

Prospective Study of Clinical Outcome of Arthroscopic ACL Reconstruction by Autologous Bone-Patellar Tendon-Bone Graft using Interference Screws

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Abstract:

Background and Objectives: The anterior cruciate ligament (ACL) is injured frequently during sports participation. Arthroscopic evaluation of patients with an acute traumatic hemarthrosis of the knee has demonstrated repeatedly a 60% to 70% incidence of ACL injury. Furthermore, the incidence of associated meniscal injury at the time of acute ACL injury approaches 50%. Once the decision is made to proceed with ACL reconstruction, a variety of graft choices and surgical procedures are available. Historically, surgical treatment of ACL injuries involved an arthrotomy to repair or reconstruct the ACL. Advances in arthroscopic techniques have led to the use of both two-incision arthroscopically assisted techniques and one-incision endoscopic techniques for ACL reconstruction. Advantages of arthroscopic techniques include improved cosmesis, less disruption of the quadriceps mechanism, improved early rehabilitation, and maintenance of articular cartilage hydration. To study the short term functional outcome of arthroscopically assisted ACL reconstruction using autologous bone patellar tendon bone graft using interference screws and comparing between biodegradable and non-biodegradable groups in terms of Post operative knee stability, subjective knee functions.

Materials and Methods: This study was conducted in Adult patient of either sex having Anterior cruciate ligament injury with or without associated meniscal injuries who are admitted to NMCH Patna. During this period 30 cases of adult patients with ACL knee were selected according to inclusion criteria.

Conclusion: Arthroscopic anterior cruciate ligament reconstruction with bone- patellar tendon-bone autograft is an excellent treatment option and provides a stable knee with minimal complications for anterior cruciate ligament deficient knees. Because of the superior results in the bioscrew group in our study, we found the potential advantages of using bioscrews compared to metal screws sufficient to warrant the routine use of PLLA screws in ACL-reconstructions.

Keywords: Anterior Cruciate ligament, Bone patella bone tendon, Biodegradable screws, Non-biodegradable screws.

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Introduction

The knee joint is the largest and probably the most complex joint within the human body. Its position between the two longest lever arms of the skeleton makes it vulnerable to injury by the tremendous moments that can be transmitted to it from loads applied at great distance to the ligaments and capsular structures that provide the structural integrity of the joint [1] The knee joint is the most commonly injured of all joints and the anterior cruciate ligament is the most commonly injured ligament [2]. The modern high speed vehicular trauma and sporting life style has led to increased ligament injuries of the knee. The anterior cruciate ligament forms the pivot in the functional congruence and stability of the knee in association with the other ligaments, capsule, muscles and bone. [3,4] The Anterior Cruciate ligament

(ACL) is the primary stabilizer of the knee and prevents the knee against anterior translation [5]. It is also important in counteracting rotational and valgus stress [6]. After ACL injury, most patients experience recurrent episodes of instability, pain and decreased function. ACL tears have been termed as the 'Beginning of the end of the knee'. Whilst some patients can be managed non-operatively with intense physiotherapy, bracing and modification of activity, severe symptoms may require reconstruction of the injured ligament. Reconstruction of ACL allows the patient to return to a pre trauma activity level and delays the occurrence of associated meniscal injury and onset of osteoarthritis [7]. The incidence of associated cartilage damage in acute tears is reported at 15 - 40% whereas it increases to 79% in chronic

tears [8]. Reconstruction is also essential to restore the stability of the knee [9]. A stable knee in turn prevents worsening of existing chondral lesions as well as occurrence of newer lesions. Arthroscopic reconstruction of torn ACL has become the gold standard in treating ACL tears [10]. The surgical reconstruction of the anterior cruciate ligament with Bone - Patellar tendon - Bone autograft represents an attempt to reestablish knee kinematics. It has the added advantage of bone to bone healing and it does not sacrifice the knee stabilizers. [11] Earlier open arthrotomy and reconstruction of the ACL was done using central third patellar tendon graft. However excessive soft tissue dissection led to complications like increased post operative pain and increased infection rate. Complaints of post surgical knee stiffness and prolonged duration of rehabilitation were other complications that led to the development of Arthroscopy assisted ACL reconstruction. The advantages were keyhole incisions, less intense inflammatory response thus reducing the post op morbidity and early recovery to full range of motion and also less potential for functional imbalance. Also the posterior aspect of knee joint can be better visualized through the arthroscope which was not possible in arthrotomy procedures.

Objectives

- Post operative knee stability.
- Subjective knee functions.
- Patient satisfaction.
- Graft site morbidity.
- Range of motion.

Material and Methods

All patients who underwent single-incision arthroscopically assisted ACL reconstructions using the bone-patellar tendon-bone graft using interference screws between 2015 and May 2019 were prospectively reviewed and compared the outcome between biodegradable and non-biodegradable screw groups. Clinical diagnosis was made by positive Anterior drawer, Lachman and Pivot shift tests. The indication for surgery was an ACL tear confirmed by clinical diagnosis and radiologically by MRI of knee joint in an otherwise healthy patient who experienced knee instability in daily activities or wished to maintain his or her pre-injury level of activities. Exclusion criteria included

contralateral ACL deficiency, bilateral ACL reconstruction, revision ACL surgery, previous knee operation, concomitant extra-articular reconstruction and concomitant medical illness or geographic constraint that precluded follow-up evaluations. All operations were performed by one surgeon.

The type of graft tissue used for reconstruction (bone-patellar tendon-bone autograft) was not randomized. The outcome testing in all cases was performed at the latest follow-up (at least one year).

The anterior cruciate ligament was reconstructed with a single-incision, arthroscopic assisted techniques. Prophylactic antibiotic was given prior to the skin incision. The bone-patellar tendon-bone autograft was harvested via a longitudinal incision (usually 4-5 cm in length) over the patellar tendon. The graft was prepared into a bone-patellar tendon-bone construct with the leading suture on the patellar side.

The following methods of statistical analysis have been used in this study.

The results for each parameter (numbers and percentages) for discrete data and averaged (mean \pm standard deviation) for continuous data are presented.

Inclusion Criteria

1. Male and Female adult patients aged more than 19 and less than 40 years with ACL injury with or without associated meniscal or chondral injuries.
2. Patients who are medically fit for surgery
3. Patients who have given Written informed consent for the surgery.

Exclusion Criteria

1. All Patients aged less than 19 and more than 40 years, PCL injury, open injuries, associated with isolated meniscal injury, fractures around knee joint, degenerative joint diseases and infections of knee.
2. Patients who are medically unfit for surgery

Patients who have not given written informed consent for surgery.

Results

Table 1: number of patients and sex distribution

Sex	Patients	Percentage
Male	25	83.33%
Female	05	16.66%
Total	30	100 %

Table 2: Age distribution (19 years – 40 years)

Age	Patients	Percentage
19-24	10	33.33%
25-30	14	40%
30-35	05	16.66%
35-40	01	3.33%

Table 3: Side affected

Side	Patients	Percentage
Right	16	53.33%
Left	14	46.66%
Total	30	100%

Table 4: Mechanism of injury

Mode	Patients	Percentage
Sports	15	50%
RTA	08	30%
Fall	07	20%
Total	30	100%

Table 5: IKDC knee examination score – post op at 1 year

IKDC Score	ACLR - Biodegradable	ACLR –Non-Biodegradable	Total	Chi square test
A -Normal	10 (66.66%)	08 (53.33%)	18 (60%)	6.68 P<0.05
B- Nearly Normal	4 (26.66%)	06 (40%)	10 (33.33%)	
C Abnormal	01 (6.66%)	01 (6.66%)	2 (6.66%)	
TOTAL	15(100%)	15 (100%)	30 (100%)	

Table 6: x-ray findings after 1 year

Grade	ACLR - Biodegradable	ACLR –Non-Biodegradable	Total	Chi square test
A- None	13 (86.66%)	12 (80%)	25 (83.33%)	6.12 P<0.05
B- Mild	02 (13.33%)	03 (20%)	05 (16.66%)	
Total	15 (100%)	15 (100%)	30 (100%)	

Only about 14% in ACLR with biodegradable group and about 20% of non- biodegradable group had mild joint space obliteration after 1 year of surgery.

About 14% in ACLR with biodegradable group and about 20% of non-biodegradable group had graft site pathology after 1 year of surgery.

Table 7: anterior knee pain after 1 year

Grade	ACLR - Biodegradable	ACLR –Non Biodegradable	Total	Chi Square Test
A- None	10 (66.66%)	08 (53.33%)	18 (60%)	6.09 P<0.05
B- Mild	04 (26.66%)	04 (26.66%)	08 (26.66%)	
C-Moderate	01 (6.66%)	03 (20%)	04 (13.33%)	
Total	15(100%)	15(100%)	30 (100%)	

About 7% in ACLR with biodegradable and 20% in ACLR with non- biodegradable group had moderate anterior knee pain at the end of 1 year after surgery. About 87% of ACLR with biodegradable screws group group an about 74% of ACLR with non-biodegradable screws group were able to do 90% and more single leg functional hop test 1 years after surgery.



Figure 1: Anterior Draw Positive

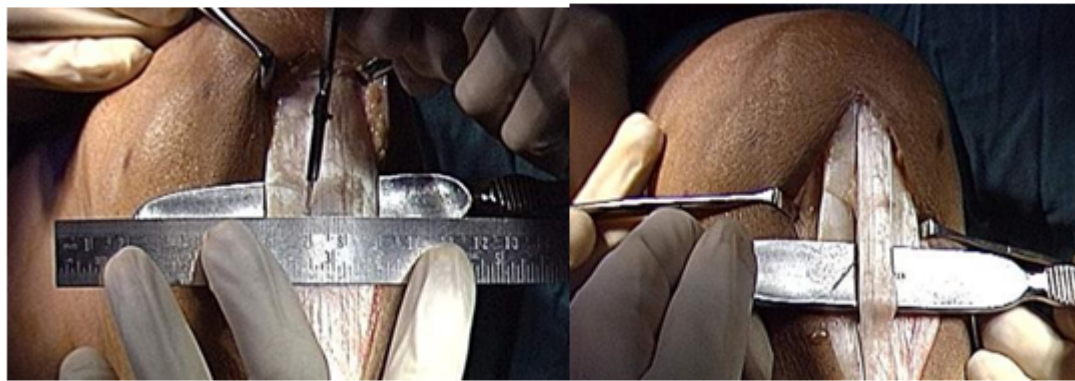


Figure 2: Incision For Patellar tendon Graft



Figure 3: Bone patellar tendon bone graft

Results

Majority of study subjects were males i.e, 25 out 30. Mean age was 28 years.

There is significant risk of associated injuries with ACL deficient knees, among group who underwent surgeries 3 months after the injury than those who underwent before 3 months.

Only 8 patients had isolated ACL injury, remaining 22 patients had ACL associated injuries.

Right side was affected in 16 patients and left side in 14 patients.

Most common mechanism of injury was sports related in 15 patients. Road traffic accident in 8 and fall in 7 patients.

About 64% of patients were able to do strenuous activities like heavy physical work in biodegradable screws group compared to 54% in non-biodegradable screws group one year after surgery with statistically significance.

About 5% in each group had knee effusion in both groups after 1 year of surgery.

Extensor lag in the range of 3-5 degrees is significantly less in biodegradable screw group i.e only about 7% when compared to 14% of non-biodegradable screws group after 1 year of surgery.

ACL laxity in the range of 3-5 mm is significantly less in biodegradable screw group i.e only about 7% when compared to 20% of non-biodegradable screws group after 1 year of surgery.

About 7% of biodegradable screws group and 20% of non-biodegradable screw group had moderate anterior knee pain at the end of one year.

All the patients at the end of 1 yr follow up were functionally evaluated based on IKDC and Tegner Lysholm knee scoring systems. Of the 30 patients 18 patients had normal result and 10 patients had nearly normal outcome. 2 of our patients had poor results (1 patient with restricted ROM and 1 with Lachmans > 6 mm with severe anterior knee pain). Of the patients taken up for the study 15 patients had improved by two grades and 11 patients had improved by one grade. 2 patients did not show any improvement and 2 had worsened.

Grade	Patients	Percentage
Normal	18	(60%)
Nearly normal	10	(33.33%)
Abnormal	2	(6.66%)
Severely Abnormal	30	(100%)

Of the 18 patients with excellent results 6 were operated upon the left knee and 12 in the right knee,

of that biodegradable screws were used in 8 patients and non-biodegradable screws in 10 patients. 10 patients had improved by 2 grades. 8 patients had improved by 1 grade. The patients of this group had a normal knee on subjective assessment. They had no symptoms post surgery on the affected knee and had a full range of motion. And the ligament examinations were also normal. All the patients had posteriorly angled tibial tunnel. Of the 6 patients with left sided ACL reconstruction 4 patients had tunnel at 1'0 clock and 2 patients at 2'0 clock position. Of the 12 with right side reconstruction 8 had femoral

tunnel at 10 '0 clock position and 4 patients at 11'0 clock position. In the lateral view 16 patients had a posterior femoral tunnel placement and 2 patients had an anteriorly placed tunnel.

Lysholm & Gillquist Knee Scoring Scale

This scale was used to evaluate functional status of our patients. We had 15 patients with excellent outcome. 9 patients with Good outcome and 4 patients had a Fair outcome and 2 patients had poor outcome.

Outcome	Patients	Percentage
Excellent	15	50%
Good	09	30%
Fair	04	13.33%
Poor	02	6.66%
Total	30	100%

In one patient screw guide wire broke while fixing the tibial tunnel and was removed under C-arm guidance through a small anteromedial arthrotomy. In one patient biodegradable screw broke which was replaced. One patient had a chip fracture patella while removing a bone block.

Discussion

The advantages of arthroscopically assisted reconstruction of the anterior cruciate ligament are that there is minimum injury to the synovial membrane of the joint and yet it achieves the goals accomplished by open operative technique. The theoretical advantage of arthroscopic surgery includes less injury to patella-femoral mechanism and possibly less frequent symptoms and contractures of the patella-femoral joint post operatively. The proper site for location of bone tunnels can be better identified by an arthroscope. In addition, the correct relationship of the graft with respect to the lateral wall of the intercondylar notch can be established. At present the most commonly used grafts for ACL reconstructions are bone-patellar tendon-bone autograft and hamstring tendon grafts. The central one third of the bone patellar tendon bone graft was used because of its excellent biomechanical properties. It is the strongest of the immediately available substitute. Precise location of its tissue ends influences joint kinematics. The graft can be placed accurately during the surgery for it to act isometrically both in its location and tension. Bone to bone healing is more secure and rapid when compared to other grafts. It does not sacrifice the knee stabilizers. The bone-patellar tendon-bone graft is time tested and has lesser complications and less significant morbidity. Fu *et al.*¹¹ and Ritchie¹² had stated that bone-patellar tendon-bone autograft is gold standard and the first choice in anterior cruciate ligament reconstruction. Also the rigid fixation of the bone graft using interferential screws adds to the stiffness of the graft

Thirty patients were included in our study. There were 15 patients in the biodegradable screws group and 15 in non-biodegradable screws. The mean age was 28 years. Majority were males 25, and 5 were females. There is significant difference between duration of injury and procedure done. More number of Late group (>3 months) had associated injuries. Manual Lachman's and anterior drawer's tests were used for stability testings. There was no difference in the number and the distribution of grading of instability in both groups. Otero *et al.* in 1993 compared the post operative success and stability of ACL reconstruction with bone-patellar tendon-bone autograft and doubled semitendinosus/ gracilis graft. He suggested that bone-patellar tendon-bone graft provides more overall knee stability. He also stated that the method of interference screw fixation adds to stability. Fox *et al.* published that anterior knee pain incidence was 3% to 17%. In three studies it was greater than 20% and in one study it was 50%. Ibrahim *et al.* in 2005 has recorded anterior knee pain in 24% patients. Marder *et al* reported anterior knee pain in 24%. In our study anterior knee pain was present in 28% of the patients. In our study in both the type of screw group 26% of the patient had mild anterior knee pain and severe in 14% of the patients of which more in non-biodegradable group which is comparable with the above studies. Goldblat *et al.* in 2005 did a meta-analysis of articles that compared both patellar tendon graft and hamstring graft and concluded that the bone-patellar tendon-bone autograft was preferred in terms of better stiffness and fewer patients with loss of flexion. Corry *et al* recognized the increased laxity in the patients operated using hamstring tendon. In another recent meta-analysis, the return to pre injury level of activity for a patellar tendon ACL reconstruction was 18% greater than for a hamstring reconstruction⁹⁶. Aglietti, O'Neill [5] and Corry concluded that greater activity level was attained in the patellar

tendon group. In our study 94% patients had functional improvement post operatively. 60% patients had improved by 2 grades and 35% improved by 1 grade as per IKDC grading. Anderson *et al.*[13] concluded that anterior cruciate ligament reconstruction lowered the meniscal tear rate from 27% to 3% at 2 year follow up. 60% of our patients had associated chondral lesions and 35% had lesions at more than one site. 47.5% of our patients had meniscal injuries. These associated lesions increased with the duration of the injury. And meniscal injuries did not affect the functional stability or outcome of the knees post operatively in our short term follow up.

Conclusion

Arthroscopic anterior cruciate ligament reconstruction with bone-patellar tendon- bone autograft is an excellent treatment option and provides a stable knee with minimal complications for anterior cruciate ligament deficient knees. Tibial tunnel position affects the functional outcome of the patients in Arthroscopic anterior cruciate ligament reconstruction.

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