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Original article

WHEN RETURN TO SPORT ATHLETES AFTER THE ANTERIOR CRUCIATE LIGAMENT (ACL) INJURY?

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Abstract

Aim. Anterior cruciate ligament (ACL) tears represent a public health challenge (Wilk, 2015) with an incidence reported as 60–71 per 100 000 subjects (Parkkari, et al, 2008; Nordenvall, et al, 2012).

ACL tears often give rise to problems like post-traumatic osteoarthritis, which could lead to middle-term and long-term problems for the patient.

The anterior cruciate ligament is the most commonly disrupted ligament in the knee in high-performance athletes. An athlete's intention to return to sport following anterior cruciate ligament (ACL) injury is a major indication for surgical intervention

Return to sports after ACL reconstruction is a big challenge for the athlete and for the physical therapist. The most frequent questions of the athlete are: When I return to the field? I will be able to play again? Is it safe to return or i will injury again?

When an athlete is injured today, it is expected that arthroscopic surgery will take place a few weeks after injury, that rehabilitation is started immediately, and that the patient is able to return to sport in four to nine months or even sooner (Myklebust, Bahr, 2005).

Recent study showed that psychological readiness to return to sport, patient expectations, and locus of control predicted returning to sport by 12 months (Arderm et al, 2013)

The surgery is recommended to help injured athletes return to their sports career.

When the anterior cruciate ligament (ACL) is injured, ACL reconstruction is usually considered the gold standard of treatment, especially in active young patients (Zaffagnini, Grassi, Serra, Marcacci, 2015).

In order to participate in cutting and pivoting sports a stable knee is required, this usually means having an intact ACL. Damage to the ACL is a serious injury resulting in instability and poor function of the knee.

The purpose of this review is therefore to present all the issues that should be taken into account before allowing an athlete to return to unrestricted activity and the factors that could affect the return to sport outcome.

Conclusions. When an athlete is injured today, it is expected that arthroscopic surgery will take place a few weeks after injury, that rehabilitation is started immediately, and that the patient is able to return to sport in four to nine months or even sooner.

Keywords: anterior cruciate ligament, surgery, rehabilitation, athlete

Introduction

It is possible that the knowledge of these details may help the surgeon and the physical therapist to optimize the results and to avoid possible failures, although there are still no universal criteria for the resumption of sport.

Participation in sport and recreational activity is complex and multifactorial; and there may be individual differences in the factors that impact on returning to participation in the pre-injury activity following ACL reconstruction. Therefore, taking account of a range of psychological and contextual factors may improve our understanding of what influences returning to the pre-injury activity, and help direct rehabilitation interventions aimed at

improving the return to pre-injury sport and recreational activity rate.

The decision to allow an athlete to return to sport should be based first of all on a series of intrinsic factors, that depend exclusively on the patient himself such as genetics, lesion type, anatomical features, rehabilitation protocols, motivation, psychological attitude and extrinsic factors type of graft, surgical technique, rehabilitation phases, biological support (Zaffagnini et. al, 2015).

The cartilage lesions, are a fundamental variable in the final return to sport decision, as even isolated cartilage procedures need a longer recovery time compared with ACL reconstruction, i.e. about 8–12 months even in competitive athletes submitted

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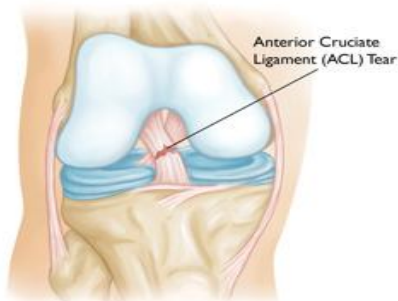
to aggressive rehabilitation (Kon et al 2011; Della Villa et al, 2010).

Meniscal deficiencies should be considered, in order to identify patients with higher laxity and a potential risk of failure (Zaffagnini et. al, 2015).

Medial meniscus deficiency is responsible for increased stress on the ACL during AP tibial translation (Spang et al, 2010), while lateral meniscal deficiency is responsible for increased rotational laxity during the pivot-shift manoeuvre (Musahl et al, 2010).

Anatomical features, can potentially affect outcomes (Zaffagnini et. al, 2015).

The knee alignment, varus deformity has been demonstrated to increase tension on the ACL (Van de Pol et al, 2009).



Organise and compliance the rehabilitation protocol

If the athlete's return to training is performed as a result of surgery or not, the role of the physiotherapist is essential.

Organise rehabilitation protocol with addressability to the specifics practiced sport is necessary. Each athlete is unique and therefore generalisation of rehabilitation protocols could lead to unsatisfactory outcomes.

Motivation and psychological attitude

Sport returners had significantly higher self-trust levels than those who did not return to sports, without observable differences in knee stability or time since surgery.

Psychological factors have been significantly associated with various aspects of ACL reconstruction recovery. Return to sport has been a marker of surgical success after ACL reconstruction, particularly in high-level athletes (Melissa et al, 2016).

It is intuitive that psychological factors would play an important role in recovery after ACL reconstruction; however, few studies have sought to correlate psychological factors with objective clinical data, functional performance, and patient-oriented outcomes (Melissa et al, 2016).

Fear of reinjury is the most commonly cited reason among athletes for not returning to sport after ACL reconstruction (Arderm et al, 2011; McCullough et al, 2012)

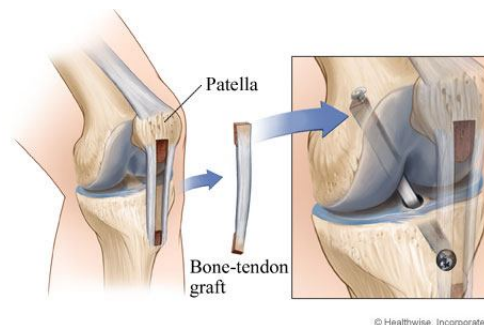
Type of graft

There is no ideal graft, as each graft has advantages and disadvantages. One of the crucial aspects to consider in relation to the graft is its maturation. (Zaffagnini et. al, 2015).

Maturation is a slow process that can even take longer than two years (Zaffagnini et. al, 2007; Zaffagnini et. al, 2010), and must be sure that it is complete before allowing activities that could stress an incompletely remodelled graft (Zaffagnini et. al, 2015).

It is in fact well known from histological studies that autografts like bone-patellar tendon-bone (BPTB) grafts and hamstring grafts show quite rapid healing compared with allografts (Zaffagnini et al, 2007; Zaffagnini et al, 2010; Malinin et al, 2002).

Another systematic review did not report noticeable differences in time to return to sport based on the type of graft, with most of the studies reporting values of 6–9 months (Barber-Westin, Noyes, 2011).



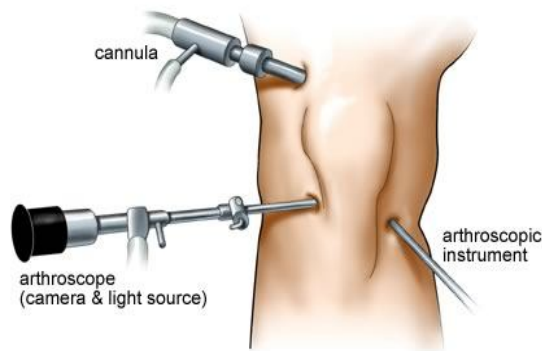
Surgical technique

There are controversies to identify the technique showing the best performance, when sports activity is considered.

To consider an ACLR successful, the patient should be able to return to the same level of sporting activity as before the injury (Lynch, Logerstedt, Grindem, et al., 2015).

From an impairment perspective, patients recover physical function well after surgery (Arderm et al, 2011).

Dejour et al. (2013) showed that lateral plasty had no effect on the return to sport rate, while Zaffagnini et al. (2006, 2011) reported better results for lateral plasty compared with isolated single-bundle reconstruction.



Biological support

When a patient presents with knee instability following ligament reconstruction and there is no history of a new trauma or identifiable technical error, biological failure should be considered (Ménétrety et al, 2008)

Rehabilitation phases

A variety of exercises and protocols exist in the literature; however, there are specific concepts that must be emphasized to achieve a successful outcome.

For athletes to return to competition, they must regain muscular strength and neuromuscular control in their injured leg while maintaining static stability (Negrea, 2016).

Incomplete rehabilitation and rushing back to sport can result in additional knee injuries and graft rupture. In addition to the physical recovery after an ACL reconstruction there are psychological factors that can affect an athlete's readiness to return to sport as well.

Dejour et al, (2013) showed that lateral plasty had no effect on the return to sport rate, while Zaffagnini et al (2006, 2011) reported better results for lateral plasty compared with isolated single-bundle reconstruction.

The goals of rehabilitation of the ACL-injured knee:

- gain good functional stability;
- the quadriceps and hamstring musculature must be strengthened to achieve muscular balance in the affected extremity;
- neuromuscular training and proprioception aid in returning athletes to a high performance;
- progression through a protocol using distinct phases allows for a complete rehabilitation while reducing the risk of reinjury.

Some factors that can affect rehabilitation after reconstructive ACL surgery include concomitant

injuries, timing of surgery, graft selection, concomitant surgeries, quality of rehabilitation, and the goals and desire of the athlete.

Return to sport, after ACL without surgical reconstruction

Although studies suggest that some individuals can return to sport without surgical reconstruction and adequate rehabilitation, the majority of patients continue to have knee instability requiring ACL reconstruction. Sports participation with an unstable knee can lead to further injuries to the cartilage and the meniscus tissues, increasing the risk of future arthritis.

Returning to pivoting sport without a reconstruction results in considerable risk of injury to the meniscus and cartilage (Myklebust, Bahr, 2005).

The return rate varies from 19% to 82% (Myklebust, Bahr, Engebretsen, et al., 2003; Roos, Ornell, Gardsell, et al., 2005).

The athletes who successfully return to sport after non-operative treatment probably represent a selected group with functionally stable knees and a strong motivation to continue pivoting sport despite their injury (Eastlack ME., et al, 1999).

Return to sport after ACL surgery

The decision regarding a return to sport is based on time to allow the graft to mature, functional status of the patient, and the psychological readiness to return to the sport and participate.

The conclusions of the meta-analysis (Arden, Webster, Taylor, et al 2011) that included 48 studies and evaluating 5770 participants at a mean follow-up of 41.5 months showed the following data:

- 82% of participants had returned to some kind of sports participation;
- 63% had returned to their preinjury level of participation;
- 44% had returned to competitive sport at final follow-up.
- 90% of participants achieved normal or nearly normal knee function when assessed postoperatively using impairment-based outcomes such as laxity and strength;
- 85% when using activity-based outcomes such as the International Knee Documentation Committee knee evaluation form.

The relatively low rate of return to competitive sport despite the high rates of successful outcome in terms of knee impairment-based function suggests that other factors such as psychological factors may be contributing to return-to-sport outcomes (Arden, Webster, Taylor, et al 2011).



Most studies deal with ACL reconstructed patients, and the results vary between studies with a range from 8% to 82%.

A number short of studies confirm that most patients (65–88%) are able to return to sport within the first year (Feller, 2003; Corry, Webb, Clingeffer, 1999).

Reinjury rate after surgery

Only few studies have examined reinjury risk, and they report a wide range of re-rupture rates ranging from 2.3% to 13% (Sandberg, Balkfors, 1988; Bak et al 1997).

The highest ACL re-rupture risk (13%) was found by Myklebust et al, (2003) in their study of team handball players.

Most evidence suggests waiting a minimum of 6-9 months before resuming pre-injury sports.

Recent evidence reported a 50% reduction in risk of knee re-injuries (all injuries, not only ACL) for each month that a return to sport is delayed beyond 6 months up to 9 months (Grindem, et al, 2016; Kyritsis, et al, 2016).

Conclusions

When an athlete is injured today, it is expected that arthroscopic surgery will take place a few weeks after injury, that rehabilitation is started immediately, and that the patient is able to return to sport in four to nine months or even sooner.

The quadriceps and hamstring musculature must be strengthened to achieve muscular balance in the affected extremity.

Neuromuscular training and proprioception aid in returning athletes to a high performance

Sports participation with an unstable knee can lead to further injuries to the cartilage and the meniscus tissues, increasing the risk of future arthritis.

The athletes who successfully return to sport after non-operative treatment probably represent a selected group with functionally stable knees and a strong motivation to continue pivoting sport despite their injury.

When the anterior cruciate ligament (ACL) is injured, ACL reconstruction is usually considered the gold standard of treatment, especially in active young patients.

Incomplete rehabilitation and rushing back to sport can result in additional knee injuries and graft rupture.

It is intuitive that psychological factors would play an important role in recovery after ACL

reconstruction. Fear of reinjury is the most commonly cited reason among athletes for not returning to sport after ACL reconstruction.

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References

- Ardern CL, Webster KE, Taylor NF, Feller JA, 2011, Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis of the state of play. *Br J Sports Med.* 45:596–606. Crossref, Medline
- Ardern CL, Taylor NF, Feller JA, et al., 2012, Return to sport outcomes at 2 to 7 years following anterior cruciate ligament reconstruction surgery. *Am J Sports Med.*;40:41-8.
- Ardern CL, Taylor NF, Feller JA, Whitehead TS, Webster KE, 2013, Psychological responses matter in returning to preinjury level of sport after anterior cruciate ligament reconstruction surgery. *Am J Sports Med.*;41:1549-1558.
- Bak K, Scavenius M, Hansen S, et al., 1997, Isolated partial rupture of the anterior cruciate ligament. Long-term follow-up of 56 cases. *Knee Surg Sports Traumatol Arthrosc*;5:66–71.
- Barber-Westin SD, Noyes FR, 2011, Factors used to determine return to unrestricted sports activities after anterior cruciate ligament reconstruction. *Arthroscopy*; 27:1697–1705. [PubMed]
- Corry IS, Webb JM, Clingeffer AJ, et al., 1999, Arthroscopic reconstruction of the anterior cruciate ligament. A comparison of patellar tendon autograft and four-strand hamstring tendon autograft. *Am J Sports Med* ;27:444–54.
- Della Villa S, Kon E, Filardo G, Ricci M, Vincentelli F, Delcogliano M, Marcacci M, 2010, Does intensive rehabilitation permit early return to sport without compromising the clinical outcome after arthroscopic autologous chondrocyte implantation in highly competitive athletes? *Am J Sports Med.* Jan; 38(1):68-77.
- Dejour D, Vanconcelos W, Bonin N, Saggin PR, 2013, Comparative study between mono-bundle bone-patellar tendon-bone, double-bundle hamstring and mono-bundle bone-patellar tendon-bone combined with a modified Lemaire extra-articular procedure in anterior cruciate ligament reconstruction. *Int Orthop.* Feb; 37(2):193-9.
- Eastlack ME, Axe MJ, Snyder-Mackler L., 1999, Laxity, instability, and functional outcome after



- ACL injury: copers versus noncopers. *Med Sci Sports Exerc*;31:210–15.
- Fithian DC, Paxton LW, Goltz DH, 2002, Fate of the anterior cruciate ligament-injured knee. *Orthop Clin North Am*;33:621–36.
- Feller JA, Webster KE. 2003, A randomized comparison of patellar tendon and hamstring tendon anterior cruciate ligament reconstruction. *Am J Sports Med*;31:564–73.
- Grindem, H, Snyder-Mackler L, Moksnes H, Engebretsen L & Risberg MA, 2016, Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. *Br. J. Sports Med.* Epub ahead of print. doi:10.1136/bjsports-2016-096031
- Kon E, Filardo G, Berruto M, Benazzo F, Zanon G, Della Villa S, Marcacci M, 2011, Articular cartilage treatment in high-level male soccer players: a prospective comparative study of arthroscopic second-generation autologous chondrocyte implantation versus microfracture. *Am J Sports Med.* Dec; 39(12):2549-57.
- Kyritsis P, Bahr R, Landreau P, Miladi R, Witvrouw E, 2016, Likelihood of ACL graft rupture: not meeting six clinical discharge criteria before return to sport is associated with a four times greater risk of rupture. *Br. J. Sports Med.* bjsports-2015-095908
- Lynch AD, Logerstedt DS, Grindem H, et al. 2015, Consensus criteria for defining 'successful outcome' after ACL injury and reconstruction: a Delaware-Oslo ACL cohort investigation *Br J Sports Med*;49:335–42.
- Musahl V, Citak M, O'Loughlin PF, Choi D, Bedi A, Pearle AD, 2010, The effect of medial versus lateral meniscectomy on the stability of the anterior cruciate ligament-deficient knee. *Am J Sports Med.* ;38:1591–1597. [PubMed]
- Myklebust G, Bahr R, 2005, Return to play guidelines after anterior cruciate ligament surgery *British Journal of Sports Medicine* ;39:127-131.
- Melissa A, Christino MD, Braden C, et al., 2016, MD Children's Orthopaedics of Atlanta, Atlanta, Georgia, USA. Department of Orthopaedic Surgery, The Warren Alpert Medical School of Brown University, Providence, Rhode Island, USA. Volume: 4 issue: 3, March 23,;
- McCullough KA, Phelps KD, Spindler KP, 2012, Return to high school and college-level football after anterior cruciate ligament reconstruction: a Multicenter Orthopaedic Outcomes Network (MOON) cohort study. *Am J Sports Med.*;40:2523–2529. [Link](#)
- Malinin TI, Levitt RL, Bashore C, Temple HT, Mnaymneh W. 2002, A study of retrieved allografts used to replace anterior cruciate ligaments. *Arthroscopy.* ;18:163–170. [PubMed]
- Myklebust G, Bahr R, Engebretsen L, et al., 2003, Clinical, functional and radiological outcome 6–11 years after ACL injuries in team handball players: a follow-up study. *Am J Sports Med*;31:981–9. Abstract/FREE Full Text
- Ménétreay J, Duthon VB, Laumonier T, Fritschy D. 2008, "Biological failure" of the anterior cruciate ligament graft. *Knee Surg Sports Traumatol Arthrosc.* Mar;16(3):224-31. doi: 10.1007/s00167-007-0474-x. Epub Jan 9.
- Negrea V, 2016, Metodica jocului de baschet, Ovidius university Press, Constanta.
- Nordenvall R, Bahmanyar S, Adami J, et al. 2012, A population-based nationwide study of cruciate ligament injury in Sweden, 2001-2009: incidence, treatment, and sex differences. *Am J Sports Med*;40:1808–13.
- Parkkari J, Pasanen K, Mattila VM, et al., 2008 The risk for a cruciate ligament injury of the knee in adolescents and young adults: a population-based cohort study of 46 500 people with a 9 year followup. *Br J Sports Med*;42:422–6.
- Roos H, Ornell M, Gardsell P, et al., 1995, Soccer after anterior cruciate ligament injury: an incompatible combination? A national survey of incidence and risk factors and a 7-year follow-up of 310 players [see comments]. *Acta Orthop Scand*;66:107–12. Cross Ref Pub MedWeb of Science
- Sandberg R, Balkfors B. 1988, Reconstruction of the anterior cruciate ligament. A 5-year follow-up of 89 patients. *Acta Orthop Scand*;59:288–93.
- Spang JT, Dang AB, Mazocco A, Rincon L, Obopilwe E, Beynon B, Arciero RA, 2010, The effect of medial meniscectomy and meniscal allograft transplantation on knee and anterior cruciate ligament biomechanics. *Arthroscopy*; 26:192–201. [PubMed]
- Van de Pol GJ, Arnold MP, Verdonchot N, van Kampen A, 2009, Varus alignment leads to increased forces in the anterior cruciate ligament. *Am J Sports Med.* ;37:481–487. [PubMed]



- Zaffagnini S, Grassi A, Serra M, Marccaci M, 2015, Return to sport after ACL reconstruction: how, when and why? A narrative review of current evidence. *Joints*; 3(1):25-30.
- Zaffagnini S, De Pasquale V, Marchesini Reggiani L, Russo A, Agati P, Bacchelli B, Marcacci M, 2010, Electron microscopy of the remodelling process in hamstring tendon used as ACL graft. *Knee Surg Sports Traumatol Arthrosc*;18:1052–1058. [[PubMed](#)]
- Zaffagnini S, De Pasquale V, Marchesini Reggiani L, Russo A, Agati P, Bacchelli B, Marcacci M, 2007, Neoligamentization process of BTPB used for ACL graft: histological evaluation from 6 months to 10 years. *Knee*. ;14:87–93. [[PubMed](#)]
- Zaffagnini S, Bruni D, Marcheggiani Muccioli GM, Bonanzinga T, Lopomo N, Bignozzi S, Marcacci M, 2011, *Knee Surg Sports Traumatol Arthrosc. Mar*; 19(3):390-7.[[PubMed](#)] [Ref list] Prospective and randomized evaluation of ACL reconstruction with three techniques: a clinical and radiographic evaluation at 5 years follow-up.
- Zaffagnini S, Marcacci M, Lo Presti M, Giordano G, Iacono F, Neri MP, 2006, Prospective and randomized evaluation of ACL reconstruction with three techniques: a clinical and radiographic evaluation at 5 years follow-up. *Knee Surg Sports Traumatol Arthrosc. Nov*; 14(11):1060-9.
- Zaffagnini S, Bruni D, Marcheggiani Muccioli GM, Bonanzinga T, Lopomo N, Bignozzi S, Marcacci M, 2011, Single-bundle patellar tendon versus non-anatomical double-bundle hamstrings ACL reconstruction: a prospective randomized study at 8-year minimum follow-up. *Knee Surg Sports Traumatol Arthrosc. Mar*; 19(3):390-7.
- Wilk KE, 2015, Anterior cruciate ligament injury prevention and rehabilitation: let's get it right. *J Orthop Sports Phys Ther* 2015;45:729–30.