

Evaluation of the results of early arthroscopic anterior cruciate ligament (ACL) reconstruction using the anatomic (central to central) single bundle technique using the Hamstring graft.

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Abstract

Background

Anatomic anterior cruciate ligament (ACL) reconstruction has become popular during the last decade. This procedure is designed to reconstruct the anatomic insertion of the ACL footprint. Previous biomechanical basic studies and clinical results have demonstrated the advantages of this procedure compared with conventional ACL reconstruction technique. The aim of study is to evaluate the results of early arthroscopic ACL reconstructions using single bundle anatomic central to central technique using the semi-tendinosus and gracilis autografts which were fixed by end button on the femoral side and biodegradable interference screws on the tibial side.

Patients and Methods

Thirty patients with a primary diagnosis of acute Anterior Cruciate Ligament tear seen in the clinic were evaluated and prepared for early arthroscopic ACL reconstructions. All the patients had a post operative accelerated rehabilitation program similar to that designed by (K. Donald Shelbourne and Christine Klotz, 2007) was used for the patients. Evaluation was done by the use of International Knee Documentation Committee (IKDC) evaluation form (subjective and objective).

Results

The comparison between IKDC objective score pre and postoperatively showed a significant improvement in the final score.

Conclusion

This study suggests that early arthroscopic ACL reconstructions using single bundle anatomic central to central technique gives good functional results with no increased incidence of ROM loss.

Key Words

anatomic ACL reconstruction, timing, accelerated rehabilitation, arthrofibrosis).

Introduction

Currently, a large number of Anatomic anterior cruciate ligament (ACL) reconstructions are performed each year around the world, therefore, the ACL has been one of the most frequently studied structures of the musculoskeletal system during the last decades.

Biomechanics of the intact and ACL replacement graft, different types of grafts, mechanism of failure, treatment, surgical techniques, and postoperative rehabilitation protocols have been intensively studied.[1]

Fu and Karlsson described anatomic ACL reconstruction as 'the functional restoration of the ACL to its native dimensions, collagen orientation and insertion

sites'. It is a detailed and meticulous procedure that involves visualization of the native ACL insertion site, measuring ACL and knee dimensions, appropriate graft tensioning and evaluation of graft and tunnel position. It encompasses single and double bundle reconstruction and can be applied to primary, revision and augmentation surgery. The development of the anatomic technique has made us take a closer look at the ACL anatomy.[2]

Early surgical intervention during the initial 6 weeks post-injury weeks have suggested that restoring tibio-femoral stability may minimize the risk of further meniscal and chondral injury which may be associated with degenerative joint changes. Early surgery may also facilitate rapid return to sporting and occupational pursuits with considerable economic consequences.[3]

Delayed ACL reconstruction may be associated with an increase in muscle atrophy and reduced strength which may delay early rehabilitation. Conversely, delaying surgical intervention allows optimisation of pre-operative knee range of motion and recovery of surrounding soft tissues from the initial injury and potentially reducing the incidence of post-operative arthrofibrosis and wound complications.[3]

Patients and Methods

From March 2013 to August 2014, in a prospective non-randomized clinical outcome study, thirty patients (n = 30) with a primary diagnosis of acute ACL tear within one month from injury seen in the outpatient clinic were evaluated and prepared for arthroscopic ACL reconstruction.

Selection of the patients was done based on certain inclusion criteria:

- 1-ACL tear within one month.
- 2- Age between 20 -30 years.
- 3- Single-leg insufficiency of ACL (Normal contra-lateral ACL).
- 4- Minimal abnormalities of the knee radiographs.

Exclusion criteria includes:

- 1. Associated other ligamentous injury requiring reconstruction.
- 2. Previous reconstruction of cruciate ligaments in the involved knee.
- 3. Meniscal injury that requires meniscal suture at the time of reconstruction or removal of more than 1/3 of the meniscus.

Table 1: Age and injury – surgery time

Age & time	N	Mean	Std. Deviation
Age	30	25.20	3.188
Injury-Surgery time	30	30.03	6.636
Valid N (listwise)	30		

All patients were seen within one month from injury and were subjected to thorough history taking, proper clinical examination and imaging investigative work up.

In the first visit examination was focused on the ROM & swelling that was monitored.

Aspiration under complete aseptic technique was done for patients with tense swelling causing severe pain (8 patients required aspiration).

Analgesic was given in the form of Declofenac Na. 50 mg.TDS daily & amorphous aescin 40 mg. TDS as an anti-eoedematous.

Crepe bandages were applied in a Robert-Jones (R-J) manner for one week.

The second visit was one week later, evaluation of the patients regarding level of pain, ROM & swelling was done. The patients with mild pain and swelling were sent for physiotherapy for preparation for surgery,while those still having pain and moderate to severe swelling are kept in Robert-Jones bandages with continuation of the same medications and re-evaluated on weekly basis to be sent for physiotherapy after improvement of pain and swelling.

Pre operative physiotherapy excercises are in the form of heel props, towel stretches, prone hangs; gait and stance training; heel slides, flexion hangs, wall slides. The goal of these excercises is to regain full ROM , normal gait and no or mild swelling before surgery. Patients failed to achieve these criteria were excluded.

Method of Evaluation:

All patients were subjected to thorough history taking, proper clinical examination and imaging investigative work up including plain radiograms and MRI. Data of the preoperative period and postoperative follow up put in the International Knee Documentation Committee (IKDC) evaluation form (subjective and objective) if these data were found to match the inclusion criteria.

Surgical Technique:

Grafts were harvested through a vertical 3 CM incision by use of inside-out technique to harvest the tendons of semitendinosus or gracillis and semi tendinosus muscles. Arthroscopy was carried out using anterolateral and anteromedial portals. Femoral was done through the medial portal. An attempt to preserve large stumps and remnant ACL fibres with intact connections with the tibia and the femur , and use them as a guide for the anatomic drilling for femoral and tibial tunnels (Fig:).

These fibers are thought to contain proprioceptive elements, other remnant of the ACL is debrided for visualization.

Arthroscopic ACL reconstruction using single bundle anatomic central to central technique using the semitendinosus and gracilis autografts which were fixed by end button on the femoral side and biodegradable interference screws on the tibial side was done for all patients.

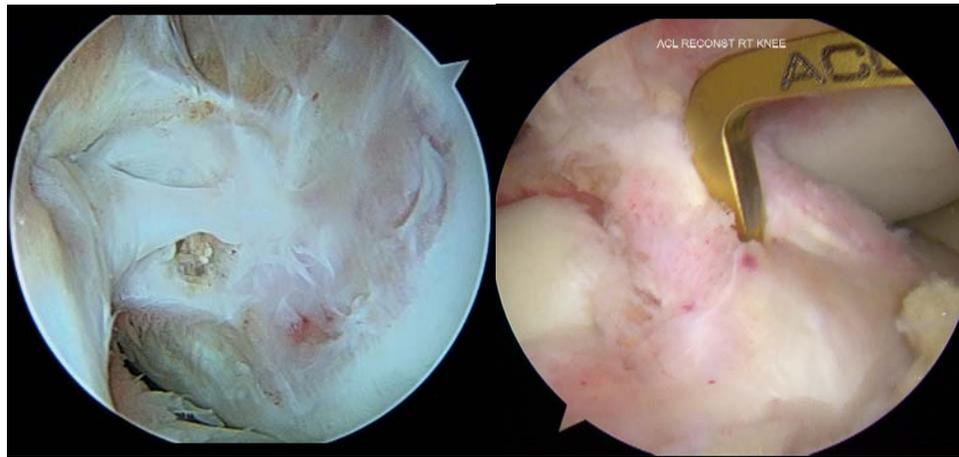


Fig. 1: LEFT : Mark for femoral tunnel , RIGHT : Guide for tibial tunnel

Drain, crepe bandages were applied in a Robert-Jones (R-J) manner for all patients postop.

Rehabilitation:

An accelerated rehabilitation program similar to that designed by (K. Donald Shelbourne and Christine Klotz, 2006) was used for the patients.[4]

The Statistical Methods:

Data were statistically described in terms of mean \pm standard deviation (\pm SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between pre-and post-treatment was done using paired *t* test while comparison of qualitative data was done using McNemar test. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done us-

ing computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

Results

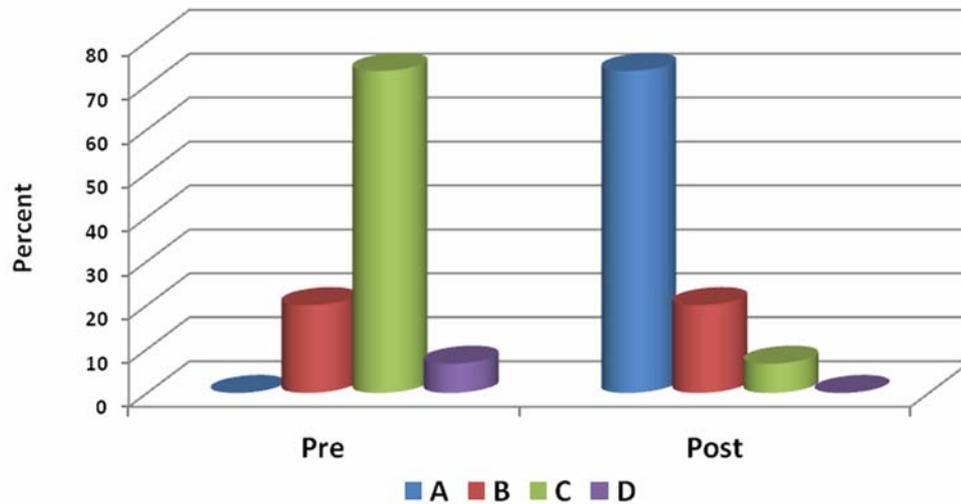
The comparison between IKDC objective score pre and postoperatively showed a significant improvement in the final score ($p < 0.001$) besides, there was a significant improvement in the lack of flexion and extension, ligament examination (lachman, ant. Drawer and pivot shift test) , effusion and single hop test . There was no significant difference in x ray findings . compartment findings and graft site pathology (4 patients reported symptoms from their graft site. That was statistically insignificant. No patients graded their symptoms as greater than mild).

Table 2: Final score pre and post operative

Final score			Time		Total
			Pre operative	Post operative	
A	No.	0	21	21	
	%	0%	70.0%	35%	
B	No.	0	7	7	
	%	.0%	23.3%	11.7%	
C	No.	11	2	13	
	%	36.7%	6.7%	21.6%	
D	No.	19	0	19	
	%	63.3%	.0%	31.7%	
Total		No.	30	30	60
		%	100.0%	100.0%	100.0%
X ²		64.228			
p		.0001*			

The comparison between IKDC subjective score pre and postoperatively showed a significant improvement in the final score, also all the items of subjective

score showed a significant differences postoperatively.



Graph 1: Distribution of single leg hop test results pre- and post-treatment among the study sample

Table 3: pre and post op. final subjective IKDC score

IKDC score	Mean	N	Std. Deviation	Std. Error Mean	p value
Total Pre IKDC subjective score	34.43	30	6.290	1.148	0.000
Total post IKDC subjective score	80.07	30	6.928	1.265	

The correlation between the interval between injury and the surgery, and the final subjective scoring showed a significant relation, the short time lapse give better results.

Table 4: Correlation between time from injury to surgery and the total subjective score.

Min.,Max.&Mean	Time from injury to Surgery	Total Subjective score
Min.	20	60
Max.	45	87
Mean	30.03	80.07
S.D.	6.64	6.93
r	-0.425	
p	0.003*	

Discussion

In our study, results of subjective IKDC score and IKDC knee ligament examination showed a significant improvement postoperatively in the patients who

had early ACL reconstruction and improvement of the patients' symptoms which matches the results of Martina et al who compared the results 2 years after ACL reconstruction using a hamstring tendon (HT) autograft in patients operated within 5 months after the

injury and patients operated more than 24 months after the injury. At 2 years post-operatively, patients who underwent early reconstruction had a significantly better outcome in terms of the Lysholm score and Tegner activity level than those had delayed reconstruction. Evaluation of the stability by lachman test showed that 97 % showed normal or near normal lachman test (100 % in our study). [5]

T. Järvelä et al 1999 assessed the 5–9 years results of the patients who had anterior cruciate ligament reconstruction by bone patella-tendon bone autograft within 6 weeks of the injury and those done more than 3 months after the injury. The Patients who undergo early ACL reconstruction are more satisfied with the end result, have fewer symptoms and can return to sports activities more often than patients with late ACL reconstruction. Evaluation using single leg hop test showed 90 % of the patients were normal or near normal and that matches our result(92%).[6]

David et al 2013 did a meta-analysis to systematically analyze aggregated data from the literature to determine if a benefit exists for either nonoperative or early operative treatment for ACL injuries in the children and adolescents.

Five studies (353 patients) comparing early to delayed reconstruction were identified, 2 of them used the IKDC score. Meta-analysis revealed multiple trends that favor early surgical stabilization over nonoperative or delayed treatment. Patients after nonoperative and delayed treatment experienced more instability and pathological laxity and inability to return to previous activity levels than did patients treated with early surgical stabilization.[7]

Forbell et al 2013 compared the mid-term (five year) followup and patient reported and radiographic outcomes between those treated with rehabilitation plus early ACL reconstruction and those treated with rehabilitation and optional delayed ACL reconstruction in active adults, 18 to 35 years of age, having an anterior cruciate ligament tear not more than four weeks old to a previously uninjured knee.

Evaluation included KOOS score, Tegner activity scale, meniscal surgery, and radiographic osteoarthritis at five years. The strategy of rehabilitation plus early ACL reconstruction did not provide better result

at five years than a strategy of initial rehabilitation with the option of having a later ACL reconstruction. No statistically significant differences existed in return to pre-injury activity between patients treated with early or delayed ACL reconstruction or with rehabilitation alone. [8]

Meighan et al 2003 randomized acute tears of the an-

terior cruciate ligament (ACL) to receive either early (within 2 weeks) or delayed (8 to 12 weeks) reconstruction using a quadruple hamstring graft in order to determine if there was any functional advantage to early reconstruction. Outcome measures included return of knee movement, muscle dynamometry, International Knee Documentation Committee (IKDC) scores and Tegner activity levels. After one year follow up he concluded that there is no functional advantage to be gained by early reconstruction.[9]

Regarding the incidence of loss in ROM the results of our study are comparable with the results of Bottoni et al 2008 made a prospective, randomized clinical trial on the postoperative range of motion following early and delayed reconstructions of the ACL Using hamstring autograft . patients were randomized to either early (within 21days) or delayed (beyond 6 weeks) reconstruction.

No exceptions were made for swelling, limitations in range of knee motion, or pain in contrast to our study. Postoperative assessments included range of motion and KT-1000 arthrometer measurements compared with the contralateral knee, Lysholm, and Tegner Activity Score. Follow up done after one year showed no significant differences between the 2 treatment groups in degrees of extension or flexion lost relative to the nonoperative side, or in subjective knee evaluations. 14 % had flexion loss of 5-10 degrees (16.7 in our study) and 3 % had extension loss of 5-10 degrees and 0 % in our study. [10]

Raviraj et al 2010 randomised 105 consecutive patients with injury associated with chondral lesions no more severe than grades 1 and 2 and/or meniscal tears which only required trimming, to early (< two weeks) or delayed (> four to six weeks) reconstruction of the anterior cruciate ligament using a quadrupled hamstring graft. The outcomes were assessed using the Lysholm score, the Tegner score and measurement of the range of movement showed no distinction could be made for stability testing by clinical examination between the two groups.[11]

Hermann et al 2004 studied the risk factors of reduced ROM in the knee including the time of surgery ,following ACL reconstruction in a retrospective study .The time gap from trauma to ACL reconstruction was documented. Furthermore, the state of the knee and the ROM before reconstruction of the patients. The state of the knee at follow-up examination, evaluated using the IKDC form, there was also a highly significant correlation between preoperative irritation of the knee (swelling, effusion, hyperthermia) at the time of ACL reconstruction and development of arthrofibrosis. This shows that not timing of surgery is a relevant factor for minimizing the risk of

arthrofibrosis but irritation of the knee, which matches our study. Also ROM at the time of ACL reconstruction, showed a significant correlation with the development of arthrofibrosis.[12]

In contrast to the previously mentioned studies.

Shelbourne et al 1991 did a retrospective study of acute ACL reconstruction in young athletes to determine the optimum time to perform ACL reconstruction with respect to arthrofibrosis. He found that there are a significant incidence of arthrofibrosis in patients who had surgery before 3 weeks from injury.[13]

Harner et al 1992 did a retrospective review and follow up examination to investigate the incidence and risk factors of loss of motion after ACL reconstruction (No exceptions were made for swelling, limitations in range of knee motion, or pain). He found a significant correlation between acute ACL reconstruction and post op. decreased ROM. [14]

Conclusions

Despite significant advances in the surgical techniques of ACL reconstruction, there is no consensus as to the ideal timing for ACL surgery which is an issue of considerable debate.

Many studies favours the delay of ACL surgery to avoid the complications of arthrofibrosis and motion loss. Other studies favours the early ACL reconstruction to avoid meniscal and articular cartilage damage.[15,16]

This study confirms that early ACL reconstruction with single bundle anatomic central to central technique using the semi-tendinosus and gracilis autografts can restores knee stability and allows return to a high level of functional and sports activity.

There was a statistically significant improvement in the IKDC subjective and objective scoring including the ROM and stability with no incidence of arthrofibrosis or motion loss.

Early ACL reconstruction can be done once preoperative irritation of the knee (swelling, effusion, hyperthermia) disappears and after regaining of full ROM and normal gait in the affected knee.

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