

An Observational Assessment of the Functional Outcome of Anatomical Reconstruction of ACL with Quadrupled Hamstring Graft

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Conflict of interest: Nil

Aim: The objective of the present study was to assess the functional outcome of anatomical reconstruction of ACL with quadrupled hamstring graft.

Methods: The present study was conducted in the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India for the period of one year and 50 patients were included in the study who had undergone Anterior Cruciate Ligament reconstruction using quadrupled Hamstring graft.

Results: The youngest patient was 21 years and the oldest patient was 52 years old. The maximum number of patients were in the age group of 18-25 (40%) followed by the age group 26-29yrs (30%). The mean age was 29.2 yrs. In our series of 50 patients, 40 patients (80%) were males and 10 patients (20%) female, (Male Predominance). It may be because of the involvement of males in outdoor activities like sports and motor vehicle accidents. Right knee was injured in 42 patients (84%) and left knee was injured in 8 patients (16%). Most of the ACL tears were caused by RTA (72%). Next common cause was sports activities (16%). Some patients (12%) got injured while doing daily activities like slip and fall. 40% Patients were having instability and 28% cases presented with knee pain. 12% gave history of locking of knee, 20% presented with instability and knee pain. Diagnostic arthroscopy prior to ACL reconstruction confirms the medial meniscal tear in 36% cases and 12% lateral meniscal tear. Both the menisci were injured in 8%. 44% were isolated ACL injuries.

Conclusion: Anatomical reconstruction of ACL with quadrupled hamstring graft gives better clinical outcomes. The advantages of using hamstring graft are reduced donor site morbidity and less anterior knee pain in long term follow up. It has better subjective and objective functional outcome with low graft rejection or failure rate.

Keywords: Arthroscopic ACL Reconstruction, Hamstring Graft, Endobutton, Quadrupled Hamstring Graft, Lysholm And Gillquist Score.

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Introduction

Arthroscopic anterior cruciate ligament reconstruction has remained a treatment of choice for anterior cruciate ligament deficient knees, since majority of non-operative procedures have resulted in functionally unacceptable outcomes. [1] The incidence of ACL deficient knees due to trauma is reported as 1 in 3,500 people, resulting in 95,000 new ACL ruptures per year in few studies. ACL is the primary (85%) restraint to limit anterior translation of the tibia. In full extension, ACL also serves as a secondary restraint to tibial external rotation. The average tensile strength of ACL is 2160N which is half as strong as medial collateral ligament and slightly less than posterior cruciate ligament. [2,3]

There are many factors which influence the clinical outcomes of ACL reconstruction like type of graft used, method of fixation, placement of graft and post-operative rehabilitation programme. [4] The Anterior cruciate ligament (ACL) provides anteroposterior and rotational stability at the knee joint and hence it is crucial for various activities of daily living (ADL) like running, climbing stairs, and turning around the corners. [5-9] ACL is one of the most commonly injured and reconstructed ligaments in the knee. [10,11]

The treatment of choice for ACL injuries is ACL reconstruction (ligamento-plasty). ACL reconstruction is the surgical intervention used to replace the damaged ACL with a bone-patella tendon-bone (BTB) graft or with soft parts (semitendinosus – gracilis muscles (ST-G) – a method more frequently used nowadays). [12] Arthroscopic anterior cruciate ligament reconstruction has remained a treatment of choice for anterior cruciate ligament deficient knees, since majority of non-operative procedures have resulted in functionally unacceptable outcomes. [13]

ACL injuries are frequently associated with meniscus and osteochondral injuries which need to be considered during the surgical repair else the person will progress towards degenerative changes of the knee. [14] Open reconstruction of ACL which has complications like post operative knee pain, stiffness, prolonged period of rehabilitation. Considering these complications and time consuming procedure, Arthroscopic reconstruction of ACL has become the gold standard procedure in recent times. [15] If surgery is indicated for reconstruction of ACL, then the use of autologous tendon grafts for the substitution of the injured ligament is endorsed. [16] But the graft of choice is still in altercation. Arthroscopic ACL reconstruction, with both BPTG and hamstring graft has gained popularity in recent times. Rehabilitation following ACL reconstruction has emerged with time and is more emphasized on strengthening of the muscles and joint kinematics. An ACL deficient knee must be reconstructed to an ACL efficient knee by all means.

The objective of the present study was to assess the functional outcome of anatomical reconstruction of ACL with quadrupled hamstring graft.

Materials and Methods

The present study was conducted in the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India for the period of one year and 50 patients were included in the study who had undergone Anterior Cruciate Ligament reconstruction using quadrupled Hamstring graft.

Inclusion Criteria

1. Both genders above 18yrs of age.
2. Symptomatic unilateral ACL rupture
3. ACL injury associated with meniscus injury
4. Chondral lesion (type 1&2).

Exclusion Criteria

1. ACL rupture associated with posterior cruciate ligament injury,
2. Lateral collateral ligament injury, previous ligament reconstruction,
3. Stage 3 & 4 chondral lesion and advanced osteoarthritis of knee,
4. Patient with history of concurrent fracture,
5. Patient with history of operation on either knee.

Methodology

After all pre-operative patient was taken to operation theatre, under combined spinal and epidural anesthesia patient positioned supine on a standard operating table with knee joint little further from the distal breakpoint of the table.

1-liter saline bottle is placed below the injured knee to allow easy mobilization during the procedure. Uninjured limb is placed on a well-padded support. The following tests are performed under anesthesia ADT, PDT, LT & PST. The tourniquet is placed on the upper thigh. The limb is then scrubbed from the foot till the tourniquet and draped with sterile aseptic precautions. Illumination of the scope and monitor brightness ensured in advance before making a skin incision. Diagnostic arthroscopy was performed to detect any associated meniscal lesion. Before the harvesting of graft, diagnostic arthroscopy was done first. In 90 degrees of knee flexion, anterolateral port (viewing portal) is made using 11 number blades at the level of inferior pole of patella just lateral to the patellar tendon. After all the pathologies have been recorded, the anteromedial (working) portal is then established. The associated pathologies are dealt accordingly such as partial / total meniscectomy for meniscal tears and loose body removal. A 4cm skin incision is taken 3cm medial to tibial tuberosity and 4cm below the joint line. Subcutaneous dissection done. Hemostasis achieved and insertion of pes anserinus is exposed.

The superior and inferior border of Sartorius tendon is palpated and gracilis and semitendinous tendon are identified 3-4 cm medial to tendinous insertion. A small incision is made in line with the superior border of the gracilis tendon and the underlying medial collateral ligament is protected with care. Staying in the same plane adequate exposure is maintained by retracting without injuring the saphenous vein and nerve. The tendons are identified and with aid of right-angled artery forceps gracilis, semitendinous are released from its fibrous extension to gastrocnemius and semi membranous muscle. Keeping the knee in 90-degree flexion, dissection is done using finger upto musculo-tendinous junction, in order to release adhesion with persistent traction applied through the double loop knot in end of tendon with threads. Now the distal part of the tendon is dissected subperiosteally and released from its origin Before releasing the tendon with stripper, the tendon carefully palpated to ensure that it is free from any adhesions and fibrous extension, then the tendon is stripped with controlled traction. In the same manner semitendinous tendon is also stripped. The Harvested graft is then soaked in a saline bowl and its residual muscle fibres are carefully removed. The second graft is then folded and quadrupled and placed on graft master. The graft is then trimmed to same size, looped to form quadrupled graft and stitched together with whip stitch pattern. The graft length and diameter measured.

Through Anterolateral port scope is inserted and shaver introduced through the anteromedial port. Joint is debrided of reflections of synovial fat and torn ACL. Femoral and tibial footprints are visualized and marked.

To gain access to the medial aspect of lateral femoral condyle notchplasty is done. It has significance in chronic ACL tear where osteophytes intrude the notch and it presents the impingement of graft in full extension of knee. Notchplasty

restricted to anterior intercondylar notch, excess lateral notchplasty is refrained, else lateralization of graft will occur in the femoral attachment site.

Femoral Tunnel Preparation: The native ACL footprint is marked keeping knee in 90 degrees of flexion and entry point is marked with aid of femoral offset aimer the marked point is drilled till the tip of guide wire pierces the lateral side of thigh. Now with drill bit the femoral tunnel is established by drilling both the cortices. Later the tunnel is reamed according to the diameter of the graft. The reaming is limited to 20mm from the far cortex.

Tibial Tunnel: With the aid of tibial guide, the tibial tunnel is established by keeping the knee in 70–90-degree flexion. The tibial guide placed 55-60 degree to tibial plateau to obtain accurate angle of native ACL. For stable fixation it should have a minimum of 20mm bone to secure

the graft. With the rasp the tunnel is contoured and confirmed the outer portion tunnel is free of any soft tissues.

Graft Fixation: Graft is then passed through the femoral tunnel through arthroscopic guidance and the endobutton in flipped, cyclical tensioning of the graft is done by flexion and extension of the knee joint and then fixed with interference screw on the tibial side. The excess graft is trimmed and the stability of the knee is assessed by Lachman and pivot shift test. The incision is closed in layers.

Postoperative Management:

Rehabilitation protocol initiated from POD 1. Dressing done on POD 2, 5, 7 and suture removed on 12th day. The patients were evaluated by ADT, PST & LT and Lysholm knee scoring scale.

Results

Table 1: Patient characteristics

Age in years	N %
18-25	20 (40%)
26-29	15 (30%)
30-34	4 (8%)
35-39	3 (6%)
40-44	3 (6%)
45-49	3 (6%)
50-54	2 (4%)
Gender	
Male	40 (80%)
Female	10 (20%)
Knee involved	
Right	42 (84%)
Left	8 (16%)
Cause	
RTA	36 (72%)
Sports Activities	8 (16%)
Daily Activities	6 (12%)

The youngest patient was 21 years and the oldest patient was 52 years old. The maximum number of patients were in the age group of 18-25 (40%) followed by the age group 26-29yrs (30%). The mean age was 29.2 yrs. In our series of 50 patients,

40 patients (80%) were males and 10 patients (20%) female, (Male Predominance). It may be because of the involvement of males in outdoor activities like sports and motor vehicle accidents. Right knee was injured in 42 patients

(84%) and left knee was injured in 8 patients (16%). Most of the ACL tears were caused by RTA (72%). Next

common cause was sports activities (16%). Some patients (12%) got injured while doing daily activities like slip and fall.

Table 2: Distribution of cases based on lysholm knee score

Lysholm knee score	Excellent	Good	Fair	Poor
3 months	28	16	6	0
6 months	35	11	4	0
9 months	40	7	3	0

Majority of the patients who were operated had a time interval from injury to surgery between 6 weeks – 3 months (32%) followed by 3 months- 6months (30%).. At the 9th month follow up 80% of the patient

had excellent score which were 56% at the 3rd month. 14% of patient had good score at the end of 9th month and 6% of patient had fair score. None of the patient had poor score.

Table 3: Distribution of cases based on presenting symptoms, based on associated injuries

Symptoms	N	%
Instability	20	40
Knee pain	14	28
Locking	6	12
Instability and knee pain	10	20
Associated injuries		
Isolated ACL tear	22	44
MM Tear	18	36
LM Tear	6	12
MM and LM tear	4	8

40% Patients were having instability and 28% cases presented with knee pain. 12% gave history of locking of knee, 20% presented with instability and knee pain. Diagnostic arthroscopy prior to ACL

reconstruction confirms the medial meniscal tear in 36% cases and 12% lateral meniscal tear. Both the menisci were injured in 8%. 44% were isolated ACL injuries.

Table 4: Postoperative complications

Postoperative complications	N	%
Pain	8	16
Infection	3	6
Laxative	3	6
Restricted Movements	4	8

8 patients (16%) had pain. Infection was present in 3 cases (6%), patients (6%) were having grade I laxity, 4 patients (8%) had flexion difficulty.

reconstruction to become one of the most successful surgical techniques in sports medicine. [17,18] Injury to the anterior cruciate ligament (ACL) is the most common ligamentous injury, ranging up to 200,000 injuries per year in the United States. [19] Sports such as soccer, football, and skiing have been reported to be high-risk sports and individuals who participate

Discussion

Development in arthroscopic techniques and improvement in technology and research have allowed anterior cruciate

in these sports are 10 times more likely to rupture the ACL when compared to other sport activities. [20]

Even though reconstruction is the most common treatment for ACL rupture, there remains debate in the literature regarding the optimal timing of surgery. [21] Smith et al concluded from their systematic review that there were no differences in clinical outcomes between early (less than 3 weeks) and delayed (greater than 6 weeks) ACL reconstruction (ACLR); however, their conclusion is based on present literature that has limitations, such as non-randomization and lack of appropriate blinding. [22]

The authors documented the irritability of the knee before surgery (i.e. swelling, effusion, hyperthermia), ROM, and additional injuries. Timing of surgical intervention may only be one factor that should be considered when determining optimal timing of surgery. The decision of when to undergo ACLR is likely multifactorial and may include factors such as pre-operative status of the knee, family, school or work obligations, as well as mental preparation. More research is needed in order to identify a multifactorial objective algorithm that could be used to assist the surgeon and patient in determining when surgical interventions should occur in order to yield optimal clinical results. [23,24]

The options of graft for ACL reconstruction comprehend Hamstring auto graft, bone patellar tendon graft, quadriceps graft, allograft and various synthetic graft. Out of these frequently used grafts are Hamstring graft and bone patellar tendon graft. The use of hamstring graft had credence as panacea for the problems with bone patellar tendon graft and has advantage in spite of having a reduced strength of the native ACL.

In our study the most common mode of injury was found to be Road traffic accident followed by sports. Among sports

football was the commonest cause of ACL injury. Male form most part in our study. Abundant of the patients were in the age group of 18-25 (40%) patients underwent ACL reconstruction 6 weeks to 3 months after initial injury. Tetsuo Hagino et al. [25] commented that in acute group medial meniscus tear was found in 69.4%, lateral meniscus was 10.8% and both meniscus in 19.9%, whereas in chronic group medial meniscus 33.9%, lateral meniscus in 24.7% and both the meniscus in 41.4%. The study concluded that meniscal tear associated with ACL injury is more in chronic cases and medial meniscus predominantly higher. In our study associated meniscal injury is found to be 50%. 13 patients had isolated ACL injury, 11 pts had medial meniscus injury and 4 patients had lateral meniscus injury and 2 patients had both the meniscus injured. Commonly injured was isolated ACL which was in commiserating with the other studies. [26] In our study among the patients with meniscal injury 3 patients were treated by partial meniscectomy and meniscus repair was done for 6 patients and rest were managed conservatively. We have tried to avoid doing meniscectomy since that accelerates the degenerative changes the knee joint. So this in commiserate with the functional outcome of isolated ACL injury.

The fixation of the graft has been proved to be the site of failure rather than the graft itself irrespective of the type of graft especially in the early rehabilitation phase when the graft integration has not taken place and the fixation is of little significance after 8 to 12 weeks when graft has integrated with the bone as proposed by Dawn T Gulick. [27]

There was no significant patellofemoral pain noticed in the patients in our study. This is similar to the study by Railey et al. [28] Williams et al in their study of 2500 cases of arthroscopic ACL reconstruction, reported an infection rate of 0.3%. In our study 2 patients had superficial infection

which subsided with IV antibiotics. [29] The rehabilitation programme followed in our study ensured from preventing the complication due to ACL reconstruction like pain, inflammation, swelling, restoring normal range of motion, preventing muscle atrophy. [30,31]

Conclusion

Anatomical reconstruction of ACL with quadrupled hamstring graft gives better clinical outcomes. The advantages of using hamstring graft are reduced donor site morbidity and less anterior knee pain in long term follow up. It has better subjective and objective functional outcome with low graft rejection or failure rate. The success of the Anterior Cruciate Ligament Reconstruction depends of experience of the surgeon in arthroscopic technique, exact placement of the graft and patients' compliance on rehabilitation protocol. The accurate placement of graft in the tunnel and preparation of graft are important to obtain optimal results. Further studies with reference to long term follow up; radiological parameters including MRI, relevant subjective scores, and double-blind prospective trials comparing the effectiveness of different methods of graft fixation are however required to provide more clarity on the use of femoral fixation systems.

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