

ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT TEARS: OUR EXPERIENCE

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ABSTRACT: BACKGROUND: Anterior knee instability associated with rupture of the ACL (Anterior Cruciate Ligament) is a disabling clinical problem. The ACL has a poor capacity for intrinsic repair. Thus for patients who have knee symptoms related to ACL deficiency, one may consider ligament reconstruction as a means of stabilizing the Tibio-Femoral articulation and restoring high level function of the knee joint. Arthroscopically assisted ACLR (ACL Reconstruction) has the advantage of being minimally invasive, accurate graft placement, less disturbance of normal tissue resulting in quicker recovery and rehabilitation, minimal hospital stay and very less infection rate. **MATERIAL AND METHODS:** Between April 2012 to May 2013, 30 patients who underwent arthroscopic assisted ACL reconstructions using either bone-patellar tendon-bone auto graft (BTB) or Quadrupled hamstring auto graft (QHG) or Quadriceps tendon graft (QTG) in the Department of Orthopaedics and Traumatology, Osmania Medical College, Hyderabad, Andhra Pradesh is the material in our study. **CONCLUSIONS:** Arthroscopic reconstruction of Anterior Cruciate Ligament is a reliable, safe procedure. It helps in the early restoration of function and stability of the Knee joint and helps the patient to get back to his normal activity much earlier than with the traditional open surgical methods. The choice of the graft does not play a major role in the function of the knee in the long run. **KEYWORDS:** ACL Injuries, Arthroscopic Repair, Good Functional Outcome.

INTRODUCTION: It is said that Anterior cruciate ligament ruptures are "The beginning of the end of Knee".¹

The Anterior Cruciate ligament is weaker of the two cruciate ligaments and probably due to this it is more frequently torn than the posterior cruciate ligament, especially in athletic activities.² Anterior knee instability associated with rupture of the ACL is a disabling clinical problem, leading to Instability of the knee joint and early onset of Osteoarthritic changes.^{3,4,5} the ACL has a poor capacity for intrinsic repair. Thus for patients who have knee symptoms related to ACL deficiency, one may consider ligament reconstruction as a means of stabilizing the tibio-femoral articulation and restoring high level function of the knee joint.

Numerous authors have described successful reconstruction of the ACL with use of a donor auto graft (Patellar tendon, hamstring tendon, or quadriceps tendon) and allografts (Achilles tendon, patellar tendon, hamstring tendon, or tibialis anterior tendon).^{6,7,8,9,10} anterior Cruciate Ligament Reconstruction (ACLR) has been attempted using Silver wire, Fascia lata, and Iliotibial band. To date more than 400 different techniques have been described for the ACL reconstruction from open to arthroscopic technique. The bone patellar tendon bone is the most commonly used graft in ACLR.^{11,12,13,14,15} however, concerns regarding problems with the extensor mechanism of the knee, loss of motion, patella infra, patellar fracture and the development of chronic anterior knee pain have promoted surgeons to seek other graft materials for use in ACL reconstruction.

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As such the semitendinosus and gracilis tendon represent an alternative auto graft donor material that may be used for the reconstruction of ACL without disturbance of the extensor mechanism. The autologous quadriceps tendon is thought to come somewhere in between the bone patellar tendon bone graft and the hamstring tendon graft in terms of donor site morbidity and the strength of the graft fixation. In 1954, the development of Arthroscope brought new possibilities to the field of knee surgery. Since 1982, the ACLR has often been performed arthroscopically.

Arthroscopically assisted ACLR has the advantage of being minimally invasive, accurate graft placement, less disturbance of normal tissue resulting in quicker recovery and rehabilitation, minimal hospital stay and very less infection rate. ACLR with hamstring tendon is becoming increasingly popular in patients with symptomatic instability and in appropriately selected patients can yield successful and satisfactory results.

The cells of a quadrupled hamstring tendon graft probably survive intra articular implantation, but the cells of a bone patellar tendon bone graft do not. The quadrupled hamstring tendon graft is nourished by synovial fluid and doesn't depend on revascularization for viability.

There are a wide variety of fixation devices for the quadrupled hamstring tendon graft; however only a few provide better strength and stiffness than interference screw fixation of bone patellar tendon bone graft at implantation. Aggressive rehabilitation is safe with both types of autogenous graft as long as strong, stiff fixation methods are used.

There is fair evidence that patients reconstructed with hamstring graft report less morbidity than those reconstructed with bone patellar tendon bone graft. The improvement of stability with bone patellar tendon bone graft compared with 4 strand hamstring graft remains of questionable importance for most patients. The present study is designed to analyze the post-operative outcome of arthroscopic ACLR with various auto grafts fixed in femoral and tibial tunnels using interference screws.

OBJECTIVES:

1. To know the functional outcome of ACLR using different grafts.
2. To list and evaluate the complications encountered with anterior cruciate ligament reconstruction in different methods.
3. To analyze and compare the result with the standard published data in the literature.

Functions of ACL¹⁶:

1. The ACL is the primary restraint to anterior tibial translation on femur in flexion (Clinically assessed by the anterior drawer test). With the ACL resisting 86% of the total resisting forces on the anterior drawer test.
2. Preventing the hyperextension of the knee.
3. Checking the internal axial rotation of tibia and thereby it affords rotatory knee control acting as a secondary restraint to prevent excessive valgus and varus.
4. Fine tuning of the screw home stabilization of the knee joint as it approaches terminal extension.
5. Proprioceptive properties.

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Mechanism of Injury: ACL and PCL injuries are significant events that can occur with virtually any mechanism of injury, if the force is sufficient to cause permanent deformation. As a rule ligaments can stretch to 10-25% of the usual resting length. Mechanism of injury can either be direct or indirect.

Palmer described four mechanisms of injury to the ligament.¹⁷:

1. Abduction, Flexion and Internal rotation of femur on tibia.
2. Abduction, Flexion and External rotation of femur on tibia.
3. Hyperextension.
4. Antero-posterior displacement.

Abduction, flexion and internal rotation is the commonest mechanism and if the injury is sever it can result in the "O'DONOGHUE" triad.¹⁸ i.e. an injury to ACL, MCL and medial meniscus Hyperextension is the second most common mechanism of injury to the ACL. Disagreements still exist about the incidence of isolated tears. All supporting structures about the knee function in concert and probably no single ligament can be disrupted without sustaining some degree of injury to the other supporting structures. The injury to the supporting structure may be minimal and may heal with conservative measures leaving what is apparently and isolated injury of the ACL on clinical examination.

Treatment Options for ACL Injury: The management goal of the ACL – injured patients is to prevent recurrent knee injury while allowing the patient to return to his desired work and level of sports participation. Some patients are able to cope with their injury without sustaining further injuries. Younger, more active individuals who are unwilling to modify their activity level should be considered for surgical management.

Non-operative Indications: Those with isolated injury, intrinsic damage or partial tear, who are willing to modify their activities that cause pain, swelling and instability.

AIM:

1. Resolve inflammation.
2. Restore range of motion.
3. Regain muscle power.
4. Protecting knee from further injury.

OPERATIVE METHODS:

1. Direct repair.
2. Repair with augmentation.
3. Reconstruction –Extra-articular.
 - Macintosh.
 - Modified Macintosh.
 - Andrews.
- Intra Articular.
 - Arthroscopic ACLR.

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MATERIALS AND METHODS: Between April 2012 to May 2013 all patients who underwent arthroscopic assisted ACL reconstructions using either bone-patellar tendon-bone auto graft or quadrupled hamstring auto graft or quadriceps tendon graft in the Department of Orthopaedics and Traumatology, Osmania Medical College, Hyderabad, Andhra Pradesh is the material in our study.

Inclusion Criteria: All patients with ACL Tear age groups between 18 to 45 years. History of repeated & episodic knee instability (ACL tear) with no evidence of clinical and radiological degenerative change in the knee joints.

Exclusion Criteria: Patients with ACL tear in age groups less than 18 and greater than 45 years Patients with ACL tears with associated injuries of tibial or femoral condyles Patients with ACL tears with tri-compartmental osteo-arthritis of knee joint Contra-lateral ACL deficiency Bilateral ACL Revision Previous knee operation Concomitant medical illness or geographic constraints that precluded follow up evaluation.

PROCEDURE: All the patients were selected into the study based on inclusion and exclusion criteria. The type of surgery was arthroscopic guided anterior cruciate ligament reconstruction with Bone Tendon Bone Graft (BTB), Quadriceps Harvested Graft (QHG) and Quadriceps Tendon GRAFT (QTG). The fixation of the graft is achieved with cannulated interference screw both proximally (Femoral) and distally (tibial). All the patients were follow-up periodically 3 months, 6 months, 1 year, and 18 months.

In the present study, a total number of 30 patients underwent anterior cruciate ligament reconstruction in which BTB tendon graft was used in 13 patients, QHG in 13 and QTG in 4.

Out of this 29 patients were male and 1 patient was female. All the patients were kept on a standard postoperative ACL rehabilitation protocol. Outcome was measured using Lysholm knee score, anterior drawer test, Range of motion of the knee joint and Quadriceps power of ipsilateral knee.

After the patient is clinically and radio-logically (Magnetic Resonance Imaging) diagnosed to have tear, and after meeting inclusion criteria, the patients were taken up for ACL reconstruction. All the patients were followed up at regular interval i.e., 3 months, 6 months, 12 months and 18 months (Prospective study). In our study we have used autologous BTB/QHG/QTG in the patients for ACL reconstruction. In all the patients the graft is fixed with interference screw (Titanium or Bio absorbable) on femoral and tibial sides.

EVALUATION OF RESULTS: All the patients were evaluated periodically at 3 months, 6 months, 12 months, and 18 months. The minimum period of follow up was 6 months.

The standard protocol of Lysol knee scoring system is used for evaluation of the results of the surgery during follow up. At each follow up along with subjective evaluation, the following clinical examinations were also done.

- Ligament laxity was assessed using Lachman's test, Anterior drawer's test and Pivot shift test.
- Range of motion of the operated knee was noted and compared with the opposite knee.
- Knee extension or straight leg raising (quadriceps power) was assessed.

Subsequent steps differ for each of the three different grafts used in the study. The technique of each of them is described separately.

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Observations: In our study of Arthroscopic Anterior Cruciate Ligament reconstruction using autologous bone-patellar tendon-bone graft or quadrupled hamstring graft and quadriceps tendon graft, a total of 30 cases were operated and followed up. Minimum follow up period was six months and patient follow up was done for a maximum of eighteen months period.

Age Distribution: (TABLE No. 1, Fig 1): Majority of patients i.e. 13(43.34%) patients in our study were in the age group of 18-24 years, 10(33.33%) were in the age group of 25-31 years, 4 (13.33%) were in the age group of 32-38 and 3(10%) were in the age group of 39-45.

Sex Distribution: (Table No. 2, Fig 2 & 3): Male predominance was found in our study. 29 (96.6%) patients were males and 1(3.4%) patient was female. This probably because males are more frequently involved in sports and road traffic accidents.

Laterality (Table No. 3 & Fig 4): Left knee was affected in 12(40%) patients and Right knee was affected in 18(60%) patients. There was not much difference in lateralization of the injury.

Associated Injuries (Table 4): Twelve patients in our study had isolated ACL tears and rest had associated injuries to menisci in ipsilateral knee. Two patients had associated lateral meniscal tear, sixteen patients had medial meniscal tear.

Average Lysholm Score (Fig 5): We have used the Lysholm score for subjective evaluation of all our patients at each follow up. The following are the parameters and the maximum points given for each. Parameters (100 points):

1. Limp (5 points)
2. Support (5 points)
3. Stair climbing (10 points)
4. Squatting (5 points)
5. Instability (30 points)
6. Pain (30 points)
7. Swelling (10 points)
8. Atrophy of thigh (5 points)

In our study Lysholm score was done at 3 months, 6 months, and 1 year. Average Lysholm score for the patients for whom BTB graft was used at 3 months was 80.46, at 6 months 86.30, and at 1 year it was 91.33.

For patients in whom Quadrupled hamstring graft was used the average Lysholm score at 3 months was 81.69, at 6 months 88.00, and at 1 year it was 92.33.

For patients in whom quadriceps tendon graft was used the average Lysholm score at 3 months was 76.25, at 6 months 82.00, and at 1 year it was 92.00.

Other Parameters were also used to Evaluate the Patients Clinically like:

- I. Instability was assessed using anterior drawer test, Lachman test and pivot shift test.
- II. Range of motion of the knee was compared with the contra lateral side.
- III. Quadriceps muscle strength was assessed by using MRC grading for muscle.

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Anterior Drawer Test (Table 5, 6, 7): At 3 Months follow up 28(93.33%) patients had negative anterior drawer test. 2(6.67%) patients had 1+laxity. This is due to poor post-operative rehabilitation.

At 6 months follow up 29 (96.6%) patients had negative anterior drawer test, 1 (3.4%) patients had mild (1+) laxity.

Anterior drawer test was negative in 29(96.6%) patients. These patients had no instability at 1 year follow up during activities like running or climbing up and down stairs. 1 patient (3.4%) had 1+laxity. These patients had no instability while walking. None of the patients had pivot shift testpositive.

Range of Motion Operated Knee (Table 8, 9, 10): In our study of 30 patients, at 3 Months follow up 27(90%) patients had normal range of motion of the operated knee, at 6 months follow up 28(93.34%) patients had equal range of motion compared to normal contra-lateral side, and at 1 year follow up 29(96.67%) patients had equal range of motion compared to contra-lateral side. of all patients in whom full range of movements couldn't be achieved two of them had ACLR with BTB graft, and one with QHG.

Quadriceps Power (Table 11, 12, 13): At 3 Months follow up only 20 patients (66.67%) had grade of 5/5 (MRC) power in Quadriceps muscles this is because of poor rehabilitation. At 6 Months 23 patients (76.67%) had grade 5/5 power. At 1 year follow up all the 10 patients had grade 5/5 power. This shows that there was significant improvement in Quadriceps muscle strength at long term follow up with good rehabilitation program.

Various Complications (Table 14):

In the present study three complications were noted i.e.,

1. Anterior knee pain.
2. Superficial infection.
3. Extensor Lag.

Out of 30 patients, three patients developed anterior knee pain during first 3 Months. Treatment received in the form of Non-Steroidal Anti Inflammatory Drugs and physical therapy and modified rehabilitation program to avoid any concentric-resisted quadriceps exercises, patients are relieved of pain by 6 months. In all of them BTB graft was used.

1 patient out of 30 developed superficial infection at tibial site and received treatment in the form of intravenous Ceftriaxone 1gm twice a day for 10 days thereby infection subsequently subsided.

In the present study three patients had Extensor lag at 3 Months follow up for whom vigorous physiotherapy was done. All of them had BTB graft ACLR.

DISCUSSION: The present study of Arthroscopic guided anterior cruciate ligament reconstruction using BTB, QHG and QTG grafts was done during the period of April 2012 to May 2013, at Osmania Medical College & Hospital, Afzalgunj, Hyderabad. A total of 30 cases were considered for this study.

Outcome was measured using Lysholm knee score, anterior drawer test, Range of motion of the knee joint and Quadriceps power of ipsilateral knee. And result of the present study was compared with studies of Patel et al. 2010¹⁹, Jomha et al. 2008.²⁰ and Bach et al. 2008.²¹

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Average age at surgery in the present study group was 27 years and that of Patel et al. 2000 was 33 years and that of Jomha et al. 1999 was 26 years and Bach et al. 1998 was 25 years.

Average duration of follow-up of the present study was 10 months with a minimum follow-up period 6 months and maximum follow-up period was 24 months. Average duration of follow-up Bach et al. 1998 was 26 months. Average age at surgery in the present study group was 27 years and that of Patel et al. 2000 was 33 years and that of Jomha et al. 1999 was 26 years and Bach et al. 1998 was 25 years. (Table 16)

It is observed that anterior drawer test was negative in 93.33% of patients at 3 months, 96.6% of patients at 6 months and at 1 year 96.6% of patients had negative anterior drawer test. Full range of motion attained in 90% of patients at 3 months, 93.34% of patients at 6 months and at 1 year 96.67% of patients. Postoperatively no patient in our study had pivot shift positive.

The measured Lysholm score of Patel et al. 2000 at the end of the study was 89, Jomha et al. 1999 at the end of the study was 94, Bach et al. 1998 at the end of the study was 90 and our study average Lysholm score at the end of the study is 92.

The measured Lysholm score of Patel et al. 2000 at the end of the study was 89, Jomha et al. 1999 at the end of the study was 94, Bach et al. 1998 at the end of the study was 90 and our study average Lysholm score at the end of the study is 92. (Table 17).

Associated meniscal injuries and their treatment, (Table 18) 40% of patients in Patel series had meniscal tears, majority of them being in medial meniscus (77%) and the remaining in the lateral meniscus which were treated by menisectomy.

In Bach's series 52% of the patients had meniscal injuries and were treated by medial menisectomy (34%) and 42% were by lateral menisectomy.

In our study we had 60% of the patients with associated meniscal injuries, of which 89% were treated by medial menisectomy and 11% by lateral meniscus excision.

In the present study no patient had Pivot Shift Test positive Post-operatively (Table 19)

CONCLUSIONS: Arthroscopic reconstruction of Anterior Cruciate Ligament is an established method of treating Anterior Cruciate Ligament injuries. It is the method of choice of treating these debilitating injuries. It is a reliable and safe procedure. Though the graft used can be of different types the end result rests on the expertise of the surgeon, correct alignment of the graft in the tunnel and secure fixation, and in preventing the laxity of the graft.

Our study corroborated the findings of several similar studies done earlier that the choice of the graft will not have a permanent bearing on the successful outcome of the surgery. In the long run all graft materials behave equally and that the choice of the graft material is an individual choice of the treating surgeon depending upon his preference, training and his experience.

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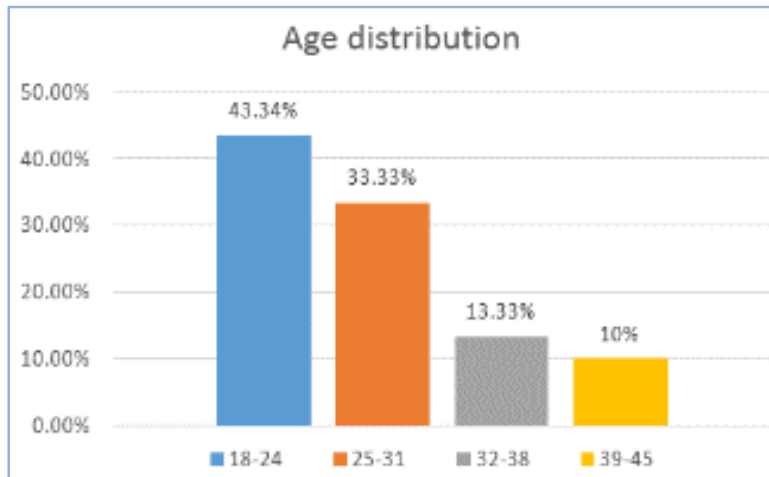


Fig. 1: BAR Diagram Showing the AGE GROUP

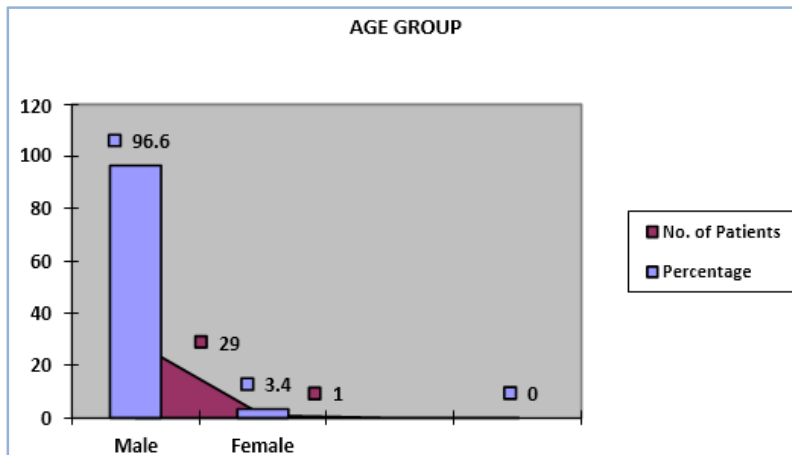


Fig. 2: BAR Diagram Showing the SEX DISTRIBUTION

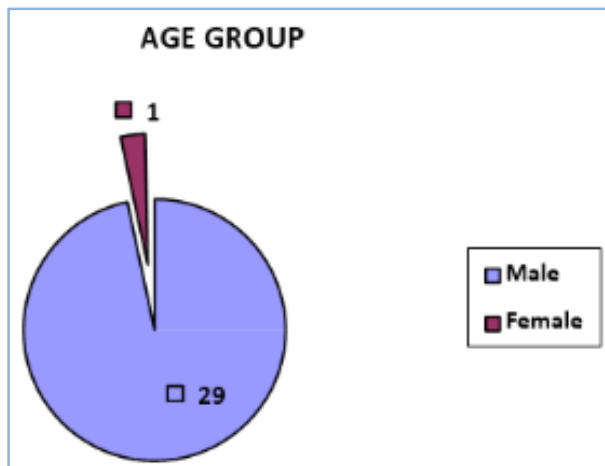


Fig. 3: PIE Diagram Showing the SEX DISTRIBUTION

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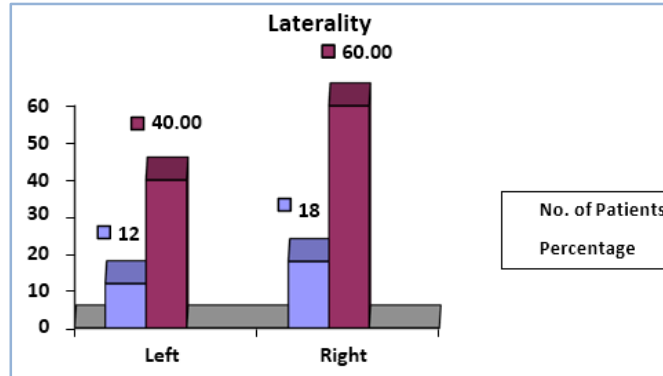


Fig. 4: Column Diagram Showing the LATERALITY

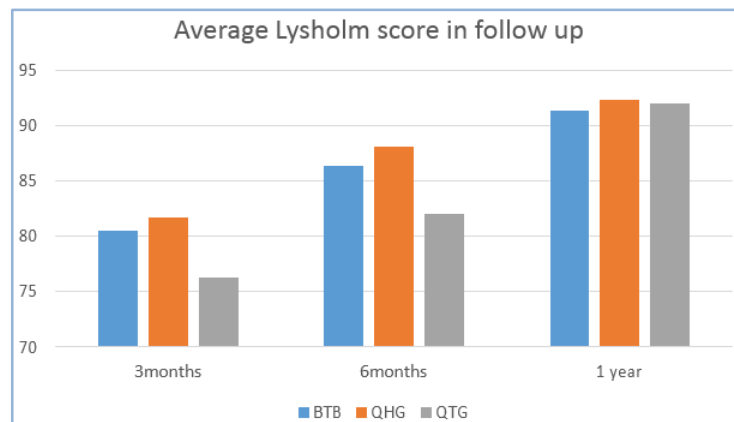


Fig. 5: Average Lysholm score in follow up

Age Group (Yrs.)	No. of Patients	Percentage
18-24	13	43.34%
25-31	10	33.33%
32-38	04	13.33%
39-45	03	10.00%

Table 1: Age Group (n=30)

Sex	No. of PTS	Percentage
Male	29	96.6%
Female	1	3.4%

Table 2: Sex Distribution (n=30)

Side	No. of PTS	Percentage
Left	12	40%
Right	18	60%

Table 3: Laterality (n=30)

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Structures Involved	No. of Patients
ISOLATED ACL TEAR	12
ACL+LM TEAR	2
ACL+MM TEAR	16

Table 4: Associated Injuries (n=30)

Test Result	No. of Patients
NEGATIVE	28 (93.33)
1+	2 (6.67%)

Table 5: Anterior Drawer Test At 3 Months Follow Up (n=30)

Test Result	No. of Patients
NEGATIVE	29 (96.6%)
1+	1 (3.4%)

Table 6: Anterior Drawer Test at 6 Months Follow Up (n=30)

At 6 months follow up 29 (96.6%) patients had negative anterior drawer test, 1(3.4%) patients had mild (1+) laxity.

Test Result	No. of Patients
NEGATIVE	29(96.6%)
1+	1 (3.4%)

Table 7: Anterior Drawer Test at 1 Yr. Follow up (n=30)

Decreased ROM	No. of Patients
No Decreased ROM	27 (90%)
Up to 10 Degree	3 (10%)

Table 8: Range of Motion (ROM) at 3 Months of follow up (n=30)

Decreased ROM	No. of Patients
No Decreased ROM	28(93.34%)
Up to 10 degree	1(3.33%)
>20 degree	1(3.33%)

Table 9: Range of Motion (ROM) of operated knee at 6 Months of follow up (n=30)

Decreased ROM	No. of Patients
No Decrease ROM	29(96.67%)
>10 degree	1(3.33%)

Table 10: Range of Motion (ROM) of operated Knee at 1 Yr. Follow up (n=30)

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Grade	No. of Patients
3/5	4(13.33%)
4/5	6(20.00%)
5/5	20(66.67%)

Table 11: Quadriceps Power (MRC Grade) at 3 Months (n=30)

Grade	No. of Patients
3/5	2(6.67%)
4/5	5(16.66%)
5/5	23(76.67%)

Table 12: Quadriceps Power (MRC Grade) At 6 Months (n=30)

Grade	No. of Patients
4/5	0(0.00%)
5/5	10(100%)

Table 13: Quadriceps Power (MRC GRADE) at 1 Year (n=10)

Complications	No. of cases	Treatment Given
Anterior knee pain	03	NSAIDS
Infection (Superficial)	01	Intravenous antibiotics
Infection (Deep)	0	
Extensor Lag	03	Rehabilitation

Table 14: Complications

Author & Year of Publisher	Graft used	Technique	Femoral Fixation	Tibial Fixation
Patel 2010	Ipsilateral autogenous BTB/QHG	Arthroscopic	Interference screw	Interference screw
Jomha 20008	Ipsilateral autogenous BTB/QHG	Arthroscopic	Interference screw	Interference screw
Bach 2008	Ipsilateral autogenous QTG/BTB	Arthroscopic	Interference screw	Interference screw
Our Study	Ipsilateral autogenous BPTB/QTG/QHG	Arthroscopic	Interference screw	Interference screw

Table 15: Surgical Protocol

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Author & Year of Publisher	No. of Patients	Follow up	Mean age at surgery	Mean Follow up interval (mo.)	Gender
Patel 2010	32	73%	33 Years	30	75% Male
Jomha 2008	59	74%	26 Years	24	73% Male
Bach 2008	103	81%	25 Years	26	63% Male
Our Study	30	85%	27 Years	10	96.6% Male

Table 16: Patient Variables

Author & Year of Published	Average LYSHOLM Score
Patel 2010	89
Jomha 2008	94
Bach 2008	90
Our Study	91.86

Table 17: Lysholm Knee Score

Author & Year of Publisher	Patients with Meniscal Tears (%)	Meniscal Tears treated by PMM (%)	Meniscal Tears treated by PLM (%)
Patel 2010	40	77	23
Jomha 2008	N/A	31	25
Bach 2008	52	34	42
Our Study	60	89	11

Table 18: Meniscal Disease at Reconstruction

PMM -Partial Medial Meniscectomy, PLM -Partial Lateral Meniscectomy.

Author and Year Published	Postoperative Grade (%)			
	0	1+	2+	3+ or 4+
Patel 2000	91	N/A	N/A	N/A
Jomha 1999	76	22	2	0
Bach 1998	91	9	0	0
Our Study	100	0	0	0

Table 19: Pivot Shift Examination

In the present study no patient had Pivot Shift Test positive Post-operatively

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