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Swedish ACL Register.
Annual Report 2013.

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3471 primary operations and 281 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 at recreational or elite level without satisfactory treatment. Regardless of the primary treatment, studies have revealed that about 50% of patients present radiological signs of knee arthrosis 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 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 anterior cruciate ligament injuries every year and that some 3,500 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 attempts are now being made to register all the patients with this injury, regardless of surgical or non-surgical 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. We are working to involve our physical therapists in this work to a greater degree and are planning, in connection with the replacement of IT platforms, to improve our website when it comes to follow-ups after surgery and rehabilitation.

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 soccer, 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 is 100% coverage of the number of registered operation reports. An annual check is made with the Swedish Board of Health and Welfare's patient register at ID number level. At the present time, more than 90% of all operations are registered.

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. The database now contains some 2,600 patients who have registered an ACL injury prior to a decision to treat. Of these 2,600, some 1,500 have since undergone surgery. Of the remaining 1,100 patients, around 500 have been followed up.

We have previously reported coverage of around 90% following comparisons with the patient register and this figure has now been confirmed in a separate validation process. More than half the cases missing from the validation process were due to administrative errors at one of the selected clinics and they were found before the work began. The true coverage of the register is therefore at least 90% of all the operations performed in Sweden. When it comes to individuals who injure their ACL, the coverage is probably not higher than 50%.

Registration after injury

In 2013, we held discussions with Professor Roland Thomeé with a view to collaborating on the registration of injured patients via treating physical therapists. We are very optimistic that this partnership will get under way in 2014-15.

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.

Validity of input data

Patient-reported data cannot be validated retrospectively, but they are assumed to be valid, as the patients themselves register them.

The surgical data are fed in by surgeons and the target for the Swedish ACL Register is that at least 95% of all the data that are entered are a direct match with patient notes and surgery reports. In 2014, we have performed a validation process on the data that were entered in 2012.

Eleven clinics were selected and, at each of them, 50 consecutive operations from 1 March 2012 were identified. Validation data were entered for all the register variables using data from patient notes in 581 individual cases. These validation data were compared with existing register data and the differences were evaluated.

The coverage level, i.e. the percentage of the 581 cases which could also be found in the Swedish ACL Register, was 90%. However, more than half the missing cases were due to administrative errors at one clinic and they were found before the study began.

The agreement between register data and validation data was generally good (most variables above 97%). The cases in which the agreement was less than 97% (18 variables) and some key variables with higher agreement were analyzed in more detail. In most cases, trivial explanations could be found, thereby confirming the relative reliability of the variable in question.

Inherent problems with some variables (such as operation times and injury dates) were, however, noted and this therefore means that the suitability of using these data for research purposes can be questioned. By improving definitions, eliminating obvious error sources, modifying the design of the variable or simplifying the alternatives for entering data, the reliability of the problem variables can probably be improved.

The result of the validation process will be published in scientific journals and the steering committee is going to discuss future changes to the structure of the variables in the register.

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 by translating it and through participation at different international meetings.

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. The steering committee is also planning to commission an English translation of the 2013 report.

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 arthrosis 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 arthrosis.

As a result, an important line of development for the ACL register is to include all patients with ACL injuries, regardless of how they are treated in the short and long term. 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 presenting during the next year. There is, however, real scope for improvement when it comes to patient-reported follow-up data, where more than half of all patients are lost after five years.

The database is run by the Capio Artro 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 steering committee favors. A change of IT platforms is planned in 2015.

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 should 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.

Recently published incidence data reveal 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, it should 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 increased from 70% in 2012 to 74% in 2013, which is really positive. There is a large difference between clinics, but the Capio Artro Clinic still has the highest reporting rate for patient-reported preoperative data (> 95%). The steering committee has 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 recent validation reveals that the quality of the input data is generally good (the majority with more than 97% agreement compared with patient notes), but it has also identified variables with poorer quality. In 2014, the steering committee is going to examine all the variables and facilitate the registration of some, while removing variables with poor reliability.

Data loss

The response frequency for patient-relevant data on all follow-up visits is low, even if the trend is improving. We are hoping that, by collaborating with QRC Stockholm, we shall be able to initiate a joint project to increase patient response frequencies. The follow-up data after two and five years, however, still have a low response frequency (50% and 39% 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 2014, in collaboration with QRC Stockholm.

Feedback

Each surgeon is able to 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 steering committee organized one meeting for users in 2013.

Coverage and response rate

The Swedish National Board of Health and Welfare registered 3,700 ACL operations (both primary and revisions with surgery code NGE41) in 2012. The ACL register contains 3,709 registered operations for 2012.

Matching at personal ID number level reveals that the ACL register and the patient register have a total of 4,150 unique ACL operations.

The exact agreement on the number of ACL operations in the two registers was around 80% in 2012. Some 10% were only found in the ACL register and around 10% only in the patient register.

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, for example). 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 2013 are not yet available and this comparison has therefore been made with 2012.

	KOOS				EQ5			
	Preop	1 year	2 years	5 years	Preop	1 year	2 years	5 years
2013	74				72			
2012	70	56			66	55		
2011	71	66	47		65	65	46	
2010	69	61	54		65	59	53	
2009	73	61	52		70	59	50	
2008	65	60	47	36	63	62	46	36
2007	57	55	49	40	57	62	48	39
2006	58	50	49	41	55	56	50	40
2005	57	50	50	38	54	50	52	35

If the results are to be credible and applicable in a research context, the response rate for patient-reported data should be high. The response rate for the KOOS preoperatively once again increased slightly in 2013 compared with 2012. The response rate for the EQ5D is lower than that for the KOOS.

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 Artro Clinic. The registrar, Magnus Forssblad, is employed on a part-time basis at the Orthopedic Clinic at Karolinska Hospital. Two administrators work part time on the ACL register.

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 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 remuneration 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 is estimated at 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.

Organization

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

Magnus Forssblad at the Capio Artro Clinic has been appointed by Karolinska University Hospital and the steering committee as the registrar.

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

In 2013, the steering committee was made up of the following representatives from different regions in Sweden.

- Martin Englund, Associate Professor, Skåne University Hospital
- Karl Eriksson, Associate Professor, Söder Hospital, Stockhom
- Magnus Forssblad, Associate Professor, Capio Artro Clinic and Sports Trauma Research Center at Karolinska Institutet, Stockholm
- Richard Frobell, Associate Professor, Skåne University Hospital
- Professor Joanna Kvist, Linköping University
- Pär Herbertsson, MD, Orthocenter and Skåne University Hospital
- Professor Jon Karlsson, Sahlgrenska University Hospital, Gothenburg
- Professor Jüri Kartus, NU-sjukvården, Trollhättan/Uddevalla
- Marjut Sohlman, Karolinska University Hospital, Stockholm
- Anders Stålman, MD, Sabbatsberg 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). In 2013, a procurement process for the replacement of IT platforms was initiated.

Research partnerships

The ACL register protocol is virtually identical to that of the ACL registers that were set up in Norway in 2004 and Denmark in 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).

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. Researchers in Stockholm, Gothenburg and Linköping have published and will be publishing a number of reports. Collaboration with Norway continues. Every year, the international ACL registers in the USA meet for a brief review. A number of new international initiatives have been taken in the past few years – ESSKA, ISAKOS and the ACL study group.

The steering committee 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 2005-2013, 27,072 primary ACL reconstructions and 1,756 revisions from a total of 78 clinics were registered.

Number of operations per clinic in 2013

Clinic	Primary	Revisions	Total no. KOOS responses	Preop no. KOOS
CAPIO ARTRO CLINIC	577	64	627	98
SKÅNES UNIVERSITETSSJUKHUS	283	28	249	80
SAHLGRENSKA	193	20	198	93
ORTHOCENTER/IFK-KLINIKEN	140	11	127	84
SÖDERSJUKHUSET	128	10	98	71
KUNGSBACKA SJUKHUS	127	11	80	58
VRINNEVISJUKHUSET	92	3	67	71
NU-SJUKVÅRDEN	87	10	88	91
NORRLANDS UNIVERSITETSSJUKHUS, UMEÅ	83	8	45	49
HELSINGBORGS SJUKHUS	82	4	76	88
ELISABETH SJUKHUSET	73	8	35	43
HÄSSLEHOLMS SJUKHUS	73	3	67	88
KARLSTAD CENTRALSJUKHUS	73	7	20	25
LINKÖPINGS UNIVERSITETSKLINIK	72	5	55	71
MOVEMENT MEDICAL AB	71	10	59	73
ORTOPEDISKA HUSET CAREMA	61	3	32	50
DANDERYDS SJUKHUS	58	5	36	57
SPORTS MEDICINE UMEÅ	57	8	49	75
CENTRALLASARETTET VÄXJÖ	56	4	57	95
MEDICIN DIREKT	54	2	36	64
KALMAR SJUKHUS	51	5	14	25
FALU LASARETT	50	3	11	21
GÄVLE SJUKHUS	46	1	25	53
LÄNSSJUKHUSET RYHOV	46	6	21	40
SUNDERBY SJUKHUS	42	2	32	73
VÄSTERÅS CENTRALLASARETTET	42	3	25	56
ÖREBRO USÖ	38	2	14	35

SABBATSBERG NÄRSJUKHUSET	38	4	13	31
FRÖLUNDA SPECIALISTSJUKHUS	35	6	36	88
HÖGLANDSSJUKHUSET	33	3	32	89
LIDKÖPINGS SJUKHUS	33	1	14	41
SÖDERTÄLJE SJUKHUS	32	0	2	6
KAROLINSKA UNIVERSITETSSJUKHUSET/ ORTOPEDKLINIKEN	31	1	14	44
ALERIS ORTOPEDI ÄNGELHOLM	30	3	20	61
OSKARSHAMNS SJUKHUS	29	0	28	97
CAPIO LÄKARGRUPPEN I ÖREBRO AB	28	1	28	97
HUDIKSVALLS SJUKHUS	25	4	25	86
SPORTMED	25	2	11	41
SÖDRA ÄLVSBORGS SJUKHUS	23	0	16	70
NORRTÄLJE SJUKHUS	22	1	16	70
PERAGO ORTOPEDKLINIK	22	3	11	44
BLEKINGESJUKHUSET	21	0	14	67
ORTHOCENTER I SKÅNE	21	2	16	70
VÄSTERÅS ORTOPEDPRAKTIK	21	0	14	67
MÄLARSJUKHUSET ESKILSTUNA	19	0	13	68
ALINGSÅS LASARETT	17	3	14	70
LJUNGBY LASARETT	17	0	3	18
VÄRNAMO SJUKHUS/ORTOPEDKLINIKEN	16	1	13	76
LÄKARHUSET HERMELINEN	15	0	6	40
CAPIO LUNDBY NÄRSJUKHUS	15	0	1	7
VISBY LASARETT	15	0	10	67
ÖRNSKÖLDSVIKS SJUKHUS	14	1	12	80
CITYAKUTEN PRIVATVÅRD	13	0	0	0
SOLLEFTEÅ SJUKHUS	13	0	10	77
ART CLINIC	11	1	9	75
NACKA NÄRSJUKHUS	11	1	2	17
ORTHOCENTER STOCKHOLM	11	0	2	18
VÄSTERVIKS SJUKHUS	11	0	5	45
ODENPLANS LÄKARHUS	10	1	1	9
AKADEMISKA SJUKHUSET	8	0	0	0
KÄRNSJUKHUSET I SKÖVDE	8	0	0	0
KUNGÄLVS SJUKHUS	7	0	6	86
NYKÖPINGS LASARETT	7	0	0	0
LÄNSSJUKHUSET SUNDSVALL	6	0	6	100
SOPHIAHEMMET	5	0	3	60
GÄLLIVARE SJUKHUS	3	0	2	67

In order to follow up patients, the clinics have to ensure that patients complete their preoperative questionnaires. If they do not, no comparison can ever be made in individual cases. The last column in the above table shows the number of completed KOOS questionnaires within 180 days prior to an ACL operation.

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 2013. During the period 2009-2013, 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.

The average age at revision surgery is 25 for women and 27 for men.

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	Men %	Women %
2009	1,789	1,300	1.38	58	42
2010	1,944	1,366	1.42	59	41
2011	1,896	1,415	1.34	57	43
2012	1,970	1,444	1.36	58	42
2013	2,020	1,451	1.39	58	42

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. Another explanation could be that men are more risk prone than women. 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 2009-2013.

Year	Men	Women	Ratio Men/Women	Men %	Women %
2009	110	81	1.36	58	42
2010	136	88	1.55	61	39
2011	122	100	1.22	55	45
2012	131	112	1.17	54	46
2013	149	132	1.10	53	47

There is a slight preponderance of men undergoing revision surgery, but the ratio between men and women appears to be declining. Based on clinical experience, the reason for this could be that more men than women return to their previous activity level.

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.

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 2013, football was the cause of ACL injuries in 33.5% of women and 48.4% of men.

The second most common activity was downhill skiing for women and floorball among men in 2010, 2011, 2012 and 2013.

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.

	Total	Women	%	Men	%
FOOTBALL	1,466	486	33.2	980	66.8
ALPINE/TELEMARK	465	271	58.3	194	41.7
FLOORBALL	321	106	33.0	215	67.0
OTHER	256	125	48.8	131	51.2
HANDBALL	189	138	73.0	51	27.0
OTHER SPORT RECREATION	123	62	50.4	61	49.6
TRAFFIC	85	30	35.3	55	64.7
MARTIAL ARTS	75	28	37.3	47	62.7
BASKETBALL	65	36	55.4	29	44.6
GYMNASTICS	54	43	79.6	11	20.4
ENDURO/MOTORCROSS	53	5	9.4	48	90.6
WORK	50	9	18.0	41	82.0
ICE HOCKEY/BANDY	38	4	10.5	34	89.5
OUTDOOR LIFE	36	21	58.3	15	41.7
SNOWBOARDING	31	11	35.5	20	64.5
DANCING	27	16	59.3	11	40.7
EXERCISE	26	15	57.7	11	42.3
AMERICAN FOOTBALL/RUGBY	26	1	3.8	25	96.2
VOLLEYBOLL	21	13	61.9	8	38.1
RACKET SPORTS	13	5	38.5	8	61.5
TRAMPOLINE	10	3	30.0	7	70.0
TOURING SKIING	9	4	44.4	5	55.6
HORSE RIDING	8	8	100.0	0	0.0
EQUESTRIAN SPORT	7	6	85.7	1	14.3
CYCKLING	7	2	28.6	5	71.4
SKATEBOARD	4	1	25.0	3	75.0
WAKEBOARD	4	0	0.0	4	100.0
WRESTLING	3	2	66.7	1	33.3

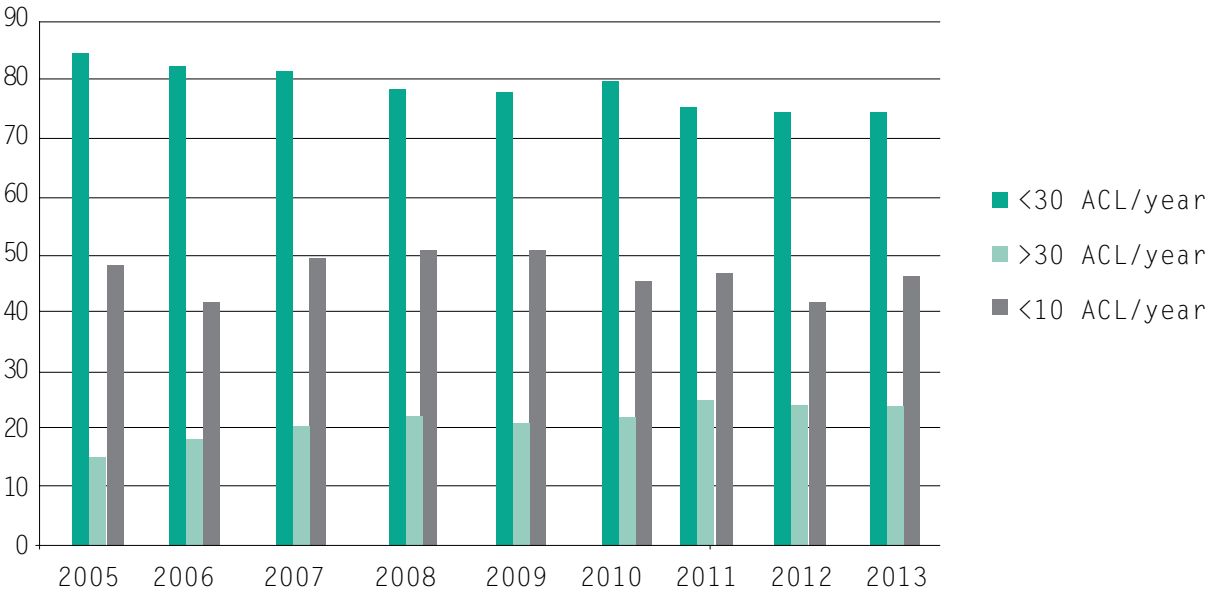
Duration of surgery and number of surgeons

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 46% perform fewer than 10 operations a year. These figures have been much the same since the ACL register was set up in 2005.

In 2012, 41% performed fewer than 10 operations a year.

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. Nor are there any obvious differences between private and public caregivers.

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.

Average number of days between injury and surgery

	Total	Women	Men
Stor Stockholm	400	388	409
Svealand + Gotland	342	358	331
Skåne	472	459	459
Halland	479	395	532
Småland + Blekinge	308	287	324
Västra Götaland	267	252	276
Östergötland	334	310	350
Norrland	327	351	310

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, 83.1% in 2012 and, in 2013, slightly higher at 84.5%.

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 (36%) based on 79 patients.

Needless to say, a low percentage of day surgery could also be due to the remuneration system and a tendency towards in-patient care.

2013	Total	Percentage of day surgery %
Totalt	3,471	84.5
Stor Stockholm	841	85.6
Svealand + Gotland	573	78.9
Skåne	485	88.9
Halland	79	54.4
Småland + Blekinge	194	66.5
Västra Götaland	670	89.3
Östergötland	276	89.5
Norrland	340	88.5

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 2013, 75 ACL reconstructions were performed on children under 15 years of age in Sweden compared with 71 in 2012. Only one revision was performed in 2013 (by NU sjukvården). Operations were performed at 27 clinics.

	Primary
CAPIO ARTRO CLINIC	34
SKÅNES UNIVERSITETSSJUKHUS	6
SUNDERBY SJUKHUS	3
KALMAR SJUKHUS	3
KUNGSBACKA SJUKHUS	3
MOVEMENT MEDICAL AB	3

LINKÖPINGS UNIVERSITETSKLINIK	3
NORRLANDS UNIVERSITETSSJUKHUS, UMEÅ	2
HELSINGBORGS SJUKHUS	2
FALU LASARETT	2
SAHLGRENSKA	2
NU-SJUKVÅRDEN	2
ELISABETH SJUKHUSET	2
GÄVLE SJUKHUS	1
LÄKARHUSET HERMELINEN	1
SPORTS MEDICINE UMEÅ	1
LÄNSSJUKHUSET RYHOV	1
KARLSTAD CENTRALSJUKHUS	1
CAPIO LÄKARGRUPPEN I ÖREBRO AB	1
VRINNEVISJUKHUSET	1
CAPIO LUNDBY NÄRSJUKHUS	1
HÖGLANDSSJUKHUSET	1
ÖRNSKÖLDSVIKS SJUKHUS	1
MEDICIN DIREKT	1
HUDIKSVALLS SJUKHUS	1
PERAGO ORTOPEDKLINIK	1
CENTRALLASARETTET VÄXJÖ	1

More than half of all the patients had meniscal injuries (53%), half of which were resected and half sutured. Girls accounted for 73% of the patients. The cause of accidents is similarly distributed between boys and girls. Football dominated and accounted for 46% of accidents. It was followed by handball (14%) and Alpine/Telemark skiing (14%).

Miscellaneous

The use of the double-tunnel technique as a surgical method continues to decline in Sweden. In 2013, only 36 such operations were performed, which corresponds to around 1% of all the operations performed. The corresponding figure for 2012 was 42 (1.2%).

Thromboprophylaxis is administered in 33% of all operations. Antibiotic prophylaxis is basically administered in all operations. A research project studying the risk of thrombosis and infection following ACL surgery is going to be conducted in 2014-2015.

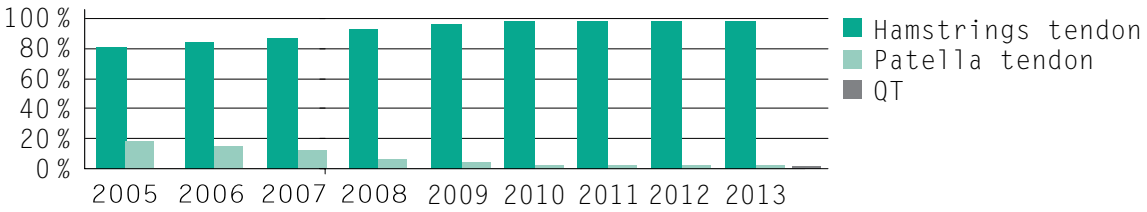
Surgical variables
Graft selection

Since the ACL Register was created in 2005, the use of hamstring grafts rose from 80% to 98% in 2012, but this figure fell last year and the use of patellar tendons increased from 2% to 3%. An increase has also been seen in the use of quadriceps grafts, which now account for 1% (41). Patellar tendons are used as a free transplant with bone at both ends. As a result, the patellar tendon heals more rapidly and more effectively in the skeleton. Hamstring tendons can be used 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. The most common procedure is a doubling of the gracilis and the semitendinosus, which accounts for 43% of all grafts. The quadriceps tendon is used as a free transplant, but there is only bone at one end and the bone plug can then be inserted in either the femur or the tibia. It can be divided and have two attachment points at the end of the tendon. In this case, the bone plug is inserted in the femur and there are two attachment points in the tibia.

Hamstring tendons are a less complex graft for surgeons and there is no clear difference in the long-term results produced by the methods. 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. Patellar tendon grafts are used in 58% of revisions, quadriceps tendons in 6%, allografts in 5%, while the remaining 31% are hamstring grafts.

The use of allografts (grafts from deceased individuals) is still unusual in ACL surgery in Sweden compared with the USA, for example. In 2008, nine allografts were used and this figure gradually increased until 2013 when 31 allografts were registered. Of these, 16 were used in primary surgery and 15 in revisions. The fact that allografts are not used on the same scale in Sweden is probably governed by the cost of around SEK 20,000 per graft, plus expensive transport, as allografts have to be kept frozen at a temperature of minus 70°C and, if several are sourced at the same time, the rules governing public procurement in public health care have to be observed. Allografts are primarily used in revision surgery and multiple ligament reconstructions (knee luxations and so on).

Graftchoice 2005-2013



Tibial fixation

Screw fixation alone with interference screws dominates in the tibia and currently accounts for 55%, while resorbable screws are used in 33%. The use of resorbable screws has doubled since 2009. The reason for this is undoubtedly to avoid revisions involving the removal of the screw in the tibia. The use of the AO screw, which is not an interference screw, has been between 10% and 20% since the ACL register was created, but it has now fallen somewhat. The use of the Tightrope in the tibia is a new fixation method which began to be used in 2012. The Tightrope in the tibia is currently used in 7% of operations. The use of the screw and staple sink and the use of intrafix have steadily fallen since 2009.

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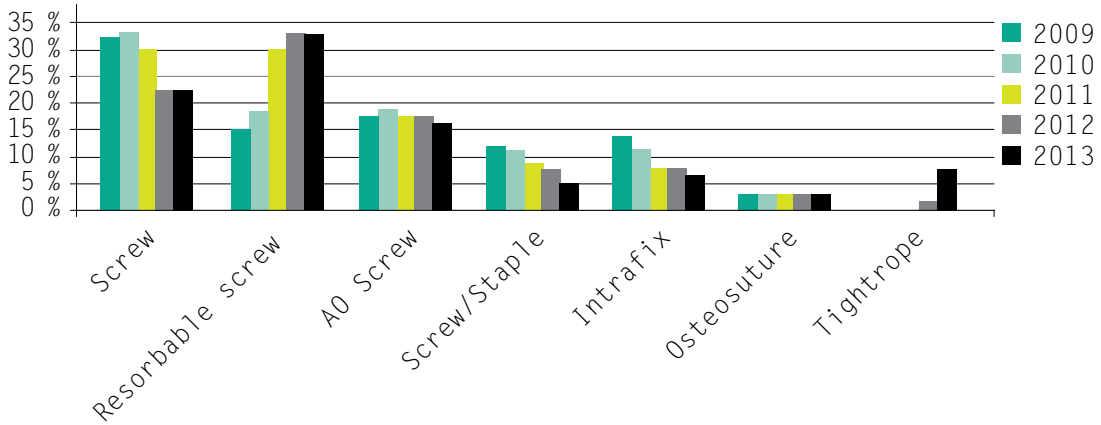
Fixation Tibia Hamstringsgraft

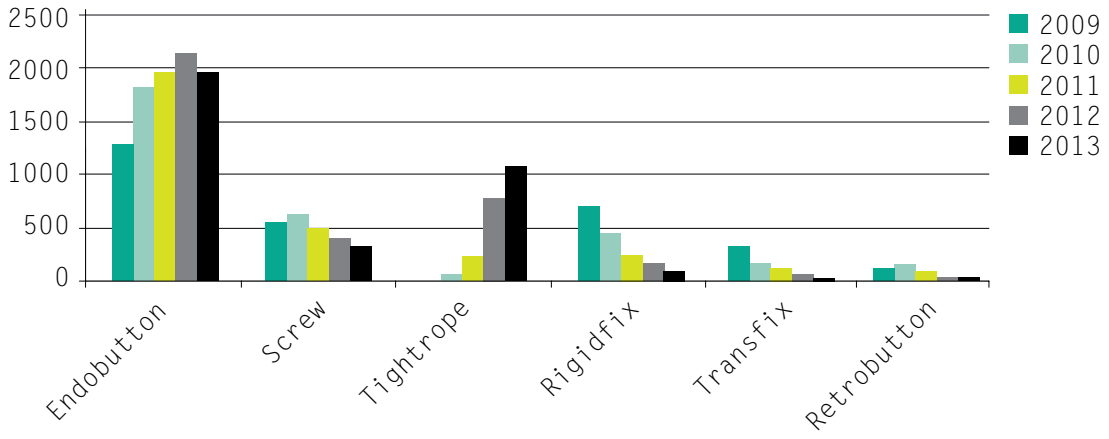


Femoral fixation

The most common form of fixation at the present time is the cortical button, which is used in 88% of all femoral fixations. The most common cortical button is still the Endobutton. Other cortical buttons are the Retrobutton and the ToggleLoc, but the use of both of them has fallen. When the Tightrope is

used, the cruciate ligament transplant can be tightened after it has been inserted in the canal and even after it has been fixed distally. The use of cortical buttons has increased every year, from 37% in 2008 to 88% in 2013. The reason for this increase is that the cortical button is easy to use 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. Cortical buttons are 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 created, but this figure has fallen slightly in recent years and is currently around 8%.

Fixation Femur Hamstringsgraft



Revisions and surgery on the contralateral side

A total of 1,756 revisions were registered in the ACL Register in 2005-2013. If we instead choose to follow the patients who initially underwent surgery within the framework of the ACL Register and then underwent revisions, 907 (3.4%) 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 2013 during that same year. In addition, 875 (3.2%) underwent a new ACL operation on the contralateral knee. Women underwent revisions on a larger scale than men – 3.7% compared with 3.1% for the same knee and 3.7% compared with 2.9% for the contralateral knee.

Patients receiving hamstring tendon grafts underwent revisions on the same knee in 3.3% of cases compared with 3.9% for patients receiving patellar tendon grafts, but this figure is difficult to assess, as the number of primary patellar tendon operations is only around 1,700 compared with 25,000 hamstring operations. As the number of patellar tendon operations was also higher at the beginning of the study period, this figure is probably also misleading. If the follow-up period is limited to three years, the number of revisions for patellar tendons is 1.9% compared with 1.7% for hamstring tendons. This still indicates a slightly larger number of revisions for patellar tendons, which does not match data presented from Norway and Denmark.

Patients under 20 years of age underwent revisions on a wider scale and this is obviously due to the fact that this patient group is more active and more frequently returns to active sports; 5.7% underwent revisions on the same knee and the same percentage applies to the contralateral knee.

If the follow-up period is limited to three years and we choose to follow the patients undergoing primary surgery in 2005-2010, 578 new operations were performed in 2005-2013. Of these, 290 were revisions on the same knee, corresponding to 1.7% of all primary operations.

For the first time, we have now chosen to present revisions on the same knee by clinic. The following table presents both the number of revisions in which hamstring grafts were used and the percentage of

patients who, at the two-year follow-up, had a KOOS score of less than 40 points for quality of life. A low value like this should indicate that, at this point, the ACL was still not fully functional. The clinics that are presented are those that initially performed the first operation but not necessarily the revision. Needless to say, there are sources of error in this type of presentation, such as the clinic choosing not to perform a revision on the patient. We have chosen to present all the clinics without taking account of the number of primary operations.

Primary operations 1.1.2005-31.12.2011

CLINIC	Number of op	Number of revs	Number of KOOS <40	Percentage of revs	Percentage of KOOS	Percentage total
SPORTS MEDICINE UMEÅ	125	8	0	6.4%	0.0%	6.4%
HALMSTADS SJUKHUS	64	3	1	4.7%	1.6%	6.3%
CAPIO LÄKARGRUPPEN I ÖREBRO AB	363	19	3	5.2%	0.8%	6.1%
VISBY LASARETT	19	1	0	5.3%	0.0%	5.3%
KUNGSBACKA SJUKHUS	236	10	2	4.2%	0.8%	5.1%
LÄNSSJUKHUSET RYHOV	111	3	2	2.7%	1.8%	4.5%
KUNGÄLVS SJUKHUS	92	3	1	3.3%	1.1%	4.3%
HELSINGBORGS SJUKHUS	119	3	2	2.5%	1.7%	4.2%
ORTHOCENTER/IFK-KLINIKEN	581	22	2	3.8%	0.3%	4.1%
FRÖLUNDA SPECIALISTSJUKHUS	124	3	2	2.4%	1.6%	4.0%
NU-SJUKVÅRDEN	870	32	3	3.7%	0.3%	4.0%
ORTOPEDISKA HUSET CAREMA	311	9	3	2.9%	1.0%	3.9%
KAROLINSKA UNIVERSITETSSJUKHUSET /ORTOPEDKLINIKEN	502	12	6	2.4%	1.2%	3.6%
BLEKINGESJUKHUSET	29	0	1	0.0%	3.4%	3.4%
DANDERYDS SJUKHUS	119	3	1	2.5%	0.8%	3.4%
ÖREBRO USÖ	186	4	2	2.2%	1.1%	3.2%
LÖWETS SPECIALISTMOTTAGNING	224	5	2	2.2%	0.9%	3.1%
SAHLGRENSKA	971	23	6	2.4%	0.6%	3.0%
S:T GÖRANS SJUKHUS CAPIO. STOCKHOLM	102	3	0	2.9%	0.0%	2.9%
HUDIKSVALLS SJUKHUS	171	4	1	2.3%	0.6%	2.9%
NORRTÄLJE SJUKHUS	36	1	0	2.8%	0.0%	2.8%
CAPIO ARTRO CLINIC	4086	98	15	2.4%	0.4%	2.8%
ÖSTERSUNDS SJUKHUS	77	2	0	2.6%	0.0%	2.6%
NACKA NÄRSJUKHUS	78	2	0	2.6%	0.0%	2.6%
LÄNSSJUKHUSET SUNDSVALL	39	1	0	2.6%	0.0%	2.6%
ODENPLANS LÄKARHUS	117	3	0	2.6%	0.0%	2.6%
MOVEMENT MEDICAL AB	743	15	4	2.0%	0.5%	2.6%
MALMÖ ALLMÄNNA SJUKHUS	869	17	5	2.0%	0.6%	2.5%
VARBERGS SJUKHUS	283	4	3	1.4%	1.1%	2.5%
SÖDERSJUKHUSET	779	17	2	2.2%	0.3%	2.4%
KALMAR SJUKHUS	415	10	0	2.4%	0.0%	2.4%
ALINGSÅS LASARETT	211	5	0	2.4%	0.0%	2.4%
KARLSTAD CENTRALSJUKHUS	527	10	2	1.9%	0.4%	2.3%
LJUNGBY LASARETT	132	3	0	2.3%	0.0%	2.3%
HÖGLANDSSJUKHUSET	349	5	2	1.4%	0.6%	2.0%
MÄLARSJUKHUSET ESKILSTUNA	302	5	1	1.7%	0.3%	2.0%
SKÅNES UNIVERSITETSSJUKHUS	305	6	0	2.0%	0.0%	2.0%
CAPIO LUNDBY NÄRSJUKHUS	107	1	1	0.9%	0.9%	1.9%

FALU LASARETT	278	4	1	1.4%	0.4%	1.8%
LINKÖPINGS UNIVERSITETSKLINIK	513	4	5	0.8%	1.0%	1.8%
CENTRALLASARETTET VÄXJÖ	307	5	0	1.6%	0.0%	1.6%
ELISABETH SJUKHUSET	444	5	2	1.1%	0.5%	1.6%
LUNDS UNIVERSITET	433	6	0	1.4%	0.0%	1.4%
ORTHOCENTER STOCKHOLM	217	3	0	1.4%	0.0%	1.4%
HÄSSLEHOLMS SJUKHUS	464	6	0	1.3%	0.0%	1.3%
LIDKÖPINGS SJUKHUS	155	2	0	1.3%	0.0%	1.3%
NORRLANDS UNIVERSITETSSJUKHUS. UMEÅ	719	5	4	0.7%	0.6%	1.3%
ÖRNSKÖLDSVIKS SJUKHUS	85	1	0	1.2%	0.0%	1.2%
KAROLINSKA UNIVERSITETSSJUKHUSET /ALB	174	2	0	1.1%	0.0%	1.1%
GÄVLE SJUKHUS	178	0	2	0.0%	1.1%	1.1%
ALERIS ORTOPEDI ÄNGELHOLM	552	4	2	0.7%	0.4%	1.1%
VÄSTERÅS CENTRALLASARETTET	113	0	1	0.0%	0.9%	0.9%
SAMARITERHEMMETS SJUKHUS	243	1	1	0.4%	0.4%	0.8%
MEDICIN DIREKT	168	1	0	0.6%	0.0%	0.6%
SUNDERBY SJUKHUS	308	1	0	0.3%	0.0%	0.3%
VRINNEVISJUKHUSET	451	0	1	0.0%	0.2%	0.2%
OSKARSHAMNS SJUKHUS	220	0	0	0.0%	0.0%	0.0%
GÄLLIVARE SJUKHUS	46	0	0	0.0%	0.0%	0.0%
SKELLEFTEÅ SJUKHUS	30	0	0	0.0%	0.0%	0.0%
NYKÖPINGS LASARETT	78	0	0	0.0%	0.0%	0.0%
PERAGO ORTOPEDKLINIK	38	0	0	0.0%	0.0%	0.0%
KARLSKOGA LASARETT	11	0	0	0.0%	0.0%	0.0%
PITEÅ ÄLVDAL SJUKHUS	71	0	0	0.0%	0.0%	0.0%
VÄSTERVIKS SJUKHUS	76	0	0	0.0%	0.0%	0.0%
SÖDRA ÄLVSBORGS SJUKHUS	55	0	0	0.0%	0.0%	0.0%
SOPHIAHEMMET	21	0	0	0.0%	0.0%	0.0%
VÄRNAMO SJUKHUS/ORTOPEDKLINIKEN	20	0	0	0.0%	0.0%	0.0%
SOLLEFTEÅ SJUKHUS	14	0	0	0.0%	0.0%	0.0%
LÄKARHUSET HERMELINEN	14	0	0	0.0%	0.0%	0.0%
ORTHOCENTER I SKÅNE	5	0	0	0.0%	0.0%	0.0%
Alla operationer	**21275**	**425**	**94**	**2.0%**	**0.4%**	**2.4%**

Multiligament injuries

Multiligament and isolated other ligament injuries can and should be registered in the ACL Register. However, we have no idea of the extent to which this is done, but the different combinations that were registered in 2013 are presented below. It is clear that the most common combination is the anterior cruciate ligament (ACL) and the medial cruciate ligament (MCL). The number of posterior cruciate ligament (PCL) operations registered in 2013 totaled 34, of which 10 were isolated. There were 59 medial cruciate ligament injuries and 22 lateral collateral ligament (LCL) injuries, plus 12 posteriolateral cruciate (PLC) injuries.

Different combinations of multiligament cruciate ligament operations in 2013 and 2005-2013. The abbreviations are explained in the text above.

2013

ACL---MCL------	43
------MCL------	1
ACLPCLMCL------	7
---PCL---------	10
ACL------LCL---	10
---PCLMCL------	7
ACLPCLMCLLCLPLC	1
ACL------LCLPLC	6
ACLPCL---------	4
ACL---------PLC	2
ACLPCL---LCLPLC	3
---PCL---LCL---	1
ACLPCL---LCL---	1

2005-2013

ACL---MCL------	217
---PCL---------	124
ACL------LCL---	70
ACLPCL---------	50
ACL------LCLPLC	38
ACLPCLMCL------	35
---PCLMCL------	22
ACLPCL---LCLPLC	18
ACL---------PLC	14
------MCL------	9
ACLPCL---LCL---	9
---PCL---LCL---	7
ACLPCLMCLLCLPLC	5
ACLPCL------PLC	5
ACL---MCLLCL---	4
ACL---MCL---PLC	1
ACL---MCLLCLPLC	1
ACLPCLMCL---PLC	1

Data loss analysis

In 2013, a data loss analysis was performed on the ACL Register to validate its data, in spite of the large-scale data loss rate after two years. All the patients undergoing surgery in 2010 were included in the analysis. The patients who answered the two-year KOOS (responders were compared with those that did not (non-responders) in terms of gender, age at surgery, time between injury and surgery, activity at the time of the injury, associated meniscal and/or cartilage damage, graft type, primary or revision surgery and region. At the same time, a questionnaire was sent to non-responders asking about the reasons for not responding, whether they had received information about the register at the time of surgery, reminders to complete questionnaires and whether the KOOS questions felt difficult, time consuming, a violation of their integrity, unclear or whether it was difficult to understand the reason for asking them. It was also possible to make comments.

The average age was significantly higher in the responder group (27.8 years) than in the non-respnder group (25.8 years ($p < 0.0001$). The time between injury and surgery differed significantly (18 days, $p = 0.005$); non-responders had a longer waiting time. On the other hand, there was no significant difference in gender distribution, associated injuries, graft type or type of surgery. There was a significant difference in response frequency between the "Greater Stockholm" and "Östergötland regions, 54.9% and 40.1% respectively. In all, there were 359 responders, 214 men and 145 women, from 1,775 (20%) patients on the drop-out questionnaire. In this questionnaire, 64% of the patients said they had received information about the register and 85% replied that they had received reminders about the two-year follow-up. None of the statements in the dispatched questionnaire had a percentage agreement of > 50%, but the statement with which most respondents agreed was that answering the questions was time consuming. Most of the comments (29/55) were variations on "didn't have time, was not a priority and forgot".

As shown in the 2012 annual report, large differences in QoL do not appear until > 46 years of age. Together with the fact that there were no differences in associated injuries, the differences in age and the time between injury and surgery were regarded as too small to be clinically relevant. The results

indicate that the data in the register are valid in relation to the studied data and the steering committee is working actively to improve the response frequency using information and new technical solutions.

PERCENTAGE OF RESPONDERS1 IN THE INITIAL AND DEMOGRAPHIC DATA IN THE 2010 SKLR

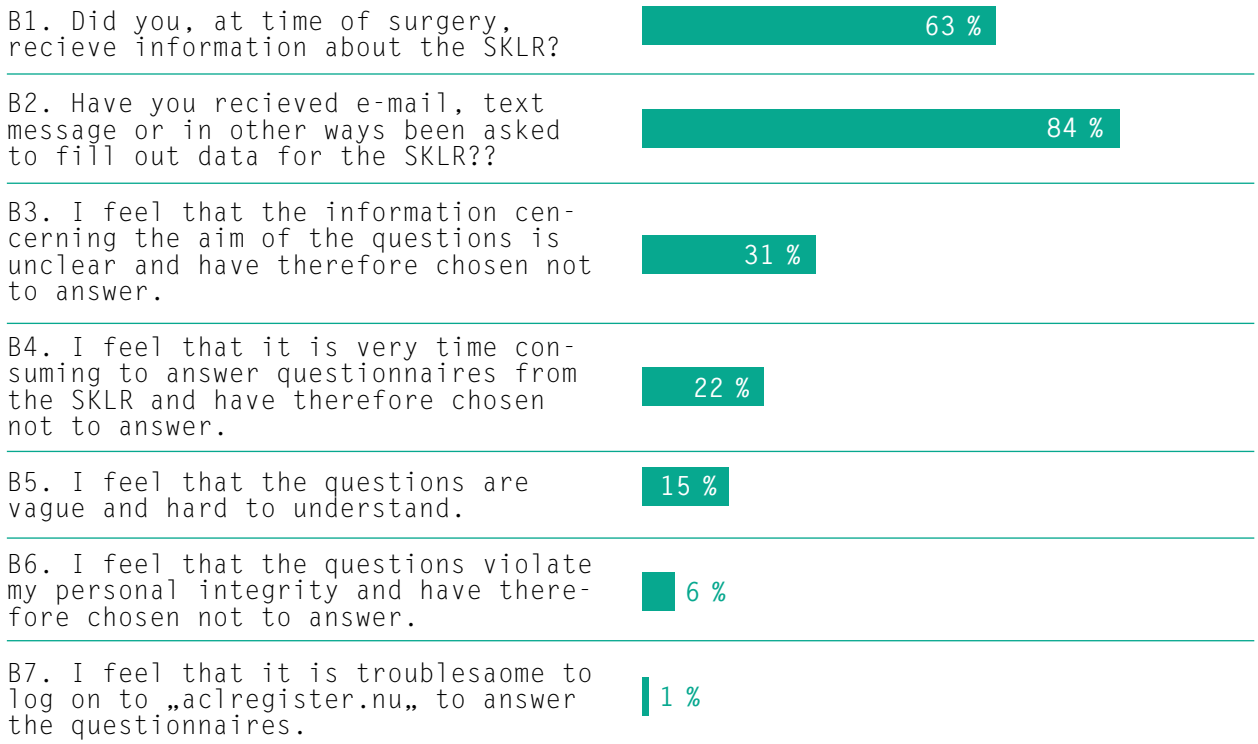
Initial and demographic data	Group	n	Responders %	p-värde
Gender	Male	2,113	51.8	0.994[2]
	Female	1,476	51.8	
Associated meniscal injuries	No	2,050	51.9	0.854[2]
	Yes	1,539	51.6	
Associated meniscal injuries and/or cartilage damage	No	1,576	52.5	0.415[2]
	Yes	2,013	51.6	
Graft type	Patellar	202	52.0	0.503[2]
	Allograft	44	50.0	
	Hamstring	3,229	51.5	
	Other	48	62.5	
Surgery type	Primary	3,362	51.6	0.452[2]
	Revision	227	54.2	
Region	Greater Stockholm	943	54.9	0.006[3]
	Svealand/Götaland	646	50.7	
	Skåne	393	51.8	
	Halland	61	45.8	
	Småland/Blekinge	184	51.8	
	Västra Götaland	700	52.4	
	Norrland	354	52.8	
	Östergötland	272	40.1	
Activity at time of injury	Alpine/telemark skiing	510	54.4	0.174[3]
	Football	1,534	50.6	
	Floorball	296	56.3	
	Martial arts	76	55.8	
	Handball	193	49.5	
	Other	978	50.4	

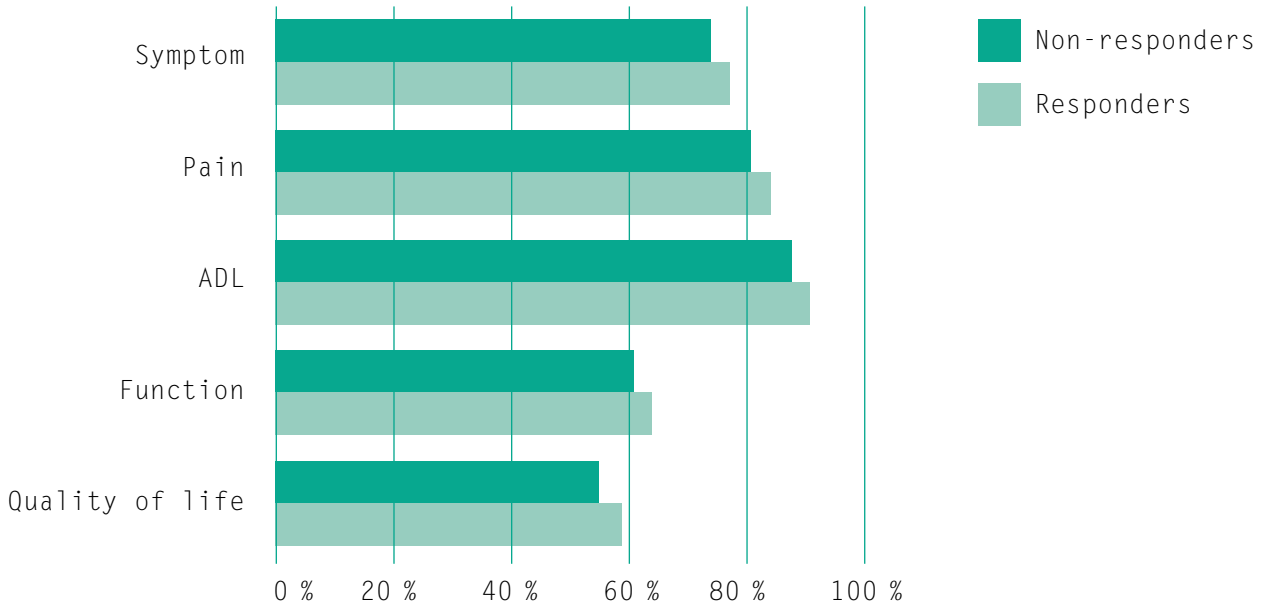
Abbreviations: n = total number of patients in the group

[1]Percentage of responders in each group

[2]Pearson's $\chi 2$ test

[3]Analysis of covariance with correction for age





Scale	Responders	Non-responders	
Quality of life	59%	55%	5
Function	63%	61%	4
ADL	90%	88%	3
Pain	84%	80%	2
Symptoms	77%	74%	1

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).

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 or 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 2013 do not differ markedly from those in previous years.

The following tables show the data for the KOOS, clinic by clinic, two years postoperatively. We have only included patients aged between 20 and 30 who underwent surgery with hamstring grafts in 2007-2011. The first table presents an average value for the first dimensions of the KOOS, i.e. pain, other symptoms, such as swelling, joint mobility and mechanical symptoms, and functional impairment in connection with daily activities. In a similar way, the second table presents the average value for the last two dimensions of the KOOS, i.e. functional impairment in connection with sport and recreational activities and knee-related quality of life.

We have chosen to present all the clinics, without taking account of the number of responses, in order to give readers the opportunity to assess the value of the tables for themselves. .

AVERAGE KOOS SCORES FOR PAIN, SYMPTOMS AND ADL
FOR PATIENTS UNDERGOING SURGERY IN 2007-2011

CLINIC	Nr of ops	Average age	Nr of responses	KOOS
NACKA NÄRSJUKHUS	21	25.4	8	89.7
LÄKARHUSET HERMELINEN	5	26.4	3	88.8
VISBY LASARETT	4	21.8	1	87.7
VÄSTERÅS CENTRALLASARETTET	32	24.2	13	87.5
LÖWETS SPECIALISTMOTTAGNING	78	24.2	38	87.5
PITEÅ ÄLVDAL SJUKHUS	19	24.4	9	87.5
ORTHOCENTER I SKÅNE	2	20.5	2	87.0
CAPIO ARTRO CLINIC	909	24.9	445	86.8
ELISABETH SJUKHUSET	178	24.1	72	86.8
ORTOPEDISKA HUSET CAREMA	66	24.4	23	86.6
KAROLINSKA UNIVERSITETSSJUKHUSET/ ORTOPEDKLINIKEN	140	24.8	64	85.8

NORRLANDS UNIVERSITETSSJUKHUS, UMEÅ	217	23.8	100	85.7
MEDICIN DIREKT	39	25.1	16	85.6
LÄNSSJUKHUSET SUNDSVALL	19	23.8	6	85.2
ORTHOCENTER STOCKHOLM	48	24.0	18	85.2
LUNDS UNIVERSITET	98	23.9	51	85.1
KALMAR SJUKHUS	116	24.0	54	85.1
MÄLARSJUKHUSET ESKILSTUNA	79	23.9	37	84.9
LÄNSSJUKHUSET RYHOV	37	24.3	17	84.8
SAHLGRENSKA	282	24.5	137	84.7
CAPIO LUNDBY NÄRSJUKHUS	38	25.1	18	84.7
SPORTS MEDICINE UMEÅ	44	24.3	17	84.6
LJUNGBY LASARETT	56	23.3	30	84.6
OSKARSHAMNS SJUKHUS	59	23.9	26	84.6
ÖSTERSUNDS SJUKHUS	16	24.4	9	84.4
HÄSSLEHOLMS SJUKHUS	132	23.7	65	84.3
SUNDERBY SJUKHUS	72	24.3	36	84.2
SÖDERSJUKHUSET	236	24.8	100	84.1
NYKÖPINGS LASARETT	25	23.8	9	84.0
KUNGÄLVS SJUKHUS	23	23.4	11	83.8
MOVEMENT MEDICAL AB	220	24.0	102	83.8
ORTHOCENTER/IFK-KLINIKEN	144	24.5	69	83.8
HÖGLANDSSJUKHUSET	80	24.8	45	83.7
VARBERGS SJUKHUS	54	24.1	27	83.4
SKÅNES UNIVERSITETSSJUKHUS	112	24.6	49	83.4
NU-SJUKVÅRDEN	175	24.5	95	83.3
ALINGSÅS LASARETT	57	23.7	27	83.2
ALERIS ORTOPEDI ÄNGELHOLM	92	23.8	36	83.1
CENTRALLASARETTET VÄXJÖ	77	23.6	30	82.9
GÄVLE SJUKHUS	61	23.5	35	82.5
FRÖLUNDA SPECIALISTSJUKHUS	44	24.8	23	82.5
CAPIO LÄKARGRUPPEN I ÖREBRO AB	92	24.1	47	81.9
MALMÖ ALLMÄNNA SJUKHUS	183	24.6	83	81.7
SAMARITERHEMMETS SJUKHUS	42	23.2	17	81.4
VRINNEVISJUKHUSET	141	23.7	65	81.0
VÄSTERVIKS SJUKHUS	32	23.5	10	80.5
KUNGSBACKA SJUKHUS	83	24.5	49	80.5
ODENPLANS LÄKARHUS	42	24.5	16	80.1
ÖREBRO USÖ	55	24.1	26	80.0
LINKÖPINGS UNIVERSITETSKLINIK	140	24.1	60	79.9
KARLSTAD CENTRALSJUKHUS	91	24.1	48	79.2
HUDIKSVALLS SJUKHUS	66	23.3	27	79.1
HELSINGBORGS SJUKHUS	31	23.9	13	78.7
FALU LASARETT	72	24.2	32	78.3
PERAGO ORTOPEDKLINIK	12	23.0	5	76.8
LIDKÖPINGS SJUKHUS	61	24.3	33	75.0
DANDERYDS SJUKHUS	22	25.2	6	74.9
BLEKINGESJUKHUSET	9	24.1	3	74.3
NORRTÄLJE SJUKHUS	16	24.9	4	73.5
SOLLEFTEÅ SJUKHUS	9	24.3	3	73.4
SÖDRA ÄLVSBORGS SJUKHUS	22	23.6	11	73.0
SOPHIAHEMMET	5	25.6	2	70.8

HALMSTADS SJUKHUS	22	24.3	8	69.3
ÖRNSKÖLDSVIKS SJUKHUS	14	24.6	5	69.0
VÄRNAMO SJUKHUS/ORTOPEDKLINIKEN	8	24.0	1	52.7

AVERAGE KOOS SCORES FOR FUNCTION AND QUALITY OF LIFE
FOR PATIENTS UNDERGOING SURGERY IN 2007-2011

CLINIC	Nr of ops	Average age	Nr of responses	KOOS
ORTHOCENTER I SKÅNE	2	20.5	2	76.0
NACKA NÄRSJUKHUS	21	25.4	8	72.9
LÖWETS SPECIALISTMOTTAGNING	78	24.2	38	70.3
ORTHOCENTER STOCKHOLM	48	24.0	18	68.6
LÄKARHUSET HERMELINEN	5	26.4	3	68.2
VÄSTERÅS CENTRALLASARETTET	32	24.2	13	67.3
ELISABETH SJUKHUSET	178	24.1	72	66.8
CAPIO ARTRO CLINIC	909	24.9	445	66.7
PERAGO ORTOPEDKLINIK	12	23.0	5	66.0
MEDICIN DIREKT	39	25.1	16	65.8
HÄSSLEHOLMS SJUKHUS	132	23.7	65	65.5
LJUNGBY LASARETT	56	23.3	30	65.5
PITEÅ ÄLVDAL SJUKHUS	19	24.4	9	65.4
VISBY LASARETT	4	21.8	1	65.0
SUNDERBY SJUKHUS	72	24.3	36	64.9
KAROLINSKA UNIVERSITETSSJUKHUSET/ ORTOPEDKLINIKEN	140	24.8	64	64.4
CENTRALLASARETTET VÄXJÖ	77	23.6	30	64.3
HÖGLANDSSJUKHUSET	80	24.8	45	64.0
LUNDS UNIVERSITET	98	23.9	51	63.9
ORTHOCENTER/IFK-KLINIKEN	144	24.5	69	63.9
SPORTS MEDICINE UMEÅ	44	24.3	17	63.4
HELSINGBORGS SJUKHUS	31	23.9	13	63.4
ORTOPEDISKA HUSET CAREMA	66	24.4	23	63.0
SAMARITERHEMMETS SJUKHUS	42	23.2	17	62.8
KALMAR SJUKHUS	116	24.0	54	62.5
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MÄLARSJUKHUSET ESKILSTUNA	79	23.9	37	62.2
NYKÖPINGS LASARETT	25	23.8	9	62.1
OSKARSHAMNS SJUKHUS	59	23.9	26	61.9
MOVEMENT MEDICAL AB	220	24.0	102	61.7
KUNGÄLVS SJUKHUS	23	23.4	11	61.6
CAPIO LÄKARGRUPPEN I ÖREBRO AB	92	24.1	47	61.2
NORRLANDS UNIVERSITETSSJUKHUS. UMEÅ	217	23.8	100	61.0
SAHLGRENSKA	282	24.5	137	60.8
FRÖLUNDA SPECIALISTSJUKHUS	44	24.8	23	60.8
CAPIO LUNDBY NÄRSJUKHUS	38	25.1	18	60.8
NU-SJUKVÅRDEN	175	24.5	95	60.3
LÄNSSJUKHUSET SUNDSVALL	19	23.8	6	60.1
GÄVLE SJUKHUS	61	23.5	35	60.0
SKÅNES UNIVERSITETSSJUKHUS	112	24.6	49	59.8
LÄNSSJUKHUSET RYHOV	37	24.3	17	59.7
VÄSTERVIKS SJUKHUS	32	23.5	10	58.9

ALERIS ORTOPEDI ÄNGELHOLM	92	23.8	36	58.9
ÖSTERSUNDS SJUKHUS	16	24.4	9	58.7
VARBERGS SJUKHUS	54	24.1	27	58.6
ODENPLANS LÄKARHUS	42	24.5	16	57.8
MALMÖ ALLMÄNNA SJUKHUS	183	24.6	83	57.2
ÖREBRO USÖ	55	24.1	26	56.7
HUDIKSVALLS SJUKHUS	66	23.3	27	56.6
VRINNEVISJUKHUSET	141	23.7	65	56.3
KARLSTAD CENTRALSJUKHUS	91	24.1	48	56.2
KUNGSBACKA SJUKHUS	83	24.5	49	56.0
ALINGSÅS LASARETT	57	23.7	27	54.6
DANDERYDS SJUKHUS	22	25.2	6	53.5
BLEKINGESJUKHUSET	9	24.1	3	53.2
FALU LASARETT	72	24.2	32	52.7
LINKÖPINGS UNIVERSITETSKLINIK	140	24.1	60	52.7
LIDKÖPINGS SJUKHUS	61	24.3	33	49.2
SOPHIAHEMMET	5	25.6	2	47.3
SOLLEFTEÅ SJUKHUS	9	24.3	3	46.7
SÖDRA ÄLVSBORGS SJUKHUS	22	23.6	11	46.0
NORRTÄLJE SJUKHUS	16	24.9	4	43.6
HALMSTADS SJUKHUS	22	24.3	8	35.3
ÖRNSKÖLDSVIKS SJUKHUS	14	24.6	5	35.1
VÄRNAMO SJUKHUS/ORTOPEDKLINIKEN	8	24.0	1	30.0

Gender aspects

Age

Some 40% of the primary ACL reconstructions that were performed in 2013 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, 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 28 years of age). There is, however, a difference in the age at revision surgery, where the average age of women is 25 compared with 27 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 equestrianism and gymnastics are more common among women than among men, but this probably reflects the differences in the gender of people taking part in these activities. The differences in gender ratios (women/men as a percentage) in activities such as handball (73/27), Alpine skiing (58/42) and basketball (55/45) are surprising, as the number of male participants can be expected to be as high as or higher than the percentage of females.

Time between injury and operation

In average terms, there was no difference between the genders when it came to the time between injury and operation in 2013.

Anterior cruciate ligament reconstruction in older patients

As many as 86% of all ACL reconstructions are performed on patients under 40 years of age. Of the remaining 14%, only 2.2% are 50 or older. A considerable number of reconstructions are therefore performed on patients aged between 40 and 50. It appears that these patients still wish to maintain a high activity level to a greater degree than before. This high activity level means that a larger number of patients, perhaps more than ever before, are faced with the question of whether or not they should undergo surgery.

The most common question facing an orthopedist is whether ACL reconstruction in an older patient could lead to poorer results compared with younger patients as a result of possible established cartilage and/or meniscal damage. What results can be expected and what can we recommend to our patients?

A recently published study containing data from the Swedish ACL Register reports comparable results for patient-related result measurements (KOOS) for patients from different age categories. This study was based on data from 2005 up to and including 2012. The total patient cohort was stratified into the age groups of 0-19, 20-29, 30-39 and ≥ 40 years. The median age was 24, where 60.3% were men with a median age of 26 and 39.7% were women with a median age of 21. In all, 13.3% of the patients were ≥ 40 (Table 1).

TABLE 1. BASELINE DATA

Age	0-19	20-29	30-39	≥40	Total
Men (n)	1,827	3,511	2,040	1,103	8,481
Women (n)	2,707	1,913	953	887	6,460
Total (n)	4,535	5,424	2,993	1,990	14,941

In the younger age groups, sports such as football, handball and floorball dominate as the etiology for ACL injuries. In the oldest age group, Alpine skiing was the most common activity at the time of injury (Table 2), while football was the second most common. A clear reduction in football as the primary cause of ACL injury and an increase in Alpine skiing can be seen in each age category.

TABLE 2: ACTIVITY IN CONJUNCTION WITH INJURY

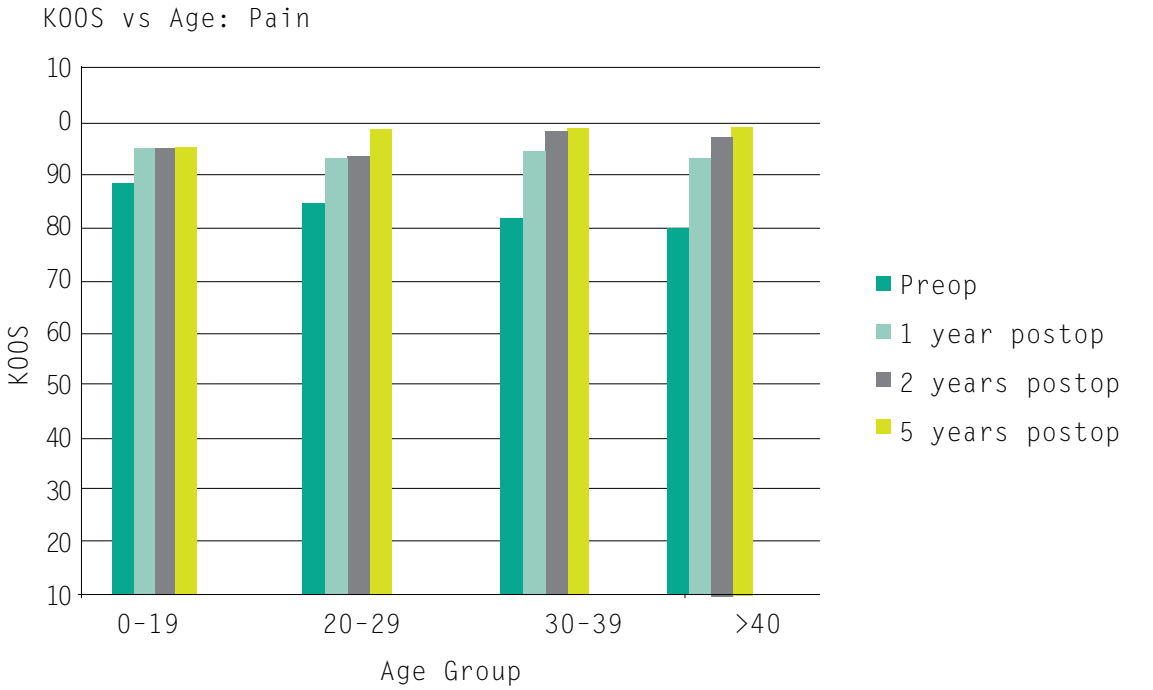
Age	0-19	20-29	30-39	≥40
Rank 1	Football 52.1 %	Football 50.0 %	Football 34.6 %	Alpine/Telemark 28.8 %
Rank 2	Handball 10.5 %	Alpine/Telemark 11.4 %	Alpine/Telemark 16.7 %	Football 17.1 %
Rank 3	Floorball 8.4 %	Floorball 9.1 %	Floorball 11.1%	Annat 15.1 %

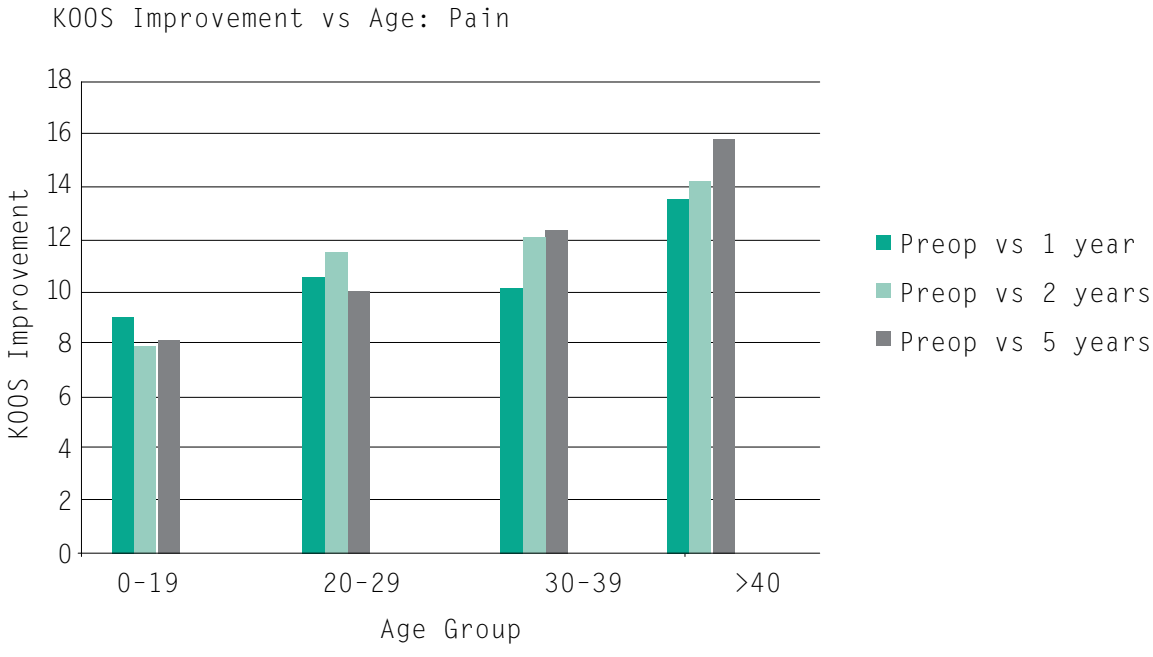
Older patients had more cartilage and/or meniscal damage and a longer time to operation compared with the younger age groups. The second of these factors perhaps illustrates that surgeons apply stricter indication criteria when deciding on ACL reconstructions among older patients, but also that patients are more likely to adopt a wait-and-see attitude to possible surgical intervention. In spite of this, the data from the study reveal that the result did not differ between age categories, indicating that a longer period of time between injury and surgery in itself does not influence the analyzed results.

The preoperative KOOS was significantly lower in the older age groups for all the sub-groups in the KOOS. One explanation could be that older patients have lower KOOS scores in overall terms related to impaired knee function secondary to simultaneous cartilage or meniscal damage.

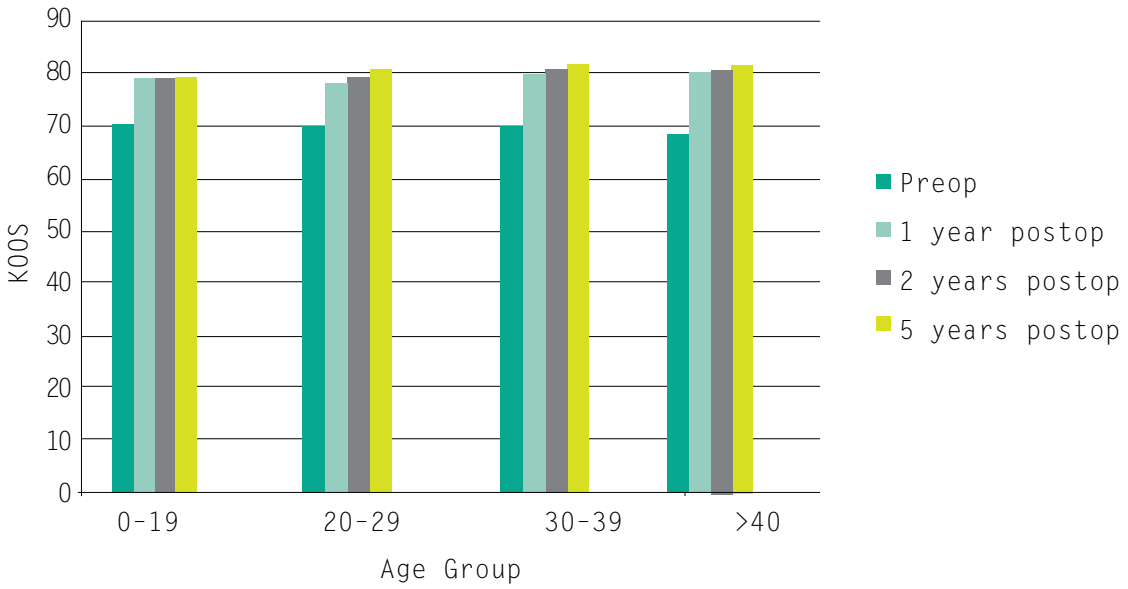
Interestingly, a significant improvement in all the KOOS sub-scales was found with increasing age.

The greatest improvement was seen in the oldest group (≥ 40 years) and the one-, two- and five-year follow-up. One possible explanation could be that younger patients perceive lasting knee instability and a deterioration in knee function as more of a handicap to a greater degree than older patients would, possibly as a result of more physically demanding occupations and/or hobbies. This could then impact and perhaps also explain the shorter period between injury and surgery in the younger patient category. The relatively high postoperative KOOS scores in older patients could perhaps be explained by the fact that they are still actively involved in sports but generally have lower total demands when it comes to knee function compared with younger patients. Older patients may have higher total rehabilitation motivation and determination and lower expectations in terms of the results of surgery and are therefore more satisfied with the result of surgery. This is reflected in higher KOOS scores postoperatively.

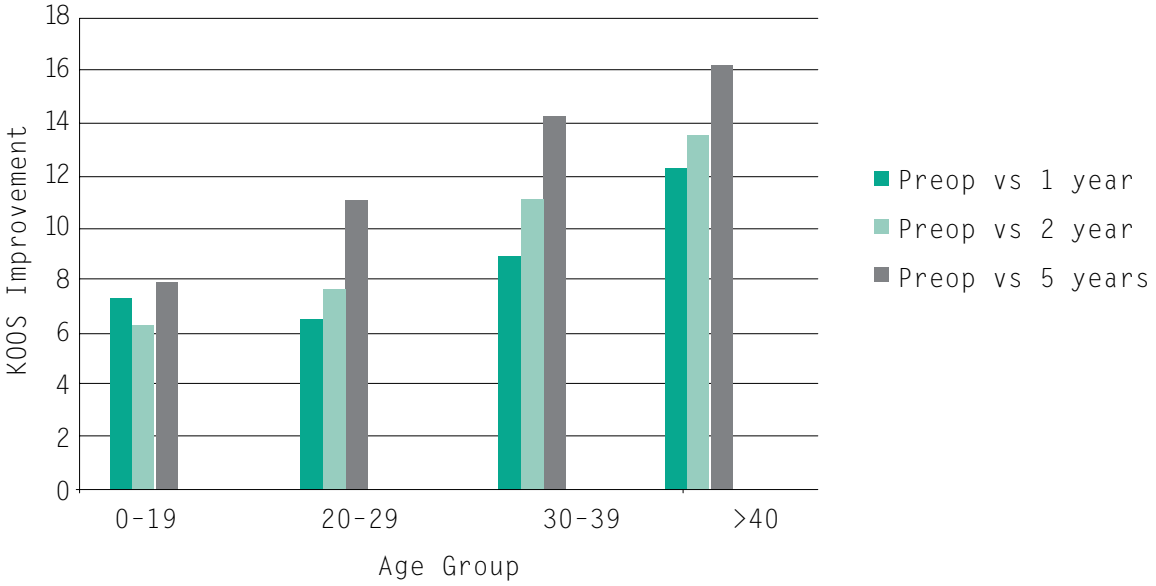




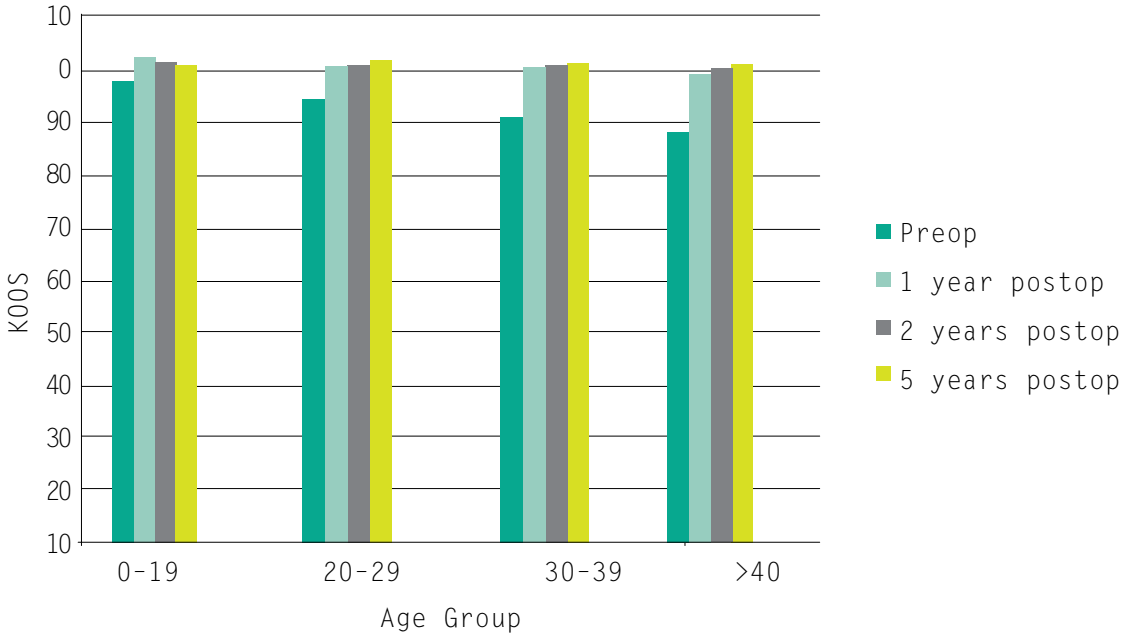
KOOS vs Age: Symptoms



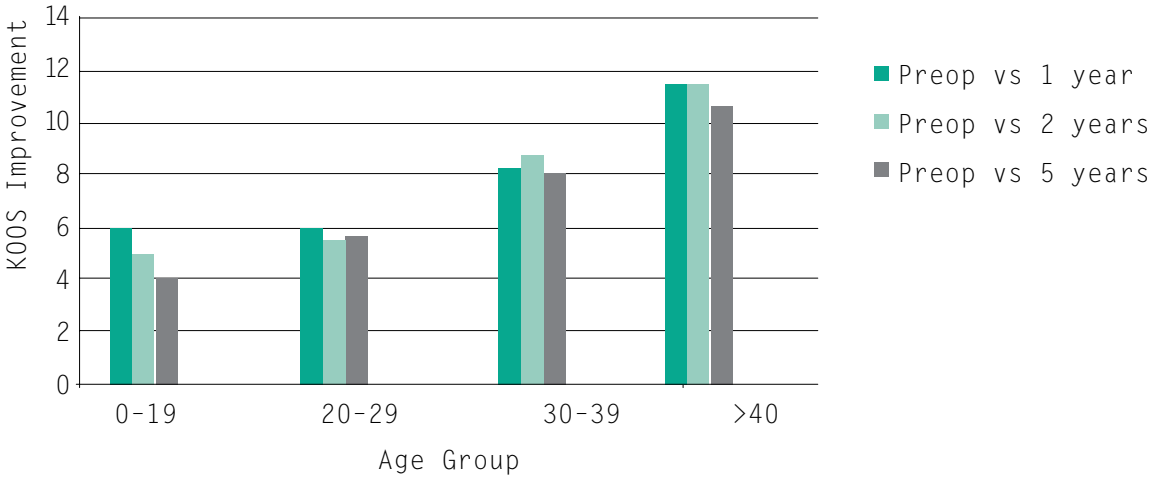
KOOS Improvement vs Age: Symptoms



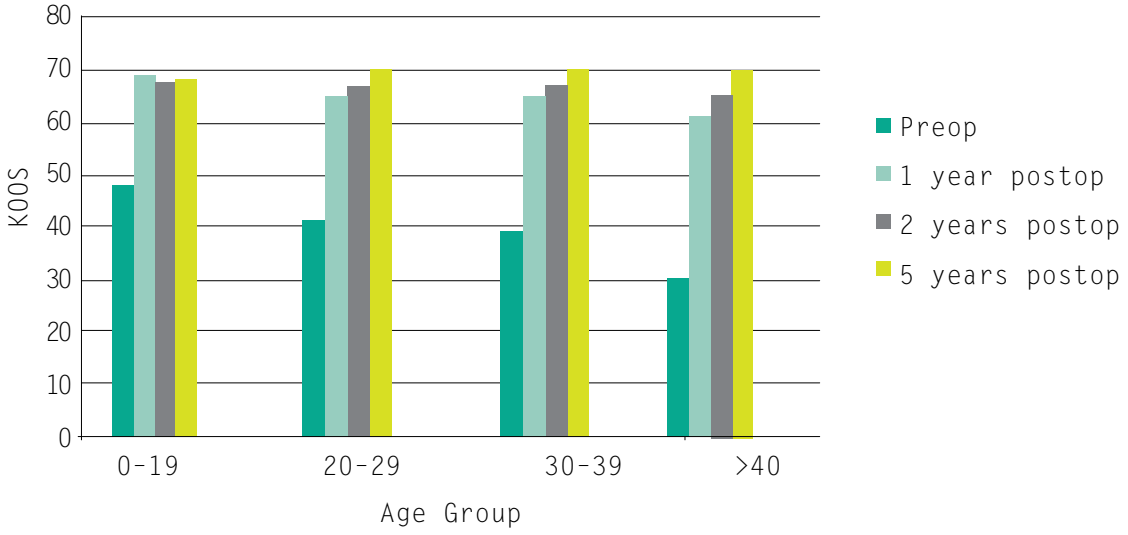
KOOS vs Age: ADL



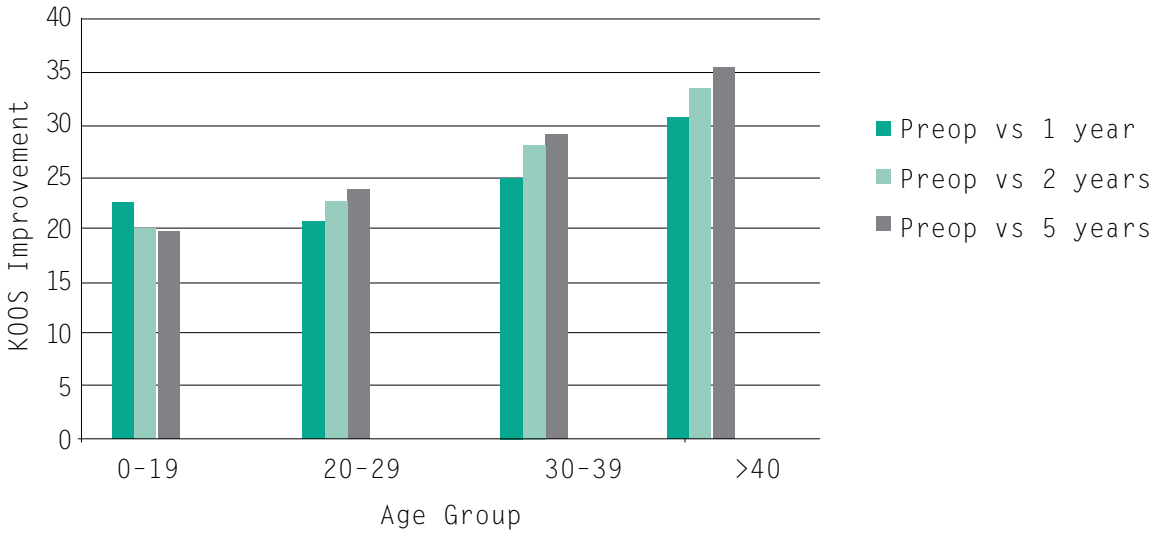
KOOS Improvement vs Age: ADL



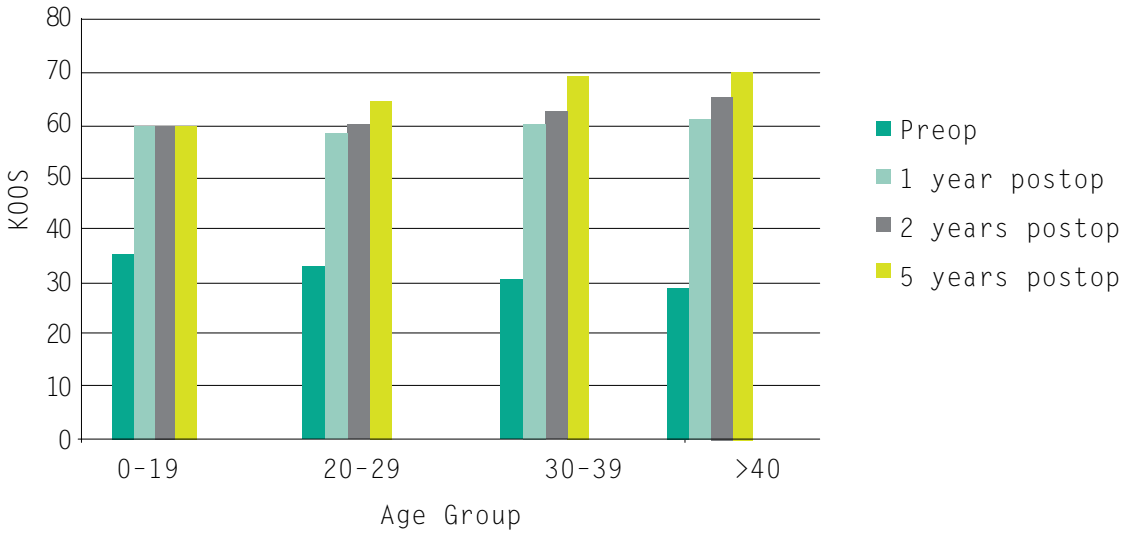
KOOS vs Age: Function



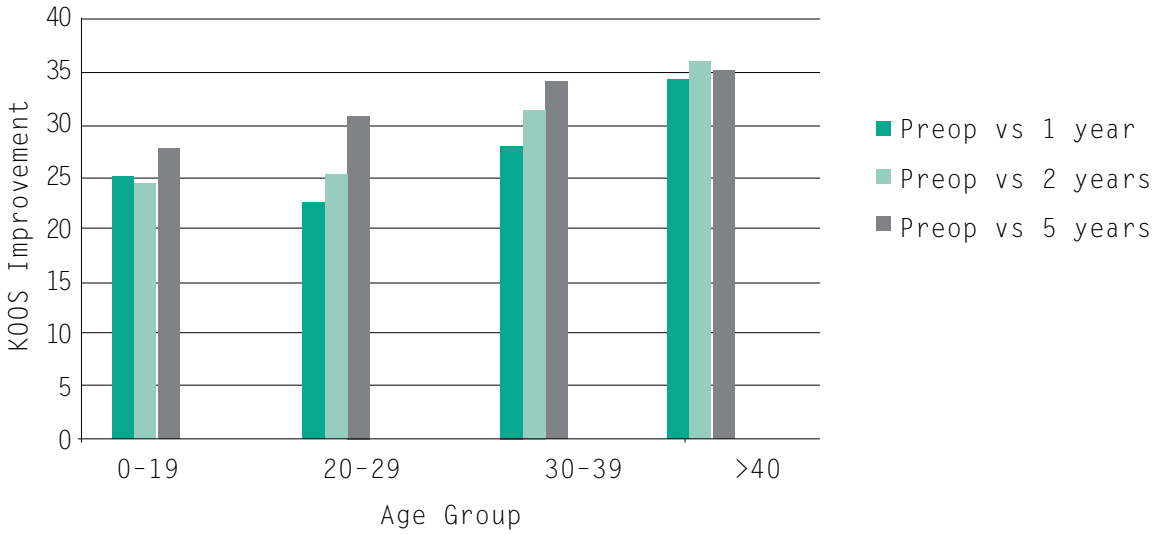
KOOS Improvement vs Age: Function



KOOS vs Age: Quality of Life



KOOS Improvement vs Age: Quality of Life



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 steering committee 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.

The response rate to questionnaires has improved in recent years. The steering committee 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 steering committee 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 steering committee therefore recommends that patients should be informed of the negative impact of smoking prior to possible surgery.

The register would like to thank all the participating clinics and users. Without your contributions, this kind of register cannot survive.

Special thanks to John Reinholdsson, Neel Desai and Martin Mansten who wrote the sections on data loss analysis, ACL reconstruction in older patients and checking the input data.

The national ACL Register is collaborating with other orthopedic registers and with a number of other quality registers. The aim is to help in the development of simplified methods for the collection and feedback of data. The ACL Register's steering committee 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 steering committee welcomes comments and views on this annual report and looks forward to continued good collaboration.

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- Forssblad M, Svenska korsbandsregistret, Korsbandsoperatörer, Göteborg 2013
- Forssblad M, SOF Årsmöte, Upsala 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 (Swedish ACL Register), Korsbandsoperatörer, Göteborg 2013
- 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 (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 (Swedish ACL Register), 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 (Swedish ACL Register), 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 Republic 2009
- Forssblad M, Swedish ACL registry, Zwolle, Netherlands, 2009
- Forssblad M, Svenska korsbandsregistret (Swedish ACL Register), Korsbandsoperatörer, 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
- Forssblad M, Wredmark T. Svenska korsbandsregistret (Swedish ACL Register), IMF, Stockholm. Podium presentation, 2008
- 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 20 års jubileum Nasjonalt Register for Leddproteser, Bergen 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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