Return to Sports After ACL Reconstruction Surgery: A Risk for Further Joint Injury?

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Markus Waldén

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16.1 Introduction

Anterior cruciate ligament (ACL) tear constitutes a serious problem in many sports regardless of sex or playing level. Reconstruction of the ACL is therefore a common procedure in this patient group, and although not supported by sound evidence, most knee surgeons typically advocate a layoff from sports of around 6 months following ACL reconstruction [12]. It has been argued that too little attention is paid to the risks of reinjury and other subsequent knee injuries with early development of osteoarthritis (OA) when advising the athlete on whether to return to sports or not after the index injury [15]. The present review therefore describes the return to sports success rate after ACL reconstruction, in particular for team sports, and discusses the potential risk for further joint injury after return to sports from an evidence-based perspective.

16.2 Return to Sports as an Outcome Measure

The return to sports rate is sometimes used as a measure of successful outcome after ACL reconstruction. There are, however, some limitations to consider when using return to sports as an outcome measure. First, what does return to sports mean; is it return to partial training, full training, or to competition? Return to competition might not be an ideal definition since this depends on many nonmedical factors such as length and

M. Waldén, M.D., Ph.D.
Department of Medical and Health Sciences,
Linköping University, Linköping 581 83, Sweden
e-mail: markus.walden@telia.com

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Table 16.1 Sport-specific studies reporting return to sports success rates after anterior cruciate ligament reconstruction surgery in high-level team sports

Study	Study type	Inclusion period	No. of players	Sport	Return rate
Busfield et al. [3]	Case series (evidence level IV)	10 years (1994–2005)[a]	27 males	Basketball	21/27 (78 %)
Fabbriciani et al. [6]	Case series (evidence level IV)	1 year (1997–1998)	18 males	Rugby	18/18 (100 %)
Myklebust et al. [16]	Cohort study (evidence level II)	2 years (1989–1991)	57 females	Team handball	50/57 (88 %)
Shah et al. [22]	Case series (evidence level IV)	5 years (2001–2006)	49 males	American football	31/49 (63 %)
Waldén et al. [27]	Cohort study (evidence level II)	9 years (2001–2009) 6 years (2004–2009)	57 males 14 females	Football	57/57 (100 %) 12/14 (86 %)

[a]1998–1999 was not included

period of season, frequency of matches or other competitions, confidence of the coach, etc. In addition, some athletes are exercising only on a recreational basis without competing at all. Second, even if return to competitive sports is possible after an ACL tear, the athlete might not be able to compete at the same level as prior to injury, a factor that is often not taken into account [2]. Third, given the variability in the functional demands put on the knee joint in different sports, all athletes are not equally dependent on their ACLs to perform well within their sport. For example, a footballer, golfer, cyclist, and sprinter could cope differently with their injuries, and it might be easier to return to bicycling or jogging than to pivoting sports [28]. Fourth, the assessment of time to return can differ between studies, and the ideal cutoff threshold for reporting return to sports is not known. In one recent study on male elite footballers, the majority of those returning to play after ACL tears did so within the first year after surgery [27]. In contrast, only one-third of competitive team sport athletes had returned to competitive sports 12 months after surgery in another recent study [1]. Fifth, ACL-injured athletes rarely have completely symptom-free knees, for example, as seen by low average scores in the knee injury and osteoarthritis outcome score (KOOS) for function in sport and recreation or knee-related quality of life, in spite of being able to participate in their sport [9]. Sixth, one ACL tear is not identical to another ACL tear, and only a minority of ACL tears can be considered as "isolated" [11]. Hence, there are often concomitant ligament, meniscus, or cartilage injuries that may interfere with the ability to return to sports after an ACL tear [3]. Finally, professional athletes who make a lot of money from their sport will have another incentive to return to sports than recreational or amateur athletes. Consequently, the overall financial situation must be put into perspective when comparing return to sport success rates between different sports or between different settings within the same sport.

Nevertheless, a recent systematic review of 48 studies reporting return to sports outcomes after ACL reconstruction showed from pooled meta-analysis that 82 % in a general athletic population were able to participate in sports, while only 63 % could return to preinjury level [2]. In addition to the studies included in that review, a few more studies reporting sport-specific outcomes after ACL reconstruction can be found in the literature (Table 16.1). In these studies, all conducted on collision or contact team sports with a follow-up of at least 1 year after surgery, the return to sports success rates were varying (63–100 %) [3, 6, 16, 22, 27].

16.3 Subsequent ACL Injury

As for many other sports injuries, a history of previous ACL tear is associated with substantial risk of future ipsilateral or contralateral ACL tear [7, 19]. In a study on male Australian Rules

Table 16.2 Patient studies reporting new ipsilateral and contralateral tears after anterior cruciate ligament reconstruction surgery

Study	Study type	Inclusion period	Follow-up (years)	No. of patients	New tears
Hui et al. [11][a]	Case series (evidence level IV)	1993–1994	15	90	Ipsilateral: 7/90 (7.8 %) Contralateral: 22/90 (24.4 %)
Salmon et al. [21][a]	Case series (evidence level IV)	1993–1994	5	612	Ipsilateral: 39/612 (6.4 %) Contralateral: 35/612 (5.7 %)
Shelbourne et al. [23]	Cohort study (evidence level II)	1992–2001	≥5	1,415	Ipsilateral: 61/1,415 (4.3 %) Contralateral: 75/1,415 (5.3 %)
Wright et al. [29]	Cohort study (evidence level II)	2002	2	235	Ipsilateral: 7/235 (3.0 %) Contralateral: 7/235 (3.0 %)

[a]These two studies are reporting on the same patient series, but only "isolated" tears are included in the study by Hui et al. [11]

footballers between 1992 and 1999, 63 players with noncontact ACL tears treated with ACL reconstruction were studied for different intrinsic and extrinsic risk factors [19]. The strongest risk factor for a new ACL tear was previous ACL tear with around 11 times higher risk within the previous year after ACL reconstruction and around 4 times higher risk if the reconstruction occurred prior to the previous 12 months. In another study on 143 female elite footballers in Germany during 2003–2004, a fivefold increased risk of a new ACL tear was found among the 19 players who had a history of previous ACL tear [7]. Importantly, these two studies suggest that the first year after ACL reconstruction is of particular concern regarding the risk of incurring ipsilateral reinjury, whereas contralateral tears are rare within the first year. The influence of aggressive rehabilitation and early return to sports on the risk of reinjuring the ACL is far from completely understood, but there are some new data from a questionnaire follow-up 3–4 years after ACL reconstruction showing that return to competition within 7 months following ACL reconstruction was associated with a significantly higher reinjury risk than return later than 7 months (15.3 % vs. 5.2 %) [13].

The risk of incurring subsequent ACL tear has also been studied in different patient cohorts (not only including athletes) that have undergone ACL reconstruction [11, 21, 23, 29]. Taken together, the annual rate of further ACL injury seems to be around 1 % each in rough terms for both ipsilateral and contralateral tears up to 5 years after index ACL reconstruction (Table 16.2). This trend was verified in a recent systematic review including six other studies than those listed in Table 16.2, where it also was shown that the rate of contralateral ACL tear diverges from the retear rate after around 5 years [30]. Further support of a higher overall rate of contralateral tear than ipsilateral tear was also found in another recent systematic review including eight further studies [24]. In addition, the risk of incurring a subsequent ACL tear seems to be strongly associated with age lower than 18 years at the index tear. One of the studies has reported a sevenfold higher risk of contralateral tear [11], and another study found around 3.5 times higher risk of ipsilateral or contralateral tear [23]. The other important risk factor for incurring a contralateral tear after unilateral ACL tear seems to be return to high-level activity [21, 24], whereas female sex does not seem to be of similar importance as for index ACL injuries [24].

16.4 Secondary Meniscal or Cartilage Damage

Associated meniscal tears and joint cartilage lesions are very common findings at ACL reconstruction surgery, and the occurrence of these concomitant injuries increases with time elapsed from ACL tear to ligament surgery [8]. Similarly, it is well known that ACL reconstruction in

general is protective against new meniscal and cartilage injuries compared to nonoperative treatment [4]. However, it is unclear from the literature to what extent return to sports after ACL reconstruction per se leads to subsequent meniscal or cartilage lesions and possibly further knee surgery. In a prospective one-season study on male elite footballers, players with previous ACL injury had a threefold higher rate of new traumatic knee injury compared to players without history of an ACL tear [26]. Most of the traumatic knee injuries recorded were, however, sprains involving the joint capsule or ligaments, and only a few meniscal and cartilage injuries were identified. The main limitation of that study was that the rate of subsequent meniscal tears and cartilage lesions during the remaining player career is unknown since only one season was studied. Still, it is a worrying scenario that return to sports following ACL reconstruction might expose the athlete to subsequent knee injury leading to a vicious circle of repeated traumas and surgeries with accelerated knee joint degeneration in the long term.

16.5 Long-Term Consequences

ACL injury is without doubt associated with development of premature OA in the knee joint of former team sport athletes [16, 25], even if the figures vary because of differences in study design, follow-up period, and radiological classifications used [14, 18]. The development of OA after ACL injury is far from completely understood and is both complex and multifactorial [14]. Associated injuries, such as meniscus lesions, increase the frequency of radiological OA compared to "isolated" ACL injuries [17, 18]. However, the role of the bone marrow edema seen on magnetic resonance imaging (MRI) in almost all typical acute ACL injuries is so far not clear [14]. To date, ACL reconstruction has not been found to be protective against OA [14], and return to high-level sports or other knee-demanding activities after ACL reconstruction might even result in a higher rate of OA development compared to nonoperatively treated ACL injuries given advice on activity modification [17]. Consequently, based on the high rates of subsequent knee injury and OA after ACL injury, it has been questioned whether return to high-level pivoting sports is in the athlete's best interest if long-term knee health is the primary concern [5, 15].

16.6 Summary Statement

An ACL tear usually causes long layoff from sport, and return to sports is often used as a measure of successful outcome after ACL reconstruction. Recent studies on different team sports have shown between 63 and 100 % return to sports rates. However, return to sports following ACL reconstruction is not uncomplicated and is associated with a high risk of incurring a new ipsilateral or contralateral ACL tear as well as other knee injuries. There is also a considerable risk of developing premature OA after an ACL tear. More attention should therefore be paid to the risks of reinjury or other subsequent knee injuries as well as early development of OA when giving the athlete advice on return to sports after ACL tear.

16.7 Future Research

There is an urgent need for more research evaluating the risk for further joint injury after return to sports following ACL reconstruction. First, it would be of great interest for all the different sports medicine practitioners involved in the treatment of ACL tears to know more when (and if) to safely allow return to different sports. In this respect, it could be valuable to identify athletes who are able to return to sports without suffering any new knee injuries and to study the underlying (success) factors among these athletes. Moreover, it is nowadays common (or even mandatory) to obtain baseline data on anthropometrics, physical examination, psychological questionnaires, radiological imaging, etc., for injury-free athletes as a part of the preseason medical assessment in many high-level sports. These data should ideally be available for

researchers in future studies on return to sports after ACL tear to be able to evaluate any persisting deficits compared to baseline values in a larger study sample. Second, the influence of accelerated rehabilitation and early return to sports on the reinjury risk should be studied further since some recent evidence exists that return to competition within 7 months following ACL reconstruction is associated with a higher risk of ipsilateral graft tear. Similarly, more studies are needed to validate the different sport-specific tests used at the end of the rehabilitation to determine readiness to return to sports. A good example of such research is a recent study that followed athletes with reconstruction surgery for an index ACL tear prospectively for 12 months after having tested them biomechanically at the release to return to sports [20]. Hopefully this can end up with some form of consensus guidelines on how to test and medically clear athletes before allowing them to return to sports [15]. Third, as for all injuries, the best "treatment" of ACL tear is without doubt prevention. This area of research should have a high priority in the future, since there is a lack of adequately sized high-quality randomized controlled trials with ACL injury as the primary outcome [10].

16.8 Take-Home Messages

- Recent studies on common team sports have reported return to sports success rates between 63 and 100 % following ACL reconstruction surgery (evidence levels II and IV).
- The risk of incurring new ipsilateral or contralateral ACL tears is increased severalfold after return to sports following ACL tear in team sports compared to noninjured athletes (evidence level II). This risk increase is highest within the first year after surgery for ipsilateral graft retears (evidence level II), whereas it increases with time for contralateral tears (evidence levels II and IV).
- There is a substantial risk of developing premature OA after ACL tear, in particular for tears with associated intra-articular lesions such as meniscal tears (evidence level II).
- More attention should be paid to the risks of reinjury or other subsequent knee injuries as well as early development of OA when advising the athlete on whether to return to sports after ACL tear, in particular for the young athlete with a first-time injury or an athlete suffering a second ACL tear.

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