

An early ACL reconstruction is required to prevent additional knee injury: A misconception not supported by high-quality evidence

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It is evident that meniscus injury is associated with increased rates of osteoarthritis and joint replacement surgery, and that preserving the meniscus should be a key priority when managing ACL-injured individuals. A common belief within the orthopaedic community is that early ACL-reconstruction is necessary to prevent additional meniscus and cartilage injury.¹ The studies referenced to support this argument (Table 1) are limited by selection and indication bias. Whilst these studies highlight the importance of managing ACL injury early to preserve joint health, they do not provide evidence that early-reconstruction is superior to 'evidence-based rehabilitation'² in reducing subsequent meniscus or cartilage injury rates. Referenced studies share a similar conclusion; that people who present for early-reconstruction shortly after ACL injury have less meniscus or cartilage damage than those who present for ACL-reconstruction months or years after injury (Table 1). This is not surprising, individuals who are chronically ACL-deficient may have been incorrectly diagnosed or exposed themselves to sport or other high-risk activities for months or years, without undertaking appropriate rehabilitation. Importantly, studies that found more meniscus or cartilage damage in patients presenting for a delayed-reconstruction (following unknown treatment/no treatment) compared with patients presenting for an early-reconstruction, *should not* be used to justify recommending early ACL reconstruction over management of an acute ACL injury with evidence-based rehabilitation.

Randomised controlled trials (RCTs) are required to compare rates of subsequent injury between ACL management strategies. These studies should assess all patients for concomitant injuries *prior to* commencing either treatment strategy and the rehabilitation received should commence early after ACL injury and be high quality, evidence-based rehabilitation. A recent review found that only 1 of 412 ACL RCTs compared ACL-reconstruction with structured rehabilitation for acute ACL injury.³ The KANON Trial, is a high-quality RCT that compared outcomes following early-reconstruction plus exercise therapy, or exercise therapy plus optional delayed-reconstruction if required and/or desired.² The KANON trial found no differences in activity levels, patient-reported outcomes or radiographic joint changes at two- and five-year follow-up between randomised groups and as-treated groups (early-reconstruction vs. exercise therapy alone vs. delayed-reconstruction).² Additionally, the proportion of people receiving meniscus surgery within five-years of ACL injury was similar between groups.^{2,4} On further analysis, we found that

baseline meniscus and cartilage injury was only related to poor five-year outcome (poor knee function and quality of life) for individuals randomised to early-reconstruction, and that commencing exercise therapy before considering ACL-reconstruction may be advantageous for these patients.⁵ Additionally, early-reconstruction predicted more knee symptoms at five-years compared with management with rehabilitation alone, and poor baseline knee scores were only related to poor five-year outcome for individuals who underwent early ACL-reconstruction.⁵ Further evidence that commencing evidence-based rehabilitation before considering ACL-reconstruction does not have negative impacts on outcome can be drawn from studies showing superior postoperative knee scores and function in patients who perform prehabilitation prior to undergoing ACL reconstruction.^{6,7}

We know that rates of subsequent knee injury are high following ACL reconstruction. One out of every three young people who undergo ACL reconstruction suffer a second ACL injury⁸ and 27% suffer a third ACL injury within 9 years of revision ACL-reconstruction.⁹ As many as 90% of individuals will damage the meniscus or cartilage at the time of ACL graft-rupture.¹⁰ Additionally, the risk of meniscus surgery remains higher for the ACL-reconstructed knee compared with the contralateral knee, even in individuals who do not rupture their ACL graft.¹¹ Research over a 10-year period found that ACL-reconstructed individuals experienced more second ACL injuries than those who elected to undergo non-operative management.¹² This remained the case when graft-ruptures were excluded from the analysis, highlighting that ACL-reconstructed individuals were at greater risk of contralateral ACL injury than their non-operatively managed counterparts. Grindem et al. (2014) found a greater proportion of ACL-reconstructed individuals reinjured their knee within 2 years of ACL rupture (24%) compared with patients managed with physiotherapist-supervised rehabilitation (9%).¹³ After adjusting for rates of return to pivoting-sports, there were no differences in subsequent knee injury rates between ACL-treatment groups, suggesting that the observed difference was largely explained by the higher rate of return to sport in ACL-reconstructed patients.

Returning to pivoting-sport is not the only modifiable factor associated with an increased risk of subsequent knee injury after ACL reconstruction. Fear of re-injury, suboptimal knee function prior to returning to sport, and returning to sport within 9 months of ACL-reconstruction, have been associated with increased odds of sustaining a subsequent knee injury.^{14, 15, 16} This highlights that there are other factors to consider, aside from selecting an operative or non-operative ACL-management strategy, to reduce the likelihood of further knee injury. Individuals who do not participate in pivoting sports after ACL injury will reduce their risk of subsequent knee injury, highlighting the importance of educating the patient to enable them to make an informed decision regarding activity choices. If an individual decides to return to pivoting-sport, ensuring they are both psychologically and physically ready can reduce the risk of subsequent knee injury. These modifiable factors associated with an increased risk of subsequent injury should be targeted after ACL injury, irrespective of ACL-management strategy.

There is no high-quality evidence to suggest rates of subsequent knee injury are higher following management with evidence-based rehabilitation compared with early ACL-reconstruction. It is critical that clinical recommendations are based on appropriate evidence, derived from studies using an appropriate study design and statistical analysis to address the study question. Retrospective observational studies showing more joint injury at the time of delayed ACL-reconstruction (following unknown treatment/no treatment) should not be used to justify favouring early-reconstruction over management with evidence-based rehabilitation. Rather, evidence supports the importance of managing an ACL rupture as soon as possible following injury to prevent further knee damage and subsequent osteoarthritis. To minimise the likelihood of subsequent injury, and thereby improve long-term outcome and reduce osteoarthritis risk, clinicians should educate patients regarding activity modification, and optimise psychological readiness and physical function before returning to sport, irrespective of ACL-management strategy. The high rates of second and third ACL injuries following ACL-reconstruction are concerning, as are the implications for long-term joint health for these individuals. This risk should be discussed with patients when informing them of the evidence surrounding ACL management options.

Table 1. Studies commonly referenced to support the belief that an early-ACL reconstruction is required to reduce the likelihood of subsequent knee injury

Study	Sample	Management between ACL injury and ACLR	Appropriateness of study design to inform ACL management choice	Statistical analysis	Authors' interpretation of findings
Karikis et al. 2018 [1]	Patients undergoing ACLR	Unknown	Inappropriate	Chi-square or Fisher's exact test, no adjustment for confounding	Patients who underwent ACLR 2-4 months after injury required fewer meniscectomies at the time of ACLR and had less OA at 10-year follow-up compared with those who underwent ACLR 24-48 months after injury. The authors suggest that ACLR should be performed before concomitant lesions occur.
Sanders et al. 2016 [2]	Review of surgical records	Unknown	Inappropriate	Cox proportional hazards regression, no adjustment for confounding	ACLR <12 months after injury reduced the risk of subsequent meniscal tears and OA compared with ACLR >12 months after injury. The authors concluded that ACLR has a lower risk of secondary meniscal tears, OA and TKA compared to non-operative treatment.
De Campos et al. 2016 [3]	Review of surgical records	Unknown	Inappropriate	Chi-square or Fisher's exact test and logistic regression, no adjustment for confounding	Associated injuries are more common if ACLR is delayed by ≥6 months (medial meniscus lesion) and ≥1 year (cartilage or meniscal lesion). High-quality evidence based data such as randomised controlled trials are needed.
Ralles et al. 2015 [4]	Review of surgical records	Unknown	Inappropriate	Chi-square test and linear regression, no adjustment for confounding	Increasing time from injury to ACLR was associated with increased incidence of cartilage and medial meniscus injury. Subject to selection bias; individuals that had delayed ACLR had probably failed non-operative treatment, whereas those successfully managed non-operatively were not included in the study.
Krutsch et al. 2015 [5]	Review of ACLR registry	Unknown	Inappropriate	Chi-square or Fisher's exact test, no adjustment for confounding	Due to the higher rate of surgically repairable meniscal injury in patients having ACLR <6 months after injury, authors recommend having ACLR <6 months after injury to preserve the meniscus and reduce the risk of developing OA.
Sri-Ram et al. 2013 [6]	Patients undergoing ACLR	Unknown	Inappropriate	Logistic regression, no adjustment for confounding	The chances of requiring medial meniscal surgery was increased by a factor of two if ACLR was delayed >5 months, and increased by a factor of 6 if delayed >12 months. The authors conclude that ideally, ACLR should not be delayed >5 months from injury. Notably, patients treated conservatively were excluded from the study.
Fok & Yau 2013 [7]	Patients undergoing ACLR	Unknown	Inappropriate	Student's t-test and logistic regression, no	ACLR ≤12 months after injury was associated with more meniscus and cartilage injury and the meniscus was less likely to be salvageable. Authors recommend informing patients that ACLR delay is associated with increased joint injury. Biases

				adjustment for confounding	acknowledged include the exclusion of patients managed non-operatively and no information on what patients were doing between injury and ACLR.
Anstey et al. 2012 [8]	Review of surgical records	Unknown	Inappropriate	Fisher's exact test, no adjustment for confounding	A delay in the timing of ACLR >6 months following injury is associated with an increase in the prevalence of medial meniscal tears. The authors highlight the need for a randomised controlled trial to evaluate the degree of joint injury relative to timing of ACLR.
Chhadia et al. 2011 [9]	Review of ACLR registry	Unknown	Inappropriate	Chi-square or Fisher's exact test, logistic regression adjusted for age and gender	Increased risk of medial meniscus and cartilage injury and a decreased meniscal repair rate were strongly associated with increased ACLR delay. Patients who elected to undergo non-operative treatment were excluded from the study resulting in selection bias.
Kennedy et al. 2010 [10]	Review of surgical records	Unknown	Inappropriate	Chi-square test, Mantel-Haenszel method adjusted for age	Higher chance of medial meniscus injury with ACLR delay >12 months; degenerative changes were more common with ACLR delay >6 months; the authors recommend that ACLR be performed within 12 months of injury.
Granan et al. 2009 [11]	Review of ACLR registry	Unknown	Inappropriate	Logistic regression, adjusted for age, sex, prior knee surgery, current ligament injury, meniscal/cartilage lesions	Early ACLR was associated with fewer meniscal tears and cartilage injuries; however, some patients may benefit from prehabilitation or management with rehabilitation.
Keene et al. 1993 [12]	Review of surgical records	Unknown	Inappropriate	Chi-square test	The incidence of meniscus injury increased with a greater ACLR delay and meniscal tears became more complex and less amendable; the authors recommend surgery be considered early.

OA: osteoarthritis; ACLR: anterior cruciate ligament reconstruction; TKA: total knee arthroplasty;

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