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Dr. Sachin Awasthi
Associate Professor,
Department of Orthopaedics,
Dr. RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Dr. Swagat Mahapatra
Assistant Professor,
Department of Orthopaedics,
Dr. RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Dr. Pankaj Aggarwal
Assistant Professor,
Department of Orthopaedics,
Dr RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Dr. SS Tripathy
Associate Professor,
Department of Emergency Medicine, Dr. RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Dr. Rajiv Ratan Singh Yadav
Associate Professor,
Department of Emergency Medicine, Dr. RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Dr. Chandrasekhar Verma
Senior Resident,
Department of Emergency Medicine, Dr. RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Correspondence
Dr. Swagat Mahapatra
Assistant Professor,
Department of Orthopaedics,
Dr. RML Institute of Medical Sciences, Lucknow,
Uttar Pradesh, India

Analysis of fixation modalities in arthroscopic anterior cruciate ligament reconstruction

Dr. Sachin Awasthi, Dr. Swagat Mahapatra, Dr. Pankaj Aggarwal, Dr. SS Tripathy, Dr. Rajiv Ratan Singh Yadav and Dr. Chandrasekhar Verma

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Abstract
Background: To study the functional outcome of arthroscopic reconstruction of the anterior cruciate ligament (ACL) using Lysholm scoring system.
Methods: This was a prospective, interventional outcome study of 64 patients presenting to the department of Orthopaedics at Dr RML Institute of Medical Sciences, Lucknow during October 2015 to October 2016 and were diagnosed to have ACL tear both clinically and radiologically. Patients were selected through a stringent inclusion and exclusion criteria. All the patients were subjected to ACL reconstruction by arthroscopic technique. Follow-up was done at three weeks, six weeks, three months, six months, nine months and one-year interval to assess the progress of rehabilitation by clinical examination and Lysholm scores.
Results: Total 64 patients were included in the study. The age group of patients ranged from 18-45 years. Most of the patients (60.37%) were of physically active age group (18-30) years. Most common mode of injury was road traffic accident in 37.5% of cases followed by sports activity in 29.68%. Most of the patients came with the time duration of 1-5 months since the date of injury. The most common complaint was of the instability of knee in the form of giving way evaluated by Lachman test. The pre-operative mean Lysholm knee score was 69.06. Around 82.75% of patients reported outcome as excellent and good according to Lysholm score in the postoperative period. Anterior knee pain was the most common postoperative complaint.
Conclusion: Arthroscopic anterior cruciate ligament reconstruction by quadrupled hamstring tendon graft gives satisfactory results in short-term follow-up regarding patient satisfaction, and return to near normal activity. Large-scale study with long-term follow-up is required to corroborate findings of the study and to find out long-term functional results.

Keywords: ACL, Hamstring, Lysholm

Introduction
The advent of high-velocity trauma and sports injuries in all age groups causing ligamentous injury of the knee has turned out to be a modern epidemic [1]. The Anterior Cruciate Ligament is the most frequently disrupted ligament in the knee [2]. The expectation of professional athletes and the younger population has increased to the extent of returning to pre-injury level activities, and hence there is an increase in the cases described above to seek surgical intervention [3]. Estimated incidences of 0.24 to 0.34 anterior cruciate ligament (ACL) injuries per 1000 population per year have been reported [4]. Some authors made an estimation of 250,000 anterior cruciate ligament (ACL) injuries per year worldwide [5]. The ACL is the primary stabilizer against anterior translation of the tibia over the femur and is important in counteracting rotation and valgus stress [6, 7]. ACL injuries result in recurrent injury and increased the risk of intra-articular damage, including meniscal tears and degenerative changes [8]. In the young and active patients, surgical reconstruction of the torn ACL is the treatment of choice [9]. The controversy for managing this injury now centers more on the choice of graft selection for reconstruction instead of whether surgery is necessary. Varieties of graft materials available are autografts, allograft, and synthetic graft materials. Success rates of ligament reconstruction using autografts are higher than when allograft or synthetic graft materials were used [10, 11].

The success of anterior cruciate ligament reconstruction also depend on methods of graft fixation. Well accepted methods of reconstruction are those involving autologous bone patellar tendon bone (BPTB) or tripled-quadrupled hamstring tendons. Despite the frequency of ACL reconstructions performed, there remain significant discrepancies in the surgeon preference regarding the choice of graft. This study evaluates the functional outcome of Arthroscopic ACL reconstruction using hamstring tendon graft in the surgical management of ACL injury using Lysholms knee score.

Materials and Methods

A prospective interventional study of 64 patients presenting with chief complaints of the knee instability and/or pain to our center who were diagnosed to have ACL tear both clinically and radiologically. Patients who satisfied the inclusion criteria **(**Age 18-45 years, complete ACL tear both clinically and radiologically, ACL injury with or without associated meniscal injury, no previous surgery on the same knee, duration of injury > 3 weeks) were included in the study. Patients having multiple intraarticular injuries, large osteochondral defects (>2 cm) and juxta-articular fractures were excluded. The clinical assessment involved detailed history, clinical examination, and neurological examination. All the patients underwent a clinical evaluation by clinical tests like Lachmann`s test**,** Anterior drawer test, McMurray's test, Pivot shift test. Patient workup included Roentgenogram of the involved knee joint – anteroposterior, lateral, Magnetic resonance imaging evaluation and Lysholm knee scoring. Written and oral consent was taken from the patient explaining clearly to the patient in their own language the procedure, risks and anticipated benefits. All patients were enrolled to undergo primary arthroscopically assisted ACL reconstruction. After obtaining adequate pre-anesthetic clearance, surgical procedure was carried out using standard portals and techniques. 35 patients were operated with quadrupled hamstring graft fixed with interference screw and endo-button. 25 patients with quadrupled hamstring graft fixed with interference screws on both sides. Four patients with Bone patellar tendon Bone graft. Hinged knee brace was applied to all cases during the immediate postoperative period and was continued till six weeks post-op. Isometric quadriceps and ankle mobilization exercises and knee ROM exercises were started on 1st post-operative day. Nonweight bearing range of motion exercises for three weeks was done with brace support. Partial weight bearing range of motion exercises was done from 3-6 weeks, and full weight bearing was allowed after six weeks. Patients were encouraged to rub the plantar surface of foot against bed after attaining 90-degree flexion at knee joint, to promote proprioception. Use of stairs was allowed at three months. Sports activities were allowed after 6 to 9 months depending on the recovery of the patient. Patients were followed at regular intervals-6weeks, 12 weeks, 3months, 6months and 12 months. Patients were assessed at every visit with clinical tests and Lysholm score. Also at every visit patients were asked to express if they in any way regretted getting the surgery done**.** All the collected data were entered into Microsoft Excel and statistical analysis was done using SPSS software. The monitored and calculated parameters were analyzed using unpaired t-test for comparison between two groups and paired t-test for comparison between pre-operative and postoperative outcomes. A p value of <0.05 was considered statistically significant.

Observation & Results

The results of the study include sixty-four patients who had undergone anterior cruciate ligament reconstruction surgery between October 2015 and October 2016. For end result evaluation**,** all patients were reviewed and analyzed at the end of 1 year postoperatively. Results include preoperative and postoperative examination findings and pre and postoperative Lysholm scores. The age of the patients ranged from 18-45 years. The average age was 32.32 years. 92.19% of patients were of physically active age group (18-40 years). Out of the 64 patients, 55 patients (85.93%) were male, and nine patients (14.07%) were female. Right side anterior cruciate ligament deficiency was seen in 36 (56.25%) patients, and left-sided involvement has been observed in 28 (43.75%) patients. Most of the patients in our study were having signs and symptoms indicating towards ACL deficiency of knee of 1-5 months duration (54.68%). Most common mode of ACL injury was by road traffic accident (37.50%). Next common cause was sports activity (29.68%) like football, kabbadi, and athletics. Rest of patients sustained injury while doing daily activities like domestic fall and fall from height. The pre-operative Lysholm knee score of 64 patients ranged from 61-90. Most of the patients (43.75%) fall in range of 71-80. The mean Lysholm knee score of patients was 69.06 points. At 9th-month follow-up, 82.75% of the patients reported outcome as excellent and good with scores above 95and 76-94 respectively according to Lysholm scoring. Ten patients (17.23%) scored 65-75 or below and were grouped as fair outcome. Regarding postoperative complications six patients had pain; post-operative superficial infection was seen in 4 patients and intra-articular infection (Septic arthritis) in one patient. Superficial infection was treated with antibiotic coverage and debridement. Knee joint arthrotomy and proper irrigation was done in the patient with septic arthritis. Four patients had stiff knee, and one patient had residual instability. Femoral tunnel blowout was seen in 2 patient. We have also compared between the two subgroups of patients operated by quadrupled Hamstring graft, one fixed with endo-button and interference screw and the other fixed with both interference screws. The difference between mean Lysholm score of two groups is statistically insignificant at $t = 0.009$, $p > 0.05$.

Table 1: Age Wise Distribution

Age (Years)	No. of Patients	Percentage
18-25	21	32.26%
26-30	18	28.11%
31-35	15	23.40%
36-40	5	7.81%
41-45	5	7.81%
TOTAL	64	100%

Table 2: Sex Wise Distribution

Sex	No. of Patients	Percentage
Male	55	85.93%
Female	9	14.07%
Total	64	100%

Table 3: Side Involved

Knee	No. of Patients	Percentage
Right	36	56.25%
Left	28	43.75%
Both	0	0%
Total	64	100%

Table 4: Duration of Symptoms

Duration	No. of Cases	Percentage
1-5 months	35	54.68%
6-10 months	10	15.62%
11-15 months	7	10.93%
16-20 months	4	6.25%
21-25 months	6	9.37%
26-30 months	2	3.12%
Total	64	100%

Table 5: Mode of Injury

Mode of Injury	No. of Patients	Percentage
RTA	24	37.50%
Sport activity	19	29.68%
Slip on ground	13	20.31%
Fall from height	7	10.93%
Assault	1	1.56%
Total	64	100%

Table 7: Pre-Operative Lysholm Knee Score

Lysholm Knee Score	No. of Patients	Percentage
<60	0	0%
61-70	23	35.93%
71-80	28	43.75%
81-90	13	20.31%
91-100	0	0%
Total	64	100%

Table 8: Post-Operative Lysholm Knee Score

	No. of Patients	Percentage
Excellent (≥95)	16	27.58%
Good (76-94)	32	55.17%
Fair (65-75)	8	13.79%
Poor (≤64)	2	3.44%
Total	58	100%

Table 9: Post Operative Complications

Complication	No. of Patients
Stiff knee	4
Pain	6
Infection	5
Instability	1
Femoral tunnel blow out	2

Table 10: Table of significance between two Groups (Both Side Interference Screw VS Endobutton and Interference Screw)

	Mean	T value	P value	results
Screw with Endobutton (n= 35)	77.28 ± 12.57	0.009	$p > 0.05$	Difference is not significant
Both sides screws (n=25)	76.2 ± 12.90			

Discussion

The goal of treatment of an anterior cruciate ligament deficient knee is to provide a stable knee to prevent secondary injury to knee and to prevent early onset of osteoarthritis. The most accepted method of surgical management at present for anterior cruciate ligament deficient knee is Arthroscopic anterior cruciate ligament reconstruction using autologous bone patellar tendon bone or hamstring tendon graft depending on operating surgeon's preference. Our study is unique due to the presence of moderately large number of patients, the high follow-up attendance frequency (100%), the prospective study design and the independent observer follow-up with self-administered questionnaires. The weakness of the study is the lack of isokinetic strength tests. The incidence of meniscal injuries at the time of injury to the ACL is common[12] and that such injury significantly influences the outcome scores has also been demonstrated previously[13, 14]. A preexisting meniscal injury is a stronger factor which determines functional outcome after ACL reconstruction than the choice of graft. In our study, the final activity level and Lysholm values were comparable with a previous study of ACL reconstruction by Risberg *et al*. [15].In our study, there was significant improvement in knee function and Lysholm scores in all study subjects following ACL reconstruction. This was also supported by the responses to simple questionnaire stating if they had any regrets about getting operated; to which unanimous answer in 100% subjects was "no regret." However, on closer introspection, we found that most patients had lowered their activity level as compared to preinjury levels, which probably brings out the fact that restoration of knee function after reconstructive surgery to complete pre-injury levels is very rare. Knee kinematics does not return to normal after reconstruction [16]. Frank Adam *et al*. studied the Biomechanical Properties of Patellar and Hamstring Graft Tibial Fixation Techniques in Anterior Cruciate Ligament Reconstruction and concluded that hamstring graft fixation displayed less stiffness and early graft motion compared to BPTB graft fixation [17]. Corry IS *et al*. stated regarding lesser anterior knee pain and lower pain on kneeling in hamstring group as compared to BPTB group [18]. On the contrary David Jean Biau *et al*. and Bruce D B *et al*. commented about the better functional outcome of BPTB graft as compared to Hamstring graft regarding better postoperative knee stability and grade of pivot shift [19, 20]. Our study also highlights that there is no statistically significant difference between fixation of graft using either two interference screws or one interference screw and endo-button. This is supported by a prospective nonrandomized clinical outcome study by Ma CB *et al*. [21] and a meta-analysis by Alexis Colvin *et al* [22] which had similar observations as our study.

Conclusion

In our study, Arthroscopic anterior cruciate ligament reconstruction gives very good results in the short term follow-up regarding patient satisfaction and return to near normal activity. In our study, we compared the functional outcomes of ACL reconstruction by using hamstring graft which was fixed by using either two interference screws or with endo-button at femur and interference screw at tibia. Functional assessment was done by Lysholm score. Both groups had similar outcome in terms of instant stability of the

graft and functional outcome at the end of one year. Large-scale study with long-term follow-up is required to corroborate findings of the study and to find out long-term functional results in the two graft groups. Preoperative counseling and motivation for rehabilitation may give better results.

Compliance with Ethical Standards

Funding: No Funding received

Conflict of Interest: All authors declare that they have no conflict of interest.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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