



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

Title: The Effect of Delaying Anterior Cruciate Ligament Reconstruction More Than 3 or 6 Months on Revision Rates and Knee Stability After 2 Years of Follow-up

Authors: Helena Amstrup Jensen, BSc,
Thorsten Grønbech Nielsen, BSc,
Martin Lind, MD, PhD, Prof.



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

Disclosures:

Helena Amstrup Jensen, BSc:

I have no financial conflicts to disclose



Introduction

- The optimal timing of anterior cruciate ligament reconstruction (ACLR) remains uncertain, and there is no consensus on whether early or delayed surgery provides the best outcome.
- Early surgery has been recommended to decrease the risk of meniscus and cartilage injury (1,2).
- Delayed surgery has been recommended to decrease the risk of stiffness and arthrofibrosis (3,4). However, recent studies have shown no increased risk of stiffness and arthrofibrosis when delaying ACLR (5,6).
- Previous studies have reported a significant increased risk of revision surgery when ACLR was performed early (7,8,9,10,11).
- There is lack of consensus on definition of early and delayed ACLR revision.
- The purpose of this study was to investigate the effect of delaying ACLR past 3 months or 6 months on revision rates and knee stability using data from the DKRR. The tested hypothesis was that surgery within the first 3 months or 6 months of injury increases the risk of revision surgery.



Methods

- Designed as a register-based prospective comparative cohort study.
- Data were obtained using the Danish Knee Ligament Reconstruction Register (DKRR), which is a nationwide, web-based clinical database (12).
- 30.280 patients were included and divided into 4 groups, based on the time from injury to ACLR and compared as follows; < 3 months vs. > 3 months, < 6 months vs. > 6 months
- Primary outcome was ACLR revision, defined as surgical replacement of the primary ACLR graft.
- Secondary outcomes:
 - 1) Objective knee laxity using Rolimeter or KT-1000 arthrometer tests and the pivot shift score as measurements.
 - 2) Subjective knee function using KOOS4 and Tegner activity score as measurements.



Results I

- The total incidence of revision surgery for those with ACLR < 3 months of injury was found to be 6.8% (95% CI: 6.0%–7.5%; P <.001).
- The total incidence of revision surgery for those with ACLR > 3 months after injury was found to be 5.4% (95% CI: 5.2%–5.7%; P < .001).
- Comparing the groups, a significantly increased risk of revision surgery was found for those with ACLR < 3 months of injury.
- The total incidence of revision surgery for those with ACLR < 6 months of injury was found to be 6.7% (95% CI: 6.2%–7.1%; P <.001).
- The total incidence of revision surgery for those with ACLR > 6 months after injury was found to be 4.9% (95% CI: 4.6%–5.2%; P < .001).
- Comparing the groups, the risk of revision surgery was significantly higher when ACLR was performed < 6 months of injury.

Table 1. Risk of revision surgery as hazard ratio and 2-year relative risk

Risk of revision	< 3 months vs. > 3 months	< 6 months vs. > 6 months
Hazard ratio (95% CI)	1.34 (1.18–1.52)	1.47 (1.34–1.62)
Hazard ratio* (95% CI)	1.27 (1.12–1.44)	1.27 (1.15–1.40)
2-year Relative Risk (95% CI)	1.81 (1.46–2.23)	1.61 (1.34–1.92)



*Adjusted for age, sex, activity leading to injury, meniscal damage, cartilage damage, and graft choice

Results II

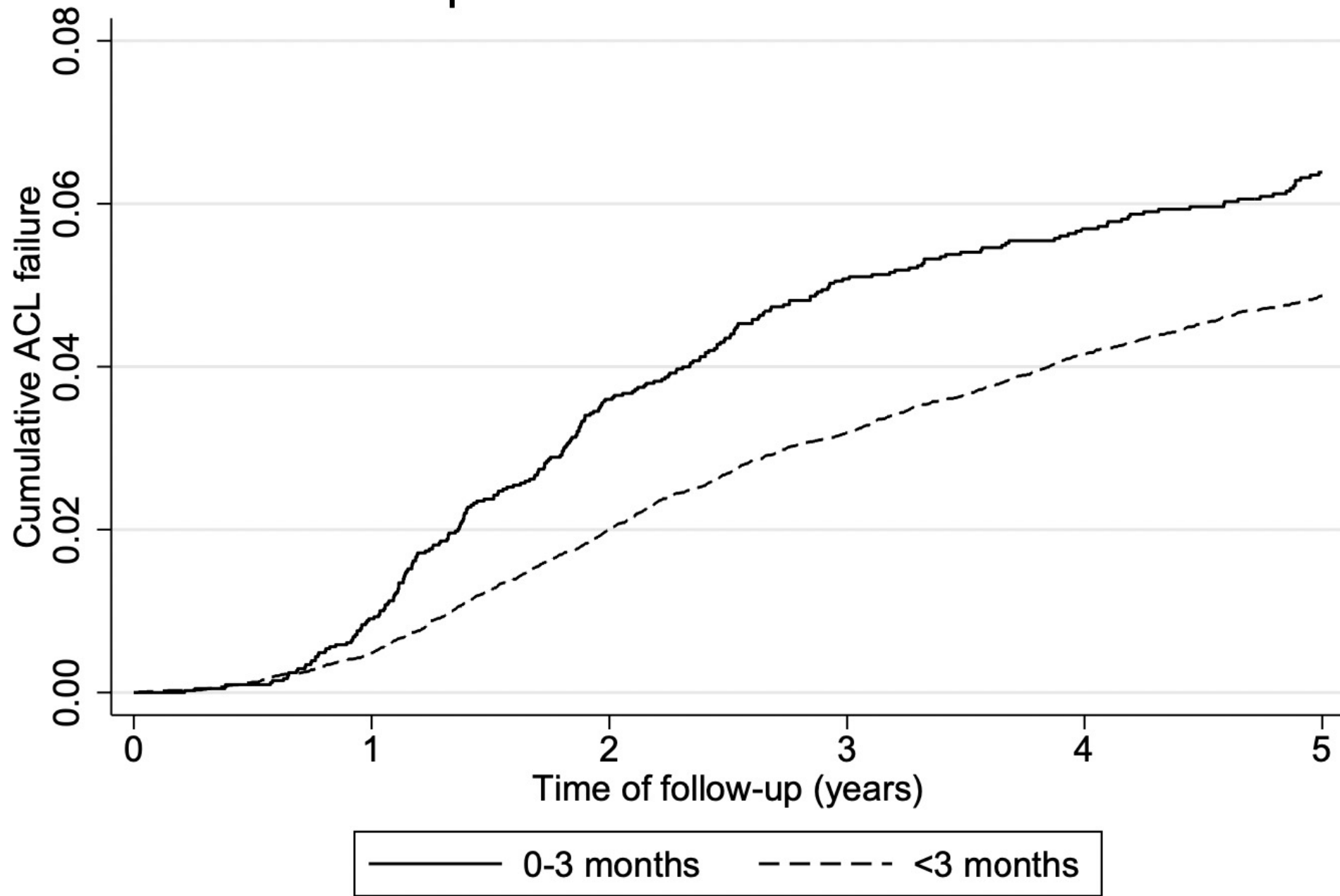
- ACLR < 3 months or < 6 months of injury was found to be associated with a lower objective knee laxity 1-year postoperatively.
- The mean KOOS4 score was found to be 1 point lower for those with ACLR < 3 or < 6 months of injury at 1-year follow-up.
- A significantly higher Tegner activity score was found for those with ACLR < 3 or < 6 months of injury ($p < .001$) at 1-year follow-up.

Table 2. One-year postoperative data on objective knee laxity and subjective outcomes

At 1-year postoperative follow-up	< 3 months n = 2416	> 3 months n = 15,212	P value	< 6 months n = 7317	> 6 months n = 10,311	P value
Instrumented sagittal knee laxity ≤ 2 mm, n (%)	1752 (86.1)	10,670 (82.2)	< .001	5266 (84.1)	7156 (81.8)	< .001
Negative pivot shift test score, n (%)	1979 (85.1)	11,925 (81.1)	< .001	5839 (82.7)	8065 (80.9)	.003
KOOS4, mean \pm SD	69 \pm 17.2	70 \pm 17.4	.063	69 \pm 17.1	70 \pm 17.5	.007
Tegner activity score, mean \pm SD	5.4 \pm 2.1	4.9 \pm 1.9	< .001	5.3 \pm 2.1	4.8 \pm 1.9	< .001



Kaplan–Meier failure estimates

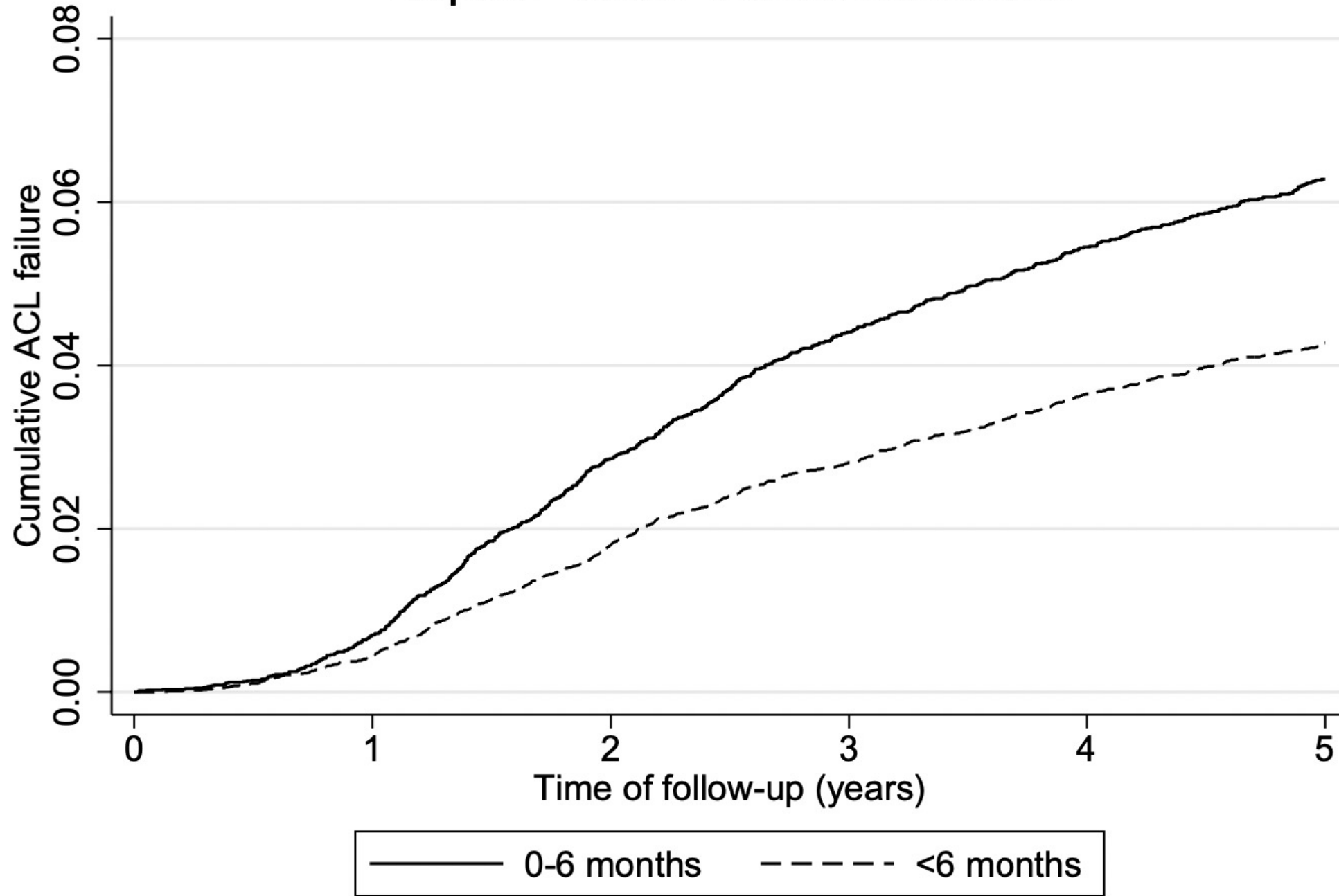


ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

Kaplan–Meier failure estimates



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

Discussion

- The primary finding of this study was an increased risk of revision surgery when ACLR was performed within 3 or 6 months of injury relative to ACLR performed later.
- A reason for early ACLR having a higher risk of revision surgery could be that patients offered early ACLR are often younger, and young age is a known independent risk factor of revision surgery (13).
- In the present study, HT autografts were found to be the most widely used ACLR graft and used significantly more often in those with ACLR < 3 months or < 6 months of injury. More studies have reported that patients having ACLR with HT autografts have a slightly greater risk of revision surgery compared to patients treated with BTB autograft (14,15).
- Those with delayed ACLR might be better physically and psychologically adapted to an injured knee. This study found higher preoperative KOOS4 scores and greater knee laxity at 1-year postoperatively in those patients with ACLR > 3 months or > 6 months after injury, which could indicate a better preoperative rehabilitation level and better coping with the ACL injury in these patients. This might result in a more realistic postoperative activity level, which is reflected by a lower Tegner activity score in those with delayed ACLR (> 3 months or > 6 months) at the 1-year follow-up.
- In the present study, the 1-year postoperative KOOS4 score was found to be 1 point lower in those with early ACLR (< 3 months or < 6 months), The clinical significance is, however, probably low, as the minimal clinically important change in the KOOS scores is considered to be 8–10 points (16).



Strengths and weaknesses

- Large cohort (30.280), exclusively with primary ACLRs and no multiligament procedures.
- Data are collected prospectively and registration of ACLR is independent of registration of a later revision surgery which limits the information bias.
- The completeness of data regarding subjective knee function (30% of patients reported) and objective knee laxity (50% was assessed at 1-year follow-up) was low.
- Using ACLR revision surgery as primary outcome might underestimate the true incidence of ACL graft failure.
- There may be residual confounders, namely, compliance and quality of rehabilitation.



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

Conclusion

The present study found an increased risk of revision ACLR surgery when ACLR was performed within 3 months or 6 months of injury compared to later surgery. 1-year postoperative objective knee laxity was found to be significantly lower in those with early ACLR (< 3 months or < 6 months). Furthermore, subjective patient-related outcome (measured as KOOS4 score) was found to be without a clinically significant difference, however, those with early ACLR (< 3 months or < 6 months) were found to have a higher activity level 1-year postoperatively.



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

References

1. Brambilla L, Pulici L, Carimati G, Quaglia A, Prospero E, Bait C, et al. (2015) Prevalence of Associated Lesions in Anterior Cruciate Ligament Reconstruction: Correlation With Surgical Timing and With Patient Age, Sex, and Body Mass Index. *Am J Sports Med* 43:2966-2973
2. Krutsch W, Zellner J, Baumann F, Pfeifer C, Nerlich M, Angele P (2017) Timing of anterior cruciate ligament reconstruction within the first year after trauma and its influence on treatment of cartilage and meniscus pathology. *Knee Surg Sports Traumatol Arthrosc* 25:418-425
3. Passler JM, Schippinger G, Schweighofer F, Fellingner M, Seibert FJ (1995) [Complications in 283 cruciate ligament replacement operations with free patellar tendon transplantation. Modification by surgical technique and surgery timing]. *Unfallchirurgie* 21:240-246
4. Shelbourne KD, Wilckens JH, Mollabashy A, DeCarlo M (1991) Arthrofibrosis in acute anterior cruciate ligament reconstruction. The effect of timing of reconstruction and rehabilitation. *Am J Sports Med* 19:332-336
5. Berbig R, Rillmann P (2000) [Timing of the surgery of rupture of the anterior cruciate ligament. Effects of acute or delayed surgery on arthrofibrosis rate and work disability]. *Unfallchirurg* 103:726-730
6. Kwok CS, Harrison T, Servant C (2013) The optimal timing for anterior cruciate ligament reconstruction with respect to the risk of postoperative stiffness. *Arthroscopy* 29:556-565
7. Cristiani R, Forssblad M, Edman G, Eriksson K, Stålmán A (2021) Age, time from injury to surgery and quadriceps strength affect the risk of revision surgery after primary ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc* 29:4154-4162
8. Ding DY, Chang RN, Allahabadi S, Coughlan MJ, Prentice HA, Maletis GB (2022) Acute and subacute anterior cruciate ligament reconstructions are associated with a higher risk of revision and reoperation. *Knee Surg Sports Traumatol Arthrosc*;10.1007/s00167-022-06912-9
9. Fältström A, Hägglund M, Magnusson H, Forssblad M, Kvist J (2016) Predictors for additional anterior cruciate ligament reconstruction: data from the Swedish national ACL register. *Knee Surg Sports Traumatol Arthrosc* 24:885-894
10. Rahardja R, Zhu M, Love H, Clatworthy MG, Monk AP, Young SW (2020) Rates of revision and surgeon-reported graft rupture following ACL reconstruction: early results from the New Zealand ACL Registry. *Knee Surg Sports Traumatol Arthrosc* 28:2194-2202
11. Snaebjörnsson T, Hamrin Senorski E, Svantesson E, Westin O, Persson A, Karlsson J, et al. (2019) Graft Fixation and Timing of Surgery Are Predictors of Early Anterior Cruciate Ligament Revision: A Cohort Study from the Swedish and Norwegian Knee Ligament Registries Based on 18,425 Patients. *JB JS Open Access* 4:e0037
12. Lind M, Menhert F, Pedersen AB (2009) The first results from the Danish ACL reconstruction registry: epidemiologic and 2 year follow-up results from 5,818 knee ligament reconstructions. *Knee Surg Sports Traumatol Arthrosc* 17:117-124
13. Wiggins AJ, Grandhi RK, Schneider DK, Stanfield D, Webster KE, Myer GD (2016) Risk of Secondary Injury in Younger Athletes After Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis. *Am J Sports Med* 44:1861-1876
14. Arida C, Tsirikas CG, Mastrokalos DS, Panagopoulos A, Vlamis J, Triantafyllopoulos IK (2021) Comparison of Bone-Patella Tendon-Bone and Four-Strand Hamstring Tendon Grafts for Anterior Cruciate Ligament Reconstruction: A Prospective Study. *Cureus* 13:e19197
15. Samuelsen BT, Webster KE, Johnson NR, Hewett TE, Krych AJ (2017) Hamstring Autograft versus Patellar Tendon Autograft for ACL Reconstruction: Is There a Difference in Graft Failure Rate? A Meta-analysis of 47,613 Patients. *Clin Orthop Relat Res* 475:2459-2468
16. Roos EM, Toksvig-Larsen S (2003) Knee injury and Osteoarthritis Outcome Score (KOOS) - validation and comparison to the WOMAC in total knee replacement. *Health Qual Life Outcomes* 1:17



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18 - June 21