

**XBase**

THE SWEDISH NATIONAL  
KNEE LIGAMENT REGISTER

# Swedish ACL Register. Annual Report 2011.

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3,311 primary operations and 222 revisions.

ALINGSÅS LASARETT BLEKINGESJUKHUSET CAPIO ARTRO CLINIC CAPIO LÄKARGRUPPEN I ÖREBRO  
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ORTHOCENTER I SKÅNE ORTHOCENTER STOCKHOLM ORTHOCENTER/IFK-KLINIKEN ORTOPEDISKA HUSET  
OSKARSHAMNS SJUKHUS PERAGO ORTOPEDKLINIK S:T GÖRANS SJUKHUS CAPIO, STOCKHOLM  
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SOLLEFTEÅ SJUKHUS SOPHIAHEMMET SPORTS MEDICINE UMEÅ SUNDERBY SJUKHUS SÖDERSJUKHUSET SÖDRA  
ÄLVSBORGS SJUKHUS VARBERGS SJUKHUS VRINNEVISJUKHUSET VÄRNAMO SJUKHUS/ORTOPEDKLINIKEN  
VÄSTERVIKS SJUKHUS VÄSTERÅS CENTRALLASARETTET ÖREBRO USÖ

## Preface

The incidence of anterior cruciate ligament (ACL) injuries has not been fully determined, but it is estimated at between 32-70/100,000 inhabitants/year. Recent Swedish studies actually indicate a somewhat higher incidence of around 80/100,000 inhabitants/year. ACL is a serious knee injury that often prevents young people from continuing to engage in heavy physical work or physical exercise without satisfactory treatment. Regardless of the primary treatment, studies have revealed that about 50% of patients experience radiological signs of knee arthrosis within 10-15 years after the initial injury.

Treatment can take the form of only rehabilitation or surgery (ACL reconstruction) and rehabilitation. It is, however, estimated that about half of all cruciate ligament injuries are not the subject of surgery for different reasons. An injury frequency of approximately 80 per 100,000 inhabitants in Sweden would mean that some 5,800 individuals suffer cruciate ligament injuries every year and that more than 3,000 undergo surgery. Recent studies reveal that around 20% of the patients undergoing surgery require repeat surgery within the space of a few years as a result of complications, first and foremost meniscal and/or cartilage damage, restricted mobility or the failure of the reconstructed cruciate ligament. The results after secondary surgery are probably poorer than after primary surgery. Good results have been reported in the short term after the primary operation, but there are only a few studies that are randomized or have a long follow-up. The number of operations per surgeon is unevenly distributed and about half of all surgeons perform fewer than 10 operations a year. A trend towards an increase in the number of operations per surgeon has, however, been seen since the ACL register began in 2005.

To begin with, the ACL register was a surgical register, but there are plans in the future to register all patients with this injury, regardless of treatment. The absolute majority of the patients registered so far have undergone surgery and this annual report therefore focuses on reporting the results after ACL reconstruction.

## Goal fulfillment

The goal when treating an individual who has suffered an ACL injury is a satisfied patient with optimal knee function and normalized, health-related quality of life. The result should also be long lasting.

The main indication for an ACL reconstruction is functional instability, which is primarily described as the “knee giving way” or the “knee buckling”.

In 2011, 3,311 primary operations were reported compared with 3,360 in 2010. The number of reported revisions in 2011 was 222 compared with 227 in 2010.

Data on patient-reported function and health-related quality of life are collected using questionnaires (see KOOS and EQ5D below). In 2012, a new measurement of satisfaction, “symptom satisfaction”, will be introduced as a pilot study.

The register performs the continuous validation of data. The internet-based data input program contains instructions, manuals, definitions and help functions, plus a number of mandatory variables, which are available interactively. This also means that some data may be changed if comparisons are made with previous years, as updating may have taken place retroactively. This year's data are based on an analysis conducted on 7 March 2012.

## Future vision for national quality registers

A review of the national quality registers and a proposal for a joint project in 2011–2015 have been published by Sveriges Kommuner och Landsting (SKL, Sweden's Municipalities and County Councils), *Guldgruvan i hälso- och sjukvården* (*The gold mine in the health-care and medical service*). In Sweden, there are more than 70 national quality registers covering over 25 percent of the total cost of health care. Musculoskeletal conditions account for a large percentage of health-care costs. Musculoskeletal conditions and injuries also generate large costs for the health service and are an important reason for sick leave in the developed countries (*The Burden of Musculoskeletal Conditions at the Start of the New Millennium*). It is estimated that the total cost is around 3% of the western world's GDP. The consequences in the form of pain and physical disabilities often lead to sick listing. Around a quarter of the inhabitants in Europe have some form of problem that results in reduced mobility, pain and suffering.

As a result, an important line of development for the ACL register is also to include and follow up patients with conservatively (non-surgically) treated ACL injuries in order to determine the long-term risk of developing arthrosis based on the way these patients are treated (no treatment, structured rehabilitation or surgical treatment). Co-ordination with closely related registers with the aim of creating a larger database with more dimension will be investigated. The register has already been linked to certain parts of the case notes system, such as the national quality register for gynecological surgery or the Swedish rheumatological quality register, and this should also be investigated with a view to simplifying the input of data and following up patients' knee function and health.

As the register has been in existence since 2005, it is also starting to be possible to study whether changes in surgical methods are leading to improvements for patients. In the same way, it is also important to identify and characterize sub-groups which do not respond to treatment and special risk groups.

As a result of personal identity numbers, Sweden offers unique opportunities for comparing statistical databases based on these personal identity numbers, following ethical approval.

The decisive factor when it comes to the success and applicability of a register is its coverage. Without good coverage, it is difficult to run qualitative improvement programs and conduct scientific studies. The coverage should be specified at individual level. Coverage relating to the participating clinics is also an important variable, but, if the participating units under-report at an individual level, the analyses and feedback will still be misleading.

To date, results are available from 2005. The level of reporting has increased when it comes to primary operations, revisions and repeat operations and the focus now is to ensure the lowest possible loss of reports over time.

## Areas for improvement and action

### Preoperative patient-reported data

The national coverage of completed operations remains high (90%). Patients' self-reported data prior to surgery are unchanged compared with 2010 (70% and 69% respectively), but the figure is still lower than in 2009, when 73% of all registered patients provided self-reported data prior to surgery. During the year, the register board tasked its individual members with contacting the clinics that displayed a negative trend in 2011 to determine the underlying causes of this trend. No single, clear-cut explanation could be identified. In 2012, we shall be recruiting a project coordinator who will be tasked with contacting all the clinics, to investigate this decline, among other things. It is the register board's aim that 80% of all patients should report preoperative data.

### Follow-up data

As before, patient-reported data are followed up using targeted questionnaires that are sent via conventional mail to the patients' home addresses 1, 2 and 5 years after surgery. KOOS (Knee injury and Osteoarthritis Outcome Score) data from the 1-year follow-up are currently missing for 40% of the registered participants, while KOOS data from the 2- and 5-year follow-ups are missing for 50% and 60% respectively of the participants. These figures are therefore unchanged and remain at a low level compared with previous years. Measures, such as the opportunity to use so-called social media or mobile applications, have been discussed, as the register primarily involves young people. Attempts to reduce the loss of data are a priority area for 2012.

### Non-operated individuals with ACL injuries

The register is still a surgery register, even if the aim for several years has also been to include non-operated individuals with ACL injuries. An information sheet has been produced and the register website has been updated to include the opportunity to register as a patient with a confirmed diagnosis, even if any decision to perform surgery has not yet been finalized. This pilot study will be conducted by the Skåne University Hospital, Helsingborg Hospital, Linköping University Hospital, Hässleholm Hospital and the Capiro Arthro Clinic. If the results are positive, other clinics will be involved and the plan is that the register will have an effective national registration system starting in 2013. Questions, such as how follow-ups will be made, how we handle the patients who eventually have surgery and specific information on the rehabilitation process, must still be resolved.

### Questions relating to surgical techniques

A national and international discussion relating to surgical techniques is currently in progress and it is now possible to begin analyzing the results. These analyses will include patient-reported outcomes and the results are expected to have a major impact both nationally and internationally. Preliminary reports from the Norwegian ACL register reveal that the number of revisions for hamstring grafts compared with patellar tendon grafts has increased. We have not been able to demonstrate this in the Swedish register, but the percentage of patients who undergo patellar tendon grafts is extremely low in Sweden (2% compared with around 30% in Norway). The Danish register has preliminarily reported an increase in the number of revisions on patients undergoing surgery with the medial portal technique compared with the transtibial technique. Unfortunately, the Swedish register does not contain any detailed information about the technique that is used, but this is an improvement that is planned in 2012.

### IT operations

The database is run by the Capiro Arthro Clinic on behalf of Karolinska University Hospital in its capacity as register owner. Future collaboration with other orthopedic registers is a future vision which the register board favors. To achieve this, however, user-friendly interfaces and the opportunity for all users to feed in data 24/7 and analyze the database are essential.

## Reporting

- At the present time, there are about 80 clinics in Sweden that provide orthopedic care. Of these, 62 have informed the ACL register that they perform ACL surgery. In 2011, 3,311 primary ACL operations and 222 revisions were registered. In 2011, 155 cruciate ligament surgeons were registered.
- Information to the database is managed via a website – [www.aclregister.nu](http://www.aclregister.nu). Patients are able to log into this website to report questionnaire answers. Each patient is given a unique user ID and a password, which cannot be traced using his/her personal ID number. The completed questionnaires cannot be opened by individual patients or any unauthorized person. Security is guaranteed both by temporary passwords via SMS (text messages) and e-mail or by e-ID. The register thus complies with the security requirements specified by the Swedish Data Inspection Board.
- The individual doctors who register data and use register data in their analyses also have unique log-ins, which have time limits and are updated regularly. They also log in using an e-ID or what is known as a double log-in, with a temporary password supplied via a text message (SMS) or e-mail. Work on logging in using a SITHS (Swedish acronym standing for Safe IT for Health Care) card is in progress, but it is also dependent on future IT solutions.
- After each ACL reconstruction, the surgeon reports the operation in question, together with associated patient-related details. The patient questionnaires are completed immediately prior to surgery. The patient can also be registered even if he/she is not going to undergo surgery (reconstruction of the cruciate ligament) but has a cruciate ligament injury that has been diagnosed. Patients are then sent a request asking them to answer the KOOS and EQ5D 1, 2, 5 and 10 years postoperatively. This work is done centrally.

## Feedback

Each surgeon can process the results in the register using statistical functions that are posted on the website and he/she can also perform calculations on different variables. A printed annual report is sent to clinical directors and health-care units that are expected to be interested in the report. An electronic interim report can also be produced and sent to all clinics and users. An annual report translated into English was produced for the first time in 2011. Users also receive information via frequent newsletters and the register board organized two meetings for users in 2011.

## Coverage and response rate

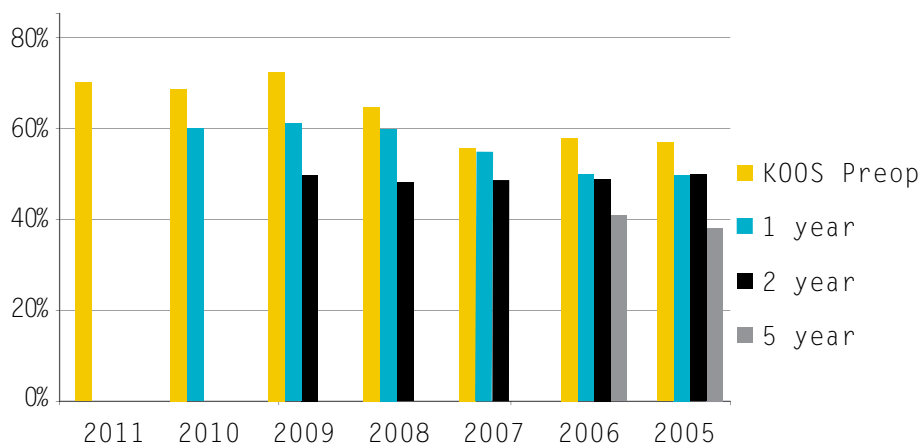
The Swedish National Board of Health and Welfare registered 3,574 ACL operations (both primary and revisions with surgery code NGE41) in 2010. The ACL register contains 3,360 registered operations for 2010.

It is estimated that the ACL register covers more than 90% of all ACL operations in Sweden. Data from 2011 is not as yet available and, as a result, no comparison has been made with 2010. However, the reports to the Swedish National Board of Health and Welfare's patient register appear to be unreliable, as some private care providers are completely absent and the validity of diagnosis/surgery codes is unclear.

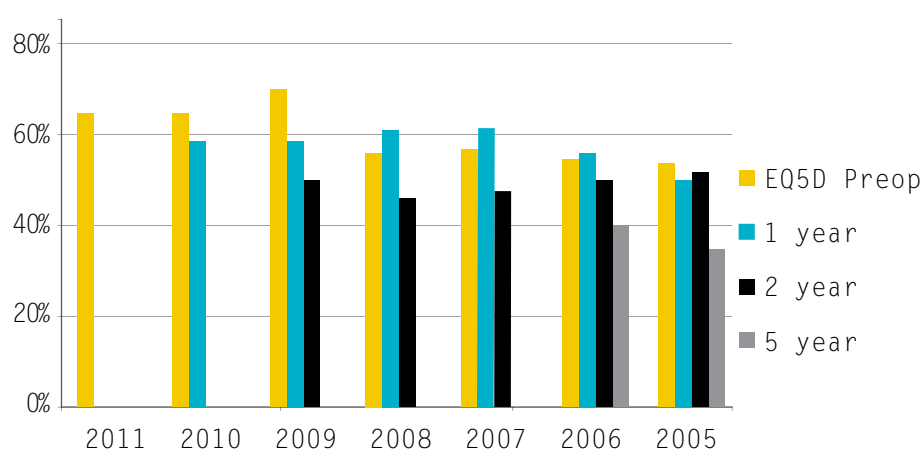
Matching at personal ID number level reveals that the ACL register and the patient register have a total of 4,247 unique ACL operations. It is impossible to estimate the actual number.

Increasing the coverage of PROM (Patient Related Outcome Measures) data is one of the main costs for the ACL register and we advocate that joint investments should be made in national web portals, for example.

Response rate KOOS



Response rate EQ5D



If the results are to be credible and applicable in a research context, the response rate should be high. The response rate for the KOOS preoperatively once again increased slightly in 2011 compared with 2010. The response rate for the EQ5D is lower than that for the KOOS. The KOOS and EQ5D are supposed to be completed by the patients 1, 2 and 5 years postoperatively.

## Funding the ACL register

In 2011, the SKL, Sweden's Municipalities and County Councils, allocated SEK 600,000 to the ACL register to cover running costs. The register is administered in collaboration with the Sports Trauma Research Center at Karolinska Institutet in Stockholm. The register provides 50% funding for one administrator. Some 7,000-10,000 questionnaires are dispatched centrally every year by regular mail, resulting in a postage cost of approximately SEK 200,000 a year. Whenever possible, the register attempts to maintain e-mail addresses and cell phone numbers to enable the questionnaires in these cases to be initiated by an e-mail or a text message, referring to the register website for questionnaire completion. At the present time, there is no cost coverage or funding for IT, rent, statistical consultants and the work done by the registrars, the people who run the register and the register board. All this work is still done on a voluntary basis. For 2012, the register has been allocated SEK 1,200,000, which will have an extremely positive impact on future development and the opportunity to create a stable infrastructure.

## Remuneration system and ACL operations

In the majority of cases, remuneration for ACL operations in Sweden is based on the DRG (diagnosis-related group) system. An ACL operation without complications is classified as DRG group 222. This group contains virtually all knee operations apart from knee arthroplasty, which means that everything from an arthroscopy under local anesthesia, with a cost price corresponding to SEK 5,000, to a complicated knee-joint operation including cartilage cell transplantation, with a cost price corresponding to SEK 200,000, carries the same remuneration. The national weighting list also includes a factor of 3 when comparing day surgery with in-patient care. In the case of DRG group 222, this dependence on point pricing results in remuneration for day surgery of between SEK 10,000 and 15,000 compared with between SEK 30,000 and 45,000 for in-patient care. The approximate cost price of an ACL operation should be around SEK 25,000. The DRG remuneration is based on cost prices from different hospitals and, with the increase in specialization that has taken place in recent years, there are bound to be large differences between the case mix of operations at different hospitals. In its current form, the system is not steering the remuneration towards increased day surgery.

Nor do many caregivers divulge their cost prices, as a result of the way negotiations are conducted. If they did, the purchaser would have complete insight into the economic situation of the person making the tender and this would then jeopardize the procurement process. In the longer term, a “less flexible” DRG system could also lead caregivers to choose not to perform more difficult operations as a result of inadequate remuneration. The register board agrees that the remuneration for knee surgery needs to be reviewed and differentiated to a greater degree when it comes to the level of detail and special requirements (such as repeat surgery) in order to achieve competitive neutrality between caregivers.

In 2011, a decision was made to introduce two sub-groups in DRG group 222 – one for more advanced surgery, such as ACL surgery. We note with satisfaction that the people responsible for the DRG system at the Swedish National Board of Health and Welfare have responded to our request.

## Organization

The registrar in 2011 was Professor Li Felländer-Tsai, Karolinska University Hospital, Huddinge. The contact person was Anna Pappas, Sports Trauma Research Center, Karolinska Institutet and Capiro Arthro Clinic. In 2011, the register board was made up of the following representatives from different regions in Sweden.

1. Johanna Adami, Associate Professor and Departmental Director, Karolinska Institutet and VINNOVA, Stockholm
2. Magnus Forssblad, MD, Capiro Arthro Clinic and Sports Trauma Research Center at Karolinska Institutet, Stockholm
3. Richard Frobell, Associate Professor, Lunds University
4. Joanna Kvist, Associate Professor, Linköping University
5. Pär Herbertsson, MD, Lund University Hospital
6. Professor Jon Karlsson, Sahlgrenska University Hospital, Göteborg
7. Professor Jüri Kartus, NU Hospital Organization, Trollhättan/Uddevalla
8. Professor Kjell G Nilsson, Umeå University Hospital, Umeå

## IT organization

The IT operations relating to the Swedish ACL register are administered by the Capiro Arthro Clinic in collaboration with the Sports Trauma Research Center at Karolinska Institutet in Stockholm. The system operates in a Progress environment, with both a relationship database as the base and a web-based solution for all users (WebSpeed).



## Research partnerships

The ACL register protocol is virtually identical to that of the ACL registers that were set up in Norway (July, 2004) and Denmark (July, 2005). A joint article was published in 2009 (*Acta Orthopaedica* 2009; 80 (5): The Scandinavian ACL registries 2004–2007: baseline epidemiology Lars-Petter Granan, Martin Lind, Magnus Forsssblad, and Lars Engebretsen). Another article was published in 2010 in the *American Journal of Sports Medicine: Sex Differences in Patient-Reported Outcomes After Anterior Cruciate Ligament Reconstruction: Data From the Swedish Knee Ligament Register*. (Eva Ageberg, Magnus Forsssblad, Pär Herbertsson, Ewa Roos). Yet another article on cartilage injuries in collaboration with the Norwegian ACL register was published in 2011 and a further two-year follow-up will be published in 2012. In 2011, a number of research students worked on questions relating to the register and the register board is looking forward with anticipation to seeing their work. A number of PhD projects based on the register are also being planned.

Separate formal research agreements have been drawn up for all the projects in which data from the register have been used.

In 2011, increased national and international collaboration was initiated. In 2011, researchers from the Sahlgrenska Academy conducted a number of register studies and they were presented in San Francisco in February 2012. At the same time, an international ACL meeting was held with representatives from different ACL registers worldwide.

The register board would like to request and encourage all the participating clinics to submit applications for research studies within the framework of the ACL register.

## Register data

The register reports ACL reconstructions in Sweden from January 2005. This information is individually based and the patient's personal ID number automatically shows his/her age and gender. The diagnosis is based on data that are entered manually. During the period 2005-2010, 20,082 primary ACL reconstructions and 1,248 revisions from a total of 70 clinics were registered.

## Number of operations per clinic in 2011

	Primary	Revisions
CAPIO ARTRO CLINIC	584	62
SAHLGRENSKA UNIVERSITETSSJUKHUSET	191	18
SÖDERSJUKHUSET	134	12
MALMÖ ALLMÄNNA SJUKHUS	128	9
NU-SJUKVÅRDEN	117	7
ORTHOCENTER/IFK-KLINIKEN	116	11
SKÅNES UNIVERSITETSSJUKHUS	107	9
KAROLINSKA SJUKHUSET / ORTOPEDKLINIKEN	94	5
NORRLANDS UNIVERSITETSSJUKHUS, UMEÅ	87	2
KUNGSBACKA SJUKHUS	82	3
MOVEMENT MEDICAL	77	5
HELSINGBORGS SJUKHUS	75	3
KARLSTAD CENTRALSJUKHUS	70	3
VRINNEVISJUKHUSET	70	4
HÄSSLEHOLMS SJUKHUS	64	1
SPORTS MEDICINE UMEÅ	62	3
ODENPLANS LÄKARHUS	60	7
LINKÖPINGS UNIVERSITETSKLINIK	59	8
ELISABETH SJUKHUSET	57	5
KALMAR SJUKHUS	56	4
ORTOPEDISKA Huset	55	5

CAPIO LÄKARGRUPPEN I ÖREBRO	51	5
MEDICIN DIREKT	50	5
GÄVLE SJUKHUS	49	0
CENTRALLASARETTET VÄXJÖ	48	2
MÄLARSJUKHUSET ESKILSTUNA	41	4
FALU LASARETT	41	0
FRÖLUNDA SPECIALISTSJUKHUS	38	2
SUNDERBY SJUKHUS	37	1
LÄNSSJUKHUSET RYHOV	37	1
LJUNGBY LASARETT	37	1
LIDKÖPINGS SJUKHUS	34	0
LÖWETS SPECIALISTMOTTAGNING	33	0
OSKARSHAMNS SJUKHUS	32	0
ÖREBRO USÖ	32	1
HÖGLANDSSJUKHUSET	31	0
HUDIKSVALLS SJUKHUS	30	1
BLEKINGESJUKHUSET	28	1
VÄSTERVIKS SJUKHUS	27	2
NORRTÄLJE SJUKHUS	24	0
SÖDRA ÄLVSBORGS SJUKHUS	24	0
ALINGSÅS LASARETT	24	2
DANDERYDS SJUKHUS	21	3
VÄRNAMO SJUKHUS/ORTOPEDKLINIKEN	20	0
KAROLINSKA/ASTRID LINDGRENS BARNSJUKHUS	20	0
PERAGO ORTOPEDKLINIK	17	2
LUNDBYSJUKHUS	17	0
SOLLEFTEÅ SJUKHUS	14	0
LÄKARHUSET HERMELINEN	13	0
KUNGÄLVS SJUKHUS	13	0
VARBERGS SJUKHUS	9	0
S:T GÖRANS SJUKHUS CAPIO, STOCKHOLM	9	0
SAMARITERHEMMETS SJUKHUS	9	0
LÄNSSJUKHUSET SUNDSVALL	9	0
ORTHOCENTER STOCKHOLM	8	0
NACKA NÄRSJUKHUS	8	0
VÄSTERÅS CENTRALLASARETTET	8	1
NYKÖPINGS LASARETT	6	1
ORTHOCENTER I SKÅNE	5	0
SOPHIAHEMMET	5	0
GÄLLIVARE SJUKHUS	4	0
HALMSTADS SJUKHUS	3	1
	3 311	222

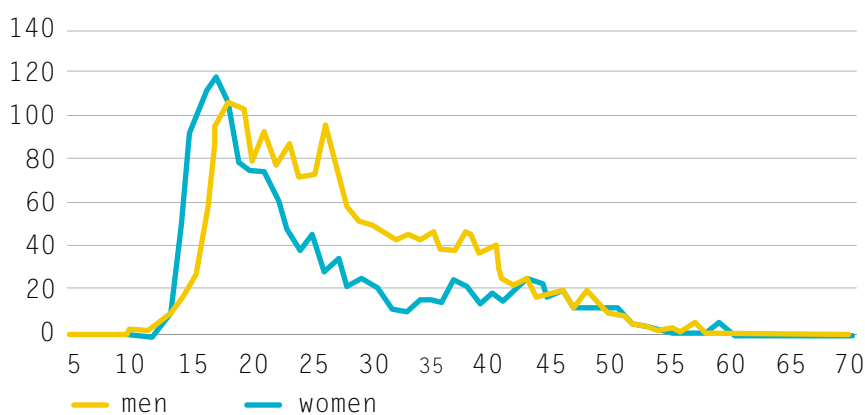
## Age at surgery

The average age of patients undergoing ACL surgery in the whole of Sweden is 27. This can be interpreted as meaning that not only young active sportsmen and sportswomen but also somewhat older individuals with unstable knees undergo surgery. Women generally have surgery at a younger age than men, 26 and 28 respectively in both 2010 and 2011. The probable explanation is that women reach senior levels in ball sports earlier than men and therefore expose themselves to greater risks of an ACL injury at a younger age. Men are probably active as sportsmen for a longer period than women.

In 2011, the age at revision surgery was 24 for women and 29 for men. It is important to note that women are forced to undergo a second ACL operation at such a young age.



Number per age 2011



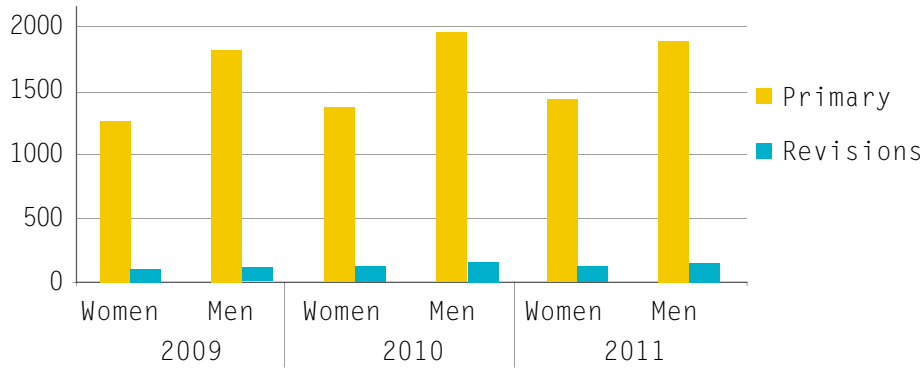
## Gender distribution in ACL operations

As in a number of previous studies conducted in Sweden, some 40% of the patients who undergo ACL surgery are women and this percentage is the same as in previous years. In 2009, 1,300 ACL reconstructions were performed on women and 1,789 on men, while the corresponding figures in 2010 were 1,366 women and 1,944 men and, in 2011, 1,415 women and 1,896 men.

This is extremely interesting, as it is also known that women run a far higher risk of sustaining an ACL injury than men. One explanation could be that there are a number of unknown cases among women who voluntarily reduce their activity level, take part in a rehabilitation program and thereby never undergo surgical treatment for their ACL injury. It is therefore important in the future also carefully to register and follow up patients with ACL injuries who seek medical care for their injuries but receive non-surgical treatment. So no major change has taken place since 2009 when it comes to the gender distribution for primary ACL reconstruction.

When it comes to revisions, 110 were performed in men and 81 in women in 2009; in 2010, the corresponding figures were 136 in men and 88 in women, while, in 2011, 122 were performed in men and 100 in women.

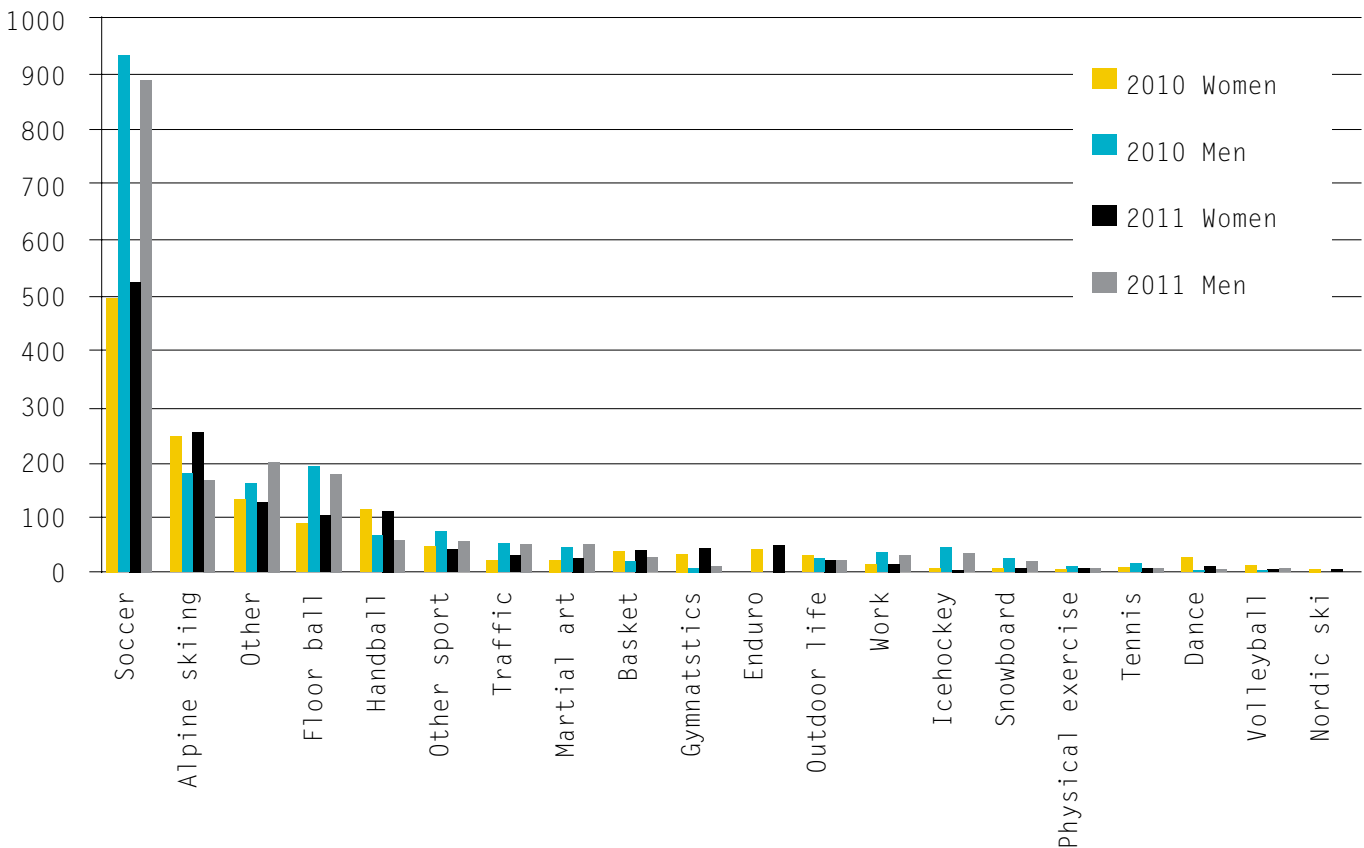
An analysis of the number of revisions reveals a preponderance of men. This probably reflects the true need for revisions, as more men than women return to their previous activity level. It is pleasing that the number of revisions in patients with a new ACL injury to the knee that has already undergone surgery or with an unsatisfactory result after the first operation is relatively small compared with the number of primary reconstructions.



## Activity in connection with injury

Among both men and women, football is the most common activity associated with an ACL injury and this situation has not changed compared with previous years. In 2011, football was the cause of 37% of ACL injuries among women and 47% among men. The second most common activity was downhill skiing for women and floorball among men in both 2010 and 2011.

As football is the leading cause of ACL injuries, it is both extremely important and valuable that projects including preventive training in young people playing football are in progress in Sweden.

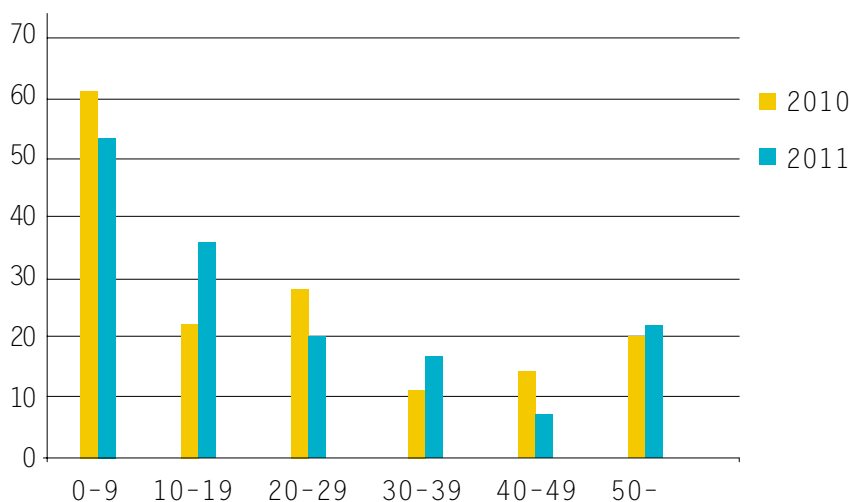


## Duration of surgery and number of surgeons

In Sweden, as in a number of other countries, many surgeons perform relatively few ACL operations. Of the Swedish ACL surgeons, 70% perform fewer than 30 operations a year and almost 35% perform fewer than 10 operations a year, while 30% perform more than 30 operations a year. This is similar to the frequency at other clinics internationally.

Since 2005, the duration of surgery for an ACL reconstruction has been around 75 minutes for a primary operation and about 90 minutes for a revision.

Number of procedures (in groups) performed by individual surgeons



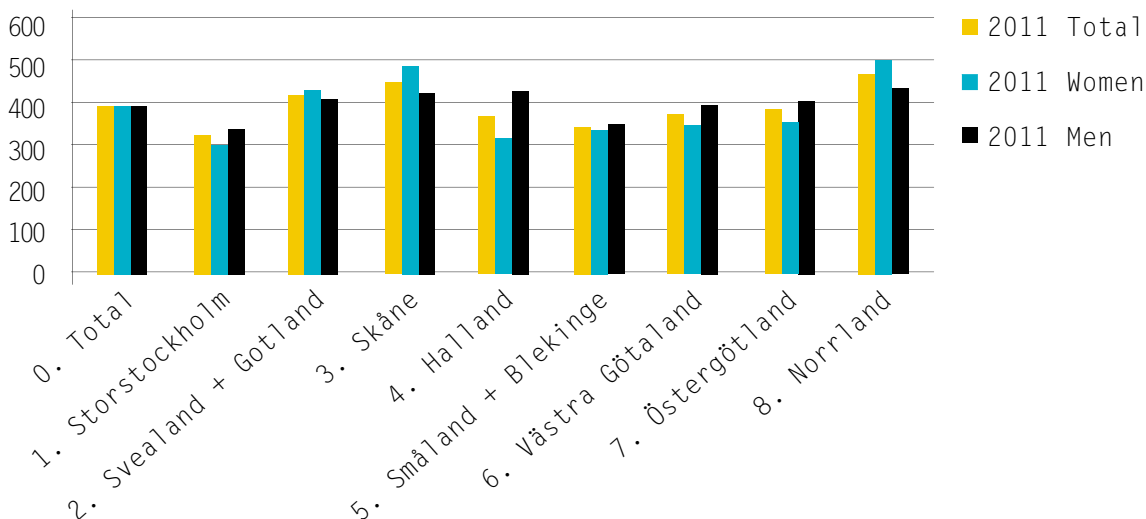
## Time between injury and surgery

The average time between injury and surgery in 2011 was 397 days for the whole of Sweden. The corresponding time in 2008 was 402 days, in 2009 48 days and in 2010 432 days. In other words, it appears that the time between injury and surgery remains at around 400 days year on year. A subgroup analysis based on gender reveals that the time between injury and surgery was basically the same for men and women; 395 and 398 days respectively in 2011. In 2009, the corresponding time was 445 days for men and 402 days for women. In all probability, this difference is of no practical significance.

The Norrland region had the longest time between injury and surgery in 2011; in 2009 and 2010, the County of Halland had the longest time. It is difficult to say why this is; it is probably a random variation rather than a real difference.

There could be a number of reasons explaining why the average time between injury and surgery is more than a year, but the question has not been formally investigated. It could be that Sweden has adopted a treatment regimen which means that the majority of patients initially undergo non-surgical treatment. This is completely in line with the recent discussion relating to the fact that patients with ACL injuries do not always require surgery but can become symptom free with the support of training and the adjustment of activity levels. Another less appealing reason could be that many patients are not identified at emergency departments or local medical centers after their injury. A scenario of this kind would mean that a large number of patients are not diagnosed and are therefore not given satisfactory rehabilitation or surgery when this is necessary at an early stage. A patient group of this kind probably runs an increased risk of suffering a new giving-way episode, possibly with serious consequences, including the risk of cartilage and meniscal injury. Such a long period between injury and diagnosis is not desirable, especially in the case of young women who more easily sustain a new injury in a knee that has undergone surgery and also in the contralateral knee.

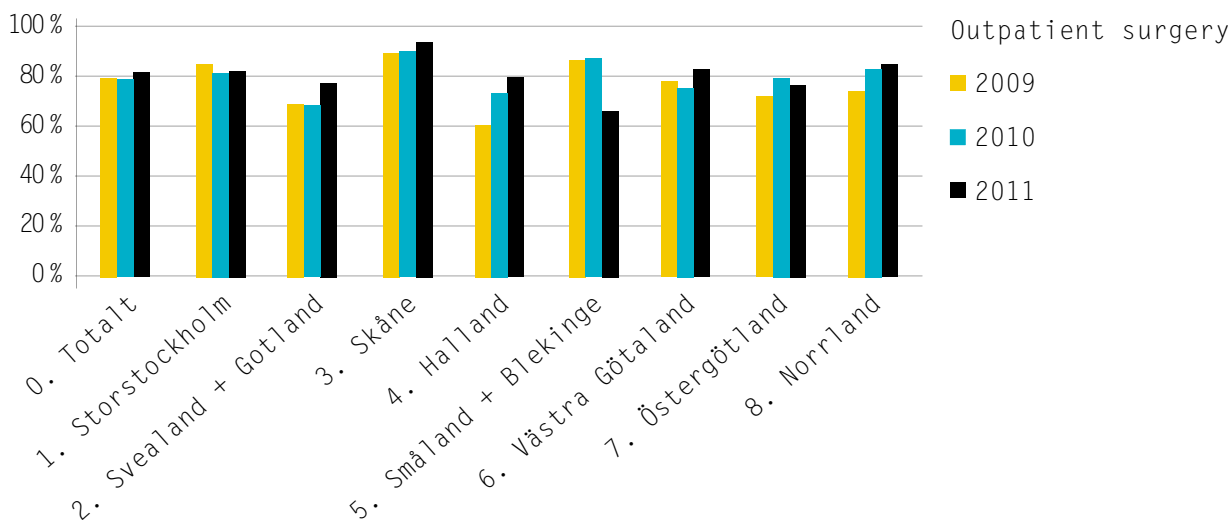
Time between injury and surgery in days



## Percentage of day surgery in relation to in-patient care

The percentage of patients who undergo day surgery is increasing and appears to remain at around 80%. In 2008, 74% of ACL operations were performed as day surgery. In 2009 and 2010, the frequency rose to 80% and it then rose again in 2011 to 82.4%. In Skåne in southern Sweden, more than 90% of ACL reconstructions have been performed as day surgery during the past few years. One reason for performing in-patient surgery could be that long distances in the region prevent patients being sent home the same day. This is, however, contradicted by the fact that Norrland in northern Sweden, where the distances are very long, is not characterized by a smaller percentage of day surgery. It now appears to be established practice that ACL surgery can and should be performed as day surgery whenever possible

Ratio Outpatient surgery in different Swedish regions



## ACL reconstruction in children under 15 years of age

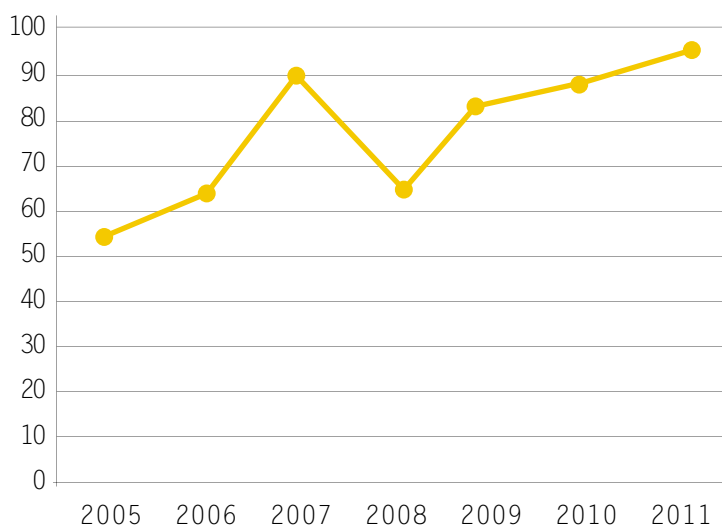
It appears that substance ruptures in the ACL of children with open growth zones are increasing. The annual incidence has previously been estimated at 0.5/10,000 children under 15 years of age, but this figure may have doubled. The reason has not been identified, but increased awareness of the fact that

children can also sustain this injury, improved MRI diagnostics and increasing performance demands in organized sport involving children and young people have been cited as some of the possible reasons. Even the associated meniscal injuries in association with ACL injuries are thought to be growing in number based on an historical comparison. In a Swedish study from 1996 of children under 15 years of age, 21% had meniscal injuries at the time the ACL injury was diagnosed, while this figure rose to 31% at surgery.

In 2011, ninety-five ACL reconstructions were performed on children under 15 years of age in Sweden, constituting 3% of all operations. Four patients were under 12 years of age. In the Stockholm area, 37 operations were performed (ALB/Capio Artro Clinic 34, Odenplans läkarhus 3). In the Gothenburg area, 11 operations were performed (Sahlgrenska 8, Orthoscenter/IFK kliniken 3), while nine were performed in Umeå (Norrland University Hospital 6, Sports Medicine Umeå 3) and eight at MAS/Skåne University Hospital. Nineteen of these operations were performed at units which perform between one and two operations a year. The number of operations is increasing successively over the years, see the diagram.

Half of all the patients had meniscal injuries (47%) and half of these were sutured (46%). Girls accounted for 61% of the patients. The cause of accidents is distributed equally between boys and girls. Football dominated and accounted for 59% of accidents. It was followed by floorball (9%), handball (8%) and Alpine/Telemark skiing (7%).

Number of procedures on patients <15 years, 2005-2011



## Miscellaneous

The use of the double-tunnel technique as a surgical method continues to decline in Sweden. In 2011, only 43 such operations were performed, which corresponds to 1.3%. The corresponding figures for 2010 were 81 and 2.4% respectively. The percentage of day surgery rose to 82.4% in 2011 (79.6% in 2010). Thromboprophylaxis is administered in 35% of all operations. Antibiotic prophylaxis is basically administered in all operations.

## Surgical variables

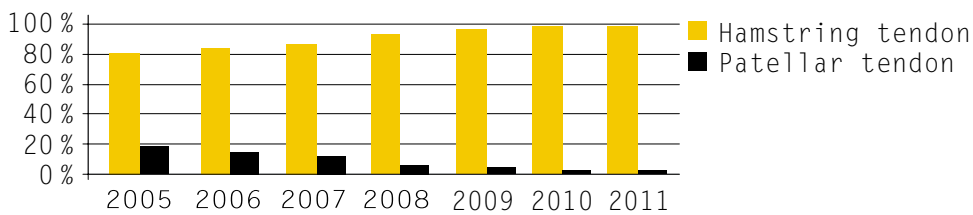
### Graft selection

Since the ACL register was created in 2005, hamstring tendon grafts have dominated. They can be performed with only the semitendinosus or only the gracilis tendon and they are then doubled, tripled or quadrupled. It is also possible to use both the semitendinosus and the gracilis tendon, which can then be sextupled at the very least.

With every year that passes, the use of hamstring tendons is increasing the whole time; in 2005, the percentage was 82%, whereas it is now 98%. This probably indicates that it is a less complicated graft for the surgeon to use and that there is no difference in the results produced by the two methods. The main reason for currently using the patellar tendon is that the patient has already undergone surgery with a hamstring tendon in the primary reconstruction. Patellar tendon grafts are therefore used most frequently in revision surgery. As a result, there is a risk that new ACL surgeons will not learn to use the patellar tendon.

The use of allografts in primary reconstruction is still unusual in Sweden. In 2008, nine allografts were used, in 2009, the figure was 15 allografts, in 2010, 30 allografts were used, while, in 2011, 30 allografts were used in primary ACL reconstruction. The use of allografts is probably governed by the cost, as an allograft costs around SEK 10,000. Allografts are used on a relatively large scale in revision surgery and multiple ligament reconstructions (knee dislocations). Allografts were used in 23 of 222 revisions, compared with 88 patellar tendon grafts and 91 hamstring grafts.

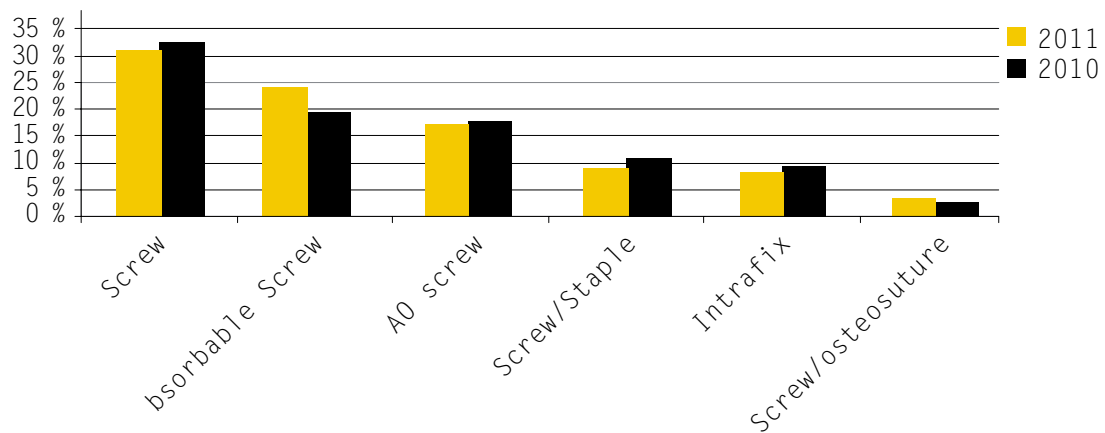
Graft selection 2005-2011



## Tibial fixation

In this context, screw fixation still dominates and its use has once again increased. Standard interference screws are most common, but the use of resorbable screws and AO screws is also increasing. Sometimes, interference screws are reinforced with a staple or an osteosuture below the screw anchor.

Top 6 Fixation Tibia Hamstring tendon

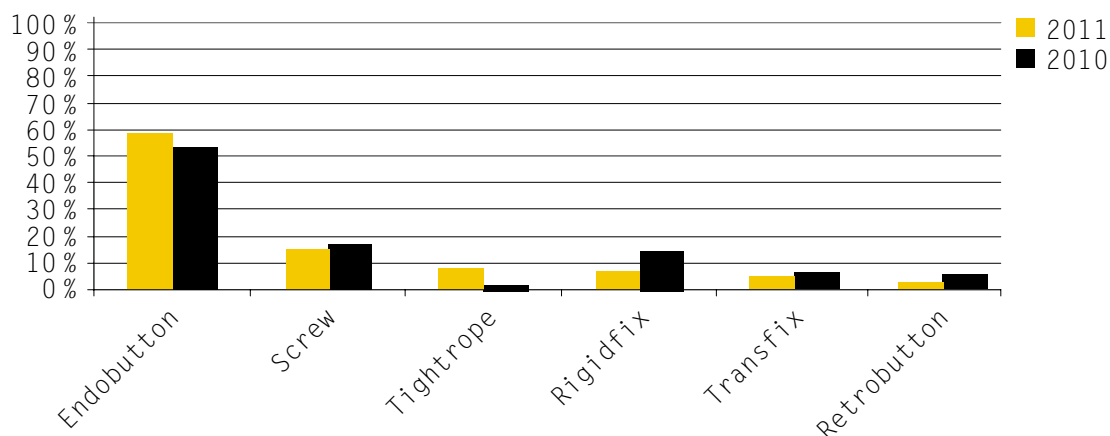


## Femoral fixation

Over the years, a major change has taken place in this area. In the past, resorbable cross-pins (such as Rigidfix) were the most widely used form of femoral fixation, but the cortical button (such as Endobutton) is by far the most commonly used form of fixation. The use of cortical buttons has increased every year and, since 2008, its use in femoral fixation has risen from 37% to 59%. The reason for this increase is that the cortical button is easy to use and can be used without any alignment instruments. It can be inserted through the medial portal and, unlike the transtibial method, the surgeon is not obliged to use the tibial canal.



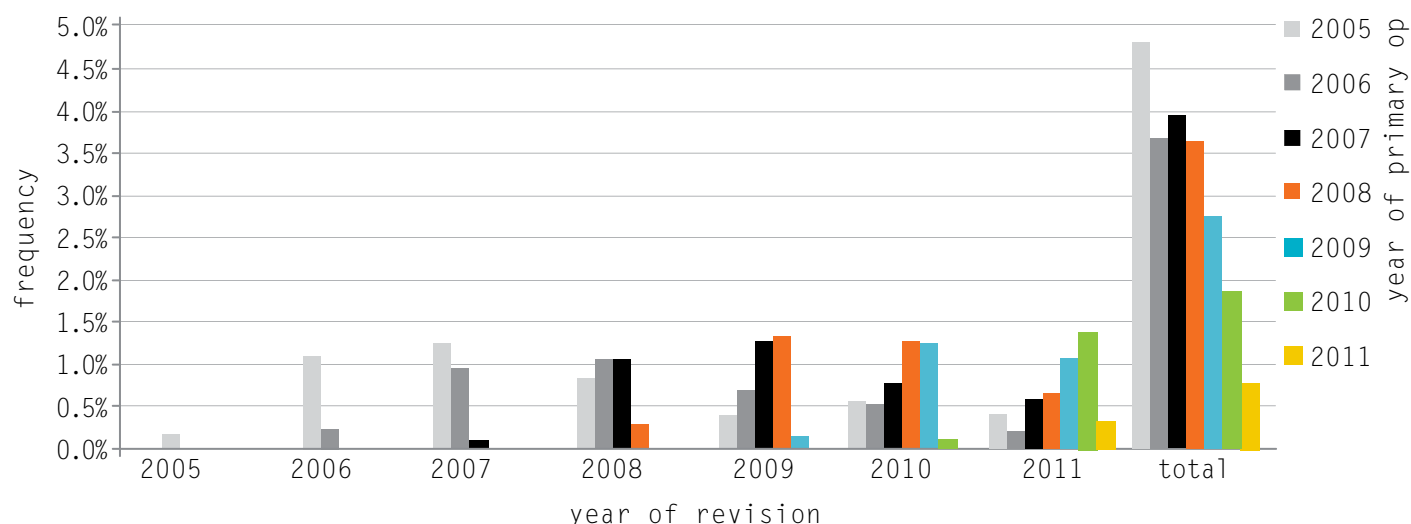
## Top 6 Fixation Femur Hamstring tendon



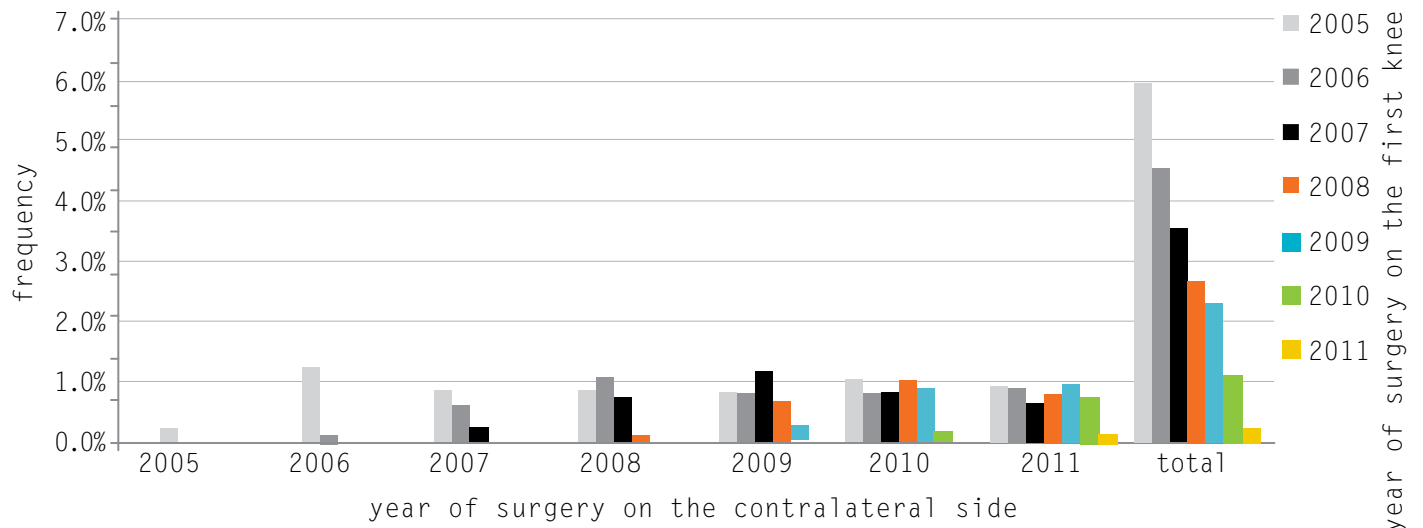
## Revisions and surgery on the contralateral side

A total of 1,248 revisions were registered in the ACL register in 2005-2011. Of the patients undergoing primary surgery in 2005-2011, a total of 579 underwent revision surgery involving a new ACL reconstruction. This means that 669 revisions have been performed on patients who underwent primary surgery before 2005.

The figure below shows the time of primary and revision surgery respectively. Of the patients who underwent surgery during the first two years of the register, 2005 and 2006, 4.8% and 3.7% have undergone revision surgery. The revision frequency is still highest during the first two years after the primary operation. The total revision frequency for the entire period is 2.9%. For patients aged 20 and below, the corresponding revision frequency is 4.3%.



Of the patients who underwent surgery in 2005-2011, 2.6% have also undergone ACL surgery on the contralateral side. For patients aged 20 and below, the corresponding revision frequency is 4.1%. The longer the time that elapses after the original operation, the higher the frequency. Of those that underwent surgery in 2005, 6% have undergone surgery on the contralateral side. For patients aged 20 and below, the corresponding revision frequency is 10.1%. Since 2005, the frequency of either revision surgery on the same knee or surgery on the contralateral knee is 8.4%. For patients who underwent surgery in 2005, the corresponding figure is 17.6%.



In the group comprising female football players aged between 15 and 18, more than 26% of those that underwent primary surgery in 2005 have undergone a new operation either on the same knee or on the contralateral knee. A questionnaire study targeting this groups reveals that a further 8% or so have chosen not to have a new operation. As a result, the overall risk of a new injury actually exceeds 30%.

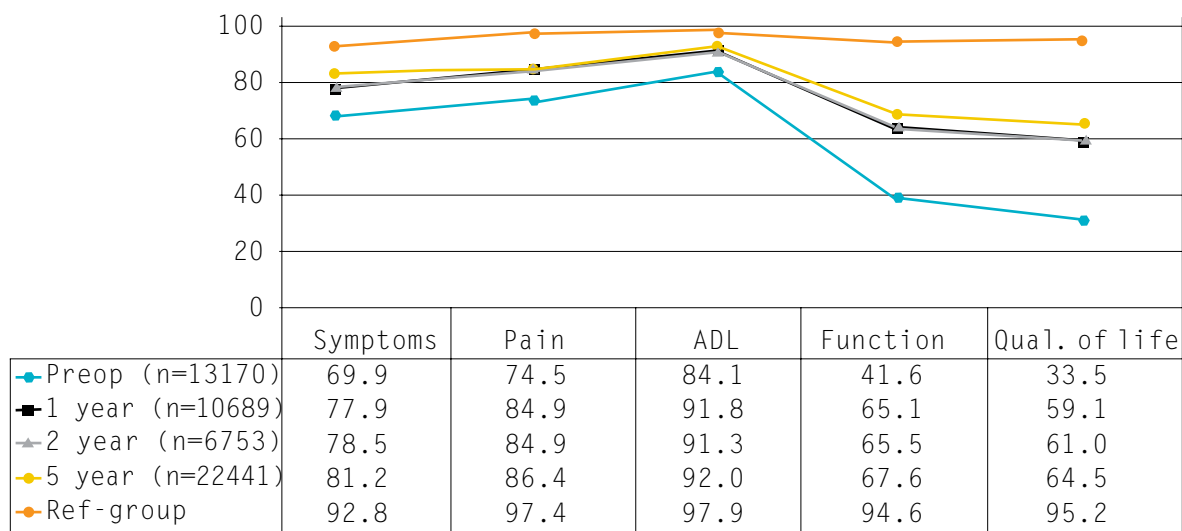
## Patient-reported outcome and quality of life (PROM)

### KOOS (Knee injury and Osteoarthritis Outcome Score)

The KOOS is a knee-specific instrument for evaluating the patient's perception of his/her knees and knee-related problems. The instrument evaluates five aspects: pain, other symptoms, such as swelling, joint mobility and mechanical symptoms, functional impairment in connection with daily activities, functional impairment in connection with sport and recreational activities and knee-related quality of life.

Prior to surgery, the patients experience an impairment in their self-rated function. We can see a clear-cut improvement in self-rated knee function one year after surgery, followed by a successive improvement two and five years after surgery. A comparison with reference data from 118 football players with healthy knees reveals that patients do not achieve normal function one, two and five years after surgery. The greatest differences between patients before and after surgery and the reference group can be seen in the aspects of "functional impairment in connection with sport and recreational activities" and "knee-related quality of life". The results for 2011 do not differ markedly from those in previous years.

KOOS (2005-2011)

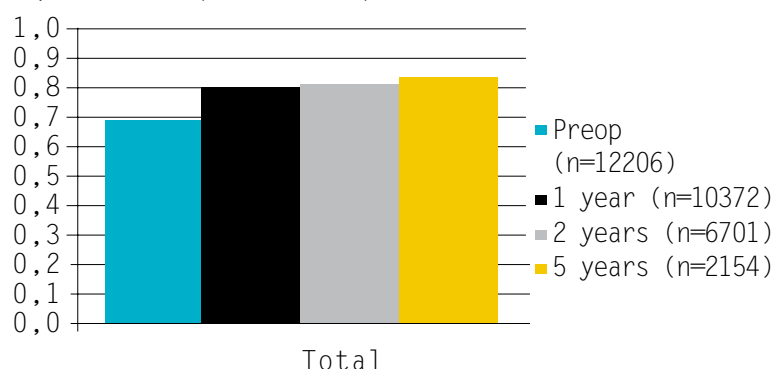


The report presents a number of comparisons between different groups using KOOS and EQ5D data. We have, however, decided not to present statistical analyses, as the differences are relatively small, but, in view of the scope of material, they could be statistically significant. A clinically relevant difference in the KOOS is usually estimated at between 5 and 10 points. Readers of the report can themselves assess any differences in outcome.

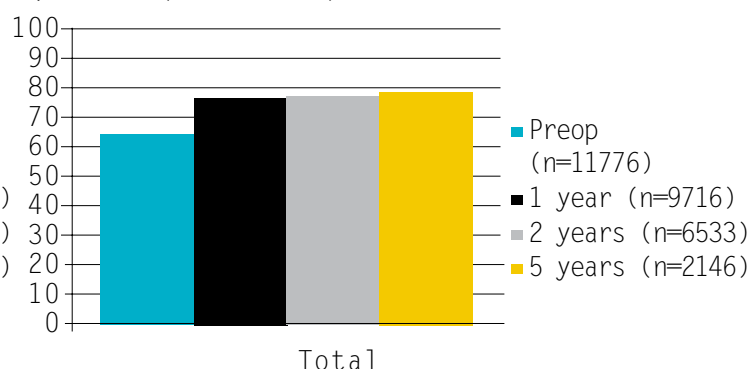
## EQ5D

Health-related quality of life is impaired in patients prior to and one, two and five years after ACL reconstruction ("UK EQ5D index tariff" score 0.69-0.83) compared with reference values from a Swedish population aged 20-40 ("UK EQ5D index tariff" score between 0.88 and 0.89) (Burström et al. 2001) and compared with a football population ("UK EQ5D index tariff" score 0.90, n=92). The following figures reveal that both indices and self-rated health improve after surgery.

EQ5D-Index (2005-2011)

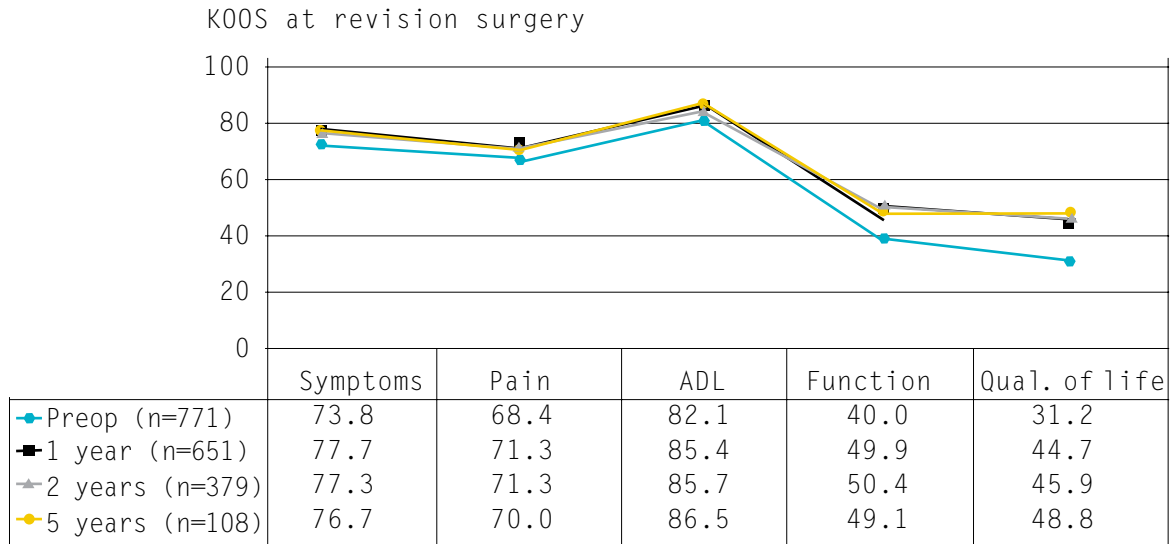


EQ5D-VAS (2005-2011)

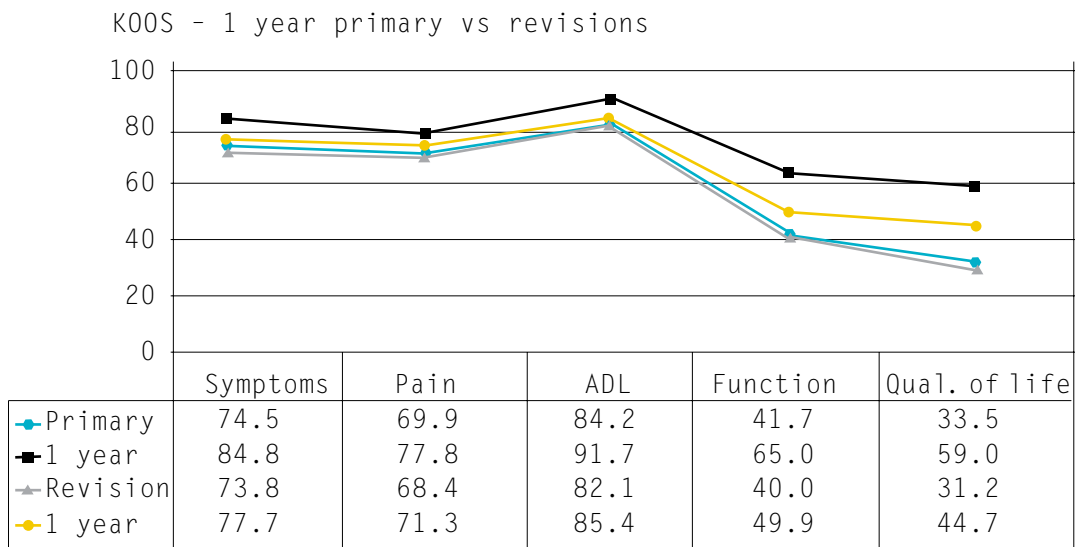


## Outcome and quality of life in conjunction with revision surgery

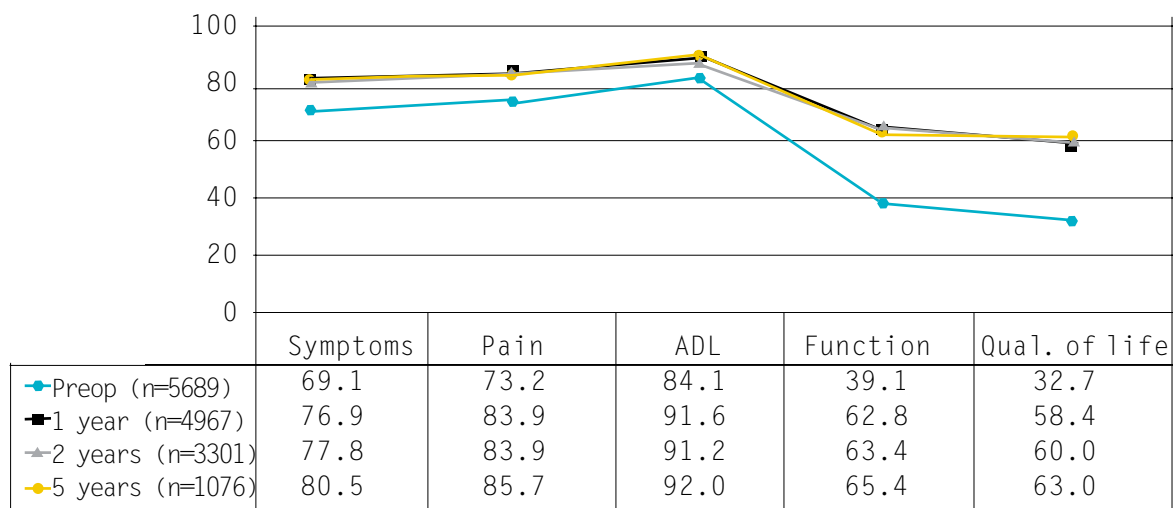
In connection with revision surgery, an improvement can be seen in the KOOS, but it is not as marked as the improvement in conjunction with primary reconstruction.



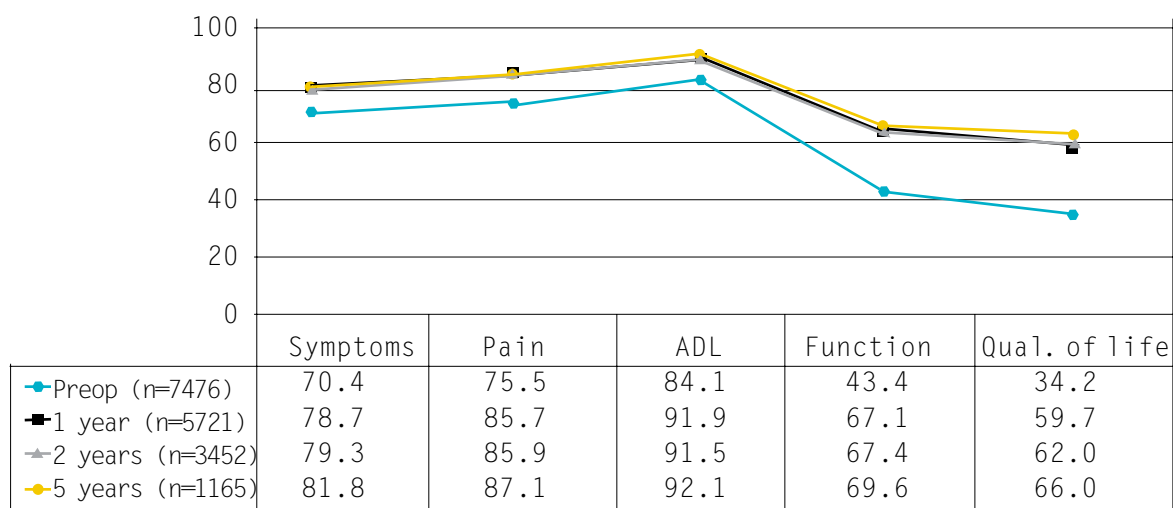
This can be clearly seen in the following graph in which primary reconstructions are compared with revisions and the KOOS at one year.



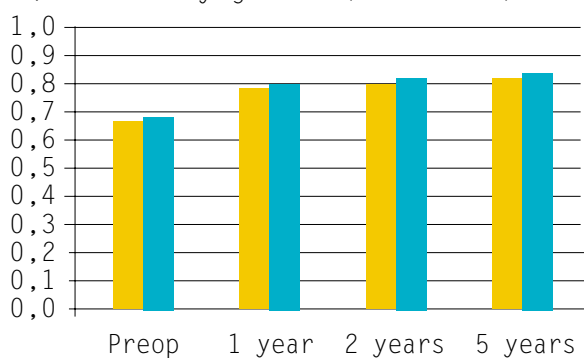
K00S - women (2005-2011)



K00S - men (2005-2011)

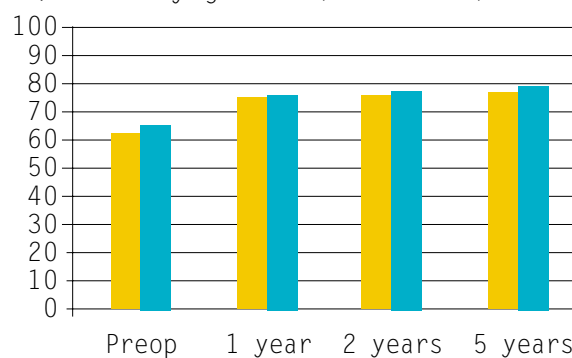


EQ5D-Index by gender (2005-2011)



- Women:  
Preop (n=5852), 1 year (n=4859),  
2 years (n=3270), 5 years (n=1042).
- Men:  
Preop (n=6949), 1 year (n=5512),  
2 years (n=3431), 5 years (n=1112).

EQ5D-VAS by gender (2005-2011)

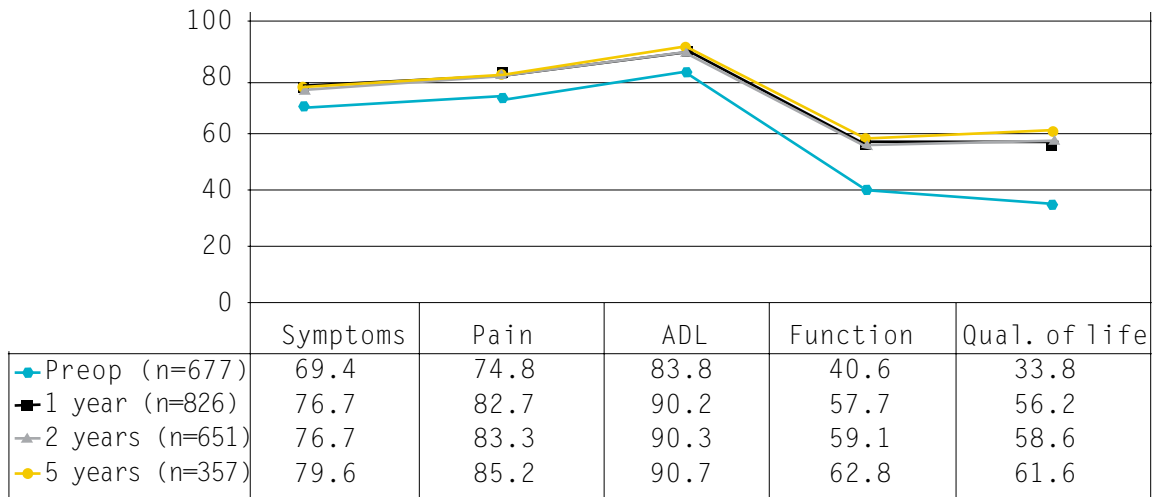


- Women:  
Preop (n=5076), 1 year (n=4585),  
2 years (n=3187), 5 years (n=1038).
- Men:  
Preop (n=6696), 1 year (n=5130),  
2 years (n=3336), 5 years (n=1108).

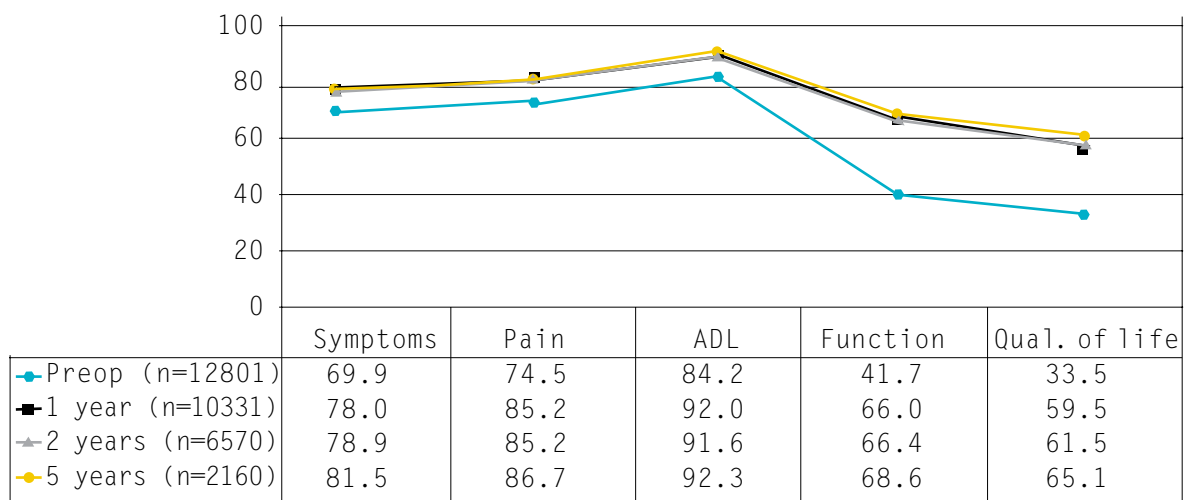
## Outcome and quality of life in relation to gender

There is no difference in subjective knee function and health-related quality of life between men and women.

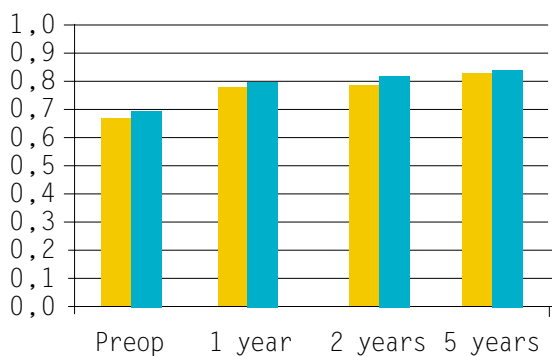
KOOS - patellar tendons (2005-2011)



KOOS - hamstring tendons (2005-2011)



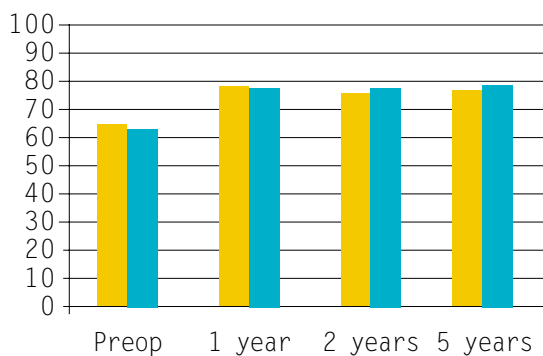
EQ5D-Index by graft (2005-2010)



■ Patellar tendons:  
Preop (n=633), 1 year (n=795),  
2 years (n=660), 5 years (n=339).

■ Hamstring tendons:  
Preop (n=11882), 1 year (n=10035),  
2 years (n=6515), 5 years (n=2085).

EQ5D-VAS by graft (2005-2010)



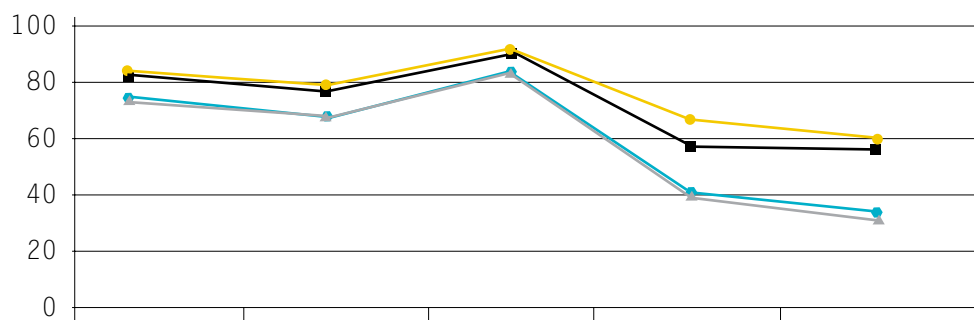
■ Patellar tendons:  
Preop (n=620), 1 year (n=731),  
2 years (n=634), 5 years (n=338).

■ Hamstring tendons:  
Preop (n=11460), 1 year (n=9396),  
2 years (n=6355), 5 years (n=2077).

## Outcome and quality of life in relation to graft

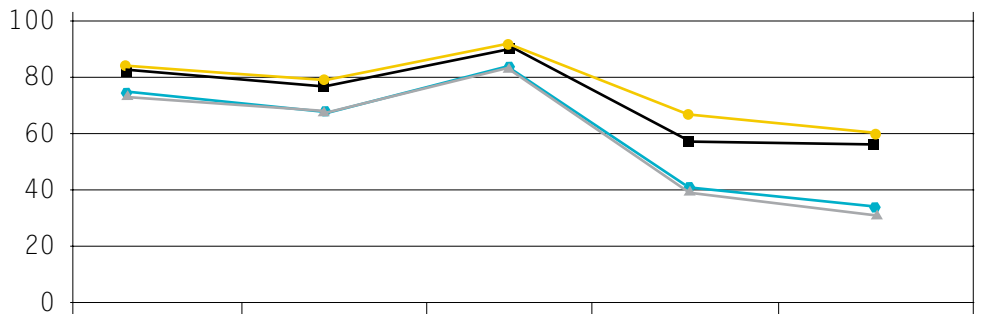
Patient-reported knee function and health-related quality of life do not differ in comparisons between the most commonly used grafts (patellar tendons and hamstring tendons). In this context, it is also important to point out that the number of operations involving patellar tendon grafts only account for 2% of all operations and the result should therefore be interpreted with care.

K00S 1 year - all patients



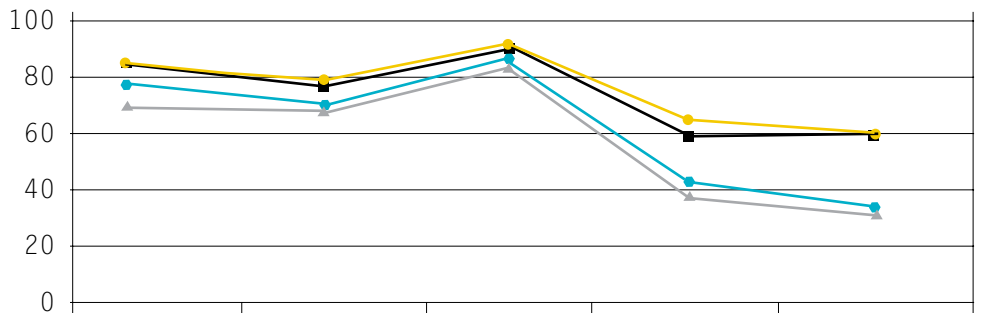
	Symptoms	Pain	ADL	Function	Qual. of life
● Preop patellar tendon (n=677)	75.2	69.6	84.2	40.9	33.8
■ 1 year (n=826)	82.7	76.6	90.2	57.6	56.2
▲ Preop hamstring tendon (n=12801)	74.4	69.9	84.3	41.8	33.5
● 1 year (n=10331)	85.1	78.0	91.9	65.8	59.4

KOOS 2 years - all patients



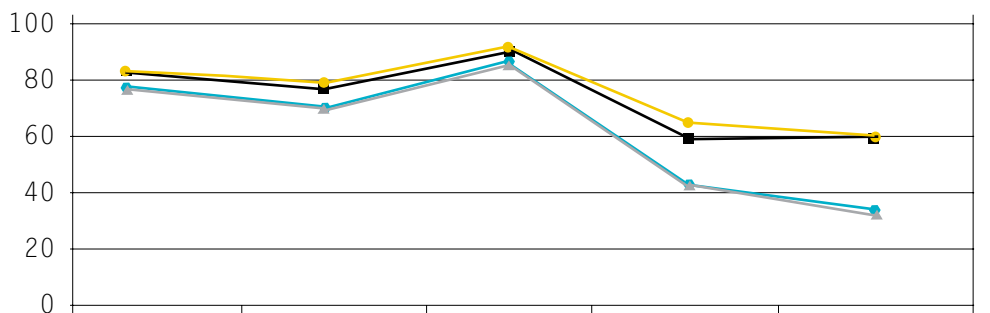
	Symptoms	Pain	ADL	Function	Qual. of life
Preop patellar tendon (n=677)	75.2	69.6	84.2	40.9	33.8
1 year (n=651)	83.3	76.7	90.3	59.1	57.6
Preop hamstring stendon (n=12801)	74.4	69.9	84.3	41.8	33.5
1 year (n=6570)	85.2	78.9	91.6	66.4	61.5

KOOS 2 years - women 20-30 years



	Symptoms	Pain	ADL	Function	Qual. of life
Preop patellar tendon (n=48)	77.7	72.1	87.7	42.6	36.3
2 years (n=84)	84.9	76.3	92.7	59.2	59.9
Preop hamstring tendon (n=1639)	70.2	69.0	84.8	39.1	33.1
2 years (n=837)	84.3	78.2	92.1	64.9	60.5

KOOS 2 years - men 20-30 år

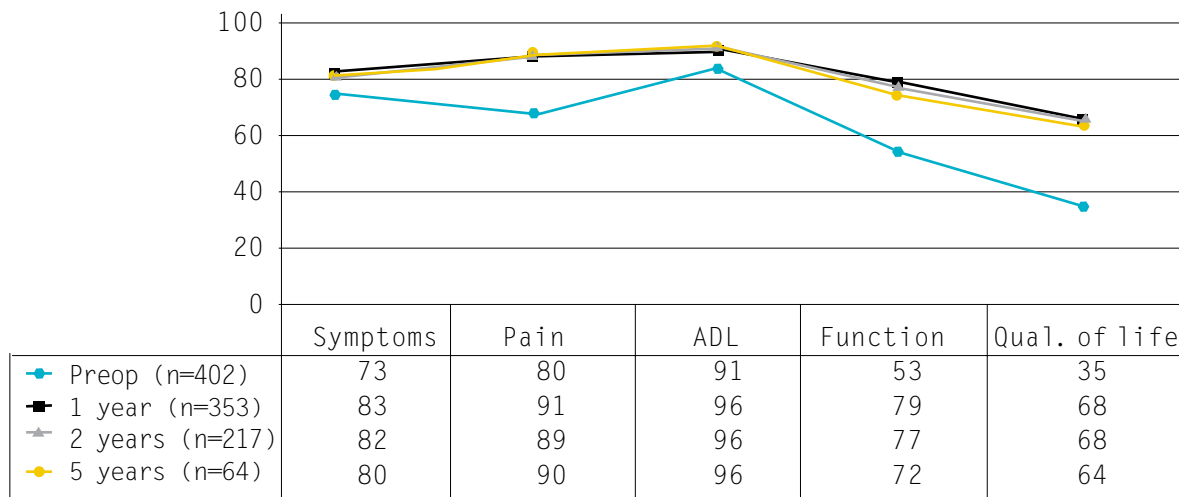


	Symptoms	Pain	ADL	Function	Qual. of life
Preop patellar tendon (n=236)	77.1	69.9	85.8	44.3	35.1
2 years (n=174)	83.4	77.0	91.0	61.2	58.0
Preop hamstring tendon (n=2968)	76.0	70.7	85.2	44.6	34.6
2 years (n=1228)	85.3	78.1	91.4	66.9	60.3

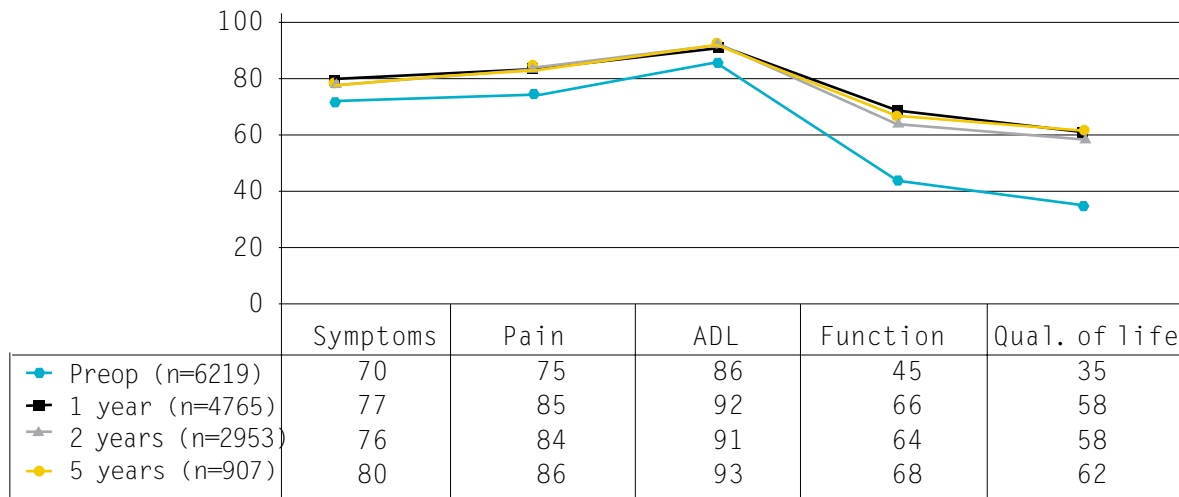


Based on KOOS data from the register one and two years after surgery, a possible clinically relevant difference can be seen on the “sports and recreational function” sub-scale in favor of operations involving hamstring tendons compared with patellar tendons. No relevant differences can, however, be seen on the other KOOS sub-scales. There is no difference in the KOOS preoperatively. A comparison of women and men aged between 20 and 30 reveals that the patellar tendon could be an alternative.

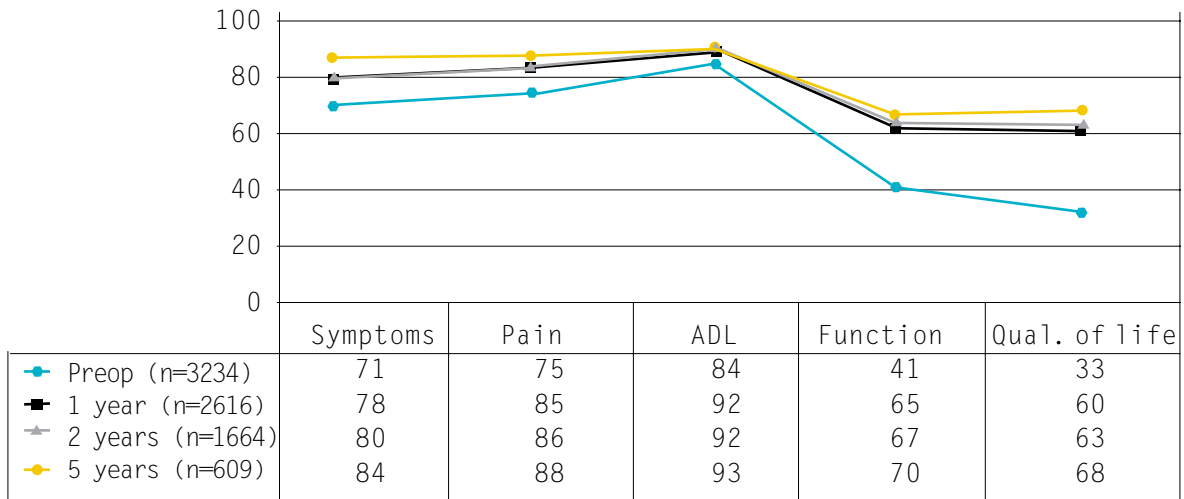
KOOS 1-15 years 2005-2010



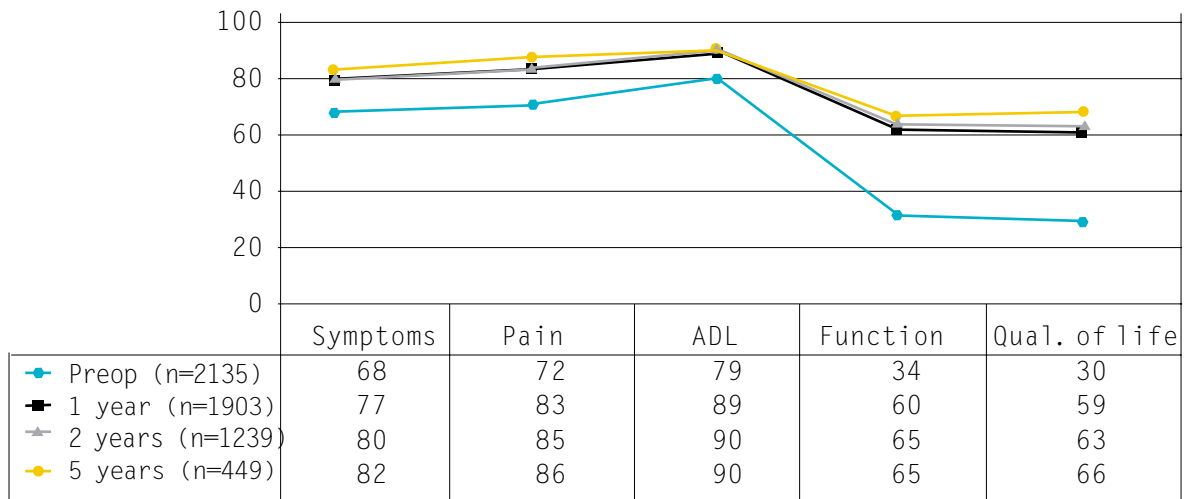
KOOS 16-25 years 2005-2010



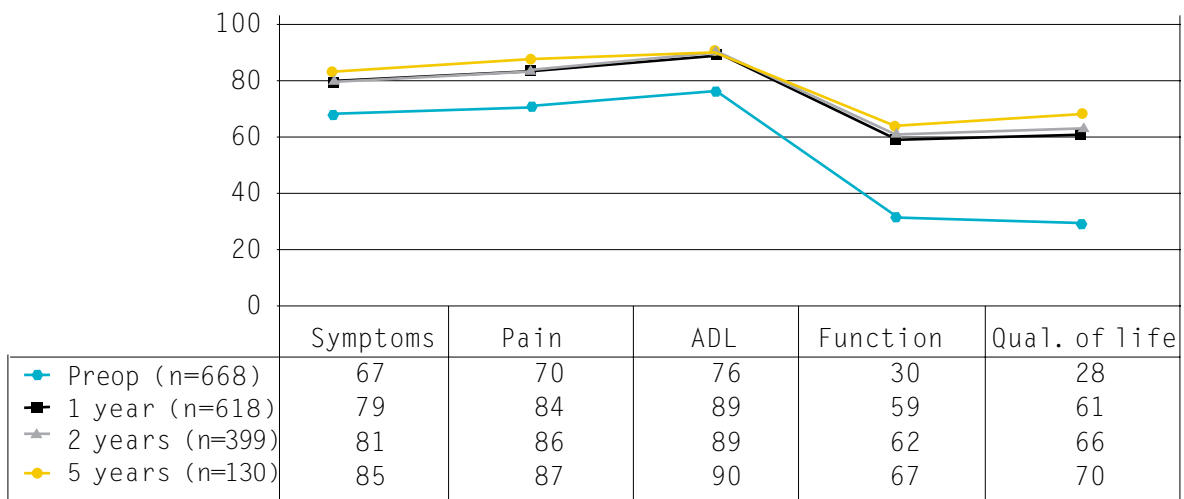
KOOS 26-35 years 2005-2010

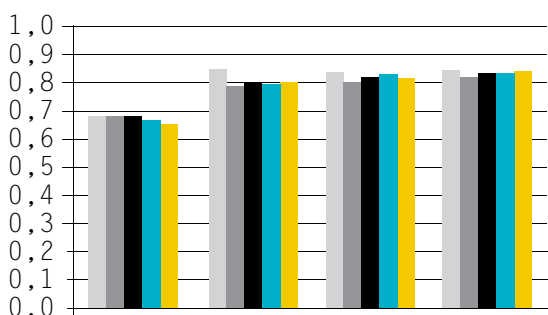


KOOS 36-45 years 2005-2010

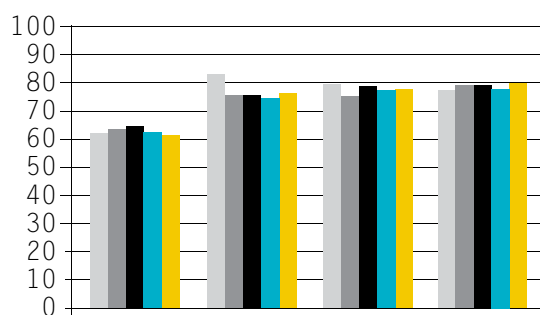


KOOS 46- years 2005-2010



EQ5D-Index by age groups  
(2005-2011)

ANTAL	Preop	1 year	2 years	5 years
1-15 years	363	337	217	60
16-25 years	5802	4636	2925	872
26-35 years	2994	2538	1657	586
36-45 years	1964	1856	1236	435
46+ years	610	591	384	120

EQ5D-VAS by age groups  
(2005-2011)

ANTAL	Preop	1 year	2 years	5 years
1-15 years	348	300	211	59
16-25 years	5602	4377	2846	868
26-35 years	2891	2378	1620	585
36-45 years	1892	1722	1211	434
46+ years	587	549	374	120

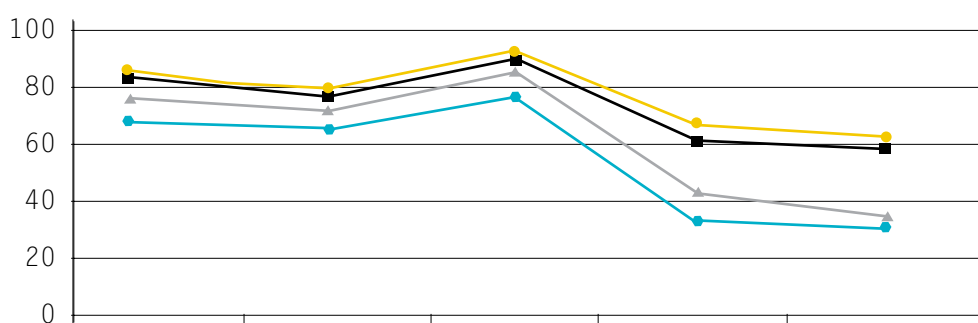
## Outcome and quality of life in relation to age

The majority of patients undergo ACL reconstruction in the 16-35 age group. In spite of the uneven number of patients in each age group, neither subjective knee function nor health-related quality of life differs between the age groups.

## Impact of smoking on surgical results

Smoking has a negative impact on the results of the KOOS. Both before ( $p < 0.001$ ) and two years after ( $p < 0.01$ ) an ACL reconstruction, smokers obtain significantly poorer values on every dimension of the KOOS. For practical reasons, the statistical analysis of smokers only comprises patients included until the end of 2010. However, the KOOS values in the following table apply to all patients until the end of 2011.

KOOS - smoker/non smoker



	Symptoms	Pain	ADL	Function	Qual. of life
Preop smokers (n=357)	68.2	65.1	77.4	32.9	30.3
2 years (n=146)	82.1	76.8	88.5	59.9	58.0
Preop non smokers (n=5390)	75.8	71.5	85.7	43.1	34.4
2 years (n=2590)	86.6	80.1	93.0	68.3	62.7

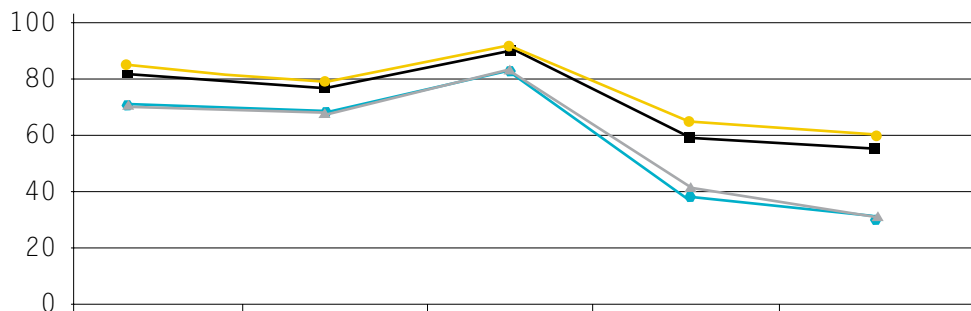
I table 2 = Preop <100 (n=426) 1 year (n=416) Preop > 500 op (n=7749) 1 year (n=6336)

It has long been known that smoking has a negative effect on every kind of surgical result, when it comes to both wound healing and the result of knee- and hip-prosthesis surgery, for example. Using the results from the register as the basis, everyone should actively inform patients of the importance of stopping smoking prior to an ACL reconstruction in the future.

## Does the number of operations at a clinic influence the result?

The KOOS results are higher both preoperatively and after one year at clinics which performed at least 500 operations during the period compared with those that performed fewer than 100. There is no difference in the increase in the KOOS.

KOOS 1 year



	Symptoms	Pain	ADL	Function	Qual. of life
● Preop <100 op (n=426)	72.9	68.6	82.4	38.3	29.9
■ 1 year (n=416)	81.9	75.6	89.8	60.1	53.9
▲ Preop >500 op (n=7749)	74.2	70.2	84.3	41.8	33.4
◆ 1 year (n=6336)	85.2	78.3	91.9	65.7	59.2

## Gender aspects

The results after ACL reconstruction are similar for both men and women. The time from injury to surgery has declined for both men and women since 2008. In 2011, the distribution between the genders when it comes to ACL reconstructions shows a preponderance in favor of men; 57% men and 43% women. In the case of revisions, the percentages were 55% and 45% respectively. The age distribution between the genders differs. One contributory factor could be the difference in physical activity between the genders at different ages, primarily because women are active in high-level sports at a younger age. The three activities in which the percentage of injuries differed most between men and women were gymnastics (77% women), dancing (75% women) and handball (65% women). The three corresponding activities for men were enduro (96% men), ice hockey (90% men) and snowboarding (72% men). In contact ball sports, the female:male ratio was 59:41 in basketball, 64:36 in handball and 37:63 in football. In racket sports, the ratio was 50:50. See also the discussion relating to gender aspects in the sections entitled “Gender-related rating of knee function in conjunction with an ACL injury” and “Outcome and quality of life in relation to gender”.

## Discussion

The Swedish ACL Register was started in 2005 and it now covers more than 90% of all the ACL operations performed in Sweden. ACL reconstruction improves both function and knee-related quality of life, but there are still limitations after ACL surgery and patients do not achieve the same function as an uninjured, age-matched population. Self-reported, patient-perceived quality indicators reveal that patients experience a deterioration in quality of life after injury and that it is primarily related to restricted knee-related quality of life.

The register board is discussing a number of improvement projects. This is necessary when it comes to improving the treatment of patients with ACL injuries in Sweden. The project with the highest priority aims to transform the ACL register from a surgery register to a diagnosis register. It is already possible to register untreated patients with an ACL injury, but a real effort needs to be made to improve reporting.

The response rate to questionnaires has improved in recent years. The register board believes that national collaboration with web portals and the improved registration of e-mail addresses, for example, would further facilitate this process and would also contribute to increased reporting and reduced costs.

The register board also feels that there is a need for continuous training for ACL surgeons in Sweden, especially those that perform fewer than 10 operations a year.

## Conclusions

One important conclusion from the analyses conducted during the year is that smoking has a negative effect on the result of an ACL reconstruction. The register board therefore recommends that patients should be informed of the negative impact of smoking prior to possible surgery.

The national ACL register is collaborating with other orthopedic registers and with a number of other quality registers (such as the gynecological surgery register). The aim is to help to simplify the techniques used for the collection and feedback of data. The ACL register's register board would like to express its gratitude for excellent collaboration during the past year. It is clear that collaboration relating to the follow-up of patient-perceived health is becoming increasingly interactive, which is leading to constructive in-depth studies. The register board welcomes comments and views on this annual report and looks forward to continued good collaboration.

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## Presentations

- Tsai L, Svenska Korsbandsregistret (Swedish ACL register), Chinese Orthopedic Association (COA), Beijing 2011
- Karlsson J, Forssblad M, Svenska korsbandsregistret (Swedish ACL register), ACL Panther meeting, Pittsburgh 2011
- Forssblad M, Svenska korsbandsregistret och fotboll (Swedish ACL register and football), FIFA, Qatar 2011
- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer (Swedish ACL register, ACL surgeons), Göteborg 2011
- Elmqvist LG, The Swedish ACL Registry – Characteristics of injuries caused by alpine skiing and snowboard, ISSS meeting, Keystone, USA, 2011
- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer (Swedish ACL register, ACL surgeons), Göteborg 2010
- Forssblad M, Wredmark T. Swedish ACL registry, ACL study group, Phuket, Podium presentation, 2010
- Jon Karlsson, MD, PhD, Torsten Wredmark, MD, PhD, Magnus L Forssblad, MD, PhD, Juri Kartus, MD, PhD, Par Herbertsson, MD, PhD, Li Tsai, MD, PhD, Johanna Adami, MD, MPH, PhD, Joanna Kvist, RPT, PhD, Lars Gunnar Elmqvist, MD, PhD. The Swedish National Anterior Cruciate Ligament Register. A report of 12,456 ACL reconstructions – Background variables and outcome. Podium presentation AAOS, 2010 and Speciality Day Sports Medicine, New Orleans
- Forssblad M, Swedish ACL registry and cartilage injuries, Prague, Czech Republic 2009
- Forssblad M, Swedish ACL registry, Zwolle, The Netherlands, 2009
- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer (Swedish ACL register, ACL surgeons), Göteborg 2009
- Wredmark T, Engebretsen L, Fjeldsgaad K, Forssblad M, Granan L. National ACL-reconstruction Registries a Quality measure for ACL surgery. Podium presentation AAOS, 2008
- Forssblad M, Wredmark T. Swedish ACL registry, ACL study group, Engelberg, Podium presentation, 2008.
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- Forssblad M, Wredmark T. The results from the Swedish Registry. Podium presentation ESSKA, 2008
- Stenros C, Tsai L, Forssblad M, Wredmark T. X-base: Report from the Swedish national ACL register 2005-2006, ESSKA 2008 (poster presentation)
- Forssblad, M. The Swedish ACL Registry. Podium presentation, 20th anniversary, National Register for Joint Prostheses, Bergen, Norway, 2007
- Forssblad M, Wredmark T. The Swedish ACL registry. ISAKOS, Florence. Podium presentation, 2007
- Wredmark T, Forssblad M. Svenska korsbandsregistret (Swedish ACL register), SOF, Umeå. Podium presentation 2007
- Wredmark T et al. Svenska korsbandsregistret (Swedish ACL register), Halmstad. Podium presentation 2007.

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