

XBase

THE SWEDISH NATIONAL
KNEE LIGAMENT REGISTER

Swedish ACL Register. Annual Report 2012.

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Contents

Preface	3	Patient-reported outcome and quality of life (PROM)	18
Goals and goal fulfillment	3	Outcome for primary ACL reconstructions.....	19
Future vision for Swedish quality register.....	4	Outcome for function and quality of life in relation to gender for primary ACL reconstructions.....	20
Areas for improvement and action	4	Outcome for function and quality of life in relation to graft for primary ACL reconstructions.....	21
Reimbursement system and ACL operations	8	Outcome for function and quality of life in relation to age for primary ACL reconstructions.....	22
Organization	8	Outcome for revision surgery.....	25
IT organization.....	8	Outcome for the reconstruction of the contralateral knee (bilateral injury)	26
Research partnerships.....	9	Patients not undergoing surgery	28
Register data.....	9	Impact of smoking on surgical results.....	29
Number of operations per clinic in 2012	9	Does the number of operations at a clinic influence the result?	29
Age at surgery	11	Gender aspects	29
Gender distribution of ACL operations.....	11	Discussion	31
Activity in conjunction with injury.....	12	Conclusions.....	31
Duration of surgery and number of surgeons	13	Own references.....	32
Time between injury and surgery.....	14	External references.....	33
Percentage of day surgery in relation to in-patient care.....	14	Presentations.....	34
ACL reconstruction in children under 15 years of age	15		
Miscellaneous	15		
Surgery variables	15		
Graft selection.....	15		
Tibial fixation	16		
Femoral fixation	16		
Revisions and operations on the contralateral side	17		

3414 Primary Operations and 243 Revisions.

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Preface

The incidence of anterior cruciate ligament (ACL) injuries has been reported from a number of studies with a range of between 32–70/100,000 inhabitants/year. Recent Swedish studies based on national data from population-based studies indicate an incidence of around 80/100,000 inhabitants/year. ACL injury is a serious knee injury that often prevents young people from continuing to engage in heavy physical work or physical exercise and sport without satisfactory treatment. Regardless of the primary treatment, studies have revealed that about 50% of patients experience radiological signs of knee osteoarthritis within 10–15 years after the initial injury.

Treatment can take the form of only rehabilitation or a combination of surgery (ACL reconstruction) and rehabilitation. It is estimated that about half of all ACL 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 anterior 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 40% 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 most patients with this injury are now registered, 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.

Goals and goal fulfillment

The overall goal of the register is to promote the improved care of individuals with ACL injuries.

Treatment

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

In every case, an ACL injury should be treated with structured, purpose-designed rehabilitation. In at least 50% of cases, surgical stabilization of the injured knee is also needed to meet the patient's knee-function requirements (Frobell et al., 2010 & 2013), but which individuals require which treatment has not been scientifically documented. In all probability, a return to a high activity level, first and foremost in contact sports (such as football, handball and floorball), will necessitate an increase in the need for surgical treatment.

The main indication for an ACL reconstruction is, however, lasting symptoms in the form of functional instability. This is frequently described as the “knee giving way” or the “knee buckling”.

Register coverage

The target for the Swedish ACL Register is 100% coverage of every individual in Sweden who injures his/her ACL.

ACL injuries

In 2005–2010, the register was only a surgical register and, as a result, the coverage for patients who were treated non-surgically was non-existent. In 2012, 504 non operated ACL injured patients registered and we try to increase that number in 2013.

ACL reconstruction

At the present time, there are about 80 clinics in Sweden that provide orthopedic care. Of these, 66 have informed the ACL register that they perform ACL surgery. It is estimated that the ACL register covers 90% of all the ACL operations in Sweden.

Input data

The target for the Swedish ACL Register is that at least 95% of all the input data directly matches patient notes and surgical records.

The register data are fed in by surgeons and/or patients directly and we therefore believe that the error percentage is low. We have received funding to perform a formalized validation of the register data in 2013-2014 and we shall be applying for ethical approval to validate the register data against case notes/surgical records in a random selection of the input data in the register (see areas for improvement below).

Not included and drop-outs

The target is to ensure that at least 80% of the patients in the Swedish ACL Register answer patient-relevant questionnaires at the time of injury surgery and at follow-ups after one, two and five years.

At the present time, we have a low response frequency when it comes to patient-relevant questionnaires on all occasions. Some 70% have entered data at the time of surgery and between 40% and 60% lack data from the various follow-up visits. In 2012, we initiated a number of different projects which are directly designed to improve these results.

Dissemination of register data and results

The target is that register data should be readily available to all caregivers and that the annual report from the register should reach all the clinics in Sweden running orthopedic programs. We are also hoping that the annual report will be disseminated at international level.

The register is open to all the participating clinics when it comes to their own data. The annual report is distributed to all the orthopedic clinics and their clinical directors in Sweden. In 2010, the annual report was translated into English for the first time and it attracted a great deal of international interest.

Future vision for the Swedish quality register

Every individual who suffers an ACL injury in Sweden is to be included in the Swedish ACL Register and followed up.

An ACL injury has serious consequences for the individual. In the short term, the injury causes a reduction in activity levels and, in the longer term, one in every two sufferers develops knee osteoarthritis in the injured knee. Treatment can take the form of rehabilitation alone or with the addition of the surgical reconstruction of the damaged ligament. In the short term, many individuals experience a return to satisfactory knee function with the help of the two treatment methods, but we do not know which individuals should avoid surgical treatment and which require it. Nor is there currently any scientific proof that either treatment reduces the risk of future knee osteoarthritis.

As a result, an important line of development for the ACL register is to include all patients with ACL injuries, regardless of how they were treated at the acute stage. In this way, data from the register will be able to spotlight the risk of both short-term and long-term consequences of the injury in relation to the treatment that was given (no treatment, structured rehabilitation alone and surgical reconstruction combined with rehabilitation).

The success and usefulness of a register are dependent on its coverage in terms of both baseline data and follow-up data. We currently have good coverage of the ACL reconstructions that are performed in Sweden (approx. 90% compared with the patient register), but this figure needs to be confirmed in a separate validation process which we shall be implementing during the next year. There is, however, real scope for improvement when it comes to patient-relevant follow-up data, where more than half of all patients are lost after five years.

The database is run by the Capio 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 board favors.

Areas for improvement and action

Inclusion of all injured individuals regardless of treatment

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. In 2012, we produced a brochure containing information about the register which will be given to all patients diagnosed with ACL injuries. In addition to general information for the injured individual, the brochure also encourages patients to report to the register via our web portal. The website has been updated to include the opportunity to register as a patient with a confirmed diagnosis. In 2012, 504 patients registered in this way and, in May 2013, 206 of them had still not undergone surgery. Of these patients, 185 (90%) had filled in the patient-relevant questionnaires at the end of the year.

Recently published incidence data suggest that some 40-50% of all individuals with ACL injuries are treated without surgery. Within the framework of this project, we plan to contact specialist rehab units to evaluate the potential for registering patients via physical therapists offering treatment. Our aim is to involve these physical therapists as informants in the same way surgeons have provided information in previous years. This should increase the amount of information on specific knee function and a possible return to sports but, first and foremost, increase the flow of patients who have recently incurred injuries and have been treated without surgery.

Preoperative patient-reported data

In the case of patients who undergo surgery, the frequency of patients' self-reported data prior to surgery is basically unchanged (70%). There is a large difference between clinics, but the Capio Arthro Clinic still has the highest reporting rate for patient-relevant preoperative data. In 2012, the board recruited a coordinator who has been tasked with contacting all the clinics, to investigate how we can improve the reporting of data. This work is ongoing and we are optimistic that the frequency of preoperative data reporting will improve in the future.

Quality of input data

At the present time, the register data are fed in by patients (patient-relevant data) and surgeons (surgical data) and we are reliant on the precision of the person responsible for registration when this takes place. The current validation of register data is based on surgical codes and comparisons with the patient register (coverage). Previous yearly comparisons have revealed discrepancies of varying degrees in both

directions (i.e. registrations in the patient register have not been found in the ACL register and vice versa). The validity of the input data is currently not known and is based on reliance on the surgeon's precision when entering data. A plan for future continuous validation of both coverage and input data is essential. We are planning to conduct a validation of register coverage by performing a crosswise comparison of a random selection of register data with the patient register and a random selection of patient data with register data.

Data loss

The response frequency for patient-relevant data on all follow-up visits is strikingly low. For the KOOS, data registration at the one-year follow-up increased compared with 2011 (64% vs 61%), which is pleasing. The follow-up data after two and five years, however, still have a low response frequency (50% and 30% in 2010 and 2007 respectively). Patient-reported data are still followed up through targeted inquiries to patients' home addresses using the conventional postal service, one, two and five years after surgery. We are looking into the potential for registering these data via the internet to facilitate the processing of data and reduce the time it takes for patients to fill in their data. Measures, such as the opportunity to use social media or mobile applications to maintain contact with patients, have been discussed. This is, however, associated with some ethical and technical problems which need to be resolved before implementation can take place. Attempts sharply to reduce the loss of data remain a priority area for 2013.

Feedback

Each surgeon can process the de-identified data 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 2010. Users also receive information via regular newsletters and the board organized two meetings for users in 2012. There are plans to distribute a new monthly report on the preoperative response frequency in the form of e-mail from 1 May 2013 with a view to increasing the preoperative response frequency.

Coverage and response rate

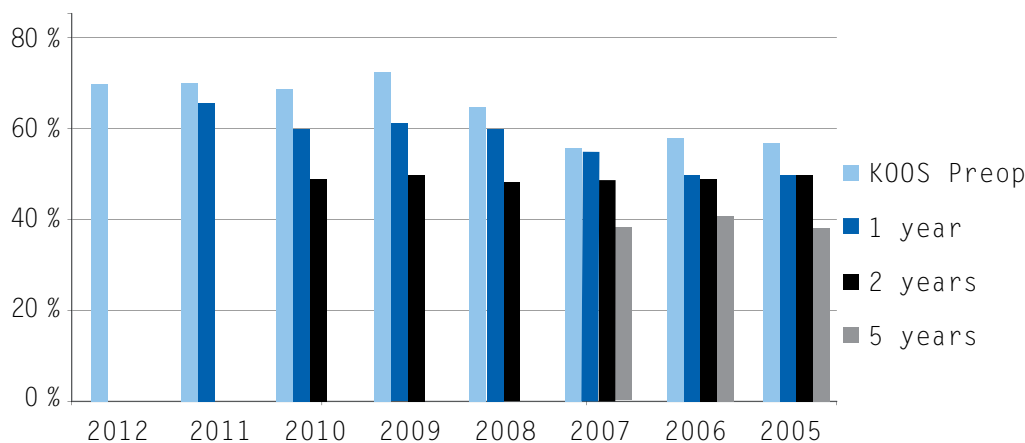
The Swedish National Board of Health and Welfare registered 3,543 ACL operations (both primary and revisions with surgery code NGE41) in 2011. The ACL register contains 3,346 registered operations for 2011.

Matching at personal ID number level reveals that the ACL register and the patient register have a total of 4,052 unique ACL operations.

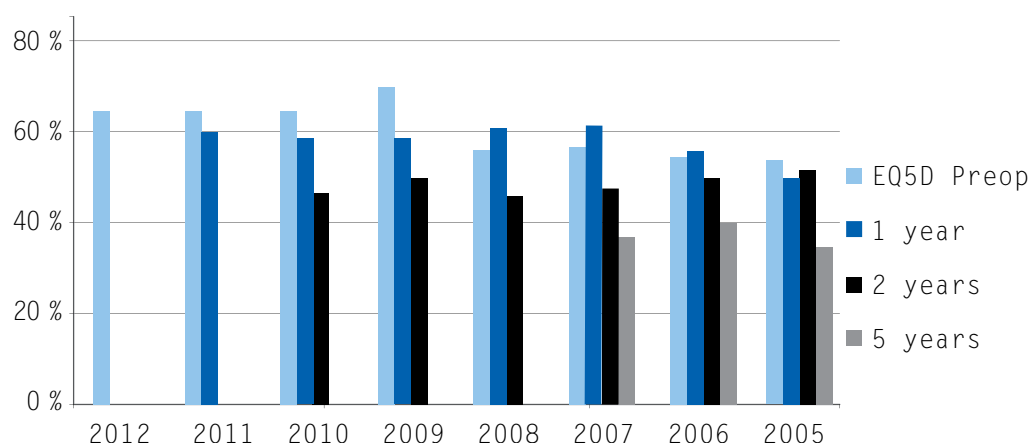
The exact agreement on the number of ACL operations was 75% when a comparison was made between the ACL register and the patient register in 2011. Of the remaining 25%, half were only found in the ACL register (12.5%) and half in only the patient register (12.5%). One possible explanation of why a patient can only be found in the ACL register could be incomplete reporting to the patient register. If the opposite applies (i.e. the patient can only be found in the patient register), the reason could be an incorrect surgery code (NGE41 has been selected for an arthroscopy). It goes without saying that these differences also reflect shortcomings in coverage. In spite of this, it is estimated that the ACL register covers more than 90% of all the ACL operations in Sweden. Data for 2012 are not yet available and this comparison has therefore been made with 2011. In 2013, extra funding has been applied for with a view to studying the question of coverage in greater detail by examining case notes at individual clinics.

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 2012 compared with 2011, but it declined slightly compared with 2010. The response rate for the EQ5D is lower than that for the KOOS. Both the KOOS and the EQ5D are supposed to be completed by the patients one, two and five years postoperatively.

Funding the ACL register

In 2012, the SKL, Sweden's Municipalities and County Councils, allocated SEK 1.2 million to the ACL register to cover running costs. The same amount has been allocated for 2013 and 2014 in the form of a two-year grant. The register is administered in collaboration with the Capio Arthro Clinic. The register provides 50% funding for two administrators. 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. The increase in funding should enable these activities to be extended.

Reimbursement system and ACL operations

In the majority of cases, reimbursement for ACL operations in Sweden is based on the DRG (diagnosis-related group) system. An ACL operation without complications is classified as DRG group H100 as day surgery and H13E as in-patient care. This group contains virtually all knee operations apart from knee arthroplasty and less complex knee surgery in the form of day surgery (H120). The national weighting list also includes a factor of 2 when comparing day surgery with in-patient care. In the case of DRG H100, this dependence on point pricing results in reimbursement for day surgery of between SEK 10,000 and 20,000 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 reimbursement 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 reimbursement 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 reimbursement.

Organization

The Swedish ACL Register is administered by Karolinska University Hospital and the principal is the board.

Magnus Forssblad at the Capio Artro Clinic was appointed by Karolinska University Hospital and the board as the registrar.

The contact person was Anna Pappas, Sports Trauma Research Center, Karolinska Institutet and Capio Artro Clinic. The administrator was Lotta Falkendal, Sahlgrenska University Hospital, Göteborg.

In 2012, the board was made up of the following representatives from different regions in Sweden.

- Johanna Adami, Professor and Departmental Director, Karolinska Institutet and VINNOVA, Stockholm
- Magnus Forssblad, MD, PhD, Capio Artro Clinic and Sports Trauma Research Center at Karolinska Institutet, Stockholm
- Richard Frobell, Associate Professor, Lund University
- Joanna Kvist, Associate Professor, Linköping University
- Pär Herbertsson, MD, PhD, Lund University Hospital
- Professor Jon Karlsson, Sahlgrenska University Hospital, Göteborg
- Professor Jüri Kartus, NU-Hospital Group, Trollhättan/Uddevalla
- Professor Kjell G Nilsson, Umeå University Hospital, Umeå
- Professor Christer Rolf, Karolinska University Hospital, Stockholm (from December 2012)
- Anders Stålman, MD, PhD, Karolinska University Hospital, Stockholm

IT organization

The IT operations relating to the Swedish ACL register are administered by the Capio Artro Clinic. 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 (2004) and Denmark (2005). The first 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 Forssblad and Lars Engebretsen).

In 2011, "Effect of gender and sports on the risk of full-thickness articular cartilage lesions in anterior cruciate ligament-injured knees: a nationwide cohort study from Sweden and Norway of 15 783 patients" (Røtterud JH, Sivertsen EA, Forssblad M, Engebretsen L, Årøen A) was published in the American Journal of Sports Medicine. This study was conducted in collaboration with Norway and our registers were analyzed together. We found that cartilage damage was more common among men undergoing surgery for ACL injuries, first and foremost handball players. We were also able to demonstrate that the risk of cartilage damage increased with age, previous surgery and a period of more than 12 months between injury and surgery. This article was presented with the Hughston Award for the best article in the American Journal of Sports Medicine.

In 2012, a number of research students continued to work on questions relating to the register. 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.

There has been an increase in national and international collaboration. 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, international ACL meetings were held on two occasions with representatives from different ACL registers worldwide and this will probably result in joint research projects.

The 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 2005-2012, 25,532 primary ACL reconstructions and 1,491 revisions from a total of 76 clinics were registered.

Number of operations per clinic in 2012

	Primary	Revisions
CAPIO ARTRO CLINIC	594	63
SKÅNES UNIVERSITETSSJUKHUS	254	19
SAHLGRENSKA	214	16
KUNGSBACKA SJUKHUS	143	9
VRINNEVISJUKHUSET	100	2
MOVEMENT MEDICAL AB	95	7

NU-SJUKVÅRDEN	92	15
SÖDERSJUKHUSET	91	7
ORTHOCENTER IGÖTEBORG	91	17
NORRLANDS UNIVERSITETSSJUKHUS, UMEÅ	81	5
KAROLINSKA UNIVERSITETSSJUKHUSET	79	9
ELISABETH SJUKHUSET	77	8
HÄSSLEHOLMS SJUKHUS	73	4
MEDICIN DIREKT	67	4
LINKÖPINGS UNIVERSITETSKLINIK	66	2
HELSINGBORGS SJUKHUS	63	2
CENTRALLASARETTET VÄXJÖ	61	5
KARLSTAD CENTRALSJUKHUS	61	8
KALMAR SJUKHUS	60	2
FALU LASARETT	51	1
ODENPLANS LÄKARHUS	49	2
LÄNSSJUKHUSET RYHOV	47	3
HÖGLANDSSJUKHUSET	44	0
LIDKÖPINGS SJUKHUS	44	1
ORTOPEDISKA HUSET CAREMA	43	5
GÄVLE SJUKHUS	43	2
MÄLARSJUKHUSET ESKILSTUNA	41	2
SPORTS MEDICINE UMEÅ	39	1
SUNDERBY SJUKHUS	38	0
CAPIO LÄKARGRUPPEN I ÖREBRO AB	35	5
ÖREBRO UNIVERSITETSSJUKHUS	33	2
ORTHOCENTER I STOCKHOLM	29	0
PERAGO ORTOPEDKLINIK	28	1
HUDIKSVALLS SJUKHUS	27	1
PROXIMA ORTOPEDI ÄNGELHOLM	27	2
OSKARSHAMNS SJUKHUS	26	0
SÖDRA ÄLVSBORGS SJUKHUS	26	0
ALINGSÅS LASARETT	24	1
DANDERYDS SJUKHUS	23	0
LÖWETS SPECIALISTMOTTAGNING	23	0
NORRTÄLJE SJUKHUS	23	0
VÄSTERÅS ORTOPEDPRAKTIK	22	1
FRÖLUNDA SPECIALISTSJUKHUS	22	3
NACKA NÄRSJUKHUS	20	0
VÄSTERVIKS SJUKHUS	20	1
SABBATSBERG NÄRSJUKHUSET	20	0
BLEKINGESJUKHUSET	17	0
LJUNGBY LASARETT	17	2
KUNGÄLVS SJUKHUS	17	0
SOLLEFTEÅ SJUKHUS	16	1
LÄKARHUSET HERMELINEN	16	0
SÖDERTÄLJE SJUKHUS	15	0
ORTHOCENTER I SKÅNE	15	2
NYKÖPINGS LASARETT	11	0
VÄRNAMO SJUKHUS	10	0
VISBY LASARETT	8	0
VÄSTERÅS CENTRALLASARETTET	8	0
LÄNSSJUKHUSET SUNDSVALL	8	0
KÄRNSJUKHUSET I SKÖVDE	6	0
SAMARITERHEMETS SJUKHUS	6	0
S:T GÖRANS SJUKHUS CAPIO, STOCKHOLM	5	0
CAPIO LUNDBY NÄRSJUKHUS	4	0
GÄLLIVARE SJUKHUS	2	0
SPORTSMED	2	0
SOPHIAHEMMET	1	0
ART CLINIC	1	0

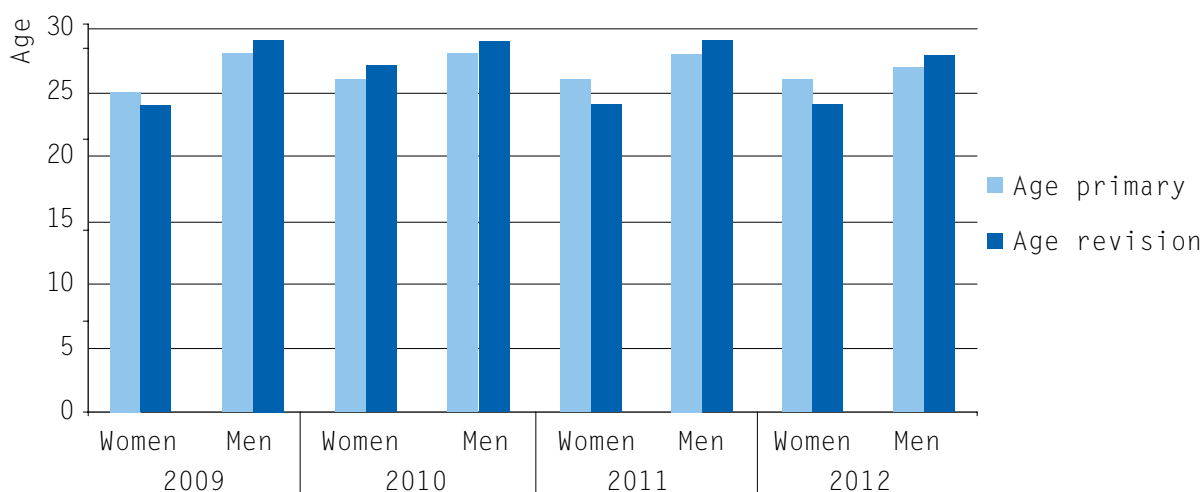
Age at surgery

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 27 respectively in 2012. During the period 2009-2012, women were always several years younger than men when it came to primary ACL surgery. 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 2012, the age at revision surgery was 24 for women and 28 for men. The reasons for this gender difference should be analyzed in greater detail.

It is important to note that women are forced to undergo a second ACL operation at such a young age.

Age at primary ACL surgery



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.

Year	Men	Women	Ratio men:women
2009	1,789	1,300	1.38
2010	1,944	1,366	1.42
2011	1,896	1,415	1.32
2012	1,970	1,444	1.36

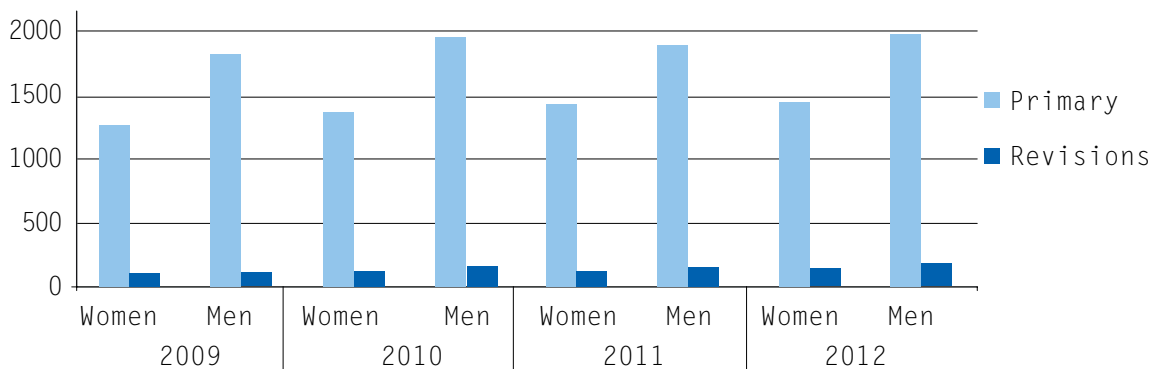
This may seem surprising, as it is also known that women run a far higher risk of sustaining an ACL injury than men. One explanation could be that there are a number of unknown cases among women who voluntarily reduce their activity level, take part in a non-surgical rehabilitation program and thereby 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 only rehabilitation. So basically no major change has taken place since 2009 when it comes to the gender distribution for primary ACL reconstruction.

The following table shows the number of revisions in 2009–2012.

Year	Men	Women	Ratio men:women
2009	110	81	1.36
2010	136	88	1.55
2011	122	100	1.22
2012	131	112	1.17

There is a slight preponderance of men undergoing revision surgery, but the ratio between men and women appears to be decreasing. Based on clinical experience, the reason for this could be that more men than women return to their previous activity level but that this trend is in the process of being reversed. The number of revisions in patients with a new ACL injury to the knee that have already undergone surgery or with an unsatisfactory result after the first operation is relatively small compared with the number of primary reconstructions.

Number of ACL operations 2009-2012



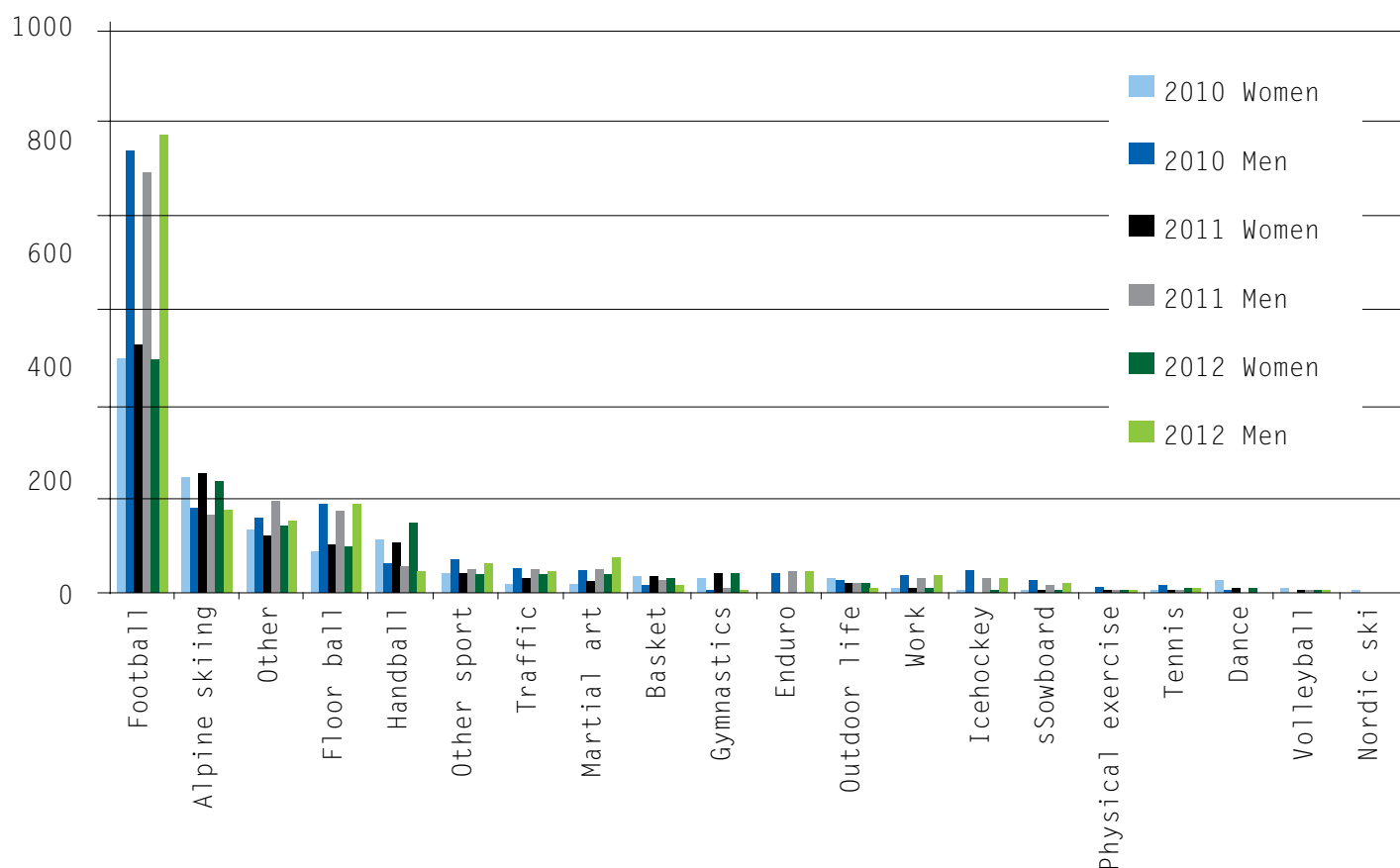
Activity in connection with injury

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 2012, football was the cause of ACL injuries in 495/1,444 women (34.2%) and 971/1,970 (49.3%) men.

The second most common activity was downhill skiing for women and floorball among men in 2010, 2011 and 2012.

As football is the leading cause of ACL injuries, it is interesting that projects including prophylactic training for young people playing football are in progress in Sweden. This training is designed to create improved balance and proprioception in the lower extremities, thereby teaching ball-playing youngsters to avoid situations in which an ACL injury could occur.

Number of primary ACL reconstructions, injury caused by sports

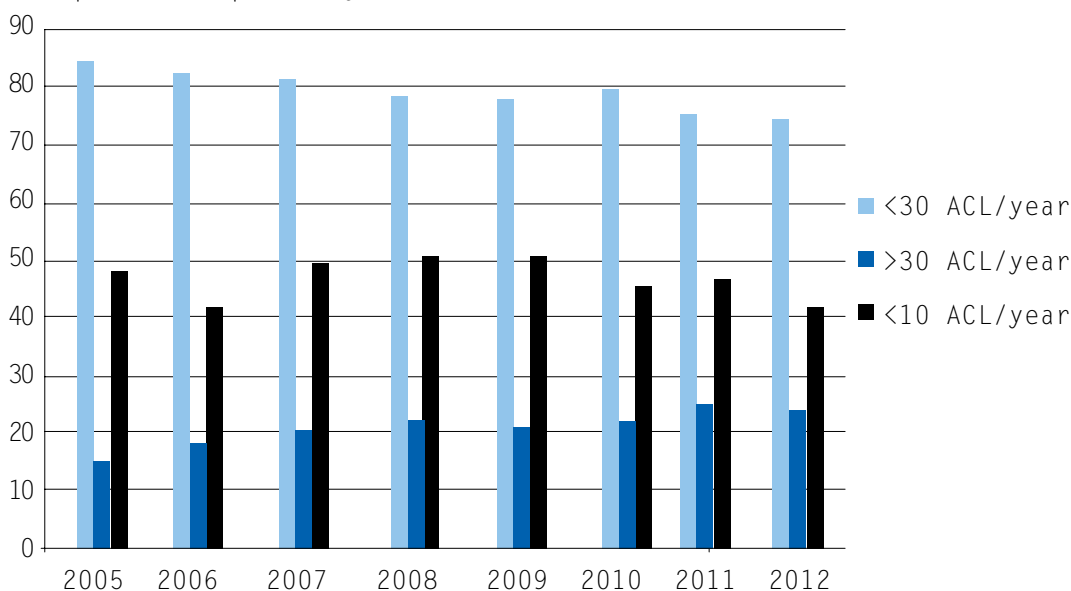


Duration of surgery and number of surgeons

In Sweden, as in a number of other countries, including the USA, many surgeons perform only a few ACL operations. Of the Swedish ACL surgeons, 75% perform fewer than 30 operations a year and 41% perform fewer than 10 operations a year. These figures have been much the same since the ACL register was set up in 2005.

The average duration of surgery for an ACL reconstruction is around 75 minutes for a primary operation and about 90 minutes for a revision.

Number of primary ACL reconstructions given the number of operations per surgeon

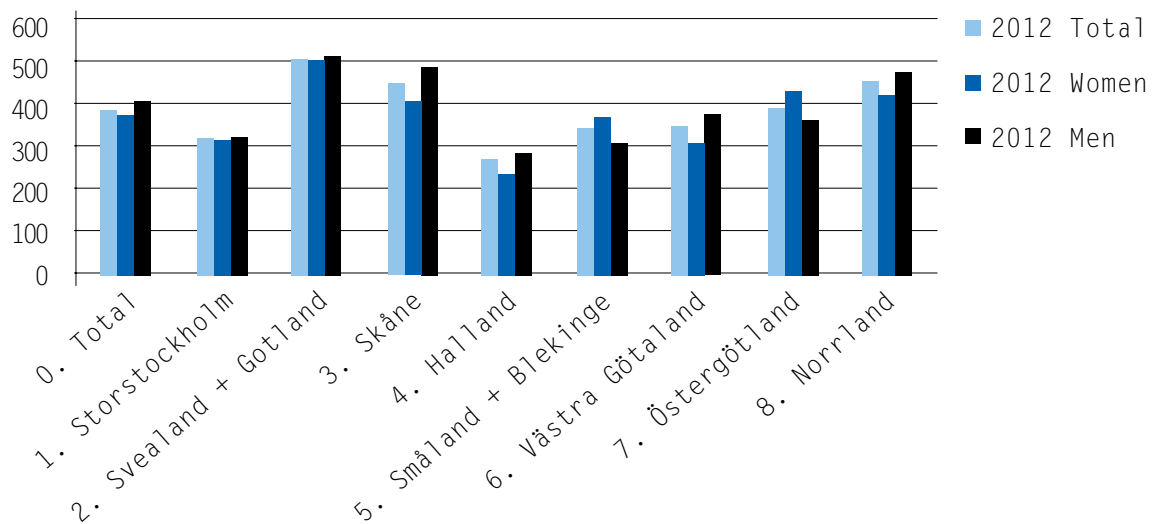


Time between injury and surgery

Since 2009, the average time between injury and surgery has been 400 days and there is no marked gender difference. In 2012, the corresponding time was 393 days for the whole of Sweden.

The reason why there is a long period between injury and surgery is not known. One reason could be that many patients are not identified at emergency departments or local medical centers after their injury. In other words, they are not given the correct diagnosis at the acute stage. This would be extremely unfortunate, as it would mean that treatment is not given, resulting in a major risk of new and repeat trauma to the knee (which is unstable). Another reason could be that Sweden has embraced a treatment algorithm which means that most patients first receive non-surgical treatment, thereby extending the time to surgery. This is completely in line with the recent discussion and hypothesis that patients with ACL injuries may not always require surgery but can instead eliminate their problems using rehabilitation and activity modification.

Time between injury and surgery in days for different Swedish regions

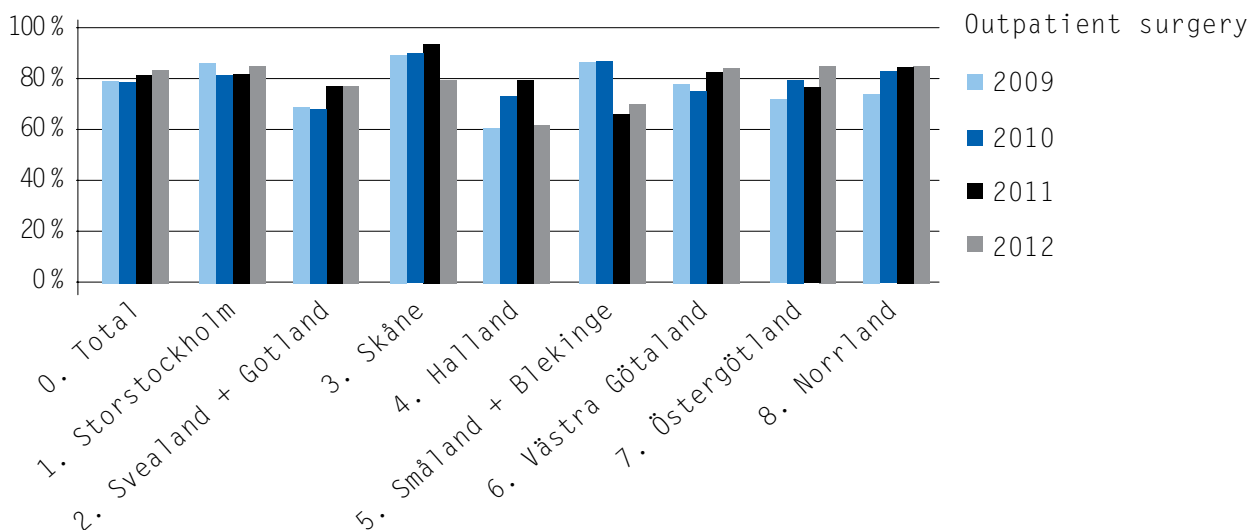


Percentage of day surgery in relation to in-patient care

The percentage of patients who undergo day surgery is slowly increasing and now appears to have stabilized at more than 80% of the total number of operations. In 2008, 74% of ACL operations were performed as day surgery. In 2009 and 2010, this figure was almost 80%, whereas it was 82.4% in 2011 and 83.1% in 2012. In Skåne in southern Sweden, some 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. Halland in southern Sweden, on the other hand, has the lowest percentage of day surgery (62%), but this is based on a small number of registered patients (n = 76). 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 2012, 72 ACL reconstructions were performed on children under 15 years of age in Sweden compared with 95 in 2011; this constitutes 2% of all operations in 2012. Of the operations performed in 2012, 47 involved girls and 25 involved boys. Two patients were under 12 years of age compared with four in 2011. A total of 16 clinics performed operations on children under 15 years of age – the majority were performed at the Capio Artro Clinic, with 33, Skåne University Hospital, with seven, Växjö and Sahlgrenska, each with four, and Sports Medicine Umeå, with 3. The remaining 11 clinics performed one to two operations.

More than half of all the patients had meniscal injuries (57%) and three-quarters of these were sutured (75%). Girls accounted for 76% of the patients. The cause of accidents is distributed equally between boys and girls. Football dominated and accounted for 44% of accidents. It was followed by floorball (13%), handball (11%) and Alpine/Telemark skiing (8%).

Miscellaneous

The use of the double-tunnel technique as a surgical method continues to decline in Sweden. In 2012, only 42 such operations were performed, which corresponds to 1.2% of all the operations performed. The corresponding figure for 2011 was 43 (1.3%).

Thromboprophylaxis is administered in 33% of all operations. Antibiotic prophylaxis is basically administered in all operations.

Surgical variables

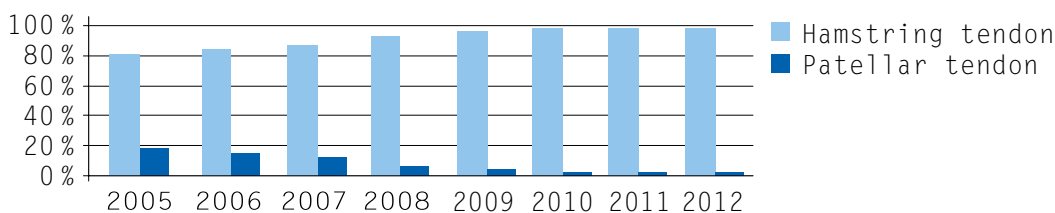
Graft selection

When the ACL register was started in 2005, 20% still used patellar tendon grafts with bone at both ends of the tendon as a free transplant. Today, 2% use the patellar tendon graft as a transplant and hamstring tendons are totally dominant. 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 (or more). The most common is a doubling of the gracilis and the semitendinosus, which accounts for 48%.

Hamstring tendons are a less complex graft for surgeons and there is no difference in the long-term results produced by using either the patellar tendon or the hamstring tendon. The main reason for currently using the patellar tendon is a revision, when the patient has already undergone surgery with a hamstring tendon in the primary reconstruction. As a result, there is a risk that new ACL surgeons will not learn to use the patellar tendon as a graft. The only difference between the two grafts in scientific studies is that the people who receive a patellar tendon graft have slightly more problems when they kneel and crawl and the problems that occur are pain at the front of the knee.

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, in 2011, 30 allografts were used and, in 2012, 33 allografts were used in primary ACL reconstruction. So, in revisions, some 10% are accounted for by allografts; in 23 of 243 revisions, tibialis allografts were used. The use of allografts is probably governed by the cost, as the price of an allograft has more than doubled in recent years and will soon have reached around SEK 20,000. There are also problems when it comes to ordering allografts from countries that sell them and the transport of allografts is not without its problems, as they have to be transported in refrigerated form in freezer boxes and transport frequently takes several days. For this reason, allografts are primarily used in revision surgery and multiple ligament reconstructions (knee luxations).

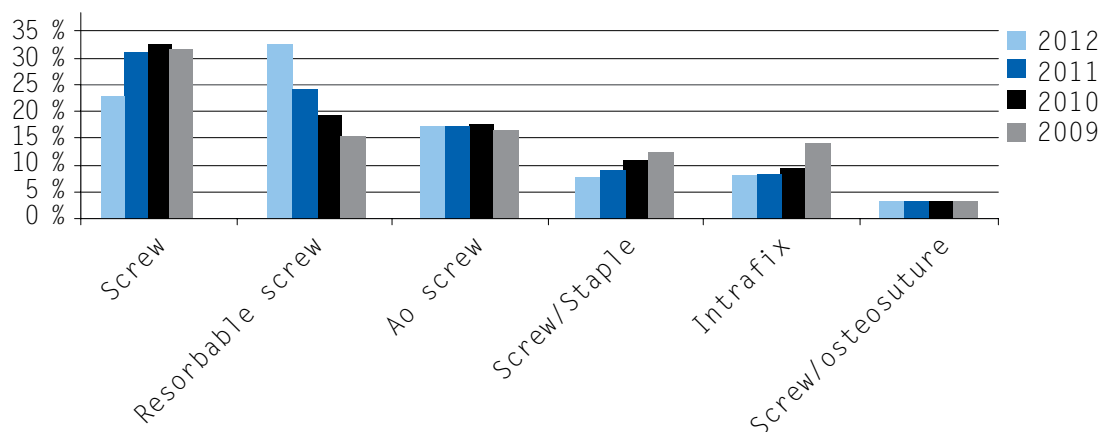
Graft selection 2005-2012



Tibial fixation

In this context, screw fixation still dominates, but a change has taken place which has resulted in resorbable screws being used more frequently than titanium screws. The use of the AO screw, which is not an interference screw, has been between 10% and 20% since the ACL register was started and, since 2009, this figure has been 18%. The screw and staple sink to some degree and this method is primarily used in Lund/Malmö. The use of intrafix did not continue to decline in the past year and is used in about 8% of patients.

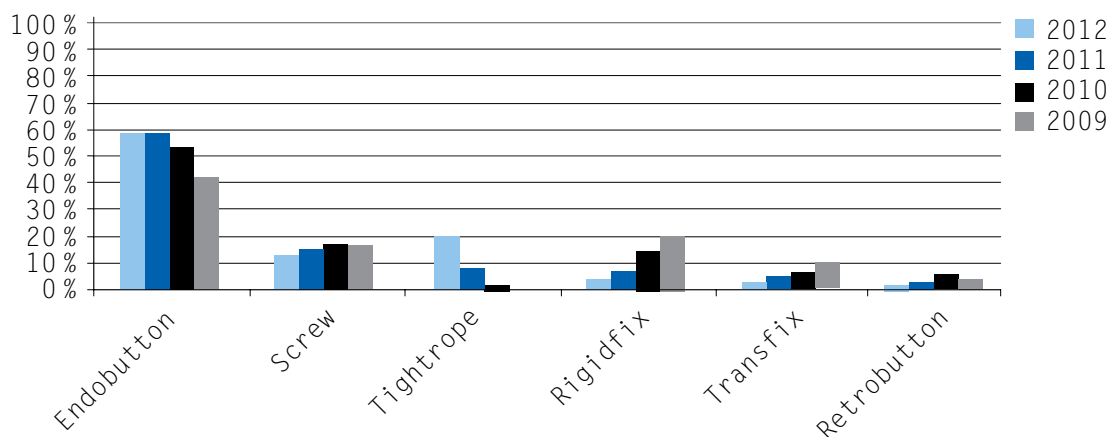
Top 6 Fixation Tibia Hamstring tendon



Femoral fixation

The most common form of fixation at the present time is the cortical button, which is used in 80% of all femoral fixations. Over the years, a major change has taken place in this area. In the past, resorbable cross-pins (such as Rigidfix and Transfix) were the most widely used form of femoral fixation, but the cortical button (such as Endobutton, Tightrope and Toggleloc) is currently 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 80%. 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, where it is necessary to drill through the lower part of the leg using alignment instruments, the surgeon is not obliged to use the tibial canal. The cortical button is also stable and there is no risk that the transplant will move or slip. Interference screws in the femur were used in some 20% of patients in 2005, when the ACL register was started, but this figure has fallen slightly in recent years, even if this screw is still used in around 12% of cases.

Top 6 Fixation Femur Hamstring tendon



Revisions and surgery on the contralateral side

A total of 1,491 revisions were registered in the ACL register in 2005-2012. If we instead choose to follow the patients who initially underwent surgery within the framework of the ACL register and then underwent revisions, 1,382 new operations were registered on patients who had previously undergone surgery. In this way, the follow-up period is longest for patients who underwent surgery in 2005, while it was only possible to follow up patients who underwent surgery in 2012 during that year. Of these 1,382,

721 were performed on the same side (genuine revision), while there were 661 primary operations on the other side, making the percentage of “genuine” revisions 5.9%.

If the follow-up period is limited to three years and we choose to follow the patients undergoing surgery in 2005-2009, 452 new operations were performed in 2005-2012. Of these, 248 were genuine revisions, making the percentage 3.4%.

We have not found any large differences between women and men or between various kinds of graft.

In the group comprising female football players aged between 15 and 18, more than 27% 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 group 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 35%, i.e. more than a third. 2005 was, however, an exceptional year; the percentage of new operations for the same group of girls varies between 12% and 20% in the following years.

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%.

Patient-reported outcome and quality of life (PROM)

All patients are asked to complete two questionnaires, the KOOS and the EQ5D.

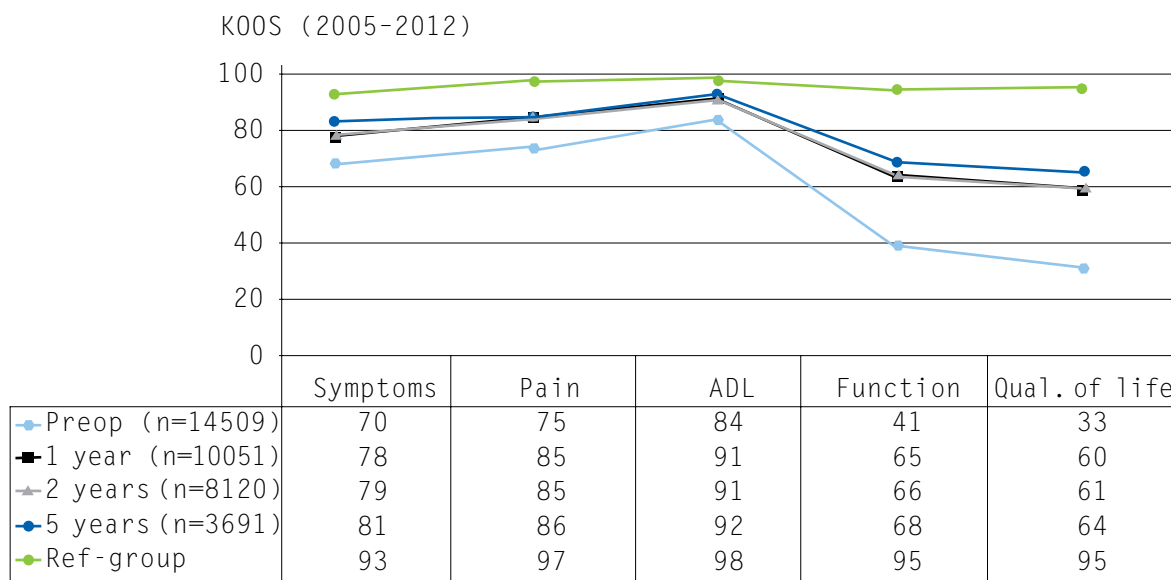
The KOOS (Knee injury and Osteoarthritis Outcome Score) is a knee-specific instrument for evaluating the patient’s perception of his/her knees and knee-related problems. The instrument evaluates five aspects: pain, other symptoms, such as swelling, joint mobility and mechanical symptoms, functional impairment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

The EQ5D is a questionnaire on non-illness-specific health-related quality of life. It comprises five questions with three alternative answers. Each question covers a separate dimension: mobility, hygiene, main activities, pain/problems and fear/depression. The results are presented as an index, a quality of life weighting between 0 (death) and 1 (complete health). A negative index is also possible and then indicates a state of health worse than death. This self-rated health status is also assessed using a thermometer-like scale, the EQ5D-VAS, with the end-points of “worst conceivable health status” (assessed as 0) and “best conceivable health status” (assessed as 100).

The PROM is presented below in the form of a figure. The data (average value and distribution) can be found on the register homepage.

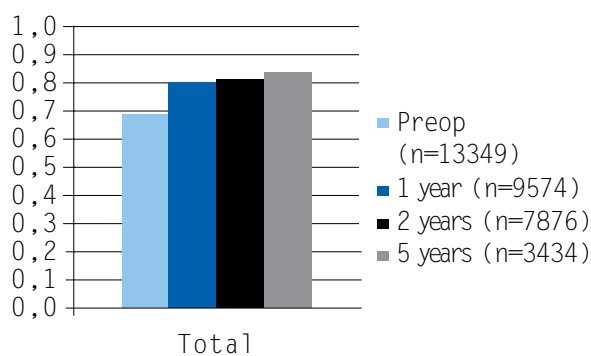
Prior to surgery, the patients experience an impairment in their self-rated function. We can see a clear-cut improvement in self-rated knee function one year after surgery, followed by a successive improvement two and five years after surgery. A comparison with reference data from 118 football players 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 2012 do not differ markedly from those in previous years.

Outcome for primary ACL reconstructions

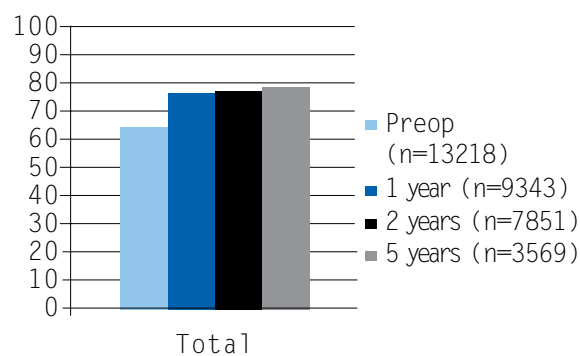


Health-related quality of life is impaired in patients prior to and one, two and five years after ACL reconstruction (“UK EQ5D index tariff” score 0.69-0.83) compared with reference values from a Swedish population aged 20-40 (“UK EQ5D index tariff” score between 0.88 and 0.89) (Burström et al. 2001) 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 (2005-2012)



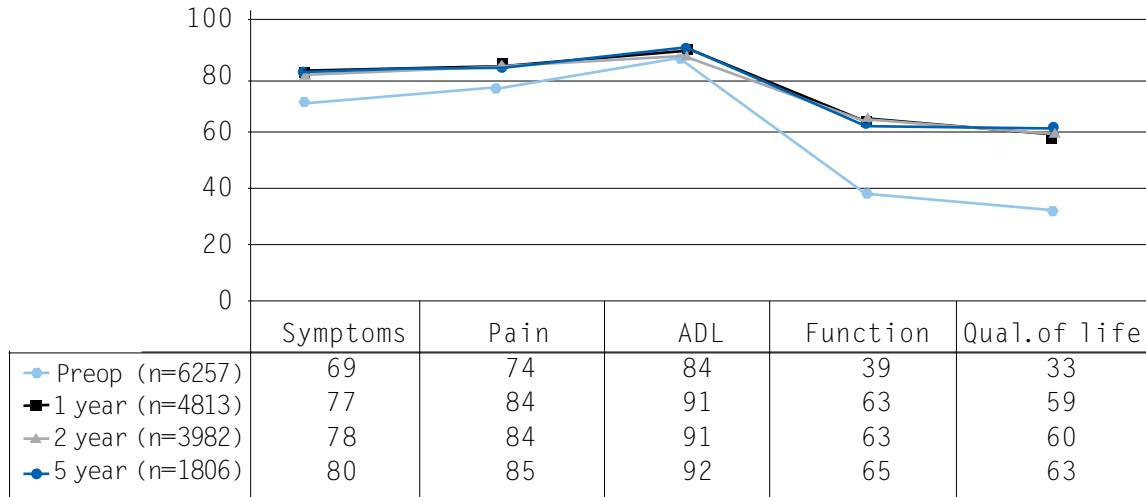
EQ5D-VAS (2005-2012)



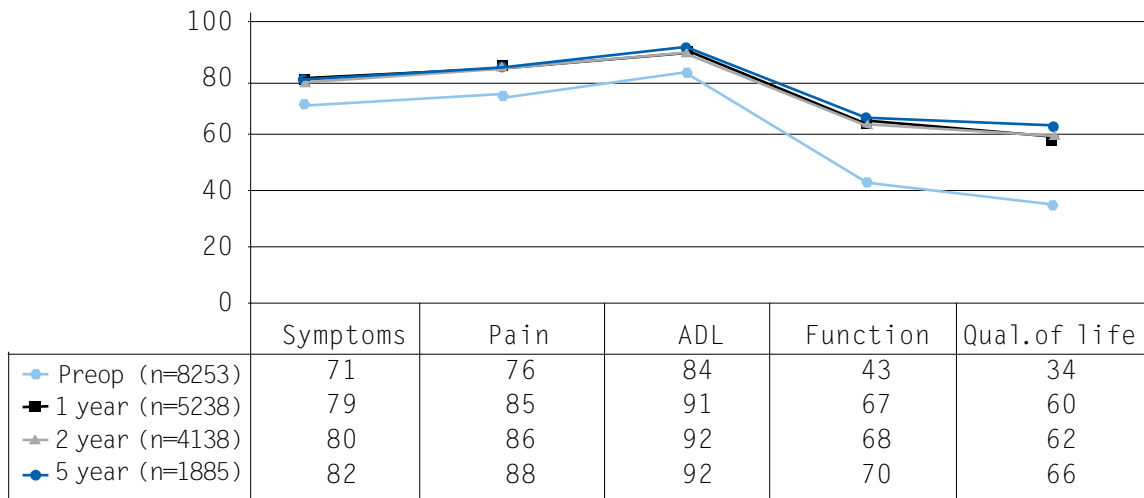
Outcome for function and quality of life in relation to gender for primary ACL reconstructions

There is no difference in subjective knee function and health-related quality of life between men and women. A somewhat lower rating for the aspect of “functional impairment in connection with sport and recreational activities” can be seen for women, both preoperatively and at all follow-ups.

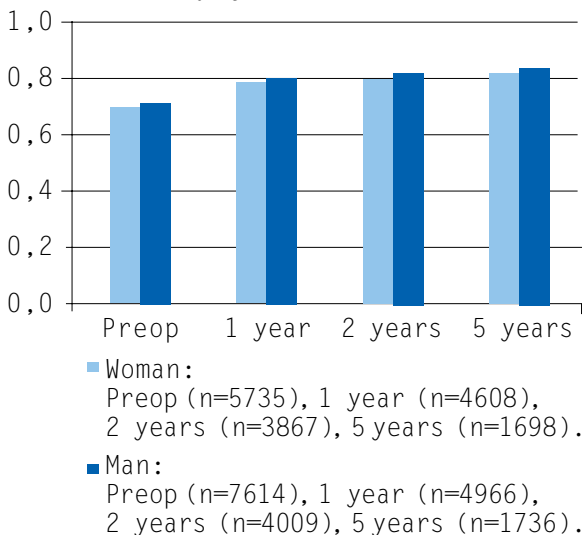
K00S for primary reconstructions - women (2005-2012)



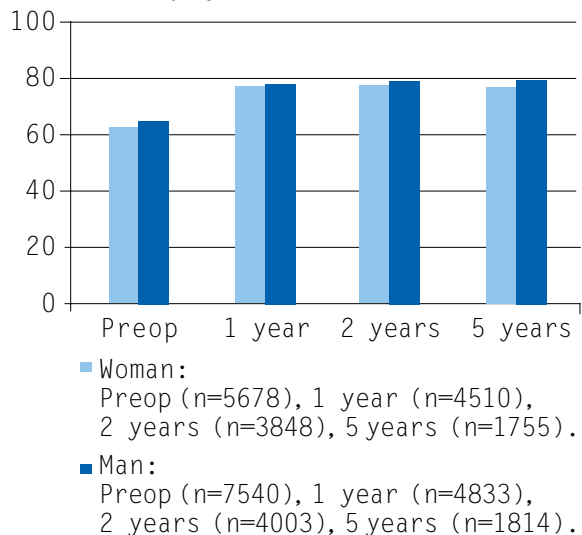
K00S for primary reconstructions - men (2005-2012)



EQ5D-Index by gender (2005-2012)



EQ5D-VAS by gender (2005-2012)

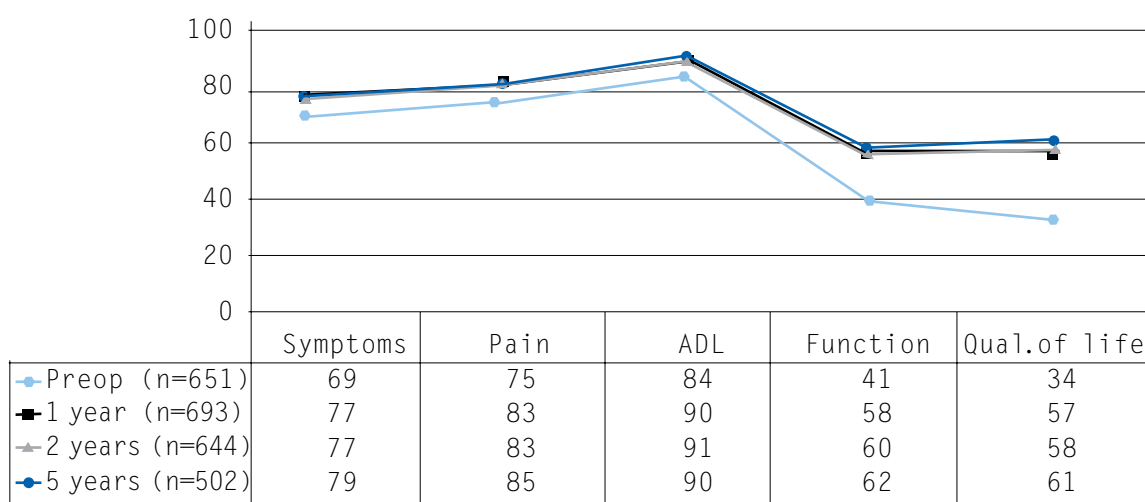


Outcome for function and quality of life in relation to graft for primary ACL reconstructions

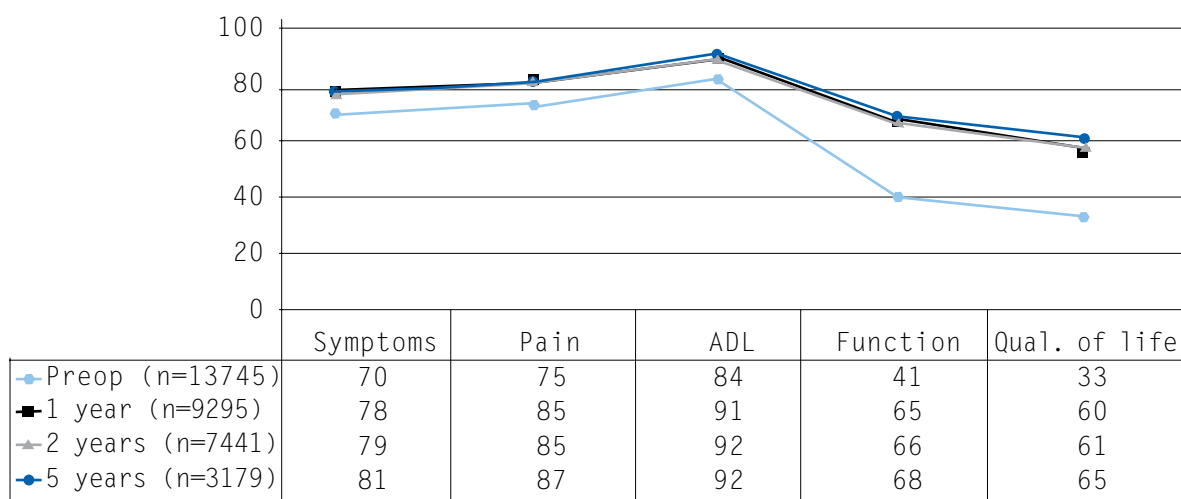
Patient-reported knee function and health-related quality of life do not differ in comparisons between the most commonly used grafts (patellar tendons and hamstring tendons) or allografts. In this context, it is also important to point out that the number of operations involving patellar tendon grafts only account for 2% of all operations and the result should therefore be interpreted with care. Only 33 operations involving allografts were performed in 2012.

Based on KOOS data from the register one and two years after surgery, a possible clinically relevant difference can be seen on the “function, sports and recreational function” sub-scale in favor of operations involving hamstring tendons compared with patellar tendons. The mean value (SD) for the KOOS one, two and five years postoperatively is 58 (27), 60 (27) and 62 (28) for patients undergoing surgery involving patellar tendon grafts and 65 (27), 66 (27) and 68 (28) for patients undergoing surgery involving hamstring grafts. 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. The same tendency could also be seen in the data from previous years.

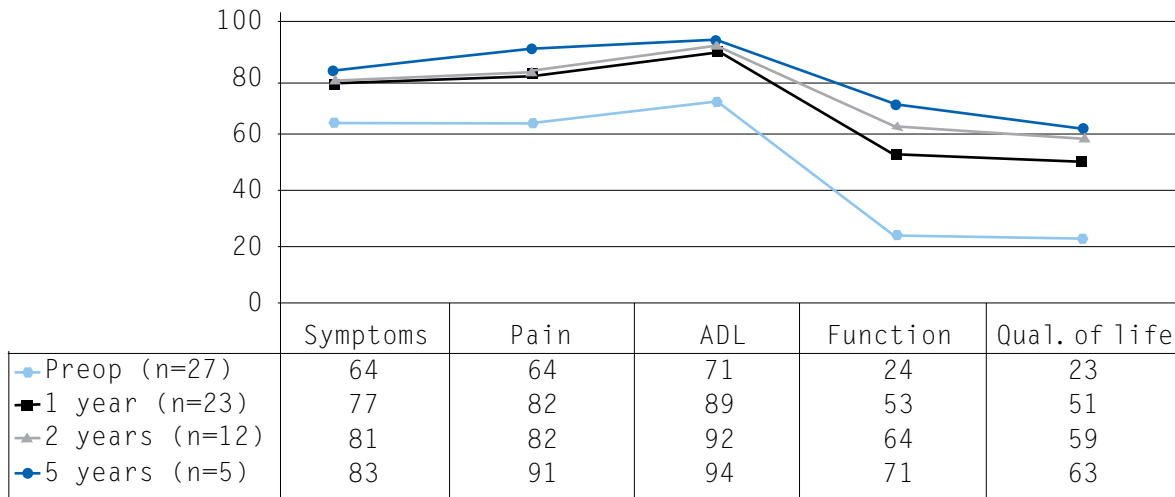
KOOS för primary reconstructions - patellar tendons (2005-2012)



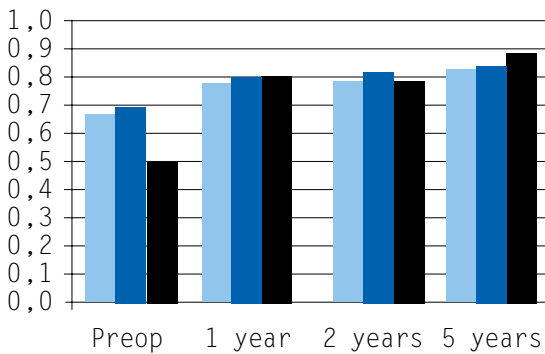
KOOS för primary reconstructions - hamstring tendons (2005-2012)



KOOS for primary reconstructions - allograft (2005-2012)

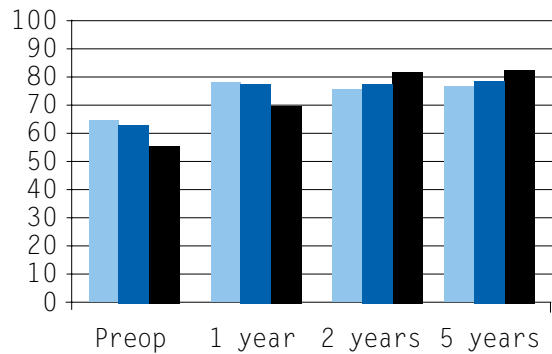


EQ5D-Index by graft (2005-2012)



- Patellar tendons:
Preop (n=604), 1 year (n=668),
2 years (n=646), 5 years (n=464).
- Hamstring tendons:
Preop (n=12637), 1 year (n=8843),
2 years (n=7195), 5 years (n=2960).
- Allograft:
Preop (n=26), 1 year (n=22),
2 years (n=12), 5 years (n=5).

EQ5D-VAS by graft (2005-2012)

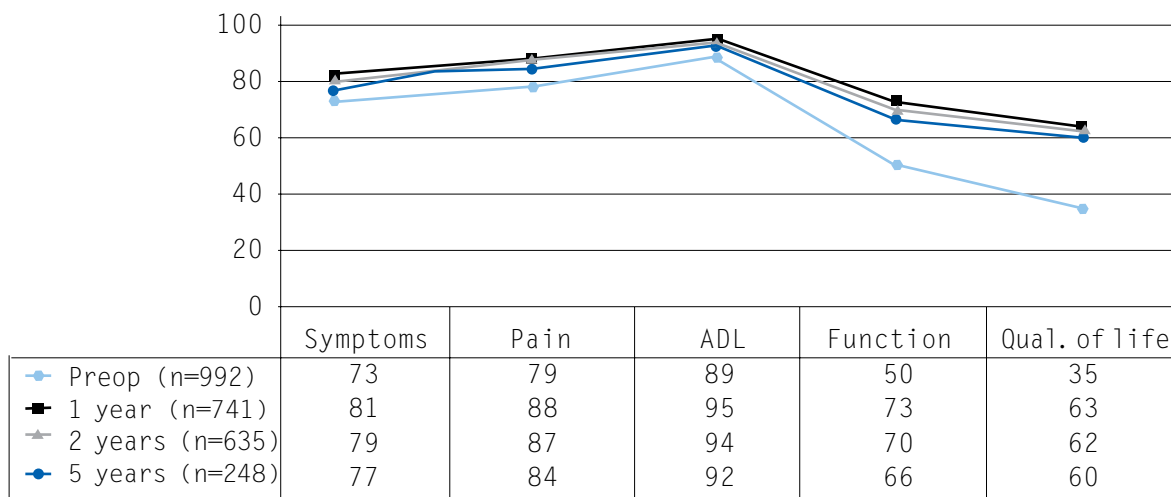


- Patellar tendons:
Preop (n=600), 1 year (n=621),
2 years (n=624), 5 years (n=481).
- Hamstring tendons:
Preop (n=12514), 1 year (n=8860),
2 years (n=7190), 5 years (n=3078).
- Allograft:
Preop (n=26), 1 year (n=22),
2 years (n=12), 5 years (n=5).

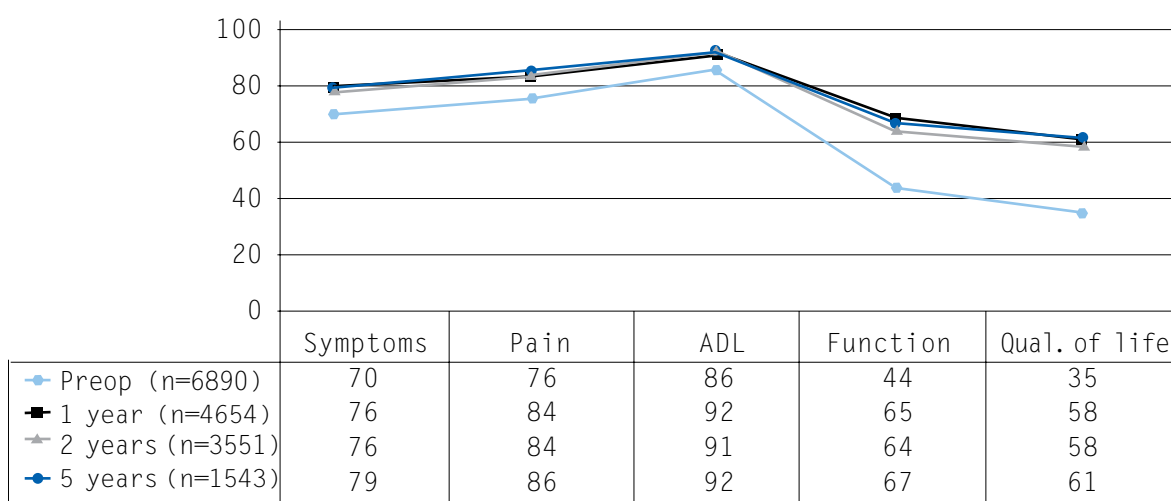
Outcome and quality of life in relation to age for primary ACL reconstructions

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, there are small, inconclusive differences. More analyses need to be conducted to assess the significance of these differences.

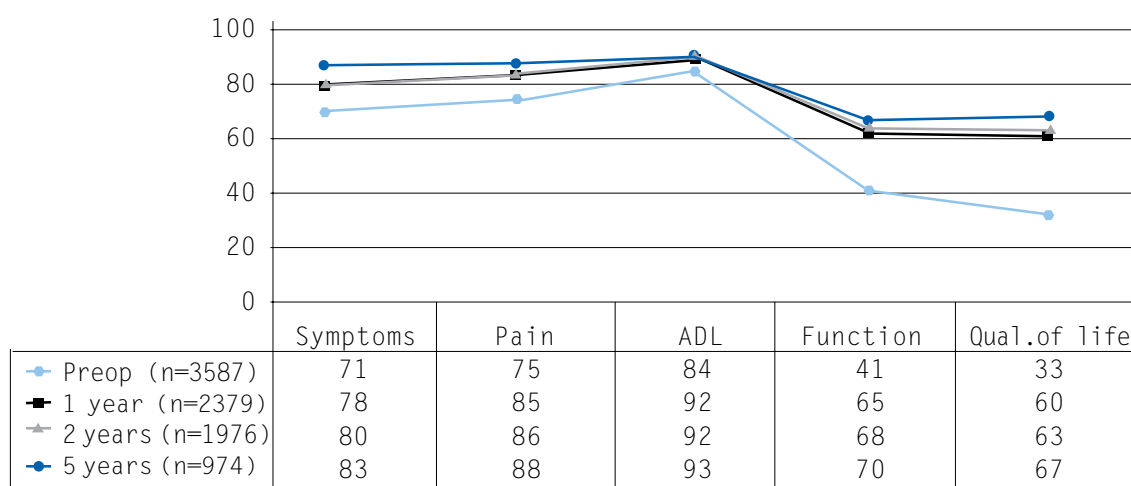
K00S for primary reconstructions - 1-15 years (2005-2012)



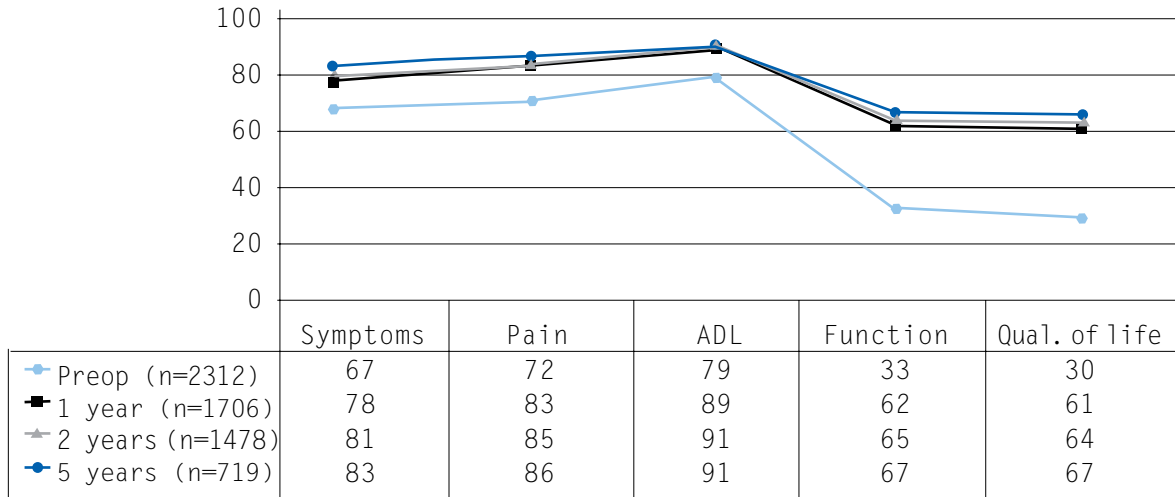
K00S for primary reconstructions 16-25 years (2005-2012)



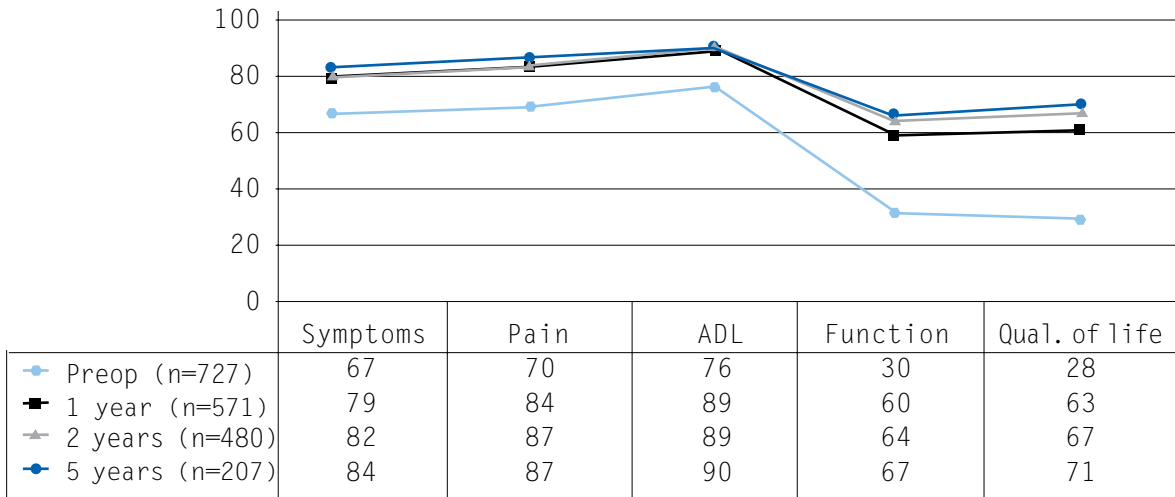
K00S for primary reconstructions 26-35 years (2005-2012)



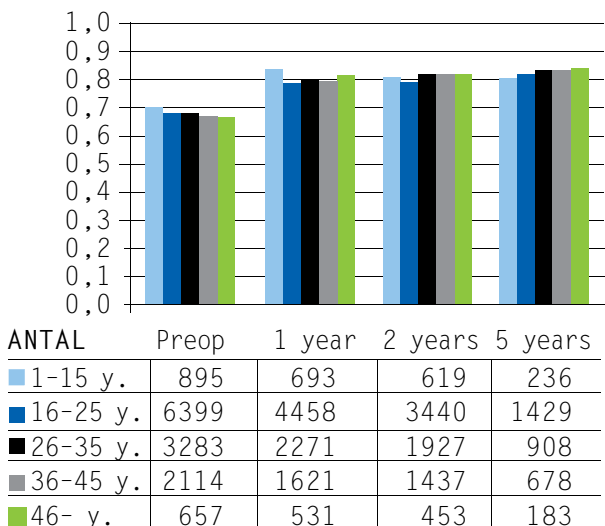
K00S for primary reconstructions 36-45 years (2005-2012)



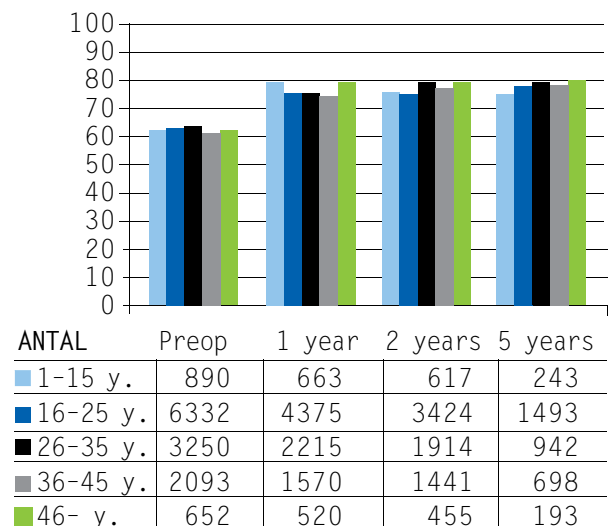
K00S for primary reconstructiona - 46- years (2005-2012)



EQ5D-Index for primary unilateral reconstructions by age (2005-2012)



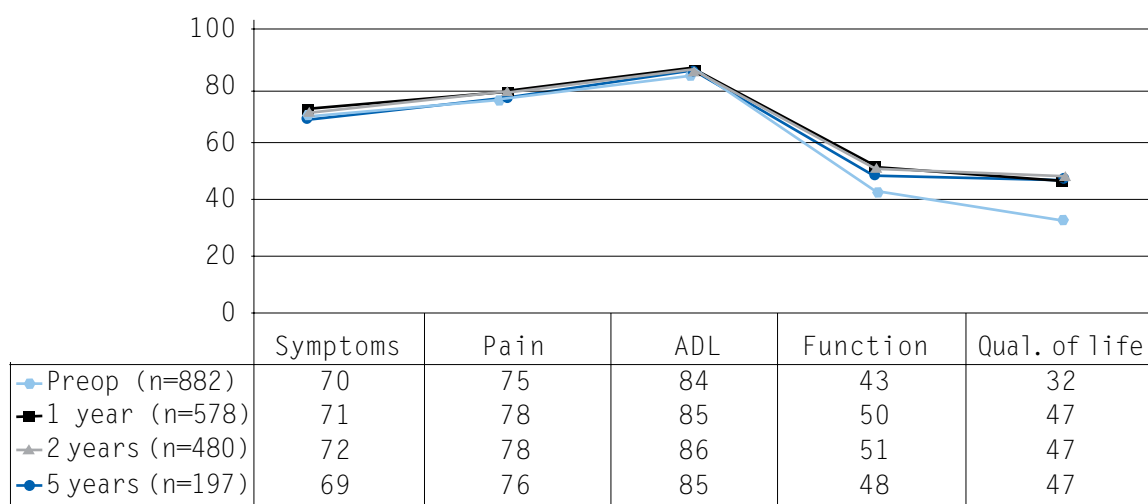
EQ5D-VAS for primary unilateral reconstructions by age (2005-2012)



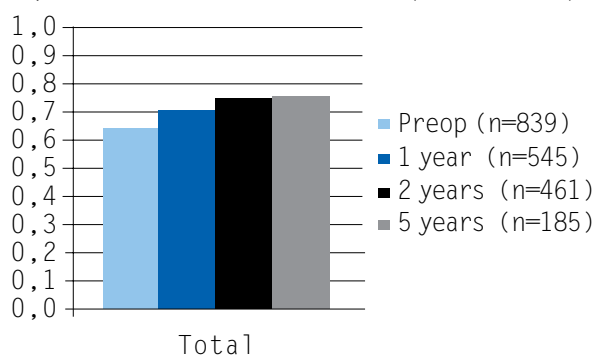
Outcome for revision surgery

Of the patients undergoing revision surgery, 882 answered the KOOS and EQ5D. An improvement in function and quality of life can also be seen in connection with revision surgery at the follow-ups, even if the improvement is not as marked as it is in connection with primary reconstruction. Patients generally give function (around 15 points on the KOOS) and quality of life lower ratings after revision surgery compared with primary surgery at the different follow-ups.

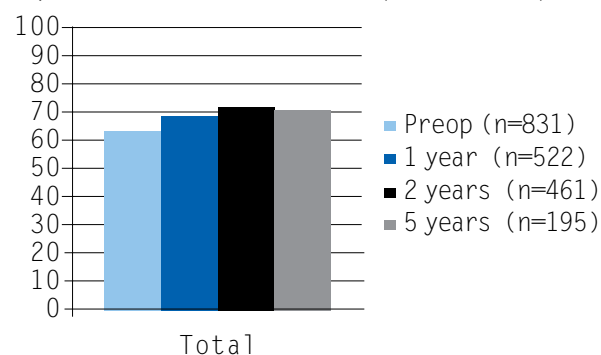
KOOS for revisions (2005-2012)



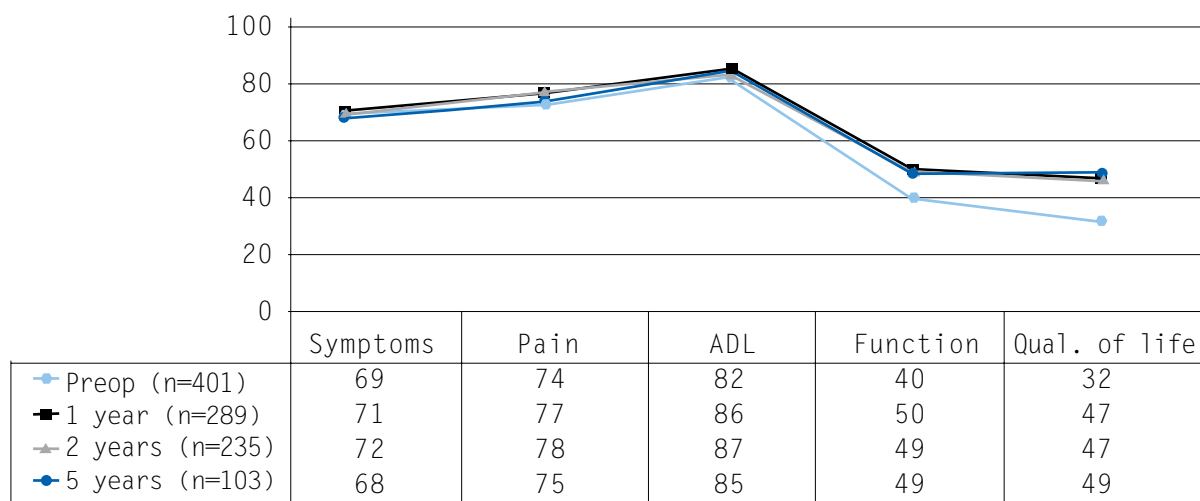
EQ5D-Index for revisions (2005-2012)



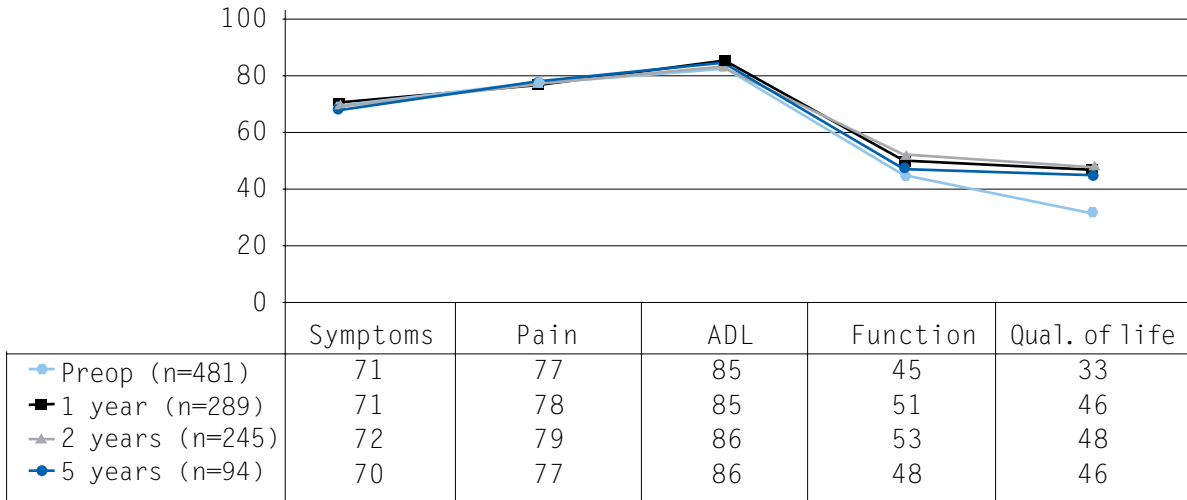
EQ5D-VAS for revisions (2005-2012)



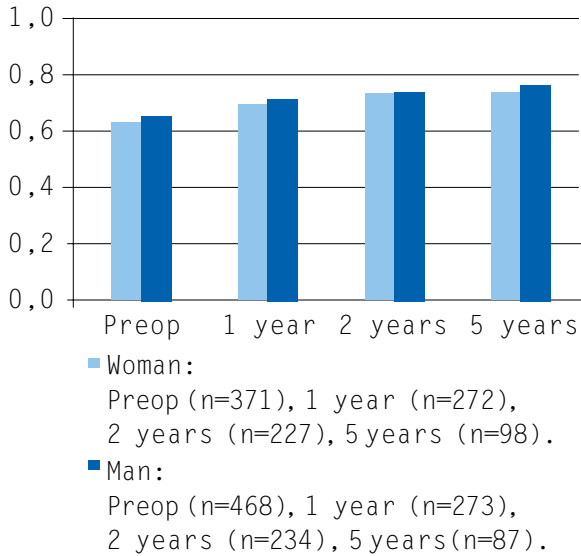
KOOS for revisions - women (2005-2012)



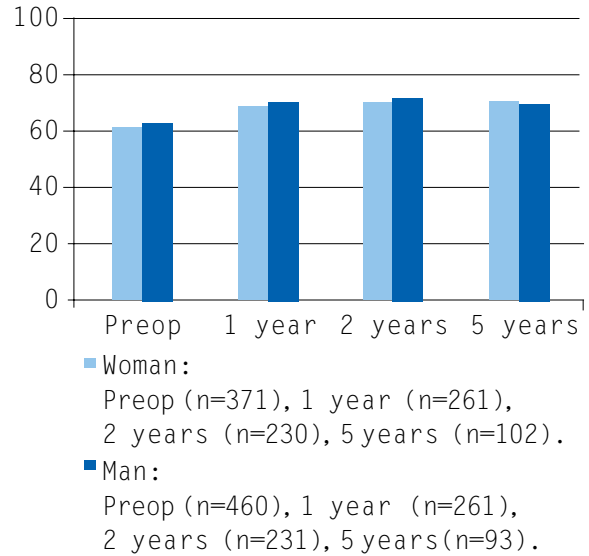
K00S for revisions - men (2005-2012)



EQ5D-Index for revisions by gender (2005-2012)



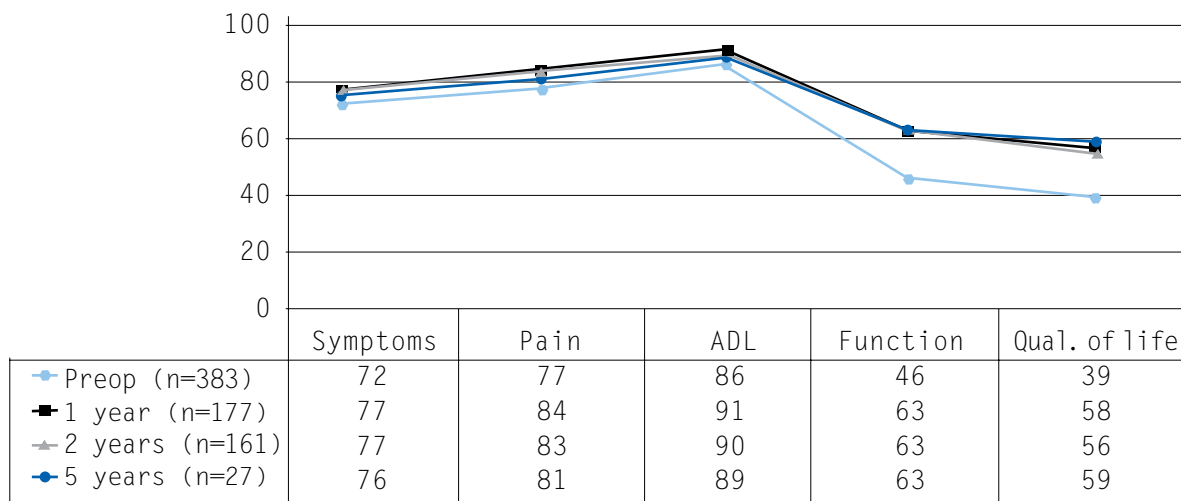
EQ5D-VAS for revisions by gender (2005-2012)



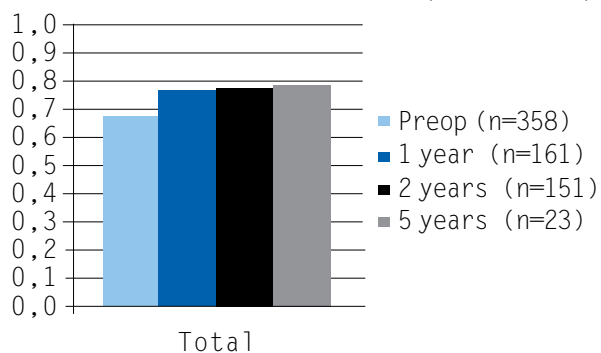
Outcome for the reconstruction of the contralateral knee (bilateral injuries)

When patients suffer an ACL injury on the other leg, on a previously healthy knee, they also perceive an improvement following reconstruction. Function and quality of life are given slightly lower ratings following a contralateral injury, but the ratings are higher compared with revision surgery.

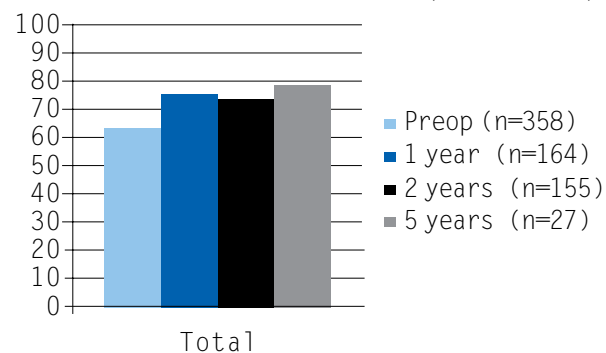
K00S for reconstructions of the contralateral side (2005-2012)



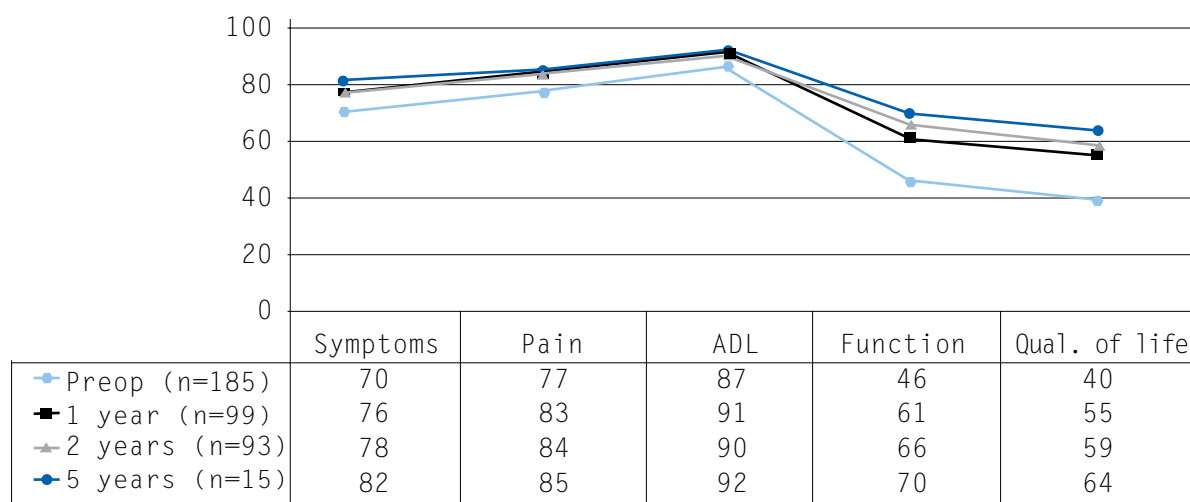
EQ5D-Index for reconstructions of the contralateral side (2005-2012)



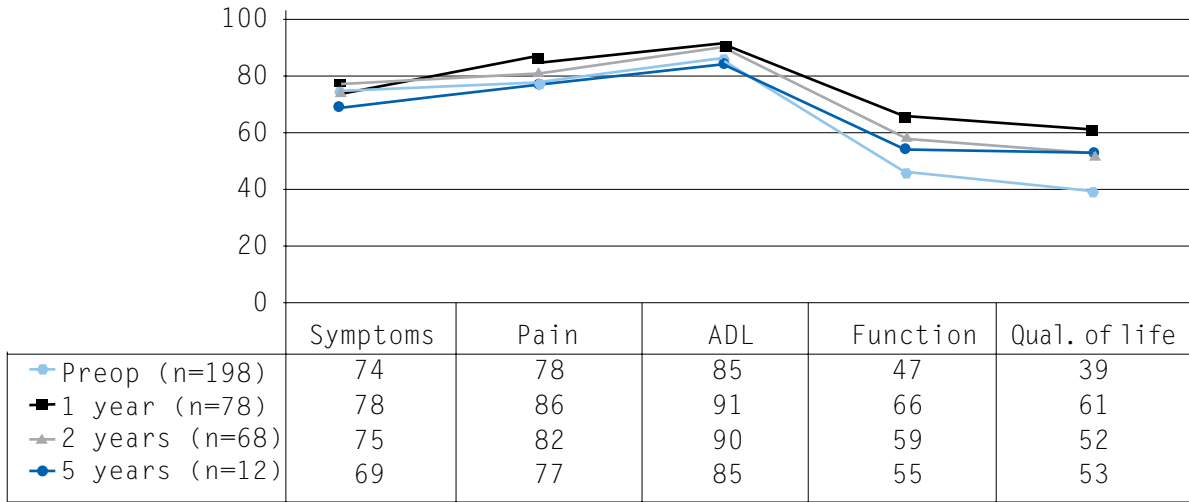
EQ5D-VAS for reconstructions of the contralateral side (2005-2012)



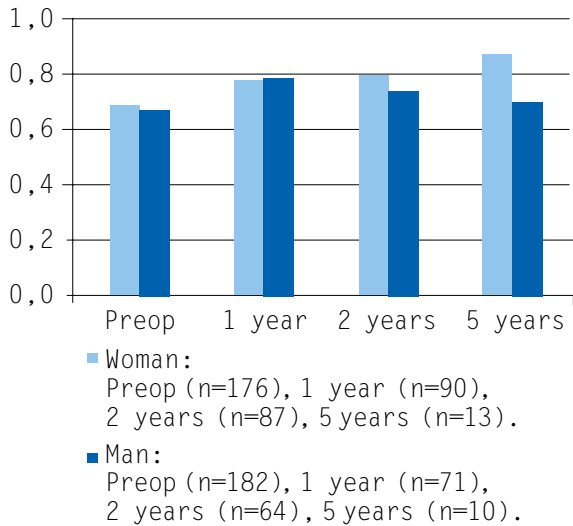
K00S for reconstructions of the contralateral side - Women (2005-2012)



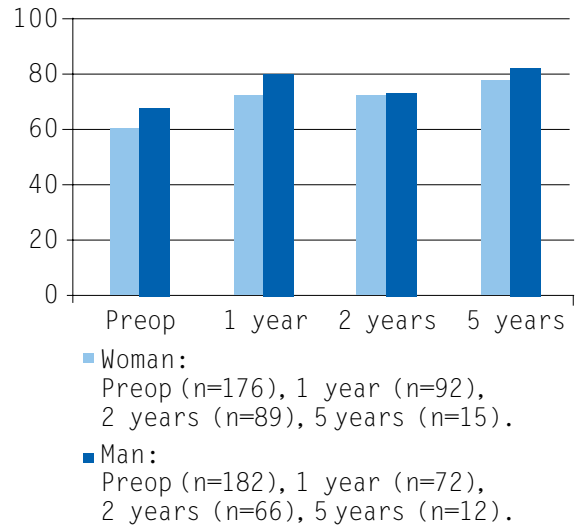
KOOS for reconstructions of the contralateral side - men (2005-2012)



EQ5D-Index for reconstructions of the contralateral side by gender (2005-2012)



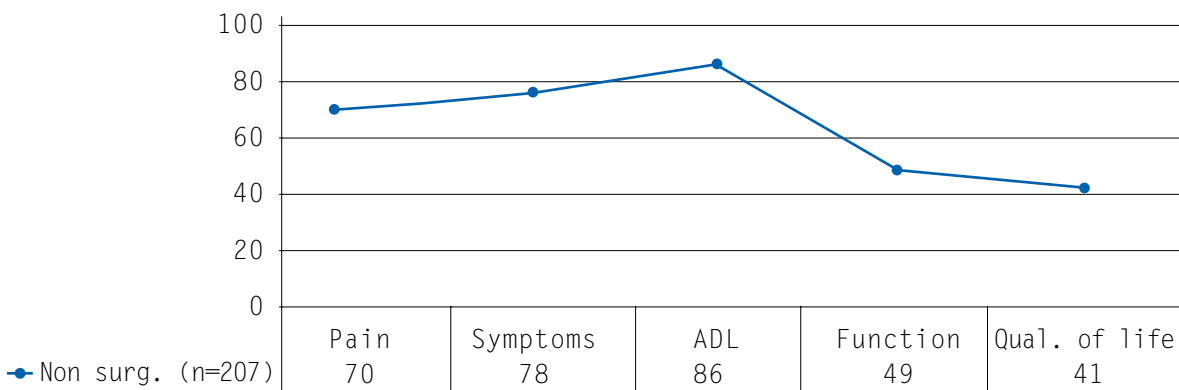
EQ5D-VAS for reconstructions of the contralateral side by gender (2005-2012)



Patients not undergoing surgery

In 2012, 207 patients who had not undergone reconstruction were registered. Their average age was 29 (SD, median 27) and the most common activities when the injury occurred were football (40%), Alpine skiing (14%) and floorball (13%). The KOOS is shown in the figure.

KOOS for non surgery (2012)



EQ5D was index 0,688 and VAS 64

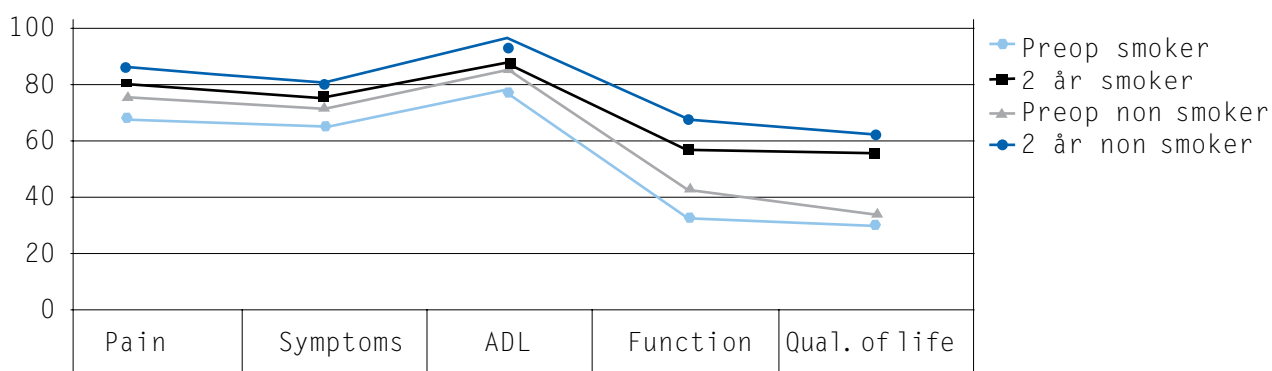
Impact of smoking on surgical results

Information on smoking began to be registered in 2009. Up to the end of 2012, information had been registered for 14,915 patients, 14,022 of whom were non-smokers and 893 smokers.

Smoking has a negative impact on the results of the KOOS. Both before and two years after an ACL reconstruction, smokers obtain significantly poorer values on every dimension of the KOOS.

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, it is therefore extremely important actively to inform patients of the importance of stopping smoking prior to an ACL reconstruction and every type of surgery in the future.

KOOS smoker/non smoker preop and at 2 years



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.

Gender aspects

Age

Some 40% of the primary ACL reconstructions that were performed in 2012 involved women and the 60/40 relationship between the genders has been relatively constant since the start in 2005. The same thing basically applies to revision surgery (54% men and 46% women), but an increasing trend for women can be seen in this context. The average age for patients undergoing primary reconstruction is 27, but there are no relevant differences between the genders (26 vs 27 years of age). There is, however, a difference in the age at revision surgery, where the average age of women is 24 compared with 28 for men. It is worth noting that the average age of women in conjunction with revision surgery is lower than the average age in connection with primary surgery.

Activity in conjunction with injury

Reconstruction after injuries suffered during dancing and gymnastics are more common among women than among men (73% and 64% respectively of the registrations), but this probably reflects the differences in gender of people taking part in these activities. The differences in gender ratios (women/men as a percentage) in activities such as handball (75/25), Alpine skiing (58/42) and basketball (64/36) are surprising, as the number of male participants can be expected to be as high or higher than the percentage of females. When it comes to handball, the ratio has also increased sharply compared with 2011 (64/36).

Time between injury and operation

In average terms, there was no difference between the genders when it comes to the time between injury and operation in 2012 (379 and 404 days respectively for men and women). In regional terms, there is possibly a relevant difference for Skåne and Västra Götaland, where women had a shorter time between injury and operation on average than men (48 and 76 days respectively) and for Östergötland, where the reverse was seen (52 days longer for women).

Discussion

The Swedish ACL Register was started in 2005 and it is estimated that 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 compared with the situation prior to surgery, but there are still limitations after ACL surgery. Patients with an ACL injury who undergo stabilization surgery do not achieve the same function as an uninjured, age-matched population. Self-reported, patient-perceived quality indicators reveal that these patients experience a deterioration in quality of life one, two and five years after surgery and that it is primarily related to restricted knee-related quality of life.

The board is discussing a number of improvement projects. This is necessary in order to improve the applicability of the register. 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. For the first time in this annual report, we present data from patients who have not undergone surgery.

The response rate to questionnaires has improved in recent years. The 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 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 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 in the development of simplified methods for the collection and feedback of data. The ACL register's 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 board welcomes comments and views on this annual report and looks forward to continued good collaboration.

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Presentations

- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer, Göteborg 2013
- Ahlden M, A Prospective Randomized Study Comparing Double- and Single-Bundle Techniques for ACL Reconstruction, AAOS Chicago 2013 och Sports Medicine Day Chicago 2013
- Kartus J, The Swedish National Anterior Cruciate Ligament Register, International ACL Registry meeting AAOS, Chicago 2013
- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer, Göteborg 2012
- Kartus J, The Swedish National Anterior Cruciate Ligament Register: a report on baseline variables and outcomes of surgery for almost 18,000 patients, AAOS San Francisco 2012 och Sports Medicine Day San Francisco 2012
- Tsai L, Svenska Korsbandsregistret, Chinese Orthopedic Association (COA), Beijing 2011
- Karlsson J, Forssblad M, Svenska korsbandsregistret, ACL Panther meeting, Pittsburgh 2011
- Forssblad M, Svenska korsbandsregistret och fotboll, FIFA, Qatar 2011
- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer, 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, 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 och Speciality Day Sports Medicine, New Orleans
- Forssblad M, Swedish ACL registry and cartilage injuries, Prague, Czech 2009
- Forssblad M, Swedish ACL registry, Zwolle, Netherlands, 2009
- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer, Göteborg 2009
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- Forssblad M, Wredmark T. Swedish ACL registry, ACL study group, Engelberg, Podium presentation, 2008
- Forssblad M, Wredmark T. Svenska korsbandsregistret, IMF, Stockholm. Podium presentation, 2008
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- Forssblad M, Wredmark T. The Swedish ACL registry. ISAKOS, Florens. Podium presentation, 2007
- Wredmark T, Forssblad M. Svenska korsbandsregistret, SOF, Umeå, Podium presentation 2007
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