Transportal Anterior Cruciate Ligament Reconstruction with Quadrupled Hamstring Tendon Graft: A Prospective Outcome Study

Chandan Kumar, Anil Kumar Gupta, Santosh Kumar Singh, Rohit Jain

Department of Orthopaedics, G.S.V.M. Medical College, Kanpur, Uttar Pradesh, India

Abstract

Background: Anterior cruciate ligament (ACL) reconstruction has been one of the most commonly performed procedures throughout the world. Unsatisfactory outcome with conventional ACL reconstruction has been attributed to nonanatomic graft placement. Researchers have advised placing the graft in the native footprint of ACL to avoid nonanatomic graft placement. The goal of this study was to analyze the outcome of anatomic single bundle ACL reconstruction using transportal technique. **Materials and Methods:** This was a prospective outcome study conducted on 85 consecutive patients of ACL reconstruction of which 62 patients met inclusion and exclusion criteria and were analyzed for final results. All the patients underwent ACL reconstruction by quadrupled hamstring tendon graft using transportal technique and the accessory anteromedial (AAM) portal for femoral tunnel creation. The graft was fixed with endobutton on femoral side and bioabsorbable screw on the tibial side. Patients were evaluated for range of motion, International Knee Documentation Committee (IKDC) score, and Lysholm scores at a minimum followup period of 2 years. The mean pre- and postoperative scores were compared using Wilcoxon signed-rank test. **Results:** The mean Lysholm and IKDC scores improved significantly ($P < 0.0001$) from preoperative value. According to IKDC score, 90.3% ($n = 56$) were either normal or near normal at final followup. According to Lysholm score, 75.8% of patients had excellent and 13.3% had good results. Preoperatively, pivot shift was present in 85.5% ($n = 53$) of patients which reduced to 4.8% ($n = 3$) postoperatively. Infection and knee stiffness occurred in two patients, and femoral tunnel blowout and graft re-rupture occurred in one patient each. **Conclusion:** Anatomic ACL reconstruction by AAM portal is a reproducible technique which gives good clinical outcome at short-term followup.

Keywords: *Accessory anteromedial portal, anatomic anterior cruciate ligament reconstruction, artrhroscopy, knee*

MeSH terms: *Arthroscopy, anterior cruiciate ligament, surgical procedures*

Introduction

Many techniques of ACL reconstruction and its modifications have been described in the literature.[1-5] While conventional transtibial ACL reconstructions were reported to have good results, 11%–30% of patients were unsatisfied with the outcome, especially during cutting movements.[2-5] These unsatisfactory results were attributed to nonanatomic graft placement.[6]

Therefore, many researchers advocated anatomic placement of ACL tunnels in its native footprint to better restore knee kinematics.[7-9] Although, there are few recent studies which suggest no difference in outcome when conventional transtibial reconstruction or its modifications were compared with the anatomic single bundle ACL reconstruction.[10-13] When conventional anteromedial (AM) portal is used for femoral tunnel creation, the field of view is limited by the sole availability of the anterolateral (AL) portal for visualization, extensive cortical bone destruction is unavoidable, and femoral tunnel is relatively short.[14,15] Drilling of the femoral tunnel through accessory AM (AAM) portal, in contrast, offers several advantages such as:

1. Femoral tunnelling can be performed without interference with visualization by lateral femoral condyle using the AM portal as viewing portal. Tunnel position can be identified intra-operatively without drilling instrument removal
2. The femoral tunnel can be created close to the lateral wall of the notch by adjusting the obliquity compared to the AM technique. Notchplasty for working space and visualization is avoided.

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Address for correspondence:
Dr. Anil Kumar Gupta, Department of Orthopaedics, G.S.V.M. Medical College, P-6, Medical College Campus, Kanpur - 208 002, Uttar Pradesh, India.
E-mail: guptadrakg@rediffmail.com

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This study reports the outcome of footprint ACL reconstruction with hamstring tendon graft at a minimum followup of 2 years.

Materials and Methods

This was a prospective study conducted on 85 consecutive patients with chronic ACL deficiency who underwent arthroscopic ACL reconstruction by quadrupled hamstring tendon graft between December 2009 and May 2013. The diagnosis of complete ACL tear was made on the basis of clinicoradiological evaluation including MRI, evaluation under anaesthesia and by diagnostic arthroscopy at the time of reconstruction. Skeletally mature patients, with symptomatic chronic ACL deficiency (range 2.5-30 months) were included in the study. Exclusion criteria were ACL tear in skeletally immature patients, partial ACL tears, other significant ligamentous injuries, meniscal tears requiring suturing, significant osteochondral defects, or arthrosis or patients with <2 years of followup. Twenty three patients were excluded from the study based on the above mentioned exclusion criteria. Hence, 62 patients were included in the final results. Approval by the Institutional Ethics Committee was obtained and written informed consent was taken from all the patients.

Operative procedure

All the procedures were done under regional anesthesia (spinal or epidural) and tourniquet was used in all the cases. High AL and standard AM portals were established and thorough diagnostic arthroscopy was carried out [Figure 1].

Semitendinosus and gracilis tendons were harvested by a 3 cm longitudinal incision placed over AM surface of the tibia from tibial tuberosity downward. All the muscle fibres were removed, and quadrupled graft was prepared by whipstitching each tendon ends. Length and diameter of the prepared graft were measured.

Arthroscope was again inserted into the joint. Fat pad was resected generously so as to allow unimpeded view of the intercondylar notch in maximum knee flexion. Remnants of ACL insertion from tibia were removed with shaver and soft tissue notchplasty was performed. Care was taken to preserve the remnants of ACL attachment over femoral footprint. An AAM portal was established with the help of a spinal needle, just clear of the lateral margin of the medial femoral condyle and just above the level of the medial meniscus. Femoral ACL footprint was inspected, and a guide pin was inserted in the centre referencing the pertinent osseous landmarks as described by Ferretti *et al*.[16] [Figure 2]. Guide pin postion was verified by placing the scope in the standard medial portal. Femoral Tunnel was reamed while keeping the scope in the AM portal up to the size of the quadrupled graft diameter taking care not to blow out the lateral cortex. Tibial guide pin was passed outside in at an angle of 55° from the tibia with the help of ACL tibial jig aiming the exit point just posterior and lateral to posterior border of anterior horn of lateral meniscus [Figure 3]. Tibial tunnel was drilled according to the size of the graft. Passing sutures were passed through the femoral tunnel and were shuttled through the tibial tunnel [Figure 4]. Graft was passed

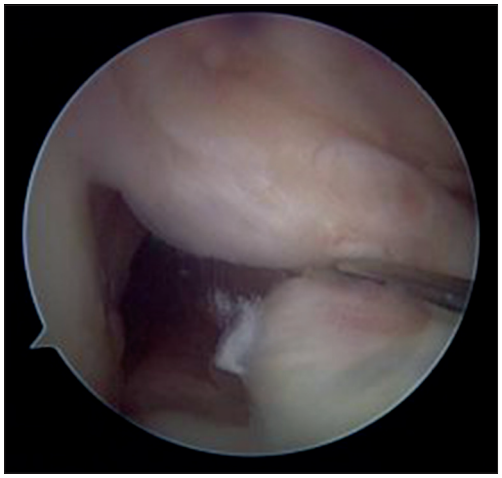

Figure 1: Arthroscopic view showing torm anterior cruciate ligament with empty intercondylar notch

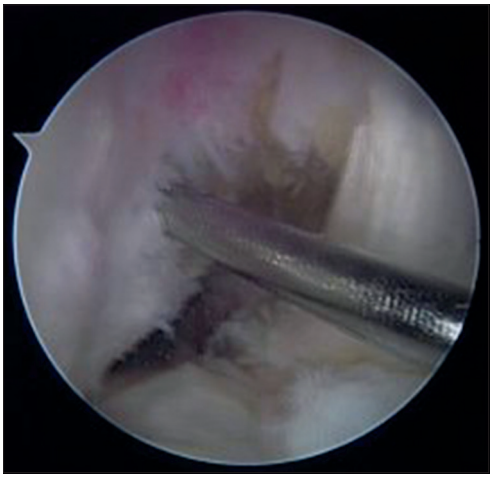

Figure 2: Arthroscopic view showing guide wire placed through accessory anteromedial portal in the center of femoral footprint of native anterior cruciate ligament

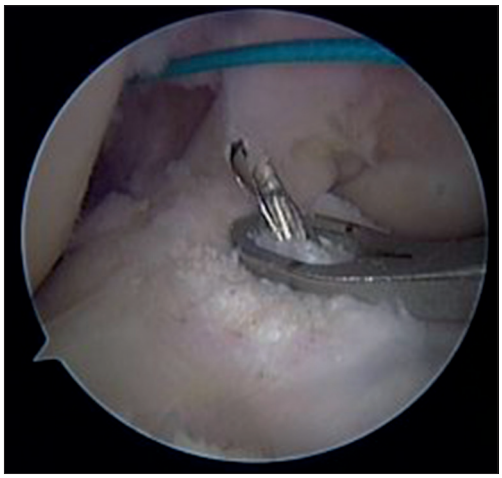

Figure 3: Arthroscopic view showing tibial guide wire placed in the centre of tibial footprint with tibial aimer

with the help of passing sutures from tibial tunnel to femoral tunnel. Graft was fixed with endobutton (Smith & Nephew) on femoral side and with appropriate size bioabsorbable interference screw (Smith & Nephew) on tibial side and final position was verified [Figure 5].

Postoperative protocol and rehabilitation

Postoperative radiographs were taken to document proper implant and tunnel position [Figure 6]. All the patients were given knee range of motion (ROM) brace. Quadriceps and ankle ROM exercises were started on the 1st postoperative day. Patients were started weight bearing when sufficient quadriceps control was obtained. Complete knee extension was achieved at the end of 1st month. Sports activities were allowed after 9 months only when at least 80% of quadriceps and hamstring strength compared to contralateral limb was obtained.

Clinical examination was done at every followup visit with Lysholm knee score, International Knee Documentation Committee (IKDC) score, Lachmann test, anterior drawer test, and pivot shift test, and comparisons were made with preoperative values. All the statistical calculations were done using SPSS (version 16.0, Chicago, SPSS Inc. USA). Pre- and postoperative scores were compared using Wilcoxon signed-rank test.

Results

Nearly 87.1% were male (n = 54) and 12.9% were female (n = 8). The mean age of the patients were 28.07 ± 7.59 years (range 18–45 years) [Table 1]. The dominant mode of injury was motor vehicle accident in 39 patients (62.9%) while sports-related injuries occurred in 19 patients (30.6%). In four patients (6.5%), mode of injury other than these two was identified. Concomitant meniscal injury was found in 19 cases (30.6%) and was treated with partial menisectomy. The mean followup period was 31.15 ± 3.6 months (range 24–39 months). Preoperative pivot shift was present in 53 patients (85.5%) and postoperatively in 3 patients (4.8%). The mean Lysholm and IKDC scores improved significantly ($P < 0.0001$ each) at final followup when compared to their preoperative value [Table 2]. According to IKDC score, 90.3% (n = 56) of patients were either normal or nearly normal (A or B) at final followup, whereas only 9.7% (n = 6) had a poor result. According to Lysholm score, 75.8% of patients had excellent, and 13.3% had good results. Only 11.9% of patients had fair or poor results [Table 3]. Six complications occurred in four patients [Table 4]. In two patients, infection occurred. Both the patients were treated by knee arthrotomy and debridement with graft retention. In both the patients, knee stiffness was reported at final followup.

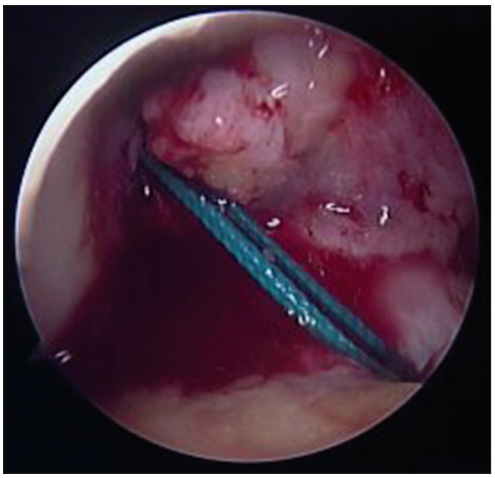

Figure 4: Arthroscopic view showing sutures shuttled from femoral to tibial tunnel

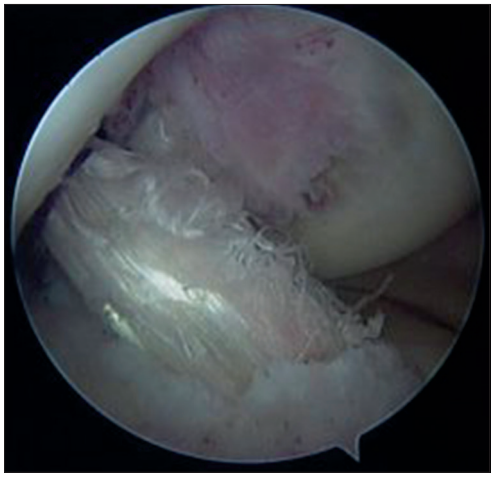

Figure 5: Arthroscopic view showing reconstructured anterior cruciate ligament

Figure 6: (a) Postoperative anteroposterior radiograph and (b) lateral radiograph of knee joint showing proper implant and tunnel position

Discussion

The goal of ACL reconstruction is to restore the knee kinematics and to prevent the development of early osteoarthritis.[17] Conventionally, ACL reconstruction has provided consistently good results in terms of restoring

anteroposterior knee stability in flexion. To improve the rotational stability of knee drilling, the femoral tunnel in the footprint of native ACL has been recommended by many authors.[7,18-20]

There is extensive clinical and laboratory evidence in the literature which has established the superiority of anatomic tunnel placement.[6,9,21] Many clinical and cadaveric studies have questioned the ability of conventional transtibial drilling technique to restore the ACL footprint.[22,23] Hence, for drilling the center of femoral tunnel in anatomic, ACL reconstruction has been recommended through an AAM portal established just above the medial meniscus. We in our study also used AAM portal to drill the femoral tunnel.

Table 1: Patient characteristics

Parameters	Values
Age	28.07±7.59
Sex (male/female)	54/8
Right/left	42/20
Interval between injury and operation (in months)	7.8±7.08 (2.5-30)

Table 2: Pre- and post-operative comparison of clinical scores

Score	Preoperative	Final followup	*P*
Lysholm score	75.06±7.67	92.23±2.78	0.0001
IKDC score	46.39±5.06	71.60±3.49	0.0001

IKDC=International Knee Documentation Committee

Table 3: Postoperative clinical and functional outcome

Clinical test	Preoperative	Postoperative
Anterior drawer test		
Equal	0	21
I	0	39
II	34	1
III	28	1
Lachmann test		
0	0	55
1+	5	4
2+	57	3
Pivot shift test	53	3
IKDC score		
A	0	46
B	0	10
C	24	5
D	38	1
Lysholm score		
Excellent	0	47
Good	0	8
Fair	38	6
Poor	47	1

IKDC=International Knee Documentation Committee

Table 4: Complications

Complication	Number of patients
Knee stiffness	2
infection	2
Femoral tunnel blow out	1
Graft re-rupture	1

In this study, Lysholm knee score improved significantly from the preoperative value at final followup ($P < 0.0001$). Our results also showed that 89.1% ($n = 55$) had excellent to good result according to the Lysholm score. According to IKDC scoring system, 90.3% of patients ($n = 56$) were graded as having either Grade A or B. Only 9.7% ($n = 6$) of patients were in Grade C.

Inácio *et al*.[24] in their study on ACL reconstruction by AM portal and femoral fixation using rigid fix showed mean postoperative Lysholm score as 87.81 and median subjective IKDC score as 83.72. The results of their study are comparable to our study in terms of outcome although we fixed the graft with endobutton on femoral side.

Sun *et al*.[25] in a study of anatomic ACL reconstruction in Asian population on 32 patients with 6-stranded autogenous hamstring tendon graft showed median Lysholm score at 92 at 2 years followup. Of the 32 patients, 26 were negative and 6 positive for Grade 1 Lachmann and 31 were negative and 1 patient had positive Grade 1 pivot shift test. There were 4 patients with 5° flexion limitation. In this study, of 62 patients, only 4 patients had 1+ positive Lachmann test and only 3 patients had pivot shift test positive at final followup.

Porter and Shadbolt[26] in their study on twenty patients used computer navigation intraoperatively to plot the pivot shift before and after reconstruction. The opposite uninjured knee was used as a control. Their study demonstrated a significant reduction in anterior translation as well as in internal rotation. In this study, only 4.8% ($n = 3$) of patients had positive pivot shift test at more than 2 years followup. This signifies the importance of anatomical graft positioning in reducing the incidence of pivot shift post-ACL reconstruction.

Abdekfy[27] in his prospective study on anatomic single bundle ACL reconstruction by an outside in femoral tunnel drilling method showed sixty patients out of 64 in IKDC Grade A and four patients in IKDC Grade B. No patients were in Grade C or Grade D. The average Lysholm score was 92.4 and the average subjective IKDC score was 91.5. Average followup period was 15.8 months. We are of the opinion that anatomical graft placement is possible by the creation of an AAM portal. The location of this portal is critical to achieve perpendicular access to the medial wall of lateral femoral condyle, at the same time avoiding iatrogenic damage to the cartilage of medial femoral condyle.

Abdekfy[28] in another prospective study on anatomic single bundle ACL reconstruction using cortical femoral suspensory fixation using screw post on 64 patients

with average followup period of 52.6 months showed 59 patients had Grade A and 3 patients as having Grade B IKDC. No patients had Grade C or D results. The average Lysholm score was 90.7 and average IKDC score was 89.5. Our experience with cortical fixation using endobutton and bioscrew on tibial side produced equivalent results. Mean Lysholm score in our study at an average period of 31.15 ± 3.6 months was 92.23. Nearly 90.3% of our patients were Grade A or B according to IKDC score.

There are few limitations of our study. One is a lack of a randomized design and absence of a control group. Another limitation is absence of long term followup data, because of which we cannot comment on the development of degenerative changes in the knee joint of operated patients.

Conclusion

Anatomic single bundle ACL reconstruction using AAM portal is a reproducible technique which gives acceptable results at short term followup. It has the advantage of reducing rotational instability by placing the graft in a more horizontal position as against during conventional transtibial reconstruction.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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