Anterior Cruciate Ligament Reconstruction with Bone Patellar Tendon Bone Graft through a Mini Arthrotomy

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Abstract

Instability after rupture of anterior cruciate ligament (ACL) may lead to recurrent episodes of giving way, an increased risk of meniscal injury and premature degenerative changes. A total of 25 cases with ACL injuries were evaluated after reconstruction with bone patellar tendon bone graft through a mini-arthrotomy. All patients were male. Maximum number of patients were between 25-30 years of age (40%). The most common modality of injury was contact sports (44%). Most common complaint was instability of knee (100%). Average Lysholm score increased from pre-operative of 47 (27-75) to post-operative of 87 (68-95). Two patients (8%) had retropatellar pain. Moderate to severe graft site tenderness was present in 4 (21%). After an average follow up of one year three months, the results were comparable with the results of arthroscopic reconstruction.

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Key Words : Anterior cruciate ligament reconstruction; Mini arthrotomy

Introduction

In the past loss or damage to ACL was considered to be of little importance to the long-term functions of the knee [1]. Several studies have shown, however, that the instability after rupture of the ACL may lead to recurrent episodes of giving way, an increased risk of meniscal injury and premature degenerative changes [2].

In today's world of motorcycle, football, increased fitness awareness and highly competitive sports, injury to ACL has assumed increasing importance both from the diagnostic as well as therapeutic angle. If ACL is ruptured, the synchronous rolling and gliding movement of the knee disintegrates and causes uneven load distribution through knee joint because of instability.

Reconstruction of ACL will balance the loading of the knee joint and reduce the incidence of meniscal damage and prevent early osteoarthritic changes. Surgical methods of reconstructing the torn ACL can be divided into three broad categories; intra-articular reconstruction, extra-articular reconstruction and combined intra-articular and extra-articular reconstruction using either autogenous material or synthetic material. There is no single best procedure to repair chronic knee ligament laxity associated with ACL tear. The most commonly used autograft for intra-articular reconstruction of ACL is central one-third of the patellar tendon. Tension to failure studies of various donor tissues have revealed that bone patellar tendon bone graft (14mm-15mm wide) has the strongest mean strength of 163%-175% of that of normal ACL. It is the gold standard for ACL reconstruction [3].

Material and Methods

Twenty five patients with ACL lesions of the knee admitted to two large hospitals in Pune during the years Jan 1999 - Dec 2000 formed the material of this study. Subjective scoring with Lysholm score was followed by detailed examination of the patient for detecting ACL injury and any associated pathology of the meniscus or ligaments. All patients were given spinal/epidural anaesthesia with lignocaine/bupivacaine. After anaesthesia all patients were subjected to clinical tests for ACL, meniscus and other ligamentous injury to confirm the clinical diagnosis. The joint was thoroughly examined arthroscopically by anterolateral portal using the 30° scope in sequential manner. Any associated meniscal lesions were managed with arthroscopic partial menisectomy. ACL reconstruction was done with bone patellar tendon bone graft through a mini-arthrotomy.

With the knee held in 90° of flexion, a 8 cm midline anterior incision starting at the middle of the patella and extending distally to the tibial tuberosity was made. Patella and tendon were exposed by subcutaneous dissection. A straight midline incision was made through the peritenon. A mid-third wide graft (8-9mm) was harvested from the central portion of the ligamentum patellae, extending proximally from the middle of the patella to the tibial tuberosity. An oscillating saw with a 1 cm wide blade was used to make the bone cuts. Saw was run initially parallel to the anterior cortex of the patella, keeping 2mm of the saw blade visible below inferior pole of patella, and then run oblique to join the bone cuts so as to make a cut 8mm in depth. The cut was about 8/9mm wide and 27mm long, graft was freed with a curved osteotome. One hole each was made into patellar bone fragment and tibial bone fragment with the help of 2mm drill bit. A 20 gauge stainless steel wire was passed through patellar and tibial drill hole.

Mini arthrotomy was performed through the defect in the patellar tendon (Fig. 1). Tibial tunnel was prepared by

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Fig. 1 : Mini arthrotomy being performed through defect in patellar tendon

Fig. 2 : Graft being placed into tunnels

directing a 2 mm K-wire at an approximately 30° angle with the tibia, beginning just medial to tibial tuberosity and 25-30 mm below joint surface. K-wire was inserted, entering the joint at the tibial attachment of the ACL with the help of C-angle guide. Tibial tunnel was prepared by drilling with graduated cannulated drills and reamers (6-10 mm) over the K-wire. With the knee in 90° flexion notchplasty was performed. A K-wire was advanced through the tibial tunnel and joined into the intercondylar notch at isometric point (postero-superior part of lateral surface of intercondylar notch) and brought out through lateral part of distal femur. Lateral incision was given near the projecting end of K-wire over lower end of femur. Fascia and muscle were cut along the skin incision. Bone was exposed subperiosteally around the K-wire. Femoral tunnel was prepared by drilling over K-wire with graduated cannulated reamers. Joint wash was given to remove all bone dust.

Tendon tunnelling forceps was introduced from femoral tunnel into joint and through tibial tunnel. Graft was pulled from tibial tunnel into intercondylar notch and through femoral tunnel keeping tibial bone plug into femoral tunnel and patellar bone plug into tibial tunnel respectively (Fig. 2). Tibial tunnel graft was fixed with 6.5 mm fully threaded cancellous screw

Fig. 3 : Radiograph showing placement of screws

Fig. 4 : Patient doing full range of motion at 3 months post-operative

with interference fit. With knee kept in 30° of flexion and keeping tension on the graft, femoral tunnel bone plug was fixed with 6.5 mm cancellous screw. Tension on the graft was assessed by probing with help of curved artery forceps.

Arthrotomy was closed and patellar tendon along with sheath was approximated. Wound was closed in layers over suction drain. Compression dressing was provided and limb was immobilised in 30° of flexion with anterior and posterior slabs. Post operative radiographs were taken to confirm placement of screws (Fig. 3). Sutures were removed on 14th post-operative day. Limb was immobilized in plaster cylinder in 30° of flexion for another 4 weeks. Rigorous postoperative physiotherapy protocol was followed (Fig. 4).

Post operatively patients were reviewed at 6 weeks, 3 months, 6 months and at one year. They were all evaluated clinically as per Lysholm score. The results of the surgery were graded as excellent, good, fair and poor.

Results

Twenty five cases of ACL injuries of the knee were studied. All the patients included in the study were soldiers of the Army. In our series the maximum number of patients, 10 cases (40%) were grouped between 25-30 years of age. The distribution is shown in Table 1. The most common modality

of injury was contact sports like football, basketball, kabbadi and horse riding (44%). Patients had presented after varying periods of delay following their injury. Maximum number of patients, 10 cases (40%) reported late (1-2 years), after the initial injury. There were only two patients (8%) who reported within 6 weeks of injury. Chief complaint of almost all patients was instability and painful swelling of the involved knee which kept recurring. However, they all had various associated complaints like limp (76%), locking of the knee joint (16%), difficulty in climbing staircase and difficulty in squatting. The Gillquist Lysholm score was used to grade knee function. On clinical evaluation, right knee was involved in 15 patients (60%). Large number of patients presented late to us and hence most of them had wasting of the quadriceps muscle ranging from 1-4 cm (average 2.7 cm). Other clinical findings recorded were as per Table 2. Anterior Drawer Test, Lachman Test and Pivot shift test were positive in 100%. Various grades of these tests are shown in Table 3. On arthroscopy, 13 (52%) patients were found to have ACL torn from femoral attachment, 7 (28%) had mid substance tear and 5 (20%) had ACL torn from tibial attachment. There were 5 patients with meniscus lesions. All the patients with meniscus pathology were managed with partial meniscectomy arthroscopically. All patients were evaluated symptomatically by Lysholm Score, clinically and radiographically at 3 months, 6 months and one year. At six months of follow up 17 (68%) patients were satisfied with their result. The average pre-operative Lysholm score was 47 (27-75). Average post operative Lysholm score at six months follow up was 82 (64-94). The average increase in points was 25.5. After average follow up of one year 3 months (8 months to 2 year and 4 months), 21 (84%) patients were satisfied with their result. Average Lysholm score increased from pre-operative of 47 (27-75) to post-operative of 87 (68-95) as shown in Table 4.

There were only 2 patients (8%) who had retropatellar pain. These were the cases that had presented late and had some degenerative changes prior to surgery. Moderate to severe graft site tenderness was present in 4 (12%) patients. Most of the patients had no other complications except one, who had superficial infection of operative wound, which resolved on treatment with antibiotics and antiseptic dressings.

Discussion

It is controversial whether all patients with anterior cruciate deficient knee require reconstruction of ACL. McDaniel and Dameron [4] and Balkfors [5] have presented patients with ACL injuries who resumed normal life-style without surgical intervention. In contrast to this, Johnson et al reported high incidence of meniscal tears, early traumatic arthritis and functional instability in individuals with ACL deficient knees [6]. The primary goal of reconstruction is to restore stability to the knee and thereby, presumably to restore its function and allow the patient to return to normal activities, including sports. Another goal is to prevent early degenerative changes. The incidence of erosion

Table 1

Age distribution of cases

Age (years)	Cases (25)
20-25	5 (20%)
26-30	10 (40%)
31-35	8 (32%)
35-40	2 (8%)

Table 2

Distribution of associated clinical signs

Clinical sign	Cases
Effusion	21 (84%)
Joint line tenderness	10 (40%)
< 100° flexion	4 (16%)
Flexion deformity <10°	2 (8%)

Table 3

Pre-operative test for anterior cruciate ligament laxity

Test	Negative	Positive (+)	Positive (++)	Positive (+++)
Lachman	0	0	4 (10%)	21 (84%)
Anterior drawer	0	0	5 (20%)	20 (80%)
Pivot shift	0	1 (4%)	6 (24%)	18 (72%)

Table 4

Pre-operative and post-operative Lysholm score

Lysholm score	Pre-operative (Cases)	Post-operative (Cases)
< 60	17 (68%)	0
60-76	8 (32%)	6 (24%)
77-90	0	15 (60%)
> 91	0	4 (16%)

of articular cartilage and osteoarthritis due to ACL instability is more than 60% [7], so early recognition of the injury and adequate operative repair are essential [8]. In order to achieve these goals, the immediate objective of the operation is to reduce abnormal laxity by substituting the injured ACL with a graft.

Noyes et al [7] studying the biomechanical properties of tissues around knee have shown that bone patellar tendon bone graft unit 14-15mm wide was the strongest with a mean strength of 163% to 175% of that of ACL. Keeping this fact in mind, present study has been undertaken to evaluate the results of reconstruction of ACL by patellar tendon bone graft through a mini-arthrotomy. The bone peg unites in about 6 weeks time rendering early rehabilitation of the knee possible. The average age in the present series was 27.8 years (20-39). In Kevin D Plancher et al series the average age was 46 years (40-65) [9].

In our series, the most common modality of injury was contact sports like football, basketball, kabbaddi, horse riding and gymnastics (44%). Next to that was on landing after a jump (9 feet ditch, 16%), road traffic accident (16%) and fall after slipping (16%). There were 8% cases that sustained injury while running. In Kevin D Plancher series, the primary mechanism of injury was accidents that occurred during skiing (40%), tennis (20%) and soccer (8%) [9]. The average time between injury and time of presentation for ACL reconstruction was sixteen months (1 week - 6 years). In Kevin D Placher et al series, the mean interval between the injury and operation was 194 weeks although 14 knees were operated within twenty-one days after injury [9].

In our study, there were 5 (20%) patients with meniscus lesions. In KD Plancher et al series, there were 28.2% (22/77) cases with associated meniscal tear [9]. In our series, 19 (76%) patients were rated as good or excellent. Average Lysholm score increased from pre-operative of 47 (27-75) to post operative of 87 (68-95). In AL Zarahini et al series, he had 41 (82%) patients who were rated good and excellent after an average follow up of 24 months [10]. In JM Webb et al series, the pre-operative Lysholm score was poor, with a mean of 61 (6-95). The mean Lysholm score at 12 months was 95 (70-100). 90% of patients scored good or excellent at 24 months of follow up [11]. In KD Plancher et al series, average pre-operative Lysholm score was 63 (11-100) and the average post-operative improved to 94 (69-100) [9].

Post operatively the results of Anterior Drawers, Lachman and Pivot shift Tests were as shown in Table 5.

Table 5

Post-operatively the results of knee instability are:

	Negative	Positive (+)	Positive (++)	Positive (+++)
A. Lachman Test				
Present series	21 (84%)	4 (16%)	0	0
S Al-Zarahini	47 (94%)	3 (6%)	0	0
JM Webb	81 %	19 %	0	0
KD Plancher	60 (80%)	11 (15%)	4 (5%)	0
B. Anterior drawer test				
Present series	18 (72%)	7 (28%)	0	0
S Al-Zarahini	30 (60%)	20 (40%)	0	0
JM Webb	99 %	1 %	0	0
KD Plancher	50 (66%)	20 (20.6%)	6 (7.2%)	0
C. Pivot shift test				
Present series	22 (88%)	3 (12%)	0	0
S Al-Zarahini	48 (96%)	2 (4%)	0	0
JM Webb	91 %	9 %	0	0
KD Plancher	60 (80%)	10 (13%)	5 (7%)	0

23 (92%) patients had full range of movement. 2 (8%) patients had restriction of last 10° of flexion and 2 (8%) patients had extension deficit of 5°. In S AL-Zarahini et al series, 46 (92%) patients had full movement and 2 (4%) had an extension deficit [10]. In JM Webb series, at 24 months follow up 99% patients had full flexion or lacked less than 5° and 1% lacked more than 7° of flexion. 97% patients had full extension or lacked < 3° and 3% were lacking 4°-5° of full extension [11]. In KD Plancher et al series, the average post-operative knee flexion was 136° (112-150). One knee flexed to less than 125° post-operatively [9].

In our series only 2 patients (8%) had retropatellar pain. These were the cases that had presented late and had some degenerative changes prior t surgery. In Al-Zarahini et al series, he had 4(8%) with retropatellar pain and crepitus [10]. In KD Plancher et al series, patellofemoral crepitations were noted in 25(33%) patients at the time of latest follow-up [9]. However, no patients reported retropatellar pain at the time of the latest follow-up.

15 (60%) patients didn't have any tenderness, irritation or numbness about the patellar tendon graft site. 6 (24%) patients had slight symptoms, 3 (9%) had moderate symptoms and one (4%) had severe symptoms. In JM Webb series, 56% of the patients did not have any symptoms, 34% had slight, 9% had moderate and 15 had severe symptoms [11].

20 (80%) patients showed quadriceps wasting of 1 cm compared with the uninjured leg. 4 patients had wasting of 1-2 cm and only one (4%) had 3 cm of thigh wasting. In JM Webb et al series at 12 months, 86% showed wasting of 1 cm, 13% had 1-2 cm wasting and 1% had 3 cm wasting after arthroscopic ACL reconstruction [11]. Dejour et al had excellent results after reconstruction using a patellar tendon graft augmented with extra-articular reconstruction [12]. We achieved similar success without the additional procedure. O'Brein et al reported good results using a patellar tendon graft through a medial arthrotomy, but one-third of their patients had marked retropatellar pain due to displacement of the patella during operation [13].

In our procedure, we used only a mini arthrotomy, so eliminating the need for displacement of the patella and minimizing biomechanical disturbance to the patellofemoral joint after operation. Our subjective and objective results showed that 80% of our patients had good and excellent results with full movement and without pain and effusion. The pivot shift was negative in 88% and only 8% had retropatellar pain and crepitus, which is comparable with the results of arthroscopic reconstruction [14]. Avoiding patellar displacement

during the operation and good rehabilitation programme reduces morbidity, retains full movement, decreases patellofemoral pain and prevents muscle wasting.

Mini arthrotomy is a good procedure, which can be done where arthroscopic assisted ACL reconstruction is not available. Post-operative rehabilitation is the key to success. Successful ACL reconstruction performed before significant joint deterioration has occurred, can preserve joint function while allowing a resumption of high-level sporting activity.

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