DOI: 10.14260/jemds/2015/865

ORIGINAL ARTICLE

FUNCTIONAL OUTCOME OF ARTHROSCOPY ASSISTED ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING BONE PATELLAR TENDON BONE AUTOGRAFT

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HOW TO CITE THIS ARTICLE:
Vinod Kumar A. C, Ravish V. N, Bharath G. Raju, Rohit Dumra. "Functional Outcome of Arthroscopy Assisted Anterior Cruciate Ligament Reconstruction Using Bone Patellar Tendon Bone Autograft." Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 34, April 27; Page: 5913-5922, DOI: 10.14260/jemds/2015/865

ABSTRACT: INTRODUCTION: The anterior cruciate ligament (ACL) is one of the most frequently injured ligaments in the human body.[1] The Anterior Cruciate ligament (ACL) is the primary stabilizer of the knee and prevents the knee against anterior translation.[2] It is also important in counteracting rotational and valgus stress.[1] The middle third of the patellar tendon autograft for ACL reconstruction can be readily procured and firmly fixed.[3] It can tolerate the loads produced by an intensive rehabilitation programme.[3] Fixation of bone plugs using interference screws provides sufficient stability to meet the demand of a vigorous postoperative protocol.[3] It remains the gold standard for ACL reconstruction.[3] This study is to assess the functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction using bone patellar tendon bone autograft. **METHODS:** This study was conducted in Kempegowda Institute of Medical Sciences Hospital from November 2012 to April 2014. During this period 20 cases of adult patients with ACL deficient patients were selected according to the inclusion criteria. Study aims to assess the functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction using bone-patellar tendon-bone autograft in terms of range of motion, postoperative knee stability, graft site morbidity and subjective knee functions. **RESULTS:** Results of our study showed that arthroscopy assisted anterior cruciate ligament reconstruction with bone-patellar tendon-bone autograft could effectively improve knee stability and functions after surgery without any complication. **CONCLUSION**: Arthroscopy assisted anterior cruciate ligament reconstruction with bone-patellar tendon-bone autograft is an excellent treatment option for anterior cruciate ligament deficient knees. It provides a stable knee and reduces postoperative morbidity and enables early rehabilitation. The functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction with Bone Patellar tendon Bone autograft is excellent too good. The functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction with Bone Patellar tendon Bone autograft is excellent to good and allows the patients to return to pre injury level of activity.

KEYWORDS: Anterior Cruciate Ligament, Bone Patellar Tendon Bone Autograft.

INTRODUCTION: The anterior cruciate ligament (ACL) is one of the most frequently injured ligaments in the human body. Estimated incidences of 0.24 to 0.34 ACL injuries per 1000 population per year have been reported. Some authors made an estimation of 250,000 ACL injuries per year worldwide. The Anterior Cruciate ligament (ACL) is the primary stabilizer of the knee and prevents the knee against anterior translation. It is also important in counteracting rotational and valgus stress.[1] intact knee ligaments provide a constraint between the articular surfaces of the joint which protects the meniscus from injury. The loss of one or more ligaments removes this constraint and predisposes the meniscus to injury. Loss of anterior cruciate ligament is a potent cause of meniscal

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injury.[2] Anterior Cruciate Ligament Reconstruction has been attempted using Silver wire, Fascia lata, and Iliotibial band. In 1939, Campbell demonstrated reconstruction using the medial portion of the patellar tendon. In 1954, the development of successful arthroscope brought new possibilities to the field of knee surgery.[3] The middle third of the patellar tendon autograft for ACL reconstruction can be readily procured and firmly fixed. It can tolerate the loads produced by an intensive rehabilitation programme. Fixation of bone plugs using interference screws provides sufficient stability to meet the demand of a vigorous postoperative protocol. It remains the gold standard for ACL reconstruction.[3] Arthroscopically assisted ACL reconstruction using a hamstring or patella-bone- tendon-bone auto-graft is the standard surgical treatment particularly for those who are unable to perform jumping and cutting manoeuvres in sports because of resulting knee instability.[4] Firm attachment of the tendon graft to the bone allows earlier and more aggressive rehabilitation and a quicker return to sports and work.[5] Arthroscopic techniques have been advanced and refined to assist in the reconstruction of the anterior and posterior cruciate ligaments. The arthroscopically aided approach has the advantages of smaller skin and capsular incisions, improved viewing of the intercondylar notch for placement of the tunnel and attachment sites, less postoperative pain, fewer adhesions, earlier motion, and easier rehabilitation.[6] In this study, we have done arthroscopy assisted anterior cruciate ligament reconstruction using bone patellar tendon bone autograft.

The objective of this study is to assess the functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction using bone-patellar tendon-bone autograft in terms of:

1. Range of motion.
2. Postoperative knee stability.
3. Graft site morbidity.
4. Subjective knee functions.

MATERIALS AND METHODS: The clinical material for the study of Arthroscopy assisted Anterior Cruciate Ligament reconstruction by Bone-Patellar Tendon-Bone autograft consists of 20 cases of ACL rupture meeting the inclusion criteria & exclusion criteria, admitted to Kempegowda Institute of Medical Sciences Hospital between November 2012 to April 2014.

Inclusion Criterion:

1. Age 20 to 40 years old.
2. Related injuries ACL alone or with associated meniscal injuries.
3. Confirmed by clinical examination and M.R.I.

Exclusion Criterion:

1. ACL injuries with avulsion injuries or associated intra-articular condylar fractures.
2. Osteoarthritic changes in x-ray.
3. Pre-existing:- congenital/developmental/collagen diseases.
4. Infected knee joint.
5. Previous surgery.

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Operative Technique: The patient is placed in supine position on the operating table under spinal anaesthesia. The normal limb is examined to obtain a reference examination for ligament laxity. The injured limb is examined to record Lachman & pivot shift test. The knee to be operated is kept in 90^0 of flexion over the edge of the operating table. Secure the contralateral leg in a foot holder with the hip and knee slightly flexed and the common peroneal nerve well padded. Tourniquet application: After exsanguination of the lower limb with Esmarch wrap, tourniquet is applied around the upper thigh and inflated to 100 mm Hg above the systolic pressure and a well-padded lateral post is applied. The lower limb is scrubbed with Betadine scrub upto mid-thigh proximally, upto the foot and toes distally including the popliteal fossa & posterior aspect of the limb for 10 min, painted with Betadine solution and spirit, draped with linen & Opsite over the proposed incision site. Arthroscopic joint portals were marked. Diagnostic arthroscopy is performed through an anteromedial and anterolateral portals, and meniscal procedures are performed at this time.

The knee is held in 90^o of flexion and incision starting from the superior pole of the patella and extending distally to the inferior end of tibial tuberosity is made. Incise sharply down to the transverse fibers of the paratenon and create skin flaps. Using a number 11 blade, the paratenon in the mid portion of the patella tendon is incised. Undermine beneath the paratenon edges medially and laterally to expose the entire width of the patella tendon. 10 mm width at middle $^1/_3$ of the patellar tendon is marked using methylene blue solution. Keeping the knee flexed to put the tendon on stretch, the tendon on one side of the graft is incised. The other side of the graft is cut to yield a 10 mm-wide graft. Over the patella, 10 mm wide and 2.5 cms long bone plug corresponding to middle $1/3^{rd}$ of patellar tendon is marked with methylene blue solution. Similarly 10 mm wide and 2.5 cms long bone plug at the tibial tuberosity corresponding to middle $1/3^{rd}$ of patellar tendon is marked with methylene blue solution. Oscillating saw with a 1cm wide blade is used to make bone cuts. The saw is kept at 45 degrees angulation to the anterior surface of the patella on either side of the vertical line of methylene blue and 2.5 cms long, 10mm wide and 5 mm deep cuts are taken from patella. Similarly 2.5 cms long, 10mm wide and 5 mm deep cuts are made distally from the tibial tuberosity directing the saw at a 45 degree angle to each side of the vertical line of methylene blue. The terminal cuts of the graft is made by 5mm curved osteotome to elevate the graft from the patella and the tibial tuberosity. Soft tissue attachments are removed from the graft and the graft is taken for preparation on the table. Total graft length of the graft is measured, the length of the bone plugs, and the length of the tendinous portion. The graft is contoured with rongeurs so that it fits through the 10 mm trial. The end of the bone plug is rounded to make the passage easier.

Using a 0.062-inch K-wire or similarly sized drill bit, two drill holes are made approximately 5mm from the ends of bone plugs on both the patellar and tibial bone plugs to secure the graft either by vicryl or 20 Gauge stainless steel wire. The bone tendon junction on the cancellous side of the graft at both ends is marked with methylene blue to make intra-articular visualization easier. The prepared graft wrapped in a moist sponge is placed into a kidney tray. Tibial tunnel guide is placed 15mm medial to the tibial tuberosity and 25 to 30 mm below the joint surface. The guide is placed so that the kirschner wire enters the joint in the centre of the anterior cruciate ligament footprint, which is approximately anterior to the anterior horn of lateral meniscus lateral to tibial spine. The guide wire is drilled through the guide into the joint & the direction is noted arthroscopically through anterolateral portal. The drill guide is removed. With the knee flexed 90^0 the tibial guide wire is advanced to the anticipated site of the femoral tunnel opening at the medial surface of lateral femoral

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condyle at 11o'clock position for right knee and 1o'clock position for left knee. Check that the guide wire position is appropriate and that there is adequate clearance in the superior notch when the leg is brought into extension. A 4cm lateral incision starting 1.5cms proximal to the flare of the lateral condyle and centered directly over the iliotibial band. The iliotibial band is divided in it's midline and extended proximally and distally from the skin incision. The vastus lateralis muscle is retracted superiorly using a retractor and drill the guide wire further to get the wire out through the lateral incision. Reaming is done over the previously placed tibial wire with 8mm, 9mm, and 10mm reamers.

The reamer tip is kept in the joint & the knee is moved through the range of motion. Any impingement on the roof or walls of the joint is noted through the arthroscope. Femoral tunnel preparation: The Femoral tunnel is reamed with 8mm, 9mm, and 10mm reamers. Care is taken to prevent the guide wire from advancement during reaming. With the arthroscope in the anterolateral portal, the graft is passed from the tibial guide wire entry site and pulled through the femoral tunnel by passing the sutures in the end of the graft through guide wire eyelet. Once the graft has been properly positioned in the tunnel, an appropriate-size Kirschner wire is inserted down the femoral tunnel into the tibial tunnel parallel with the bone plug. The graft is secured in the femoral tunnel with an appropriate sized cannulated interference screw over the guide pin from outside in from femoral side. Holding tension on the sutures in the distal end of the graft the knee is moved through the range of motion to make sure there is no impingement. The knee is placed in 30^0 flexion and maintaining moderate tension on the graft by way of the previously placed sutures, the graft is secured in the tibia with a cannulated interference screw. The graft is observed arthroscopically and it is probed to make sure it is adequately tight and that no bone or screw is left protruding. The knee is examined for stability by Lachman, pivot shift maneuvers. The operated knee should be slightly tighter than the uninjured knee. Thoroughly lavage the joint and the incision is closed in a standard manner. The knee is immobilized in a long knee brace for 3 weeks.

Fig. 1:Intra-operative photos

POSTOPERATIVE REGIMEN: Post Op Day 1 To 3 Weeks knee bending(Heel sliding) as patient is tolerable, static quadriceps exercises, slrt with long rigid brace in situ, if pain tolerable, start with CPM, if pain tolerable, walking with brace with crutch/walker with partial weight bearing and patella glides after suture removal, From 3 Weeks To 6 Weeks to increase knee bending exercises to achieve full range of movements up to 120-130 degrees, hamstring exercises, heel rise to toe rising exercises,

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to step down from with crutches to without crutch walking-depend on tolerance of patient, without brace walking if tolerable, brisk walking on plane surface in straight line and quadriceps strengthening by straining quadriceps (By lifting weight at ankle while extending knee,6 weeks to 12 weeks brisk walking, slow jogging, cycling, stairs climbing and walking normally, 12 weeks to 24 weeks-running, playing alone without people group and personal hobbies like dancing aerobics and yoga and after 9 months playing with group of people.

Follow Up: All the cases were regularly followed up at 3 weeks, 6 weeks, 12 weeks, 16 weeks, 6 Months.

On each follow up clinical and radiological examination was done to assess knee stability.

At 6 months follow up Tegner Lysholm knee score is noted.

Limp	
None	5
Slight or periodical	3
Severe and constant	0
Support	
None	5
Stick or crutch	2
Weight bearing impossible	0
Instability	
Never giving way	25
Rarely during athletics or other exertional activities	20
Frequently during athletics or other exertional activities	15
Occasionally in daily activities	10
Often in daily activities	5
Every step	0
Locking	
No locking and catching sensation	15
Catching but no locking	10
Locking Occasionally	6
Frequently	2
Locked joint on examination	0
Pain	
None	25
Inconstant & severe during exertion	20
Marked during exertion	15
Marked on or after walking > 2km	10
Marked on or after walking < 2km	5
Constant	0
Swelling	
None	10
On severe exertion	6
On ordinary exertion	2
Constant	0

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Stairs climbing	
No problem	10
Slightly impaired	6
One step at a time	2
Impossible	0
Squatting	
No problem	5
Slightly impaired	4
Not beyond 90^0	2
Impossible	0
TOTAL	**100**

< 65 Poor, > 65 – 83 Fair, > 84 – 94 Good, > 95 Excellent

RESULTS:

Fig. 2: Showing pre-operative MRI scan and Post-operative x-rays

In this series 16(80%) patients were male and 4(20%) were female patients.10(50%) patients were in 20-25 years age group, 1(5%) patient was in 26-30 years age group, 3(15%) patients were in 31-35 years age group and 6(30%) patients were in 36-40 years age group. 9(45%) patients had injury on the right side and 11(55%) patients had injury on the left side. No patients were operated within 3 weeks after injury, 9(45%) patients were operated within 3weeks-12 weeks after injury and 11(55%) patients were operated more than 12 weeks after injury. 9(45%) patients having household injuries as the most common mode of injury, 7(35%) due to sports related injury and in 4(20%) patients mode of injury was Road Traffic Accident. All the 20(100%) patients complaint of pain in the knee at the time of admission, 8(40%) patients complaint of recurrent swelling, 18(90%) complaint of giving way sensation of knee and 2(10%) complaint of locking sensation of knee. 9(45%) patients had taken treatment elsewhere and 11(55%) patients had not taken any treatment before getting admitted to us. Only 3(15%) patients had isolated Anterior Cruciate Ligament injury, 13(65%) patients had an associated injury to medial meniscus, 1(5%) patient had an associated injury to lateral meniscus and 3(15%) patients had associated injury to both medial and lateral

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menisci. 8(40%) patients had less than 65 pre-operative Lysholm score, 12(60%) patients had pre-operative Lysholm score between 65-83 and no patient had pre-operative Lysholm score of more than 83.14(70%) patients had post-operative Lysholm score between (84-94) at 6 months follow up, 6(30%) patients had post-operative Lysholm score of more than 95 at 6 months follow up and no patient had post-operative Lysholm score of less than 84 at 6 months follow up. 18(90%) patients achieved knee flexion from 0-140 degrees within 6 months after surgery, 2(10%) achieved knee flexion from 0-130 degrees within 6 months after surgery and no patient had knee flexion of less than 130 degrees after 6 months of surgery. No patient had screw back out at 6 months follow up and only 1(5%) patient developed superficial infection immediately post-operative at tibial screw insertion site which subsided with oral antibiotics and dressings. No patient had numbness, rupture of the graft, deep infection, anterior knee pain or graft site tenderness at 6 months follow up. All the 20(100%) patients were able to return to pre-injury level of activity after 6 months of surgery. All the 20(100%) patients had difficulty in squatting pre-operatively and all the 20(100%) patients had no difficulty in squatting post-operatively at 6 months follow up. All the 20(100%) patients had difficulty in sitting crossed leg pre-operatively and all the 20(100%) patients had no difficulty in sitting crossed leg post-operatively at 6 months follow up. All the 20(100%) patients had difficulty in climbing stairs pre-operatively and all the 20(100%) patients had no difficulty in climbing stairs post-operatively at 6 months follow up. No patient had thigh atrophy at 6 months follow up. All the 20(100%) patients had positive pre-operative Lachman test, anterior drawer test and Slocum test. At 6 months follow up all the 20(100%) patients had negative Lachman test, anterior drawer test and Slocum test.

DISCUSSION: The results of arthroscopy assisted anterior cruciate ligament reconstruction using bone patellar tendon bone autograft were consistent with those that have been reported previously. In our study we had 80% male patients and 20% female patients. D Chaudhary et al.[7] in their study had 93.59% males and 6.41% females. Bernard R. Bach et al.[8] in their study had 74.23% males and 25.77% females. Catherine Hui et al.[9] in their study had 51% males and 49% females. D.J. Deehan et al.[10] in their study had 53% males and 47% females. N. M. Jomha et al.[11] in their study had 72.88% males and 27.12% females. In our study the mean age was 29.15 years. D Chaudhary et al.[7] in their study had a mean age of 26.8 years. Bernard R. Bach et al.[8] in their study had a mean age of 26 years. Catherine Hui et al.[9] in their study had a mean age of 25 years. D.J. Deehan et al.[10] in their study had a mean age of 25 years. N.M. Jomha et al.[11] in their study had a mean age of 26 years. In our study 45% patients had injury on the right side and 55% patients had injury on the left side. D Chaudhary et al.[7] noted in their study that 56.41% patients had injury on the right side and 43.59% patients had injury on the left side. Bernard R. Bach et al.[8] in their study noted that 54.64% patients had injury on the right side and 45.36% patients had injury on the left side. Catherine Hui et al.[9] in their study noted that 61% patients had injury on the right side and 39% patients had injury on the left side. D.J. Deehan et al.[10] in their study noted that 61% patients had injury on the right side and 39% patients had injury on the left side. N.M. Jomha et al.[11] in their study noted that 45.76% patients had injury on their right side and 54.24% patients had injury on their left side. In our study no patients were operated within 3 weeks after injury, 45% patients were operated within 3weeks-12 weeks after injury and 55% patients were operated more than 12 weeks after injury. In Catherine Hui et al.[9] study 3% patients were operated within 3 weeks after injury, 71% patients were operated within 3weeks-12 weeks after injury and 26% patients were operated more than 12 weeks after injury. In D.J.

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Deehan et al.[10] study 3% patients were operated within 3 weeks after injury, 71% patients were operated within 3weeks-12 weeks after injury and 26% patients were operated more than 12 weeks after injury. In N.M. Jomha et al.[11] study 35.60% patients were operated within 3 weeks after injury, 18.64% patients were operated within 3weeks-12 weeks after injury and 45.76% patients were operated more than 12 weeks after injury. In our study we had 45% patients having household injuries as the most common mode of injury, 35% due to sports related injury and in 20% patient's mode of injury was Road Traffic Accident. D Chaudhary et al.[7] in their study noted that injury caused by sporting activities accounted for 66.7% of the patients, whereas motor vehicle accident and household injuries accounted for 30.8% and 2.5% respectively. In our study only 15% patients had isolated Anterior Cruciate Ligament injury, 80% patients had an associated injury to medial meniscus and 20% patients had an associated injury to lateral meniscus. D Chaudhary et al[7] in their study noted that 23.1% patients had an isolated injury to anterior cruciate ligament, 37.9% patients had an associated injury to medial meniscus and 16.7% patients had an associated injury to lateral meniscus. Bernard R. Bach et al.[8] in their study noted that 38.14% patients had an isolated injury to anterior cruciate ligament, 37.12 % patients had an associated injury to medial meniscus and 24.74 had an associated injury to lateral meniscus. In our study mean post-operative Lysholm score was 92.2. Bernard R. Bach et al.[8] in their study noted that the mean Lysholm score postoperatively was 87. Catherine Hui et al.[9] in their study noted that the mean post-operative Lysholm score was 95. D.J. Deehan et al.[10] in their study noted that the mean post-operative Lysholm score was 96. N.M. Jomha et al.[11] in their study reported 94 as the mean post-operative Lysholm score. In our study the mean post-operative knee flexion was 139 degrees. In Bernard R. Bach et al.[8] study the mean post-operative knee flexion was 137 degrees. In our study only 1(5%) patient developed superficial infection immediately post operatively at tibial screw insertion site which subsided with oral antibiotics and dressings.

No patient had screw back out/painful screw requiring removal, deep infection, numbness or anterior knee pain at 6 months follow up. D Chaudhary et al.[7] reported anterior knee pain in 23% of patients. Catherine Hui et al[9] in their study reported that 1.11% patients had superficial wound infection and 2.22% patients had patellar tendinitis. Bernard R. Bach et al.[8] reported that 6.19% patients had removal of painful tibial screws. D.J. Deehan et al[10] in their study reported that 3.33% patients had rupture of the graft and 1.11% patients developed patellar tendinitis. N.M. Jomha et al.[11] in their study reported that 10.17% patients had graft failures and 1.69% patients had deep infection which requires lavage and screw removal. Anterior knee pain and tenderness at graft site were reported to be present in 19% patients in N.M. Jomha et al.[11] study. In our study no patient had thigh atrophy at 6 months follow up. D. J. Deeham et al[10] in their study noted that 87% had wasting of less than 1 cm, 9% had a wasting of 1-2 cms and 4% had wasting of 3 cms. Bernard R. Bach et al.[8] in their study noted that 74.22% of patients had thigh atrophy of less than 1 cm, 19.58% patients had thigh atrophy of 1-2cms and 6.20% patients had thigh atrophy of 3 cms. N.M. Jomha.[11] et al in their study noted that 66.1% patients had no thigh atrophy, 27.12% patients had thigh atrophy of less than 1 cm and 6.78% patients had thigh atrophy of 1-2 cms.

CONCLUSION: This study was conducted to assess the functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction using bone-patellar tendon-bone autograft. This study was conducted on 20 patients suffering from ACL deficiency in the age group of 20 - 40 years. All patients

had instability of knee in the form of giving way evaluated by Lachman test, anterior drawer test and slocum test and confirmed by arthroscopy. Anterior cruciate ligament injuries are common in younger age group individuals. Males are more prone for anterior cruciate ligament injuries. Household injuries and sports related injury are the most common modes of injury. Arthroscopy assisted anterior cruciate ligament reconstruction with bone-patellar tendon-bone autograft is an excellent treatment option for anterior cruciate ligament deficient knees. Meniscal injuries do not affect the final outcome in arthroscopy assisted anterior cruciate ligament reconstructed patients in short term follow up. Arthroscopy assisted ACL reconstruction using bone-patellar tendon-bone autograft provides a stable knee.

Arthroscopy assisted anterior cruciate ligament reconstruction with bone patellar tendon bone autograft reduces postoperative morbidity and enables early rehabilitation. The functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction with Bone Patellar tendon Bone autograft is excellent to good and allows the patients to return to preinjury level of activity. Arthroscopy assisted anterior cruciate ligament reconstruction with bone patellar tendon bone autograft allows the patient to squat, sit crossed leg and climb stairs without difficulty. Management of anterior cruciate ligament tear requires careful pre-operative planning, patient selection, radiological evaluation and meticulous intraoperative care and post-operative rehabilitation including detailed counselling for good functional outcome.

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FINANCIAL OR OTHER COMPETING INTERESTS: None

Date of Submission: 25/03/2015.
Date of Peer Review: 26/03/2015.
Date of Acceptance: 16/04/2015.
Date of Publishing: 25/04/2015.