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Research Article

Post-Operative Radiological Outcome of Hamstring Graft in ACL Reconstruction after Augmentation of Graft with Periosteal Envelope

DS Bhamare¹, Girish Nathani^{2*}, Clevio Desouza², Ishan Shevate², Ashwin Deshmukh²

¹Professor, Department of Orthopaedics, Dr DY Patil Medical College, Hospital and Research Centre, Pune, India

²Assistant Professor, Department of Orthopaedics, Dr DY Patil Medical College, Hospital and Research Centre, Pune, India

***Corresponding Author:** Girish Nathani, Assistant Professor, Department of Orthopaedics, Dr DY Patil Medical College, Hospital and Research Centre, Pune, India; Email: girishnathani786@gmail.com

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Abstract

Introduction: Anterior Cruciate Ligament (ACL) reconstruction with hamstring graft is usually done for the surgical management of ACL tear. The post-operative outcome of ACLR is mainly dependant on graft healing its integration into the femoral and tibia tunnels. For the tendon to bone integration it can take up to several months post-surgery. Incorporation of graft into the bony tunnels plays an important role in post-operative outcome after ACL reconstruction surgery. In our study we have aimed to compare hamstring graft healing time post ACL reconstruction when graft was enveloped with periosteum as envelope.

Material and Methods: 30 patients with isolated ACL tear were selected between age group of 18 to 40 years and were grouped randomly into 2 groups. In first group the hamstring graft was enveloped with the surrounding periosteum harvested were as second group the patients were not augmented with periosteal envelope. Post-operative rehabilitation remained similar in both the groups and MRI scan was done at 6 months, 9 months and 1 year post operatively to check for graft maturity.

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Results: Graft healing was faster in the group which was augmented with periosteum (Mean time 7.5 months) as compared to the group which was not augmented (Meantime 9.5 months).

Conclusion: Periosteum allows for faster graft healing in patients of ACL reconstruction.

Keywords

Anterior Cruciate Ligament Reconstruction; Hamstring Graft; Periosteum; Sports Injury; Biological Augmentation; MRI

Introduction

ACL reconstruction with hamstring graft is usually done for the surgical management of ACL tear. The post-operative outcome of ACLR is mainly dependant on graft healing its integration into the femoral and tibia tunnels [1-3]. For the tendon to bone integration it can take up to several months post-surgery [4-7]. Incorporation of graft into the bony tunnels plays an important role in post-operative outcome after ACL reconstruction surgery as this is main weak point of the graft also continuous micro motion, tunnel expansion and synovial extravasation makes the graft more weak [8].

Periosteum is a bilayer tissue between bone and soft tissue. The inner cambium layer is a rich source of mesodermal cells which can transform into various osteo progenitor and chondro progenitor cells [9-10]. It can also seal the intra-articular opening of tunnel in the early postoperative period, preventing synovial fluid reflux into the tunnel [11,12]. MRI being and non-invasive technique can be used to monitor post-operative graft healing time. Healing of the graft histologically and radiologically was studied by various authors [13-19]. A clinical study was done which demonstrated histological and MRI assessment of graft at 6, 9 and 12 months of postoperatively [20].

This study is done to show the outcome of augmenting hamstring graft with periosteal envelope in terms of healing time.

Material and Methods

30 patients between the age group of 18 to 40 years were selected with isolated ACL Tear and were grouped into two groups and standard ACL reconstruction was performed in both the groups, however group 1 was augmented with periosteum in addition to ACL reconstruction.

A 5 cm vertical incision was made approximately 2 cm medial to tibia tubercle. Sartorial fascia identified after subcutaneous dissection. Semitendinosus and gracilis tendon were palpated and identified. Sartorial fascia was incised from the interval between gracilis and semitendinosus tendons. Gracilis tendon is placed more proximally, whereas the semitendinosus is distally one. Number 2 Ethibond suture is passed separating the tendons and the tendons are stripped out from its origin using an open tendon stripper after releasing all the accessory bands. The tendons are then detached from its insertion site keeping the periosteum intact. A 3* 3 cm periosteum flap is harvested distal to pes anserine. The periosteum is then divided into 2 equal size flaps. The graft is then fashioned and a quadruple leg graft of size approximately 9 cm is achieved and then sutured with Mersilene Tape. A reference point is marked with a 3-0 vicryl approximately 35 mm from the looped end tendon is then sutured together with 3-0 vicryl suture at 2 cm from each end make circumferential reference marks at 25 mm from the loop end. A second reference mark is made according to measure intra-articular distance between femoral and tibia tunnels. The periosteum is then sutured around the tendon at both sides at the marked points with a 3-0 vicryl suture and measured with graft sizers. The tunnels are prepared in standard manner with an appropriate size drill bits. Graft is then fixed using a suspensory fixation with the help of a titanium button on femoral side while it is fixed with a bio absorbable interference screw of appropriate size. The knee is then taken into full range of motion visualised arthroscopically for laxity and impingement. The knee is kept locked in full extension with the help of a brace for 1 day patient is started with quadriceps strengthening exercise like quadriceps isometric exercises, straight-leg raising exercise to gain quadriceps power as early as possible and complete range of movement is started with flexion from 00 to 300 in first 3 day and further increased to 00 to 600 in next three days further aiming to achieve function movement of 90 degrees by 14th day when sutures were removed. Full weight bearing is allowed as tolerated (Fig. 1-3).

Patients were usually made to return to normal daily activity by 3rd month however preinjury sports activities were usually started at 9 to 12th month post operatively. On follow up radiological evaluation of knee was done with a T1 and T2 sequence MRI with a 1.5-T Siemens Magnetom MRI Scanner (Siemens AG, Erlangen, Germany). Slices of 2 mm thickness slices were taken in an oblique parasagittal view between 10° and 15°, centring on the intercondylar region, keeping knee flexed at 9° to 10° on 6th month, 9th month and 1 year post surgery for all the patients. The scans were analysed by the same radiologist and was blinded to the time of surgery and to group of the patient. The radiologist determined the healing by comparing the intensity of the graft to that of posterior cruciate ligament. IKDC guidelines for clinical examination was also done (Fig. 4 and 5).

Figure 1: Graft taken with periosteum from proximal tibial attachment.

Figure 2: Semitendinosus and gracialis graft with periosteum.

Figure 3: Graft fixed with suspensory fixation using a titanium button with periosteum envelope 25 mm from button.

Figure 4: Graft with periosteum.

Figure 5: 7 month post-operative MRI of a patient with ACL reconstruction done with hamstring graft and periosteum sleeve done showing graft healing.

Results

Group 1 in which hamstring graft was augmented with periosteum showed healing on MRI at a mean time of approximately 7 and half months to that of the group which was not augmented which showed healing at around 9 and half month, as shown in the following Table 1:

Groups	Periosteum Augmented Group	Control
Minimum time for graft healing	7 months	8 months
Maximum time for graft healing	9 months	12 months
Mean time for graft healing	7.5 months	9.55 months

Table 1: Comparison of the periosteum augmented group with the control.

Discussion

For active sportsmen, recovery from ACL injury must be as normal and in the least duration so that it doesn't affect his sports carrier. In last few years various procedures are done in ACL reconstruction so as to improve its outcome [21]. By inducing the mesenchymal cells to differentiate into chondroblasts and osteoblast, periosteum has shown to initiate bone formation there by helping in tendon to bone healing inducing mesenchymal cells to differentiate into chondroblasts and then into osteoblasts [11]. It was also found to help in sealing the tunnel opening intra articularly in the early postoperative phase, preventing extravasation of synovial

fluid into the tunnel [11,22]. It was found that when a tendon is wrapped around with a free periosteal transplant could lead to bony in- growth in the tendon by 2 weeks after surgery [23].

Histologic examination showed better tendon-bone integration when periosteum was enveloped to tendon [11]. Biomechanical testing was also found to show higher maximal pull-out load in the periosteum-enveloped group. In a study it was showed that synovial fluid influx between the tendon and bone tunnel and impaired tendon-bone healing and caused micro motion of the tendon-bone interface, leading to osteolysis and eventually tunnel enlargement [24]. Significant reduction in tunnel enlargement with the periosteal flap in femoral tunnel in previous studies [25]. Post operatively CT scan was done by few researchers to see for tunnel widening after augmentation with PRP [26]. An association between the homogeneity of the graft on MRI and maturation and strength, similar to the native ACL was done in sheep models [26].

A study was done to see for graft healing post PRP augmentation on MRI finding [20]. MRI being less specific as compared to a relook surgery but being a non-invasive modality, cost effective and easy to do was preferred. Biomechanical properties were also not evaluated. Graft healing in ACL reconstruction has been conventionally categorized as a 3-stage process, namely early healing, proliferation, and maturation phase. The early healing phase is characterized by graft necrosis and hypo cellularity without any significant detectable revascularization occurs, followed by the proliferation phase with the most intensive cell infiltration, and finally a maturation phase with slow matrix remodelling in our study we have taken the maturation phase as the stage to be monitored for graft healing [27].

A study was performed previously which showed the functional outcome post ACL reconstruction with periosteal augmentation in form of IKDC knee scores [12]. Thus we studied the radiological graft healing on MRI post ACL reconstruction and also compared it with control in which no augmentation was done. The limitation to this study was that we did not compare the clinical outcome in ACL reconstruction with and without periosteum. There was also no comparison between “aggressive” and “nonaggressive” physiotherapy protocols.

Conclusion

The study showed that there was significant difference in graft healing time documented on MRI when the graft was enveloped with periosteum in ACL reconstruction. The graft enveloped with periosteum showed better tendon to bone incorporation and faster healing.

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