



ISSN (P): 2521-3466
ISSN (E): 2521-3474
© Clinical Orthopaedics
www.orthoresearchjournal.com
2019; 3(1): 70-74
Received: 11-11-2018
Accepted: 15-12-2018

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Outcome analysis of arthroscopic single bundle anterior cruciate ligament reconstruction through an accessory antero medial portal technique

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DOI: <https://doi.org/10.33545/orthor.2019.v3.i1b.15>

Abstract

Introduction: Anterior Cruciate Ligament (ACL) injuries are quite common among young sportspersons and those leading an active life, thereby stressing on the need to provide a rehabilitation that provides full functionality and can cut-back the duration of hospital stay in order to enable these persons to contribute actively to the society. As far as the incidence of ACL injuries in general population is concerned, it is one of the most common ligament injuries in sports traumatology.

Materials and Methods: This is a comparative prospective study comprising of two groups each having 30 patients with complete ACL tear. In one group Accessory Antero medial portal technique was used and in the other group antero medial portal technique was used. The follow period was 1 year. Patients were assessed clinically and by lysholm knee score.

Result: On the basis of this study it was found that patients in short term there is no significant difference between two techniques. However, in mid-term (6 months and 12 months) functional results are better in AAM as compared to AM. Femoral tunnel angles are smaller in AAM as compared to AM.

Conclusion: For single bundle ACL reconstruction Accessory antero medial portal technique is a better procedure.

Keywords: Anterior cruciate ligament, accessory antero medial portal technique

Introduction

Anterior Cruciate Ligament (ACL) injuries are quite common among young sportspersons and those leading an active life^[1], thereby stressing on the need to provide a rehabilitation that provides full functionality and can cut-back the duration of hospital stay in order to enable these persons to contribute actively to the society. More than 3% of athletes in a 4-year of sporting activity sustain a rupture of the ACL and the risk is higher in females^[2]. The decision to undertake a surgical procedure for rehabilitation is dependent on the patient's degree of symptoms and requirements in terms of activity level and participation in activities requiring pivoting motions^[3]. ACL reconstruction is a surgical tissue graft replacement of ACL in the deficient knee to restore its function after ACL injury^[4].

ACL reconstruction has traditionally been performed using two arthroscopic portals: the anterolateral (AL) and the anteromedial (AM) portal. In the two-portal technique, the AL portal is used as the arthroscopic viewing portal and the ACL femoral tunnel is drilled through the AM portal. Drilling the ACL femoral tunnel through the AM portal can also result in a shorter femoral tunnel length, limiting the amount of ACL graft that can be inserted into the ACL femoral tunnel when a cortical suspensory femoral fixation device is used.

This approach requires an exact appreciation of the intra-articular bony anatomy, particularly on the medial face of the lateral femoral condyle to define tunnel placement^[5]. This can be difficult to establish using traditional lateral portal arthroscopic viewing, where the femoral intercondylar and bifurcate ridges are not readily identified. Furthermore, use of the clock-face reference can lead to a high or anterior placement of the graft leading to graft failures^[6].

The additional medial portal allows the ACL femoral attachment site to be viewed through the AM portal, while working instrumentation is inserted into the notch through the AAM portal.

Drilling the ACL femoral tunnel through an AAM portal increases the obliquity of the ACL femoral tunnel relative to the lateral wall of the notch, resulting in a longer femoral tunnel length and a more elliptical ACL femoral tunnel aperture compared to drilling the femoral tunnel through the AM portal [7]. Clinical studies have demonstrated that non-anatomic ACL graft placement is the most common technical error leading to recurrent instability following ACL reconstruction [8, 9].

Material and Method

After ethical clearance from institutional review board this prospective comparative study was carried out at Department of Orthopaedic Surgery, Era's Lucknow Medical College, Lucknow during January 2017 to June 2018. Patients were selected having inclusion criteria with patient age 18-50 years (both male and female), active, motivated patients with future interest in professional / recreational sports who were involved in vigorous activities. Patients with an active lifestyle who have an acute ACL deficiency and those with chronic ACL deficiency that may result in functional instability. The exclusion criteria were for the patients with bilateral ACL tear. Patients with other systemic diseases compromising their Pre-anaesthetic fitness. Patients with associated fractures involving lower limbs or spine. Patients with any other associated ligament and meniscal injuries of the knee.

Cases were recruited from Orthopaedics OPD/ Emergency. Detailed history and physical examination was done x-ray of bilateral knee joint and MRI of the knee joint were done to confirm for confirm the diagnosis. Lysholm knee scoring, Anterior drawer test, Lachman tests were done. Sixty (60) patients were randomized into two groups: 30 each using ACL reconstruction with two port or AM in one and three port or AAM in other group.



Fig 1: x-ray of knee joint with distal thigh and proximal leg bones showing illustration of method to measure tibial tunnel coronal angle (α) and femoral tunnel inclination (β)



Fig 2: X-ray of knee joint with distal thigh and proximal leg anteroposterior view showing illustration of the method to measure the distance of center of tibial tunnel from medial edge of tibia (orange line ab) on anteroposterior radiograph. Blue line AB is the distance from the medial border to the lateral border of the tibial plateau.

Assessment of results

Radiological

On x-ray, angles of femoral and tibial tunnels were measured on immediate postoperative knee radiograph (Anteroposterior). Coronal obliquity of the tunnel was measured and compared between the two groups.

The parameters measured were as follows:

Anteroposterior radiograph (coronal measurements)

1. The coronal position of the tibial tunnel was determined by dividing the distance from the medial border of the tibial plateau to the midpoint of the tibial tunnel (ab) by the distance from the medial border to the lateral border of the plateau (AB) and expressing it as a percentage. The midpoint of the tibial tunnel in anteroposterior view was determined at the aperture of the tunnel by measuring the positions of the medial and lateral borders of the tibial tunnel relative to the medial border of the tibial plateau. (figure 2)
2. The coronal angle (α) was determined by the angle formed by a line drawn parallel to the tibial tunnel (C) and another line along the tibial plateau (AB). (figure 1)
3. The coronal angle (obliquity) of the femoral tunnel (β) was

determined by drawing a line parallel to the femoral tunnel (F) and another line tangent to distal femoral condyles at the level of knee joint (T) and measuring the angle between them [10]. (figure 1)

Functional

Functional assessment was done using Lysholm Knee Score. Grading of laxity was evaluated by Anterior Drawer Test.

Patient follow up was done post-operatively at 1, 3, 6, 9 and 12 months.

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 statistical Analysis Software. The values were represented in Number (%) and Mean \pm SD.

Statistical Analysis

Student 't' test and Mann-Whitney U test was used.

Level of significance: "p" is level of significance

$p < 0.05$ Significant

$p < 0.01$ Highly significant

$p < 0.001$ Very highly significant



Fig 3: The above Radiological Image showing anteroposterior and lateral view of the ACL reconstruction by anteromedial portal technique (2 Portal)



Fig 4: The above Radiological Image showing anteroposterior and lateral view of the ACL reconstruction by accessory anteromedial portal technique (3 Portal)

Results

The study was carried out with an aim to study the outcome analysis of arthroscopic single bundle anterior cruciate ligament

reconstruction through an accessory antero medial portal technique (three-ports) and to compare the same with anteromedial portal technique (two ports)

Table 1: Age and Demographic Profile of Patients in two groups

S. N	Characteristic	Total (n=60)	Group I (AM) (n=30)	Group II (AAM) (n=30)	Statistical significance
1.	Mean Age±SD (Range) in years	26.28±5.57 (18-38)	27.27±5.74 (19-38)	26.50±5.47 (18-38)	t'=0.530; p=0.598
2.	Gender				χ ² =0.098; p=0.754
	Male	47 (78.3%)	23 (76.7%)	24 (80.0%)	
	Female	13 (22.7%)	7 (23.3%)	6 (20.0%)	
3.	Occupation				χ ² =5.389; p=0.250
	Athlete/Sports	18 (30.0%)	8 (26.7%)	10 (33.3%)	
	Business	8 (13.3%)	5 (16.7%)	3 (10.0%)	
	Housewife	4 (6.7%)	4 (13.3%)	0	
	Service	6 (10.0%)	3 (10.0%)	3 (10.0%)	
	Student	24 (40.0%)	10 (33.3%)	14 (46.7%)	

Table 2: Comparison of Femoral Tunnel angle (Independent samples 't'-test) Mean±SD

S. N	Parameter	Total (n=60)	Group I (AM) (n=30)	Group II (AAM) (n=30)	Statistical significance
1.	Femoral tunnel angle	38.73± 4.60	44.93± 4.60	32.53± 4.78	t=10.23; p<0.001

Mean femoral tunnel was 44.93±4.60° respectively in Group I and 32.53±4.78° respectively in Group II. On evaluating the data statistically, the difference between femoral tunnel angle was

found to be significantly shorter in Group II as compared to that in Group I (p<0.001).

Table 3: Comparison of Laxity evaluation using Anterior drawer test at Baseline and subsequent intervals (Mann Whitney U test)

S. N	Time interval and Grade	Total (n=60)	Group I (AM) (n=30)	Group II (AAM) (n=30)	Statistical significance
1.	Preoperative				z=0.543; p=0.587
	2	40 (66.7%)	19 (63.3%)	21 (70.0%)	
	3	20 (33.3%)	11 (36.7%)	9 (30.0%)	
2.	One month				z=1.654; p=0.098
	1	49 (81.7%)	22 (73.3%)	27 (90.0%)	
	2	11 (18.3%)	8 (26.7%)	3 (10.0%)	

3.	Three months				z=1.719; p=0.086
	0	14 (23.3%)	5 (16.7%)	9 (30.0%)	
	1	43 (71.7%)	22 (73.3%)	21 (70.0%)	
	2	3 (5.0%)	3 (10.0%)	0 (0%)	
4.	Six months				z=1.762; p=0.078
	0	57 (95.0%)	27 (90.0%)	30 (100%)	
	1	3 (5.0%)	3 (10.0%)	0	
5.	9 months				z=0; p=1.000
	0	60 (100%)	30 (100%)	30 (100%)	
6.	12 months				z=0; p=1.000
	0	60 (100%)	30 (100%)	30 (100%)	

At baseline Anterior drawer test grades were 2 and 3 in 63.3% and 36.7% patients respectively in Group I and in 70% and 30% patients respectively in Group II. Statistically, the difference was not significant (p=0.587).

At 9 and 12 months intervals, all the patients in both the groups had grade 0, thus showing no difference between two groups (p=1).

Table 4: Comparison of lachman test at baseline and subsequent intervals (Mann Whitney U test)

S.N	Time interval and Grade	Total (n=60)	Group I (AM) (n=30)	Group II (AAM) (n=30)	Statistical significance
1.	Preoperative				z=1.420; p=0.155
	2	43 (71.7%)	19 (63.3%)	24 (80.0%)	
	3	17 (28.3%)	11 (36.7%)	6 (20.0%)	
2.	One month				z=0.605; p=0.545
	1	46 (76.7%)	22 (73.3%)	24 (80.0%)	
	2	14 (23.3%)	8 (26.7%)	6 (20.0%)	
3.	Three months				z=0.252; p=0.801
	0	11 (18.3%)	5 (16.7%)	6 (20.0%)	
	1	43 (71.7%)	22 (73.3%)	21 (70.0%)	
	2	6 (10.0%)	3 (10.0%)	3 (10.0%)	
4.	Six months				z=0.858; p=0.391
	0	51 (85.0%)	27 (90.0%)	24 (80.0%)	
	1	6 (10.0%)	0 (0%)	6 (20.0%)	
	2	3 (5.0%)	3 (10.0%)	0	
5.	9 months				z=1.762; p=0.078
	0	57 (95.0%)	27 (90.0%)	30 (100%)	
	1	3 (5.0%)	3 (10.0%)	0	
6.	12 months				z=0; p=1.000
	0	60 (100%)	30 (100%)	30 (100%)	

Preoperatively, in Group I, 19 (63.3%) had score 2 and remaining 11 (36.7%) had score 3 whereas in Group II, 24 (80%) had score 2 and 6 (20%) had score 3. Though proportion of those with score 3 was higher in Group I as compared to that in Group II yet this difference was not significant statistically (p=0.155).

At 9 months, in Group I, 27 (90%) had score 0 and remaining 3 (10%) had score 2 whereas in Group II, all the 30 (100%) patients had score 0. Statistically, the difference between two groups was not significant (p=0.078).

At 12 months, all the patients in both the groups had score 0 thus showing no difference between two groups (p=1).

Table 5: Comparison of Lysholm Score at Baseline and subsequent intervals (Independent samples 't'-test) Mean±SD

S. N	Time interval and Grade	Total (n=60)	Group I (AM) (n=30)	Group II (AAM) (n=30)	Statistical significance
1.	Preoperative	37.42± 5.15	36.40±5.64	38.43±4.47	t=1.547; p=0.127
2.	One month	46.77± 4.84	46.27±0.88	47.27±4.02	t=0.871; p=0.387
3.	Three months	57.37± 4.95	57.27±5.67	57.47±4.20	t=0.155; p=0.877
4.	Six months	70.70± 4.46	69.93±3.98	71.47±4.84	t=1.340; p=0.186
5.	9 months	80.15± 4.80	78.40±4.80	81.90±4.89	t=2.799; p=0.007
6.	12 months	91.37± 5.65	87.90±4.87	94.83±4.04	t=6.002; p<0.001

At 9 and 12 months' assessment, mean values in Group II(AAM) were significantly higher as compared to that in Group I(AM) (p<0.05).

Discussion

The present study was carried out with an aim to compare the early functional outcomes of Arthroscopic ACL reconstruction using arthroscopic single bundle anterior cruciate ligament reconstruction through an accessory antero medial three portal technique with traditionally used two-portal technique. The

femoral tunnel placement in our study was through an accessory anteromedial portal instead of the trans-tibial technique where femoral tunnel placement is directed by the tibial tunnel. Coronal obliquity of graft is one of the most crucial factors for rotational stability of the knee. A femoral tunnel placed obliquely is more efficient in resisting rotatory loads when compared with a vertical tunnel close to the roof of the intercondylar notch [12, 13].

It was carried out as a randomized trial study. Randomized trials are the most rigorous way of determining whether a cause-effect

relation exists between treatment and outcome^[11]. In this study, age of patients ranged from 18 to 38 years with a mean age of 26.28 ± 5.57 years. Mean age of patients in both the groups was close to that reported in different case series which report the average age of patients with ACL tear to be 26.8 to 31.5 years. The present study also endorsed this finding. In present study, postoperative assessment of femoral tunnel and tibial tunnel angulation showed that these values were lower in three-port group as compared to two-port group but the difference was significant statistically for femoral tunnel angle. It was observed that femoral tunnel angulation was 44.93 ± 4.60 in two-port and $32.53 \pm 4.78^\circ$ in three-port technique, thus showing a significantly shorter or more oblique placement in three portal technique. The shorter femoral tunnel angle thus provided an anatomical placement of graft which could minimize the technical errors leading to recurrent instability. Functional recovery as measured by clinical knee stability test by Anterior drawer test and Lachman test were observed in all the patients at the end of 12 months of follow up. However, these results were observed to be slightly earlier in AAMP group as compared to AMP group. In this study, mean Lysholm scores reached from preoperative 36.40 ± 5.64 to 87.90 ± 4.87 at 12 months in AMP group as compared to change from preoperative 38.43 ± 4.47 to 94.83 ± 4.04 at 12 months in AAMP group, thus showing a significant change in both the groups, but functional scores being significantly higher in AAMP as compared to AMP group at 12 months follow-up. However, despite this limitation, the present study for the first time showed a statistically significant difference in functional outcome of AAMP as compared to AMP with respect to Lysholm score.

Conclusion

The findings of present study thus showed that arthroscopic single bundle anterior cruciate ligament reconstruction through an accessory antero medial portal technique offers a more oblique femoral tunnel placement and a better functional outcome. However, these results need further validation in studies incorporating a larger sample size and a longer duration of follow-up.

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