DIFFERENT METHODS OF FIXATION OF SEMITENDINOSUS GRAFTS IN ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT

Rajiv Roy¹, Alok Sobhan Datta², Mritunjoy Roy³
¹Assistant Professor, Department of Orthopaedics, North Bengal Medical College and Hospital.
²Associate Professor, Department of Orthopaedics, North Bengal Medical College and Hospital.
³Post Graduate Trainee, Department of Orthopaedics, North Bengal Medical College and Hospital.

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Address for Correspondence: Dr. Alok Sobhan Datta, Associate Professor, Department of Orthopaedics, Institute of Postgraduate Medical Education and Research, Kolkata.
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Abstract
BACKGROUND: The Anterior Cruciate Ligament (ACL) is the most commonly injured ligament in the human body. Earlier treatment of ACL injury was mainly restricted to sportsmen, but has increased over the years because of awareness and accessibility to treatment facilities. Arthroscopic reconstruction is now the gold-standard for the treatment of ACL tear.
MATERIALS AND METHODS: This study was conducted at IPGME & R, Kolkata in the department of Orthopaedics, where forty patients with single knee injury were taken into consideration, the injury being more than two months old, in the age group 20-50 years, with clinically significant knee instabilities and confirmed on MR imaging.
RESULTS: This was a prospective randomised study where 95% of the patients were male. The outcome was based on regaining pre-injury status and recovery was based on pre- and post-operative clinical and radiological findings and marked according to Tegner-Lysholm scale.
CONCLUSION: Clinical and radiological (MRI) proved knee instabilities due to standardised Anterior Cruciate Ligament injury were best treated by arthroscopic repair using semi-tendinosus graft, which provided to be the gold-standard treatment protocol.

Keywords: ACL Injury, Knee Instability, Arthroscopic Repair, Semitendinosus Graft.

Introduction
Anterior cruciate ligament is most commonly injured ligament, which provides stability to the knee. Previously the concern regarding ACL injury was largely restricted mainly amongst the sportsmen as they required a stable knee most, but now-a-days there is a change in this trend, due to increased awareness of people and easier availability of facilities.

Arthroscopic reconstruction with tendon graft is now the gold standard for the treatment of ACL tear. Among the different graft materials, autologous semitendinosus graft is most popular.

This study deals with the results of different methods of fixation in arthroscopic ACL reconstruction using semitendinosus graft.

This work concerns only about semitendinosus graft (Single bundle). The graft was fixed with tibial tunnel in one end and with femoral tunnel on the other end. The method of fixation was any one of the following:

1. Titanium screw in both femoral and tibial tunnel.
2. Bio-absorbable screw in both femoral and tibial tunnel
3. Endobutton-Mersilene tape for femoral tunnel and bio-absorbable screw for tibial tunnel.

In our study, we evaluated the results of different fixation methods used to fix the semitendinosus graft in arthroscopically assisted anterior cruciate ligament reconstruction. Of all the ligaments providing stability to the knee joint, ACL is most commonly injured.

The anterior cruciate ligament is the primary restraint to the anterior tibial displacement, accounting for approximately 85% of the resistance to the anterior displacement of the tibia on the femur.
drawer test when the knee is at 90 degrees of flexion and neutral rotation. Selective sectioning of the anterior cruciate ligament has shown that the anteromedial band is tight in flexion, providing the primary restraint, whereas the posterolateral bulky portion of this ligament is tight in extension.

The posterolateral bundle provides the principal resistance to hyperextension. Tension in the anterior cruciate ligament is least at 30 to 40 degrees of knee flexion. The anterior cruciate ligament also functions as a secondary restraint on tibial rotation and varus-valgus angulation at full extension.

Investigators have studied the biomechanical properties of anterior cruciate ligament. Noyes, in a comprehensive biomechanical study, determined the ultimate load to be 1725±269N; the stiffness, 182±33 N/mm; and the energy absorbed to failure, 12.8±2.2 N-m. Woo et al., in younger specimens, found the ultimate load to be 2160±157 N and the stiffness 242±28 N/mm.

Most of the ACL injuries often occur during sports. The injury can happen following a sudden force acting on a straight or slightly flexed knee while the foot is firmly placed on the ground, when changing directions rapidly, sudden deceleration when running, or landing from a jump. This type of injury is common in soccer, skiing, hockey, polo, rugby and other sports with lots of stop-and-go movements and lots of body contact, jumping, or weaving. Falling off a ladder or missing a step on a staircase are other likely causes. The classic history of an anterior cruciate ligament injury begins with a noncontact deceleration, jumping, or cutting action.

An ACL injury can cause small or medium tears of the ligament, a complete tear of the ligament (Rupture), a separation (avulsion) of the ligament from the tibia or femur, or a separation of the ligament and part of the bone from the rest of the bone (Avulsion fracture). When any of these occur, the tibia translates abnormally forward under the femur, with a sense of the knee giving out or buckling.

The prognosis for a torn ACL after conservative management is often unfavourable, with the recovery and rehabilitation period usually very long. Even patients with partial ACL tears may have instability following conservative management. After a complete ACL tear, some patients are unable to participate in cutting or pivoting-type sports, while others have instability even during normal activities, such as walking.

With the increasing trend of diagnosed ACL injury in our day to day life and the demand for returning to one’s normal activity as early as possible, surgical treatment for torn ACL has become the standard protocol.


Various options, namely bio-absorbable screws, titanium screws, Endobutton-suture wheel, Endobutton-Mersilene tape are available for fixation of the graft. Graft fixation is the crucial step because without proper fixation stability cannot be offered to the knee. Again there is no clear-cut demarcation about which fixation method is best.

MATERIALS AND METHODS
This study was conducted in the Department of Orthopaedics, Institute of Post Graduate Medical Education & Research and S.S.K.M. Hospital, Kolkata-20, from December 2011 to October 2013. In this
prospective randomised study, 40 patients (40 knees) were taken into consideration.

Study population

Patients attending Orthopaedics OPD of IPGME&R, SSKM Hospital with isolated traumatic ACL tears of more than 2 months duration, in the age group 20-50 years of age, symptomatic knee instability, positive Pivot shift test, Lachman test and confirmed by MRI findings.

Inclusion Criteria

- Isolated, traumatic ACL tear.
- More than 2 months duration.
- Symptomatic knee instability.
- 20-50 years of age.
- Positive Pivot-shift test.
- Positive Lachman test.
- MRI finding suggesting ACL tear.

Exclusion Criteria

- Non traumatic ACL tear.
- ACL tears lesser 2 month duration.
- Less than 20 years or more than 50 years of age.
- Non demanding patient.
- ACL tear associated with other ligament injuries.

Outcomes were defined on the basis of regaining pre injury status of the knee in respect of movement, stability of the knee, reduction in pain, swelling and returning to one’s normal activity level. Outcome evaluation was done by preoperative and postoperative clinical and radiological findings, and Tegner-Lysholm score.

RESULTS

In this prospective randomised study, 40 patients (40 knees) were taken into consideration. Among them 38 (95%) were males and 2 were females (5%). All the patients were followed up at least for six months. Outcomes defined on the basis of regaining pre injury status of the knee in respect of movement, stability of the knee, reduction in pain, swelling and returning to one’s normal activity level. Outcome evaluation was done by preoperative and postoperative clinical and radiological findings, Tegner-Lysholm score.

The above table shows that majority of the patients were male (95%). Among the affected males mostly were from age group 20-29 years, and among the affected females majority were from age group 40-50 years. The average age of affected
The table below shows the Lysholm Knee Score of patients at the time of presentation, at 1 month, and at 6 months postoperative follow-up:

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Age</th>
<th>Sex</th>
<th>Lysholm Knee Score</th>
<th>1 Month</th>
<th>6 Months</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>M</td>
<td>62</td>
<td>72</td>
<td>90</td>
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<tr>
<td>2</td>
<td>22</td>
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<td>3</td>
<td>20</td>
<td>M</td>
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<td>72</td>
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<tr>
<td>4</td>
<td>20</td>
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<td>74</td>
<td>84</td>
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<td>5</td>
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<td>M</td>
<td>57</td>
<td>76</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 6: Lysholm knee score of the patients at the time of presentation, at 1 month and at 6 month postoperative follow-up.

The table shows that average Lysholm score of the patients at the time of presentation was 68.1. At 1 month postoperative follow-up the average score was 74.4 and at 6 month postoperative follow-up the average score was 94.1.

Evaluation of results of different methods of fixation in arthroscopic ACL reconstruction using semitendinosus graft: Statistical analysis.

Software Used
- GraphPad Prism version 5 [San Diego, California: GraphPad Software Inc., 2007]
Thus there is significant difference between groups in Age and Duration of FU, but not in other parameters compared.

**Comparison of change over time in Group 1**
Repeated measures ANOVA followed by Tukey’s test for multiple comparison if ANOVA returns p value < 0.05

LKS
Repeated measures ANOVA  No. of datasets 3  F value 54.066  p value < 0.001

<table>
<thead>
<tr>
<th>Tukey’s Multiple Comparison Test</th>
<th>Mean Diff.</th>
<th>q</th>
<th>P value</th>
<th>95% CI of diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>LKS_B vs LKS_1m</td>
<td>-14.000</td>
<td>8.6738</td>
<td>&lt; 0.001</td>
<td>-19.825 to -8.1749</td>
</tr>
<tr>
<td>LKS_B vs LKS_6m</td>
<td>-23.600</td>
<td>14.622</td>
<td>&lt; 0.001</td>
<td>-29.425 to -17.775</td>
</tr>
<tr>
<td>LKS_1m vs LKS_6m</td>
<td>-9.6000</td>
<td>5.9477</td>
<td>&lt; 0.01</td>
<td>-15.425 to -3.7749</td>
</tr>
</tbody>
</table>

**Comparison of change over time in Group 2**
Repeated measures ANOVA followed by Tukey’s test for multiple comparison if ANOVA returns p value < 0.05

LKS
Repeated measures ANOVA  No. of datasets 3  F value 55.775  p value < 0.001

<table>
<thead>
<tr>
<th>Tukey’s Multiple Comparison Test</th>
<th>Mean Diff.</th>
<th>q</th>
<th>P value</th>
<th>95% CI of diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>LKS_B vs LKS_1m</td>
<td>-14.800</td>
<td>8.0879</td>
<td>&lt; 0.001</td>
<td>-21.404 to -8.1959</td>
</tr>
<tr>
<td>LKS_B vs LKS_6m</td>
<td>-27.300</td>
<td>14.919</td>
<td>&lt; 0.001</td>
<td>-33.904 to -20.696</td>
</tr>
<tr>
<td>LKS_1m vs LKS_6m</td>
<td>-12.500</td>
<td>6.8310</td>
<td>&lt; 0.001</td>
<td>-19.104 to -5.8959</td>
</tr>
</tbody>
</table>

**Comparison of change over time in Group 3**
Repeated measures ANOVA followed by Tukey’s test for multiple comparison if ANOVA returns p value < 0.05

LKS
Repeated measures ANOVA  No. of datasets 3  F value 99.656  p value < 0.001

<table>
<thead>
<tr>
<th>Tukey’s Multiple Comparison Test</th>
<th>Mean Diff.</th>
<th>q</th>
<th>P value</th>
<th>95% CI of diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>LKS_B vs LKS_1m</td>
<td>-18.100</td>
<td>13.708</td>
<td>&lt; 0.001</td>
<td>-22.657 to -13.543</td>
</tr>
<tr>
<td>LKS_B vs LKS_6m</td>
<td>-25.650</td>
<td>19.425</td>
<td>&lt; 0.001</td>
<td>-30.207 to -21.093</td>
</tr>
<tr>
<td>LKS_1m vs LKS_6m</td>
<td>-7.5500</td>
<td>5.7178</td>
<td>&lt; 0.001</td>
<td>-12.107 to -2.9934</td>
</tr>
</tbody>
</table>

Evaluating the results of different methods of fixation, no statistically significant difference was found regarding outcome.
DISCUSSION

Anterior cruciate ligament is the most commonly injured ligament which provides stability to the knee. Earlier, ACL reconstruction was done by open methods but with time this went out of favour due to various drawbacks like risk of infection, long term hospital stay, joint stiffness, loss of working days, prolonged rehabilitation, and advent of arthroscopy.

Arthroscopic reconstruction with tendon graft is now the gold standard for the treatment of ACL tear. Among the different graft materials autologous semitendinosus graft is preferred. (1) The method of fixation of the graft is of primary importance as it is the weakest link and mainly responsible for complications. Without proper fixation the graft cannot withstand the stress generated to keep the knee stable. This study dealt with the results of different methods of fixation in arthroscopic ACL reconstruction using semitendinosus graft.

Selection of 40 patients by proper clinical and radiological evaluation was based on the inclusion criteria. Among them 38 patients (95%) were male, 2 patients (5%) were female. Among the affected males, most were from the age group 20-29 years, and among the affected females majority were from age group 40-50 years. The average age of affected males was 29.1 years and females were 41.5 years. The male: female ratio was 19:1.

Most of the cases (25, 62.5%) were operated within 2-6 months, 27.5% cases were operated within 7-12 months, only 4 cases (10%) were operated after 12 months.

Patients were divided in three groups according to the method of fixation chosen. Endobutton-Mersilene tape/loop for femoral tunnel and Bioscrew for tibial tunnel was chosen as fixation method for 20 (50%) patients (group-III), Titanium screw for both the tunnels was chosen as fixation method for 10(25%) patients (group-I), Bioscrew for both tunnels chosen as fixation method for another 10(25%) patients (group-II).

In our study more than 75% patients were followed up for 13-22 months, 15% patients were followed up for 7-12 months and only 10% patient were followed up for 6 months.

The average Lysholm score of the patients at the time of presentation preoperatively was 68.1. At 1 month postoperative follow-up the average score was 74.4 and at 6 month postoperative follow-up the average score was 94.1. The average Lysholm score at 6 month postoperative follow-up for Group-I patients was 93.1. The average Lysholm score for Group-II patients at 6 month postoperative follow-up was 93.4. For Group-III patients the Lysholm score at 6 month follow-up was 96.6. For all three Groups the scores were marked excellent. According to Lysholm score the criteria for grading the outcome were:

- Poor – a score < 65;
- Fair – a score of 65-83;
- Good – a score of 84-90;
- Excellent – a score >90.

Lachman test & Pivot-shift test were negative at 1 month and 6 months follow-up for all the patients.

Complications like superficial infection was noted in 3 patients, recurrent knee effusion occurred in 2 patients. No case of graft fixation failure requiring repeat surgery was noted.

Outcome was measured with preoperative and postoperative clinical evaluation and by the Tenger-Lysholm scoring system. No significant difference was found between the three groups regarding outcome.

Most of the studies showed that there was no significant difference between bioabsorbable fixation material and metallic fixation devices regarding clinical outcome: pain, swelling- with- activity & range of motion. Thus bioabsorbable screw provided a reasonable alternative to titanium screw (5) and the results were comparable.

The serial follow-up study showed significant improvement in outcome in all three groups. The
outcome for individual groups were found to be excellent as also the average Lysholm score.

In our study we evaluated 40 patients. The results could have been more significant had the study population been a larger one with a longer follow up.

**SUMMARY AND CONCLUSION**

The prognosis for a torn ACL after conservative management is often unfavourable, with the recovery and rehabilitation period usually very long. Even patients with partial ACL tears may have instability after conservative management. Nonoperative treatment is a viable option for those who are willing to make lifestyle changes and avoid activities that cause recurrent instability. [16] Arthroscopic reconstruction with tendon graft is now the standard option for the treatment of ACL tear. Among the different graft materials, autologous semitendinosus graft is a preferred one.

For fixation of the graft, available fixation devices are either bioabsorbable or metallic. Studies done in this field comparing the outcome between bioabsorbable and titanium fixation devices showed no significant differences. (7,8,10,11)

We selected 40 patients by proper clinical and radiological evaluation based on our inclusion criteria. Among them 38 patient (95%) were males and 2 patients (5%) were females. Among the affected males most were from age group 20-29 years, and among the affected females majority were from age group 40-50 years. The average age of affected males was 29.1 years and females were 41.5 years. The male: female ratio was 19:1

In conclusion, this procedure benefitted all the end-users with excellent results.

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