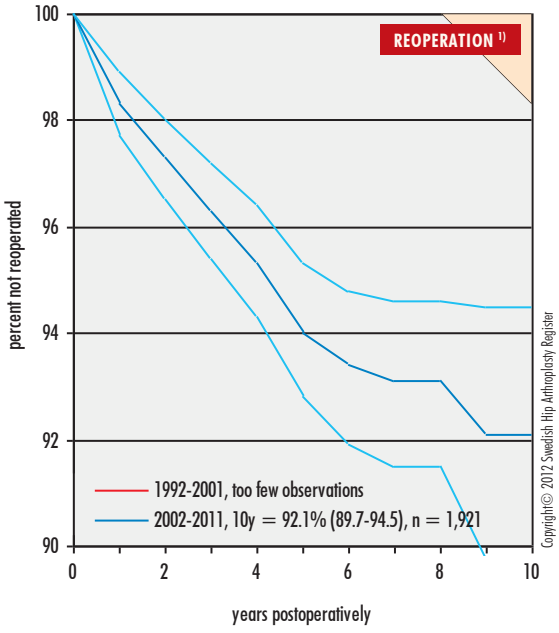
All hybrid implants
all diagnoses and all reasons



All reversed hybrid implants
all diagnoses and all reasons



All resurfacing implants
all diagnoses and all reasons



1) Survival statistics according to Kaplan-Meier with reoperation (all form of further surgery, including revision) as end-point definition.

Short-term complications – reoperation within 2 years

In traditional survival statistics (Kaplan-Meier), exchange of some component or removal of the entire implant is the definition of failure. Five- or 10-year survival illustrates long -term results chiefly regarding aseptic loosening. Reoperation within two years, on the other hand, refers to all forms of further surgery (not only interventions in which implant components are replaced) to the hip following insertion of a total hip prosthesis. This variable chiefly reflects early and serious complications such as deep infection and dislocation. The variable is therefore a faster indicator and easier to use for clinical improvement work than 10-year survival, which is important, but a slow and, to a certain extent, historical indicator.

Reoperation within two years has been selected by the Swedish Association of Local Authorities and Regions and the National Board of Health and Welfare as a national quality indicator for this type of surgery and is included in "Regional comparisons". The indicator may be seen as one of the most important and easily influenced outcome markers that the Swedish Hip Arthroplasty Register reports.

Definition

By short-term complication is meant all forms of open surgery within two years of the primary operation. The most recent four-year period is studied – in this report, 2008 up to and including 2011. Note that the report refers only to complications dealt with surgically. Infections treated with antibiotics, and non-surgically treated dislocations, are not captured by the Registry. Patients undergoing repeated operations for the same complication are reported as one complication. A number of patients, however, undergo reoperation for different reasons (then recorded as several complications) within a short period. Patients reoperated at another department than their primary one, however, are ascribed to the primary department.

Results

Results by clinic are given in the following table. Hospital type, number of primarily operated patients during the observation period, and proportion of reoperated patients, are presented. The national mean value during the observation time was 1.8% (unchanged for several years). The complication rate varied from 0.0% to 4.4%. Departments with a frequency one SD over the mean value are shown in red. Ten (10/79) departments exceeded this value. The hospitals reporting the highest reoperation frequency during the observation period had a predominance of infections or dislocations. During previous years, it was mainly the dislocation problem which dominated among the hospitals reporting high complication figures; but it is now more common for infections to dominate. Considerable local improvement work during the past few years has been directed to the problem of dislocation.

Underreporting

Some units reported extremely low figures for complication 2008-2011. That certain high-production units should have no more than one or two complications according to the above definition – and over a period of four years – appears improbable. An ongoing study matching the Register with the Pharmaceuticals Register has, unfortunately, found a large amount of hidden statistics concerning the clinics' reporting of implant-related infections. The study is now being concluded but is presented below in a summary. For many years we have published our annual analysis of coverage. This does not, however, include secondary interventions. This is disturbing considering the data quality of the Register. The reason is, unfortunately, the continued low quality of surgeons' coding (ICD-10) and provision of measure codes (KVA) for secondary interventions. Despite several attempts we have found up to 30 different (and often inadequate) measure codes used for various types of reoperation. Since the Patient Register also lacks laterality in its database, comprehensive system development is required for a coverage analysis of secondary interventions – at present we lack the resources for such a development.

The following action plan has been started by the Registry to achieve better coverage of secondary interventions:

- Monitoring of hospitals. See separate chapter!
- Create resources for coverage analyses of secondary interventions according to the above.
- Open publication of the infection study.
- A renewed call to all chiefs of staff to work locally for an improved coding culture at our units, via meetings or even local courses in the subject.
- Each unit should review its routines for reporting reoperations that constitute **a wider concept** than reoperations– "any kind of further surgery".
- Renewed appeal to, above all, the country's private sector to follow legislation and report not only to the Swedish Hip Arthroplasty Register (voluntarily) but also to the Patient Register at the National Board of Health & Welfare (which is mandatory!).

Discussion

When interpreting results one should only compare clinics from similar hospital types, considering the varying patient demographics. Clinics that operate on the most difficult cases with greater risks for complication can of course have a higher frequency. Besides the hospital's different risk profiles even the following should be considered when interpreting its results:

- Underreporting – see the above!
- Complications are generally few and chance variability has considerable influence on the results. This variability can, actually, only be evaluated over time, that is, in the presence of apparent trends - see separate trend table!
- Clinics adopting a hesitant attitude (non-surgical treatment, for example, of infection and dislocation), that is to say they avoid operating in the event of these complications, are not registered in the database.
- Conversely, clinics surgically "aggressive", both when sus-

picious of early infection and at first dislocation, have high rates of early complications. Treatment algorithms for early suspected deep infection have, both for knee and hip replacement surgery, changed during the last years. It is becoming more and more common to intervene surgically with"debridement" with or without replacing modular components. It is, therefore, of the utmost importance to report not only classic reoperations but reoperations of all types.

The Registry management has completely avoided and will never rank the different hospitals in regard to this important outcome indicator. Since the numbers of complications are generally low disappearance from the register can heavily influence a unit's ranking. Independent of hospital category and result the clinics should analyse its own complications (without side glancing at the country's average) and investigate whether there are systematic deficencies – all to avoid difficult complications for the individual patient.

In this account the unregistered infections revealed are not included (see separate chapter "Hidden statistics in infection reporting" on page 55).

The following factors must be considered when interpreting the variable "reoperation within 2 years":

- **Hospital type.**
- **Patient demographics.**
- **Complications are generally few and random variability has a large influence on the results.**
- **This variable can only be evaluated over time, that is to say, in the presence of clearcut trends.**
- **Observe that the report only applies to complications handled surgically.**

***Reoperation* means all forms of further surgery after implant surgery of the hip joint.**

By *revision*, which is a form of reoperation, is meant an intervention where one or more implant components are replaced or the complete implant are removed.

Reoperation within 2 years per hospital

2008-2011

	Prim.THRs	Patients [1]		Infection		Dislocation		Loosening		Others	
Hospital	number	number	%	number	%	number	%	number	%	number	%
University/Regional hospitals											
Karolinska/Huddinge	986	20	2.0%	3	0.3%	7	0.7%	0	0.0%	11	1.1%
Karolinska/Solna	854	15	1.8%	8	0.9%	1	0.1%	2	0.2%	5	0.6%
Linköping	253	4	1.6%	2	0.8%	1	0.4%	0	0.0%	2	0.8%
SU/Mölndal	1,485	43	2.9%	19	1.3%	11	0.7%	0	0.0%	17	1.1%
SU/Östra	145	2	1.4%	2	1.4%	0	0.0%	0	0.0%	0	0.0%
SUS/Lund	398	11	2.8%	7	1.8%	1	0.3%	1	0.3%	3	0.8%
SUS/Malmö	382	6	1.6%	4	1.0%	0	0.0%	0	0.0%	2	0.5%
Umeå	348	8	2.3%	4	1.1%	1	0.3%	0	0.0%	3	0.9%
Uppsala	1,237	32	2.6%	16	1.3%	10	0.8%	1	0.1%	13	1.1%
Örebro	702	9	1.3%	6	0.9%	2	0.3%	0	0.0%	4	0.6%
Central hospitals											
Borås	753	21	2.8%	11	1.5%	5	0.7%	0	0.0%	7	0.9%
Danderyd	1,418	53	3.7%	23	1.6%	11	0.8%	1	0.1%	30	2.1%
Eksjö	794	17	2.1%	15	1.9%	0	0.0%	0	0.0%	2	0.3%
Eskilstuna	451	6	1.3%	4	0.9%	3	0.7%	0	0.0%	1	0.2%
Falun	1,304	26	2.0%	19	1.5%	3	0.2%	0	0.0%	5	0.4%
Gävle	678	30	4.4%	10	1.5%	4	0.6%	1	0.1%	19	2.8%
Halmstad	876	25	2.9%	12	1.4%	8	0.9%	0	0.0%	8	0.9%
Helsingborg	251	3	1.2%	0	0.0%	1	0.4%	0	0.0%	2	0.8%
Hässleholm-Kristianstad	3,319	61	1.8%	36	1.1%	4	0.1%	11	0.3%	24	0.7%
Jönköping	833	9	1.1%	7	0.8%	2	0.2%	0	0.0%	2	0.2%
Kalmar	707	12	1.7%	7	1.0%	5	0.7%	0	0.0%	1	0.1%
Karlskrona	115	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Karlstad	1,041	45	4.3%	38	3.7%	4	0.4%	0	0.0%	8	0.8%
Norrköping	982	10	1.0%	4	0.4%	3	0.3%	0	0.0%	3	0.3%
Skövde	530	4	0.8%	4	0.8%	0	0.0%	0	0.0%	2	0.4%
Sunderby (incl. Boden)	155	6	3.9%	3	1.9%	3	1.9%	0	0.0%	0	0.0%
Sundsvall	761	26	3.4%	17	2.2%	7	0.9%	2	0.3%	6	0.8%
Södersjukhuset	1,538	24	1.6%	13	0.8%	1	0.1%	0	0.0%	13	0.8%
Uddevalla	1,294	16	1.2%	4	0.3%	5	0.4%	1	0.1%	7	0.5%
Varberg	900	12	1.3%	6	0.7%	3	0.3%	0	0.0%	5	0.6%
Västerås	1,548	59	3.8%	29	1.9%	14	0.9%	0	0.0%	24	1.6%
Växjö	514	3	0.6%	2	0.4%	1	0.2%	0	0.0%	0	0.0%
Östersund	934	21	2.2%	10	1.1%	3	0.3%	0	0.0%	11	1.2%
Rural hospitals											
Alingsås	841	18	2.1%	12	1.4%	4	0.5%	1	0.1%	3	0.4%
Arvika	680	16	2.4%	8	1.2%	2	0.3%	0	0.0%	7	1.0%
Bollnäs	1,159	10	0.9%	7	0.6%	2	0.2%	0	0.0%	2	0.2%
Enköping	1,009	27	2.7%	9	0.9%	17	1.7%	0	0.0%	3	0.3%
Falköping	694	4	0.6%	1	0.1%	2	0.3%	1	0.1%	1	0.1%
Frölunda Specialistsjukhus	320	6	1.9%	2	0.6%	0	0.0%	1	0.3%	3	0.9%

Reoperation within 2 years per hospital (cont.)

2008-2011

	Prim.THRs	Patients [1]		Infection		Dislocation		Loosening		Others	
Hospital	number	number	%	number	%	number	%	number	%	number	%
Gällivare	379	3	0.8%	2	0.5%	1	0.3%	0	0.0%	0	0.0%
Hudiksvall	515	12	2.3%	8	1.6%	1	0.2%	0	0.0%	5	1.0%
Karlshamn	826	9	1.1%	2	0.2%	3	0.4%	0	0.0%	4	0.5%
Karlskoga	498	4	0.8%	3	0.6%	1	0.2%	0	0.0%	0	0.0%
Katrineholm	967	13	1.3%	9	0.9%	2	0.2%	2	0.2%	4	0.4%
Kungälv	733	8	1.1%	7	1.0%	0	0.0%	0	0.0%	4	0.5%
Köping	70	1	1.4%	1	1.4%	0	0.0%	0	0.0%	0	0.0%
Lidköping	566	1	0.2%	0	0.0%	0	0.0%	0	0.0%	1	0.2%
Lindesberg	805	5	0.6%	1	0.1%	0	0.0%	0	0.0%	4	0.5%
Ljungby	627	7	1.1%	2	0.3%	4	0.6%	1	0.2%	3	0.5%
Lycksele	1,191	12	1.0%	7	0.6%	3	0.3%	0	0.0%	4	0.3%
Mora	850	8	0.9%	1	0.1%	3	0.4%	0	0.0%	4	0.5%
Motala (t o m 2009)	692	19	2.7%	9	1.3%	7	1.0%	0	0.0%	4	0.6%
Norrtälje	470	15	3.2%	6	1.3%	5	1.1%	0	0.0%	4	0.9%
Nyköping	690	30	4.3%	24	3.5%	4	0.6%	0	0.0%	3	0.4%
Oskarshamn	823	12	1.5%	10	1.2%	2	0.2%	0	0.0%	1	0.1%
Piteå	1,432	13	0.9%	8	0.6%	5	0.3%	0	0.0%	3	0.2%
Skellefteå	357	2	0.6%	1	0.3%	1	0.3%	0	0.0%	1	0.3%
Skene	376	5	1.3%	2	0.5%	0	0.0%	0	0.0%	5	1.3%
Sollefteå	480	3	0.6%	1	0.2%	2	0.4%	0	0.0%	1	0.2%
SUS/Trelleborg	2,351	31	1.3%	13	0.6%	2	0.1%	3	0.1%	20	0.9%
Södertälje	479	2	0.4%	2	0.4%	0	0.0%	0	0.0%	1	0.2%
Torsby	389	3	0.8%	3	0.8%	1	0.3%	0	0.0%	3	0.8%
Visby	494	8	1.6%	1	0.2%	1	0.2%	1	0.2%	5	1.0%
Värnamo	564	5	0.9%	1	0.2%	2	0.4%	0	0.0%	3	0.5%
Västervik	449	16	3.6%	10	2.2%	4	0.9%	0	0.0%	3	0.7%
Ängelholm	350	3	0.9%	2	0.6%	0	0.0%	1	0.3%	2	0.6%
Örnsköldsvik	680	5	0.7%	2	0.3%	2	0.3%	0	0.0%	2	0.3%
Private hospitals											
Aleris Specialistvård Elisabethsjukhuset	357	3	0.8%	2	0.6%	0	0.0%	0	0.0%	1	0.3%
Aleris Specialistvård Motala	866	18	2.1%	11	1.3%	3	0.3%	0	0.0%	5	0.6%
Aleris Specialistvård Nacka	367	2	0.5%	1	0.3%	0	0.0%	0	0.0%	1	0.3%
Aleris Specialistvård Sabbatsberg	426	5	1.2%	3	0.7%	1	0.2%	0	0.0%	2	0.5%
Capio S:t Göran	1,655	21	1.3%	9	0.5%	3	0.2%	0	0.0%	15	0.9%
Carema Ortopediska Huset	1,599	27	1.7%	9	0.6%	5	0.3%	4	0.3%	14	0.9%
Carlanderska	365	3	0.8%	2	0.5%	1	0.3%	0	0.0%	0	0.0%
Movement	892	19	2.1%	6	0.7%	5	0.6%	0	0.0%	10	1.1%
Ortho Center Stockholm	1,460	31	2.1%	12	0.8%	8	0.5%	2	0.1%	12	0.8%
OrthoCenter IFK-kliniken	464	2	0.4%	1	0.2%	0	0.0%	0	0.0%	1	0.2%
Sophiahemmet	690	12	1.7%	3	0.4%	2	0.3%	1	0.1%	6	0.9%
Spenshult	597	14	2.3%	9	1.5%	5	0.8%	0	0.0%	6	1.0%
Nation	62,079	1,134	1.8%	591	1.0%	241	0.4%	38	0.1%	426	0.7%

[1] Refers to number of patients with short-term complications which may differ from the sum of complications since each patient may have more than one type of complication.

Reoperation within 2 years per hospital - trend

Klinik	2004-2007	2005-2008	2006-2009	2007-2010	2008-2011
University/Regional hospitals					
Karolinska/Huddinge	3.0%	3.3%	3.0%	2.4%	2.0%
Karolinska/Solna	3.4%	3.2%	3.2%	2.7%	1.8%
Linköping	1.4%	0.9%	1.4%	1.3%	1.6%
SU/Mölndal	3.4%	4.5%	4.5%	3.5%	2.9%
SU/Östra	2.3%	2.7%	3.0%	2.9%	1.4%
SUS/Lund	4.5%	4.2%	4.0%	2.9%	2.8%
SUS/Malmö	2.1%	1.6%	1.2%	2.2%	1.6%
Umeå	1.3%	0.9%	1.1%	1.4%	2.3%
Uppsala	3.4%	3.4%	3.0%	2.8%	2.6%
Örebro	1.5%	1.3%	1.4%	1.7%	1.3%
Central hospitals					
Borås	2.7%	2.4%	2.7%	2.4%	2.8%
Danderyd	2.3%	2.8%	3.3%	3.6%	3.7%
Eksjö	2.0%	2.5%	2.8%	2.4%	2.1%
Eskilstuna	1.9%	1.4%	1.5%	1.8%	1.3%
Falun	0.8%	1.3%	1.6%	2.1%	2.0%
Gävle	5.8%	5.0%	5.4%	5.1%	4.4%
Halmstad	1.9%	2.4%	2.6%	2.7%	2.9%
Helsingborg	2.5%	3.4%	3.7%	2.0%	1.2%
Hässleholm-Kristianstad	1.4%	1.7%	2.1%	1.9%	1.8%
Jönköping	1.4%	1.3%	1.8%	1.2%	1.1%
Kalmar	2.7%	2.5%	2.9%	1.9%	1.7%
Karlskrona	4.1%	5.1%	2.9%	1.8%	0.0%
Karlstad	2.7%	2.9%	3.1%	3.8%	4.3%
Norrköping	0.5%	1.1%	1.3%	1.1%	1.0%
Skövde	1.0%	0.7%	1.0%	1.1%	0.8%
Sunderby (incl. Boden)	4.8%	5.4%	5.7%	4.4%	3.9%
Sundsvall	4.5%	5.3%	4.4%	4.0%	3.4%
Södersjukhuset	2.6%	2.2%	2.1%	2.0%	1.6%
Uddevalla	2.1%	2.1%	1.9%	1.7%	1.2%
Varberg	2.7%	1.6%	2.0%	1.5%	1.3%
Västerås	1.8%	3.1%	3.4%	4.0%	3.8%
Växjö	0.4%	0.4%	0.2%	0.4%	0.6%
Östersund	2.2%	2.5%	2.1%	2.7%	2.2%
Rural hospitals					
Alingsås	1.3%	1.6%	1.9%	1.9%	2.1%
Arvika	2.4%	2.7%	2.0%	2.6%	2.4%
Bollnäs	1.7%	1.4%	1.3%	1.1%	0.9%
Enköping	1.6%	3.2%	3.3%	3.3%	2.7%
Falköping	0.2%	0.2%	0.4%	0.4%	0.6%
Frölunda Specialistsjukhus	3.0%	2.4%	2.8%	3.5%	1.9%
Gällivare	1.7%	0.9%	0.8%	0.8%	0.8%

Reoperation within 2 years per hospital - trend (cont.)

Klinik	2004-2007	2005-2008	2006-2009	2007-2010	2008-2011
Hudiksvall	3.1%	3.2%	3.1%	2.9%	2.3%
Karlshamn	1.9%	1.7%	1.6%	1.3%	1.1%
Karlskoga	1.5%	1.3%	1.1%	1.0%	0.8%
Katrineholm	1.0%	0.7%	0.9%	1.3%	1.3%
Kungälv	1.6%	2.0%	2.0%	1.8%	1.1%
Köping	1.3%	1.8%	1.9%	2.0%	1.4%
Lidköping	0.7%	0.7%	0.6%	0.2%	0.2%
Lindesberg	2.4%	1.9%	2.1%	1.5%	0.6%
Ljungby	1.1%	1.1%	1.1%	1.2%	1.1%
Lycksele	0.5%	0.6%	1.1%	1.3%	1.0%
Mora	1.4%	2.0%	1.6%	1.2%	0.9%
Motala (to 2009)	1.8%	1.9%	2.4%	2.4%	2.7%
Norrtälje	1.0%	1.2%	2.3%	2.3%	3.2%
Nyköping	1.6%	1.7%	1.7%	3.4%	4.3%
Oskarshamn	0.5%	0.9%	1.1%	1.5%	1.5%
Piteå	1.8%	1.6%	1.5%	1.2%	0.9%
Skellefteå	0.7%	0.7%	0.5%	0.5%	0.6%
Skene	1.3%	1.3%	1.6%	2.0%	1.3%
Sollefteå	1.5%	1.8%	1.0%	1.1%	0.6%
SUS/Trelleborg	1.8%	1.6%	1.6%	1.5%	1.3%
Södertälje	0.6%	0.9%	1.0%	0.8%	0.4%
Torsby	2.9%	2.5%	2.9%	2.1%	0.8%
Visby	3.0%	2.9%	1.9%	1.2%	1.6%
Värnamo	0.7%	0.7%	1.0%	1.1%	0.9%
Västervik	3.4%	2.8%	3.7%	3.8%	3.6%
Ängelholm	1.3%	0.0%	3.9%	1.0%	0.9%
Örnsköldsvik	0.6%	0.6%	0.7%	0.8%	0.7%
Private hospitals					
Aleris Specialistvård Elisabethsjukhuset	0.5%	0.5%	0.5%	1.1%	0.8%
Aleris Spec.ialistvård Motala				2.3%	2.1%
Aleris Specialistvård Nacka	3.8%	4.2%	2.5%	0.7%	0.5%
Aleris Specialistvård Sabbatsberg	0.7%		0.8%	1.4%	1.2%
Capio S:t Göran	1.9%	1.5%	1.1%	1.2%	1.3%
Carema Ortopediska Huset	1.8%	2.0%	2.5%	2.3%	1.7%
Carlanderska	0.9%	1.4%	1.9%	1.2%	0.8%
Movement	2.0%	1.6%	2.0%	2.2%	2.1%
Ortho Center Stockholm	3.3%	4.1%	3.0%	2.5%	2.1%
OrthoCenter IFK-kliniken		0.0%	0.9%	0.6%	0.4%
Sophiahemmet	1.2%	1.9%	2.1%	2.1%	1.7%
Spenshult	2.7%	2.6%	2.4%	2.7%	2.3%
Nation	1.9%	2.0%	2.1%	2.0%	1.8%

Notes

Hidden statistics in infection reporting

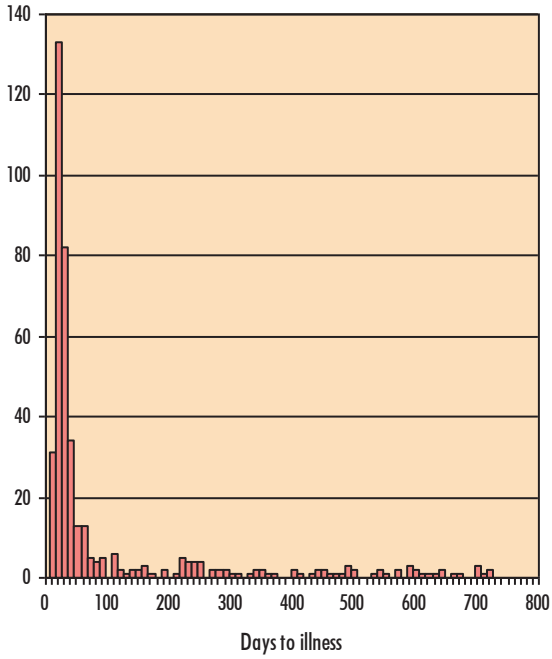
Reoperation due to infection is to be reported to the Register. Thus far this reporting has not been validated. Moreover, an unknown number of patients with suspected or confirmed infection are treated with antibiotics alone, which implies that these patients are not reported to the Register. To reach this "true" incidence of early deep postoperative infections we have closely studied all patients operated in Sweden with a total hip replacement from 2005-07-01 to 2008-12-31. The material includes 49 219 operations with identification numbers, operation side and date as unique variables. This group was linked with the Swedish Prescribed Drug Register (Swedish National Board of Health and Welfare) to find those patients that within 2 years of their primary operation had been treated with antibiotics for at least 4 weeks during the period of 2005-07-01–2010-12-31.

A total of 1 989 patients with 2 218 hip operations from the study group had been treated with at least a month of antibiotics within 2 years of their hip replacement. A questionnaire was sent for each patient to the clinic that performed the primary operation. A list indicating the antibiotic prescribed to each patient was attached to the questionnaire. The clinic was given the task to extract data from each medical history on whether an infection in the hip implant was the cause of antibiotic treatment, how and when the diagnosis was set, whether the patient was operated on due to infection, and which agents had caused the infection.

Thus far 2,147 questionnaires have been answered (97%). Only the Ortopedic clinic in Halmstad chose not to participate. We found that 465 patients had a postoperative deep hip implant infection, and of these 439 were subject to reoperation due to infection. In the Register 399 hip implants in the study group were registered for reoperation due to infection. A total of 602 reoperated patients were registered due to infection that either were included in our study or that were registered with the Register. Only 67% of these were in the Register, implying that a third are missing from the Register. Of the total number of registered primary hip replacement operations 1.2 % suffered a postoperative deep infection. In roughly 60% of cases the infection was diagnosed within the first month. The most commonly occurring bacteria were staphylococcus aureus and coagulasnegative staphylococci.

In summary 1.2 % suffered a postoperative infection and the overwhelming majority of these 94% were operated on for the treatment of infection. Coverage in the Register for reoperation due to infection is low, only 67%. In order for the register's surveilance function for the development of the incidence of infection to be reliable, and rereporting of data meaningful, registration of operative measures carried out due to infection must improve immediately.

Almost all hospitals during the study period had a certain amount of hidden statistics but a few hospitals were distinct "outliers" with a considerable amount of missing data. A partial explanation can be that a patient was primarily operated at one hospital while another operated the infection, that is to say that the "secondary" hospital did not report to the Register. This in turn can depend on shortcomings in registration logistics, but there is still a belief in the country that if they register such operations it will affect the quality rating of their own hospital. **Attention! Since 1979 all secondary interventions are attributed to the primary clinic without tainting the statistics of the clinic that possibly carries out the secondary intervention.**



The project is carried out in cooperation with Swedish Patient Insurance (LOF), the Swedish Orthopaedic Association and PRISS (Implant-related infections should be stopped) group. LOF has moreover contributed financially to this costly and labor-intensive study. The study occurs time-wise prior to the national PRISS project and is conceived as a "base-line" to determine the effect of the project. Thus, the study will be repeated in a few years. We are also working with a model of how antibiotic prescription can be used as a surrogate variable that can be used more as an "on-line" variable for infection incidence.

The Registry management fervently hopes that **all** clinics read the following table without prestige and with the intention to carry out local improvement efforts concerning infection registration. This is essential for the register's data quality and credibility for the analyses. We will, as indicated above, follow up this study, but will monitor all clinics as well.

Hidden statistics in infection reporting per hospital

2005-07-01 — 2008-12-31

Hospital	Number	SHAR [1)]	SHAR + Study [2)]	Loss [3)]	Total	Frequency of infection
Alingsås	715		3	5	8	1.12%
Arvika	393	1	5		6	1.53%
Bollnäs	881		4	2	6	0.68%
Borås	725		5	1	6	0.83%
Capio S:t Göran	1,301	1	4	24	29	2.23%
Carlanderska	184		1		1	0.54%
Danderyd	1,388	1	10	5	16	1.15%
Eksjö	659	1	9	3	13	1.97%
Elisabethsjukhuset	517		1		1	0.19%
Enköping	668		6	4	10	1.50%
Eskilstuna	324		2	2	4	1.23%
Falköping	822		1	2	3	0.36%
Falun	875	1	6	2	9	1.03%
Frölunda Specialistsjukhus	227		1		1	0.44%
Gothenburg Medical Center	79	1	1		2	2.53%
Gällivare	373			3	3	0.80%
Gävle	471	1	8	2	11	2.34%
Halmstad	786					
Helsingborg	234		5		5	2.14%
Hudiksvall	440		9	4	13	2.95%
Hässleholm-Kristianstad	2,737	6	18	5	29	1.06%
Jönköping	671	1	5	1	7	1.04%
Kalmar	623	1	9	1	11	1.77%
Karlshamn	617		1	5	6	0.97%
Karlskoga	346		1		1	0.29%
Karlskrona	102		1		1	0.98%
Karlstad	952	1	16	15	32	3.36%
Karolinska/Huddinge	914	2	2	4	8	0.88%
Karolinska/Solna	760	7	9	2	18	2.37%
Katrineholm	722		2	4	6	0.83%
Kungälv	679	1	7	1	9	1.33%
Köping	577		3	2	5	0.87%
Lidköping	476				0	0.00%
Lindesberg	494		4	1	5	1.01%
Linköping	184			1	1	0.54%
Ljungby	392		1	4	5	1.28%
Lycksele	839	1	5		6	0.72%
Mora	545	3	1	1	5	0.92%
Motala (t o m 2009)	1,393		8	8	16	1.15%
Movement	448		5	3	8	1.79%
Nacka Närsjukhus Proxima	107		1	1	2	1.87%
Norrköping	536		1	2	3	0.56%
Norrtälje	378		1	3	4	1.06%
Nyköping	531		2	11	13	2.45%
Ortho Center Stockholm	683	2	4	2	8	1.17%
OrthoCenter IFK-kliniken	112			2	2	1.79%
Ortopediska Huset	1,527		7	5	12	0.79%

Hidden statistics in infection reporting per hospital (cont.)

2005-07-01 — 2008-12-31

Hospital	Number	SHAR [1]	SHAR + Study [2]	Loss [3]	Total	Frequency of infection
Oskarshamn	799		4	2	6	0.75%
Piteå	1,140		8		8	0.70%
Simrishamn	82				0	0.00%
Skellefteå	343	1	1	2	4	1.17%
Skene	265		3	1	4	1.51%
Skövde	477			3	3	0.63%
Sollefteå	428		2	1	3	0.70%
Sophiahemmet	755	1	3		4	0.53%
Spenshult	228		3		3	1.32%
SU/Mölndal	592	2	11	3	16	2.70%
SU/Sahlgrenska	266			1	1	0.38%
SU/Östra	425	1	5		6	1.41%
Sunderby (inklusive Boden)	230		2	1	3	1.30%
Sundsvall	455		14	6	20	4.40%
SUS/Lund	312		6	4	10	3.21%
SUS/Malmö	375		1	1	2	0.53%
SUS/Trelleborg	2,082	1	12		13	0.62%
Södersjukhuset	1,441	2	23	5	30	2.08%
Södertälje	393		3	2	5	1.27%
Torsby	284	1	5	1	7	2.46%
Uddevalla	1,137		10	5	15	1.32%
Umeå	282				0	0.00%
Uppsala	977	2	10	5	17	1.74%
Varberg	730		2	5	7	0.96%
Visby	426	1	2	1	4	0.94%
Värnamo	491	1		3	4	0.81%
Västervik	362	1	7		8	2.21%
Västerås	634		4	3	7	1.10%
Växjö	448			2	2	0.45%
Ystad	30				0	0.00%
Ängelholm	6				0	0.00%
Örebro	626	1	4	2	7	1.12%
Örnsköldsvik	616		1	1	2	0.32%
Östersund	695		4		4	0.58%
Total	49,239	47	340	202	589	1.20%

[1] Infection cases only registered in the Register. In most case treated with requisition drugs not yet registered in the Swedish Prescribed Drug Register.

[2] Infection cases found via the Swedish Prescribed Drug Register and medical history searches and registered in the Register.

[3] Infection cases not registered and making up hidden statistics.

”Adverse events” within 30 and 90 days

The Register has, during the last years, established a continual cooperation with the Patient Register of the National Board of Health and Welfare. In Regional comparisons it has, via the Patient Register, created a national quality indicator: “adverse events following joint replacement after hip and knee replacement surgery.” The Registry has exploited this analysis in order to carry out a separate analysis solely for hip replacement surgery, which is now being published for the first time on a hospital level.

Since hospitalization for total hip replacement has been strongly reduced, both nationally and internationally during the past 10-year period, focus has increased on”adverse events” after this elective intervention. The concept “adverse events” means all forms of rehospitalization that can be dependent on the intervention performed – and then not only local complications but even general medical complications and death.

The Registy’s and the National Board of Health and Welfare’s definition of ”adverse events” after hip replacement surgery is all forms of reoperation of the hip in question, as well as cardiovascular, cerebrovascular and thromboembolic complications, pneumonia, ulcers, urinary retention, and whether these complications imply hospital care and death. The analysis was based on the register’s database of primary total replacements 2009 up until September 2011 (42 788 operations). This database was linked to the National Patient Register (PAR).

Results

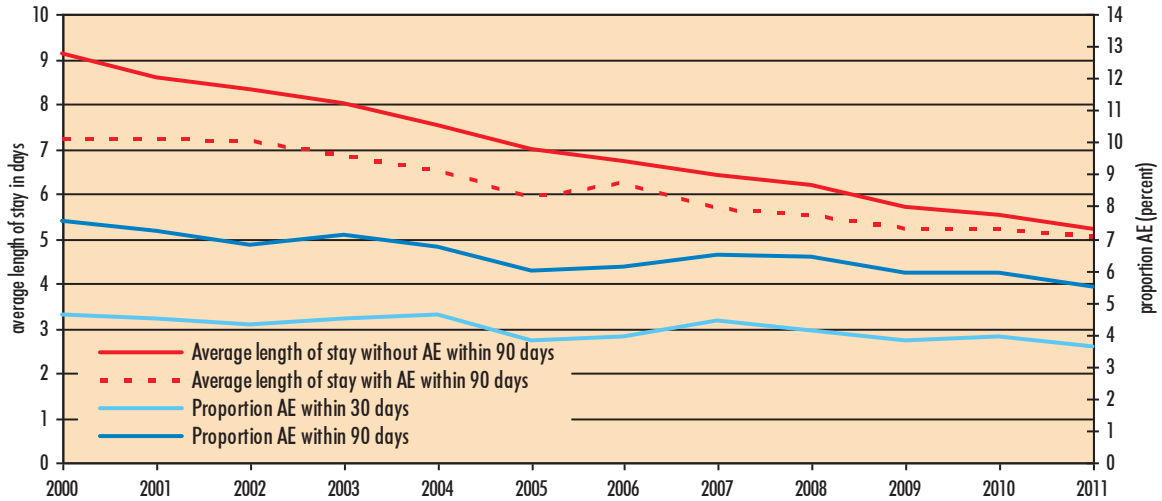
See table below. The national average is 3.8%, after 30 days, and 5.8% after 90 days. Men have significantly more “adverse events” both at 30 and 90 days. The frequency of “adverse events” varies rather largely between different hospitals. 30 days: 1.5–13.6%. 90 days: 2.4–17.5%. Hospitals that deviate from the mean with a standard deviation are marked in red in the table. At analysis we found, in discrepancy with some other studies, no clear connection between shorter hospitalization and the frequency of rehospitalization (see figure below). However, patients in need of rehospitalization, a primary hospitalization that surpassed the mean by 1-2 days (constantly during the entire 10-year period). This speaks for the fact that the population that needed rehospitalization within 30 an 90 days were initially “sicker”.

Problem and discussion

This type of analysis from PAR can have great significance in the future for continued quality development for Swedish hip replacement surgery. In PAR we can capture variables we don’t register in our usual register routines. There are, however, currently a number of sources of error illuminated in the chapter “Degree of Coverage”. A number of mergings of hospitals has been carried out with joint reporting to the Patient Register despite surgery being performed at different hospitals. The largest error source is probably suboptimal coding, and that many patients have a large number of secondary subdiagnoses at discharge, where the most relevant diagnosis for the current treatment session is not always noted as the first diagnosis. These factors probably result in the analysis showing values that are a bit too low.

Generally, striving toward reducing length of stay for this type of surgery continues. The concept “fast track” with, among other things, ultra short hospitalization, is gaining increased attention both in Europe and North America. LoS = Length of Stay is often presented as decisive in cost-effectiveness analyses. However, ”adverse events” both in the short and long term perspectives must be included, although they are not in most length of Stay studies. Even in Sweden the average length of stay during the last 10-year

Average length of stay vs Adverse events (AE)
within 30 and 90 days after hip prosthetic surgery



period has been lowered from roughly 10 days (1998) to 5.2 days (2011). Endeavoring to lower LoS has both a productivity and accessibility incitement. A possible cost reduction should, however, directly disappear if rehospitalizations should simultaneously increase due to shorter lengths of stay. The halfed LoS in Sweden has not as yet in any way influenced the frequency of "adverse events" (see figure). The Registry will, in the future, have an increased focus (both for operational analyses and clinical research) on adverse events after hip surgery, and has begun to cooperate developmentally with the National Board of Health and Welfare. Seen from a patient perspective these types of analyses are probably more relevant compared with analyses of only implant-related occurrences/complications. The large variation between different hospitals implies that there is a potential for improvement within this area. Obviously a different "case-mix" can explain some of the differences, but the differences for preoperative medical assessment/optimation, indications etc. should be discussed at the clinics when these figures are interpreted locally.

Adverse events within 30 and 90 days per hospital

2009-2011

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	number	number	%	±	number	%	±
University/Regional hospitals							
Karolinska/Huddinge	688	21	3.1	1.3	37	5.4	1.7
Karolinska/Solna	532	25	4.7	1.8	38	7.1	2.2
Linköping	179	14	7.8	3.9	21	11.7	4.7
Lund	270	24	8.9	3.4	42	15.6	4.3
Malmö	257	7	2.7	2.0	18	7.0	3.1
SU/Mölndal	1,106	50	4.5	1.2	80	7.2	1.5
Umeå	250	8	3.2	2.2	16	6.4	3.0
Uppsala	869	44	5.1	1.5	81	9.3	1.9
Örebro	484	20	4.1	1.8	27	5.6	2.0
Central hospitals							
Borås	507	23	4.5	1.8	41	8.1	2.4
Danderyd	912	57	6.3	1.6	76	8.3	1.8
Eksjö	532	21	3.9	1.7	31	5.8	2.0
Eskilstuna	308	14	4.5	2.3	25	8.1	3.1
Falun	901	30	3.3	1.2	49	5.4	1.5
Gävle	467	28	6.0	2.2	46	9.9	2.7
Halmstad	606	31	5.1	1.8	42	6.9	2.0
Helsingborg	191	17	8.9	4.0	24	12.6	4.7
Hässleholm-Kristianstad	2,252	71	3.2	0.7	113	5.0	0.9
Jönköping	567	19	3.4	1.5	35	6.2	2.0
Kalmar	487	15	3.1	1.5	25	5.1	2.0
Karlskrona	84	6	7.1	5.5	8	9.5	6.3
Karlstad	698	51	7.3	1.9	69	9.9	2.2
Norrköping	640	40	6.3	1.9	53	8.3	2.1
Skövde	371	17	4.6	2.1	22	5.9	2.4
Sunderby	103	14	13.6	6.6	18	17.5	7.4
Sundsvall	560	35	6.3	2.0	54	9.6	2.5
Södersjukhuset	1,016	43	4.2	1.2	74	7.3	1.6
Uddevalla	885	24	2.7	1.1	44	5.0	1.4
Varberg	619	24	3.9	1.5	29	4.7	1.7
Västerås	1,179	85	7.2	1.5	117	9.9	1.7
Växjö	339	18	5.3	2.4	24	7.1	2.7
Östersund	663	21	3.2	1.3	33	5.0	1.7
Rural hospitals							
Alingsås	575	23	4.0	1.6	34	5.9	1.9
Arvika	474	11	2.3	1.4	24	5.1	2.0
Bollnäs	839	20	2.4	1.0	33	3.9	1.3
Enköping	692	29	4.2	1.5	43	6.2	1.8
Falköping	368	8	2.2	1.5	15	4.1	2.0
Frölunda specialistsjukhus	224	4	1.8	1.7	8	3.6	2.4
Gällivare	253	10	4.0	2.4	16	6.3	3.0
Hudiksvall	355	18	5.1	2.3	24	6.8	2.6

Adverse events within 30 and 90 days per hospital (cont.)

2009-2011

	Patients	Adverse events within 30 days			Adverse events within 90 days		
Hospital	number	number	%	±	number	%	±
Karlshamn	577	18	3.1	1.4	25	4.3	1.7
Karlskoga	363	16	4.4	2.1	22	6.1	2.5
Katrineholm	647	18	2.8	1.3	28	4.3	1.6
Kungälv	497	11	2.2	1.3	17	3.4	1.6
Lidköping	482	10	2.1	1.3	19	3.9	1.7
Lindesberg	588	14	2.4	1.2	25	4.3	1.6
Ljungby	482	13	2.7	1.4	20	4.1	1.8
Lycksele	862	31	3.6	1.2	39	4.5	1.4
Mora	598	17	2.8	1.3	29	4.8	1.7
Motala	1,079	47	4.4	1.2	66	6.1	1.4
Norrtälje	325	21	**6.5**	2.7	27	**8.3**	3.0
Nyköping	449	27	**6.0**	2.2	42	**9.4**	2.7
Oskarshamn	543	12	2.2	1.2	23	4.2	1.7
Piteå	986	21	2.1	0.9	44	4.5	1.3
Skellefteå	243	5	2.1	1.8	12	4.9	2.7
Skene	259	8	3.1	2.1	11	4.2	2.5
Sollefteå	333	5	1.5	1.3	8	2.4	1.6
Södertälje	322	10	3.1	1.9	18	5.6	2.5
Torsby	285	17	**6.0**	2.8	20	**7.0**	3.0
Trelleborg	1,565	30	1.9	0.7	51	3.3	0.9
Visby	336	16	**4.8**	2.3	20	6.0	2.5
Värnamo	372	12	3.2	1.8	18	4.8	2.2
Västervik	292	14	**4.8**	2.5	19	**6.5**	2.8
Ängelholm	311	12	3.9	2.1	19	6.1	2.7
Örnsköldsvik	445	10	2.2	1.4	20	4.5	1.9
Private hospitals							
Aleris Specialistvård Sabbatsberg	382	7	1.8	1.3	10	2.6	1.6
Capio S:t Göran	1,146	38	3.3	1.0	61	5.3	1.3
Carlanderska	272	4	1.5	1.4	8	2.9	2.0
Elisabethsjukhuset	194	4	2.1	2.0	7	3.6	2.6
Movement	628	14	2.2	1.2	16	2.5	1.2
Nacka närsjukhus Proxima	316	5	1.6	1.4	8	2.5	1.7
OrthoCenter IFK-kliniken	317	8	2.5	1.7	12	3.8	2.1
OrthoCenter Stockholm	1,138	29	2.5	0.9	47	4.1	1.2
Ortopediska Huset	1,000	28	2.8	1.0	32	3.2	1.1
Sophiahemmet	462	8	1.7	1.2	12	2.6	1.5
Spenshult	390	10	2.6	1.6	14	3.6	1.9
Nation	42,788	1,610	3.8	0.2	2,478	5.8	0.2

Red marking denotes values one standard deviation above the national average.

Revision

Revision of a hip implant entails that a previously hip-replaced patient undergoes a further operation where part or all of the implant is replaced or extracted. During the period 1991-2011 the proportion of multiple reoperations slowly increased. During the period 1991-1993 they made up 14.5% of all reoperations and increased to 24.3% during the period 2009-2011. This observation should be seen against the background of an increasing proportion of the population with hip replacement, increased life expectancy, and improved possibilities to carry out more advanced reoperation surgery.

During the period 1991-1993, 3 243 revision operations were performed. Thereafter the number of revision operations has increased. Between 2009 and 2011 the number reached 5 388. During the entire period the relative proportion of revisions due to loosening/osteolysis decreased fran 77.5% during 1991-1993 to 58.1% during 2009-2011 (Figure 4). The relative proportion of revisions due to infection more than doubled (6.4 till 13.1%) corresponding to an increase from 209 to 708 per 3-year period. Even the group periprosthetic fractures increased (175 to 518) corresponding to a relative increase from 6.2 to 13.6%. The proportion of reoperations carried out due to dislocation increased until 2006-2008, but have thereafter decreased. Redistribution in relative numbers can be partly caused by those factors that are believed to be the cause of an increasing number of multiple reoperations and have been discussed above. The increase of the number of revisions and other reoperations due to infection are, however, worrisome. Part of this increase can, however, be explained by a more aggressive attitude toward performing synovectomies combined with femoral head replacement and possibly liner at an earlier stage (Figure 5-6). Whether this change of treatment algorithm can explain the entire increase is unclear. A substantial increase of the incidence of infections can also be forthcoming. We have also shown an underreporting of infections in this annual report.

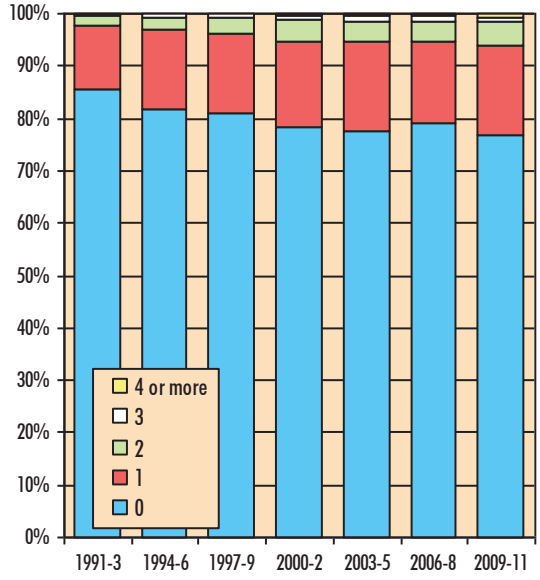


Figure 4. Proportion with differing numbers of previous implant replacement related to three-year periods between 1991-2011. The proportion of multiple revisions has slowly increased.

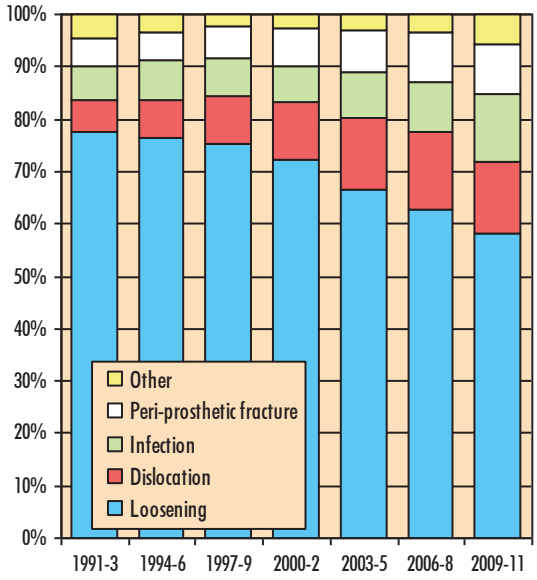


Figure 5. The division of reasons for revision during the period 1991-2011 divided into three-year periods. The proportion revised due to loosening/osteolysis has decreased, infection and periprosthetic fractures has increased while the cause group dislocation increased up until 2006-2008 but later decreased.

Revision within 3 years – an indicator of trend shifts

In order to obtain a somewhat fast indicator of trend shifts for causes of early revision we have chosen a 3-year limit. This implies that patients operated up until 2008 have a minimum follow-up within a 3-year limit. Data for 2009 has also been included despite the observation period for these patients varying between 2 and 3 years. Certain complications that lead to reoperation (i.e. infection, dislocation, technical causes, periprosthetic fractures at uncemented stems) occur early, which can motivate a 3-year limit. To illustrate this relationship we have calculated the proportion revised within 3 years relative to revisions performed due to infection and loosening during a 16-year period. We have selected operations carried out 1992-1995 because all patients shall have then been observed for 16 ar. Regarding the reason for infection, 57.4% were carried out within 3 years after the primary operation. The corresponding proportion of revision due to dislocation was 49%. Approximately 40-50% of revisions thus do not fall within a three-year limit, a concession, within a reasonable space of time, to gain an idea of whether the complication in question changes in time.

We find, for both infection and dislocation that the proportion of reoperations of the total number of primary hip arthroplasties performed during 1991-1992 was about 0.4% (Figure 7). The proportion reoperations within 3 years due to dislocation increased up until 2006, but decreased thereafter. The corresponding proportion for infection stayed relatively constant during the 1990s but later increases. The increase accelerates toward the end of the period, an increase

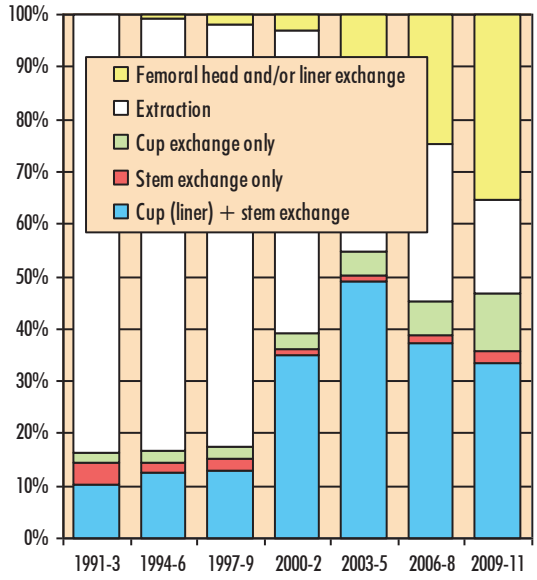


Figure 6. The distribution of measures for revision due to infection 1991-2011. The proportion of revisions where only replacement of joint head and/or liner was performed (as well as eventual proximal part of modular stem) has increased particularly during the period of 2003-2005.

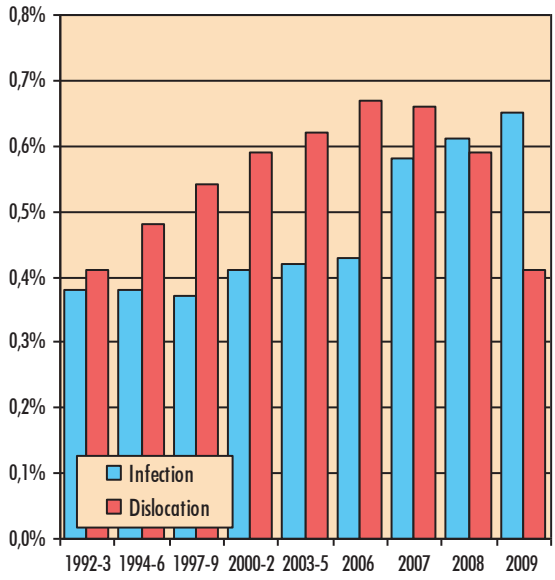


Figure 7. Proportion of patients revised within 3 years due to infection and dislocation in three-year periods up until and including 2005 and thereafter annually. Since 2007 the proportion of primary implants revised due to dislocation has decreased, while the proportion revised due to infection increased.

coinciding relatively well with the increase noted for replacement of femoral head and/or liner in Figure 6.

Fixation, implant and bearing selection

Until 2009 a successive transition occurred from cemented to uncemented fixation for revision operations. This trend seems to have been broken during the last three years. From 2009 there was a relatively equal distribution between fixation method for both cup and stem (Figure 8). The most common cemented and uncemented cups and stems respectively during 2011 are shown in Table 2.

As for primary arthroplasty the shift is occurring from the older polyethylene type to the newer sooner in revision with uncemented cup or liner replacements (Figure 9). Articulations on the acetabular side made of metal or ceramics are seldom used. The highest proportion of metal articulations was noted at liner replacements in 2003 and 2004 (0.6%). Ceramic liners were also seldom used for revision. The highest proportion was noted 2011 (0.9%). At revision with cemented cups metal joint surfaces on the cup were used only on isolated occasions during the early half of the 2000s.

Metal-on-metal articulation combined with a large head

A total of 185 revisions of resurfacing cups and 117 revisions of femur components of resurfacing type have been reported to the Register. In 50 of these cases only the femoral component was revised. It was then replaced by a conventional stem with a head size between 42 and 57 mm resulting in a metal-on-metal articulation with a large head (22 women, 28 men). In another 39 cases a cup of resurfacing type was used as a revision cup (22 women, 17 men). If one adds to these 89 hip arthroplasties those where a metal implant was used for an uncemented cup vid revision with a head size of 36 mm or larger (n=4), we can estimate the number of completed revisions using metal-on-metal articulation to roughly 100, including a possible loss of data in reporting of up to 10%. These patients have an increased compication risk and should be followed up as discussed in "Primary total arthroplasty".

Cup revision with and without hydroxyapatite

In collaberation with Stergios Lazarinis and Nils Hailer, Uppsala University Hospital, we have previously compared the risk for revision with the use of cups (Romanus, Harris-Galante, Trilogy) and stems (Bi-Metric) with and without hydroxyapatite (HA) reported to the Swedish Hip Arthroplasty Register. The ceramic coating was, for certain implant types, mixed with Tricalcium phosphate (TCP). We were unable to find any advantage in using HA or HA/TCP coating concerning the risk for revision (read more: Lazarinis et al. Acta Orthop, 2010 Feb;81(1):53-59 and Acta Orthop, 2011 Aug;82(4):399-404).

In an analysis of the revision database we studied whether hydroxyapatite coating influences results after a primary revision of the cup. In the database, two designs (Harris-

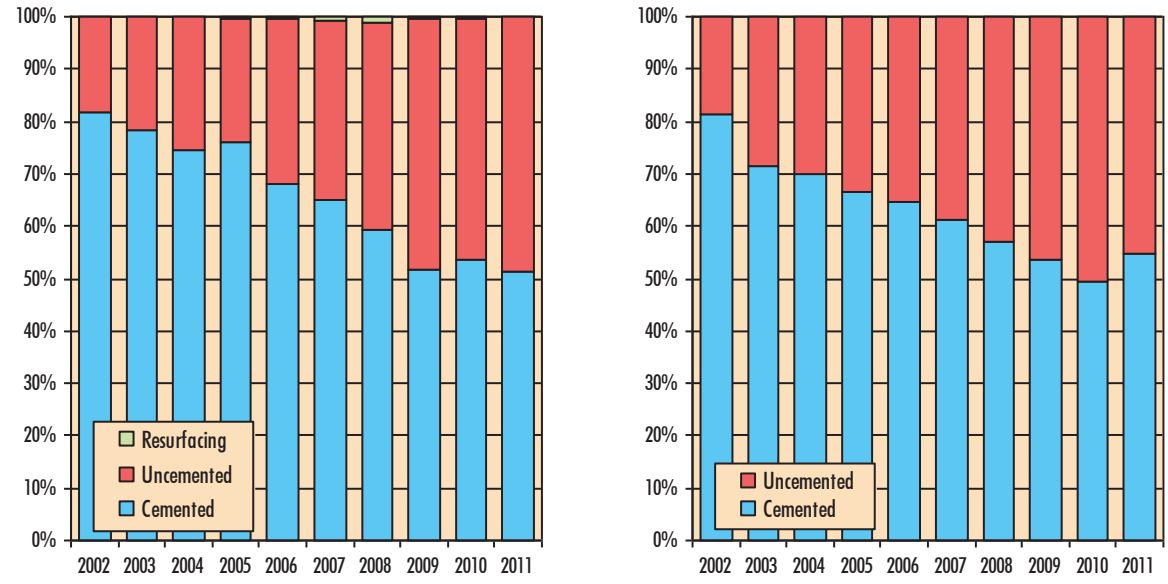


Figure 8. The distribution of cemented and uncemented cups (left) and stem (right) for revision operations. Since 2009 it appears that the trend of using increasingly more uncemented implants has been broken. Resurfacing is seen registered only on the cup side.

Galante and Trilogy) were found that were used both with and without ceramic coating. A total of 1 780 revisions, 71.4% with and 28.6% without coating were included. HA/TCP-coating did not influence the risk for revision regardless if one analysed all causes of revision or only aseptic loosening. On the other hand it was seen that the risk for liner revision was higher if the revision cup at the first revision was coated with HA/TCP (RR 1.8, 1.0-3.3). At the primary revisions studied, liners made of both older polyethylene and newer with highly cross-linked were used with the Trilogy cup. Since more revisions were performed before the registration of separate implant components was begun, we couldn't adjust for this factor (the study has been accepted for publication).

Implant survival after 10 years

The concept of implant survival within 10 years is based on revisions carried out on hip implants inserted during the last 10 years. This implies an observation period of 9-10 years only for those implants inserted during the first observation year. In this year's analysis they correspond to patients operated during 2002. Since all the more hip implants were operated on during the interval 2002-2011 the average observation period for the entire country becomes shorter than 5 years (4.3 years). Despite this relatively short observation interval aseptic loosening, that includes osteolysis, is the most usual cause of revision (28.0% of all revisions within the interval) followed by dislocation (26.4%) and infection (24.4%).

The variable is very important primarily for those clinicians that have had a relatively intact organisation having not made any great changes in their operating process, including the selection of routine implants, during the last 10 years. The outcome variables of dislocation and infection reflect the process surrounding primary hip arthroplasty as well as the case-mix of the clinic in question. The revision frequency due to loosening provides relatively good information of how implant selection and surgical technique influence outcome. For clinics that have undergone organizational changes during the last 10 years or have changed standard implant, implant survival within ten years can be more difficult to interpret since it only partially reflects the current organization and implant selection.

This year's analysis shows four clinics (Sahlgrenska University Hospital/Molndal, Karolinska University Hospital/Solna, Sodertalje Hospital, Stockholm OrthoCenter) having a higher than expected revision frequency (data from OrthoCenter has turned out to be scewed, because some of the primary hip prostheses performed during the same period were reported from another hospital). The reasons for revision, however, vary between clinics. Sahlgrenska University Hospital/Molndal has a cause mix that approximately corresponds to the country's average, which implies an overrepresentation in all of the cause groups aseptic loosening, deep infection, infection, dislocation and others. For the other three hospitals there is, relatively speaking, more problems with asepic loosening, and for the OrthoCenter in Stockholm, even a somewhat increased proportion of revision due to dislocation. As for aseptic loosening the two university clinics stand out as well as Sodertalje by way of Spectron EF Primary implants being those chiefly revised (79 to 97% of cups and stems, respectively).

In the previous annual report a review of Sahlgrenska University Hospital/Molndal's high proportion of reoperations within 2 years was performed. The clinic has now initiated an improvement effort. The high proportion of revisions

Cup at revision (2011)			
Cemented	N=609	Uncemented	N=576
	%		%
Exeter Rim-fit	**19.5**	**TMT revision**	**22.4**
Marathon	**19.4**	**Trilogy HA**	**21.9**
Lubinus	**18.2**	**Continuum**	**14.2**
Avantage	12.5	TMT modular	14.1
ZCA	7.1	Trident AD LW	5.9
Contemporary Hooded Duration	6.4	Mallory Head	4.2
Elite Ogee	2.8	Trident hemi	4.2
FAL	2.8	Tritanium	3.0
Contemporary	2.3	Regenerex	1.9
Polarcup cemented	1.8	Others	8.3
Charnley Ogee	1.6		
Others	5.6		

Stem at revision (2011)			
Cemented	N=535	Uncemented	N=445
	%		%
Exeter Polished	**54.0**	**MP revision**	**45.6**
Lubinus SP II	**25.2**	**Restoration**	**22.7**
CPT (CoCr)	**11.8**	**Revitan**	**17.1**
291 MS30 Polished	5.2	Corail/KAR	5.6
Spectron Revision	2.6	Bi-Metric	2.5
Others	1.1	Others	6.5

Table 2. Implants used in revision surgery 2011. Models used in less than 10 revisions is included with others.

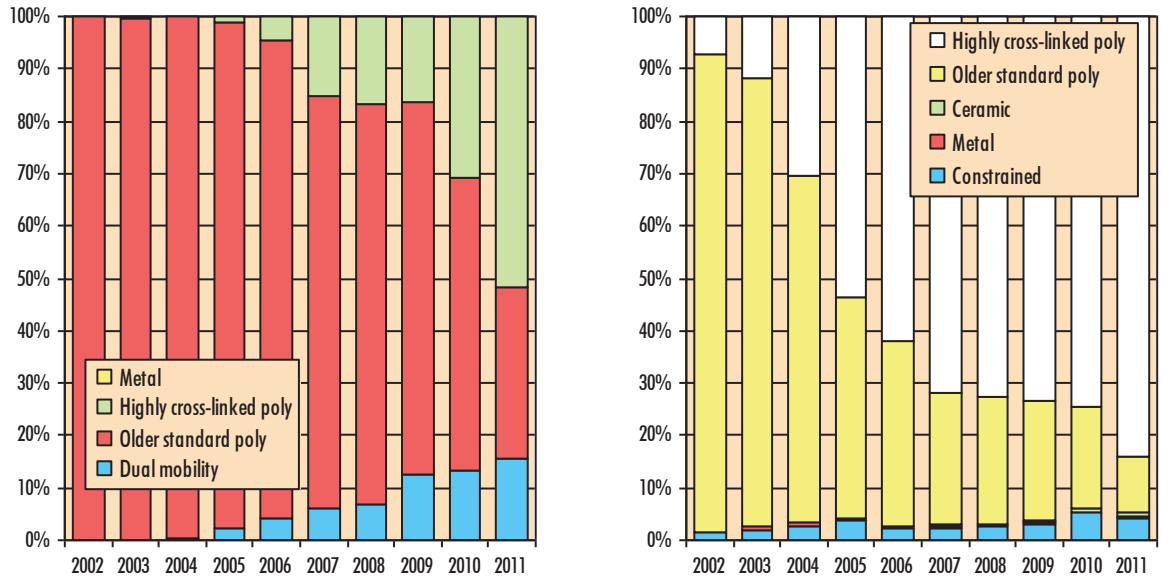


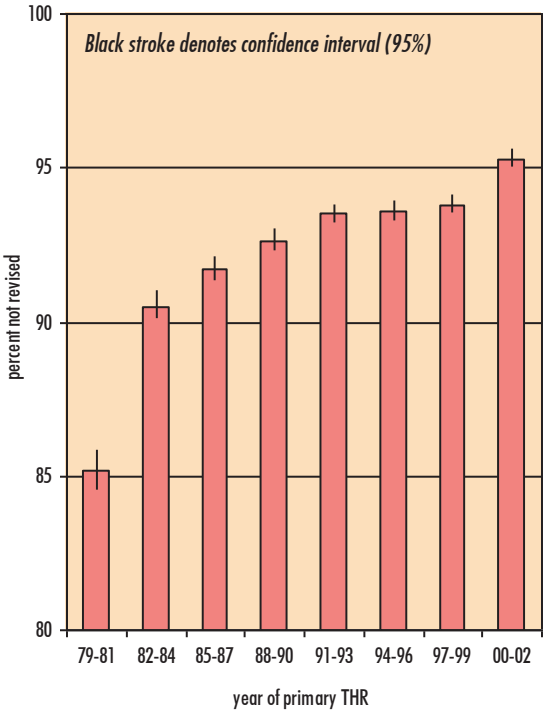
Figure 9a-b. Selection of cup material (to the left) and in liners (right). Dual articular cups and joint stabilizing liners ("constrained") are presented separately without indicating polyethylene quality for the sake of clarity.

within 10 years can be partially explained by many early re-operations, particularly of hip fracture patients. The use of Specton EF Primary implants up until 2006, when Sahlgrenska University Hospital/Molndal was still a separate unit, can also have affected the outcome. The problem at Karolinska University Hospital/Solna and in Sodertalje can be partly explained by the choice of primary implant, where both have now changed to another implant with better documentation.

Happily, the country's total 10-year survival continues to improve. See Figure and Table to the right.

Implant survival after 10 years

during different periods of time



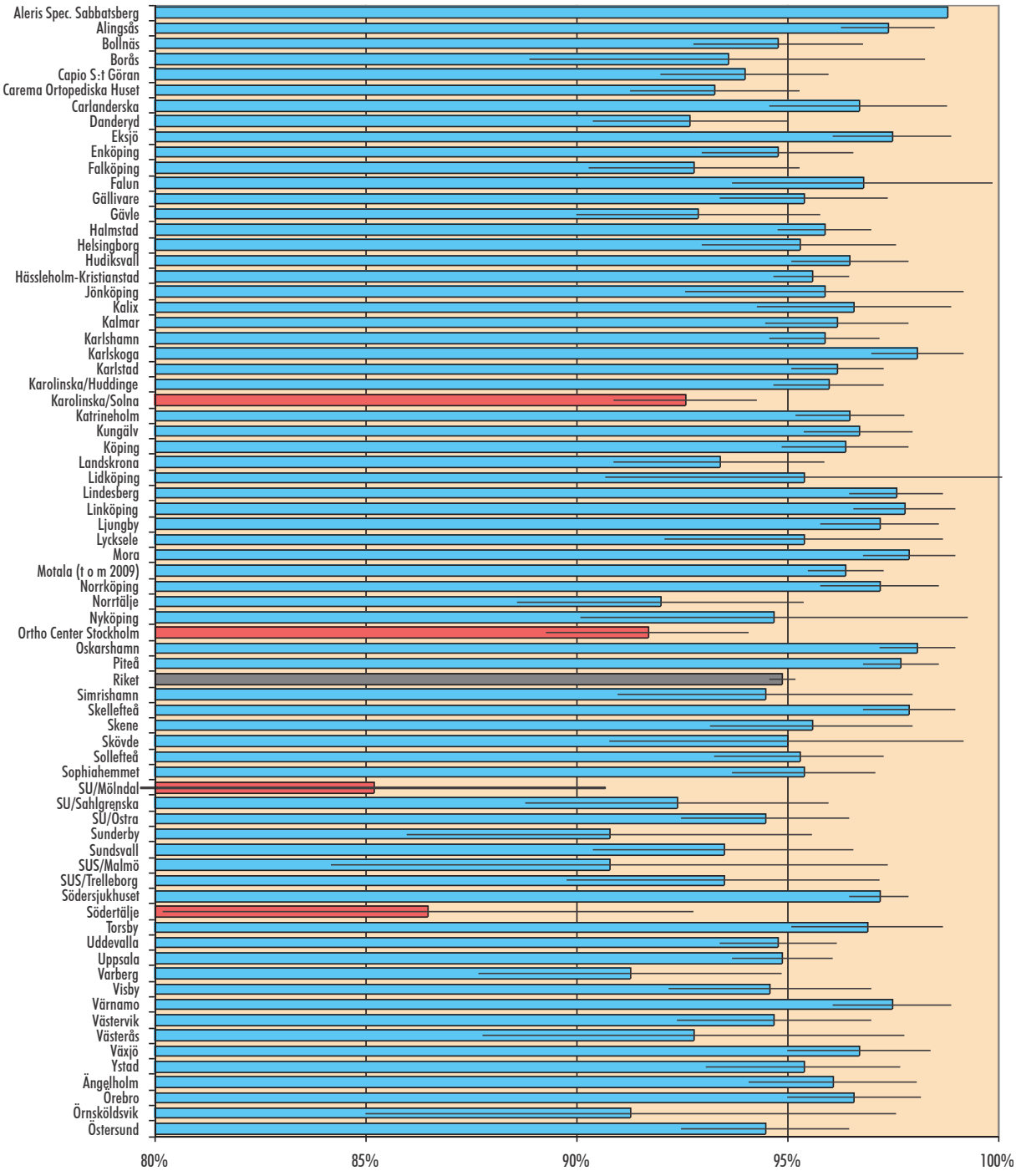
Primary THR during	10 years	95% C.I.
1979-1981	85.2%	±0.7
1982-1984	90.5%	±0.4
1985-1987	91.7%	±0.4
1988-1990	92.6%	±0.3
1991-1993	93.5%	±0.3
1994-1996	93.6%	±0.3
1997-1999	93.8%	±0.3
2000-2002	95.3%	±0.3

Average implant survival after 10 years for all active clinics in the respective time period. Each period encompasses all primary total hip arthroplasties performed during the three-year period. All revisions of these primary operations are included. Tables show the values behind the bar graph on the left.

In all survival analyses according to Kaplan-Meier the analysis is concluded when the number of patients 'at risk' is lower than 50.

Implant survival after 10 years

each bar represents a hospital, primary operation 2002-2011



Implant survival after 10 years divided by clinic. Grey bar indicates the national average. Red bars are clinics with an upper confidence interval under the nation's lower confidence interval, that is, clinics with 95% certainty have poorer implant survival after 10 years than the national average. Primary operation was performed during the last 10-year period.

Number of revisions per diagnosis and number of previous revisions

primary THRs 1979-2011

Diagnosis at primary THR	0		1		2		> 2		Total	Prop.
Primary osteoarthritis	21,107	74.0%	3,552	70.1%	690	64.7%	201	60.9%	25,550	73.0%
Fracture	2,477	8.7%	408	8.1%	83	7.8%	17	5.2%	2,985	8.5%
Inflammatory arthritis	2,188	7.7%	475	9.4%	136	12.8%	45	13.6%	2,844	8.1%
Childhood disease	1,434	5.0%	368	7.3%	86	8.1%	38	11.5%	1,926	5.5%
Idiopathic femoral head necrosis	686	2.4%	131	2.6%	35	3.3%	9	2.7%	861	2.5%
Secondary arthritis after trauma	228	0.8%	69	1.4%	24	2.3%	18	5.5%	339	1.0%
Secundary osteoarthritis	233	0.8%	29	0.6%	4	0.4%	0	0.0%	266	0.8%
Tumour (malignancy)	108	0.4%	19	0.4%	3	0.3%	1	0.3%	131	0.4%
(missing)	58	0.2%	15	0.3%	5	0.5%	1	0.3%	79	0.2%
Total	28,519	100%	5,066	100%	1,066	100%	330	100%	34,981	100%

Number of revisions per reason and number of previous revisions

primary THRs 1979-2011

Reason for revision	0		1		2		> 2		Total	Prop.
Aseptic loosening	20,489	71.8%	3,000	59.2%	542	50.8%	125	37.9%	24,156	69.1%
Dislocation	2,505	8.8%	756	14.9%	205	19.2%	95	28.8%	3,561	10.2%
Deep infection	2,309	8.1%	653	12.9%	175	16.4%	77	23.3%	3,214	9.2%
Fracture	1,956	6.9%	418	8.3%	87	8.2%	16	4.8%	2,477	7.1%
Technical error	639	2.2%	112	2.2%	29	2.7%	7	2.1%	787	2.2%
Implant fracture	420	1.5%	87	1.7%	19	1.8%	7	2.1%	533	1.5%
Pain only	108	0.4%	23	0.5%	5	0.5%	2	0.6%	138	0.4%
Miscellaneous	93	0.3%	16	0.3%	3	0.3%	1	0.3%	113	0.3%
Secondary infection	0	0.0%	1	0.0%	1	0.1%	0	0.0%	2	0.0%
Total	28,519	100%	5,066	100%	1,066	100%	330	100%	34,981	100%

Number of revisions per year of revision and number of previous revisions

primary THRs 1979-2011

Year of revision	0		1		2		> 2		Total	Prop.
1979-2006	21,759	76.3%	3,633	71.7%	706	66.2%	198	60.0%	26,296	75.2%
2007	1,289	4.5%	266	5.3%	58	5.4%	21	6.4%	1,634	4.7%
2008	1,301	4.6%	256	5.1%	80	7.5%	27	8.2%	1,664	4.8%
2009	1,433	5.0%	305	6.0%	81	7.6%	23	7.0%	1,842	5.3%
2010	1,406	4.9%	312	6.2%	82	7.7%	31	9.4%	1,831	5.2%
2011	1,331	4.7%	294	5.8%	59	5.5%	30	9.1%	1,714	4.9%
Total	28,519	100%	5,066	100%	1,066	100%	330	100%	34,981	100%

Number of revisions per reason and year of revision

first revision only, primary THRs 1979-2011

Reason for revision	1979-2006	2007	2008	2009	2010	2011	Total	Prop.
Aseptic loosening	16,278	829	818	913	874	777	20,489	71.8%
Dislocation	1,654	180	190	169	163	149	2,505	8.8%
Deep infection	1,607	112	112	142	151	185	2,309	8.1%
Fracture	1,293	120	126	133	146	138	1,956	6.9%
Technical error	472	19	29	36	37	46	639	2.2%
Implant fracture	326	14	16	25	17	22	420	1.5%
Pain only	73	7	8	8	7	5	108	0.4%
Miscellaneous	56	8	2	7	11	9	93	0.3%
Total	21,759	1,289	1,301	1,433	1,406	1,331	28,519	100%

Number of revisions per type of fixation at primary THR and year of revision

first revision only, primary THRs 1979-2011

Type of fixation at primary THR	1979-2006	2007	2008	2009	2010	2011	Total	Prop.
Cemented	18,047	964	974	1 062	1 051	954	23,052	80.8%
Uncemented	1,914	147	139	150	144	153	2,647	9.3%
Hybrid	1,063	115	101	143	111	107	1,640	5.8%
Reversed hybrid	164	39	58	51	75	85	472	1.7%
Resurfacing implant	25	10	16	16	15	14	96	0.3%
(missing)	546	14	13	11	10	18	612	2.1%
Total	21,759	1,289	1,301	1,433	1,406	1,331	28,519	100%

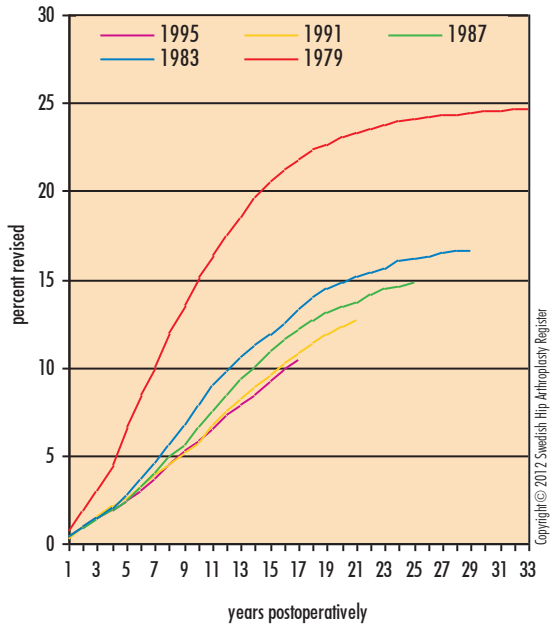
Number of revisions per reason and time to revision

first revision only, primary THRs 1979-2011

Reason for revision	0 – 3 years		4 – 6 years		7 – 10 years		> 10 years		Total	Prop.
Aseptic loosening	2,993	39.2%	3,880	79.6%	5,679	85.0%	7,937	85.1%	20,489	71.8%
Dislocation	1,548	20.3%	310	6.4%	269	4.0%	378	4.1%	2,505	8.8%
Deep infection	1,739	22.8%	243	5.0%	180	2.7%	147	1.6%	2,309	8.1%
Fracture	566	7.4%	285	5.8%	411	6.1%	694	7.4%	1,956	6.9%
Technical error	577	7.6%	27	0.6%	19	0.3%	16	0.2%	639	2.2%
Implant fracture	66	.9%	104	2.1%	119	1.8%	131	1.4%	420	1.5%
Pain only	82	1.1%	13	0.3%	3	0.0%	10	0.1%	108	0.4%
Miscellaneous	61	0.8%	14	0.3%	5	0.1%	13	0.1%	93	0.3%
Total	7,632	100%	4,876	100%	6,685	100%	9,326	100%	28,519	100%

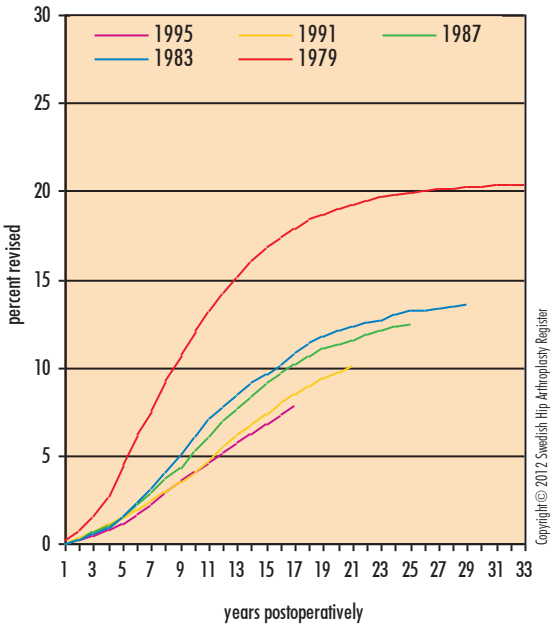
All diagnoses and all reasons

cumulative frequency of revision



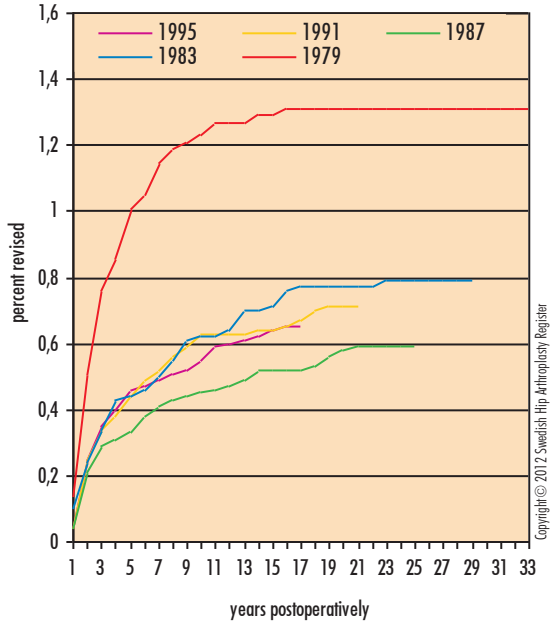
Aseptic loosening

cumulative frequency of revision



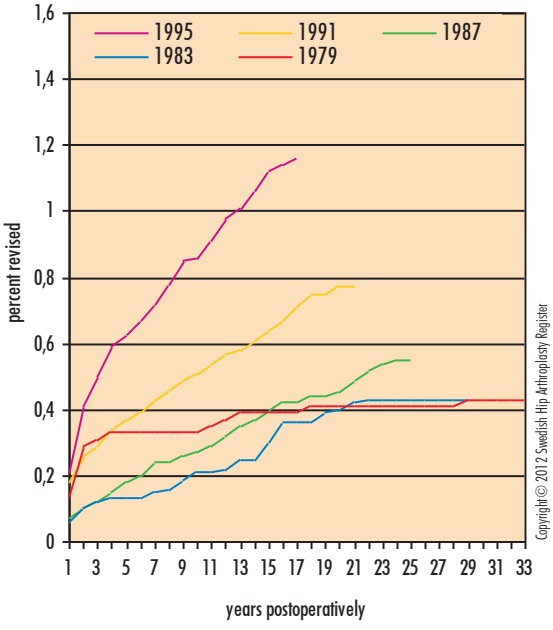
Deep infection

cumulative frequency of revision

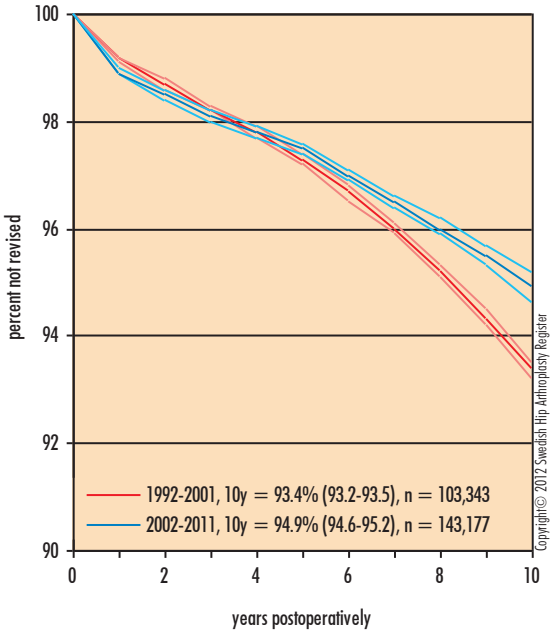


Dislocation

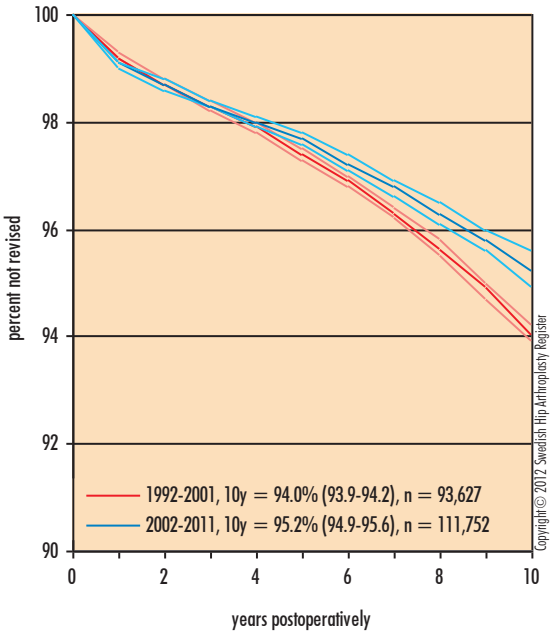
cumulative frequency of revision



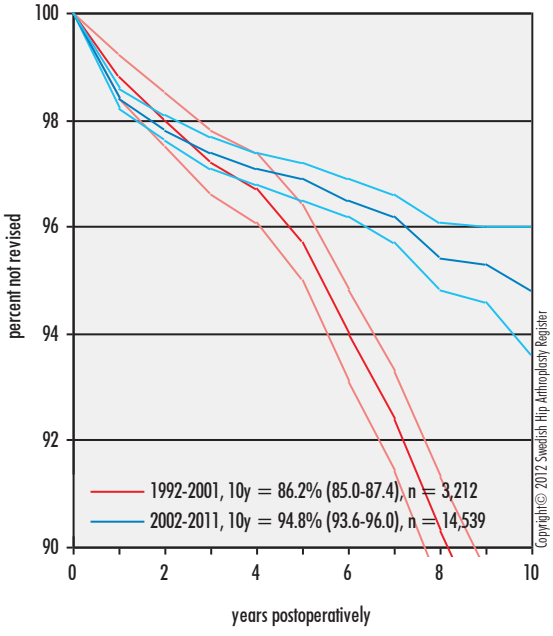
All implants
all diagnoses and all reasons for revision



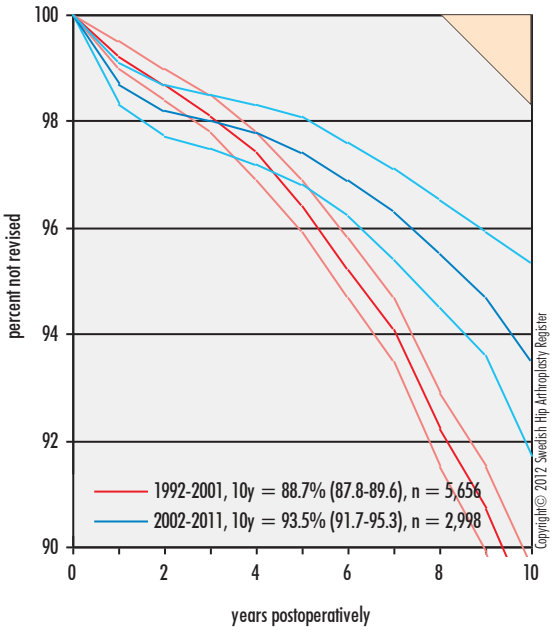
All cemented implants
all diagnoses and all reasons for revision



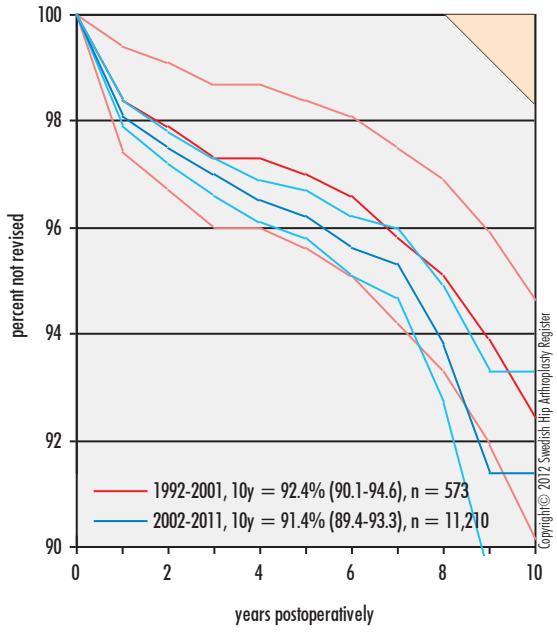
All uncemented implants
all diagnoses and all reasons for revision



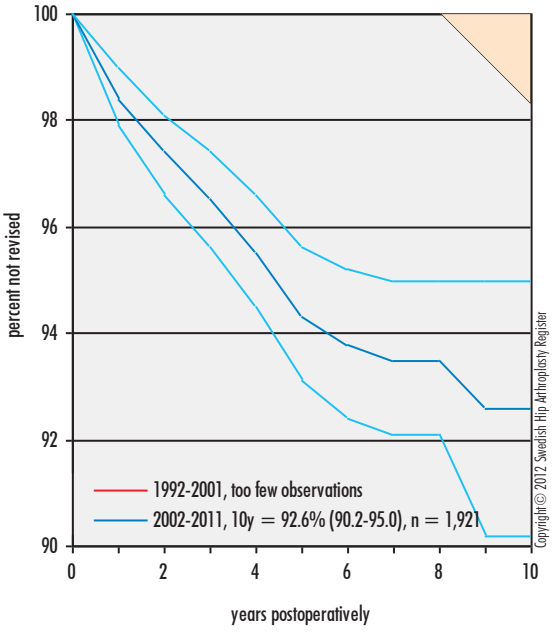
All hybrid implants
all diagnoses and all reasons for revision



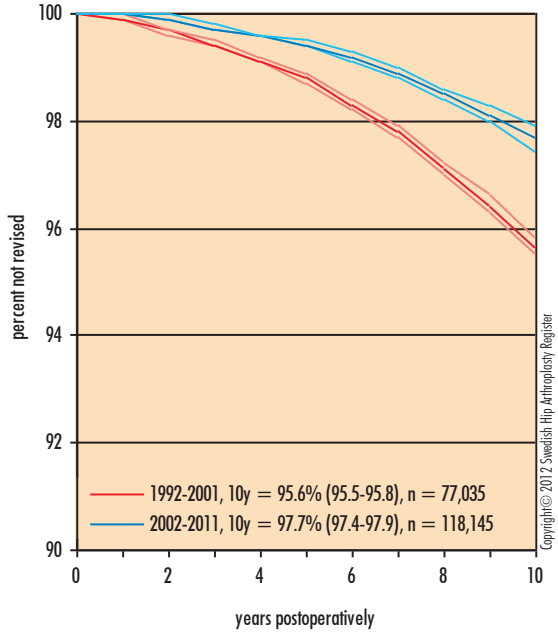
All reversed hybrid implants
all diagnoses and all reasons for revision



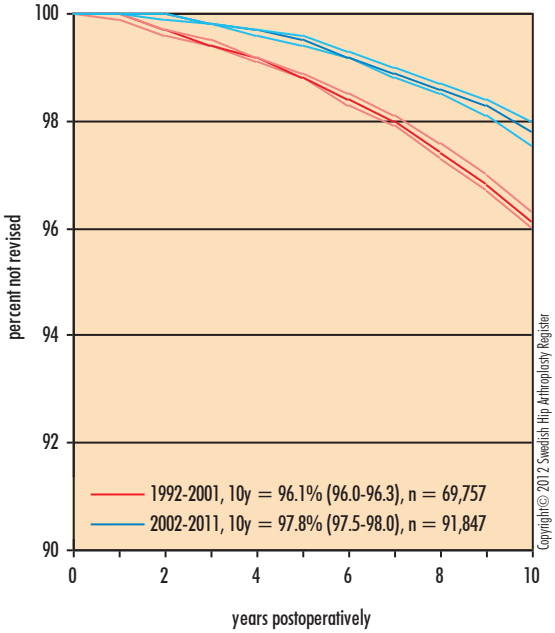
All resurfacing implants
all diagnoses and all reasons for revision



All implants
primary osteoarthritis and aseptic loosening

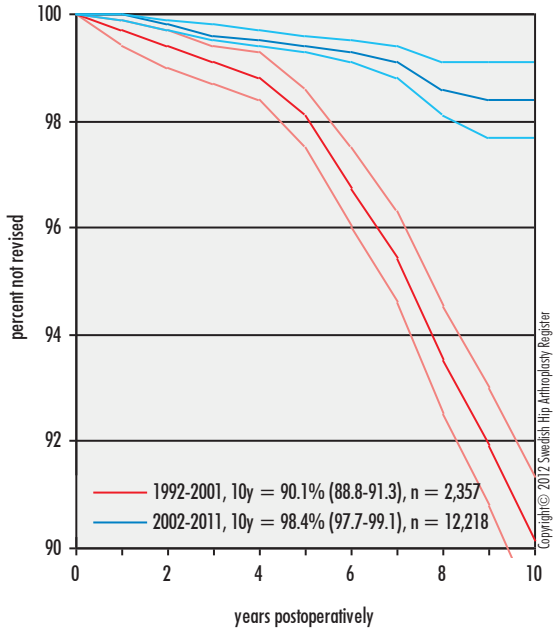


All cemented implants
primary osteoarthritis and aseptic loosening



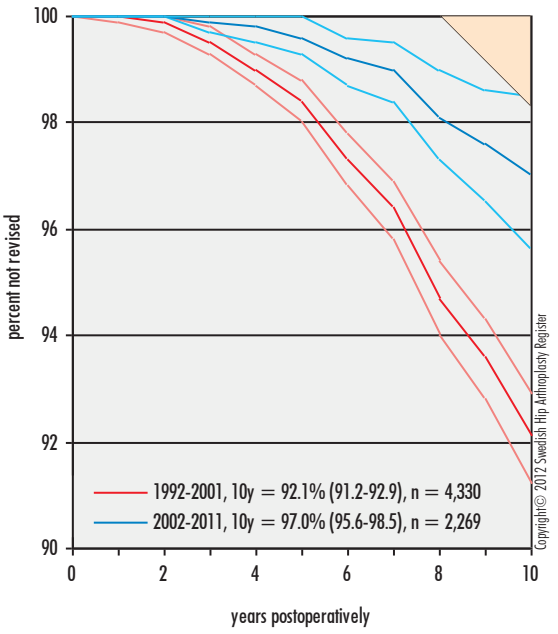
All uncemented implants

primary osteoarthritis and aseptic loosening



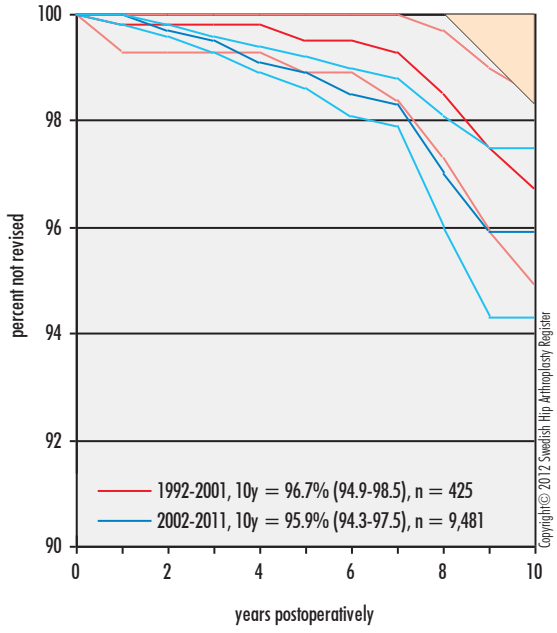
All hybrid implants

primary osteoarthritis and aseptic loosening



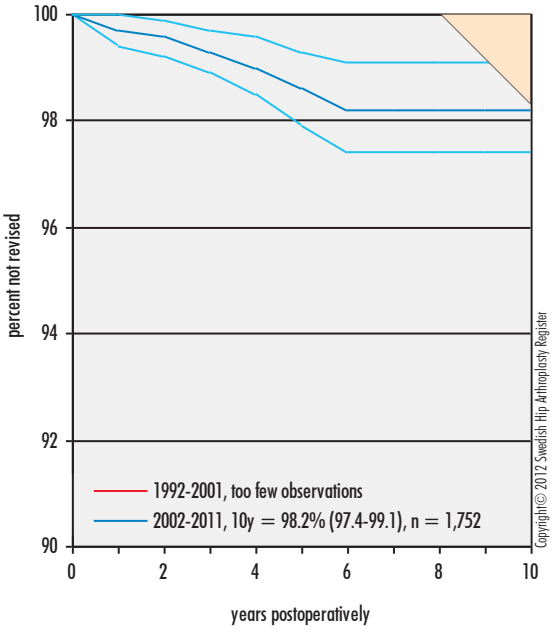
All reversed hybrid implants

primary osteoarthritis and aseptic loosening



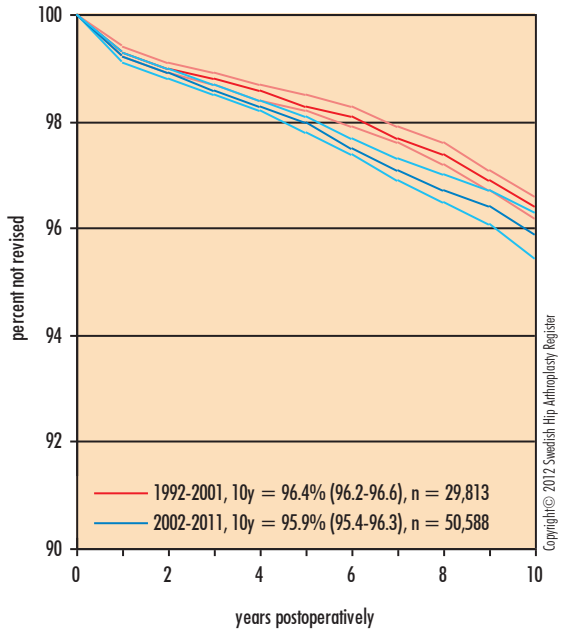
All resurfacing implants

primary osteoarthritis and aseptic loosening



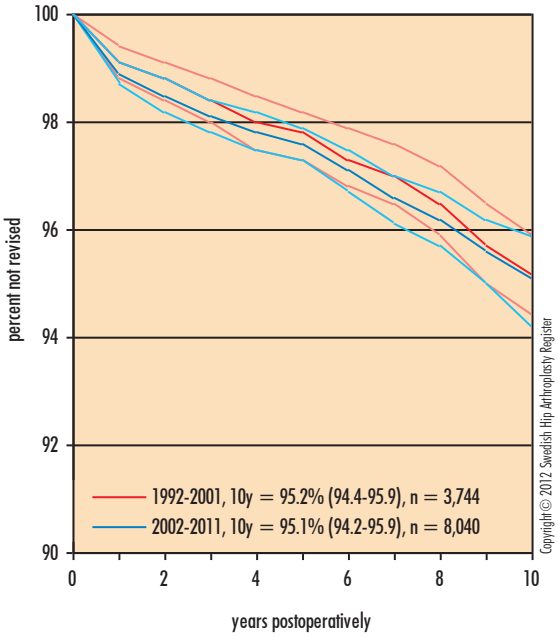
Lupinus SP II

all diagnoses and all reasons for revision



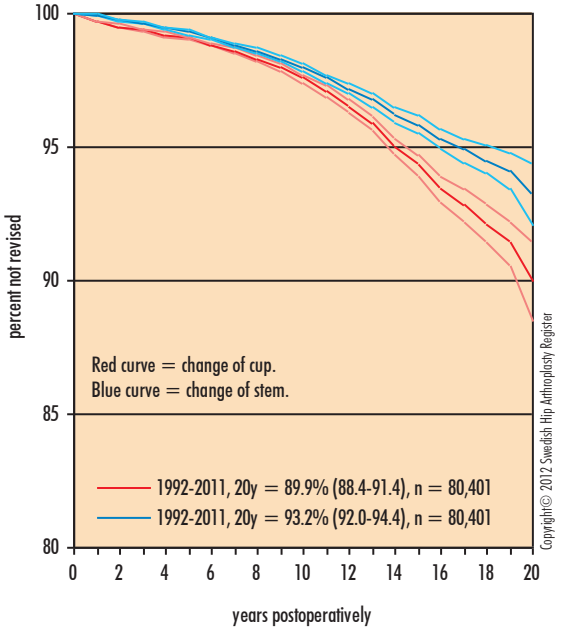
Exeter Duration (Exeter Polished)

all diagnoses and all reasons for revision



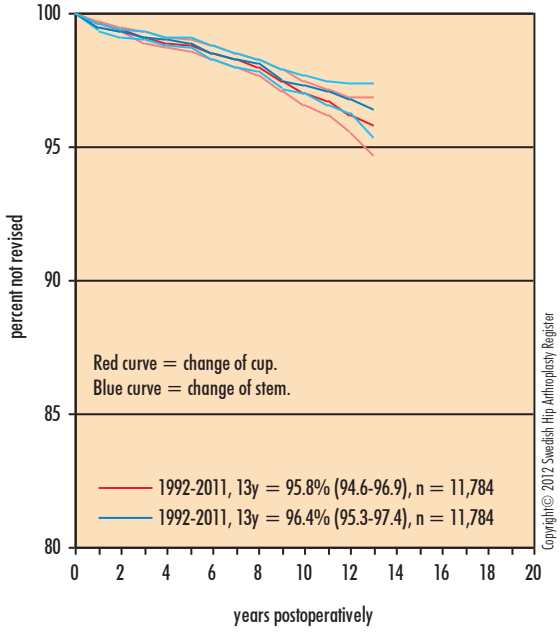
Lubinus SP II

cup-/stemrevision – all diagnoses and all reasons for revision



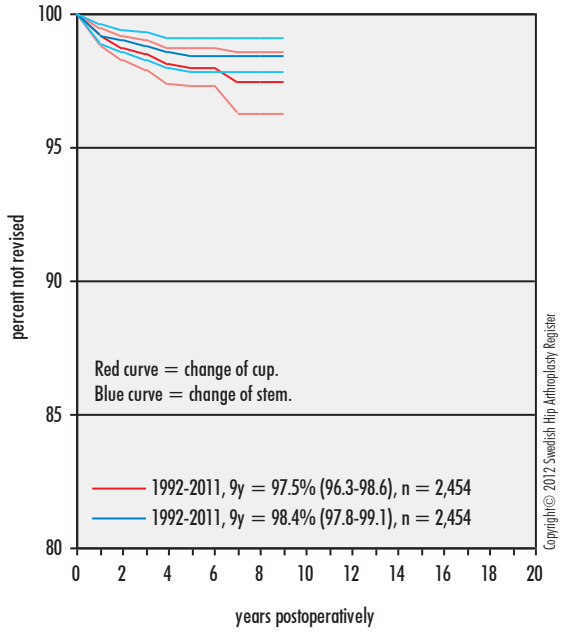
Exeter Duration (Exeter Polished)

cup-/stemrevision – all diagnoses and all reasons for revision



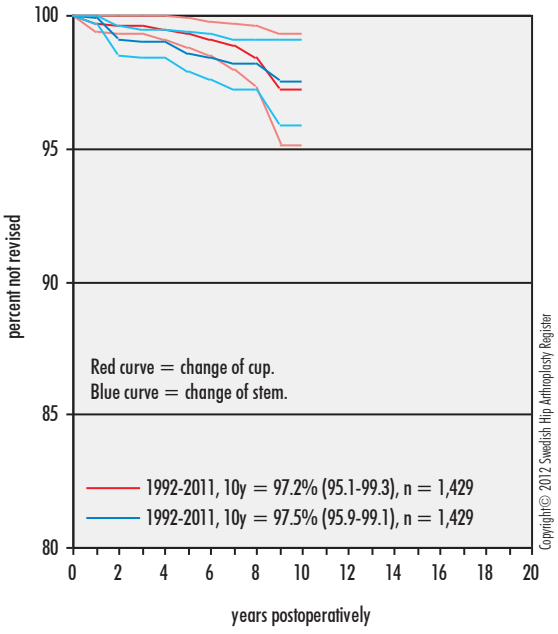
Trilogy HA (CLS Spotorno)

cup-/stemrevision – all diagnoses and all reasons for revision



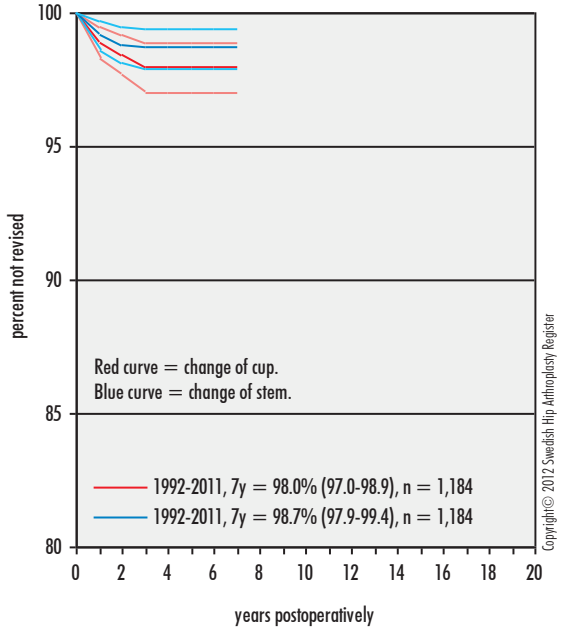
Allofit (CLS Spotorno)

cup-/stemrevision – all diagnoses and all reasons for revision



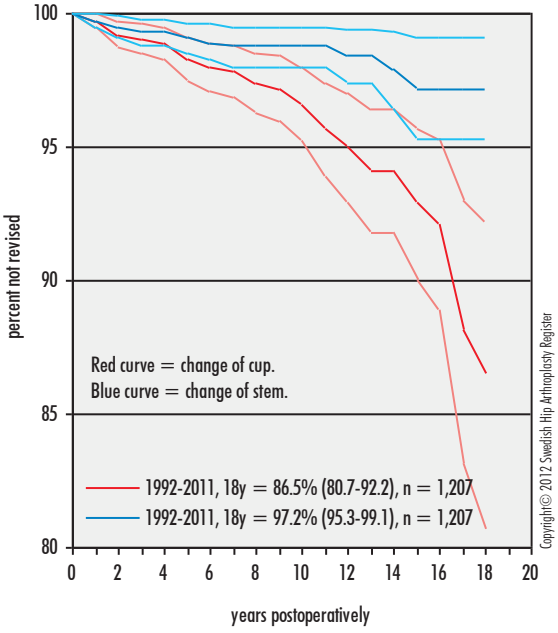
Trident HA (Accolade)

cup-/stemrevision – all diagnoses and all reasons for revision



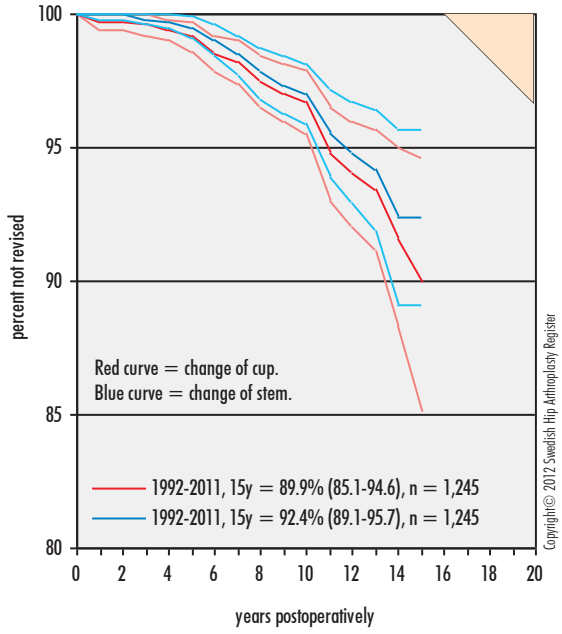
CLS Spotorno

cup-/stemrevision – all diagnoses and all reasons for revision



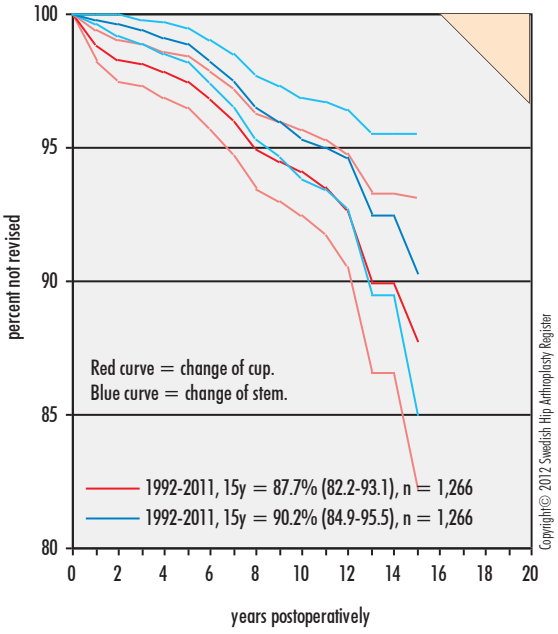
Trilogy HA (Spectron EF Primary)

cup-/stemrevision – all diagnoses and all reasons for revision



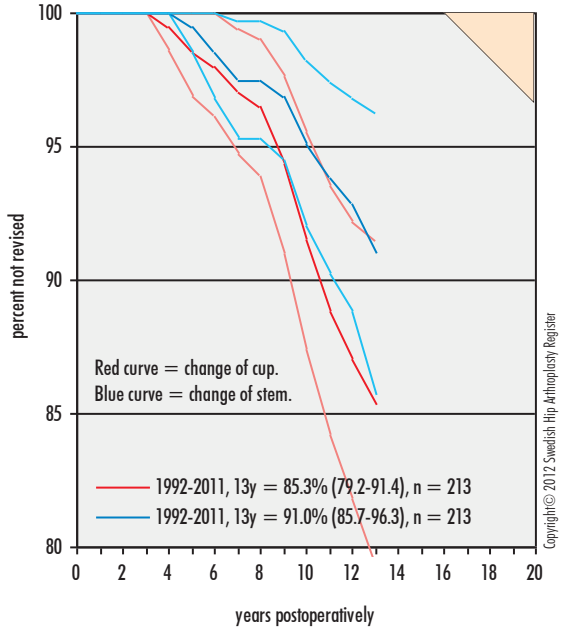
Trilogy HA (Lubinus SP II)

cup-/stemrevision – all diagnoses and all reasons for revision



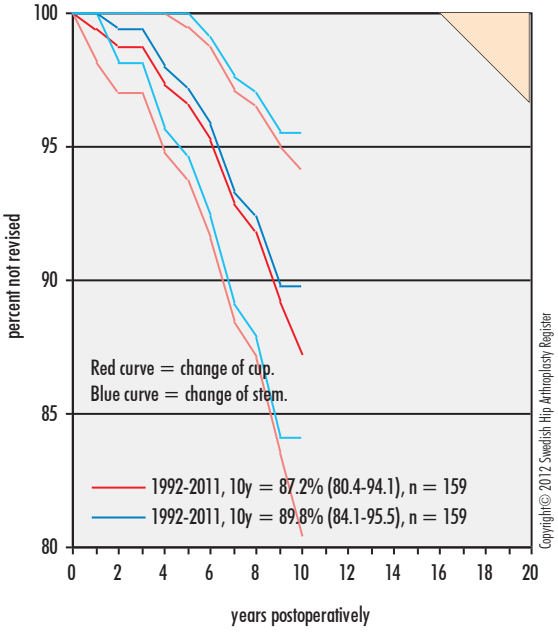
ABG II HA (Lubinus SP II)

cup-/stemrevision – all diagnoses and all reasons for revision



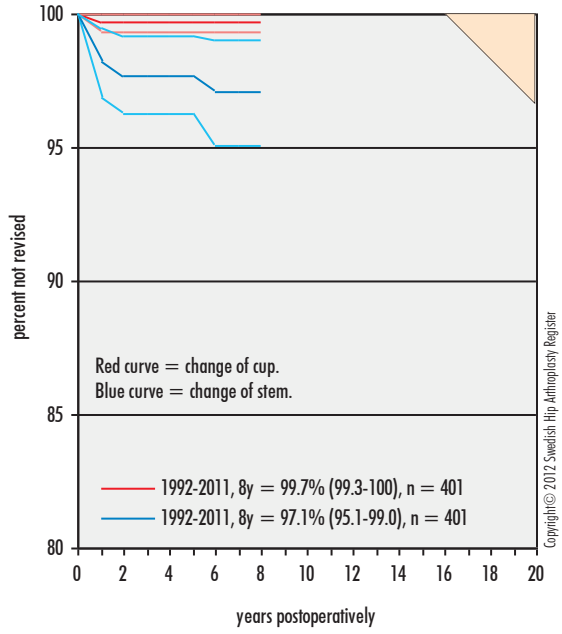
TOP Pressfit HA (Lubinus SP II)

cup-/stemrevision – all diagnoses and all reasons for revision



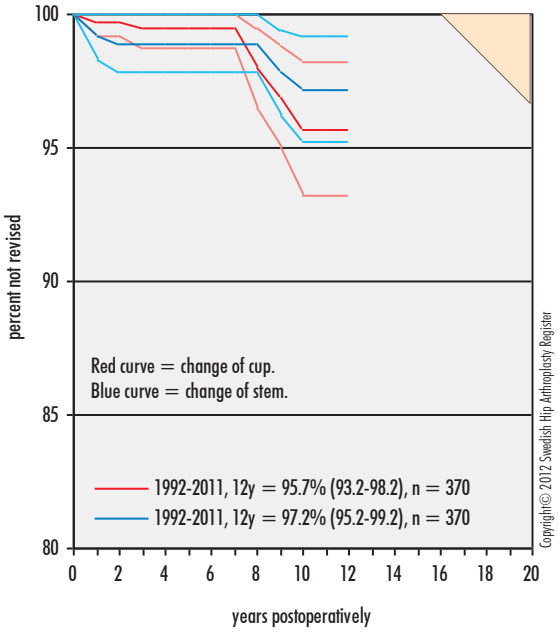
Charnley Elite (CLS Spotorno)

cup-/stemrevision – all diagnoses and all reasons for revision



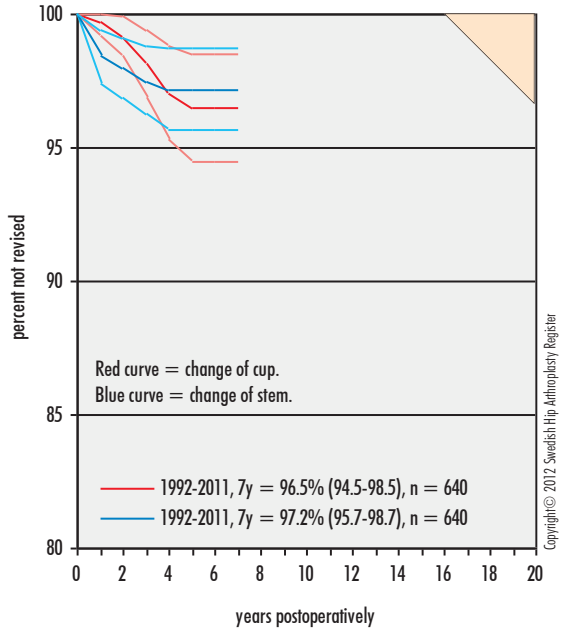
Charnley Elite (ABG)

cup-/stemrevision – all diagnoses and all reasons for revision



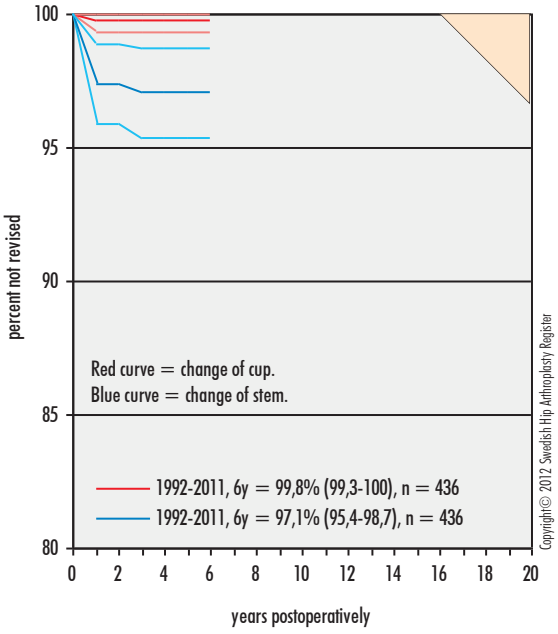
Contemporary H.D. (ABG II HA)

cup-/stemrevision – all diagnoses and all reasons for revision



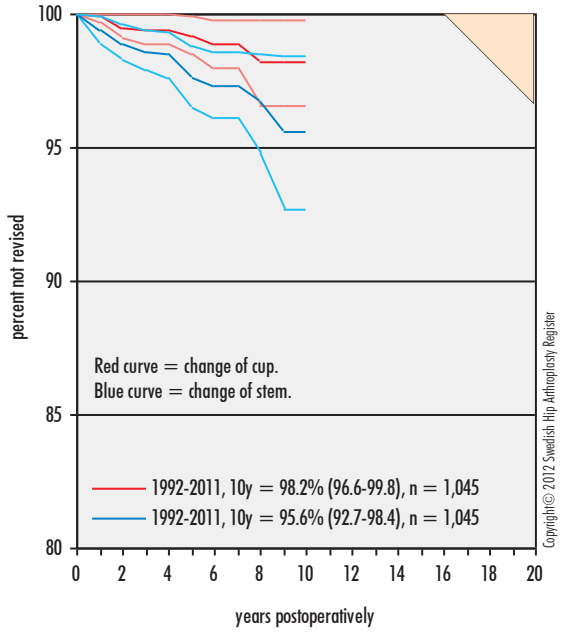
Charnley Elite (Corail)

cup-/stemrevision – all diagnoses and all reasons for revision



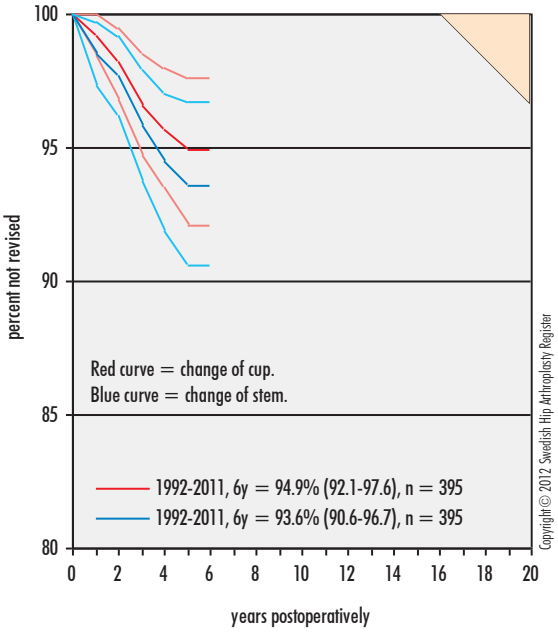
BHR

cup-/stemrevision – all diagnoses and all reasons for revision



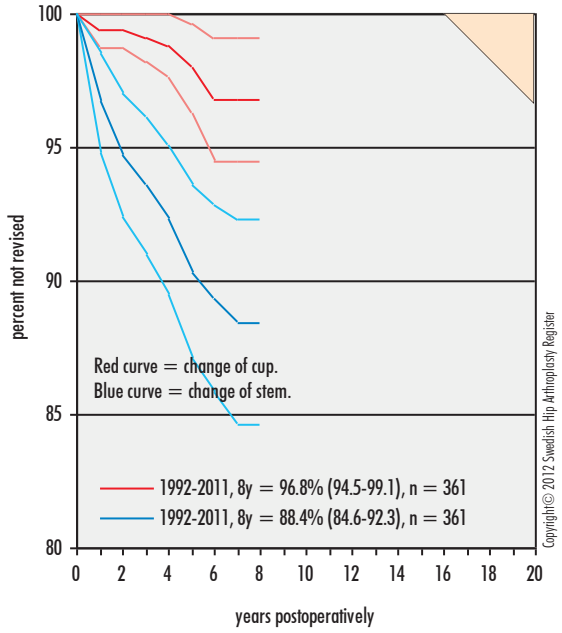
ASR

cup-/stemrevision – all diagnoses and all reasons for revision

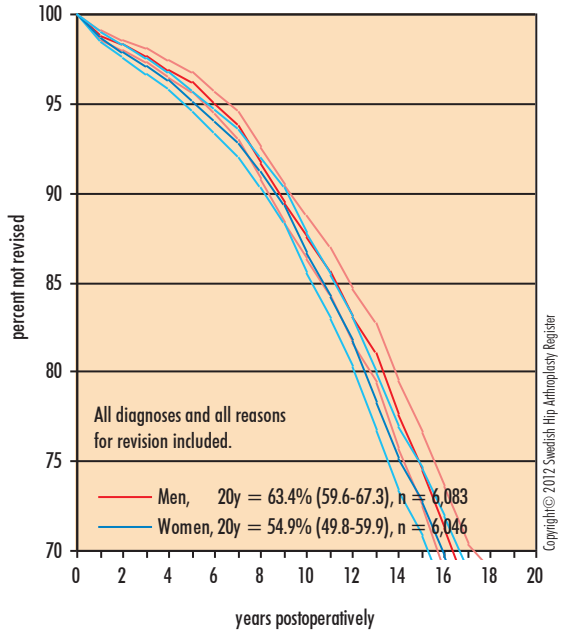


Durom

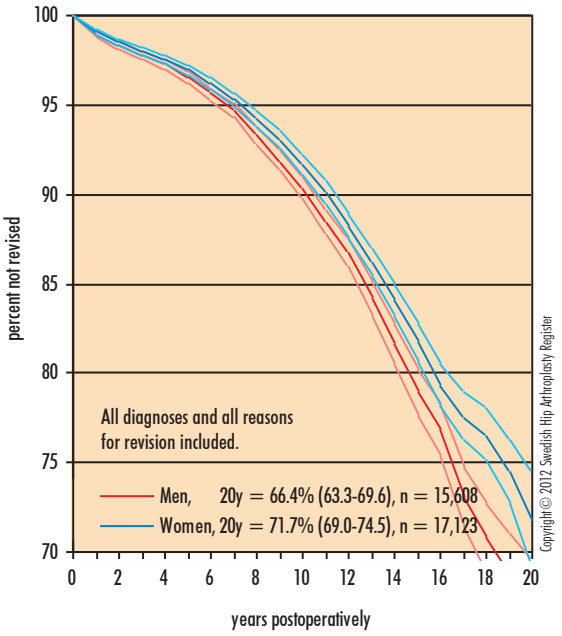
cup-/stemrevision – all diagnoses and all reasons for revision



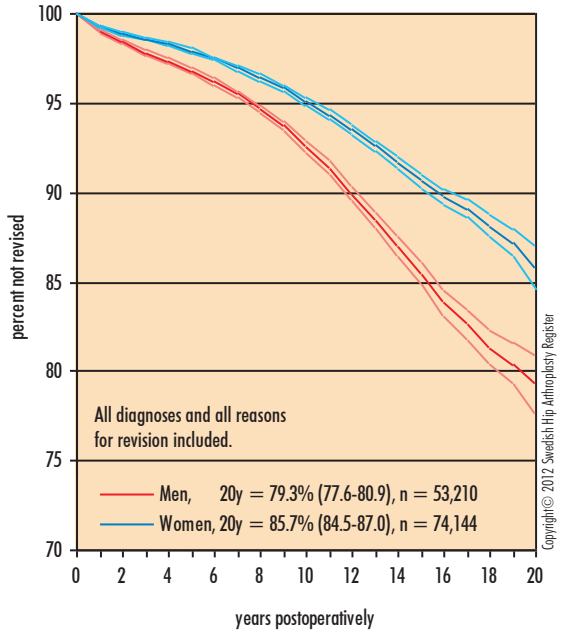
Younger than 50 years
all observations, 1992-2011



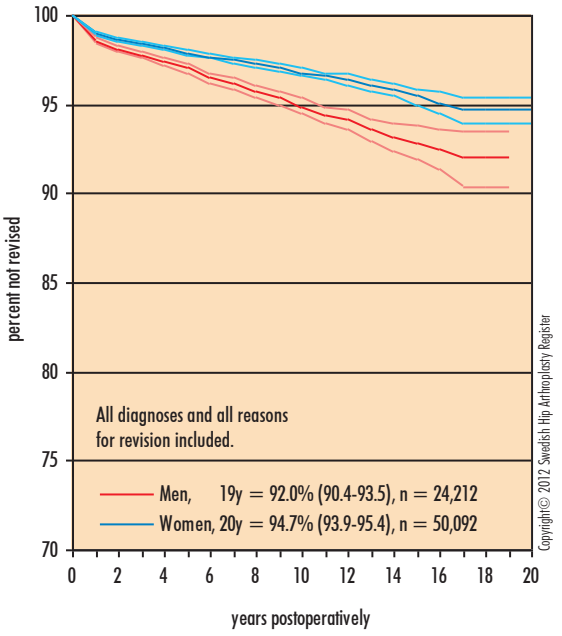
Between 50 and 59 years
all observations, 1992-2011



Between 60 and 75 years
all observations, 1992-2011



Older than 75 years
all observations, 1992-2011



Patient-reported outcomes

The results of implant surgery have historically – both nationally and internationally – been reported as implant survival. It remains important to report this variable regarding long-term surgical/technical results. The main indications for hip replacement, however, are experienced pain and low health-related quality of life. For this reason it is important to measure these variables prospectively during the course of the disease.

For many years there has been increased focus on patient-reported outcome measure (PROM) both in activity analyses and clinical research.

10 years with PROM

The Swedish Hip Arthroplasty Register began including PROMs on January 1, 2002 in the Vastra Gotaland region. This routine has been successively introduced throughout the country. During the spring of 2010 this part of the Register became fully nationalized. Two variables (EQ-5D index gain and patient satisfaction) from the PROM database have been selected by the Swedish Association of Local Authorities and Regions (SKL) and the National Board of Health and Welfare as national quality indicators in their Regional Comparisons.

Summary of logistics and method

All patients are asked to respond to a preoperative questionnaire consisting of ten questions (Charnley categories, pain VAS and EQ-5D). The same questionnaire with a supplementary question on satisfaction (VAS) is sent to all patients after one year. The procedure is repeated after six and ten years. For other details see earlier Annual Reports.

Overall objectives

- Report outcome multidimensionally after total hip arthroplasty.
- Create an opportunity for the departments to work on activity analysis and improvement, starting from patient needs and reported outcomes.
- Create a methodologically adequate health-economic instrument for cost-effectiveness analysis and resource allocation

Results

The national average for these included variables have varied during the years of data collection. Variations between hospitals are, however, more substantial. See table below. The reason for this variability is multifaceted; patient demographics including socioeconomical parameters, gender distribution, age distribution, differing indications for surgery, availability and degree of adequate information and patient expectations are factors that can influence these subjective and individually-reported variables. PROM variables are part of the register's value compass and a number of local in-depth analyses have been carried out.

Patient satisfaction

This variable does not correlate entirely to the EQ-5D results; a low EQ-5D index gain may be linked to a high degree of satisfaction and vice versa – depending on what EQ-5D index the patient-reported pre-operatively.

The Register's satisfaction question is to be considered a PROM-variable since it demands the patient's perception of results after surgical intervention. In other contexts satisfaction is often considered a measure of how well the patient feels received or treated (PREM = patient-reported experience measure).

Satisfaction is measured on a hundred-graded modified VAS (0=satisfied, 100=dissatisfied). "Satisfied" is defined as a score of 40 or less and "uncertain/dissatisfied" between 41 and 100 on the VAS scale.

The result shows that on a national level 14% (all primary diagnoses included) were uncertain or dissatisfied. If only patients with OA are included the corresponding figure is 11%, while the reported reoperation frequency is under 1%. This group of patients that responded to surgical intervention sub optimally is now being studied in detail. A qualitative study with patient interviews was started during the fall of 2012 and a number of merger studies with Statistics Sweden and the National Patient Register have been carried out aimed toward finding both socioeconomic and medical background variables with significant predictive values for patient satisfaction.

It is important to the profession that a minority of patients in their subjective evaluations don't discredit a recognized, successful and cost-effective surgical treatment. This can, in turn, influence decision makers to lower priorities for this type of treatment. Reasons for a patient to state dissatisfaction one year postoperatively (if no complications have arisen) are surely multifactorial, and in many cases several factors can interact:

- Absence of early-initiated non-surgical treatment and established fear of movement
- Doubtful indication for surgery
- Inadequate follow-up time
- Medical comorbidity and Charnley class C
- Mental illness
- Poor information for expected results' rehabilitation time
- Inadequate expectations of final results
- Socioeconomic background variables such as low educational level, country of birth, language difficulties etc. – requiring special information
- Leg length discrepancy
- Trochanteritis
- Simultaneous undiagnosed spinal stenosis - the spine hip syndrome
- Long waiting lists

Swedish orthopaedics needs predictors for both good and poor outcomes in its striving toward even better results following implant surgery. It is difficult, within this field of medicine, to improve on classic objective parameters such as implant survival after ten years. There is, however, a probable improvement potential at most implant-producing units for patient-reported outcomes. The register has, in a number of studies, found correlations between mental illness and poorer outcome following surgery. The following is a summary of these studies:

The significance of anxiety and depression before hip implant surgery

Most patients operated with hip replacement show good results for patient-reported outcomes following implant surgery. After one year 91 percent of all patients have significant pain reduction, that is, an improvement of at least 15 units on a VAS measuring hip pain. Moreover, 89% state (OA patients) that they are satisfied or very satisfied with the results of their operations, and 76% had improved in one or more dimensions of the EQ-5D without getting worse in another dimension.

But why aren't all patients completely well and satisfied? An explanation may lie in complications. In this year's annual report we show that roughly 6% suffer from "adverse events" within 90 days, which we define as rehospitalization due to local complication, cerebral and cardiovascular, thromboembolic complications, pneumonia, urinary retention or death. These complications' affect on patient-reported outcomes has not yet been studied.

Other reasons for residual pain can be incorrect indications; that the pain source and problems were not primarily caused by hip disease. Unreasonable expectations of results can explain some cases of dissatisfaction following surgery, which has been shown in previous research. Hip replacement surgery is indicated for patients with hip osteoarthritis (OA) when health-related quality of life is affected, with pronounced hip pain, and where complete non-surgical treatment cannot keep symptoms under control. How hip OA stands out in X-rays provides poor guidance for indication assessment whereby the correlation between symptomatic and radiological severity is low. Assessing severity of these subjective symptoms and relating them to function, need, comorbidity and other patient-related qualities sometime entails difficulties in determining the presence of indications for hip replacement surgery. The individual experience of pain is coupled to a number of psychological phenomena. Anxiety, depression, catastrophying, kinesiophobia and other mental illnesses influence the experience of pain, health-related quality of life and physical function. More than 40% of all those with symptomatic OA of the hip and knee display distinct signs of depression. There is an intricate connection between long standing pain, anguish and mood disorders.

To better understand the reasons why certain patients don't improve as expected we have, in three sub studies, illuminated the connection between anxiety and depression and outcomes after hip implant surgery.

The first study used data from the Registry's follow up program for patient-reported outcomes to test the hypothesis that anxiety/depression, which are one of the five dimensions included in the EQ-5D instrument, can predict results after hip implant surgery. In this study 6 158 patient with hip OA were analyzed. Forty-two per cent reported some degree of anxiety/depression in the EQ-5D-questionnaire. Those self-rated as worried/depressed had more pain and poorer health-related quality of life both before and after surgery. After adjusting for age, gender, and comorbidity (Charnley category), the regression analysis showed that anxiety/depression was strongly associated with less pain relief and a lower degree of satisfaction with the results of the intervention at the one-year follow-up. In the presence of anxiety/depression both before and one year after the operation patient-reported outcomes were further negatively influenced. Only 24% of those reporting anxiety/depression both before and one year after the operation had improved in the EQ-5D-dimensionen "mobility" compared with 58% of the others.

In the second study, data from the SHPR was combined with the National Drug Register. Of the 13 261 patients with hip OA having undergone hip replacement surgery and completed the follow-up questionnaire both before and one year after srugery, 13% had had redeemed prescriptions for antidepressants up until three years prior to surgery. These patients had less satisfaction, less pain relief, and lower health-related quality of life than those that hadn't used antidepressants prior to surgery.

The third study examined the connection between anxiety/depression and health care consumption. The study was based on 4138 patients with hip OA operated with a hip replacement in Region Vastra Gotaland 2007-2009. These patients' health care consumption during the year following surgery was analyzed by collecting data from the Care database VEGA. Patients reporting anxiety/depression in the EQ-5D had 21% higher health care consumption during the year following surgery.

Preliminary results from a fourth study showed mental illness associated with higher risk for reoperation. When comparing comorbidity we see that earlier hospitalization due to neurological or mental illness are the strongest risk factors for reoperation. Causal relationships are not always apparent and this finding is probably influenced by covariance with substance abuse and other comorbidity. One can, however, also speculate on the greater tendency toward reoperation when the primary operation failed to achieve intended results.

As a result of these studies, the conclusion can be drawn that one should be observant of how the patient's psychological state can influence the experience of pain and health-related quality of life prior to surgery, and that the risk for poorer results after surgery is greater in the presence of anxiety/depression.

It is uncontroversial to await implant surgery if the patient

Patient satisfaction 1 year after total hip replacement

2010-2011

Hospital	No.	Sat. [1]
Aleris Specialistvård Sabbatsberg	255	92.9%
Alingsås	387	85.5%
Arvika	312	86.2%
Bollnäs	607	88.5%
Borås	314	82.8%
Carlanderska	135	94.8%
Danderyd	572	85.0%
Eksjö	379	86.8%
Elisabethsjukhuset	148	92.6%
Enköping	395	83.0%
Eskilstuna	195	85.6%
Falköping	471	89.2%
Falun	612	88.2%
Frölunda Specialistsjukhus	144	79.9%
Gällivare	168	90.5%
Gävle	290	80.3%
Halmstad	362	80.4%
Helsingborg	118	80.5%
Hudiksvall	237	82.7%
Hässleholm-Kristianstad	1,508	89.8%
Jönköping	372	89.8%
Kalmar	337	89.0%
Karlshamn	380	89.7%
Karlskoga	232	90.5%
Karlskrona	52	92.3%
Karlstad	447	79.6%
Katrineholm	433	85.0%
KS/Huddinge	429	83.0%
KS/Solna	323	84.2%
Kungälv	323	81.4%
Lidköping	233	90.1%
Lindesberg	348	89.9%
Linköping	47	85.1%
Ljungby	315	87.3%
SUS/Lund	96	81.3%
Lycksele	574	89.9%
SUS/Malmö	145	80.0%
Mora	313	84.0%
Motala	286	86.7%
Movement	389	89.2%
Nacka Närsjukhus Proxima	202	92.6%
Norrköping	407	82.1%
Norrtälje	216	78.7%
Nyköping	309	81.9%
OrthoCenter Göteborg	192	90.6%
Ortopediska Huset	752	83.2%
Oskarshamn	361	91.1%
Piteå	646	93.0%
Proxima Spec.vård Motala	398	89.4%
S:t Göran	730	84.4%
Skellefteå	161	87.6%
Skene	167	74.3%
Skövde	174	81.0%
Sollefteå	155	85.2%
Spenshult	219	91.8%
OrthoCenter Stockholm	757	83.2%
SU/Mölndal	644	79.7%
SU/Östra	35	85.7%
Sunderby	64	73.4%
Sundsvall	268	82.5%
Södersjukhuset	598	78.8%
Södertälje	209	70.8%
Torsby	170	87.6%
Trelleborg	1,036	89.1%
Uddevalla	564	82.8%
Umeå	170	84.7%
Uppsala	507	84.8%
Varberg	427	90.2%
Visby	217	80.6%
Värnamo	201	86.6%
Västervik	186	89.2%
Västerås	576	87.2%
Växjö	199	84.4%
Ängelholm	162	90.7%
Örebro	332	89.5%
Örnsköldsvik	274	83.6%
Östersund	419	90.2%

[1] Proportion of patients with satisfaction values between 0 and 40 on a VAS.

displays risk factors such as uncontrolled hypertension, unstable angina, anemia, or unregulated diabetes. Investigation and intervention for such treatable risk factors are self-evident for ensuring the patient's optimum condition for surgery. It is likewise reasonable that the preoperative evaluation should also include screening of the patient's mental health.

By means of a simple history important risk factors for residual pain and dissatisfaction can be identified. A thorough assessment of the patient's health-related life quality and pain in relation to mental health can lead to improved and more effective care of patients with hip OA. We currently lack, however, highly precise methods capable of identifying those at high risk for residual problems. Continued efforts to create instruments to uncover single or combined risk factors associated with insufficient patient-reported outcomes are under way within the framework of SHPR's clinical research and improvement work.

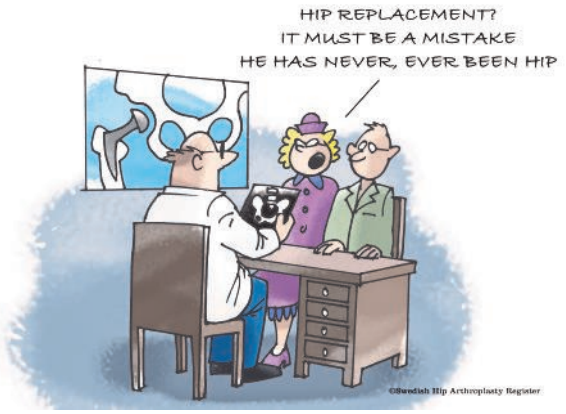
What is the influence of educational level on patient-reported outcomes?

Socioeconomic background is a collective term comprising educational level, occupational and economic status. How socioeconomic factors affect patient-reported outcomes after

joint replacement is poorly researched. Within the framework of the SHPR we have studied whether patient educational level and marital status influence patient-reported outcomes one year after total hip replacement. Patients with hip OA operated with total hip replacement during the years 2007 and 2008, and having completed the register's routine questionnaire with patient-reported variables both preoperative and one year after surgery were selected (n=9 342; 5 091 women; mean age 64). Patients having undergone reoperation during the first year were excluded. Register data from these patients were linked with data from the National Board of Health and Welfare concerning educational level, marital status and comorbidity according to Charlson's comorbidity index. Educational level was divided into three levels: low (up until primary school), middle (up until upper secondary school) and high (college level). We used regression analyses to test how gender, age, Charnley category, educational level, marital status and Charlson's index were associated with pain, health-related quality of life, and satisfaction.

Preliminary results of regression analyses showed that married patients, younger patients, those with a higher educational level and those without comorbidity gained greater pain relief. The variables that could predict a lesser degree of satisfaction were: low educational level, marital status unmarried, higher age, female gender, and presence of comorbidity. Further, the regression analyses showed that improvement in EQ-VAS was limited by male gender, higher age and Charnley category C, but not by educational level. The analyses of the responses within the five dimensions of the EQ-5D showed that low and middle levels of education were associated with a high risk of failure to improve in any dimension.

In this study educational level was seen to influence patient satisfaction, pain relief as well as changes in the EQ-5D. The results suggest that those with stable socioeconomic situations have a greater chance of gaining subjectively better results. A possible explanation can be that those with a higher educational level have more realistic expectations, and are more motivated to be rehabilitated. Moreover, educational level can contribute to their ability to utilize theoretical knowledge practically. This speaks for the fact that patients should be offered individualized information to provide a realistic picture of results after surgery. Since educational level is as powerful a predictor for patient–reported outcomes as gender, age, and comorbidity, it should also be considered in risk assessment prior to surgery.



Do not forget the patient-reported variables when reviewing the departments' results. Poorer results regarding satisfaction, health gain and pain relief may be a sign of a department's sub-optimal care of patients outside the operating theatre. Factors such as indication for surgery, adequate pre- and post-operative information and possibly inadequate expectations among patients are things that can be altered via the department's care programme.

Patient-reported outcome per hospital

2010-2011

Hospital	Preoperatively				Follow-up after 1 year				Gain [3]	Follow-up after 6 years				Gain [3]
	No.	C-cat.[1]	EQ-5D	Pain	No.	EQ-5D	Pain	Sat.[2]		No.	EQ-5D	Pain	Sat.[2]	
University/Regional hospitals														
Karolinska/Huddinge	432	58%	0.42	79	431	0.72	17	19	**0.30**					
Karolinska/Solna	281	48%	0.35	63	306	0.75	14	18	0.40					
Linköping	47	40%	0.37	64	47	0.73	13	19	0.36					
SU/Mölndal	548	49%	0.34	64	666	0.68	19	23	0.34	136	0.67	19	22	0.33
SUS/Lund	111	54%	0.29	61	237	0.68	20	23	0.39	119	0.64	16	17	0.35
SUS/Malmö	111	51%	0.24	65	249	0.69	20	22	0.46	134	0.63	22	21	0.39
Umeå	119	44%	0.32	64	173	0.75	15	17	0.43	112	0.68	17	18	0.36
Uppsala	342	53%	0.38	60	519	0.73	15	18	0.35					
Örebro	289	49%	0.40	59	334	0.78	13	15	0.39	21	0.78	13	15	0.38
Central hospitals														
Borås	226	46%	0.39	61	316	0.71	15	20	0.32	290	0.72	16	18	0.32
Danderyd	441	42%	0.37	63	576	0.75	14	18	0.38	54	0.76	13	18	0.38
Eksjö	331	31%	0.42	63	386	0.80	14	17	0.38	149	0.78	15	15	0.36
Eskilstuna	96	49%	0.30	67	196	0.72	14	19	0.42	27	0.62	17	28	0.32
Falun	629	40%	0.40	61	612	0.77	12	15	0.37					
Gävle	296	45%	0.37	63	292	0.71	16	21	0.34					
Halmstad	310	40%	0.41	64	378	0.75	17	22	0.34	124	0.70	16	19	0.29
Helsingborg	99	42%	0.22	70	118	0.70	13	17	0.48					
Hässleholm-Kristianstad	1,483	47%	0.40	60	1,505	0.80	13	14	0.40					
Jönköping	351	47%	0.40	63	376	0.79	12	14	0.39	148	0.78	11	14	0.38
Kalmar	279	39%	0.42	61	339	0.77	13	16	0.35					
Karlskrona	19	47%	0.43	62	55	0.77	13	16	0.34	3	0.58	19	12	**0.15**
Karlstad	407	52%	0.38	59	454	0.73	17	21	0.35	2	0.93	13	13	0.54
Norrköping	424	42%	0.40	62	414	0.73	16	20	0.33					
Skövde	296	47%	0.38	64	174	0.75	16	20	0.37	158	0.70	15	18	0.32
Sunderby (incl. Boden)	17	71%	0.15	71	64	0.62	18	24	0.47	177	0.73	16	18	0.58
Sundsvall	279	36%	0.37	64	270	0.75	15	20	0.37	167	0.76	15	18	0.38
Södersjukhuset	499	40%	0.39	61	610	0.70	16	22	0.31	99	0.74	15	18	0.35
Uddevalla	446	49%	0.39	63	564	0.76	16	20	0.37	384	0.70	17	20	0.31
Varberg	360	37%	0.48	62	430	0.82	11	13	0.33	149	0.78	14	15	0.30
Västerås	416	38%	0.39	65	591	0.77	14	16	0.39	42	0.75	19	16	0.36
Växjö	200	50%	0.43	60	200	0.75	18	18	0.32	31	0.61	23	22	**0.18**
Östersund	452	38%	0.43	61	423	0.80	12	14	0.37	263	0.79	15	15	0.36
Rural hospitals														
Alingsås	386	39%	0.47	60	394	0.77	12	15	**0.30**	276	0.73	16	18	0.27
Arvika	363	39%	0.39	65	316	0.75	17	18	0.37					
Bollnäs	607	39%	0.41	64	609	0.81	12	14	0.40					
Enköping	561	51%	0.42	60	405	0.77	17	21	0.35					
Falköping	220	32%	0.44	63	477	0.82	12	16	0.38	376	0.77	12	14	0.33
Frölunda Specialistsjukhus	163	35%	0.49	58	145	0.77	16	20	**0.28**	84	0.70	23	28	**0.22**
Gällivare	106	47%	0.38	65	169	0.73	17	17	0.35	149	0.75	16	20	0.37
Hudiksvall	204	46%	0.38	63	239	0.76	14	18	0.39					

(continued on next page)

Patient-reported outcome per hospital (cont.)

2010-2011

Hospital	Preoperatively				Follow-up after 1 year				Gain [3]	Follow-up after 6 years				Gain [3]
	No.	C-cat.[1]	EQ-5D	Pain	No.	EQ-5D	Pain	Sat.[2]		No.	EQ-5D	Pain	Sat.[2]	
Kalix										59	0,75	15	19	
Karlshamn	400	31%	0.45	58	385	0.80	13	15	0.35	41	0.73	15	17	0.28
Karlskoga	214	30%	0.43	64	234	0.79	12	15	0.36					
Katrineholm	406	37%	0.47	57	434	0.78	14	18	0.32	80	0.76	13	15	0.30
Kungälv	310	71%	0.47	57	326	0.74	18	22	0.27	275	0.71	19	19	0.24
Köping										84	0.75	17	19	
Landskrona										174	0.78	16	16	
Lidköping	296	39%	0.43	57	234	0.77	14	17	0.34	214	0.74	13	16	0.31
Lindesberg	354	38%	0.35	67	366	0.80	10	12	0.45	115	0.80	12	13	0.45
Ljungby	295	42%	0.53	58	326	0.81	14	15	0.27	30	0.79	12	12	0.25
Lycksele	499	41%	0.42	63	595	0.79	14	16	0.37	365	0.76	14	14	0.34
Mora	353	39%	0.38	66	321	0.75	17	19	0.37					
Motala (to 2009)					286	0.78	15	17						
Norrtälje	187	41%	0.44	62	219	0.72	19	23	0.29					
Nyköping	298	35%	0.39	64	311	0.75	15	22	0.36					
Oskarshamn	399	41%	0.46	60	362	0.81	11	12	0.35					
Piteå	497	35%	0.39	65	651	0.81	11	13	0.42	245	0.76	15	16	0.36
Skellefteå	143	45%	0.38	63	162	0.76	16	17	0.38	175	0.77	16	16	0.39
Skene	201	40%	0.43	63	170	0.73	21	25	0.30	125	0.74	16	19	0.31
Sollefteå	203	38%	0.40	64	155	0.78	15	18	0.38	169	0.75	18	20	0.35
SUS/Trelleborg	1,156	42%	0.42	63	1,060	0.80	14	15	0.38	550	0.74	18	19	0.32
Södertälje	184	36%	0.42	61	212	0.69	23	27	0.26					
Torsby	181	40%	0.37	66	172	0.73	18	20	0.36					
Visby	153	46%	0.44	61	220	0.75	17	20	0.31					
Värnamo	241	33%	0.54	58	204	0.80	15	17	0.26	77	0.74	15	15	0.20
Västervik	185	39%	0.46	60	189	0.80	13	16	0.33					
Ängelholm	296	39%	0.36	68	167	0.81	11	11	0.45					
Örnsköldsvik	253	44%	0.45	64	285	0.77	14	18	0.32	209	0.76	15	16	0.31
Private hospitals														
Aleris Specialistvård Sabbatsberg	263	32%	0.46	60	258	0.83	10	11	0.38					
Aleris Spec.vård Elisabethsjukhuset	130	32%	0.47	62	148	0.87	10	11	0.39					
Aleris Specialistvård Motala	798	37%	0.48	60	400	0.81	14	15	0.33					
Aleris Specialistvård Nacka	258	29%	0.42	65	219	0.84	11	11	0.42					
Capio S:t Göran	617	39%	0.41	61	736	0.75	16	19	0.34					
Carema Ortopediska Huset	663	34%	0.45	61	768	0.78	15	18	0.33					
Carlanderska	254	27%	0.42	62	137	0.83	12	13	0.41	39	0.82	11	12	0.39
Movement	465	29%	0.44	62	396	0.82	11	13	0.38					
Ortho Center Stockholm	802	40%	0.40	67	765	0.78	11	15	0.38					
OrthoCenter IFK-kliniken	267	27%	0.47	62	194	0.85	10	12	0.37					
Spenshult	226	38%	0.46	62	226	0.81	13	12	0.35					
Nation	25,853	41%	0.41	62	27,394	0.77	14	17	0.36	7,116	0.74	16	18	0.32

[1] Proportion of Charnley category C.

[2] Satisfaction (VAS, 0 = Completely satisfied, 100 = Dissatiesfied).

[3] Difference in EQ-5D after 1 year and pre-operatively. Note that this reflects the difference between mean values after 1 year and preoperatively, as opposed to the value compass where the gain in EQ-5D index is calculated as the average value of the individual differences.

The table presents result in the form of number of patients, mean values of pain VAS and EQ-5D index pre-operatively, together with the proportion of Charnley category C patients (i.e. patients with multiple joint disease and/or co-morbidity). Departments with a high proportion of C patients most frequently show lower average values for all parameters both pre-operatively and after one year. However, the prospectively gained values are most often not equally affected by C affiliation.

Notes

Follow-up of activities after total hip arthroplasty

The Swedish Hip Arthroplasty Register began open reporting of hospital results in 1999. The number of variables reported in this way has increased over the years, and are presented in table form throughout this Report. These tables are necessarily extensive and sometimes difficult to interpret. In addition, it is difficult, via the table system, to gain a rapid overview of the departments' results in several dimensions. This is the fifth year we have used what is termed the value compass, which contains eight variables (points of the compass). The compasses have been produced with the sole intention of providing a quick and pedagogical overview. A non-conforming result in one value compass only states whether a department has a problem area. The compass can be seen as a simplified signal system.

Using this follow-up model results are presented this year for all departments associated with the hip dispensary for more than one year, and with at least 50 patients followed. The limit values are set to the largest and smallest values plus/minus one standard deviation for that variable. This means that the norm values (red area) vary from year to year. The poorest value (0.0) for the variables is given as the origo and the best value (1.0) is at the periphery. This value compass may be viewed as a balanced control card. The greater the surface area the better the multidimensional total result for that department.

The national average is presented in each figure and the interested clinic can thus compare itself with national results during the current operational year. Note that the observation periods for variables differ.

Outcome variables

- **Patient satisfaction**. Measured on VAS. Can only, as variables 2 and 3, be presented if the department has been active with PROM routines for more than one year.
- **Pain relief.** Measured by subtracting the pre-operative VAS value from the follow-up value, i.e. the value gained after one year.
- **Gained health-related quality of life** (gain in the EQ-5D index). The prospective gain on the EQ-5D index, i.e. health gain after one year.
- **90-day mortality.** In international literature this variable is used to illustrate mortality after hip arthroplasty.
- **Completeness.** Completeness at individual level according to latest matching with the Patient Register at the National Board of Health and Welfare.
- **Reoperation within two years.** States all forms of reoperation within 2 years of the primary operation and during the most recent four-year period.
- **Five-year implant survival.** Implant survival after five years using Kaplan- Meier statistics.
- **Ten-year implant survival.** Same variables as above but with a longer follow-up.

Linked to each department's value compass is a graphic presentation of that department's 'case-mix'. This part is designed in the same way as the value compass and includes variables that on analysis of the Registry's database proved to be decisive demographic parameters for both patient-reported outcome and long-term results regarding need for revision. The greater the surface area in this figure the more favourable the patient profile for the department in question.

- Charnley classification. The figure shows the department's proportion of patients classifying themselves as Charnley class A or B, i.e. patients without multiple joint disorders and/or intercurrent diseases affecting the patient's gait.
- Proportion of primary OA. The more patients the clinic operates with the diagnosis of primary OA the better the long-term results according to the Registry's regression analysis of the database.
- Proportion of patients 60 years or older. Departments operating on many patients aged over 60 years obtain, in the same way as with the above variable, better results.
- Proportion of women. Women generally have better long-term results than men regarding need for revision, chiefly because of aseptic loosening.

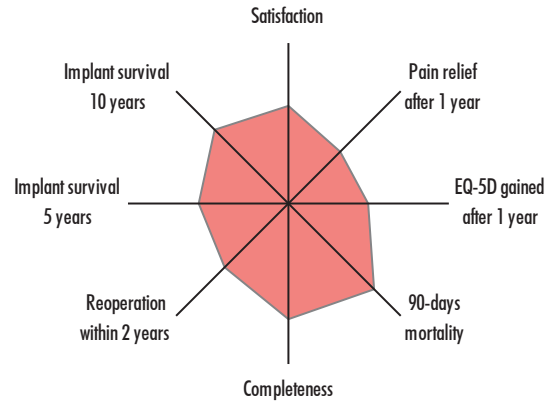
Discussion

There is a strong desire from decision-makers in medical care for easily available and summarizing presentations of departments'/county councils' results for the follow-up of activities. Another way of satisfying this desire is to create an index as a total sum comprising a number of variables. The greatest risk with indexing is that good results in one variable may be cancelled out by poor results in another variable, or vice versa. Such an index thus does not prompt in-depth analysis or work for improvement. Varying degrees of the completeness of reported variables may also affect indexing, with misleading results as a consequence.

When interpreting the clinic's value compass and especially in comparisons, the "case-mix" profile must always be observed!

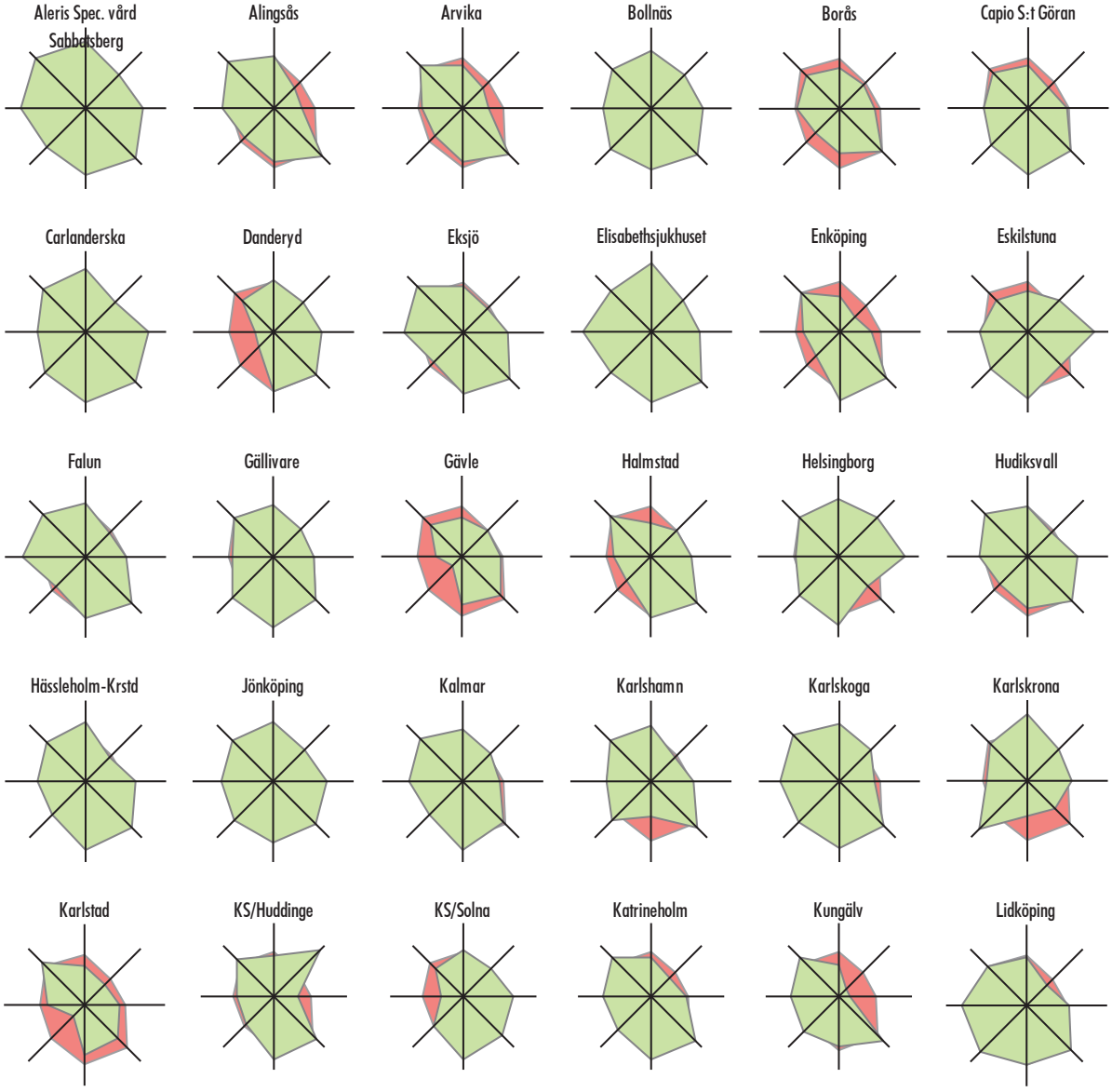
Quality indicators

clinical value compass - national averages

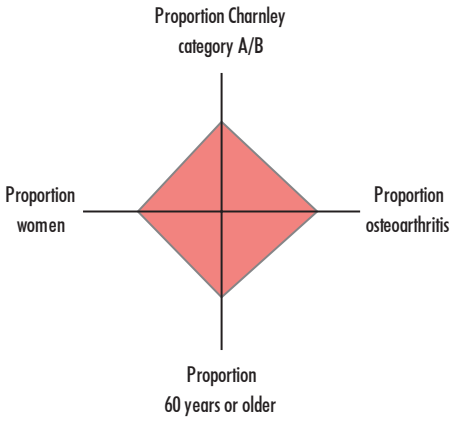


The value compasses show in red national results for the eight variables included. Each department's corresponding values are shown in green. Limit values are set to the highest and lowest value for each variable ± 1SD. The poorest value for the variables is at the origo and the best on the periphery.

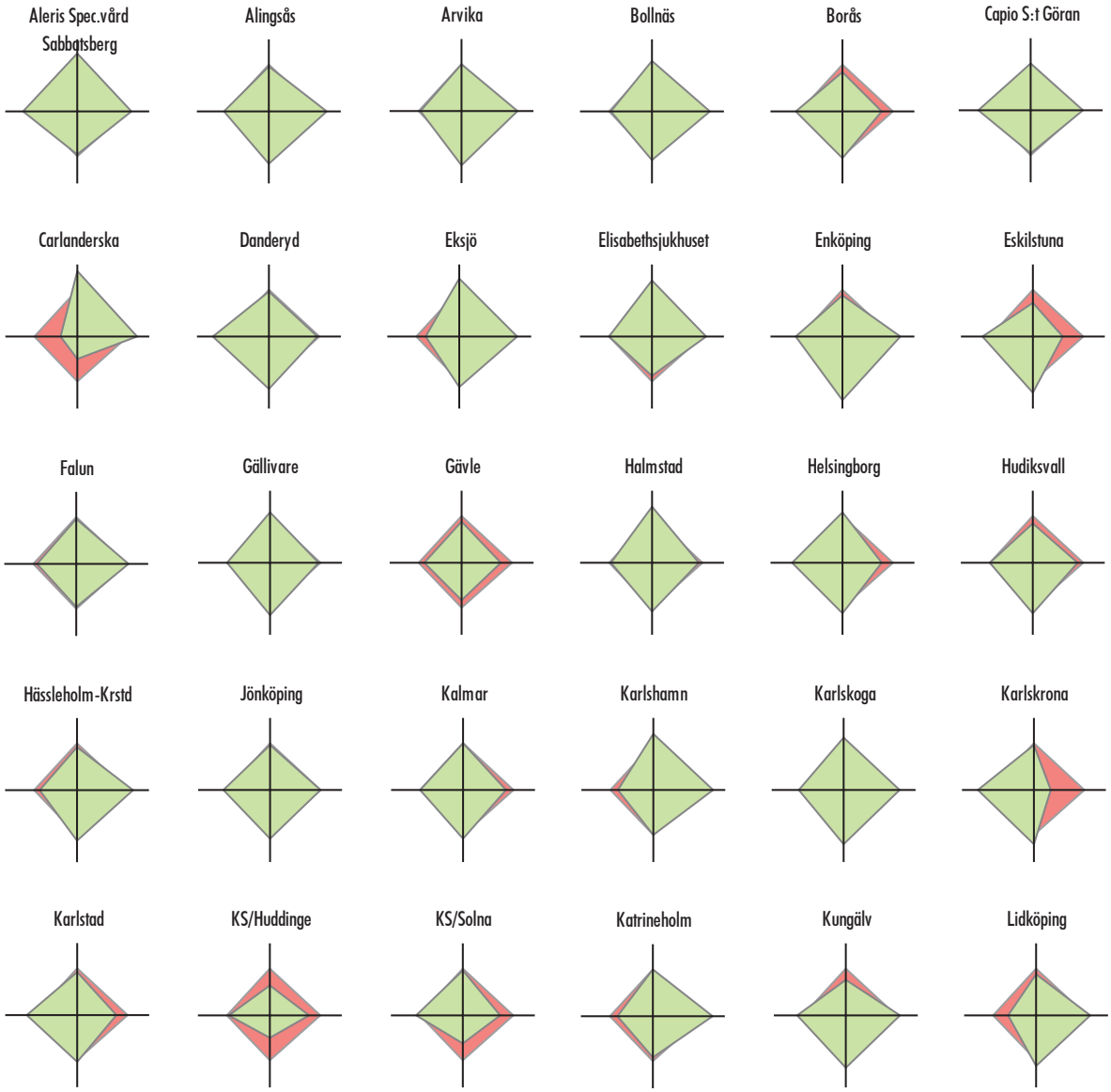
The departments where red fields are visible have a poorer value than the national average for that variable. The outcome can be studied in detail in each table.



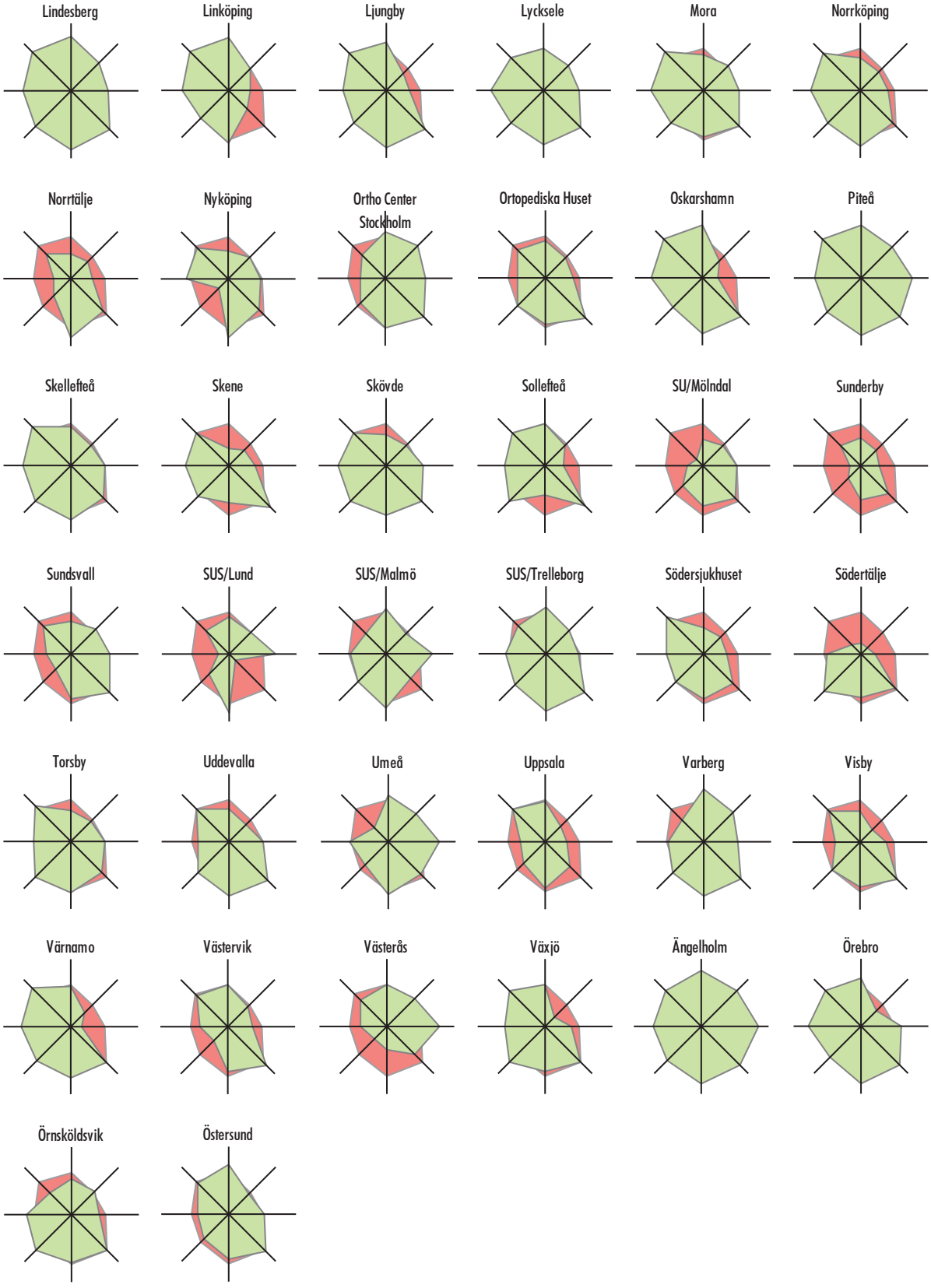
Case-mix factors
national averages



In the graphic presentation of patient demographics ('case-mix') the national result is shown regarding the four variables included, in red. The corresponding values for each clinic are shown in green. Limit values are set to the greatest and the smallest value of each variable ± 1 SD. The poorest value for the variables is at the origo and the best value on the periphery.

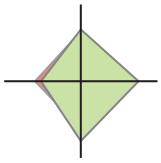


Value compasses (cont.)



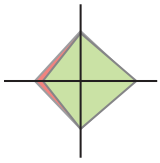
Case-mix profiles (cont.)

Lindesberg

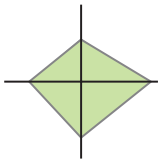


Linköping

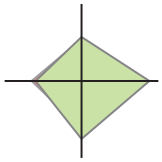
Ljungby



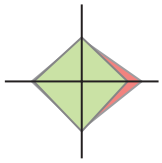
Lycksele



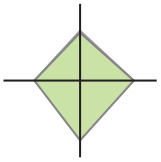
Mora



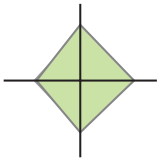
Norrköping



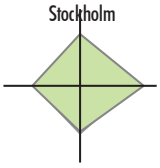
Norrtälje



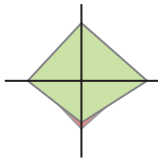
Nyköping



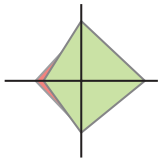
Ortho Center Stockholm



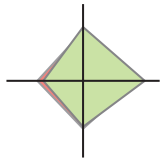
Ortopediska Huset



Oskarshamn



Piteå



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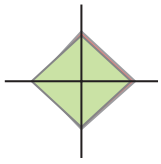

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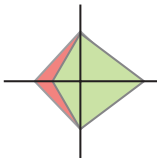

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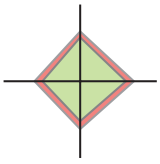

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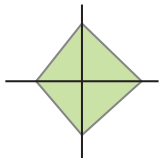

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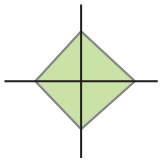

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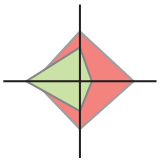

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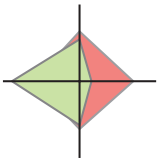

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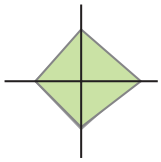

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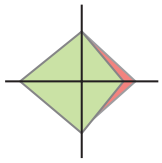

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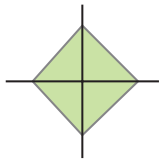

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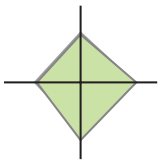

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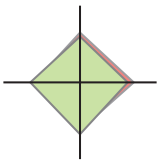

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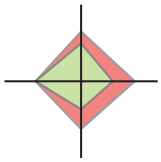

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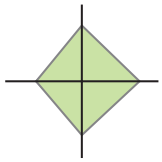

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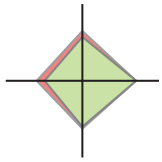

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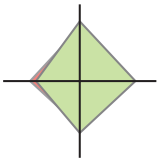

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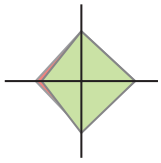

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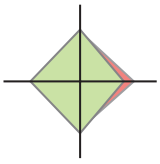

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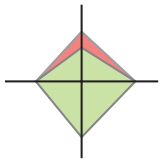

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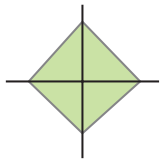

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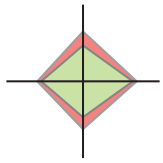

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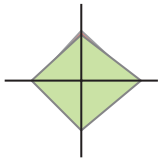

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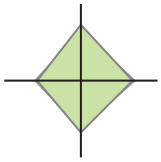

Analysis of activities and work for improvement

Nykoping hospital

Implant infections – in-depth analysis provides the basis for work for improvement.

Martin Forssberg
Resident physician orthopaedic clinic Nykoping

Background

Two hundred hip replacements and approximately 120 knee replacements are carried out yearly at the orthopaedic clinic of Nykoping. The clinic has, during a long period of time, reported good results in the Swedish Hip Arthroplasty Register for what are considered quality markers such as "10-year implant survival " and "Reoperation within 2 years". There occurred, despite unaltered routines, and increased frequency of deep hip implant infections from 2008 to 2010. This was soon noticed, and as early as 2008 a risk analysis and routine examination was performed revealing, however, nothing noteworthy. Later, the infection cases were event-analyzed in cooperation with the Hygiene and Disease Control unit. Ventilation in the operating room was examined by CFU or Colony Forming Units measurements, and because of excessively high CFU measurements a TOUL-unit was introduced in the fall of 2009. The operating room was modernized thereafter with a pass-through cabinet and laminar air-flow, which was completed in the beginning of 2010. Despite these measures several new cases of deep implant infection have arisen. There was, consequently, a clear need to further analyze implant infection cases and to thus raise the knowledge level at the clinic.

Implementation

The first step was to identify all cases of deep implant infection for the period 2008-10. Local infection registration did not exist at the clinic. Instead, auditing stemmed from the operation planning program Orbit, where all patients operated during the period 2008-2010 were sorted under their respective operation cards. Those patients, with an operation card as a potential case for reoperation due to implant infection, had their medical redords reviewed. Further, a search was carried out in Orbit for those diagnoses and intervention codes to be used at surgery caused by deep implant infection. Colleauges were also requested to report those cases of which they had personal knowledge.

Deep implant infection was identified in 22 patients operated with total hip replacement, 7 with hip hemiarthroplasty, and 5 patients operated with total knee replacement. No cases of deep infection in patients operated with a partial knee replacement of the knee were seen during the period.

When suspicion could be confirmed that the high infection rates primarily concerned hip implants, focus was directed toward the review of these cases. Patient records were analyzed and potential pre-, peri - and postoperative risk factors identified for comparison. The following data from patient records was also analyzed: which operation codes were used, problems during hospitalization (mainly wound healing problems), where, when and by whom signs of infection were first noted, CRP-level when infection was suspected, debut symptoms, how the situation came to be initially judged as deep infection, measures upon suspicion of infection, number of postoperative days until completed wound surgery, number of tissue samples taken at reoperation, time elapsed until bacteria culture results are received, bacteria demonstrated upon cultivation, antibiotic treatment prior to test results, antibiotic treatment after culture results, treatment time, follow-up after discharge, the patient's current status, treatment results and total length of stay at all clinics.

This in-depth analysis was carried out to see if any patterns could be discerned, and if not, find links in the care chain with possible improvement potential. Based on this knowledge altered clinical routines could reduce the frequency of future deep implant infections and improve and optimize preparedness and handling of this patient group.

Results

During the years 2008-2010 hip implant surgery was performed on 600 patients at Nykoping Hospital. Twenty-nine were diagnosed with infected hip implants. This is a total infection frequency of 4.8 %. 510 of these patients were operated with total hip replacement, with 22 cases of deep infection, an infection frequency of 4.3 %. The other 90 patients were operated with hemiarthroplasties. 7 of these were infected giving an infection frequency of 7.8 %.

In the mapping of risk factors the most distinctive finding in the material was the large number of wound complications. Wound hematoma and exuding wounds make up a relatively high risk for superficial sore infection[1], which in turn is a strong risk factor for late-appearing deep implant infection[2]. Of the 29 patients that later developed deep hip implant infection wound complications 13 were documented postoperatively. In three patients wound status was not documented. The other 13 patients had no wound complications during hospitalization. Formation of wound complications was seen even after discharge. Patient record reviews showed that, within 30 days after the primary surgery, 21 of 29 displayed wound complications before the debut of clinically suspected deep infection. This high frequency of wound complications possibly reflects the fact that a considerable proportion of the infections were early; as many as 25 of 29 debuted within 4 weeks. Two of the other four were acutely hematogenous and two late chronic (debut at 2.5 and 14 months, respectively).

Many cases have, at a first consultation, been judged as suspected deep infection. They were hospitalized and scheduled for surgery often on the same or the day after; in some cases a couple of days later. Most had received parenteral antibiotics after surgical reoperation and tissue culture, but in a few cases antibiotics were given directly after a blood culture at the emergency room due to their affected general condition. In three cases patients visited an open care unit and were put on peroral antibiotics. In most other cases where there was no suspicion of deep infection, wound cultures were taken and patients were given appointments at the orthopaedic clinic. In isolated cases no measures were taken despite consulting the emergency ward for oozing from the operation wound.

In all cases but one a reoperation with wound incision and debridement was carried out. The number of deep tissue cultures taken at an initial reoperation varies between 1 and 6. In 20 of 28 (71%) cases five or more tissue cultures were taken. The number of days from the day of surgery to first

notation of culture results in the patient records varies from 3 to 14 days. In four cases there is no notation in the records of when results had arrived. After culture results, adequate alteration of antibiotics took place in agreement with an infection consultant. The most common pathogen was S. Aureus followed by a mixed flora.

Treatment duration of implant infections varies from one month (one patient stopped of own free will) to seven months. In one case it was not known how long the treatment lasted, five patients died while undergoing treatment, and two patients are still being treated with continuous suppression treatment.

Of 22 patients with infected total hip arthroplasty 17 healed with implant-preserving treatment; and of seven with an infected hemiarthroplasty, only one. Two patients with total hemiarthroplasty died as a result of infection. One, an 84 -year old man, died in the days following reoperation due to a heart attack. The other, a 74-year- old woman operated with bilateral hip implants, died three months following reoperation after a prolonged bout with siphoning fever and an increasingly worsening general condition.

One of 28 patients operated for implant preservation was assessed preoperatively as non-deep infected, but erysipelas, and was given the diagnosis erysipelas (A46.9). 25 patients received the correct diagnosis of deep implant infection (T84.5F). One patient received the diagnosis purulent arthritis UNS of the hip joint (M00.9F), and another superficial wound infection (T84.1) despite preoperative suspicion of deep infection. In all 27 patients that underwent reoperation with incision and debridement local antibiotics in the form of Collatamp (gentamycin) was used. 20 patients received a correct operation code NFS49, while 5 received the code NFS19 instead. The patient preoperatively assessed with erysipelas received the operation code NFS39 (Incision and debridement for soft tissue infection of the hip or thigh with implantation medication). In this case with diagnosis code T81.4, the measure code was NFS09 (Incision and debridement for soft tissue infection). In only one case was the code NFW69 used (Reoperation for deep infection), and then only that code.

Of 22 patients with an infected total replacement during the period, 12 were reported to the SHPR. Of those seven patients with infected hemiarthroplasty during the period four were reported. Of those 13 not reported two had incorrect measure codes; the other 11 were missed by the attending secretary despite correct codes.

Conclusion

In a deeper analysis of implant infections important information can, as presented in this article, be obtained concerning both causes and handling of very significant postoperative complications. Apparently, a large proportion of the patients could have received both diagnosis and treatment early in the process with greater possibilities for successful treatment. Against the background of these experiences, we, at the orthopaedic clinic in Nykoping implemented a postoperative wound clinic where the patient's sutures/staples are removed and wound status assessed. Patient information at implant surgery has also been clarified concerning recommended measures for wound healing problems. Further, the clinic has introduced standardised registration of wound

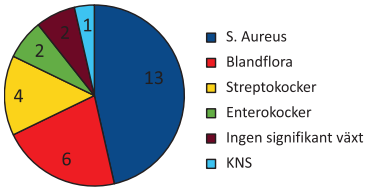

Figure 1. Pathogens in cultures taken at primary sore surgery of 28 cases of deep hip implant infection.

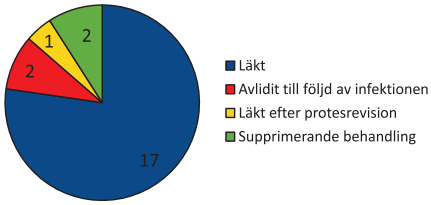

Figure 2. Treatment results of 22 total implant opererated patients with deep implant infection.

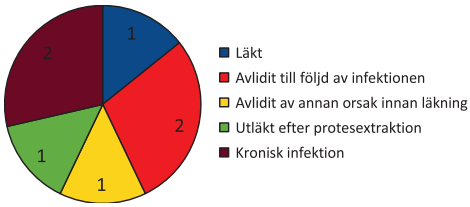

Figure 3. Treatment results of seven hemiarthroplasty patients with deep implant infection.

status under under a unique heading for all implant patients. A regional guideline has also been formed, containing structured guidance for the handling of suspected implant infection. And, in conclusion, the clinic is introducing local infection registration. Besides surer reporting to the SHPR quality registration allows for continuing analyses of upcoming cases in order to improve the management of this, both for individuals and society, so significant complication.

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Our gratitude to the PRISS-project that initiated this study.

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Follow-up of Free-Choice-of-Care scheme

Accessibility under the present healthcare guarantee and in the previous 'free-choice-of-care' scheme is judged almost exclusively as a time variable. However, the Registry management has for several years maintained that availability must be systematically linked to outcome both in the short and long term. This involves a requirement that decision-makers show greater endurance before calling for shorter waiting lists for surgery as an established quality gain for the patient.

The question is whether the result of a surgical intervention is poorer if the surgeon encounters operating environments and implant types that are often new and unknown or, alternatively, if patients are listed for operation at a different location than their home department, and indications are presented by an orthopaedic surgeon not carrying out the surgery. The highly productive elective departments often employ surgeons from other departments in order to meet requirements of high production. A possible scenario can therefore be that both surgeon and patient, when meeting in the operating theatre, come from different places and subsequently never meet again.

Against this background, the Registry in its Annual Report 2004, initiated analysis of patients receiving total hip arthroplasty outside their home regions during 2002 and 2003. As shown in previous reports we followed this group of patients continually. Below is a brief summary of the investigation as a basis for this year's follow-up (for details see Annual Reports 2004-2010).

Material

- The analysis included only 'standard patients', i.e. with primary osteoarthritis as diagnosis and receiving cemented total replacements outside university hospital departments (so as to avoid referred cases).
- Operated within the county: 14 785 hips; outside the county 1 964 hips (2002 and 2003).

Reason for reperation	Op. in home county (n = 14,785)		Free choice of care (n = 1,964)	
	No.	%	No.	%
Aseptic loosening	196	1.3	44	2.2
Deep infection	93	0.6	18	0.9
Fracture	50	0.3	4	0.2
Implant fracture	12	0.1	3	0.2
Dislocation	118	0.8	15	0.8
Technical error	11	0.1	2	0.1
Pain only	8	0.1		
Miscellaneous	20	0.1	2	0.1
Total	508	3.4	88	4.5

Tabel 1. Reoperation frequency per cause for operated in the region of residency and in the"free flow". Reoperation up to and including 2011.

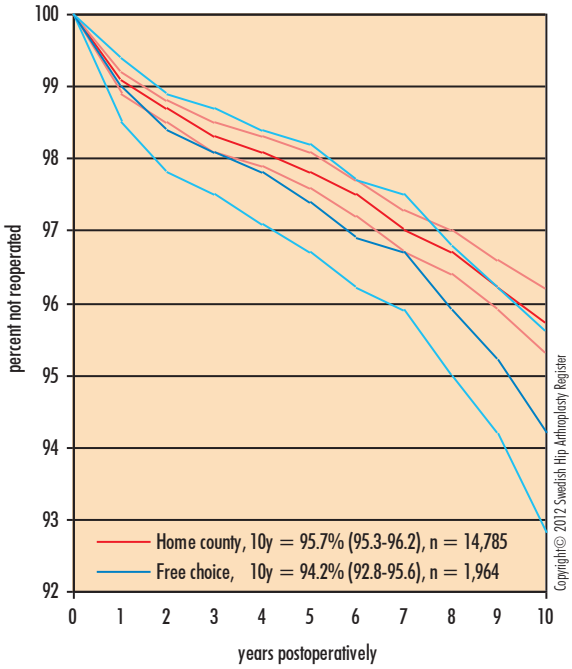


Figure 1. Implant survival for those operated in "free choice of care" and those operated within the region, respectively. The difference is significant according to the Log Rank-test (p = 0.032).

This year's comparison

The average follow-up time at this year's analysis was 108 months. A number of additional reoperations were carried out in both groups during 2011. The differences between groups for all causes of reoperations are 1.1%. In the intra-regional group 3.4% have now been reoperated, and in the free choice of care group the corresponding number is 4.5%. In a Kaplan-Meier analysis the difference is significant (Log Rank-test, p=0,032). In the material, reoperation due to aseptic loosening is now the commonest cause of replacement operations.

Discussion

The follow-up period is medium to long (9 years) and is, to a greater degree, beginning to reflect reoperation due to aseptic loosening. Many can criticize this increasingly historical monitoring, and that the studied group does not reflect the results of the current situation – however, it takes 8 -10 years to detect differences for the frequency of reoperation due to aseptic loosening.

In conclusion we now find a significantly poorer result for those operated outside the region in this earlier version of free choice of care. We cannot analyse the cause for this but the finding is sinister and clearly shows that availability measured by time to operation is a process measurement, and not an adequate and all-inclusive outcome measure.

Mortality following total hip arthroplasty

Ninety-day mortality was introduced five years ago as an open variable on a department level. The variable is also included as one of eight parameters in the value compass. While hip arthroplasty today is to be considered routine it is in fact a major surgical intervention not entirely risk-free for the patient. Indications for implant surgery have been extended during the past few years – both nationally and internationally. A greater number of both younger and older patients are undergoing this surgery now than during the 1970s and 1980s. Above all, the latter group naturally runs a greater risk of serious complications. Today, particularly at larger departments, more risk patients are undergoing surgery than before.

The Swedish Hip Arthroplasty Register updates its databases several times a year regarding the possible dates of death of individuals included via the Swedish Tax Agency (Skatteverket).

Short-term mortality

Ninety-day mortality is an indicator frequently used in the literature and applied in many medical areas. The reasons for patient mortality in connection with or within 90 days of a hip arthroplasty (and related to the intervention) may be many, but the dominant reasons are probably cardio-, cerebrovascular or thromboembolic disorders.

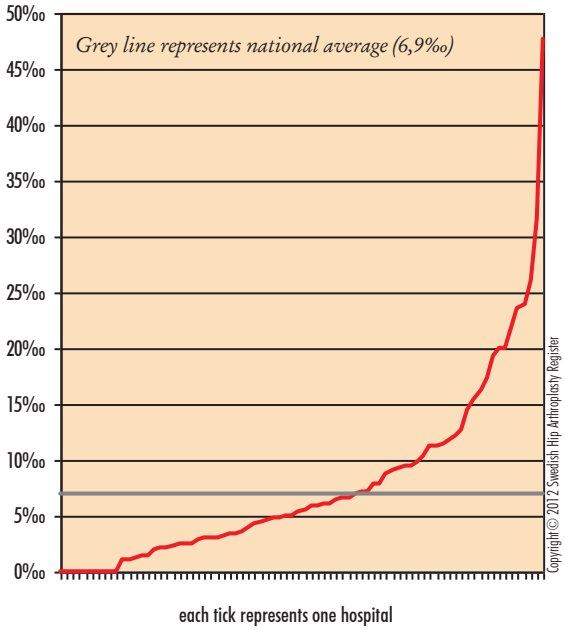
Owing to the low death rate production for the most recent four years is analysed to somewhat compensate for the risk of random variability.

Ninety-day mortality varies among Swedish hospitals during the years of observation: from 0‰-47.7‰ with a mean value throughout the country of 6.9‰. This means on a national level that one patient in about 130 undergoing hip arthroplasty died within three months after the operation between 2008 and 2011. As expected, 90-day mortality is higher after operations at university/regional hospitals and county hospitals than at district hospitals, and particularly in comparison with private care units. This reflects the various hospitals' patient material – 'case-mix'. We recommend the departments to analyse their death rates as a step in patient security work. Patients have an expected risk of dying at the age in question, but a high-quality preoperative medical risk assessment is something all units should strive for. In such a development it is important to know how many patients have died. It is not self- evident that an orthopaedic department receives feedback as to whether a patient, for example, died from a cardiovascular complaint three weeks after the operation at another department or even at another hospital.

The Registry plans an in-depth analysis and research project concerning mortality after operation with total hip replacement. We will, in this study, include the Cause of Death Register and a number of variables such as diagnosis, gender, fixation method, preoperative comorbidity, socioeconomical variables etc.

90-days mortality

primary THR performed during the past four years



each tick represents one hospital

The mortality rate is generally low and should be assessed with the same caution as the variable "reoperation within two years".

90-days mortality

proportion deceased within three months after primary THR, 2008-2011

Hospital	No. [1]	OA [2]	≥60 years [3]	Women [4]	Mortality [5]
University/Regional hospital					
Karolinska/Huddinge	986	70%	62%	55%	3.0‰
Karolinska/Solna	854	67%	66%	56%	9.4‰
Linköping	253	56%	58%	54%	**31.6‰**
SU/Mölndal	1,485	60%	76%	63%	12.1‰
SUS/Lund	398	20%	73%	64%	**47.7‰**
SUS/Malmö	382	25%	78%	65%	**23.6‰**
Umeå	348	77%	69%	54%	11.5‰
Uppsala	1,237	56%	68%	55%	**21.8‰**
Örebro	702	79%	67%	55%	4.3‰
Central hospital					
Borås	753	67%	86%	62%	6.6‰
Danderyd	1,418	73%	87%	65%	9.2‰
Eksjö	794	93%	84%	53%	5.0‰
Eskilstuna	451	59%	90%	65%	**20.0‰**
Falun	1,304	89%	79%	58%	2.3‰
Gävle	678	68%	75%	54%	11.8‰
Halmstad	876	79%	87%	58%	3.4‰
Helsingborg	251	61%	87%	65%	**23.9‰**
Hässleholm-Kristianstad	3,319	90%	85%	57%	3.6‰
Jönköping	833	83%	83%	61%	7.2‰
Kalmar	707	76%	84%	55%	9.9‰
Karlskrona	115	24%	93%	57%	**26.1‰**
Karlstad	1,041	61%	81%	63%	**17.3‰**
Norrköping	982	75%	82%	57%	11.2‰
Skövde	530	72%	76%	57%	9.4‰
Sunderby (inklusive Boden)	155	17%	88%	72%	**19.4‰**
Sundsvall	761	81%	84%	57%	3.9‰
Södersjukhuset	1,538	71%	83%	64%	**16.3‰**
Uddevalla	1,294	81%	82%	59%	4.6‰
Varberg	900	87%	85%	61%	5.6‰
Västerås	1,548	72%	85%	61%	**20.0‰**
Växjö	514	80%	85%	60%	7.8‰
Östersund	934	79%	85%	61%	6.4‰
Rural hospital					
Alingsås	841	94%	86%	61%	1.2‰
Arvika	680	90%	89%	58%	4.4‰
Bollnäs	1,159	95%	84%	58%	2.6‰
Enköping	1,009	95%	91%	60%	3.0‰
Falköping	927	93%	87%	54%	0.0‰
Frölunda Specialistsjukhus	320	99%	88%	64%	3.1‰
Gällivare	379	76%	86%	60%	7.9‰
Hudiksvall	515	75%	81%	57%	5.8‰
Karlshamn	826	96%	82%	54%	2.4‰
Karlskoga	498	93%	89%	58%	6.0‰

(continued on next page)

90-days mortality (cont.)

proportion deceased within three months after primary THR, 2008-2011

Hospital	No. [1]	OA [2]	≥60 years [3]	Women [4]	Mortality [5]
Katrineholm	967	97%	80%	54%	1.0‰
Kungälv	733	88%	86%	60%	1.4‰
Lidköping	566	90%	85%	53%	5.3‰
Lindesberg	805	88%	90%	57%	5.0‰
Ljungby	627	87%	81%	56%	3.2‰
Lycksele	1,191	97%	85%	59%	5.9‰
Mora	850	89%	90%	57%	9.4‰
Norrtälje	470	81%	89%	62%	12.8‰
Nyköping	690	82%	83%	58%	14.5‰
Oskarshamn	823	98%	83%	54%	4.9‰
Piteå	1,432	95%	81%	57%	4.9‰
Skellefteå	357	75%	79%	62%	11.2‰
Skene	376	95%	78%	53%	0.0‰
Sollefteå	480	94%	88%	58%	2.1‰
SUS/Trelleborg	2,375	92%	79%	58%	2.5‰
Södertälje	479	86%	85%	60%	10.4‰
Torsby	389	88%	85%	60%	15.4‰
Visby	494	85%	81%	55%	6.1‰
Värnamo	564	87%	87%	59%	7.1‰
Västervik	449	83%	82%	56%	2.2‰
Ängelholm	350	98%	87%	64%	2.9‰
Örnsköldsvik	680	92%	85%	60%	8.8‰
Private hospital					
Aleris Specialistvård Elisabethsjukhuset	357	90%	80%	58%	0.0‰
Aleris Specialistvård Motala	866	98%	89%	55%	1.2‰
Aleris Specialistvård Nacka	367	99%	86%	60%	0.0‰
Aleris Specialistvård Sabbatsberg	426	93%	78%	68%	0.0‰
Capio S:t Göran	1,655	86%	82%	63%	6.6‰
Carema Ortopediska Huset	1,599	100%	80%	62%	1.9‰
Carlanderska	365	98%	68%	46%	0.0‰
Movement	892	98%	79%	55%	0.0‰
Ortho Center Stockholm	1,460	97%	82%	63%	3.4‰
OrthoCenter IFK-kliniken	464	95%	65%	43%	0.0‰
Sophiahemmet	690	100%	60%	42%	1.4‰
Spenshult	597	80%	75%	62%	0.0‰
Nation	62,079	84%	82%	59%	6.9‰

[1] The number of primary THRs during the current period.
[2] Proportion of primary THRs performed on patients with primary osteoarthritis.
[3] Proportion of primary THRs performed on patients 60 years or older.
[4] Proportion of primary THRs performed on women.
[5] 90-days mortality (number of patients deceased within three months after primary THR/ total number of primary THRs).

Higher values denotes lower risk for serious complication (death) for the variables [2] [3] and [4].

Gender perspective

Operations involving hip implants are more common among women. In a longer perspective the relative proportion of women has decreased from 62.0% 1993 to 58.4% 2011. During the last three years, however, the proportion of women has been relatively constant (58.4-58.5%). Women are operated at a higher average age than men, 69.6 and 67.1 years, respectively (2002-2011). The difference can partly be due to the differing diagnosis distribution between men and women. During the last 10 years women have been overrepresented, chiefly in the diagnosis group primary or secondary OA following femoral neck fracture (women/men: 11.9/6.8%), inflammatory joint disease (2.6/1.5%), idiopathic avascular necrosis of the femoral head (2.9/2.3%), or secondary OA after childhood hip disease (2.2/1.9%). However, if one considers only the primary OA group the same difference remains, 69.6 and 67.1 years, respectively. Men are overrepresented in all age groups up to 69 years and women in the age group 70 years or older.

During the last ten-year period women have been more frequently operated with total all-cemented prostheses. All other implant concepts (all-uncemented, hybrid, reversed hybrid, resurfacing) are used more frequently on men regardless of whether one includes operations due to secondary OA or not. Posterior approach is used more often when operating on men, while the two most common lateral approaches are more common in women in the primary OA group as well. The difference between genders for the respective approaches is, however relatively small.

Of the primary prostheses operated during the period 1992 -2011, 5.9% of the men and 4.3% of the women have been revised up until and including 2011. Corresponding distribution for the outcome reoperation within 2 years was 2.6 and 2.2%, respectively. The risk and risk profile for men and women, respectively, to suffer reoperation within 2 years differs between genders (see *Primary implants* and *Reoperation*). Women undergo revision more often due to dislocation, technical causes, and pain. Reoperation due to loosening, deep infection, periprosthetic fractures and implant breakage are more common in men. The observed implant survival after 19 years regardless of cause of reoperation is for patients operated 1992-2011 75.7% for men, and 81.8% for women. (±95% confidence interval ±1.4% ±1.2%, respectively). In this case no adjustment was made for other differences between the groups. In a Cox-regression analysis adjusted for age, first or opposite sided operated, diagnosis, and implant and surgical approach selection, the risk to suffer reoperation regardless of cause increased by 41% for men (RR 1.41 1.36-1.47) based on 243 567 operations with complete data (Figure 3).

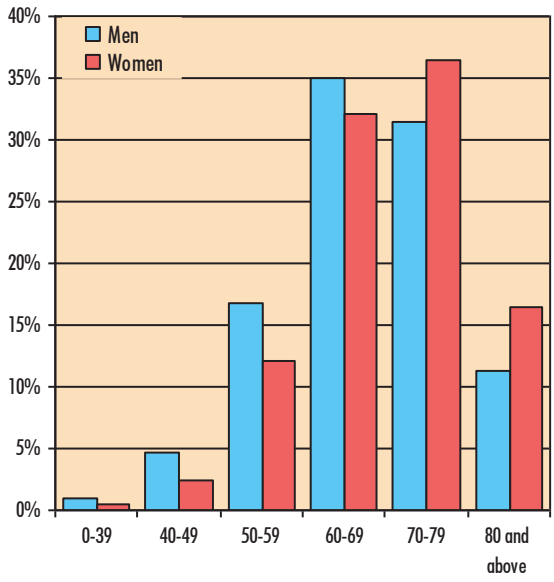


Figure 1. Age distribution between men and women operated by primary implant due to primary OA.

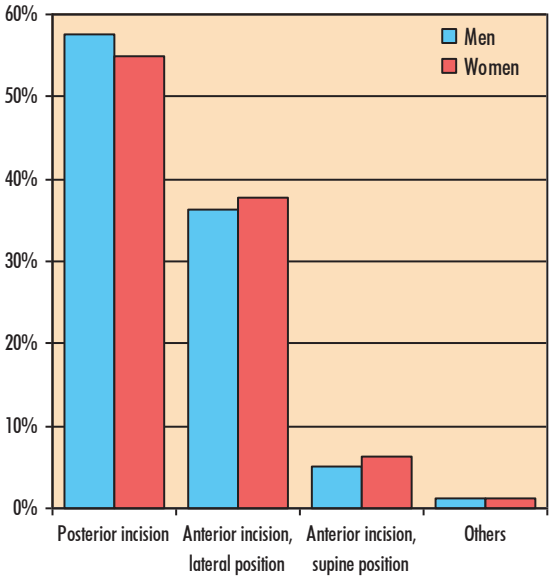


Figure 2. Surgical approach for men and women, respectively.

Patient-reported outcomes

In previous annual reports we have found that women prior to surgery with a primary implant reported lower health-related quality of life and somewhat higher pain level on a VAS. One year after surgery women report a better effect of the intervention as measured by both improved health-related quality of life and pain reduction. Despite this, women still report a somewhat lower general health-related quality of life as well as greater pain and less satisfaction one year after the intervention.

In this year's analysis we present data based on patients with primary OA in a Charnley category 1-2 (Table 1). Even in this group we find that women indicate more pain prior to surgery, greater EQ-5D gain, better pain reduction, but a somewhat lower level of satisfaction one year after surgery

(p < 0,0005; logistic regression corrected for age, diagnosis, and choice of surgical approach). Gender differences noted at one year remain at 6 years, implying that the changes occurring between 1 and 6 years after surgery are relatively equal for both sexes.

In order to gain a more nuanced understanding of how women and men experience hip implant surgery's influence on their health-related quality of life we have analysed the five dimensions of the EQ-5D questionnaire separately. The responses have been reduced to two alternatives (no or moderate/severe impact, pain or discomfort). In the logistic regression analysis adjustment was made for age, surgical approach, and preoperative response for respective dimension. Women indicate greater problems with mobility, main activities, pain and anxiety/depression more than men, but less problems managing their self-care (Table 2).

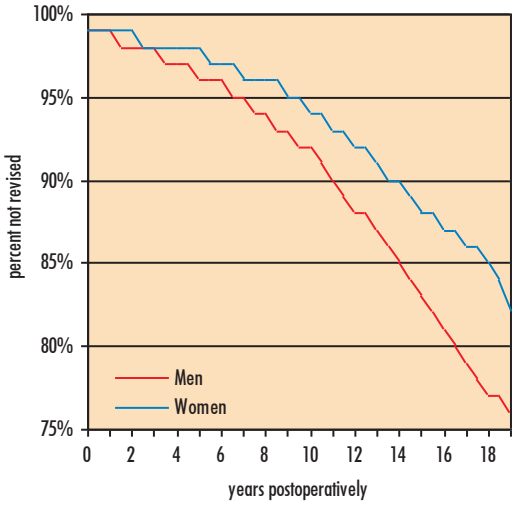


Figure 3. Unadjusted implant survival based on reoperation regardless of cause as outcome variable for men and women opererated 1992-2011. Log Rank-test: p < 0.0005. Resurfacing implants have been excluded.

	n	mean (median) *SD*		n	mean (median) *SD*
EQ-5D			**Pain VAS**		
before operation			***before operation***		
man	14,543	0.49 (0.66) *0.29*	man	14,543	58 (60) *16*
woman	16,636	0.42 (0.58) *0.31*	woman	16,636	63 (67) *16*
1 year			***1 year***		
man	14,543	0.85 (1.00) *0.20*	man	14,543	11 (5) *16*
woman	16,636	0.82 (0.80) *0.21*	woman	16,636	12 (5) *17*
6 years			***6 years***		
man	1,970	0.82 (0.85) *0.23*	man	1,970	12 (5) *17*
woman	2,293	0.78 (0.80) *0.25*	woman	2,293	14 (6) *18*
change			**change**		
before op. - 1 year			***before op. - 1 year***		
man	14,543	0.36 (0.28) *0.32*	man	14,543	-47 (-50) *21*
woman	16,636	0.40 (0.31) *0.34*	woman	16,636	-50 (-52) *22*
1 year - 6 years			***1 year - 6 years***		
man	1,970	-0.04 (0.00) *0.23*	man	1,970	2 (0) *18*
woman	2,293	-0.04 (0.00) *0.25*	woman	2,293	2 (0) *20*
Satisfaction					
1 year					
man	14,542	13 (6) 19			
woman	16,636	15 (10) *20*			
6 years					
man	1,970	13 (8) *18*			
woman	3,437	16 (10) *20*			
change					
1 year - 6 years					
man	1,970	1 (0) *17*			
woman	2,293	1 (0) *18*			

Table 1. Health-related quality of life (EQ-5D) and pain (VAS) before surgery and patient-reported outcomes after 1 and 6 years. Only patients with primary OA, Charnley category 1-2 (preoperative) and completed questionnaires at both follow-ups.

	Men	Women		
	Prop. without problems	Prop. without problems	RR man (woman=1)	95% C.I.
Mobility	74.4%	66.3%	0.7	0.7-0.8
Sel-care	94.1%	94.7%	1.2	1.04-1.3
Usual activities	84.5%	82.4%	0.9	0.8-0.96
Pain/discomfort	57.5%	48.8%	0.7	0.7-0.8
Anxiety/depression	87.1%	80.6%	0.8	0.7-0.8

Table 2. Proportion of men and women, respectively stating they had no problems/difficulties one year after hip replacement. After adjustment for age, and preoperative values, women oftener state residual problems d in all dimensions except self-care. Only patients with primary OA and Charnley category 1-2 before surgery were included.

Hip fracture and arthroplasty surgery

"Regional comparisons", a survey based on the Patient register, contains national quality indicators. The use of arthroplasty surgery in hip fracture cases is one of these. Patients over 64 with the diagnoses S72.00 and operation codes NFB09 and 19 or NFB29, 39, 49, 62 and 99 have been included, that is, femoral neck fractures treated with arthroplasties 2010 and 2011.

The 30% of those femoral neck fractures not displaced are also included in the diagnosis group; and for these, operation by internal fixation (pins or screws) is sufficient. Internal fixation can also be appropriate for the occasional patient with an acute life-threatening condition. The goal for arthroplasty use is, therefore, 65-70%.

Comparisons of different hospitals

62.1% of the patients received an arthroplasty, compared with 60.6% 2009-2010. There continues to be large variations among hospitals, 38 to 78% (Lycksele sends those patients that are to receive an arthroplasty to another hospital). Hemi-arthroplasties are used in 78% of the cases, and total hip replacement in remaining cases. An increased use of total hip replacement is supported by the current research. A large variation within the country can be seen in this regard. The use of total hip replacement varies from 2 to 63%, with the greatest use in Vasteras, Karlstad and Eskilstuna. Clinics with low use of total hip replacement should review their indications and implant selections.

The use of arthroplasty in fractures has, however, generally increased somewhat; but a worrysome tendency can be seen whereby several hospitals have clearly reduced their use compared to 2007-2008. This is true of Solleftea (reduction by 21%), Varnamo (-19%), Hudiksvall, Jonkoping (both -9%) and Sodra Alvsborgs hospital and Vaxjo (both -8%).Hip replacement surgery is initially more costly than internal fixation, but its long-term cost benefit has been clearly shown in several studies. Overlooking this, and choosing internal fixation for economical reasons is short-sighted.

Future development

An increased utilization of total hip replacement in fractures is, therefore, desirable. Since implant selection should be based on the patient's biological age, it is difficult, from simple population statistics to state how large a proportion is optimal. THR should be used for independent individuals that are mobile without walking aids and are cognitively intact. Total hip replacement should also be used for those with radiological signs of inflammatory hip disease or OA of the hip.

That some hospitals use barely 10% or less total hip replacements is a clear case of undertreatment. It is very important, now that we use more unipolar implants in Sweden, that such hemiarthroplasties are not implanted in the active patient group mentioned, since the risk for acetabulum erosion thus increases.

Successful surgery of fracture patients with total hip replacement demands qualified surgeons and good tutoring of younger physicians to reduce the risk of dislocation. Hemiarthroplasty behaves more "forgivingly" in this respect, which can defend the interventions role in acute surgery, where competence of the on call physician is not always so high. Hospitals here must decide what suits the local organisation, and carefully follow up their results.

Consideration of hemi-arthroplasty even in undisplaced fracture is a question for the future, as the risk for reoperation after hip replacement, in round figures, is lower than after internal fixation for such fractures. There is, however, no scientific support here as yet, since not just reoperations but all types of complications and cost benefits must be considered. Randomised studies have, however, been initiated.

Finally, it must be emphasized that a reduction of the proportion of arthroplasties – for economic or other reasons – must be absolutely avoided.

Arthroplasty surgery after hip fracture per hospital

2010-2011

Hospital	Primary arthroplasty at cervical hip fracture	Number of arthroplasties inserted 2010-2011	Lower confidens interval	Upper confidens interval	Proportion hemi-arthroplasties
Akademiska sjukhuset	69.7%	285	65.2%	74.2%	61.8%
Alingsås lasarett	63.4%	80	54.9%	71.9%	91.6%
Arvika sjukhus	70.2%	42	58.7%	81.6%	80.5%
Blekingesjukhuset	65.8%	160	59.8%	71.8%	79.2%
Danderyds sjukhus	64.7%	323	60.4%	69.0%	70.0%
Falu lasarett	58.1%	209	53.0%	63.3%	98.3%
Gällivare lasarett	53.3%	53	43.8%	62.7%	58.8%
Gävle sjukhus	66.3%	217	61.2%	71.5%	83.4%
Hallands sjukhus Halmstad	66.3%	144	60.0%	72.6%	68.2%
Hallands sjukhus Varberg	65.3%	166	59.3%	71.3%	80.5%
Helsingborgs lasarett	63.2%	282	58.7%	67.7%	97.2%
Huddinge sjukhus	62.6%	197	57.2%	67.9%	77.4%
Hudiksvalls sjukhus	55.9%	91	48.4%	63.4%	64.6%
Hässleholms sjukhus	63.6%	288	59.0%	68.1%	92.9%
Höglandssjukhuset	51.3%	113	44.6%	57.9%	91.6%
Karlskoga lasarett	47.8%	58	38.4%	57.2%	91.7%
Karlstads sjukhus	63.5%	216	58.4%	68.7%	54.8%
Karolinska sjukhuset	52.4%	97	45.2%	59.6%	74.5%
Kungälvs sjukhus	77.8%	129	71.4%	84.2%	81.8%
Lindesbergs lasarett	65.5%	48	54.6%	76.4%	57.0%
Ljungby lasarett	65.4%	56	55.6%	75.1%	64.5%
Lycksele lasarett	0.0%	0	0.0%	0.0%	
Länssjukhuset Kalmar	76.0%	216	71.0%	81.0%	78.3%
Mora lasarett	55.7%	91	48.1%	63.3%	76.4%
Motala lasarett	61.2%	72	51.8%	70.7%	76.6%
Mälarsjukhuset	39.8%	115	34.0%	45.5%	55.7%
Norrlands Universitetssjukhus	61.4%	138	55.1%	67.8%	94.5%
Norrtälje sjukhus	60.3%	77	51.9%	68.7%	80.8%
NU-sjukvården	73.1%	411	69.5%	76.7%	86.6%
Nyköpings lasarett	50.7%	77	42.8%	58.5%	57.5%
Ryhov. länssjukhus	55.9%	117	48.8%	62.9%	67.9%
S:t Görans sjukhus	68.8%	381	64.7%	72.9%	83.1%
Sahlgrenska universitetssjukhuset	66.6%	586	63.4%	69.7%	80.5%
Skaraborgs sjukhus	57.7%	127	51.2%	64.3%	81.2%
Skellefteå lasarett	46.9%	71	38.8%	54.9%	89.7%
Sollefteå sjukhus	43.5%	42	33.6%	53.5%	90.9%
Sunderbyns sjukhus	68.5%	262	63.8%	73.1%	88.3%
Sundsvalls sjukhus	41.6%	101	35.3%	47.8%	80.6%
Södersjukhuset	63.9%	494	60.4%	67.4%	79.3%

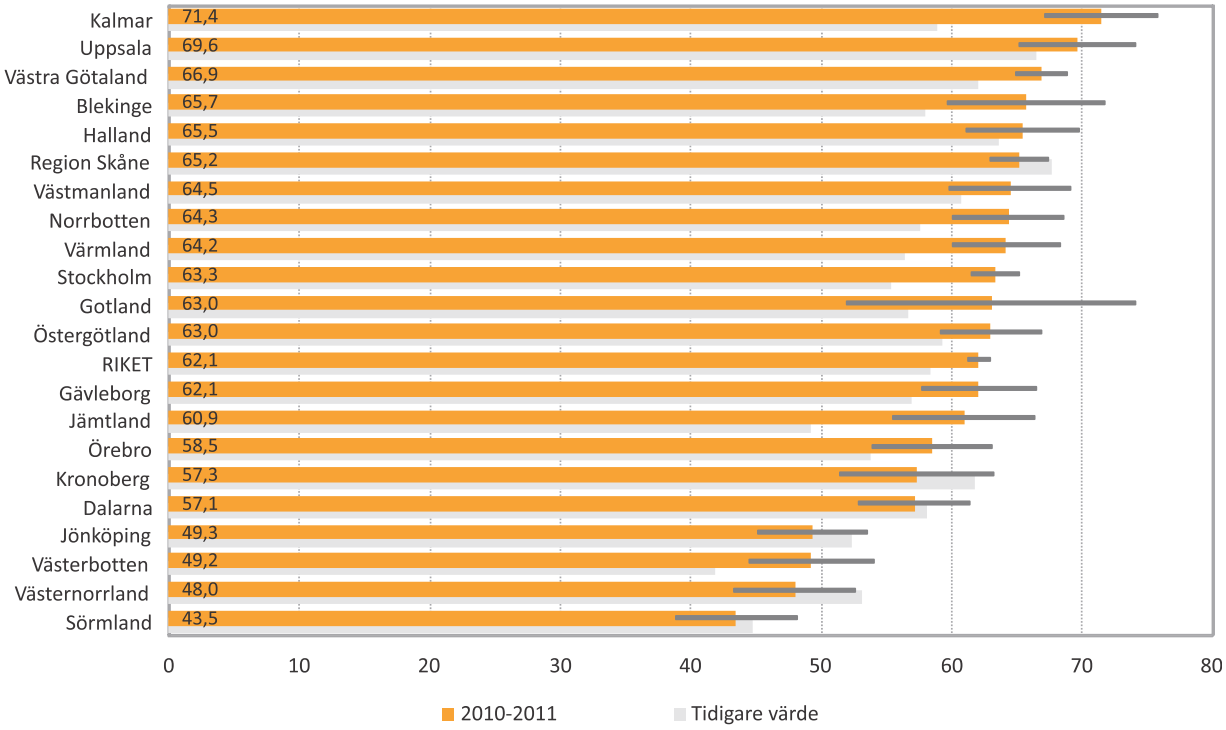
Arthroplasty surgery after hip fracture per hospital (cont.)

2010-2011

Hospital	Primary arthroplasty at cervical hip fracture	Number of arthroplasties inserted 2010-2011	Lower confidens interval	Upper confidens interval	Proportion hemi-arthroplasties
Södertälje sjukhus	54.6%	78	46.2%	63.0%	75.7%
Södra Älvsborgs sjukhus	57.6%	154	51.6%	63.5%	62.1%
Torsby sjukhus	69.5%	57	59.7%	79.3%	68.1%
Universitetssjukhuset i Linköping	63.5%	144	57.1%	69.9%	94.1%
Universitetssjukhuset i Lund	67.3%	268	62.6%	71.9%	80.5%
Universitetssjukhuset MAS	65.8%	381	62.0%	69.6%	84.0%
Universitetssjukhuset Örebro	58.1%	163	52.3%	63.8%	85.0%
Visby lasarett	65.1%	55	54.9%	75.4%	74.2%
Vrinnevisjukhuset	63.3%	162	57.6%	69.1%	65.2%
Värnamo sjukhus	38.2%	60	30.1%	46.2%	66.9%
Västerviks sjukhus	64.8%	98	57.2%	72.5%	83.3%
Västerås lasarett	64.7%	277	60.1%	69.3%	37.4%
Växjö lasarett	52.1%	91	44.8%	59.4%	70.3%
Örnsköldsviks sjukhus	67.3%	73	58.0%	76.6%	83.3%
Östersunds sjukhus	60.1%	185	54.7%	65.5%	83.1%
NATION	62.1%	8,880	61.3%	62.9%	78.1%

Arthroplasty surgery after hip fracture per county

2010-2011



Patient-reported outcomes after femoral neck fractures

In a recently published thesis in cooperation with the Swedish Hip Arthroplasty Register, the following conclusions were reached in respect of patients with displaced femoral neck fractures.

- There are no excess long-term complications for fracture-related arthroplasties within a 10-year follow-up.
- Patients treated with internal fixation without major complication never reach better results regarding pain or function than patients treated successfully with arthroplasty.
- Total hip arthroplasty is a safe method for primary fracture treatment as well as salvage treatment after failed internal fixation.
- Swedish orthopedic surgeons continually modify their practice as a way to improve the treatment and care for the patients; most likely influenced by findings and reports from the Swedish Hip Arthroplasty Register.
- Bipolar hemiarthroplasty is associated with a higher risk of re-operation than unipolar, in general as well as because of dislocation, infection and periprosthetic fracture.
- Uncemented hemiarthroplasty has a higher risk of re-operation than cemented, mainly because of periprosthetic fracture.
- Anterolateral transgluteal approach has a higher risk of total hip arthroplasty revision regardless of reason, and of hemiarthroplasty re-operation due to dislocation, compared to posterior approach.
- A mailed patient-reported outcomes questionnaire is a feasible method for a national follow-up of hip fracture patients, with an acceptable response rate.
- Total hip arthroplasty leads to the lowest level of pain and the highest level of satisfaction in patients above as well as below 70 years.

Hemiarthroplasty

The number of registered hemiarthroplasties since 2008 is approximately 4 500 annually, and the 4 523 operations from 2011 do not diverge from this pattern. However, during the same period the number of fracture-related total hip replacements increased slightly, from 1 403 to 1 509. Looking only at arthroplasty surgery performed in acute fractures the increase for total hip replacement is greater; from 2008's 1 062 to 2011's 1 207. Corresponding figures for hemiarthroplasties are 4 223 to 4 317. It thus appears as if those research papers supporting an increased use of total hip replacement have had some clinical impact. Total hip replacement leads, in these studies, to less pain and better function compared with hemiarthroplasty, particularly in a longer perspective. The price can possibly be an increased dislocation risk for total hip replacement. In studies based on data from the Swedish Hip Arthroplasty Register, however, the same occurrence of dislocation-caused revision operations is seen, 1.5% after total hip replacement and 1.6% after hemiarthroplasty. Since the increase of total hip replacement at acute fracture is pronounced for those 60 to 74 years the last five years, we can assume that the increase has also occurred at the expense of internal fixation, which is a common treatment method for younger fracture patients. Where to set the age limit in the choice between total hip replacement and internal fixation is subject to debate.

Which stems and heads have been used are shown in Table A1 and A2. No monoblock prostheses were used in 2011. The proportion of unipolar heads has further increased, and was used in 68% of the operations in 2011. The direct transgluteal approach ("lateral approach" according to Hardinge and Gammer, respectively) increased ath the expense of the posterior (Moore), and were used in 68% of the interventions (Figures 1 and 2).

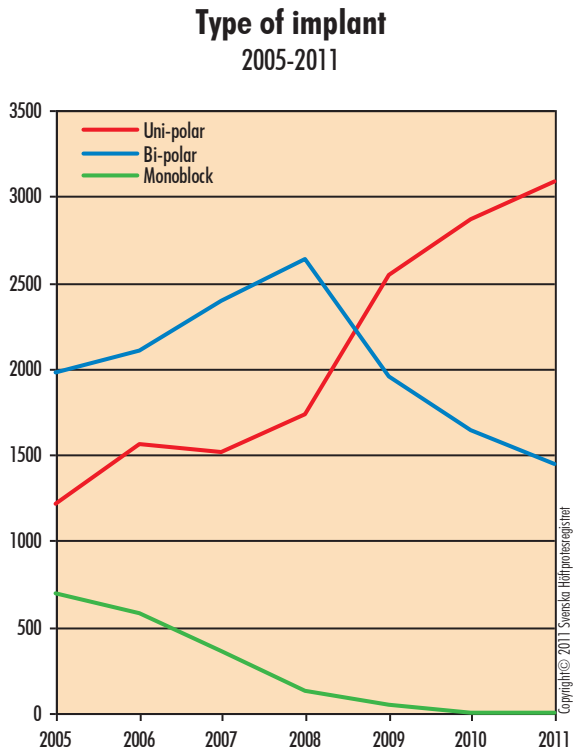


Figure 1.

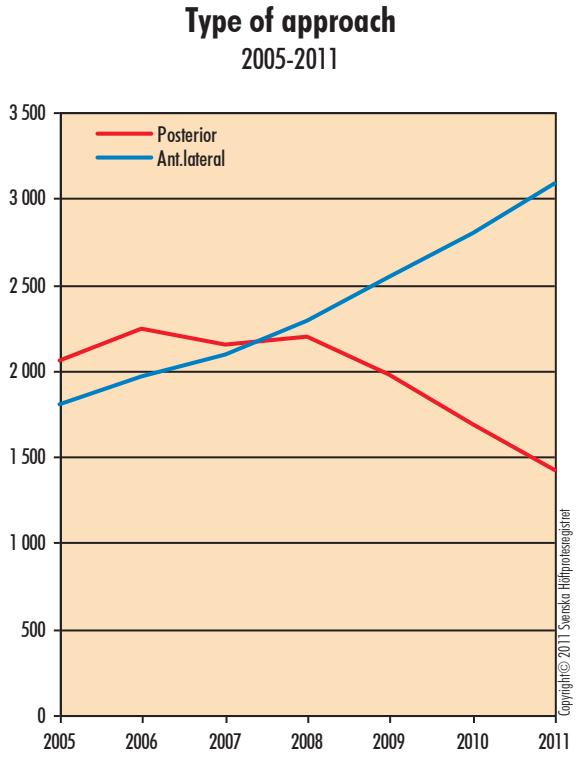


Figure 2.

Diagnoses and demographics

94% of hemiarthroplasties have been carried out due to acute fracture. The proportion has increased somewhat, from 91% 2005 to 95% 2011. Remaining operations take place after failed osteosyntes (4%), malignancy (1%), avscular necrosis without previous fracture (0.5%) and a few rare conditions. In the following analyses only modular fracture-related prostheses implanted via the usual surgical approaches (Moore, Hardinge, Gammer), have been included.

Even gender distribution has changed successively; the proportion of men has increased from 27 to 32%. The average age has increased from 83 to 84 years, but first and foremost the proportion over 85 has increased from 40 to 47% since 2005. Whereby even those with dementia and serious illness (ASA-class 3 or higher) has increased, we can draw the conclusion that it is a more vulnerable and care-intensive group that is currently treated with hemi-arthroplasty. This increases the burden on orthopedic care (Figure 3).

90-day mortality after hemiarthroplasty

90-day mortality for the nation has stabilized at 15%. Since mortality is influenced by which patients are selected for hemi-arthroplasty, a number of factors that can influence the risk for early death are presented in Table B. If one's

own department's mortality rate is higher than what can be expected with the current "risk profile" the continuum of care should be analyzed in detail.

BMI

In order to calculate body mass index (BMI) we have requested, since 2008, for height and weight to be registered even for patients operated with hemiarthroplasty. It is known that both under- and overweight influence the risk for complications, and that fracture patients are often undernourished. Unfortunately, there is extensive diversity in reporting. Durig the period 2008-2011 Ljungby, Eskilstuna and Eksjo reported height and weight for more than 90% of patients. Twelve hospitals reported for only 20%. Malmo, Umea, Ornskoldsvik and Sunderbyn did not report.

Inclusion of BMI in the risk analyses according to below has thus far not influenced results, but with increased reporting these analyses can be improved.

Every tenth patient is undernourished (BMI < 18.5), and the condition is twice as common among women. On the other hand it was shown that every third patient met the criteria for obesity (BMI > 30).

Dementia

In 2005 a fourth of the patients had some form of dementia; in 2011 the proportion was a third, with no gender differences. The increasing number with dementia indicates that those departments that previously followed the PM that gave dementia as a reason for osteosynthesis has abandoned this regime. This is supported by register data not showing dementia as a risk factor for complications after hemi-arthroplasty (see below).

There is a tendency for underreporting even for dementia, where Linkoping and Lund only reported for 15% and 3%, respectively of their patients the last five years. A clear majority of the hospitals have, however, functioning routines for this issue.

Revision and reoperation

1 083 patients underwent one (or more) reoperations during 2005-2011, corresponding to 3.9%. In 886 (3.2%) of these some implant part have been replaced or removed – revision operations. The measures are listed in Tables C and D, and the causes in table E

The diagnoses steer the choice of reoperation

Most hips are revised by replacement with total arthroplasty, which occurs mainly following dislocation (70%) and erosion/pain (17%). Replacement with total arthroplasty is unusual after infection (2%).

A third undergo replacement to a new hemiarthroplasty. The reasons are infection (59%) and periprosthetic fracture (24%). As many as 16% receive a new hemiarthroplasty after dislocation. Theoretically one can question the suitability of

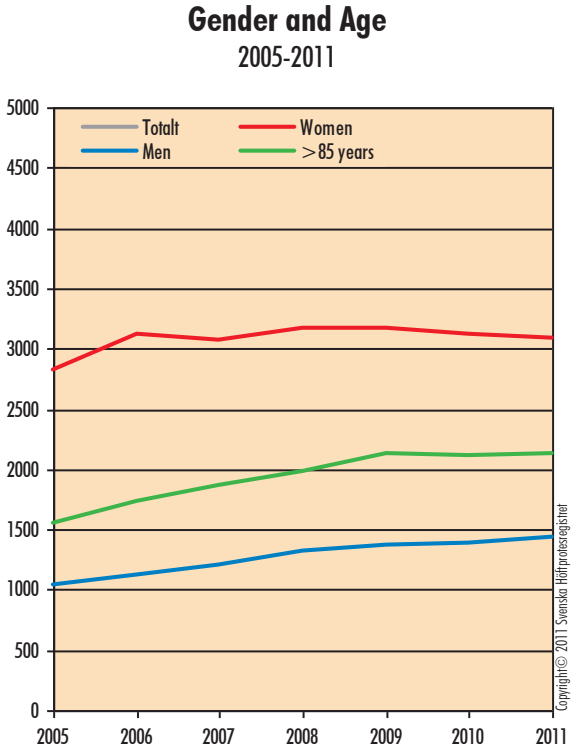


Figure 3.

replacement by hemiarthroplasty at infection or dislocation. In case of infection the cartilage is affected and risk for erosion development is likely. In the case of dislocation a total replacement ought to provide greater possibilities to increase stability through optimum positioning of the stem and cup. Scientific evidence is difficult to obtain in implant selection, whereby this issue has not been studied in detail.

Excision arthroplasty

Every fifth patient reoperated is done so by excision arthroplasty or similar intervention that leaves an "empty" hip joint, where the femoral head has been removed. The end result is a considerable shortening of the leg and greatly reduced walking ability. The surgical technique is in principle a last resort in the event of serious infection or frequent dislocations. If the patient is not ambulatory at the time of the intervention it can be considered suitable, but the question arises whether the great majority of excision arthroplasties indicate a sense of resignation from the attending physician.

258 patients underwent excision arthroplasty as a first or second reoperation. 55% had this intervention as the primary reoperation, 29% as the secondary. 12% had previously undergone two or more reoperations. Even if some of these implant extractions were intended as temporary solutions, it was only 4% that finally received a new prosthesis. 5% of the entire group underwent five or more reoperations. Dislocation and infection were as expected the most common causes of excision arthroplasty (56 and 30%, respectively).

The average age was 82, the same for all those reopererated. However, those excision arthroplasty patients represented a greater morbidity in a somewhat higher ASA class than other reopererade patients. Only every third survived to the end of the follow-up period; in the group receiving a new arthroplasty at reoperation, every second patient was alive.

A higher proportion than expected receive excision arthroplasty, often by means of several reoperations. If this is a good treatment or not cannot be determined by the Registry, whereby patient-specific factors finally decide management. Since the intervention is often final and vitiated with extensive loss of function, we urge local quality assessments; are too many excision arthroplasties being performed?

Unusual measures

There are also a small number of reoperations not entirely in agreement with clinical practice; reimplanting previously used implant parts or deepening the acetabulum as a solution to the dislocation problem. Lastly is thus an iatrogenic acetabulum erosion. The numbers are so small that any assessment of the final outcome is not possible, but that even for this fragile patient group the adherence to good clinical practice appears obvious.

Reoperation within 6 months

Variation is extensive throughout the country, from 0 to 17%, with a national average of 3.3% (Table F). Eventual underreporting of reoperations such as varying treatment strategies influence the clinics results. An active stance toward dislocation and infection can lead to a greater number of reoperations, in comparison to choosing non-operative treatment for these conditions.

Risk factors for reoperations

Those patients operated due to acute fracture (primary arthroplasty) or complications following osteosynthesis-opererated fractures (secondary arthroplasty) during 2005 to 2011 have been analyzed. Only those operated with a standard surgical approach and modern modular implants have been included, which is 27 523 hips. Gender, age, diagnosis, surgical approach, stem and head type and hospital type, respectively were evaluated in a Cox regression analysis, partly regarding all reoperations, partly regarding specific complications. The resultats are in agreement with that which the Registry demonstrated in previous years, now published in a scientific study (Leonardsson et al. Acta Orthopaedica 2012).

Male gender increases the risk for reoperation in general, as well as younger age and secondary arthroplasty. Bipolar head increases the risk compared with unipolar. Uncemented imply a higher risk for reoperation compared with cemented, curved, matte stems. A small risk increase was seen in cemented, straight polished stems and after surgery at rural hospitals.

An increased risk for reoperation due to periprosthetic fracture in uncemented stems, in straight, polished stems and in men was seen. Lower age and straight polished stems convey an increased risk for reoperation due to infection.

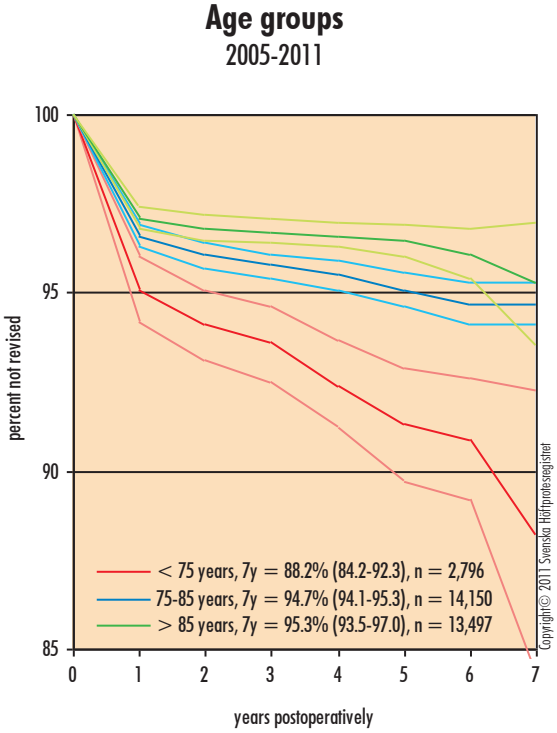


Figure 4.

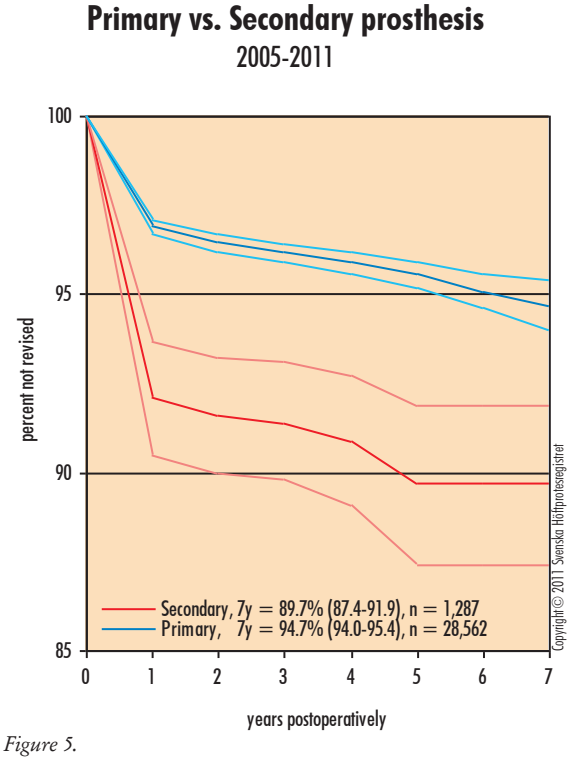


Figure 5.

Risk for reoperation due to dislocation is increased for secondary arthroplasty and operation at rural hospitals, respectively, bipolar head, age under 75, posterior approach and unpolished curved stems.

Erosion and pain remain unusual causes of reoperation. Of 18 patients that were reopererated because of pain, 17 underwent revision, which speaks for severe symptoms. 55 patients were reopererated due to erosion. We have chosen to group these reoperations together and find a strongly increased risk in both the younger age groups (under 75 and 75-84 years, respectively), as well as a clear increase in unipolar heads and uncemented stems. A slight increase was also seen in operations at university/regional hospitals. With the exception of hospital type the results remain when only the 55 with diagnosed erosion are analysed.

For 13 815 patients with data for both degree of dementia and ASA group a regression analysis was perfomed again, with these patient factors added; neither dementia nor ASA-group alone influence the risk for reoperation. And no impact on reoperation risk by underweight or obesity was seen either for those 6 915 patients with BMI-data. In figures 4-6 the proportion of non-reoperated patients is presented for the different age groups, primary and secondary procedures, respectively, as well as surgical approach including all registered hemiarthrosplasty procedures (Kaplan-Meier analysis). The lowest age group and the secondary procedures have significantly poorer results.

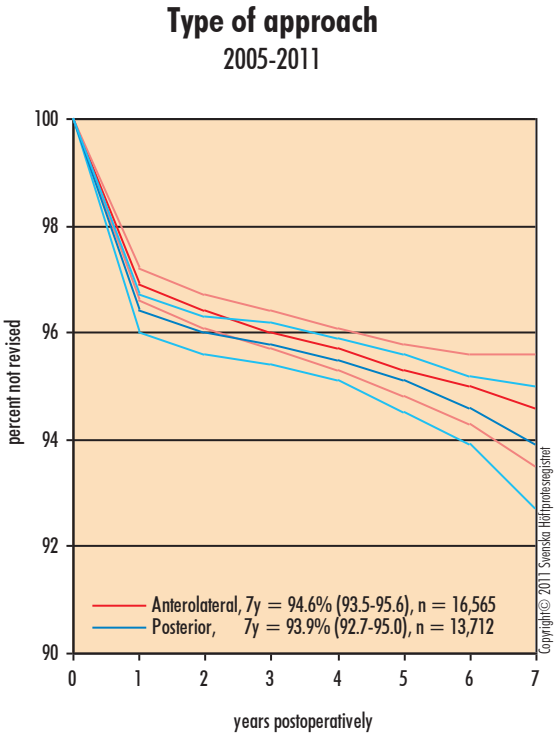


Figure 6.

Interpretation of results?

The relationships are complex and the risk of reoperation can be influenced by implant selection and technique. Patient-related factors cannot, of course, be influenced, but the intention is, in the best way possible, to adjust treatment to the patient's condition. In most cases an individual with a femoral neck fracture is best served by hemiarthroplasty.

A woman with acute fracture receiving a cemented Lubinus SP II stem – the most common in Sweden – runs only a slight general risk increase if operated at a county hospital compared to a regional hospital (1.5 times the risk). Surgical approach and choice between bi- and unipolar head does not influence her general risk. Her risk for dislocation-related operation is thought to be bound to the use of a bipolar head alone (1.4 times the risk), not the surgical approach.

In this way one can present certain "standard patients" in accord with the increased size of the register material, thus allowing these types of in-depth analyses. If we, in contrast to the example above, analyse a man treated with a straight polished stem, risk factors would look entirely different. To attempt to establish a treatment algorithm encompassing all these patient-related, diagnostic, technique and implant factors is difficult. The end result is also influenced by other factors that the Registry does not cover. Once again local in-depth analyses are encouraged.

However, based on current data, we advise against the use of uncemented stems due to their high risk for reoperation caused by periprosthetic fracture, and a newly discovered risk increase also for erosion/pain. Bipolar heads show a generally increased reoperation risk, but unipolar heads should be avoided for those that run the greatest risk for developing erosion – that is younger and more mobile individuals. Posterior approaches continue to lead to an increased risk for dislocation-related reoperation, but not for reoperation in general.

15 most common stem types

2005-2011

Stem	2005	2006	2007	2008	2009	2010	2011	Total	Prop. [1]
Lubinus SP II	1,470	1,666	1,966	2,095	1,970	1,933	1,924	13,024	42.8%
Exeter Polished	870	936	1,040	1,205	1,400	1,449	1,474	8,374	27.5%
CPT (CoCr)	187	211	240	275	336	342	368	1,959	6.4%
Spectron EF Primary	351	409	182	107	169	161	146	1,525	5.0%
Thompson	354	360	244	168	44	2	0	1,172	3.8%
Covision straight	0	0	24	152	240	273	334	1,023	3.4%
MS30 Polished	0	1	111	176	168	167	161	784	2.6%
Austin Moore (Anatomica)	329	220	78	23	28	2	0	680	2.2%
Corail Collarless	26	96	92	109	94	95	22	534	1.8%
ETS Endo	98	104	129	48	0	0	0	379	1.2%
Müller Straight	101	84	60	25	0	0	1	271	0.9%
Basis	0	41	50	54	62	19	0	226	0.7%
Bi-Metric Fracture Stem	42	53	19	13	2	0	0	129	0.4%
Corail Collar	0	0	0	0	0	28	56	84	0.3%
Charnley	26	31	3	0	0	0	0	60	0.2%
Others	21	33	28	36	24	39	37	218	0.0%
Missing	0	0	1	0	0	0	0	1	0.0%
Total	3,875	4,245	4,267	4,486	4,537	4,510	4,523	30,443	100%

Table A1.
[1] Proportion of the total number of operations with hemiarthroplasty performed during the period.

15 most common head types

2005-2011

Stam	2005	2006	2007	2008	2009	2010	2011	Totalt	Andel [1]
Unipolar head	464	656	681	705	1,180	1,415	1,552	6,653	21.9%
Vario Cup	1,015	1,053	1,320	1,380	802	550	366	6,486	21.3%
UHR Universal Head	604	583	638	709	683	686	647	4,550	14.9%
V40 Uni polar	277	333	377	498	724	772	434	3,415	11.2%
Ultima Monk	317	435	388	429	325	281	274	2,449	8.0%
Unipolar head	337	451	228	152	181	136	94	1,579	5.2%
Unipolarhuvud	95	57	120	106	92	94	68	632	2.1%
Versys endo	5	5	61	105	123	159	158	616	2.0%
Covision unipolar head for sleeves	0	0	7	33	153	163	230	586	1.9%
Covision unipolar head	0	0	19	125	87	111	111	453	1.5%
Unitrax	0	0	0	0	2	0	422	424	1.4%
Multipolar cup	0	1	37	73	71	70	89	341	1.1%
Tandem bipolar	0	0	0	14	62	53	60	189	0.6%
Moore modular hemi-head (Anatomica)	33	51	13	4	0	0	0	101	0.3%
Hastings	26	31	3	0	0	0	0	60	0.2%
Others	11	11	21	24	8	18	18	111	0.4%
Missing	1	1	0	0	2	0	0	4	0.0%
Monoblock	690	577	354	129	42	2	0	1 794	5.9%
Total	3,875	4,245	4,267	4,486	4,537	4,510	4,523	30,443	100%

Table A2.
[1] Proportion of the total number of operations with hemiarthroplasty performed during the period.

90-days mortality after hemi-artroplasty per hospital

proportion deceased within three months after hemi-arthroplasty, 2010-2011

Hospital	No. [1]	>80 years [2]	Male [3]	ASA=3 [4]	ASA=4 [5]	Primary prostheses [6]	Surgery within 24h [7]	Mortality [8]
University/Regional hospital								
Karolinska/Huddinge	200	72%	34%	66%	15%	94%	51%	19%
Karolinska/Solna	135	53%	37%	69%	11%	96%	67%	21%
Linköping	167	70%	23%	43%	4%	96%	57%	11%
SUS/Lund	278	74%	37%	64%	8%	95%	59%	16%
SUS/Malmö	409	76%	31%	78%	8%	93%	38%	15%
SU/Mölndal	603	77%	33%	54%	5%	92%	46%	14%
Umeå	157	64%	33%	71%	7%	98%		13%
Uppsala	223	83%	32%	67%	7%	96%	34%	23%
Örebro	181	74%	29%	53%	4%	94%	58%	11%
Central hospital								
Borås	139	78%	29%	58%	6%	95%	51%	19%
Danderyd	318	78%	28%	61%	14%	95%	65%	19%
Eksjö	113	72%	22%	59%	0%	97%	80%	14%
Eskilstuna	93	76%	28%	53%	5%	97%	44%	16%
Falun	246	68%	34%	40%	4%	98%	70%	12%
Gävle	252	72%	27%	47%	7%	96%		19%
Halmstad	132	81%	30%	47%	5%	95%	52%	19%
Helsingborg	354	62%	33%	39%	7%	94%	64%	13%
Hässleholm-Kristianstad	220	73%	32%	47%	2%	95%	75%	15%
Jönköping	109	82%	30%	51%	1%	92%	62%	15%
Kalmar	223	70%	29%	34%	2%	95%	75%	12%
Karlskrona	159	79%	38%	40%	3%	96%	67%	18%
Karlstad	147	79%	34%	64%	2%	95%	66%	22%
Norrköping	129	87%	32%	56%	2%	98%	56%	18%
Skövde	177	74%	33%	43%	5%	96%	39%	17%
Sunderby (incl. Boden)	272	71%	32%	65%	8%	97%	81%	15%
Sundsvall	103	70%	29%	55%	0%	94%	82%	12%
Södersjukhuset	493	78%	29%	60%	16%	94%	34%	17%
Uddevalla	454	74%	35%	53%	6%	94%	47%	14%
Varberg	165	79%	33%	26%	1%	98%	62%	12%
Västerås	124	85%	26%	63%	6%	98%		26%
Växjö	81	78%	33%	53%	10%	96%	65%	21%
Ystad	110	72%	34%	50%	13%	96%	71%	9%
Östersund	197	74%	30%	56%	7%	93%	59%	11%
Rural hospital								
Alingsås	93	56%	28%	37%	1%	96%	77%	5%
Arvika	51	75%	39%	65%	6%	96%	54%	20%
Gällivare	36	69%	25%	50%	3%	94%		11%
Hudiksvall	99	72%	31%	49%	3%	96%	80%	20%
Karlskoga	77	75%	33%	39%	3%	96%	59%	10%
Kungälv	138	67%	36%	62%	4%	98%	63%	13%
Lidköping	61	69%	34%	45%	0%	90%	74%	13%

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90-days mortality after hemi-artroplasty per hospital (cont.)

proportion deceased within three months after hemi-arthroplasty, 2009-2010

Hospital	No. [1]	>80 years [2]	Male [3]	ASA=3 [4]	ASA=4 [5]	Primary prostheses [6]	Surgery within 24h [7]	Mortality [8]
Rural hospital								
Lindesberg	39	77%	44%	41%	3%	95%	47%	8%
Ljungby	46	89%	33%	50%	4%	94%	70%	15%
Mora	93	74%	29%	26%	0%	98%	76%	11%
Norrtälje	83	74%	36%	63%	15%	95%	78%	27%
Nyköping	52	92%	15%	46%	2%	94%	59%	21%
Skellefteå	82	63%	28%	55%	4%	95%	82%	20%
Sollefteå	55	69%	33%	51%	2%	87%		7%
Södertälje	76	70%	40%	64%	3%	96%	59%	17%
Torsby	53	76%	28%	51%	2%	94%	58%	11%
Visby	65	85%	15%	59%	5%	92%	68%	11%
Värnamo	54	78%	30%	44%	2%	91%	89%	13%
Västervik	100	80%	38%	51%	2%	98%	97%	13%
Örnsköldsvik	78	73%	30%	66%	10%	95%		17%
Private hospitals								
Capio S:t Göran	416	82%	27%	66%	4%	95%	50%	15%
Nation	9,033	74%	31%	54%	6%	95%	58%	15%

Table B.
[1] The number of primary hemi-arthroplasties during current period.
[2] Proportion of primary hemi-arthroplasties performed on patients above 80 years of age.
[3] Proportion of primary hemi-arthroplasties performed on men.
[4] Proportion of primary hemi-arthroplasties performed on patients with ASA level 3.
[5] Proportion of primary hemi-arthroplasties performed on patients with ASA level 4.
[6] Proportion of primary hemi-arthroplasties performed due to acute fracture (not secondary).
[7] Proportion of patients operated within 24 hours (from Rikshoft).
[8] 90-days mortality (100(number of patients deceased within three months from primary surgery / number of operations performed during current period)).*
Hospitals with less than 30 hemi-arthroplasties during the period has been excluded.

	Number	Percent
THR	391	1.4
Hemi-prosthesis	253	0.9
Excision arthroplasty	129	0.5
Other surgery	310	1.1
Total	1,083	3.9

Table C. Procedure at first reoperation.

	Number	Percent	Alive at end of follow-up (%)
THR	406	1.5	237 (58)
Hemi-prosthesis	297	1.1	154 (52)
Excision arthroplasty	183	0.7	66 (36)
Total	886	3.2	

Table D. Procedure at first revision.

	Number	Percent
Dislocation	451	41.6
Infection	360	33.2
Periprosthetic fracture	159	14.7
Erosion and pain	73	6.7
Loosening	18	1.7
Other	22	2.0
Total	1,083	100

Table E. Cause of reoperation.

Reoperation within 6 months per hospital

2010-2011

Hospital	No. of prim.op. [1]	No. of reop. [2]	Prop. [3]
University/Regional hospital			
Karolinska/Huddinge	200	0	0.0%
Karolinska/Solna	135	6	4.4%
Linköping	167	3	1.8%
SUS/Lund	278	9	3.2%
SUS/Malmö	409	24	5.9%
SU/Mölndal	603	15	2.5%
Umeå	157	0	0.0%
Uppsala	223	7	3.1%
Örebro	181	9	5.0%
Central hospital			
Borås	139	9	6.5%
Danderyd	318	13	4.1%
Eksjö	113	4	3.5%
Eskilstuna	93	3	3.2%
Falun	246	13	5.3%
Gävle	252	5	2.0%
Halmstad	132	7	5.3%
Helsingborg	354	8	2.3%
Hässleholm-Kristianstad	220	6	2.7%
Jönköping	109	4	3.7%
Kalmar	223	10	4.5%
Karlskrona	159	5	3.1%
Karlstad	147	6	4.1%
Norrköping	129	1	0.8%
Skövde	177	1	0.6%
Sunderby (incl. Boden)	272	6	2.2%
Sundsvall	103	11	10.7%
Södersjukhuset	493	17	3.4%
Uddevalla	454	9	2.0%
Varberg	165	2	1.2%
Västerås	124	4	3.2%
Växjö	81	1	1.2%
Ystad	110	4	3.6%
Östersund	197	6	3.0%
Rural hospital			
Alingsås	93	3	3.2%
Arvika	51	0	0.0%
Hudiksvall	99	1	1.0%
Karlskoga	77	0	0.0%
Kungälv	138	3	2.2%
Lidköping	61	1	1.6%
Mora	93	1	1.1%
Norrtälje	83	4	4.8%

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Reoperation within 6 months per hospital (cont.)

2010-2011

Hospital	No. of prim.op. [1)]	No. of reop. [2)]	Prop. [3)]
Nyköping	52	9	**17.3%**
Skellefteå	82	6	**7.3%**
Sollefteå	55	2	3.6%
Södertälje	76	5	**6.6%**
Torsby	53	1	1.9%
Visby	65	6	**9.2%**
Värnamo	54	2	3.7%
Västervik	100	9	**9.0%**
Örnsköldsvik	78	4	5.1%
Capio S:t Göran	416	11	2.6%
Nation	9,033	301	3.3%

Table F.

[1)] The number of primary hemi-arthroplasties during current period.

[2)] The number of reoperations within 6 months of [1)].

[3)] Quotient between [1)] and [2)] in percent.

Red marking represents values one standard deviation above the national avergae. Hospitals with less than 50 hemi-arthoplasties 2010-2011 have been excluded.

Notes

Follow-up of activities after hemiarthroplasty

For the second time the clinics are showing the departments' results of hemiarthroplasty as value compasses. Since the Registry is not yet receiving patient-reported information regarding hemiarthroplasty, these value compasses contain only four variables (compass points).

In this overall presentation each hospital can compare itself with the national mean value and see whether there is a problem area that can prompt local work for improvement. The result must be seen in a context in which many factors play a part. The value compass may be seen as a balanced control card. The greater the surface, the better the multidimensional total result for each department.

The result is presented in this follow-up model for departments that conducted at least 30 operations during 2010- 2011 and which also satisfactorily reported the degree of dementia. Since Arvika, Jonkoping, Linkoping and Lund reported dementia grade for less than half of their patients 2010-2011 value compasses are not presented for these hospitals.

The result variables for hemiarthroplasty are somewhat different from those for total arthroplasty. Individuals undergoing hemiarthroplasty often have a hip fracture, a condition associated with general morbidity and relatively short survival. Most reoperations take place within some months and long-term complications are unusual. Observation times for reoperation and implant survival are therefore shorter than for total arthroplasty.

- 90 day mortality. In international literature this variable is used to illustrate mortality following hip arthroplasty.
- Completeness. Completeness at individual level according to the latest matching with the Patient Register at the National Board of Health and Welfare.
- Reoperation within 6 months. Provides all forms of reoperation within 6 months of the primary operation and during the most recent two-year period.
- One-year implant survival. Implant survival after one year using Kaplan-Meier statistics.

Since the groups undergoing hemi-arthroplasty differ at different hospitals, each department's 'case-mix' must be studied along with its value compass. The picture of the 'case-mix' is designed in the same way as the value compass and includes the variables, which in the Register and other research have proved to be decisive demographic parameters, for reoperation risk and, to some degree, mortality. The larger the surface in this figure, the more favourable the department's patient profile.

- Proportion of patients 85 years or older. Older age protects against reoperation and revision. The causes can be many: reduced activity reduces the risk of e.g. erosion and probably also dislocation. Short remaining life expectancy means that loosening has not had time to set in. On the other hand this 'risk reduction' that we see may be because an older individual nevertheless is affected by complications but is advised not to undergo reoperation or revision for medical reasons. Departments due to treating many patients aged over 85 years obtain better results regarding reoperation/ revision but poorer regarding mortality.
- Proportion of acute fractures (diagnosis S72.0). The more patients the department treats with hemiarthroplasty due to acute fracture the better the long-term result is according to the Registry's regression analysis of the data base.
- Proportion of non-demented patients. The figure shows the department's proportion of patients judged to be cognitively intact. Dementia does not affect the risk of reoperation/revision according to the Registry's analysis but demented individuals have higher mortality following hip fracture. If a department has a large share of non-demented people their mortality figures improve.
- Proportion of women. Women have generally better results than men regarding need for reoperation/revision.

Discussion

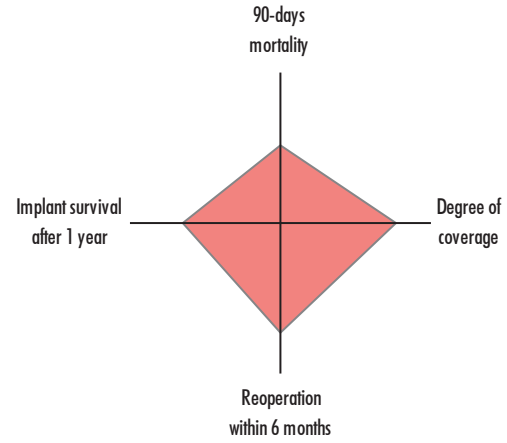
The hospitals whose value compasses signal problems in some area should conduct a local analysis to map all the factors that affect their clinical results. The Registry's staff are happy to support this work practically and can share experience of corresponding analyses of other hospitals.

Given hemiarthroplasty patients' poorer health and high age compared with osteoarthritis patients receiving total arthroplasty, there is reason to believe that it is more often decided not to reoperate a patient affected by complications than in the case of total hip arthroplasty. An infection, for example, can instead be treated with life-long antibiotics. For repeated dislocations, the department may confine itself to repeated closed reduction instead of revision. A fracture near the implant may be treated with non-weightbearing regime in a wheelchair. In special cases, non-operative treatment may be most suitable, and when assessing the value compasses this circumstance should be taken into account. To a certain limit the occurrence of reoperations and revisions can indicate an active approach to complications.

When interpreting the department's value compass, and above all in comparisons, the 'case-mix' profile must always be taken into account!

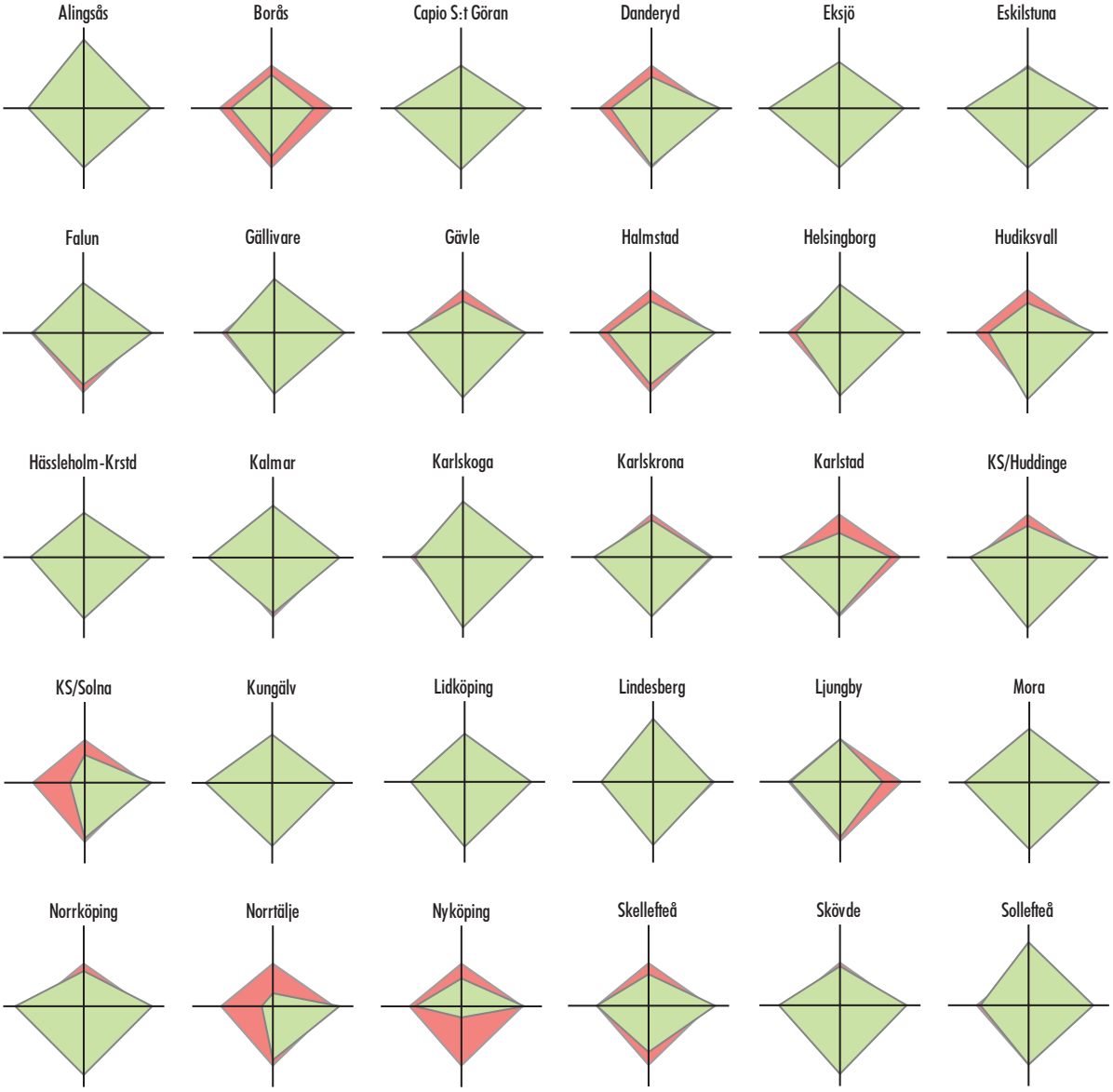
Quality indicators

clinical value compass - national averages

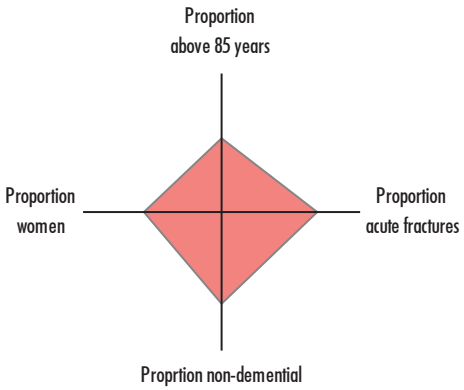


The value compasses show in red national results for the eight variables included. Each department's corresponding values are shown in green. Limit values are set to the highest and lowest value for each variable ± 1SD. The poorest value for the variables is at the origo and the best on the periphery.

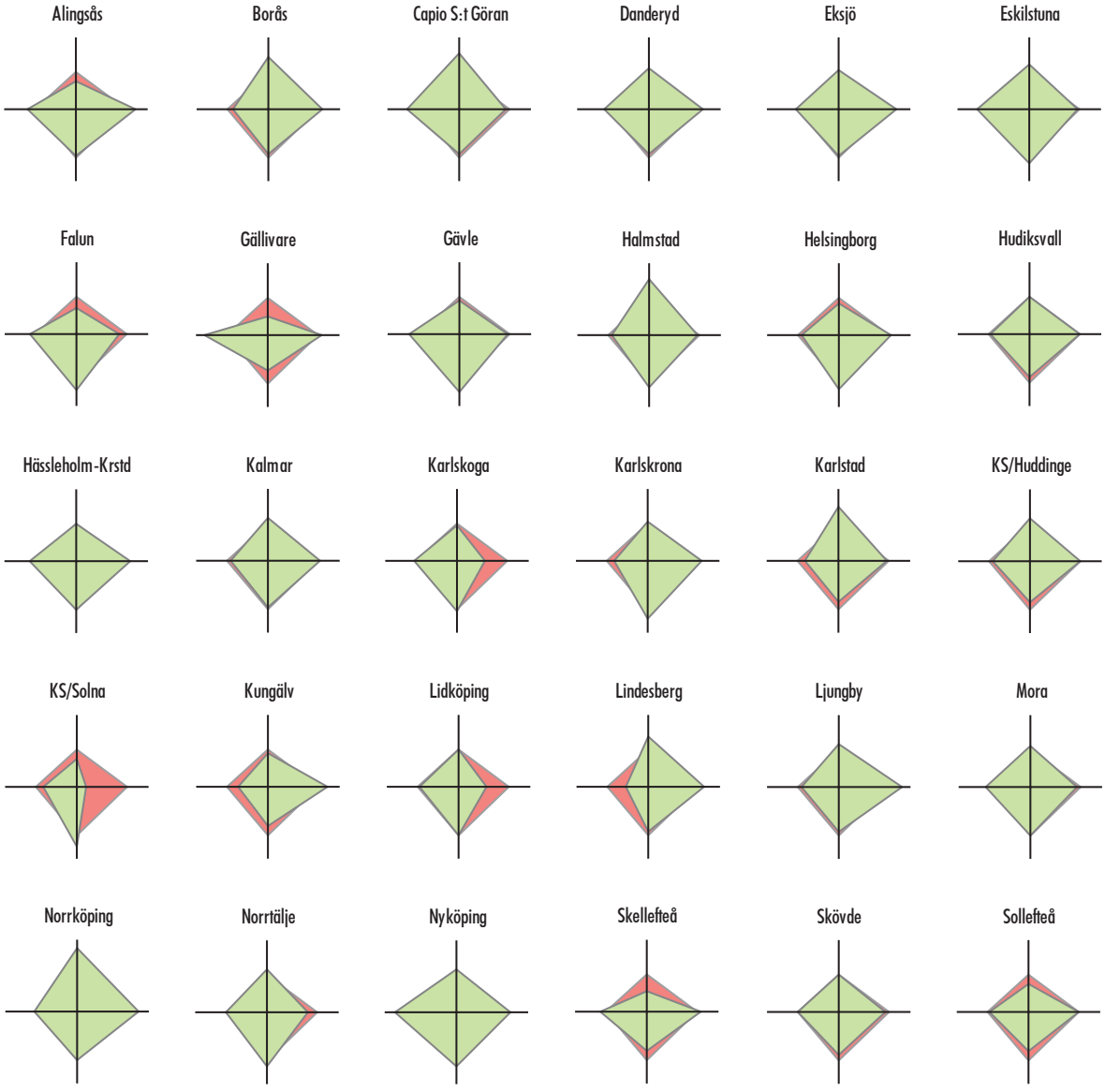
The departments where red fields are visible have a poorer value than the national average for that variable. The outcome can be studied in detail in each table.



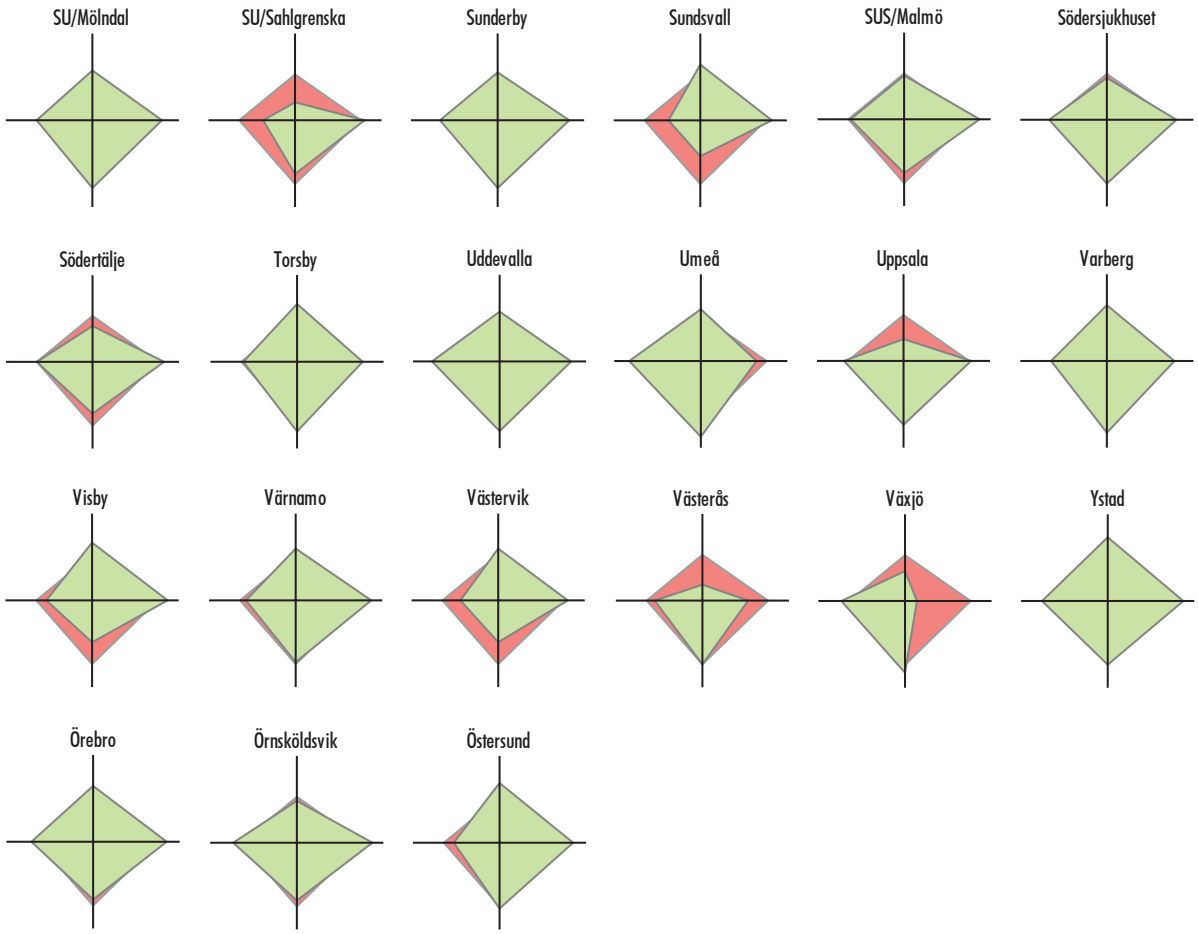
Case-mix factors
national averages



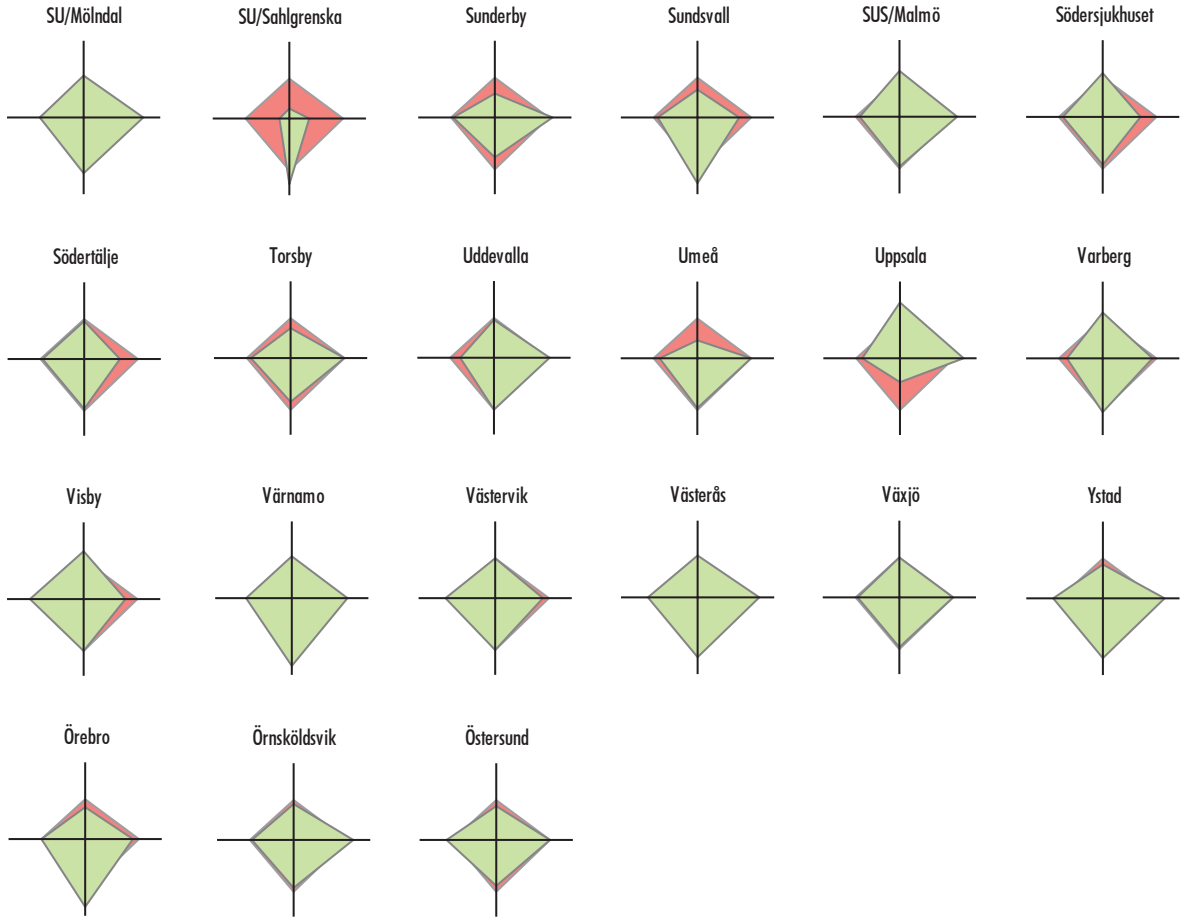
In the graphic presentation of patient demographics ('case-mix') the national result is shown regarding the four variables included, in red. The corresponding values for each clinic are shown in green. Limit values are set to the greatest and the smallest value of each variable ± 1 SD. The poorest value for the variables is at the origo and the best value on the periphery.



Value compasses (cont.)



Case-mix profiles (cont.)



The BOA-project

BOA —
Better management of patients with osteoarthritis

The Swedish National Board of Health and Welfare's guidelines for musculoskeletal disorders indicate long term supervised training as a treatment for OA of the hip and knee. This can be advantageously offered in a patient education programme, a so-called OsteoArthritis school, under the guidance of a physiotherapist. There are currently OA schools in every region and approximately 220 report to the National Quality Registry's BOA register. In the BOA register are, first and foremost patient-reported outcomes, gathered prior to, three months and one year after completed OA school. Several variables are common with PROM in the SHPR. The Swedish National Board of Health and Welfare has also described a new development indicator: each operating clinic shall in the future report the percentage of patients having previously undergone OA school.

OA school is chiefly a part of primary care. The BOA-regiser, however, has shown that two thirds of patients having attended OA school while on the waiting list to the orthopaedic clinic declined to consult an orthopaedic surgeon after OA school. OA school and individually adjusted training was apparently considered sufficient. A follow-up one to three years after the completion of OA school showed that half the patients were still satisfied without having undergone surgery.

The Swedish Hip Arthroplasty Register has therefore broadened its area of interest to the entire disease progression, especially for patients with OA. We can soon, via linkage with BOA, map OA patients' paths through health care. Operations with a choice of good surgical technique and well documented implant types has been extensively analysed in detail by the Registry. There is, however a number of factors, not operation-dependent, that influence those subjective, patient-reported results and the intervention's cost effectiveness. Examples of such factors are:

- Early care of the osteoarthritis patient with adequate non-surgical treatment.
- Avoidance of unnecessary sicklisting.
- Correct indication for surgery.
- Information on condition and correct expectations after surgery.
- Correct information post-operatively.
- Standardised rehabilitation measures.
- Adequate follow-up with early intervention after both short-term and long-term complications.

The BOA-organisation's vision and aim with OA schools is to influence several of these factors.

BOA
Bättre Omhändertagande av patienter med Artros

www.boaregistret.se

International cooperation

The Swedish Hip Arthroplasty Register continues to both intensify and extend its international co-operation. Interest throughout the world in harmonized and combined databases has increased – mostly perhaps because these have a greater potential for what is termed 'post-market surveillance' and 'early-warning signs' (results after an implant has been released on the open market) than what the Swedish Register has. This area of application of a Register has partly been lost in Sweden since six long-established implants represent more than 90% of the Swedish market.

NARA

In earlier Annual Reports we have described in detail cooperation among the established Nordic implant registries resulting in the formation of the Nordic Arthroplasty Register Association (NARA). In 2010 Finland became a full member and is included in the most recently combined database. This has further broadened NARA's opportunities for analysis. The NARA group has now published six scientific papers and several more manuscripts are in progress.

ISAR

The International Society of Arthroplasty Registers started in 2005 as an interest association for the established international implant registers. The aim of ISAR is to improve the outcome of patients throughout the world undergoing knee and hip arthroplasty and to stimulate international cooperation both for established registers and for those under development. The Registry's Project leader is currently the president of this society.

ICOR

As yet there is no functioning federal American implant register – despite several years of preparation and negotiation. The Food and Drug Administration (FDA), which, among other things, approves implants for American clinical use, in co-operation with the Kaiser Permanente and Hospital for Special Surgery/Cornell Medical College, took the initiative in 2010 for a new international collaboration resulting in the formation of the International Consortium of Orthopaedic Registries (ICOR). The first ICOR meeting was held in Washington in May 2010. In addition to the established registers even the Cochrane Collaboration participated (Musculoskeletal Group). The aim of the organisation is to harmonize the outcome variable content of the existing register in order to create a mega database for an international metaanalysis based on observational studies. In December 2012 14 "review" articles were published from this meeting, in a supplement to the American editionen of JBJS.

1st International Congress of Arthroplasty Registries

The above organisations decided in 2011 to, in a collobaration, arrange the first international congress concerning the arthroplasty Registry: 20–22 May 2012 in Bergen. The meeting gathered about 200 participants from all over the world at an intensive and eventful 2-day meeting. Bergen served up tropical summer weather, which was a surprise to the well-dressed Japanese as well as the others from "down-under", who expected glaciers and polar bears. The program consisted of a number of "key-note speakers" that spoke of general register issues such as: statistics, harmonization of variables, etc. The meeting also contained a number of sessions with free lectures and a poster exhibitition. ISARs management group had, when planning the Bergen meeting, discussed a new meeting after 2 years, but the reaction at the Bergen meeting was very positive, which is why ISAR is now planning meeting number two as early as June 2013. If anyone has the least interest in orthopaedic registers, we recommend participation in this Shakespeare-inspired meeting.

County-council results

In earlier Annual Reports we have published procedure frequencies and implant survival analyses at regional levels (older regional division). Since Regional Comparisons (*Oppna jamforelser*) reports on a county-council level we have reworked this section with reporting of procedure levels and the Registry's national quality indicators by county council.

Procedure frequencies nationally and by county council

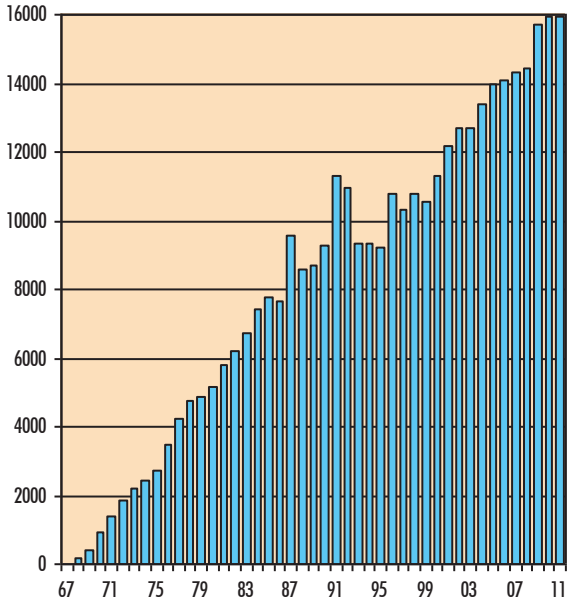
The entire procedure frequency of total hip replacements2011 in Sweden was by and large unchanged compared to 2010 but was marginally lowered per 100 000 residents from 170 to 168. This figure concerns the entire population and is based on Statistics Sweden's population statistics on the 31st of December 2011 (9 482 855 residents). Please observe that many national and international comparison reports are based on the statistics from the Swedish National Board of Health and Welfare (PAR) that since 2000 has had 5-6% lower completeness than the Register!

Production versus consumption per 100 000 inhabitants per county council

Decision-makers are, of course, chiefly interested in what are termed consumption figures by county councils – while the profession and quality registers (particularly those that oversee a surgical intervention) have, instead, focused on 'production figures'. Consumption means that county councils/regional inhabitants have access to hip arthroplasty regardless of whether the intervention is carried out in the home county or elsewhere. These figures are of significance for management and control. They can also be used for activity analysis and clinical improvement work, a large component of the quality registries' assignments.

Dissemination of both production and consumption figures per 100,000 inhabitants (not age-adjusted) shows a large variation between principals (the private entrepreneurs are included geographically); production: 139-288 and consumption 126- 230/100,000 inhabitants. That is, consumption is almost double between county councils with the lowest consumption and those county councils/regions with the highest. The reason for this considerably large variation cannot depend solely on demographic differences. The current situation speaks against geographically equal health care for the treatment of OA of the hip in Sweden. Unfortunately the Registry's management believes that non-medical and local "political" decisions are perhaps one of several reasons for this large variation. The Registry will be focusing largely on this issue in the next few years – both for regional operational analyses and clinical research. The foremost instrument for such an analysis are the extensively linked databases we have created and plan to create (SHPR, SoS, SCB och FK). Such processes are sluggish whereby they demand ethical approval and are burdened by extensive resource consumption for the Registry (competent personnel and high costs). Because of this there are always delays for such an analysis – often at least 2-3 years if one is to include short term results after elective operation by total hip replacement.

Primary total hip replacement in Sweden



The Swedish Hip Arthroplasty Registry and Regional Comparisons

In November 2012 the seventh report of Regional Comparisons was published. The report is a collaboration between the Swedish National Board of Health and Welfare and the Swedish Association of Local Authorities and Regions (SALAR). Even this year the number of national quality indicators have increased to approximately 200, whereof more than half are gathered from the National Quality Register. The report is to be considered a paradigm shift for the management of Swedish health care. County and regions have long managed health care based on cost and production analyses – the shift consists of an increasing focus on medical results. Quality registers have for many years published medical outcome measures, but it is first when they have been gathered in a common national report that medical treatment results have gained a distinct breakthrough in the strategic leadership and management of health care.

The report is not a scientific document but builds on existing data, and shall be considered a signal system preferably resulting in local analyses on a regional and local level, which is somewhat like the assignments of the individual registers.

The Swedish Hip Arthroplasty Register is one of the National Quality registers that supplies data to Regional Comparisons. The Register stands for five indicators as presented below. The indicators are also presented on a unit level, which is becoming increasingly common for indicators from the quality registers. Another 2 indicators illuminate hip replacement surgery with data from the Patient register (the Swedish National Board of Health and Welfare): Hip replacement surgery following femoral neck fracture and "adverse events" within 30 and 90 days. These indicators are shown in this report on page 58.

Production

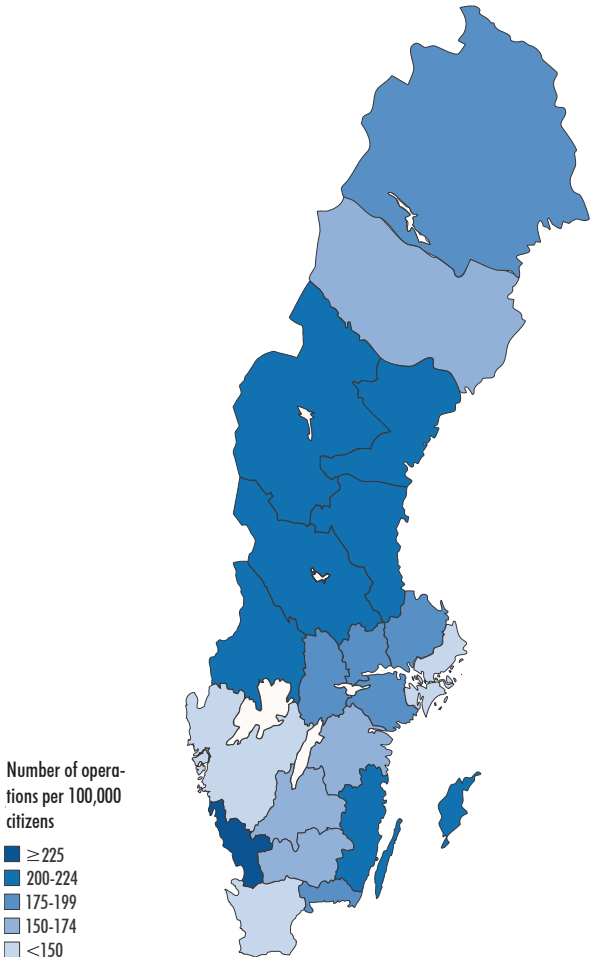
Län	Operations	Population	No. [1]
01 Stockholm	2,998	2,091,473	143
03 Uppsala	611	338,630	180
04 Södermanland	538	272,563	197
05 Östergötland	742	431,075	172
06 Jönköping	540	337,896	160
07 Kronoberg	310	184,654	168
08 Kalmar	511	233,090	219
09 Gotland	118	57,308	206
10 Blekinge	271	152,979	177
12 Region Skåne	1,779	1,252,933	142
13 Halland	877	301,724	291
14 Västra Götaland	2,196	1,590,604	138
17 Värmland	548	272,736	201
18 Örebro	531	281,572	189
19 Västmanland	460	254,257	181
20 Dalarna	589	276,565	213
21 Gävleborg	612	276,130	222
22 Västernorrland	494	242,155	204
23 Jämtland	278	126,299	220
24 Västerbotten	451	259,667	174
25 Norrbotten	489	248,545	197
Riket		9,482,855	168

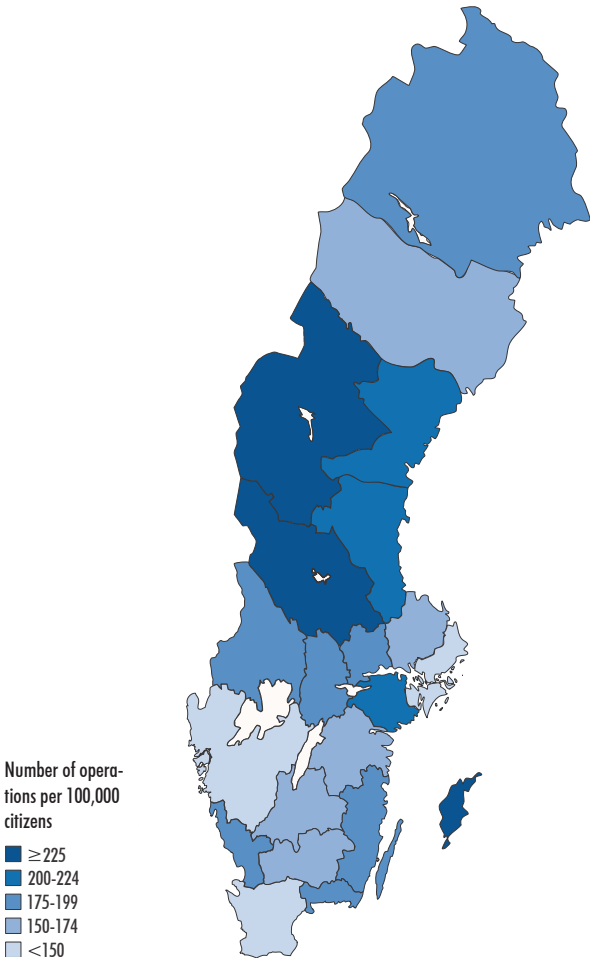
[1] The number of operations per 100 000 citizens.

Consumption

Län	Operations	Population	Prop. [1]
01 Stockholm	2,635	2,091,473	126
03 Uppsala	549	338,630	162
04 Södermanland	545	272,563	200
05 Östergötland	718	431,075	167
06 Jönköping	569	337,896	168
07 Kronoberg	310	184,654	168
08 Kalmar	429	233,090	184
09 Gotland	129	57,308	225
10 Blekinge	268	152,979	175
12 Region Skåne	1,660	1,252,933	132
13 Halland	549	301,724	182
14 Västra Götaland	2,372	1,590,604	149
17 Värmland	544	272,736	199
18 Örebro	496	281,572	176
19 Västmanland	484	254,257	190
20 Dalarna	637	276,565	230
21 Gävleborg	584	276,130	211
22 Västernorrland	492	242,155	203
23 Jämtland	287	126,299	227
24 Västerbotten	427	259,667	164
25 Norrbotten	469	248,545	189
Riket		9,482,855	168

[1] The number of operations per 100 000 citizens.





Short-term complications, meaning reoperation (all types) within two years after the primary operation. Reported for the four latest years. This variable is, in this context, to be considered a "quick" quality indicator. Observe that the report concerns complications surgically managed (see chapter "Short-term complication – reoperation within 2 years").

10-year survival of total hip replacements according to traditional Kaplan-Meier statistics. The definition of failure is the exchange of some component or the final removal of the entire implant. All primary diagnoses and all causes of revision operations are included. Their results concern the operational period 2002 up until and including 2011. This variable is to be considered as "slow" but far reaching, an important quality indicator.

EQ-5D index gain 1 year after operation. The government's mission pointed out: "that indicators reflecting patient experienced quality should be included". The patient-reported outcome with health gains is an important variable for this patient group operated on with low health-related quality of life as an indication for intervention. Even this variable is to be viewed as a "quick" quality indicator.

Porportion of patients satisfied with surgical results 1 year after operation. The definition of "satisfied" is whether patients marked, on a VAS, 0 until and including 40 (0=satisfied, 100=dissatisfied). This indicator does not completely correlate to the previous indicator: a low EQ-5D index gain can be linked to a high degree of satisfaction and vice-versa.

1-year survival of hemiarthroplasty according to traditional Kaplan-Meier statistics. The definition of implant survival is the same as for total arthroplasties. All primary diagnoses and all causes of revision operations are included. The results cover the period of 2009-2011 inclusively. Since this group of patients are older and have more multiple illnesses with a high one-year mortality, this survival statistic is a faster indicator than the corresponding 10-year analysis for total implants.

Results

When interpreting these results the confidence intervals distinctly displayed in the illustrations must be taken into account. If the confidence intervals overlap one can simply say that there is probably no statistical difference between the results presented.

One must also consider patient demographics between the different regions. Certain regions have no university/ regional hospital within its district, and can then work with a less risk-laden patient makeup. Observe that the Registry only registers complications demanding some sort of additional surgery. Non-surgical complications are captured partially by the indicator "adverse events".

Short-term complications. As stated complication rates are low and should be assessed with caution. This quality indicator can in actuality only be evaluated over time, i.e. if there are clear trends in the analyses of the previous years. For the past few years this indicator has been steady at 1.6% to 1.8%. The spread at hospital level is 0.0% to 4.4%. Ten-year survival. Sweden has the world's highest reported 10-year survival of total hip arthroplasties in international compar- isons. At county council level there are no large and significant differences which are detectable at unit level.

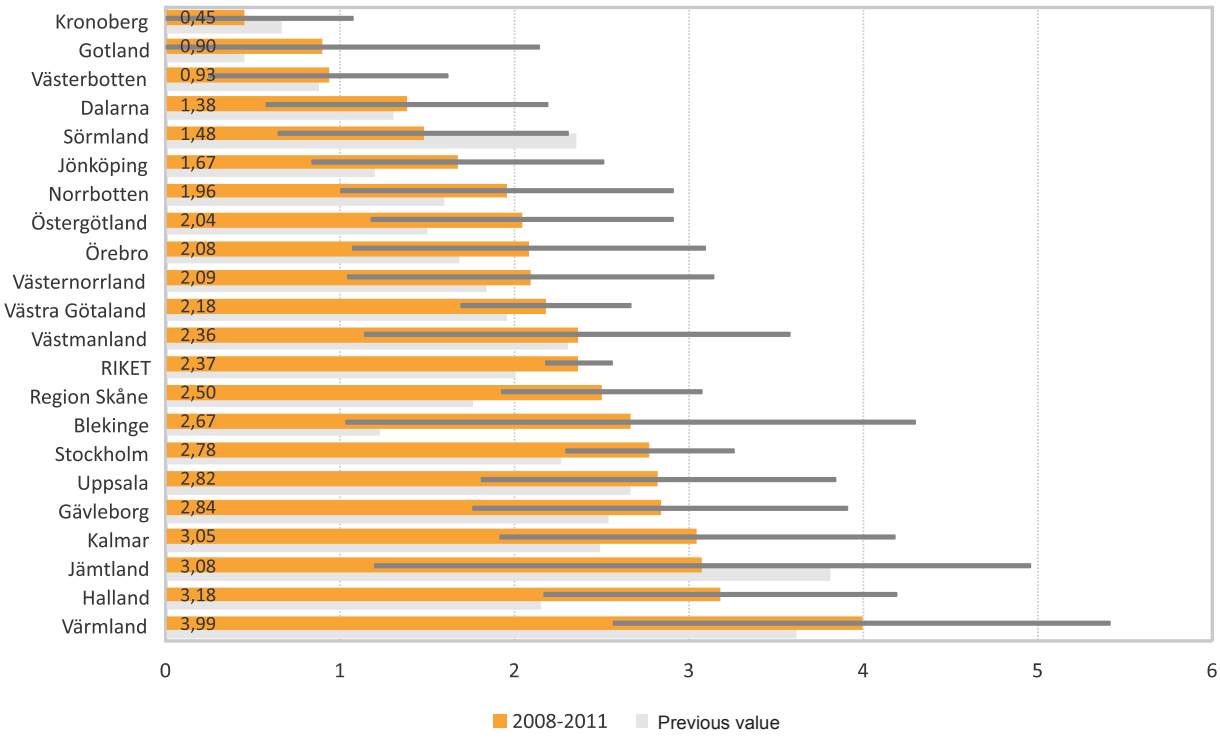
EQ-5D index gain. The routine for patient-reported outcomes has now been implemented throughout the country. Variations at county- council level are relatively large and should prompt analyses regarding indications and waiting times for the intervention.

Proportion of patients satisfied with the results of surgery one year after operation. This year's analysis shows on a national level that 14% of all patients undergoing surgery between 2009 and 2010 and one year after operation were unsure or directly dissatisfied. During this period less than 1% of cases underwent reoperation. This group of 'non -responders' is an important future target group for clinical improvement work and clinical research.

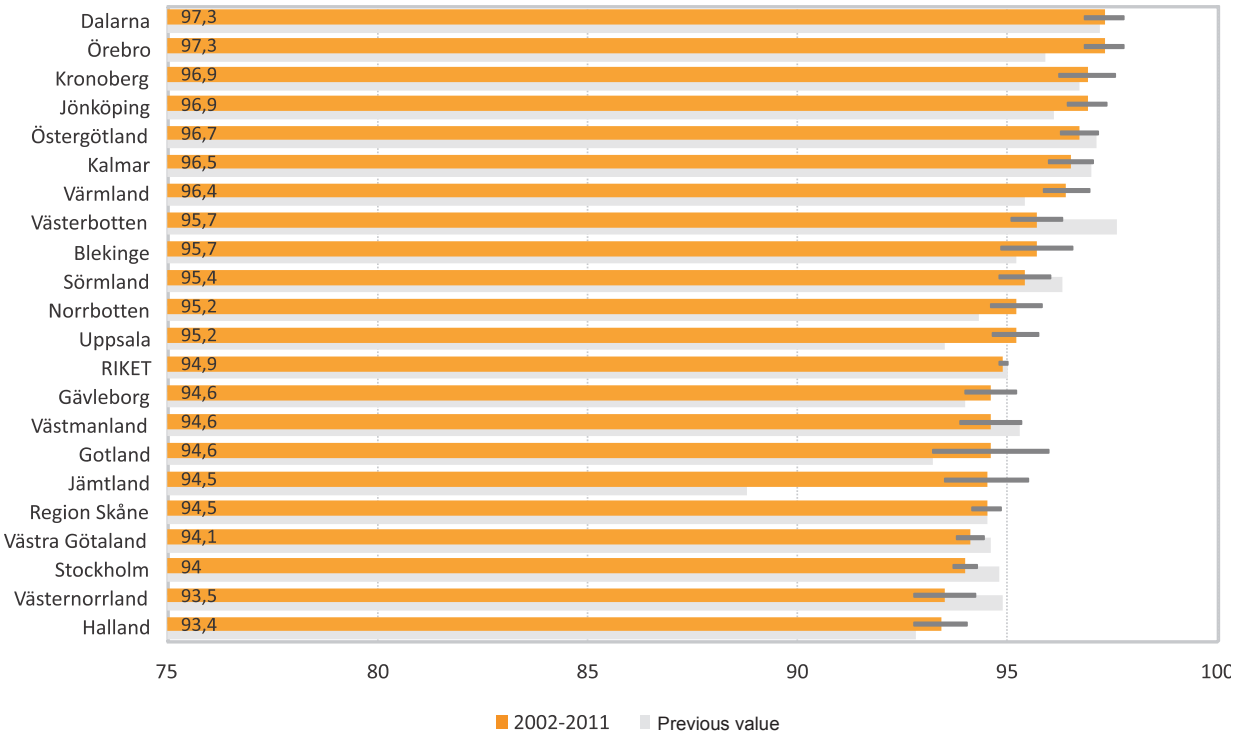
1-year survival of hemiarthroplasies according to traditional Kaplan-Meier statistics. The variation for this indicator as early as one year latern is somewhat larger than the corresponding for total hip arthroplasties after 10 years, with a county-council variation of 89%-98%. The variation can partly be because the treatment algorithm for dislocated cervical hip fractures has been implemented differently in the various county councils, with varying indicators for both hemi- and total arthroplasties following hip fracture.

The gender perspective. All five indicators show gender differences. Many previous studies have shown a generally increased risk for reoperation andrevision and male mortality. The current results confirm these earlier findings. Large population studies (cross-sectional studies) in Sweden have shown that women in general state lower health-related quality of life than men of corresponding age. The EQ-5D gains are, however, the result of a prospective longitudinal study, and women haveon average indicated a marginally, somewhat better health gain.

Proportion reoperations within 2 years after total hip arthtroplasty
2008-2011

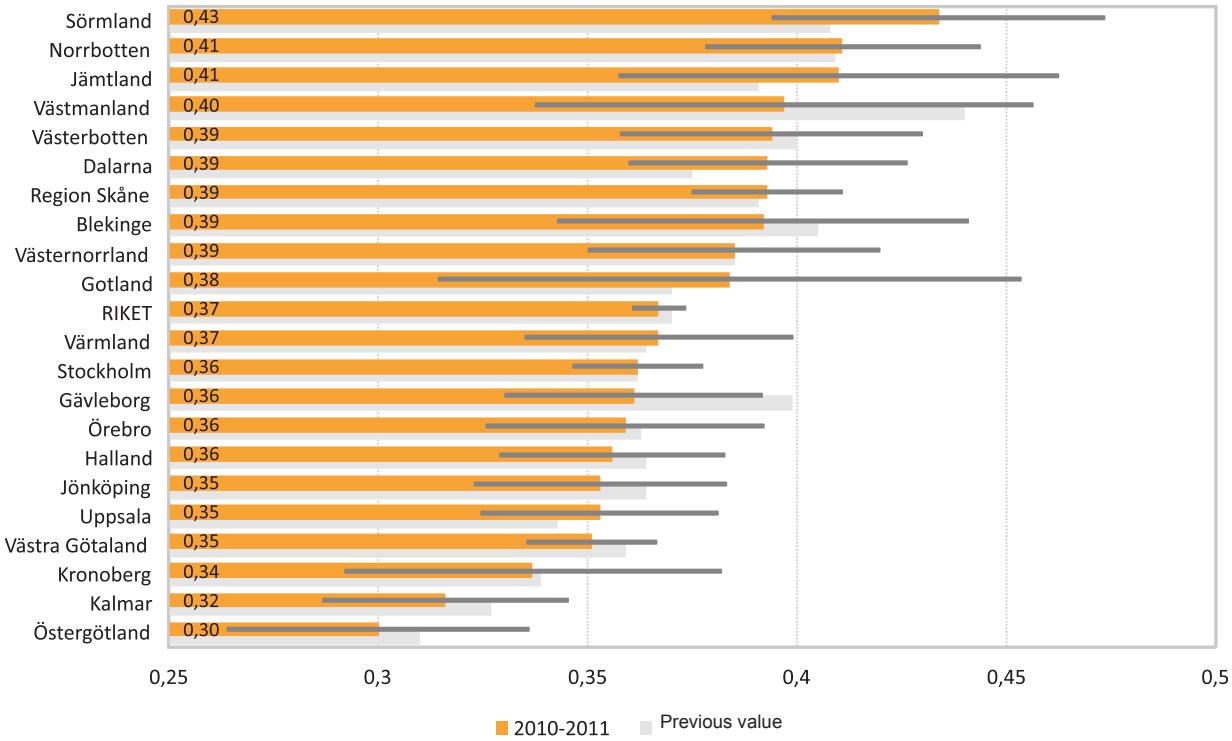


Probability to not be reoperated within 10 years after total hip arthroplasty
2002-2011



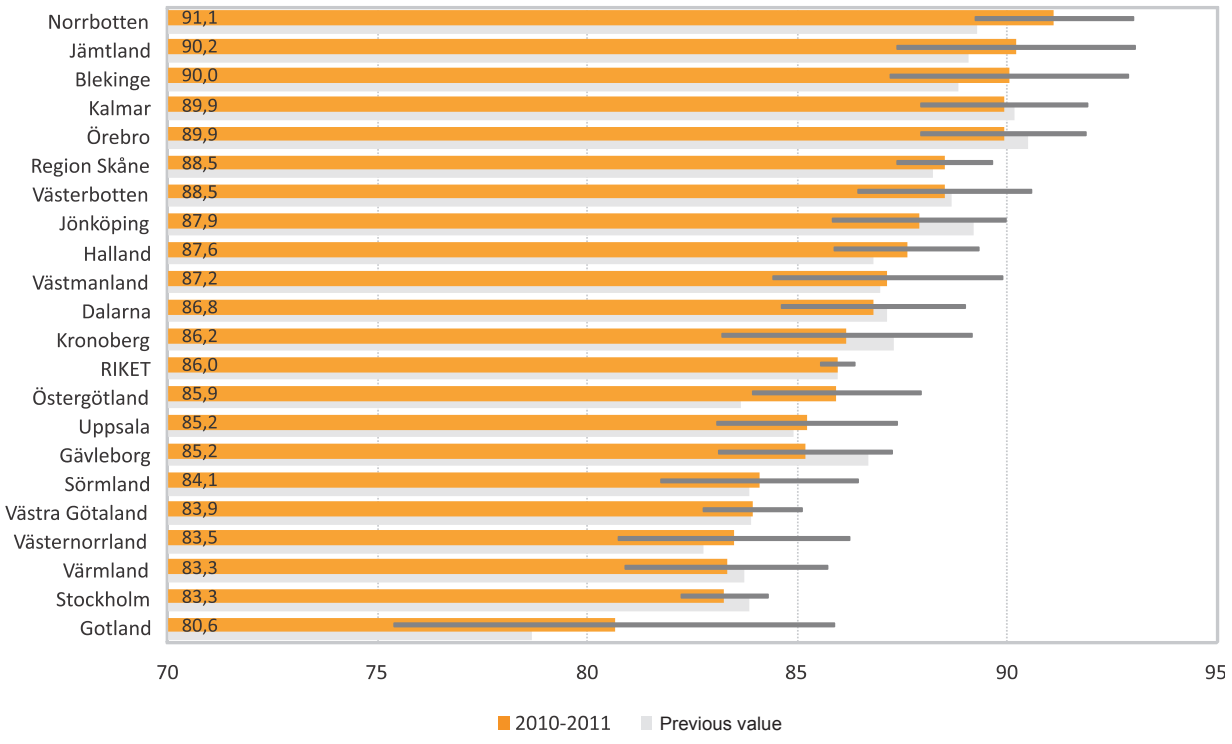
Gain in EQ-5D index 1 year after total hip arthroplasty

2010-2011



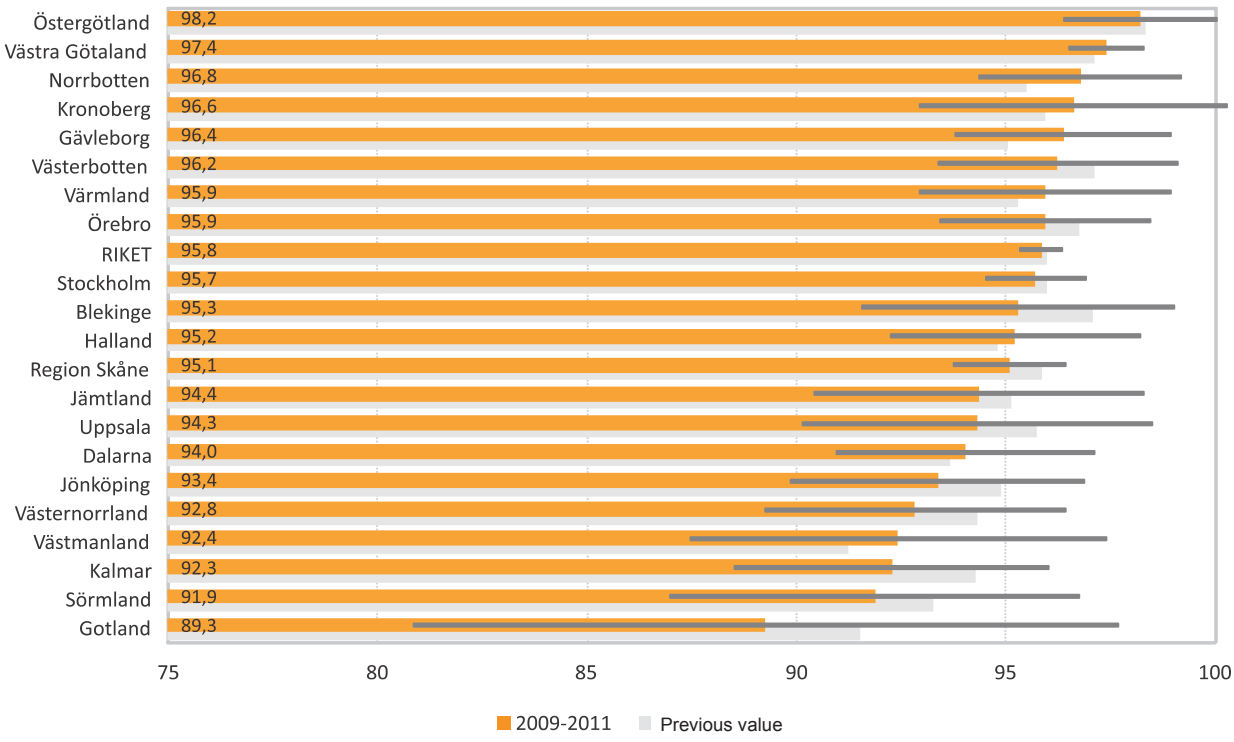
Patient satisfaction 1 year after total hip arthroplasty

2010-2011



Probability to not be reoperated within 1 year after hemi arthroplasty

2010-2011



Current research projects

The chief tasks of a National Quality Register are analysis of activities, work for improvement and clinical research. Our very extensive databases possess a large and unexploited potential for research. Combination databases using official databases such as the health data registers of the National Borad of Health and Welfare, the National Insurance Office, Statistics Sweden and regional patient-administration systems can result in globally unique databases for observational studies.

In research and evidence-based medicine the randomised controlled study (RCT) is considered the research gold standard. However we have no possibility of running this type of study in all areas – perhaps least of all within surgical disciplines. The randomisation process does not include the role of the surgeon, her or his experience and competence. What is termed 'single-surgeon' material seldom manages to attain statistical power. A national prospective observational study (register study) has characteristics unreachable with an RCT. Large materials afford above all possibilities to analyse unusual complications with great statistical power. Another great advantage is that generalisable results can be achieved – a result measured within the entire profession. In an RCT what is termed 'performance bias' can easily arise, that is, this type of study often reflects an intervention at a special unit and/or by the innovator of a method.

Clinical research and above all register-based research have for many years had low status in Sweden. However, there has been a clear break in the trend during the past few years. It is also very gratifying that Cochrane Collaboration (Musculoskeletal Group) is considering including register results in its reviews, which will then enhance the evidence value of this type of study.

Eleven doctoral theses and about a hundred scientific articles have been published, wholly or partly based on analyses from the Swedish Hip Arthroplasty Register. The Registry wishes to stress that the Register's databases are not only a matter for Registry colleagues in Goteborg. All researchers in this country and elsewhere can, if there are adequate areas for discussion, use the Register for research.

Research projects within the Registry

The Registry's management and its governing body include a number of postdoc researchers who are supervisors and deputy supervisors for a number of doctoral students. In this group, research moving into implant fixation, hip fractures and implant surgery, periprosthetic fractures, revision surgery and patient-reported outcome. This group consists of:

- Johan Karrholm, Goteborg
- Goran Garellick, Goteborg
- Henrik Malchau, Goteborg
- Cecilia Rogmark, Malmo
- Leif Dahlberg, Malmo
- André Stark, Stockholm
- Per Wretenberg, Stockholm
- Nils Hailer, Uppsala
- Hans Lindahl, Trollhattan
- Peter Herberts, Goteborg
- Rudiger Weiss, Stockholm
- Lars Weidenhielm, Stockholm
- Ola Rolfson, Goteborg
- Truike Thien, Goteborg
- Olof Leonardsson, Malmo
- Olof Skoldenberg, Stockholm

Doctoral students with all or parts of their thesis material from the Register:

Buster Sandgren, Stockholm
Computed tomography of patients receiving an uncemented acetabular component in connection with a hip arthroplasty.
Ferid Krupic, Goteborg
The significance of socioeconomic variables for outcome following hip arthroplasty.
Olof Leonardsson, Malmo
Hip fracture treatment with hip arthroses.
Oskar Strom, Stockholm
Health-economic aspects of hip implant operations and the treatment of osteoporosis.
Viktor Lindgren, Stockholm
Complications and outcome following hip Arthroplasty, with special emphasis on infections and the significance of the surgical approach.
Max Gordon, Stockholm
The significance of comorbidity and socioeconomic variables for outcome following hip arthroplasty.
Per-Erik Johanson, Goteborg
Hip implants for the younger patient. Evaluation of different prosthesis designs.
Meredith Greene, Boston and Goteborg
Predictors of patient-reported outcome following hip arthroplasty.
Georgios Chatziagorou, Goteborg
Early and late fractures near the femur.
Jonas Wohlin, Stockholm
Effects of the Free Choice of Care on results and costs of hip arthroplasty.

The Registry now also has intense research cooperation within NARA and the group's first eight scientific articles are published and several more manuscripts are in progress. The Registry is also included in the new international collaboration within ICOR (International Consortium for Orthopaedic Registries) and has participated in several international review articles.

The Swedish Hip Arthroplasty Registers databases are still under-exploited for research. The management invites cooperation from all interested researchers with adequate subjects of study.

Publications

Scientific articles

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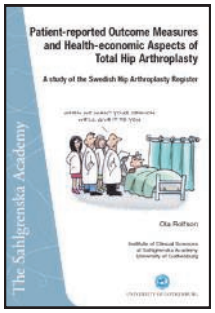

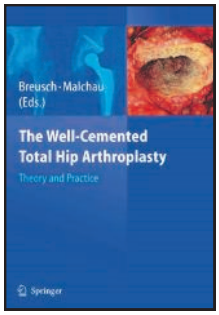

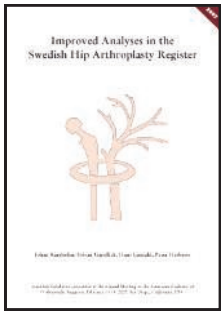

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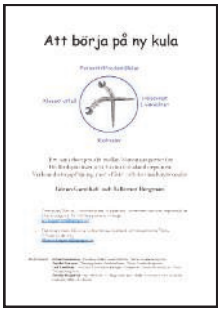

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2.1 Operative Steps: Acetabulum, pages 16-27.
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2.2 Operative Steps: Femur, pages 28-36.
Steffen J. Breusch, Henrik Malchau

6.1 Optimal Cementing Technique – The Evidence: What Is Modern Cementing Technique?, pages 146-149
Henrik Malchau, Steffen J. Breusch

7.3 Migration Pattern and Outcome of Cemented Stems in Sweden, pages 190-195
Jeffrey Geller, Henrik Malchau, Johan Karrholm

11 The Evidence from the Swedish Hip Register, pages 291-299
Henrik Malchau, Goran Garellick, Peter Herberts

19 Economic Evaluation of THA, pages 360-366
Marieke Ostendorf, Henrik Malchau

20 The Future Role of Cemented Total Hip Arthroplasty, pages 367-369
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VÄSTRA
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