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A PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF OPEN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING QUADRUPLE HAMSTRING AUTOGRAFT

Orthopaedics

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ABSTRACT

BACKGROUND: This prospective clinical study was performed to evaluate the functional outcome of open single bundle anterior cruciate ligament reconstruction using quadrupled hamstring tendon (Gracilis and semitendinosus) autograft in individuals with ACL injuries.
METHODS: from Sept. 2017 to Sept. 2019, 20 patients (17 males and 03 females) aged 20 to 40 years were enrolled in this study. Patient who met the inclusion criteria (A complete ACL tear patients, clinically and radiologically) and reported at department of Orthopaedics, Govt Medical College, Kota, included. Functional outcomes were The International Knee Documentation 2000 score (IKDC) and Lysholm Scoring Scale were used for evaluation of patients. Patients were followed at 6 weeks, 6 months and 1 year. All data were collected and analyzed with the help of suitable statistical parameters.
RESULTS: Open anterior cruciate ligament reconstruction with hamstring graft is an excellent treatment option for anterior cruciate ligament deficient knees. We are currently awaiting long term results to verify whether or not these early results persist.

KEYWORDS

Anterior Cruciate Ligament, IKDC Score, Lysholm Score, hamstring graft

INTRODUCTION

The knee joint is commonly injured during sports activities. Anterior cruciate ligament injury, alone or in conjuntion to injury of other ligaments or menisci, is a very commonly involved ligament in these injuries. Nowadays, Ligamentous injuries of the knee are being diagnosed frequently due better understanding of the complexity of knee joint and also due the advanced technology.[1]

The ACL is the primary static restraint to anterior translation of tibia and bears 75-85 % of load when an anterior force is applied to tibia in vitro.[1,2] ACL tears usually caused by deceleration with twisting, pivoting, or a change in direction, or by hyperextension of knee.[3] Perhaps the most common mechanism is valgus stress in flexion along with external rotation of tibia. When an ACL injury occurs, the symptoms of knee instability, pain and a decrease in joint function occur. Although conservative treatment with intensive physiotherapy, bracing and lifestyle modification can be tried in some patients with less anticipated knee function but in symptomatic young active individuals, ACL reconstruction is necessary. Also ACL injuries are mostly associated with injury of the meniscus which need to be addressed, else the person can develop early onset of osteoarthritis of the knee[4].

The articular cartilage of the knee joint may be injured in acute ACL tears, whose incidence range from 16–46%, and in chronic tears, the incidence increases further[5]. To prevent the deterioration of the existing lesions and to prevent occurrence of new lesions, a stable knee is necessary.

The history can be a valuable adjunct to diagnosis and the mechanism of injury should be specifically asked. Nearly 40 % of patients may report a 'pop' at the time of injury and are unable to continue further participation. Gross swelling due to hemarthrosis usually develops within 2-3 hours. In chronic tears, the chief complaint is recurrent episodes of 'giving way' of knee, associated with pain, swelling and stiffness.[2]

The patient's level of activity, occupation, and future aspirations are very important considerations in coming up with a rational individualized treatment plan.

The goal of management is to prevent recurrent instability of knee so that the patient can resume his or her pre-injury activities. The most common group of patients requiring surgical management is young people who are unwilling to modify their active lifestyle or who are professional athletes. Obtaining a normal range of motion and regaining strength equal to opposite side are of utmost importance before any surgical intervention is contemplated.

Arthroscopic reconstruction of the injured ACL has become the gold standard but open reconstruction of ACL is also being practiced nowadays where the facilities of arthroscopy and trained arthroscopic surgeons are lacking.

The “ideal graft” for ACL reconstruction is still a topic of debate. The most commonly used grafts are bone patellar tendon bone graft and hamstring graft. Several studies have demonstrated comparable functional outcomes for both grafts.

The Hamstring Graft Is Increasingly Used Nowadays For The Following Reasons :

- Advancements made in soft tissue graft fixation techniques
- Increased incidence of anterior knee pain with bone patellar tendon bone graft.

So this prospective clinical study was planned to evaluate the functional outcome of open single bundle anterior cruciate ligament reconstruction using quadrupled hamstring tendon (Gracilis and semitendinosus) autograft in individuals with ACL injuries.

MATERIAL AND METHODS

Study Area: This study was conducted in the Department of Orthopaedics, Govt. Medical College and attached group of hospitals, Kota with due permission from the institutional ethical committee and review board and after taking written informed consent from the patient.

Study Period: Data collection for study started from Sept. 2017 to Sept. 2019. Then it took another two months to process and analyze data.

Study Type And Design: Hospital based clinical prospective study.
Sample Size: There were 20 patients aged 20 to 40 yrs included in our study of which 17 patients (85%) were male and 3 (15%) were female. 11 patients (60%) had right side injury while 9 (45%) had injury to the left knee.

Study Universe: Patient who met the inclusion criteria (A complete ACL tear patients, clinically and radiologically) and reported at department of Orthopaedics, Govt Medical College, Kota, included.

Inclusion Criteria:
The following patients were included:-
- Clinical /MRI evidence of symptomatic individuals with anterior cruciate ligament insufficiency
- Patients between age 20 to 40yrs. (skeletally matured patients)
- Associated with medial or lateral meniscus tear
- Associated Grade I and II MCL and LCL injuries
- No history of previous surgery in the knee
- A normal contralateral knee

Exclusion Criteria:
- Asymptomatic individuals
- Patients with systemic diseases compromising their pre-anaesthetic fitness
- Associated with PCL tear
- Associated Grade III MCL and LCL injuries
- Patient with osteoarthritic knee
- Patients with associated fracture of tibial plateau
- Patients with local skin infections

Ethics Statement: The study protocol was approved by the institutional ethical committee**.** Informed consents were obtained in written form from patients and all clinical investigations were conducted according to the standard protocol.

Data Analysis: Data was recorded as per Performa. SPSS-22 was used for analysis. For categorical variables chi-square test was used. For continuous variables independent samples'*t*-test was used. *p*-value <0.05 was considered as significant.

Assessment Of Patients:
All patients were evaluated clinically at the time of admission to elicit mode of injury, date of injury, previous history and any other associated medical/ surgical illness and will be given primary treatment. History, general examination and local examination of both the sides was done and recorded on the Proforma attached.

Patients were investigated completely for operative and anaesthesia purpose. Any associated medical problem was taken care of before the patient was taken for surgery. A.P. and lateral radiographs of the knee were done to rule out any fractures around the knee joint. We did an M.R.I. scan of knee joint to know the status of all the ligaments and soft tissues around knee joint. Standard operative protocol followed as advised by the American knee society. The rehabilitation was according to standard protocol.

Follow Up Schedule:
The patients were followed up for an average duration of 17.6 months with minimum follow up of 7 months and maximum follow up of 24 months.

In our study, we used interference screws and endobutton.

Figure:1 Endobutton

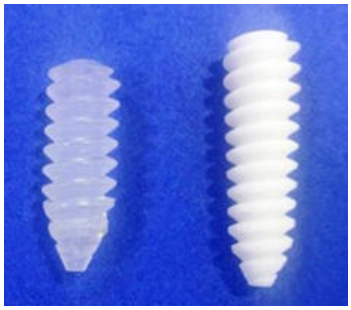

Figure:2 Bioabsorbable interference screw

Surgical Technique:
The technique of single bundle ACL reconstruction was done with one tibial tunnel and one femoral tunnel with their centers corresponding to the centre of the native ACL tibial and femoral attachment sites respectively. Thus creating an anatomic femoral tunnel position. The graft was fixed at the tibial side using bioscrew / titanium interference screw and at the femoral side by using endobutton.

Post-operative Management:
Immobilization in knee brace and limb elevation was done in the immediate post op period. Intravenous antibiotics were given post-operatively for 3 days. Wound was inspected on 2nd, 7thpost-operative day. The sutures were removed on 12 th post-operative day. Rehabilitation was started from day one.

Evaluation:
All patients were subjected to post operative anteroposterior and lateral radiographs to determine the tunnel placement and position of endobutton and interference screw. Patients were followed at 6 weeks, 6 months and 1 year and functional outcomes assessed.

The International Knee Documentation 2000 score (IKDC) and **Lysholm and Gillquist Knee Scoring Scale** were used for evaluation of patients.

RESULTS
A hospital based prospective study was conducted in the Department of Orthopaedics, Govt. Medical College and attached group of hospitals, Kota, where patients with complete ACL tear were taken. Twenty cases of open ACL reconstruction were regularly followed for an average period of 17.6 months from September 2017 to September 2019. There were significant improvements in functional outcomes over successive follow-ups. There were no major complications in our study.

Lysholm Knee Score:

Table 1: Lysholm Knee Score

S.No	Results	No. Of Cases	Percentage
1	Excellent	9	45%
2	Good	8	40%
3	Fair	3	15%
4	Poor	0	0

In our study, 9 patients (45%) had excellent functional outcome while 8 patients (40%) had good outcome. The remaining 3 patients (15%) had a fair outcome according to Lysholm knee score.

IKDC Subjective Score:

Table 2: IKDC Subjective Score

	TOTAL	Grade1	Grade 2	Grade 3	Grade 4	Grade 5
NUMBER OF NGON EYES RAPD* PRESENT(n=32)	32	2	4	7	2	17
PERCENTAGE (%) (n/N) N=68	47.3	6.3	12.5	21.8	6.3	53.1

The mean pre-op IKDC subjective score was 50.86 while the mean post op score was 87.66. There was significant improvement in post op IKDC score when compared with pre op score ($p<0.05$).

Complications:
1. One patient in our study had superficial infection at the donor site which settled with intravenous anti b iotics.
2. One patient developed deep infection of the donor site with gaping of the wound. The patient underwent wound debridement and secondary closure and was given intravenous antibiotics. The wound healed well and sutures were removed after 10 days.
3. One patient developed fixed flexion deformity of 10 degrees with range of movements ranging from 10 to 90 degrees. The patient had poor compliance to the rehabilitation protocol.

DISCUSSION
Anterior Cruciate Ligament tear is a very common diagnosis these days due to increase in number of vehicles and increasing road traffic

accidents especially motor cycle accidents in the young population and increasing participation of public in sports. We decided to take up this study to address the problem of the vast number of patients attending the out-patient department in our hospital.

Past studies have pointed out that synovial fluid from arthritic knees contains high concentrations of cytokines as well as degenerative enzymes that may play a role in early cartilage damage. Some of these factors may be released early on in the process after a knee ligament injury and may be irreversible by the time an ACL reconstruction is performed. A major goal of surgical ACL reconstruction is restoration of normal knee stability and normal knee kinematics.

In our study we have used interference screw and Endobutton. Both modes of fixation of ACL reconstruction are associated with improved function and satisfaction of patients as indicated by Lysholm and IKDC score.

The choice of graft is a topic of great debate in recent years. The hamstring graft has been increasingly used in recent. The advantages of ACL reconstruction using hamstring graft include decreased surgical site morbidity, decreased occurrence of patella-femoral adhesions and reduced incidence of anterior knee pain. Though the semitendinosus tendon has only 75% and gracilis 49% of the strength of native ACL, the quadrupled semitendinosus or semitendinosus-gracilis have a tensile load of around 4108N.

Our study is to evaluate the functional outcome of open anatomical single bundle ACL reconstruction using quadrupled hamstring autograft.

This prospective study was conducted in Government Medical College, Kota (Rajasthan) to clinically evaluate the clinical results of open single bundle ACL reconstruction. This study group comprised of 21 patients with one patient lost to follow up.

D. W Lewis et al.[6], in their study on incidence of meniscal injuries at the time of ACL reconstruction found that 58% of patients had meniscal injuries and that medial meniscus was most commonly injured. They also concluded that meniscal repair or resection did not alter the final outcome.

In our study, there was associated meniscal injury in 75 % of patients. Five patients in our study had isolated ACL injury. Eleven patients had injury to the medial meniscus whereas one patient had injury to the lateral meniscus alone. Three patients had injury to both the medial and lateral meniscus. The most commonly injured was medial meniscus which was in accordance with other studies.

Among the patients with meniscal injuries, three patients were treated by partial meniscectomy and in one patient meniscal repair was done. The rest of the patients were treated conservatively. The functional outcome of patients with isolated ACL injury was comparable with that of the patients with associated meniscal injuries. This is in accordance with the study by **D.W Lewis et al**[6] who stated that the presence of meniscal injury does not alter the functional outcome.

The most common symptom at presentation was knee pain (40% of patients). The other presenting symptoms were instability (30%), locking (15%) and 15% patients presented with both pain and instability. The results of the study were compared with the studies of D Choudhary et al. 2005[7], Jomha et al. 1999[8], Riley et al. 2004[9], Mahir et al. 2005[10] and Ashok Kumar et al.2016[11].

Average duration of follow-up of the present study was 17 months with a minimum follow-up period 7 months and maximum follow-up period was 27 months. Average duration of follow-up of D Choudhary et al.[7] was 12 months and that of Jomha et al.[8] was 84 months, Railey et al.[9] was 24 months, Mahir et al.[10] was 18 months and Ashok Kumar et al.[11]2016 was 17 months.

The average Lysholm score at the end of the study of D Choudhary et al.[7] was 92, Jomha et al.[8] was 94, Railey et al.[9] was 91, Mahir et al.[10] was 93.5, Ashok Kumar et al.[11] 2016 was 90 and in our study average Lysholm score at last follow up was 91.9 which was comparable with the above studies.

Table 3: Lysholm Knee Score

Study	Average Lysholm Score
D Choudhary et al. 2005	92
Jomha 1999	94
Railey et al. 2004	91
Mahir et al. 2005	93.5
Ashok Kumar et al. 2016	90
Present study	91.9

From the above studies, it can be seen that the functional outcome after ACL reconstruction with hamstring graft and bone patellar tendon bone graft are comparable.

The mean pre-operative IKDC score in this study was 50.86 whereas the post-operative score was 87.66. (**Table-4**) There was significant improvement in post-operative IKDC score when compared with pre-operative score.

The mean pre-operative IKDC score in the study by Kumar et al.[11] was 55.63, Prasad et al.[12] was 42.45 and Aparajit et al.[13] was 50.5 whereas the post-operative scores were 89.38, 94.33 and 86.03, respectively.

Table 4: IKDC Knee Score

Study	Pre- op IKDC Score	Post- op IKDC Score
Kumar et al.	55.63	89.38
Prasad et al.	42.45	94.33
Aparajit et al.	50.5	86.03
This study	50.86	87.66

From the above data, it can be seen that the post-operative IKDC score in this study was comparable with the scores from other studies.

There was no significant patellofemoral pain noticed in the patients in our study. This is similar to the study by Railey et al.[9] who did not observe any clinically relevant patellofemoral pain in patients in whom ACL reconstruction using hamstring graft was done.

Agiletti et al.[14] in their study, found >5 mm tibial translation in 20% of knees in which the torn ACL was reconstructed with hamstring graft. In our study, anterior tibial translation was eliminated in 85% of patients who were examined at a mean of 17 months post-operatively. The remaining 15% of patients (three) had a 1+ Lachman test at the follow up examination. However the laxity did not correlate with the functional scores.

Williams et at.[15] in their study of 2500 cases of arthroscopic ACL reconstruction, reported an infection rate of 0.3%. In our study, one patient had a deep infection and one patient had superficial infection. The patient with deep infection was managed with wound debridement and intravenous antibiotics while the patient with superficial infection was managed with antibiotics alone.

Conclusion:

We concluded that in young active adults, anatomic single bundle reconstruction with quadrupled hamstring graft gives good functional results. The absence of patellofemoral pain with the use of hamstring graft makes it a more desirable option for patients with patellofemoral cartilage disorders or those with chronic patellofemoral pain**.** Hamstring graft fixation with endobutton and interference screw gives good functional outcome**.** Open anterior cruciate ligament reconstruction with hamstring graft is an excellent treatment option for anterior cruciate ligament deficient knees.

We are currently awaiting long term results to verify whether or not these early results persist.

Conflict Of Interest

There is no conflict of interest between authors.

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