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A Study on Arthroscopic Assisted Anterior Cruciate Ligament Reconstruction

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Abstract

Background: Once upon a time, the anterior cruciate ligament (ACL) led a relatively safe existence. It was a time when only a fall from a chariot or a jostling horse might send a gladiator or a knight to retirement, because of an unstable knee. In today's world of motorcycles, sports and increased fitness awareness, the ACL and the "weakened warrior" both amateur and professional are parting company more frequently. *Materials and Methods:* Study was conducted in JJM Medical college. A total of 107 patients were included in the study. The patients were divided into 2 groups based on the timing of surgery into Early (Group I): patients who underwent surgery within 3 weeks and Delayed (Group II): the patients who underwent surgery 3 weeks later from the time of injury. Patient demographic characteristics including age, gender, weight were analysed as mean with standard deviation as appropriate. *Results:* Excellent results were obtained on subjective assessment by modified Cincinnati rating system in group I (66 patients) than group II (41 patients)which was statistically significant (p Value 0.00). Functional assessment by Lysholm's modified knee scoring scale also shows excellent results in group I (66 patients) than in group II (41 patient). 62% of patients in group I returned to preinjury levels of activity when compared to 54% in group II at the end of 2 years follow-up but was not statistically significant. Objective clinical assessment shows no difference in laxity in group I and II. Quadriceps wasting was more in group II than group I which was statistically significant. *Conclusion:* We conclude that early reconstruction of ACL has many advantages and should be offered to the patients even during their first visit after an acute ACL rupture. The risk of arthrofibrosis has been over emphasized in literature but our experience shows that it is not true. The advantages of early reconstructions grossly out weigh the disadvantages.

Keywords: ACL; Arthrofibrosis; Knee Joint; Tibia; Femur; Patella.

Introduction

The human knee joint is the result of 400 million years of terapods evolution. The brief period of human investigation of this unique structure has been unable to provide definitive answers to questions relating to the form and function of the normal and the disordered knee. Basic controversies persist regarding the pathologic anatomy, mechanics, natural history, diagnosis and surgical treatment of the ACL deficient knee. According to Jakob R.P. 1992 [1], our "modern" understanding of ACL insufficiency evolved during the 38 years, from Palmer's publication, to the classification of knee instabilities by Hughston in 1976 [2]. O' Donoghue [3] in the early 60's presented guidelines for the surgical treatment of acute cruciate ligament injuries and offered criteria for patient selection. This marked the start of a period of aggressive treatment for these injuries. The advent of arthroscopy led to the principle of

aggressive diagnostic approach to acute knee injuries.Published reports continue to differ with regard to indications for surgical treatment and the definition of functional disability in the ACL deficient knee. Viewing the situation from a historical perspective, however, we can observe a marked change in attitude regarding the management of ACL insufficiency. The initially strong practice towards immediate surgical repair of the ACL crave way to a somewhat nihilistic attitude, as it was discovered that the operative treatment of tears was not always successful. The change to a more conservative approach was also motivated by confusion, about the natural history of ACL insufficiency.

The poor correlation between the clinical features and functional stability of the operated and non-operated knee, added further to the confusion. According to Noyes, one-third of patients with ACL insufficiency will be able to compensate but must forego important activities, another third will be able to compensate but will not develop complications and the remaining third will develop complications and will probably have to undergo reconstructive operation at some point in their life. Experimental and clinical data gave no indication that the "one-third rule" of Noyes, for predicting out comes could be improved. Many patients may not require ACL reconstruction, but, there is no certain way to predict who may require the same later. The problems of masterly inactivating the knee are manifold as reported in literature (Glad stone J.N. et al.,) [4] including quadriceps wasting, increased incidence of reinjury (Noyes FR et al. 1983 and Walla D.J. et al., 1995) [5,6], meniscal tears (Splindler et al., 2005) 7 and late degenerative changes.Nevertheless, a review of present literature confirms the clinical experience that ACL insufficiency can produce significant functional disability, especially in young, active patients. Today the pendulum has swung back to a more aggressive approach to these injuries. This has been due in partto progress in arthroscopic techniques, materials for reconstruction, and 'other technical advances.

As quoted by Jakob R.P. in 1992 [1]Davangere, Karnataka 577004, India., Feagin characterized as "disastrous" the rush to market prosthetic replacements for the ACL. Today we know that the future of ACL surgery rests to a degrees on development of such materials, but this must be paralleled by the advances in the use of autogenous and homologous grafts. Key questions remain to be answered regarding long term wear and material fatigue in prosthetic ligaments. Although a variety of newer techniques and other autografts are getting popular, bone patellar tendon bone graft continues to be the most researched and commonly used autograft material. A more uniform method and "language" for the documentation of clinical results based on standardized criteria of functional disability will bring about a better understanding of the natural course of the ACL deficient knee. Technical advances involving improved surgical fixation techniques, improved tensioning of grafts at operation, better graft selection and augmentation, more appropriate patient selection, and clearer guidelines for postoperative splinting and bracing and the conduct of postoperative physical therapy will do much to lower the morbidity of operatively and non-operatively treated knees with ACL insufficiency. It is a dilemma to clinicians to decide on the choice of patients and the timing of surgery in patients with significant instability and clinical evidence of ACL insufficiency.

Materials and Methods

Study was conducted in JJM Medical college, all patients who had under gone ACL reconstruction were studied prospectively, to record patient demographics, injury variables, treatment offered & out comes following surgery.

A total of 107 patients were included in the study. The patients were divided into 2 groups based on the timing of surgery into Early (Group I): patients who underwent surgery within 3 weeks and Delayed (Group II): the patients who underwent surgery 3 weeks later from the time of injury. Of the 107 patients 78 male (47 in Group I and 31 in Group II) and 29 female (19 in group I and 10 in group II). Patient demographic characteristics including age, gender, weight were analysed as mean with standard deviation as appropriate.

Preoperative Evaluation

Preoperative evaluation of patients included a detailed history, followed by objective assessment of the injured knee with the anterior drawer test, Lachman test and Pivot shift test. Patients with a positive history suggestive of knee instability including giving way and or strong clinical evidence of ACL insufficiency underwent diagnostic arthroscopy prior to ACL reconstruction including patients with equivocal clinical findings on examination. Preoperative MRI

scan were done in patients who could afford the cost. All others underwent diagnostic arthroscopy followed bythe procedure. Co-existing meniscal injuries were managed arthroscopically prior to the reconstruction. All patients had unilateral standard arthroscopy assisted ACL reconstruction using bone patellar tendon bone graft harvested from the ipsilateral knee and anchored with interference titanium screws. All patients were operated by a single surgeon.

Surgical Technique

All the operations were carried out by senior consultant under spinal anesthesia with tourniquet control. A straight incision was made from inferior pole of patella to the tibial tuberosity. The bone blocks (25 mm x 9 mm), at the lower pole of patella and tibial tuberosity were obtained using an oscillating saw and osteotome with the central 1/ 3 of the patellar tendon. Bone block size was checked. For the ease of passage, the graft was made smooth by trimming if necessary and wrapped with a saline swab. Arthroscopy was performed through standard anterolateral portal and the knee inspected. The tibial and femoral attachment sites of the ACL were cleaned and prepared. ACL jig was set at 55° angle and introduced through the anteromedial portal aiming at the attachment of the ACL foot print which is 5-7 mm anterior to PCL. Guide wire was passed through this jig and tunnel made in the tibia through this jig with an appropriate reamer.

After visualizing the posterior margin of the lateral femoral condyle femoral Jig of ACL known as bulls eye jig fixed onto this site. This will allow a 2 mm bony margin behind the femoral tunnel without breaking the posterior wall. Beath pin guide wire was passed through this jig identifyingthe precise position 7 mm from Macintosh's "over the top position" and then a 25 mm long blind tunnel was made in the lateral femoral condyle using appropriate reamer.The patellar tendon graft was then fixed to the beath pin and introduced through the tibial tunnel into the femoral tunnel in the lateral side of the thigh. Under direct vision through arthroscope, the graft was pulled until seated in the tunnels properly. Two cannulated interference titanium screws (8 mm and 9 mm) called "Kurosaka screw" were passed to secure the graft's bone block in the femoral and tibial tunnels respectively.

The ROM of the knee was checked with the graft in place and notchplasty was done only if there was impingement in full extension. Wound closure was done with vicryl for paratendon and ethilon for skin. But under no circumstances attempts were made to stitch the edges of the defect of patellar tendon to prevent patella Baja. Sterile dressings were used for the wounds. Sutures were removed at the end of 10 days. Outcome was assessed during the followup.

Postoperative Protocol

All patients were put on an accelerated rehabilitation approach post operatively, with emphasis on early restoration of passive range of motion, early restoration of patella mobility with patellar mobilization by a rehabilitation specialist, adequate reduction of postoperative inflammation using anti-inflammatory tablets, cryotherapy and reestablishment of voluntary quadriceps control with therapeutic exercises and electrical stimulation where ever necessary. Patients with concomitant Medial Collateral Ligament (MCL) injuries were rehabilitated with a slightly accelerated ROM exercise program with a GII brace (rehabilitation Brace) providing medio-lateral stability to prevent excessive scar formation and subsequent stiffness. Patients were discharged on the 3rd to 5th day with a standard home physiotherapy program.

Follow-up

All patients were reviewed at day 10 for suture removal and to reassess their home physiotherapy program, and subsequently at 3 weeks, 6 weeks, 12 weeks, 6 months, 1 year and yearly thereafter.

Method of Evaluation

Patients were evaluated at follow up of 3 weeks, 6 weeks, 12 weeks, 6 months, 1 year and yearly thereafter, by a single examiner and assessed subjectively using a 100 point score system [8].

Patients were also assessed objectively to determine the degree of laxity/ instability with the Anterior drawers test, Lachmantest, Pivot shift test and quadriceps wasting & knee effusion [9] and finally with functionalassessment based on the modified Lysholm's knee scoring scale [10].

Radiologically patients were assessed by preoperative and follow-up radiographs included standing anteroposterior radiograph, a lateral and skyline radiographs with the knee in 30° of flexion. The radiographs were graded according to 28 point rating scale of "The Hospital for Special Surgery"[11].

Results and Analysis

Of the 107 patients in the study 66 were categorized in group I and 41 in group II. The average age of patients was 36.5. There was a strong male predominance. 83 patients (78%) sustained injury following a history of an RTA. 24 (22%) patients sustained sports injuries. There was an average follow up of 2 years and 7 months (25 months to 38 months) in group I when compared to 2 years and 9 months (24 months to 48 months) in group II with minimum follow-up of 6 months. Preoperatively 62 patients gave a history of giving way/instability (58.8%) i.e., 35 patients (53%) in group I and twenty seven patients (65%) in group II. 103 patients had clinical evidence of instability at the time of presentation including a positive Lachman/Anterior drawer and pivot shift tests. 4 patients who had significant history of instability but equivocal clinical findings needed diagnostic arthroscopy to confirm the diagnosis and to proceed to ACL reconstruction.

On arthroscopy in group I, 41 (63%) patients had co-existing meniscal injuries of whom 28 patients (43%) had medial meniscal injury, 13 patients (20%) had lateral meniscal injury & 7 patients (10%) had both. 12 patients (19%) had medial collateral ligament injury. 90% of meniscal injuries required intervention: partial meniscectomy/ trimming of meniscus being the commonly done procedure. No osteochondral fractures were found in this group. In group II, 25 (72%) patients had co-existing meniscal injuries of whom 20patients (49%) had medial meniscal injury, 5 patients (13%) had lateral meniscal injury & 2 patients (4%) had both. 8 patients (17%) had medial collateral ligament injury.

With regards to MCL injuries, there was clinical evidence of grade I MCL injury (< 5mm laxity) in 3 patients, Grade II MCL injury (6- 10mm laxity) in 7 patients and Grade III MCL injury (> 10mm laxity) in 10 patients (Figure 8). Of 10 patients with grade III MCL injury 7 of them (4 in group I and 3 in group II) underwent MCL repair after ACL reconstruction for valgus instability due to concomitant posteromedial complex injury. Most MCL tears were noted to be mid substance tear (5 patients) followed by avulsion at proximal end or distal ends (2 patients). The incidence of chondromalacia in group I was 8% (5 patients) and group II was 17% (7 patients).

There were no patients, who had postoperative compartment syndrome ineither of the groups. There was no significant difference in the operatingtime or postoperative infection in either group.

Subjective Assessment

Subjective assessment with modified Cincinnati score, revealed a significantly higher score in patients of group I - 88.4 (ranging from 81 to 96) when compared to patients in group II - 82.7 (ranging from 75 to 90) at the end of 6 weeks and at 2 years(Table 1).

Objective Assessment

On examination of patients using objective clinical tests, two patients had grade II laxity on anterior drawer test and Lachman test in group I and one patient in group II and the rest having grade 1, or no laxity. Two patients had mild quadriceps wasting in group I, compared to 32 patients in group II with gross wasting at the end of six months. None of the patients had a positive pivot shift test & knee effusion postoperatively (Table 1).

Functional Assessment

Functional assessment using modified Lysholm's activity score revealed an average score of 73.12 (ranging from 68 to 87) in group I and 70.46 (ranging from 59 to 76) in group II at average follow-up of 2 years. 41 patients in group I (62.1 %) returned to pre injury levels of activity when compared to 22 patients (54 %) in group II at the end of 6 months. We had two patients who had

Table 1: Showing different assessment methods results

	Early		Late		't' value	'p' value
	Mean	SD	Mean	SD		
Age	35.65	8.07	37.68	9.03	1.208	0.230
Subjective	88.4	5.25	82.35	4.50	6.13	0
Functional	73.12	6.7	70.46	7.5	1.8	0.6
Radiographic	26.12	1.6	23.78	2.5	5.7	0

Table 2: Postoperative radiographic changes

Sl. No.	Joint space narrowing / Osteophytes/ Spurring	Group I	Group II
1.	None	60	30
2.	Mild (small spurring, slight sclerosis, 1 -2 mm joint space narrowing)	4	5
3.	Moderate (2-3 mm of joint space narrowing and medial sclerosis)	2	4
4.	Severe (more than 3 mm joint space narrowing and medial sclerosis)	0	2

arthrofibrosis in group 2 and 1 patient in group I. Manipulation under anesthesia was done in 2 patients with good end results. One patient refused to undergo manipulation and accepted to live with it. None had superficial or deep infection post operatively (Table 1).

Radiological Assessment

On radiographic examination, no changes were found in 60 patients in group I and 30 patients in group II. Four patients in group I and five patients in group II showed mild radiological changes, two patients in group I and four patients in groups II showed moderate radiological/changes. Two patients in group II showed severe radiographic changes at the time of final follow up (Table 1,2). Compared with appropriate preoperative radiographs, according to the radiographic scoring system of "The Hospital for Special Surgery" in group I there was no change in mean score i.e., 26 (ranging from 18 to 28).There was a negative correlation between the time from the injury to the reconstruction and the preoperative radiographic score; the longer the time before the reconstruction, the lower the score. The mean radiographic score in group II at the time of recent follow-up was 24 points (ranging from 17 to 26 points). The mean radiographic score at the follow up evaluation was four points less than the preoperative mean score.

Discussion

Sixty six patients who underwent ACL reconstruction immediately within three weeks following injury (61.67%) were compared to 41 patients who underwent ACL reconstruction three weeks (38.5%) after the injury. Most injuries occurred secondary to RTA and sports injuries. Most of our patients were young & active adults. The commonest mechanism of injury in our series was a road traffic accident commonly involving a two wheeler contrary to those reported in international literature [4,7] where sports injury was the commonest cause. The demographic and injury characteristics were not statistically significant between both the groups.

The commonly associated injuries were peripheral tear of the medial meniscus with MCL injury in 48 patients, followed by 18 patients who had a radial tear of the lateral meniscus. Most peripheral tears in group I required trimming and balancing. This is contrary to the study reported by Daniel et al. [11] who noted a higher incidence of reparable meniscal tears among patientsunder going late ACL reconstruction than among patients who presented with acute ACL injury. In general approximately half of the patient with acute ACL disruptions have associated meniscal tears [12,13,14]. Many of these tears may not require surgery. The incidence of meniscal tears in patients with acute ACL injury is high, but the incidence of reparable meniscal injuries is low. Persistent ACL insufficiency leads to more complex meniscal tears that are less amenable to repair [15].

The incidence of chondromalacia was marginally higher in group II, supporting other studies revealing a higher incidence of the same in late presentations where chondral changes are more than twice as frequent inpatients with delayed ACL injuries (40%) when compared to 20% in early cases [16].

Patients with co-existing MCL injury treated conservatively were evaluated after ACL reconstruction for valgus instability. Patients who had significant valgus instability commonly due to co-existing postero-medial complex injury underwent repair of the MCL. Most MCL injuries, which were operated on were mid-substance injuries requiring end to end repair. Patients who had co-existing MCL injury alone were treated conservatively by mobilizing with a GII brace providing medio-lateral stability. MCL tears from the proximal origin or within the mid substance of the ligament tend to present with increased stiffness without residual laxity. By contrast, MCL injuries at the distal insertion site tend to have less of a healing response and often exhibit residual valgus laxity [17]. Therefore location of ligament damage may also affect the rehabilitation programme. Injuries

involving the distal aspect of the MCL may be progressed more cautiously to allow for tissue healing whereas injury to the mid substance or proximal ligament may require a slightly accelerated restoration of range of movements to prevent excessive scar tissue formation [18]. Using return to sports as an end point cannot be applied in our study as many of our patients sustain ACL injury due to RTA and many of them were not playing games or sports earlier.

Our apprehension of arthrofibrosis in group 1 was falsified, rather we had two patients in group two versus 1 patient in group 1 with the same. This was possibly due to an accelerated rehabilitative approach used in all our patients. Early intervention who reported higher incidence of arthrofibrosishave results skewed because of the postoperative immobilization due to other co-existing injuries. Arthrofibrosis once a very significant problem has been greatly reduced (less than 5%) since abandoning postoperative immobilization in flexion and instituting immediate range of motion and accelerated rehabilitation [19]. The patients who followed the accelerated approach exhibited better strength and range of movements and fewer complications such as arthrofibrosis and postoperative laxity. The accelerated group further more, had less patellofemoral complaints and an earlier return to sports. The incidence of arthrofibrosis in our series is less than 1%. Incidence of arthrofibrosis is same in early (1 case) and delayed (2 cases) reconstruction as clearly seen from our study. There is no risk of increased arthrofibrosis in early ACL reconstruction, which was a myth in the past.

The risk of extravasation of irrigation fluid posing a grave risk of compartment syndrome in acutely treated cases has been over emphasized in the past. Fully aware of this risk in an acutely injured knee we took specific precautions in patients of group I avoiding the use of an irrigation pump and regular intermittent clinical evaluation of the calf for any increased tension. There were no cases of compartment syndrome in our series. The functional assessment based on the modified Lysholm's score and subjective assessment scores were significantly better in group I at 6 weeks and 3 months following surgery, showing an accelerated functional recovery in group I patients although the final outcome at the end of 12 months was not statistically significant between the two groups. Acute intervention has inherent advantages including early definitive intervention,management of co-existing injuries, early rehabilitation, reduced emotional & financial stress and early return to pre-injury activity level. Most surgeons believe that meniscal repair and ACL reconstruction be carried out at the same time allowing a single period of anesthesia, surgery and rehabilitation [20].

In delayed intervention, Noyes et al. reported 82%) returned to sports after injury, but of these, 62% suffered a significant reinjury within a year of index injury, 74% reported moderate to severe disability in turning and twisting sports. Only 35% patients were participating in strenuous sports at the end of 5 years and only 11 had no limitations. Two patients in group I and 24 patients in group II have improved their girth of the quadriceps with accelerated rehabilitation programme at the end of 6 months. 8 in group II patients have persisted quadriceps wasting at the time of recent follow-up.

We feel there were no strong advocates of acute ACL reconstruction reported in Western literature probably because lot of arthroscopic surgeons do not see acutely injured knees and their inability to operate these patients due to long waiting lists. There is sparse literature on prospective studies comparing the outcomes of early vs delayed ACL reconstruction. The limitations of the study include the lack of objective physical examination characteristics like the use of arthrometry to accurately assess the degrees of laxity, lack of sensitive imaging studies like MRI in the preoperative and postoperative evaluation of patients.

Conclusion

Excellent results were obtained on subjective assessment by modifiedCincinnati rating system in group I (66 patients) than group II (41 patients)which was statistically significant (p Value 0.00). Functional assessment by Lysholm's modified knee scoring scale also shows excellent results in group I (66 patients) than in group II (41 patient). 62% of patients in group I returned to preinjury levels of activity when compared to 54% in group II at the end of 2 years follow-up but was not statistically significant. Objective clinical assessment shows no difference in laxity in group I and II. Quadriceps wasting was more in group II than group I which was statistically significant. Patients undergoing early ACL reconstruction have minimal or no quadriceps wasting which may be due to early rehabilitation of the patient and subsequent recovery. Early identification and repair of associated injuries reduce the incidence

of later degenerative articular changes and meniscal injuries needing intervention. The incidence of complications of arthroscopy in acute knee injuries may be avoided by taking certain precautions as mentioned earlier and there were no compartment syndrome in our study. The incidence of arthrofibrosis in early reconstruction is avoided by an early aggressive postoperative rehabilitation program. Late ACL reconstruction poses difficulties of muscular wasting of the quadriceps and an increased incidence of associated meniscal and articular injury. Last but not the least, it may be significantly cost effective to the patient when treated with a single sitting surgery and an early return topreoperative levels of activity when compared to patients who present late with associated late complications. We conclude that early reconstruction of ACL has many advantages and should be offered to the patients even during their first visit after an acute ACL rupture. The risk of arthrofibrosis has been overemphasized in literature but our experience shows that it is not true. The advantages of early reconstructions grossly outweigh the disadvantages.

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