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| ***Appendix – overview of included studies*** | | | | | | | | | |
| **Author (year)** | **Country** | **Downs and Black score** | **Title** | **Objective** | **Outcome** | **Sample size** | **Follow-up** | **Statistics** | **Result/conclusion** |
| Ageberg et al (2010) | Swe | 18 | Gender differences in patient-reported outcomes after ACL reconstruction: data from the SNKLR | Study gender differences in PROMs before and one and two years after ACLR | KOOS and EQ5-D | N = 10,164  (F = 42%) | 1 and 2 years | ANCOVA | Females report statistically significantly worse outcome preoperatively and one and two years postoperatively. No clinically relevant gender differences in improvement over time. |
| Ahldén et al (2012) | Swe | 15 | The SNKLR: a report on baseline variables and outcome of surgery for almost 18,000 patients | To report the baseline variables, patient-based outcomes and factors associated with poorer outcome | KOOS and additional surgery | N = 16,351  (F = 42.4%) | 5 years | Wilcoxon’s signed-rank test and chi-square test | Revision ACLRs do less well than primary reconstructions in terms of the KOOS. Female soccer players run an increased risk of contralateral or revision ACLR. |
| Ardern et al (2016) | Swe | 14 | Comparison of patient-reported outcomes among those who chose ACLR or non-surgical treatment | To compare PROMs between patients who undergo ACL reconstruction and patients who choose non-surgical treatment | KOOS and EQ5-D | N = 879 with non-surgical treatment compared to N = 879 with primary ACLR | 1, 2 and 5 years | Independent sample t-test | Patients undergoing surgical treatment after ACL injury might rate the knee function and quality of life as superior compared with non-surgically treated patients at short- and medium-term follow-up. |
| Årøen et al  (2013) | Nor | 16 | An isolated rupture of the PCL results in reduced preoperative knee function in comparison with an ACL injury | To compare baseline data between primary isolated PCL and ACL reconstruction | KOOS, time to surgery, concomitant injuries | N = 9,622  ACL = 9,551 (F = 36%)  PCL = 71 (F = 36%) | Preoperative | Linear regression, Wilcoxon’s rank test and chi-square test | Isolated PCL-injured knees demonstrated significantly inferior preoperative knee function in comparison with the isolated ACL-injured knees scheduled for surgery. |
| Balasingam et al (2018) | Swe | 13 | Patients with concomitant intra-articular lesions at index surgery deteriorate in their KOOS in the long term more than patients with isolated ACL rupture: a study from the SNKLR | To compare clinical outcomes at 5 and 10 years between patients with isolated ACLR and patients with concomitant intra-articular injuries. | KOOS subscales pain, symptoms, function in sport and recreation, and QoL | At 5-years n=1,295. At 10-years n=1,023. | 5 and 10 years | Linear model of longitudinal data | Patients with concomitant meniscus injuries, or combined meniscus and cartilage injuries at index ACLR, deteriorate between the 5- and 10-year follow-up in the KOOS subscales pain, sport and recreation and QoL. No such deterioration was found for patients with isolated concomitant cartilage injuries or isolated ACLR. |
| Barenius et al (2013) | Swe | 16 | Functional recovery after ACLR, a study of health-related QoL based on the SNKLR | To find predictors of a satisfactory (functional recovery) or a non-satisfactory outcome after ACLR | KOOS | N = 8,584  For KOOS two-year: N = 3,556 | 2 years | Univariate and multivariate logistic regression | Gender and additional injuries influence the chance of achieving functional recovery after ACLR. Early reconstruction decreases the risk of meniscal injury and cartilage lesions. |
| Björnsson et al (2015) | Swe | 15 | No difference in revision rates between single- and double-bundle ACL reconstruction: A comparative study of 16,791 patients from the SNKLR. | To compare revision rates and PROMS between single- and double-bundle ACLR | Revision and PROMs | N = 16,791  SB = 16,281  DB = 510 | Maximum 7 years | Kaplan-Meier for probability of revision and log-rank test | No differences in revision rates or in PROMS were found. |
| Desai et al (2014) | Swe | 14 | Outcomes after ACL reconstruction with the emphasis on older patients: results from the SNKLR | To analyse outcomes of patients over the age of 40 after ACLR and to compare them with their younger counterparts | KOOS | N = 22,699 | 1, 2 and 5 years | Chi-square test, ANOVA and two-way analysis of variance | Patients of higher age reported a lower pre-operative KOOS compared with young patients. At the one-, two- and five-year follow-up, a similar KOOS was seen in all age groups. |
| Faunø et al (2014) | Den | 18 | Risk of revision after ACL reconstruction is higher among adolescents: Results from the DKRR | To describe outcomes after ACLR in children and adolescents | KOOS  KOOS4  Tegner score | Total cohort N = 14,806  (F = 40%)  KOOS available for N = 4865. Tegner available for N = 3907 | 1 year | Kruskal-Wallis test and regression analysis. | The younger age groups showed significantly better KOOS and Tegner scores and had lower failure rates, defined as QoL ≤ 44 and Tegner ≤ 2. Older patients had a significantly worse KOOS4 compared with the younger patients. |
| Fältström et al (2016) | Swe | 18 | Predictors of additional anterior cruciate ligament  reconstruction: data from the Swedish national ACL register | To identify predictors of additional anterior cruciate ligament (ACL) reconstruction | Revision ACLR and contralateral ACLR | N = 22,429  No revision = 19,531  Revision = 702  Contralateral = 591 | 6-104 months | Simple and multivariate Cox proportional hazards regression | In terms of preoperative PROMs, lower values in the KOOS symptoms subscale, EQ-5D index and EQ VAS predicted revision ACLR. Contralateral ACLR was predicted by higher preoperative values in the KOOS subscales pain, ADL, sport/recreation and QoL. |
| Granan et al (2015) | Nor | 19 | Associations between inadequate knee function detected by the KOOS and prospective graft failure in an ACL-reconstructed knee | To investigate KOOS differences between revision cases and primary ACLR. To test whether QoL < 44 could influence the risk of revision | KOOS | N = 5,517 | Minimum 2 years KOOS. Mean for controls; 54.4 months, for revision cases; 40.0 months | Linear regression and Cox regression analyses | Inadequate knee function, as measured by the two-year KOOS, is associated with future ACL-reconstructed graft failure. |
| Grindem et al (2015) | Nor | 17 | How does a combined preoperative and postop rehabilitation programme influence the outcome of ACLR two years after surgery? A comparison between patients in the Delaware-Oslo ACL cohort and the NKLR. | To compare preoperative and two-year PROMs in patients undergoing pre- and postoperative rehabilitation at a sports medicine clinic compared with usual care | KOOS | NAR cohort = 84  NKLR cohort = 2,690 | 2 years | Chi-square test, Mann-Whitney U test, t-tests. ANCOVA to compare KOOS preop and 2y postop. | Patients who followed a progressive pre- and postoperative rehabilitation programme showed superior KOOS two-year results compared with patients who underwent usual care. |
| Hamrin Senorski et al (2018) | Swe | 17 | Increased odds of patient-reported success at 2 years after anterior cruciate ligament reconstruction in patients without cartilage lesions: a cohort study from the SNKLR | To investigate whether a detailed knowledge of surgical procedures was able to predict patient-reported success and failure in KOOS two years after ACL surgery in the SNKLR | KOOS | N = 6,889 | 2 years | Logistic regression | Surgical techniques used in primary single-bundle ACL reconstruction did not predict the KOOS two years after the reconstruction. However, the absence of concomitant injuries at index surgery predicted patient-reported success in the KOOS. |
| Hamrin Senorski et al (2017) | Swe | 18 | No differences in subjective knee function between surgical techniques of anterior cruciate ligament reconstruction at two-year follow-up: a cohort study from the SNKLR | To investigate how different techniques of single-bundle ACLR affect KOOS evaluation during two years after surgery | KOOS | N = 13,636  (F = 43.5%) | 2 years | Repeated measures ANOVA Linear mixed model | Surgical techniques of primary single-bundle ACLR did not demonstrate differences in the improvement in baseline subjective knee function in the KOOS4 during the first two years after surgery. |
| Hjermundrud et al (2010) | Nor | 17 | A full-thickness cartilage lesion does not affect knee function in patients with ACL injury | To compare knee function in patients with a combined ACL injury and full-thickness cartilage lesion with knee functions in patients with an ACL injury but no cartilage lesions | KOOS | N = 90  30 patients with a full-thickness chondral defect (ICRS grade 3-4) | Preoperative | Mann-Whitney U | The combination of a full-thickness cartilage lesion and an ACL rupture did not result in inferior knee function at the time of the ACL reconstruction, as measured by the KOOS. |
| Ingelsrud et al (2015) | Nor | 16 | Proportion of Patients Reporting Acceptable Symptoms or Treatment Failure and Their Associated KOOS Values at Six to 24 Months After ACLR: A study from the NKLR | To determine the proportion of patients reporting acceptable symptoms or treatment failure at six to 24 months after ACLR | KOOS | N = 744 | 6 months, 1 year and 2 years. | Mann-Whitney U and chi-square test | Only half the patients at six months and about two-thirds at one to two years perceived their symptoms as acceptable after ACLR. For these patients, KOOS values reflected no problems to mild problems on average, while, for patients reporting treatment failure, the KOOS values reflected moderate to severe problems. |
| Ingelsrud et al (2018) | Nor | 14 | Meaningful change scores in the knee injury and osteoarthritis outcome score in patients undergoing ACLR | To define the minimal important change for the KOOS after ACLR | Change in KOOS | Total n=542 | 6 months, 1 and 2 years | Anchor-based MIC analyses. Predictive modeling (MICpred), mean change (MICMean-Change), ROC method (MICROC) | MICpred analysis was chosen as the most robust method, which determined that 12.1 points in the KOOS sport and recreation, and 18.3 points in QoL, were regarded as minimal important change. Only mild problems are reported in the other KOOS subscales preoperatively, resulting in much lower MIC-scores for these. Sport and recreation and QoL could be regarded as the primary patient-reported domains after ACLR. |
| Kvist et al (2014) | Swe | 12 | Results From the Swedish National Anterior Cruciate Ligament Register | To analyse the baseline variables and clinical outcomes in the SNKLR | Not specified. The KOOS is part of several of the analyses. | N = 23,744  Females: 42% | Preoperative to 5 years KOOS and EQ-5D. | One-way analysis of variance with Bonferroni post-hoc test | Patients undergoing revisions fare less well than those undergoing primary unilateral ACL reconstructions, as well as bilateral reconstructions. The cumulative risk of an ACL revision or contralateral ACL reconstruction during a five-year period is approximately 7%. For patients aged less than 19 years, the cumulative risk is significantly higher. |
| LaPrade et al (2015) | Nor | 20 | Outcomes After ACL Reconstruction Using the Norwegian Knee Ligament Registry of 4691 Patients – How Does Meniscal Repair or Resection Affect Short-term Outcomes? | To compare the preoperative and two-year postoperative KOOS subscale scores after ACLR with and without meniscal injury | KOOS | N = 4,691 | 2 years | Independent t test, Mann-Whitney U test, Fisher’s exact test and chi-square test were used. Multiple linear regression model. | The two-year postoperative outcomes in patients with an LM repair, MM resection, or LM resection were not significantly different from an isolated ACLR for any of the KOOS subscales. Similar results were seen for patients in the MM repair group in comparison to an isolated ACLR on the Pain, ADL and Sport/Rec subscales; however, the results after an MM repair were significantly decreased for the Other Symptoms and QoL KOOS subscale scores. |
| Lind et al (2009) | Den | 9 | The first results from the Danish ACL reconstruction registry: epidemiologic and two-year follow-up results from 5,818 knee ligament reconstructions | To present epidemiology and short-term clinical outcome | Incidence of ACLR, revision, KOOS and Tegner | N = 5,818  Primary ACLR = 4,972  Revision ACLR = 443 | 2 years | Kaplan-Meier survival analysis | This paper describes the design and two-year follow-up results of the Danish knee ligament reconstruction registry. |
| Lind et al (2012) | Den | 13 | Incidence and Outcome After Revision Anterior Cruciate Ligament Reconstruction: results from the Danish registry for knee ligament reconstructions | To describe the epidemiology and risk factors for revision ACLR. To compare the outcome after revision with primary ACLR | Revision ACLR. KOOS and Tegner. Objective knee stability | Primary ACLR = 12,193  Revision ACLR = 1,099 | 5 years for revision. 1 year KOOS, Tegner and stability tests | Kaplan-Meier. Cox regression and Wilcoxon two-sample test | Age younger than 20 years increases the risk of revision. Acceptable knee stability was seen after revision ACL reconstruction, but subjective outcome was less favorable than after primary ACL reconstruction. |
| Owesen et al (2015) | Nor | 18 | Patients With Isolated PCL Injuries Improve From Surgery as Much as Patients With ACL Injuries After Two Years | To investigate the outcome after PCL reconstruction in patients with an isolated PCL injury and to compare this with the outcome for patients treated with isolated ACLR | KOOS | PCL n=71  Isolated ACL n=9,661 | 2 years | Paired t-test, chi-square | Patients undergoing PCL reconstruction can expect the same improvements in KOOS score as patients undergoing ACL reconstruction. However, PCL patients start out with an inferior score on average and consequently end up at a lower score compared with ACL patients for all KOOS subscales. |
| Phillips et al (2018) | Swe | 15 | Meniscus repair with simultaneous ACLR demonstrated similar clinical outcomes as isolated ACL repair: a result not seen with meniscus resection | To compare PROMs at 2-year follow-up between isolated ACLR and ACLR with simultaneous meniscal treatment. | KOOS and EQ-5D | N = 10,001 | 2 years | Linear regression | Simultaneous meniscus resection resulted in worse PROMs compared with isolated ACLR, while meniscus repair showed similar PROMs as isolated ACLR. Time from injury to surgery <12 weeks resulted in superior PROMs compared with >12 weeks. Worse PROMs were found with grade 3-4 cartilage lesions compared with grade 1-2. Surgical technique in terms of transtibial or transportal drilling did not influence PROMs at 2 years. |
| Rahr-Wagner et al (2013) | Den | 16 | Increased Risk of Revision After Anteromedial Compared With Transtibial Drilling of the Femoral Tunnel During Primary ACL Reconstruction: Results from the DKRR | To compare the revision rates and clinical outcomes between the AM and TT drilling techniques | Revision, KT-1000 and pivot shift, KOOS and Tegner | N = 8,375 | Mean 1.05 years | Kaplan-Meier and Cox regression | The AM technique resulted in a higher risk of revision than the TT technique and was associated with more objective instability. No difference was seen in the PROMs between the techniques. |
| Rahr-Wagner et al (2013) | Den | 14 | Validation of 14,500 operated knees registered in the Danish Knee Ligament Reconstruction Register: registration completeness and validity of key variables | To asses completeness, data quality and differences between responders and non-responders in the DKRR | Completeness of registration. KOOS and Tegner | N = 14,500 | 1 year | Student's t-test | Good completeness of registration of the ACL reconstructions and a high PPV for most key variables were found. The KOOS and Tegner scores were comparable for responders and non-responders. |
| Rahr-Wagner et al (2014) | Den | 15 | Comparison of Hamstring Tendon and Patellar Tendon Grafts in ACL Reconstruction in a Nationwide Population-Based Cohort Study: results from the DKRR | To compare the revision rate and clinical outcomes between HT and PT grafts used in primary ACLR | Revision ACLR. KT-1000/Rolimeter and pivot shift. KOOS and Tegner | N = 13,647  HT = 11,676  PT = 1,971 | Mean for revision: 3.01 years, for knee stability and KOOS 1 year | Kaplan-Meier, Cox regression and logistic regression | HT grafts were associated with a substantially increased risk of early revision at the one-year follow-up. A minor decrease in the risk of positive pivot-shift test results in the HT group. HT grafts had superior results in terms of the KOOS. |
| Reinholdsson et al (2016) | Swe | 19 | A non-response analysis of two-year data in the Swedish Knee Ligament Register | To investigate if there is a difference between respondents and non-respondents at the two-year follow-up. The second aim was to analyse whether the outcome variables of the KOOS and EQ5D differed between respondents and non-respondents. | Demographics, intraoperative finding, KOOS, and EQ5-D | N = 3,588  Females: 41.1%  Respondents = 1,865  Non-respondents = 1,723 | 2 years | Pearson’s chi-square, Fisher’s exact, Student’s t, analysis of covariance | The register is valid concerning baseline surgical data, but higher age, female gender and perhaps higher socioeconomic status improve the response rates. The KOOS showed small differences of questionable clinical significance. |
| Røtterrud et al (2011) | Nor Swe | 17 | Effect of Gender and Sports on the Risk of Full-Thickness Articular Cartilage Lesions in ACL Injured Knees: a nationwide cohort study from Sweden and Norway on 15783 patients. | The study aims to evaluate risk factors for full-thickness articular cartilage lesions ICRS identified during primary ACL reconstruction. | Full-thickness cartilage lesion in ACL-injured knees | N = 15,783  (F = 42%)  Patients with full-thickness cartilage lesion = 1,012 | n.a. | Logistic regression | Males run an increased risk of full-thickness articular cartilage lesions in ACL-injured knees compared with females. Handball players run an increased risk of full-thickness lesions compared with other male athletes, while no other investigated sport had a significant effect on the risk in either gender. In addition, age, time from injury to surgery and previous knee surgery are risk factors for full-thickness cartilage lesions in ACL-injured knees. |
| Røtterrud et al (2012) | Nor | 13 | Patients with focal full-thickness cartilage lesions (ICRS 3-4) benefit less from ACL reconstruction at 2-5 years follow-up | To compare patients with associated full-thickness cartilage lesion with patients without a cartilage lesion at index ACLR | KOOS | N = 90  Patients with associated full-thickness cartilage lesions = 30 | Mean 2.7 years | 1-2 paired samples t-test and standardised response mean | ACL-injured patients with a concomitant full-thickness cartilage lesion report impaired outcomes after ACLR compared with patients without these lesions. |
| Røtterrud et al (2013) | Nor Swe | 20 | Effect of Meniscal and Focal Cartilage Lesions on Patient-Reported Outcome After ACLR – A Nationwide Cohort Study From Norway and Sweden of 8,476 Patients With Two-Year Follow-up | To evaluate the effect of meniscal lesions, partial-thickness cartilage lesions and full-thickness cartilage lesions on PROMs after ACLR | KOOS | N = 8,476  (Females = 48%)  Meniscal lesions = 3,674  Cartilage lesions = 2,247 | 2 years | Linear regression model. Adjusted multiple regression model | Patients with concomitant full-thickness cartilage lesions reported more pain and symptoms, impaired function in activities of daily living, sports and recreation and reduced knee-related quality of life, compared with patients without cartilage lesions two years after ACL reconstruction. Meniscal lesions and partial-thickness cartilage lesions did not impair PROMs. |
| Røtterrud et al (2016) | Nor Swe | 20 | Effect on PROMs of Debridement or Microfracture of Concomitant Full-Thickness Cartilage Lesions in ACLR Knees: A Nationwide Cohort Study From Norway and Sweden of 357 Patients With Two-year Follow-up. | To evaluate the effect of debridement or microfracture of full-thickness cartilage lesions on PROMs after ACLR as measured by the KOOS at two-year follow-up | KOOS | N = 644  No Treatment = 164  Debridement = 129  Microfracture = 351 | 2 years | Unadjusted and adjusted linear regression | With reference to leaving concomitant full-thickness cartilage lesions untreated at the time of ACL reconstruction, MF showed adverse effects on PROMs and debridement showed no effects on PROMs at the two-year follow-up after ACLR. As a result, MF and the debridement of concomitant full-thickness cartilage lesions in ACL-injured knees should be performed restrictively. |
| Samuelsson et al (2017) | Swe | 16 | Equivalent knee injury osteoarthritis outcome scores 12 and 24 months after anterior cruciate ligament reconstruction | To investigate whether there is equivalence between the KOOS at one and two years after primary ACLR. | KOOS | N = 23,953  (F = 42.2%) | 2 years | Two one-sided tests of equivalence for paired samples. The equivalence interval was set a priori at -4 to +4. | Equivalent results within patients were found at the one- and two-year follow-up across all KOOS subscales. This result was consistent for subgroups of gender, concomitant injuries and graft type. |
| Snæbjörnsson et al (2017) | Swe | 16 | Graft diameter as a predictor of revision anterior cruciate ligament reconstruction and KOOS and EQ-5D values: A cohort study from the SNKLR based on 2240 patients | To evaluate the influence of the HT autograft diameter on patient-reported outcome | KOOS and EQ-5D | N = 2240  Revision cases n = 560  Controls n = 1680 | Mean 4.5 years | Matched control analysis (ratio 3:1). Univariate linear regression | No significant regression coefficient for the change in the KOOS or EQ-5D was found for increases in hamstring autograft diameter. |
| Soreide et al (2016) | Nor | 17 | The effect of limited perioperative non-steroidal anti-inflammatory drugs on patients undergoing ACL reconstruction | To investigate the effect of NSAID administration on patients undergoing ACLR | Revision and KOOS QoL < 44 | N = 7,822  Patients who were administered postop NSAID n = 4,144 | Mean 2.8 years | Kaplan-Meier and log-rank test. Cox regression. Logistic regression | Administration of NSAIDs to patients after ACLR does not have a negative effect on graft survival, risk of revision, or risk of a KOOS – QoL score < 44 at two-year follow-up. |
| Ulstein et al (2017) | Nor | 13 | No negative effect on patient‑reported outcome of concomitant cartilage lesions 5-9 years after ACL reconstruction | To compare PROMs five to nine years after ACLR in patients with and without a concomitant full-thickness (International Cartilage Repair Society grade 3–4) cartilage lesion | KOOS and additional radiograph | N = 89  Patients with a full-thickness cartilage lesion n = 30  Matched controls n = 59 | Mean 6.3 years (range 4.9-9.1) | T-test and Fisher's exact test | ACL reconstruction performed in patients with an isolated concomitant full-thickness cartilage lesion restored patient-reported knee function to the same level as ACL reconstruction performed in patients without concomitant cartilage lesions, five to nine years after surgery. |
| ACLR = Anterior cruciate ligament reconstruction; ADL = activities of daily living; AM = anteromedial; CACLR = contralateral anterior cruciate ligament reconstruction; DB = double-bundle; Den = Denmark; DKRR = Danish knee ligament reconstruction register; EQ-5D = European Quality of Life five dimensions; F = female; HT = hamstring tendon; ICRS = International Cartilage Repair Society; KOOS = Knee injury and Osteoarthritis Outcome Score; LM = lateral meniscus; M = male; n.a = not applicable; MF = microfracture; MM = medial meniscus; NAR = Norwegian Research Center for Active Rehabilitation cohort; NKLR = Norwegian knee ligament register; Nor = Norway; OC = oral contraceptives; PCL = posterior cruciate ligament; PPV = positive predictive value; PT = patellar tendon; PROMS = patient-reported outcome measurement; QoL = Quality of life subscale in KOOS; SB = single-bundle; SNKLR = Swedish national knee ligament register; Swe = Sweden; TT = transtibial | | | | | | | | | |