

# Acute Primary ACL Repair; Effect on Recovery and Return to Sport, a Literature Review

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## Abstract

The Anterior Cruciate Ligament (ACL) plays a significant role in stabilising the knee joint. It has a complex architecture made up of collagen fibers, which makes it well suited to guide movements especially in preventing excessive translations and rotations during functional activities. However, during daily living and sporting activities, the forces on the ACL occasionally exceed their limit, leading to a rupture. Primary repair of the anterior cruciate ligament was a popular treatment in the late 19<sup>th</sup> century, particularly, during the 1970's and the '80s on the lines of repairing MCL or the Achilles tendon, however, an open ACL repair allowed seldom healing owing to its intra-articular position and lack of clot formation due to the presence of synovial fluid.

**Keywords:** Anterior cruciate ligament • Architecture • Collagen fibers

## Introduction

Primary repair of the anterior cruciate ligament was a popular treatment in the late 19<sup>th</sup> century, particularly, during the 1970's and the '80s on the lines of repairing MCL or the Achilles tendon, however, an open ACL repair allowed seldom healing owing to its intra-articular position and lack of clot formation due to the presence of synovial fluid. Although, the short-term outcomes were initially good, there was deterioration at a longer-term follow-up, and hence was considered unpredictable, which led to the general opinion that primary repair of ACL tears deteriorates over time or were technically too demanding. An oftquoted study by Feagin and Curl in 32 military cadets at a 5 year follow up reported 53% re-ruptures and 94%instabilities with ACL repair which led to the generalised preference of ACL reconstruction over ACL repair [1].

The current gold standard treatment for an ACL tear is ACL reconstruction. Several disadvantages of ACL reconstruction, however, exist, including its inability to preserve proprioception, restore native kinematics and not preventing development of osteoarthritis, notwithstanding, the consequent potential problems due to revision surgeries. Therefore, a resurgence of interest has recently been noted in ACL preservation using arthroscopic primary repair [2].

## Materials and Methods

A literature search was performed on 3rd June 2018 with PubMed and Google scholar by authors using the key words partial tear of the ACL, ACL repair, return to play post ACL surgery and biologics in ACL repair. 36 articles were reviewed out of which 27 references are cited as they were found to be the most relevant to literature review.

## Aims and objectives

To study and research, the available literature and attempt to evaluate the previously published articles on acute primary ACL repair in order to find out if repairing proximal ACL avulsions acutely would help in accelerated recovery, return to sport, reduce complication and re-rupture rates [3].

## Eligibility criteria

The inclusion criteria for review article were studies with

- Acute ACL rupture of less than 3 months.
- Age of the patient at which ACL rupture occurred (less than 50 years),
- Type 1 rupture or ACL avulsion from femoral side. Also, some animal model studies, of ACL repair with suture and biologics was also researched.

The exclusion criteria are studies with

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- ACL repair for partial ruptures and chronic ruptures.
- Multi ligament injuries of the knee,
- ACL injury with associated severe chondral lesion.

## Review of Literature

### History of primary ACL repair

Primary open ACL repair, of which 61 patients were operated with sutures in both the cruciate stumps and rest had additional fascial augmentation done primarily. At 29 months follow up results demonstrated an average score of 42.7 on a 50 point normal knee score sheet. They concluded that primary repairs of mid-substance tears are technically possible and recommended in an athlete. They established the first classification for types of ACL tear based upon anatomic location. Type 1 tears were true soft-tissue avulsions with minimal ligament tissue left on the femur. Type 2 tears had up to 20% of the tissue left on the femur. Type 3 tears had up to 33% of the ligament tissue left on the femur. Type 4 tears were true mid-substance tears with up to 50% of the ligament tissue left on the femur. They strongly suggested consistent results could be obtained with acute of type 1 tears. Satisfactory mid-term results in 84% of acute primary repairs in 49 patients using a mini open arthrotomy. They reported that 81% had a KT-1000 laxity less than 3 mm, a negative pivot shift, and a Lysholm score greater than 85 [4].

Augmentation of repair using biological agents: Laboratory studies

Type I avulsion tears in sheep, and performed primary repair with or without an augmentation using a 3-mm polyethylene terephthalate band. Histologically, they noted that healing of ACL occurred in both the groups, but that healing was achieved after 16 weeks for the augmented repair group, and after 26 weeks for the non-augmented repair group of sheep. The authors assessed the biomechanical outcomes in both the groups, and noted that augmented repair had more anteroposterior stability in the early postoperative phase (6-16 weeks) but that this difference was not evident at longer follow-ups. Furthermore, they noted that the augmented repair group at 1 year had more ligament stiffness and tensile strength when compared with the non-augmented repair group. They concluded that augmented repair, especially in the early phases, had superior biomechanical results compared with non-augmented repair.

Collagen-Platelet Composite (CPC) to supplement the repair in 14 knees which was placed at the site of tear. Knees were harvested at 4 weeks, 6 weeks, and 3 months. Mechanical testing and histologic analysis were performed. The results were very encouraging at 3 months however, at 6 weeks, a reduction in yield load was noted and stiffness was thought to occur, which was attributed to revascularization. The authors advise that ACL repair needs to be protected till the time of complete revascularization. An instructional review provided a summary of the latest advances made in ACL repair. They opined that the improved knowledge of healing, along with recent advances in tissue engineering and regenerative medicine, has resulted in the discovery of novel biologically augmented ACL repair techniques providing satisfactory outcomes in pre-clinical studies. Evaluated the efficacy of a new technique, the dynamic intra-ligamentary stabilisation (DIS, Ligamys) that utilises biological self-healing for repair of acute ACL ruptures in sheep.

After 3 months of DIS, all animal knees were submitted to magnetic resonance imaging, biomechanical and histological evaluation. The biomechanical tests confirmed successful restoration of anteroposterior translation in the dynamic intraligamentary stabilisation knees. Histological examination revealed dense scar tissue at the ends of the transected ligaments exhibiting hypercellularity and hypervascularisation. These findings prompted the authors to conclude that the dynamic intraligamentary stabilisation technique successfully induced self-healing in the ruptured ACL, without complications, in a sheep model [5].

### The introduction of arthroscopic ACL repair using novel mechanical devices

The idea of primary repair of the ACL using arthroscopic dynamic intraligamentary stabilisation technique in 11 cases and concluded that the preservation of native ACL using the described arthroscopic primary repair technique, can achieve short-term clinical success in a carefully selected subset of patients with proximal avulsion type tears and an excellent tissue quality. In the same year presented a pilot case series, using DIS system in 10 patients aged less than 45 who played some sports which involved pivoting, with ACL rupture not less than 14 days old and no previous surgery. The authors bio-enhanced by using L-PRF and microfracture along with DIS. The Postoperative clinical and radiological evaluation, as well as assessment of knee laxity was performed at 6 weeks, 3, 6, 12, and 24 months. The authors in 2016, published a 5 year follow up result, in which, 8 patients with a functionally healed ACL showed excellent outcomes and satisfaction with regards to the treatment result, had 80% survival rate at 5 years. Case series, presented primary repair of acute ACL using Internal brace ligament augmentation system in 68 cases with minimum of one year follow up and concluded that further randomised studies are required to directly compare repair against reconstruction techniques. At 2-3 years follow-up, they reported excellent stability testing and patient-reported outcome scores in both groups. This being said, a higher revision rate following primary repair was noted. Despite this increased revision rate, they concluded that, in a significant number of patients, good results could be achieved with this minimally invasive treatment option of arthroscopic primary repair. In this particular study eight ACL ruptures occurred and 3 patients reported insufficient subjective stability of the knee at the end of the study period. The authors concluded that Anatomical repositioning, along with DIS and microfracturing of the notch, leads to clinically stable healing of the torn ACL in the large majority of patients.

## Discussion and Analysis

The trend of primary ACL repair steered towards ACL reconstruction especially after Franke pioneered the bone-patellar tendon-bone graft in 1969. ACL treatment occurred in the past, from primary repair of ACL in 1980 to reconstruction of ACL in early 1990 due to multiple factors most important being, non-strict patient selection, invasive surgical techniques, prolonged joint immobilisation, and the use of absorbable sutures. Arthroscopic ACL reconstruction is considered to be the gold standard treatment for ACL ruptures. However, it has been argued that there is also an increased chance of developing osteoarthritis of knee. The results showed that ACL-reconstructed knees had a relative risk of 3.62

uninjured knees in OA development, indicating that ACL reconstruction cannot fully prevent OA. Non-operatively treated ACL-deficient knees showed a relative risk of 4.98, suggesting that ACL reconstruction can act preventively for OA compared to non-operative treatment.

In spite of many studies which have been able to demonstrate good-to-excellent post-operative results, the meta-analysis conducted in 2007, revealed that only 40% of patients could achieve full recovery independent of the surgical technique used. One of the major explanation for this is that the removal of native ACL tissue containing sensory nerve fibers causes the ligament to lose its function within the joint's proprioceptive envelope, thus impairing muscular stabilisation of the knee. The results showed that 70% of players returned to sport with a mean age of 24 years. However, at the 7 year follow up, only 36% of people were still playing soccer. Therefore, they concluded that, "Younger and male soccer players are more likely to return to play after ACL reconstruction. Only 65% of athletes were able to return to pre-injury level following reconstruction using either patellar tendon or hamstring graft with no significant difference in the clinical outcome score. However, 11% of athletes had to leave playing all sorts of sports and had significant difference in clinical outcome scores as compared to those who returned to play to pre-injury level. On an average, 2/3rd of athletes, may require upto 24 months to return to play some sort of sport. On the contrary, most athletes are expected to return to play within 1 year of ACL reconstruction. It has now been well established that recovery and return to play after reconstruction takes longer than 1 year and the chances of re-injury are higher if the player returns to play early without complete recovery which may take as long as 2 years.

The authors reported that Second-look arthroscopy, examination and imaging at 3 months confirmed knee stability and complete ACL healing in all cases. They advocated that ACL repair in young children using this technique negates the requirement and potential morbidity of graft harvest and demonstrates the potential for excellent outcome as an attractive alternative to ACL reconstruction, if an adequate ACL remnant permits direct repair.

## Conclusion

The revived interest in the primary repair for type 1 ACL rupture in selected patients have shown promising results in the recent studies. The repaired ACL has shown clinical and radiological healing within a year. The clinical scores in some of the study group following repair, tend to reach the preinjury state as early as 3 months, with

excellent patient satisfaction. However, more randomised controlled studies are required to directly compare repair against standard ACL reconstruction techniques. The quick recovery in the early phase of rehabilitation where patients regained full range of motion in 4 weeks' time seems to be the result of minimally invasive nature of procedure, with no donor site morbidity, retained proprioception and normal kinematics of knee. Patients tend to return to play following repair early in a few studies when put on a standard ACL rehabilitation. The complications such as re-rupture though being documented in early stages, the long term results are unknown. The drawback of ACL repair is, it has shown to give good results only in type 1 acute ACL rupture and having good tissue quality. Moreover, the learning curve is high as compared to ACL reconstruction. ACL repair is therefore the new paradigm shift in the management of ACL injuries with overall very good results and minimal complications on mid-term outcomes, however, we need more randomized control trials, long term outcomes from present studies and more studies designed to focus mainly on return to play of patients to advocate ACL repair over the gold standard ACL reconstruction.

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