

## FUNCTIONAL OUTCOME OF ARTHROSCOPE ASSISTED RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT USING BONE-PATELLAR TENDON-BONE GRAFT

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### ABSTRACT

**Objective:** To evaluate arthroscopic assisted Anterior Cruciate Ligament (ACL) reconstruction using Bone-Patellar Tendon-Bone (BPTB) graft using anteromedial approach to drill the femoral tunnel followed by accelerated ACL rehabilitation protocol in terms of Lysholm score.

**Study Design:** Prospective comparative study.

**Place and Duration of Study:** The study was conducted in Combined Military Hospital (CMH) Rawalpindi and Combined Military Hospital Malir, Pakistan, from Nov 2013 to Dec 2015.

**Methodology:** This study was an analysis of prospectively collected data of patients who had undergone Anterior Cruciate Ligament reconstruction. All patients below the age of 35 years presenting with Anterior Cruciate Ligament Grade 3 tear were assessed objectively and subjectively using Lysholm score pre and post operatively. Manual laxity of knee was assessed with anterior drawer and Lachman test; and being compared with normal contralateral knee. Rotational instability was assessed by pivot shift test.

**Results:** Nineteen patients, all males, were included in this study with the mean age of  $26.7 \pm 4.68$  years. All patients underwent arthroscopic assisted Anterior Cruciate Ligament reconstruction with uneventful recovery. Every patient had his pre and post-operative Lysholm scoring done. Mean pre-operative Lysholm score was  $53.89 \pm 3.81$ . Patients were followed up at 5 months and at 9 months and their mean Lysholm scores were  $84.74 \pm 6.31$  and  $92.47 \pm 3.04$  respectively with the *p*-value of  $<0.001$ . Only 2 patients had residual Grade I Lachman laxity and none of the patients had any rotational instability.

**Conclusion:** Arthroscopic assisted Anterior Cruciate Ligament reconstruction using Bone-Patellar Tendon-Bone graft followed by accelerated Anterior Cruciate Ligament rehabilitation protocol led to significant improvement of Lysholm score.

**Keywords:** Anterior cruciate ligament reconstruction, Arthroscopic, Lysholm score, Patellar tendon bone graft.

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### INTRODUCTION

Knee joint is one of the most common joint to be affected as a consequence of trauma<sup>1</sup>. Anterior Cruciate Ligament (ACL) injuries account for 20% of knee injuries due to sports. In USA there is an estimated 120,000 ACL lesions per year. Clinically, ACL rupture is diagnosed by Lachman test and Pivot shift test; however Magnetic Resonant Imaging (MRI) provides fine details of soft tissue injuries pertaining to its injury. ACL rupture leads to instability of knee which damages the menisci and lead to premature degenerative changes<sup>2</sup>. To avoid these changes and improve overall function of lower limb ACL reconstruc-

tive surgery is indicated. Reconstruction of ACL will balance the loading of the knee joint, thus may improve knee function. ACL reconstruction can be attempted as an open procedure or arthroscopic assisted using autogenous grafts or allografts<sup>3</sup>. ACL reconstruction techniques have been divided into extra articular and intra articular techniques. Extra articular techniques have been discontinued due to residual instability and high failure rates. Intra articular ACL reconstruction technique has been adapted as main stay of treatment due to advances in arthroscopic techniques. Various tissues have been used to reconstruct ACL. These can be divided into autografts, allografts and synthetic grafts. Bone Patellar Tendon Bone grafts have been established as gold standard but over a period of time Hams-

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tring tendon grafts have gained popularity<sup>4</sup>. Bone Patellar Tendon Bone graft (14-15mm wide) has the strongest mean strength of 163-175% of that of normal ACL. This fact has been revealed by tension to failure studies of various donor tissues<sup>5-7</sup>.

Both grafting techniques (i.e. BPTB vs. hamstrings) have their advantages and disadvantages but long term (17-20 years) results with BPTB techniques have shown stable, normal or near normal results in 83% of patients with only 1.6% of patients requiring revision ACL. It allows faster incorporation of bone plugs within tibia and femoral tunnel thereby providing better stability to whole construct. It also confers more stability to knee as compared to Hamstring ACL reconstruction. On the other hand, Hamstring grafts for ACL reconstruction is associated with post-operative elongation and subsequent laxity which has been overcome by quadruple hamstring graft technique<sup>8</sup>.

Reconstruction of ACL is as important as physiotherapy and quadriceps rebuilding. It is pertinent to mention here that a well-developed musculature of quadriceps will yield better outcome after ACL reconstruction and ensure early return to work<sup>9</sup>.

The current study was conducted to assess outcomes of arthroscopic assisted reconstruction of ACL using Bone Patellar Tendon Bone graft with accelerated ACL rehabilitation protocol in our setup. It will assess strength of newly constructed ACL to withstand rigorous rehabilitation program and thus measure overall outcome in terms of Lysholm score.

## **METHODOLOGY**

This study of prospectively collected data of the patients, who had undergone arthroscopic assisted ACL reconstruction using Bone Patellar Tendon Bone graft, was conducted in CMH Rawalpindi and Malir from 1<sup>st</sup> November 2013 to 31<sup>st</sup> December 2015 after approval from respective ethical committees. Sample size was calculated by WHO calculator keeping confidence Interval of 95% and non-probability. This study

comprised of all male patients below the age of 35 years. All patients had military background explaining the nature of injury. They were clinically examined for associated ligamentous and meniscal injuries. Inclusion criteria for this study included isolated ACL ruptures with or without meniscal injuries diagnosed on MRI scans reviewed by consultant radiologist (fig-1). ACL laxity was graded clinically by Lachman/Anterior Draw and rotational instability was assessed by Pivot Shift test. Exclusion criteria included collateral ligament injuries and associated fractures.

Our study used the Lysholm scoring system to predict the early return to function which is the gold standard in assessment of ACL deficient knees<sup>24</sup>. This scoring system consists of 8 level score which focuses on patient's level of work and sports activity handicap<sup>25</sup>.

Pre-operative Lysholm score was recorded for every patient. All patients were subjected to BPTB auto graft ACL reconstruction. All procedures were done under spinal anesthesia under tourniquet control. Initial arthroscopic assessment including partial meniscectomy in 8 cases along with debridement of ACL footprint was performed. One case underwent meniscal repair for which ACL reconstruction was performed after three months. Approximately, 12-15 mm broad graft was harvested with bone plugs at both ends. Anteromedial approach for arthroscopic assisted tibial and femoral tunnels was adapted. Anatomical placement of the ACL graft was carried out and was affixed with help of titanium interference screws. At the end of procedure, no drain was placed and Jones's bandage was applied on knee before deflating the tourniquet. The knee was immobilized in an immobilizer during shifting out of operation theatre, followed by extension and elevation for 24 hours. At the end of 1<sup>st</sup> postoperative day knee immobilizer was removed. The knee had ice packs application for few minutes at an interval of 12 hours for a couple of days. Gradual Range of Motion (ROM) exercises were started on the 2<sup>nd</sup> postoperative day as pain permitted, ranging from 0° to 90° by the end of week. Patellar mobilization and

quadriceps/hamstring exercises were started by 2nd postoperative day onwards. The patient was permitted to walk partial weight bearing with immobilizer applied for the first two weeks followed by walk full weight bearing after 2 week onwards (fig-2). Knee immobilizer was replaced with knee brace at the end of two weeks. ROM to almost full flexion was achieved by the end of 3 weeks. Knee strengthening was also enhanced on a stepper after 3 weeks, followed by static cycling after 4 weeks. The patient continued with this protocol till 8 weeks when he was allowed to run in a straight line on grass. It was followed by gradual rehabilitation input with milestones of ROM exercises and muscle strengthening exercises. Post-operative Lysholm score was calculated at 5th and 9th month.

The demographic data was collected through proforma as age, gender, profession, Body Mass Index, mechanism of injury and examination findings including Lysholm score were noted. The data was analyzed using SPSS-19. Mean and standard deviations were calculated for all continuous data. The mean Lysholm score was compared between pre and post Op period using paired t-test and value of  $p \leq 0.05$  was taken as significant.

## RESULTS

This study consisted of 19 patients; all were male below the age of 35 years with the mean age of  $26.7 \pm 4.68$  years. Patients were followed up at monthly intervals. The mean body mass index of all cases was  $22.2 \pm 2.23$ . The most common mechanism was in noncontact sports in 11 (58.9%) cases. Only two (10.5%) cases reported in OPD within 6 weeks of injury. Seventeen (89.5%) reported after a year of incident. The chief complaint of patients was pain on walking 60%, followed by sense of giving way 30%. Thirteen patients (68%) had injury of left knee and 5 patients (32%) had right knee problem (table-I).

They were clinically assessed by Lachman test, anterior drawand Pivot Shift tests. All patients had their MRI scans done. After surgery and six weeks post recovery these tests were

done again. Only two patients had positive Lachman after surgery.

The Lysholm scoring was done of all patients through proforma pre-operatively and then at 5th and 9th months postoperatively respectively (table-II). The mean Lysholm score pre operatively was  $53.89 \pm 3.81$ . Post operatively mean Lysholm score at 5th month was  $84.74 \pm 6.31$  and at 9th month was found to be  $92.47 \pm 3.04$ . The  $p$ -



**Figure-1: Magnetic resonant imaging of a patient showing Anterior Cruciate Ligament rupture in sagittal section.**



**Figure-2: Bone-Patellar Tendon-Bone Graft being harvested per-operatively.**

value calculated by applying paired student t-test between pre and post-operative Lysholm at 5th and 9th month was  $<0.001$  making it significant thus rejecting the null hypothesis. Average operation time was  $90.4 \pm 15.8$  mins and all patients had unremarkable recovery in early post-operative period (table-II).

## DISCUSSION

The incidence of ACL rupture has increased due to more awareness and indulgence in sports

activities. Keeping military perspective in background, young soldiers are more likely to sustain these injuries. In our study, mean age of patients was  $26.7 \pm 4.6$  years which was comparable to other studies in which age group involved a range between 20-29 years<sup>9</sup>. These injuries were commonly witnessed in sports like football and volley ball. In our article, though, sports related injury (58%) is at the top of the causes for this injury but at the same time some of the cases were sustained due to fall in ditch (26%) and jumping from the vehicle (16%). The main mechanism of action was considered to be multiplanar loading with slight flexion and prominent valgus deformity at knee, internal tibial rotation leading

tenfold more likely to sustain ACL injuries as compared to their male counter-parts while participating in the same sport category<sup>12</sup>. In our setup, females generally do not take part in contact sports explaining decreased incidence in our population.

Osteoarthritis is more likely to develop in ACL deficient knees as compared to normal knees for the same age. There are many factors which contribute to development of osteoarthritis in ACL deficient knees such as associated meniscal injuries, osteochondral injuries, advancing age, high BMI and more than six month duration between injury and reconstruction<sup>13</sup>. In our study, only two of the patients reported within six

**Table-I: Pre and Post-Operative test results for Anterior Cruciate Ligament laxity.**

Test	Negative	Positive (+)	Positive (++)	Positive (+++)
Initial Lachman	-	-	8 (42%)	11 (58%)
Post-op Lachman	17 (89.5%)	2 (10.5%)	-	-
Initial Anterior drawer	-	-	6 (31.5%)	13 (68%)
Post-op Anterior drawer	15 (89.5%)	2 (10.5%)	-	-
Initial Pivot shift test	-	2 (10.5%)	9 (47%)	8 (42%)
Post-op Pivot shift test	19 (100%)	-	-	-

**Table-II: Pre and post-operative lysholm score.**

Lysholm Score	Pre-Op Score	Post-Op score (5 months)	Post-Op score (9 months)
<65 Poor	19 (100%)	-	-
65-83 Fair	-	4 (21%)	-
84-90 Good	-	12 (63%)	4 (21%)
>90 Excellent	-	3 (16%)	15 (79%)

to exacerbation of anterior tibial translation which culminated in ACL failure<sup>10</sup>. This mechanism particularly explains non-contact nature of ACL injuries. More than 70% of ACL injuries are attributable to non-contact nature of injuries which means that these injuries are sustained without direct blow to knee<sup>11</sup>. This aspect explains the jump from vehicle and fall in ditches while carrying out reconnaissance missions.

Our study composed of 19 males and no female reported to us with ACL rupture. However, in international studies with large population sample, incidence of this injury in young females is on the rise as they are competing more in sports. Female athletes are reportedly two to

weeks of injury and remaining 17 cases reported after a year of injury. The commonest reason that can be deduced in retrospect is that the injury was partial tear which converted in complete rupture due to nature of service. Increased anterior tibial translation can lead to generation of shearing forces being deployed on the menisci. These abnormal kinematics leads to meniscal injuries in ACL deficient knees<sup>14</sup>. Keeping all these variables in consideration, risk of early osteoarthritis despite early surgical intervention ranges from 66% to 100%<sup>15</sup>. Furthermore a meta-analysis of 33 clinical follow up states that rate of premature onset of osteoarthritis is not reduced by ACL reconstruction<sup>16</sup>. However, ACL reconstruction

provides ligamentous stability for ACL deficient knee and can have beneficial effects on restoring kinematics of knee<sup>17</sup>. Few athletes are able to resume sports at pre-injury level but at the same time they are at higher risk of developing second knee injury with less favorable outcome<sup>18-22</sup>.

In Pakistan, study by Ali *et al* showed improvement in Lysholm score of  $83.06 \pm 4.71$  and average age was 28 years. This is comparable to our study but Lysholm score is better owing to rigorous rehabilitation program<sup>9</sup>.

Rehabilitation is one of the most important corner stone in management of ACL reconstruction. All patients prior to being recruited in ACL reconstruction surgery are subjected to intensive rehabilitation protocol to improve effective range of movement of knee and develop good strength quadriceps. Usual duration of post-operative ACL rehabilitation program is 8 months, whereas accelerated ACL rehabilitation program is over 4-5 months to achieve its final goals<sup>23-25</sup>. In our study, patients were subjected to modified accelerated ACL rehabilitation protocol as per our institution guidelines.

There were two limitations in our study. First, the follow-up rate was comparatively low due to changes in contact information and geographical factors. Second, no control group was evaluated because there were not enough cases of other surgical methods for long-term evaluation. This study cannot be generalized as sample size was small. The authors recommend a randomized control trial at national level with long term follow up to assess the overall outcome.

## CONCLUSION

Arthroscopic assisted BPTB ACL reconstruction led to remarkable improvement in Lysholm score. Bone Patellar Tendon Bone technique, although an older grafting technique for ACL reconstruction, is still capable of producing very acceptable functional outcomes in experienced hands. Keeping in view the fact that strongest mean strength of BPTB graft is greater than normal ACL, accelerated ACL rehab protocol is better tolerated, improving the functional out-

comes. With advent and excellent incorporation of BPTB ACL reconstruction with emerging arthroscopic techniques has resultantly increased in number of grafting options for the orthopedic surgeon to choose from.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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