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Assessment of outcome between early and delayed arthroscopic reconstruction of anterior cruciate ligament tears: A comparative study

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Abstract
Background: The anterior cruciate ligament (ACL) is one of a pair of cruciate ligaments (the other being the posterior cruciate ligament) in the human knee. The two ligaments are also called cruciform ligaments, as they are arranged in a crossed formation. Among all knee injuries ACL sprain or tear is the most common one.
Aim: To assess the functional outcome between early and delayed arthroscopic reconstructed anterior cruciate ligament (ACL) tears.
Materials and Methods: Sixty patients with ACL injury admitted to Index Medical College Hospital form February 2017 to July 2018 were studied. The surgery was done after diagnosis was established. Early and Delayed arthroscopically reconstructed ACL done using IKDC score, Lysholm-Tegner Score, KOOS scoring and concurrently using clinical testing done by pivot shift test, Anterior drawer, Lachman test and range of movements both pre and post operatively.
Results: Sports (46.67%) was the main reason for the ACL reconstruction surgery. Among Delay and Early group, Intra-operative Chondral Injuries was found in 13 and 5 patients respectively (p=0.024). Clinical assement with Lacman Ant drawer test revealed that all the patients were positive (100%) compared to 27 (45%) patients with McMURRAY'S test and 3 (5%) patients with PIVOT SHIFT test. Forty nine (49) (85.96%) postoperative patients were found negative and 8 (14.04%) were found positive in Anterior Drawer Test. Fifty two (52) (91.22%) postoperative patients were found negative while 5 (8.73%) were found positive in Pivot Shift Test.
Conclusion: The people who underwent early surgery had better stability and early return to pre injury activity level with similar functional scores to other group.

Keywords: anterior cruciate ligament, IKDC score, lysholm-tegner score, KOOS score, pivot shift test, anterior drawer test, lachman ant test

Introduction
The anterior cruciate ligament (ACL) is one of a pair of cruciate ligaments (the other being the posterior cruciate ligament) in the human knee. The ACL is one of the four main ligaments of the knee, providing 85% of the restraining force to anterior tibial displacement at 30 degrees and 90 degrees of knee flexion. (Richard BF 2010) [1]

Among all knee injuries, ACL sprain or tear is the most common one. Athletes who participate in high demand sports like soccer, football, and basketball are more likely to injure their ACL. The incidence of ACL injury is 8 per 100,000 cases per year. (Smith TO 2010) [2]

In a national survey by Francis *et al.*, of 101 consultant orthopaedic surgeons in the UK, 81% reported that they considered the ideal time span from injury to operation to be between 1 and 6 months, although it was acknowledged that only 35% of ACL reconstructions are performed within this timeframe. (Francis *et al.* 2001) [3]

Proponents of early surgical intervention during the initial weeks post-injury have suggested that restoring tibiofemoral stability may minimise the risk of further meniscal and chondral injury, which may be associated with degenerative joint changes.

Currently, most surgeons agree that the patient should have regained full range of motion (ROM) and show no signs of arthrofibrosis or quadriceps atrophy before reconstruction. To this date, there is no consensus of the ideal timing for ACL reconstruction.

Hence, present study was planned to compare the results 6 months after anterior cruciate ligament (ACL) reconstruction using a hamstring tendon (HT) auto graft in patients operated within 12 weeks after the injury and patients operated more than 12 weeks after the injury.

Materials and Methods

The prospective cohort study performed in Sixty (60) patients with ACL injury admitted to admitted to Index Medical College Hospital form February 2017 to July 2018 were included in this study after obtaining informed consent. Diagnosis was confirmed with standard clinical test and with the help of radiograph Magnetic Resonance Imaging (MRI). Patients with complete or partial ACL Tear who are undergoing ACL reconstruction were randomly categorized for early <12 weeks and delayed >12 weeks groups depending on the time of presentation to hospital. Established ACL tear (partial or complete) were taken up for ACL reconstruction using arthroscopic reconstruction with semitendinosis and gracilis quadruple grafts. Functional evaluation of the reconstructed ACL was done using IKDC score, Lysholmtegner and KOOS scoring methods.

Inclusion criteria

Patients with complete or partial ACL Tear who are undergoing ACL reconstruction belonging to the age group of 18-60 years with ACL injury either isolated or Acute or Chronic, associated Meniscal injury, medial collateral ligament injuries (Grade 1,2), lateral collateral ligament injury (Grade 1,2) and chondral injury (Grade 1,2) were included in the study.

Exclusion Criteria

Patients with associated Posterior Cruciate Ligament (PCL) injury, ACL reinjury. periarticular fracture, ipsilateral lower limb fracture, Grade 3 & 4 chondral injuries(detected intraoperatively) and medial and lateral Collateral ligament injury (Grade 3 and Grade 4) were excluded from the study.

Methodology

Surgical procedure

All the patients diagnosed to have an ACL injury clinically underwent a MRI of the affected limb. Once the diagnosis was established, in acute stage long knee brace, anti-inflammatory medications, started on quadriceps strengthening exercises and once the tissue swelling subsided and no extension lag patient was taken up for surgery. Patient was admitted one day prior to surgery and preoperative blood tests were done. The patient underwent a pre anaesthetic check-up for fitness. Parts were prepared and a written and informed consent for the surgery was taken. Patient was shifted to the operation theatre and was given a spinal/epidural anaesthesia.

Examination under anaesthesia

Under spinal and epidural anaesthesia, the knee joint was assessed clinically for Lachman test, Anterior Drawer test, Pivot shift was graded accordingly. In cases where clinical examination and MRI was inconclusive, but patient was symptomatic, decision to do ACL was taken based EUA and arthroscopic findings. Intravenous antibiotics was started one hour before the incision. All cases have been done under spinal anaesthesia with tourniquet control in supine position with knee flexed to 90o hanging in leg holder at the edge of the OT table

Steps of the procedure

A high anterolateral portal was made to avoid the highest part of the fat pad, and for better 'look down' view of the tibial attachment site of ACL easily. Establishing the AM portal at the correct height above the medial joint line is extremely important to the success of the procedure.

Hamstring tendon graft harvation

A 3cm medial skin incision was made midway between tibial tuberosity and medial most aspect of upper tibia. The tendons were palpated and the sartorius fascia was incised parallel to the fibers of the fascia just above the thicker and more distally inserted hamstring tendons. After the vinculae had been cut under visual control, the distal end of tendons is cut and graft is harvested with a semiblunt, circular closed tendon stripper.

Hamstring tendon Graft preparation

The tendon was prepared for quadruple graft, depending on the length of the tendon, 7 cm being the minimum accepted length for the final graft. No. 5 Ethibond suture was used for preparation of proximal and distal ends of the graft by whip stitch method. Two No. 5 non-absorbable Ethibond sutures were used as the lead sutures at the distal and proximal ends. The thickness of the graft was measured using a sizer.

Femoral tunnel preparation

Maximal possible knee flexion of the knee with the leg holder on was achieved. One assistant was used to maintain the knee flexion position while drilling the femoral tunnel. The femoral aimer of appropriate offset (radius of the graft diameter+ 3) was used to avoid posterior cortex blowout. The beath pin was drilled through the aimer until it exited at the anterolateral aspect of the thigh, which was held by a hemostat. Femoral tunnel was prepared with calibrated, cannulated reamers to the desired length and diameter of the graft.

Tibial tunnel preparation

The ACL tibial jig was positioned via the anteromedial portal just over the tibial foot print of the original ACL(Fig. 8.1&8.3). The cannulated guide was then pressed against the tibial cortex 1.5 cm medial to the tubercle and 1 cm proximal to the pesanserinus tendons. A pin was drilled and observed arthroscopically as it entered the nominated site on the intercondylar region. The tunnel was prepared over the guide pin with cannulated reamers up to the desired size.

Graft placement and fixation

The graft was prepared with appropriate sized endobutton loop. Through the 'beath' pin one ethibond was pssed from tibial tunnel to femoral tunnel. The 'beath' pin was withdrawn from the femoral side by gentle pulling. The thick string of the endobutton was pulled and button was flipped at lateral cotex of the femur. An appropriate bioabsorbable interference screw was used to fix the graft at the tibial site in extension while giving the posterior drawer. Cylic loading of the graft was done following the fixation.

Statistical Analysis

The scores of both time points was expressed as mean ±SD. The normality of the data was examined. The scores followed normal distribution and was compared between pre and post-operative time points using independent student t-

test. Chi Square test was used to compare the Categorical data. All statistical analysis was considered significant at P <0.05 level of significance.

Data was analysed pre-operatively with assessment of clinical tests including Lachmann test, Anterior Drawer test, Pivot shift, X ray Knee, MRI Knee, IKDC score, Lysholm-Tegner scoring and KOOS scoring. Post operatively data was functionally analysed with IKDC, Lysholm-Tegner score, KOOS scoring Pivot shift tests, anterior drawer test and Lachmann test.

Results

Present prospective study was performed on 60 patients belonging to the age group of 18-60 years who have symptomatic ACL tear requiring arthroscopic reconstruction. The study cohort was divided in to Delay Groups (n=30, receiving arthroscopic reconstruction after >12 weeks) and Early group (n=30, receiving arthroscopic reconstruction after <12 weeks).

Mean age of study cohort of Early and Delay groups was 32.77±3.96 and 34.03±5.08years respectively. In Delay group, out of 30 patients, most of them were male (n=28) and there were 2 females and among Early group, most of them were male (n=28) and there were 2 females. Distribution of gender among both the groups was comparable (p=1.00). Analysis of mode of injury among the study cohort revealed that sports (46.67%) was the main reason for the ACL reconstruction surgery followed by self fall (30%) and RTA (23.33%). The comparison of different diagnosis between groups are mentioned in Table 01.

Table 1: Comparing distribution of different diagnosis between groups

Groups	Diagnosis				Total	P value
	ACL	ACL+ BOTH	ACL+LM	ACL+MM		
Delay	12	4	8	6	30	0.845
Eraly	13	6	6	5	30	
Total	25	10	14	11	30	

The distribution of patients was insignificant among both the groups (p=0.845). Among Delay and Early group, Intra-operative Chondral Injuries was found in 13 and 5 patients respectively (p=0.024). Functional evaluation of the reconstructed ACL was done and values mentioned in Table 02. In IKDC score, Lysholmtegner and KOOS scoring methods, There was no significance difference in mean ROM between both the groups in preoperative as well as postoperative group.

Table 2: Functional evaluation of the reconstructed ACL

Parameters	Status	Group	N	Mean	Standard deviation	Standard error mean	P Value
ROM	Preoperative	EARLY	30	103.37	3.764	0.687	0.741
		DELAY	30	103.47	3.972	0.725	
	Postoperative	EARLY	30	117.57	5.923	1.081	0.034
		DELAY	30	115.60	4.116	0.751	
IKDC	Preoperative	EARLY	30	41.27	4.068	0.743	0.878
		DELAY	30	40.70	4.129	0.754	
	Postoperative	EARLY	30	82.63	3.917	0.715	0.396
		DELAY	30	83.83	4.771	0.871	
TEGENR	Preoperative	EARLY	30	48.00	3.270	0.597	0.125
		DELAY	30	47.70	4.458	0.814	
	Postoperative	EARLY	30	90.07	4.982	0.910	0.313
		DELAY	30	89.23	4.207	0.768	
KOOS	Preoperative	EARLY	30	51.87	3.037	0.554	0.024
		DELAY	30	53.33	3.726	0.680	
	Postoperative	EARLY	30	90.17	3.611	0.659	0.596
		DELAY	30	90.67	3.594	0.656	

Independent sample t test, P value of <0.05 is considered as significant.

Clinical assessment of all patients were done thoroughly with history of instability, sense of giving way and positive clinical tests results were mentioned in Table 03. Lacman Ant drawer test revealed that all the patients were positive (100%) compared to 27 patients with McMURRAY'S test and 3 patients with PIVOT SHIFT test.

Table 3: Positive clinical tests results

Status	Lachman Ant drawer test	McMURRAY'S test	PIVOT SHIFT test
No of patient Positive	60	27	3
Percentage	100	45	5

Anterior Drawer Test post-operative revealed that out of 60 patients, only 49 (85.96%) patients were found negative and 8 (14.04%) were found positive for Anterior Drawer Test. Results of Pivot Shift Test post-operative revealed that out of 57 patients, only 52 (91.22%) patients were found negative while 5 (8.73%) were found positive for Pivot Shift Test.

Discussion

There is no consensus in the literature regarding the optimal timing of surgical reconstruction of the ruptured anterior cruciate ligament (ACL). Previous authors have suggested that early reconstruction may facilitate an early return to work or sport but may increase the incidence of post-operative complications such as arthrofibrosis. The most

important finding of the present study was that there is no statistically significant difference in outcomes between those patients who underwent earlier compared to delayed ACL reconstruction.

In this study mean age of study cohort of Early and Delay groups was 32.77±3.96 and 34.03±5.08 years respectively. Age between both the groups was comparable (p=0.266). In a study done by Bottoni *et al.*, Meighan *et al.* and Petersen *et al.* a total, 161 ACL reconstruction procedures termed as early were compared to 209 delayed procedures were performed. The mean age was 25.6 years in the early group [Standard deviation (SD) = 2.3] compared to 26.2 years (SD = 1.1) in the delayed group. (Bottoni *et al.* 2005, Meighan *et al.* 2003 and Petersen *et al.* 2006) [3, 18]

In delay group out of 30 patients, most of them were male (n=28) and there were two females and among Early group, most of them were male (n=28) and there were two females found in this study. Distribution of gender between both the groups was comparable (p=1.00). Analysis of mode of injury among the study cohort revealed that sports (46.67%) was the main reason for the ACL reconstruction surgery followed by self-fall (30%) and RTA (23.33%).

In this cohort study, most of the patients were diagnosed with ACL (n=25), out of that 13 and 12 patients were in Early and Delay groups respectively. Ten patients were diagnosed with ACL+ Both, out of that six and four patients belong to Early and Delay group respectively. Out of 14 patients who were diagnosed with ACL+LM, eight and six belong to Delay and Early group respectively. Out of 11 patients who had ACL+MM injury, six and five patients were in Delay and Early groups respectively. The distribution of patients was insignificant between both the groups (p=0.845). The study done by Villa *et al.* in 140 patients. He found that 43.2% had an isolated

ACL lesion, whereas 56.8% had one or more concurrent injuries. Patients with a higher tegner score probably have better clinical and functional conditions prior to surgery. (Villa FD 2015) [7]

In this study, mean ROM in Early and Delay groups in preoperative stage was 103.37±3.76 and 103.47±3.97 respectively. There was no difference in Mean ROM between both the groups in preoperative (p=0.741). Mean ROM in Early and Delay groups in postoperative stage was 117.57±5.92 and 115.60±4.11 respectively. There was significance difference in mean ROM between both the groups in preoperative (p=0.034).

Patient-rated outcome measures, such as the IKDC scale (Kocher MS 2011) [8] may be useful in assessing an adult patient. In this study, mean IKDC score in Early and Delay groups in preoperative stage was 41.27±4.06 and 40.70±4.12 respectively. There was no difference in Mean ROM between both the groups in preoperative (p=0.878). Mean IKDC score in Early and Delay groups in postoperative stage was 82.63±3.91 and 83.83±4.77 respectively. There was no significance difference in mean ROM between both the groups in preoperative (p=0.396). Villa *et al.* reported that the mean IKDC subjective score at final evaluation was 91.2±11.9 (range, 32.2-100). Also significantly, lower IKDC subjective scores were recorded by patients presenting with a concomitant combined collateral ligament (MCL or LCL) injury and by those who were prescribed a knee brace postoperatively. (Villa FD 2015) [7]

In this study, mean TEGENR score in Early and Delay groups in preoperative stage was 48.00±3.27 and 47.70±4.45 respectively. There was no difference in Mean ROM between both the groups in preoperative (p=0.125). Mean TEGENR score in Early and Delay groups in postoperative stage was 90.07±4.98 and 89.23±4.20 respectively. There was no significance difference in mean ROM between both the groups in preoperative (p=0.313). Villa *et al.* reported that the mean tegner activity score was 7.0±2.0 (range, 3-10). Sgaglione *et al.*, Petersen *et al.* and Bottoni *et al.* found that there was no statistically significant difference between the early and delayed ACL reconstruction groups for the Lysholm score or Tegner score. (Villa FD 2015, Sgaglione NA 1993, Petersen W 1999 and Bottoni R 2005) [7, 9, 10]

Mean KOOS total score in Early and Delay groups in preoperative stage was 51.087±3.03 and 53.33±3.72 found in this study. There was no difference in Mean ROM between both the groups in preoperative (p=0.024). Mean KOOS total score in Early and Delay groups in postoperative stage was 90.17±3.61 and 90.67±3.59 respectively. There was no significance difference in mean ROM between both the groups in preoperative (p=0.596). In Arbes *et al.* study reported that in accordance with the Knee Injury and Osteoarthritis Outcome Scoring System (KOOS), knee function was fair in nearly all 20 cases. (Arbes S 2007)

In this study results of Lacman Ant drawer test revealed that all the patients were positive (100%) for Lacman Ant drawer test. Results of McMURRAY'S test revealed that out of 60 patients, 27 (45%) were found positive for McMURRAY'S test. Results of PIVOT SHIFT test revealed that out of 60 patients, only 3 (5%) patients were found positive for PIVOT SHIFT test. Results of Anterior Drawer Test post-operative revealed that out of 60 patients, only 49 (85.96%) patients were found negative and 8 (14.04%) were found positive for Anterior Drawer Test. Results of Pivot Shift Test post-operative revealed that out of 57 patients, only 52 (91.22%) patients were found negative while 5 (8.73%) were found positive for Pivot Shift Test.

Mizuta *et al.* reported that in all 18 patients had symptoms of instability and complained of pain, and only one returned to the previous level of athletic activity. (Mizuta 1995) [13]. McCarroll *et al.* treated 16 patients conservatively. Only 7 patients returned to sports, and all 16 patients experienced giving way, effusions and pain.(McCarroll JR 1988) [14] In the study of Majors *et al.* and Sgaglione *et al.* 58 tibiofemoral laxity was assessed using a variety of outcomes including KT- 1000 arthrometer measurements, assessment of Lachman and the pivot shift tests.(Majors RA 1996, Sgaglione NA 1993) [16, 9]

Dunn *et al.* in a meta-analysis showed that nonoperative or delayed-operative patients were 33.7 times more likely to report instability than the early operative group. Those who chose the nonoperative route had a 12 times greater risk (odds ratio ¼ 12.2, 95% confidence interval ¼ 1.55, 96.3) of developing a meniscal tear after the initial injury. (Dunn KL 2016) [15]

Hunter *et al.* commented that the early literature cited that early reconstruction increased the incidence of arthrofibrosis and knee stiffness compared to later studies, through the development of modern arthroscopic techniques. Wasilewski *et al.* also noted the reduction in complications associated with arthroscopically compared to open ACL

reconstruction, supported by other studies assessing surgical technique. (Hunter RE 1996, Wasilewski 1993) [16, 17]

Meighan *et al.* in their study have found no evidence to suggest that an early reconstruction is of benefit to athletic individuals with an acute rupture of the ACL. The movement returns more slowly and the recovery of muscle function is delayed after an early reconstruction. (Meighan 2003) [5, 18]

Other studies have investigated the risks of immediate or very early reconstruction of the ACL. Shelbourne and Foulk recommended that surgery be delayed by at least three weeks, and suggested introducing an accelerated postoperative rehabilitation programme to reduce knee stiffness. (Shelbourne 1991) [19]

In fact, limitations of the present study are the limited number of patients, which restricts the possibility of performing sub-analyses and detecting confounding factors, and the short-term evaluation, which prevents us from showing whether the observed variables might also influence the long-term clinical outcome.

Conclusion

The injury was more common amongst the young male in the age group of 18 to 32 years with right side being more common compared to the left. Sports injury is the most common mode of injury in our study group. These study shows that there was no significant difference in functional outcome of the early surgery group compared with the delayed surgery group. However, the people who underwent early surgery had better stability and early return to pre injury activity level, whereas patients who underwent delayed surgery had more medial meniscal tears and chondral injuries, but there functional scores were equal to the early surgical group. Furthermore, we would conclude by saying the timing of AACL Reconstruction depend on the patient's soft tissue status, full extension of the knee and strength of the quadriceps. Furthermore, a long-term study is required to evaluate better.

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