A Comparative Study of Arthroscopic ACL Reconstruction Using Single Bundle versus Double Bundle Technique
Dr. Roshan Kumar M1, Dr. Sai Phani Chandra Balijepalli2, Dr. Sreedhar Rakasi3, Dr. Krishna Subramanyam Pannala4, Dr. Jayaprasad P5
1Assistant professor, Dept. of Orthopedics, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad India
2,3Assistant professor, Dept. of Orthopedics, Greater Eastern Medical School and Hospital, Ragolu, Srikakulam Andhra Pradesh India
4,5Professor, Dept. of Orthopedics, Kamineni Academy of Medical Sciences and Research Centre, Hyderabad India

Abstract: The present comparative study of arthroscopic ACL Reconstruction using single bundle versus Double bundle technique was performed in the Department of Orthopaedics and Sports Medicine at Kamineni Hospitals, L B Nagar, and Hyderabad between August 2016 to August 2017. A total number of 51 patients were divided into two groups 26 patients underwent single bundle and 25 patients underwent double bundle Arthroscopic ACL reconstruction. The average surgical time was 59.23 ± 14.5 minutes in single and double bundle ACL reconstruction. Modified Lysholm score for single bundle Arthroscopic ACL reconstruction group (n = 26) preoperatively was 45.38 ± 8.06. And post operatively at the end of one year was 93.65 ± 2.52 as compared to Double Bundle Arthroscopic ACL reconstruction group (n = 25), which was 45.48 ± 8.21 preoperatively. And post operatively at the end of one year was 93.60 ± 2.56 which is statistically not significant. IKDC score for single bundle arthroscopic ACL reconstruction group (n = 26) preoperatively was 40.38 ± 6.95 and post operatively at the end of was 89.93 ± 4.01 as compared to IKDC score for double bundle arthroscopic ACL reconstruction group (n = 25) which was preoperatively 52.2 ± 5.18 and post operatively at the end of one year was 92.02 ± 3.32 (p value 0.249) which is statistically not significant. Lachman test in the single bundle arthroscopic ACL reconstruction group (n = 26) preoperatively was 2.65 ± 0.48 and post operatively at the end of 1 year was 0.35 ± 0.48 as compared to double bundle arthroscopic ACL reconstruction group (n = 25) which was preoperatively 2.64 ± 0.49 and post operatively at the end of one year was 0.52 ± 0.51 which is statistically not significant. Anterior drawer test in Single bundle arthroscopic ACL reconstruction group preoperatively was 2.58 ± 0.50 and post operatively at the end of 1 year was 0.46 ± 0.50 as compared to double bundle arthroscopic ACL reconstruction group which was preoperatively 2.64 ± 0.49 and post operatively at the end of one year was 0.52 ± 0.51 (p value 0.684) which is statistically not significant. Two patients in the double bundle group had wound healing complications and 17 patients (33%) had hypoesthesia in the distribution of the infrapatellar branch of saphenous nerve, which was regained over a period of time.

Keywords: Arthroscopy, ACL reconstruction, Single bundle technique, Double bundle Technique.

INTRODUCTION
Anterior cruciate ligament (ACL) is an intraarticular extrasyovial structure present in the central complex of the knee joint which along with other structures in and around knee joint controls, limits motion and maintains static and dynamic equilibrium of knee joint[1]. ACL is commonly injured in athletic activities and in road traffic accidents eg: when a sudden loading or tension is placed on the ligament as when a running athlete plants a foot to suddenly decelerate or change direction [6]. Anterior knee instability associated with rupture of ACL is a disabling clinical problem in general and especially in athletic individuals. ACL has a poor capacity of healing. The need for surgical correction of ACL injuries arises because, untreated complete injury to the ligament leads to progressive symptomatic instability leading to recurrent injury and damage to the menisci and articular cartilage thus resulting in early osteoarthritis[2].
Standard treatment for ACL rupture is surgical reconstruction with an arthroscopic single-bundle technique, which results in good-to-excellent outcomes in only 60% of patients, according to International Knee Documentation Committee (IKDC) outcomes [3].

Arthroscopy guided ACL Reconstruction (ACLR) has multiple advantages over open ACLR i.e. Smaller surgical incision, Less extensor mechanism trauma, Improved viewing of intercondylar notch for tunnel placement, Less post-operative pain, Fewer adhesions, earlier mobilization and rehabilitation[4].

The aim of the study is to assess the clinical outcomes of ACL Reconstruction using single bundle arthroscopic ACL Reconstruction technique versus double bundle arthroscopic ACL reconstruction technique.

MATERIALS AND METHODS

The patients with isolated ACL deficiency, who came to the Department of Orthopaedics and Sports Medicine, Kamineni Hospitals, L B Nagar, Hyderabad between August 2016 and August 2017 were selected into the study. A total number of 51 patients with isolated ACL deficiency were selected based on the history, clinical examination and radiological assessment (Radiograph and Magnetic resonance imaging). Out of the 51 patients, 26 patients were included in single bundle arthroscopic ACL reconstruction group and 25 patients were included in double bundle arthroscopic ACL reconstruction group. Informed risk consent was taken from all the subjects for arthroscopic ACL reconstruction and the need for graft from contralateral leg (in the double bundle arthroscopic ACL reconstruction group).

METHODS

Inclusion criteria

- Patient in the age group 18 to 40 years.
- Patients with history of injury to knee and giving away episode.
- Patients with symptomatic instability with isolated ACL TEAR confirmed radiologically by MRI and manual examination methods.

Exclusion criteria for the surgery

- Meniscal injuries
- Other associated ligament injuries
- Patients less than 18 years
- Patients more than 40 years
- Inflammatory arthropathy

In the present study, quadrupled hamstring tendon (semitendinosus and gracilis) was used for the single bundle arthroscopic ACL reconstruction group and bilateral semitendinosus tendons for double bundle arthroscopic ACL reconstruction group. The proximal end (femoral) lead suture was suspended through a flipbutton and the distal (tibial) end was anchored with an interferential screw. All the patients in the single bundle arthroscopic ACL reconstruction group (n = 26), ipsilateral semitendinosus and gracilis tendons were used and fixed proximally with flip button and distally with interferential screw of appropriate diameter. All the patients in the double bundle arthroscopic ACL reconstruction group (n = 25), ipsilateral and contralateral semitendinosus tendons were used and fixed proximally with flip button and distally with interferential screw of appropriate diameter.

All the patients in both the groups were evaluated at one month, six months, and one year. The period of follow up was 12 months. Modified Lysholm knee score, International knee documentation committee (IKDC) score was used for evaluation of the results of surgery during follow up. At each follow up along with subjective evaluation the following clinical examinations were also done using Lachman’s test, Anterior Drawer’s test and Pivot shift test. The collected data was summarized by calculating the mean and standard deviation and presented in the form of tables and diagrams. Independent student sample t-test was used.

P value < 0.05 is considered significant.

Surgical technique of single bundle aclr

Under regional anaesthesia, preoperative antibiotics and tourniquet control, index kneewas prepared and draped. A 2-3 centimeters oblique incision was made directly over the pes anserinus in line with hamstring tendons with knee in 90 degrees flexion (figure of four positions). Semitendinosus and gracilis tendons were identified, separated, adhesions released and harvested using a tendon stripper. The tendons were prepared and double folded to form a 4 stranded hamstring graft. Graft diameter is determined with a graft sizing device. Following graft preparation, arthroscopy is done and intra articular assessment of the index knee was performed. Under arthroscopy guidance using ACL guide (STORZ, Universal guide), First, the tibial tunnel was drilled at a 45°-50° angle in the horizontal plane and approximately 2 cm medial from tibial tuberosity in the sagittal plane. The femoral tunnel was made in the femoral notch positioned at center of femoral footprint of ACL through a transportal technique. Over the guide wire the tibial and femoral tunnels are widened by gradual incremental reaming to enlarge the size of tunnel to size of the graft. Using a grasp the graft was passed through the tibial tunnel, across the joint and through the femoral tunnel using sutures. The endobutton on femoral side is flipped and then the Graft is pulled slowly by giving continuous sustained traction. Distally the graft is anchored with interference screws of appropriate diameter. Anterior Drawer’s test and Lachman’s test are performed to check for anterior translation. Wounds are closed and compression bandage applied. Patient’s limb is

Available online: http://saspublisher.com/sjams/
protected in a long leg knee immobiliser. Active ankle and toe movements, static quadriceps exercises were initiated on post-operative day ‘O’. Walker supported walking with long leg knee immobilizer applied and knee range of motion without long leg knee immobilizer applied was started on CPM Machine from post-operative day ‘1’. Intravenous antibiotics were given for 48 hours in divided doses according to weight and age and converted to oral antibiotics after 48 hours and continued for 7 days postoperatively. After 14 days suture removal was done and hinged knee brace was given and physiotherapy protocol was started.

**Surgical technique of double-bundle acl reconstruction**

Under regional anaesthesia, preoperative antibiotics and tourniquet control, both the knee was prepared and draped. A 2-3 centimeters oblique incision was made directly over the pes anserinus in line with hamstring tendons with knee in 90 degrees flexion (figure of four positions) in the index knee initially followed by the contralateral knee. Semitendinosus and gracilis tendons were identified, separated, adhesions released and harvested using a tendon stripper. The tendons were prepared and double folded to form a 4 stranded hamstring graft. Graft diameter is determined with a graft sizing device. Following graft preparation, arthroscopy of the index knee was done and intraarticular assessment of the index knee was performed. Under arthroscopy guidance using ACL guide (STORZ, Universal guide), after confirmation of the ACL attachment site, a tibial tunnel for the PL bundle, a tibial tunnel for the AM bundle, a femoral tunnel for the PL bundle, and a femoral tunnel for the AM bundle were made one by one.

Over the guide wire the tibial and femoral tunnels are widened by gradual incremental reaming to enlarge the size of tunnel to size of the graft. Using a grasp the graft was passed through the anteromedial bundle tibial tunnel, across the joint and through the anteromedial bundle femoral tunnel using sutures. The endobutton on femoral side is flipped and then the graft is pulled slowly by giving continuous sustained traction, an interference screw was inserted through the anteromedial tibial tunnel at 30° of flexion of the knee joint followed by another interference screw insertion inserted through the posterolateral tibial tunnel at a 5° to 10° flexion angle. Anterior Drawer’s test and Lachman’s test are performed to check for anterior translation. Wounds are closed and compression bandage applied. Patient’s limb is protected in a long leg knee immobiliser. Active ankle and toe movements, static quadriceps exercises were initiated on post-operative day ‘O’. Walker supported walking with long leg knee immobilizer applied and knee range of motion without long leg knee immobilizer applied was started on CPM Machine from post-operative day ‘1’. Intravenous antibiotics were given for 48 hours in divided doses according to weight and age and converted to oral antibiotics after 48 hours and continued for 7 days postoperatively. After 14 days suture removal was done and hinged knee brace was given and physiotherapy protocol was started.

**OBSERVATIONS**

The present study was performed in Kamineni Hospitals, L B Nagar, and Hyderabad between August 2016 to August 2017. Total number of 51 patients underwent Arthroscopic ACL reconstruction. 26 patients underwent Single Bundle Arthroscopic ACL Reconstruction and 25 patients underwent Double Bundle Arthroscopic ACL Reconstruction. All patients were followed up for a minimum period of 12 months. Out of the 51 patients who underwent Arthroscopic ACL reconstruction 43 patients were of 19-30 years, 8 patients were of 31 – 40 years, 47 were males and 4 were females, 20 patients (40%) had history of Road Traffic Accidents. 12 patients (24%) had injury during common sporting activities & 18 patients (36%) had injury due to other causes which include dancing, slip and fall, work related injuries etc. The average surgical time in single bundle ACL reconstruction was 59.23 ± 14.5 minutes and 98.52 ± 15.30 minutes in double bundle ACL reconstruction. This is because in double bundle ACL reconstruction the graft was harvested from both ipsilateral and contralateral hamstrings.
1. Semitendinosus and gracilis tendons
2. Semitendinosus and gracilis tendons
3. Tibial jig placement and tunneling
4. Femoral jig placement and tunneling
5. Post operative radiograph
6. Post operative radiograph

Fig-1: Surgical technique of single bundle aclr
The subjective evaluation was done using Modified Lysholm Score and International Knee Documentation Committee (IKDC) score. The clinical parameters used to evaluate all the patients were anterior drawer test, Lachman test and pivot shift test. These results were shown in table 1.

**Complications**

One patient belonging to double bundle ACL reconstruction group had superficial infection in immediate post op period that was treated with prolonged appropriate antibiotic treatment for 2 weeks. One patient belonging to double bundle ACL reconstruction group had wound gaping on the tibial incision site which was treated with secondary suturing antibiotic treatment. 17 patients (33%) of our patients had hypoaesthesia in the anteromedial aspect of the operated leg. This was however only during the initial 3 months and patients regained sensations after a period of time.
DISCUSSION

The native ACL has two bundles, Anteromedial and Posterolateral bundles. ACL is the main restraint of anterior and rotational instability of the knee. Therefore, patients with ACL deficient knees experience episodes of giving away, which is an expression of instability. Conventionally, ACL reconstruction is being performed using a quadrupled hamstring graft in single bundle fashion, which is showing consistent good results in literature. But, as the awareness about the anatomy and biomechanics of ACL has evolved surgeons all over the world tried to replicate the native ACL more using double bundle ACL reconstruction technique. In literature, some of the studies reported that single-bundle ACL reconstruction does not completely correct the rotational instability [5]. According to Hogervorst et al., who performed a long-term observational study, single-bundle reconstruction is unable to avert degenerative alteration of the knee joint[6]. Hence, in theory, double-bundle ACL reconstruction— the surgical procedure whose outcome more closely approximates the anatomy of the normal ACL— is thought to yield better results than single-bundle reconstruction. Some authors have reported no difference between single-bundle and double-bundle reconstruction [7,8], whereas others have commented on the superiority of double-bundle reconstruction [9,10,11,12]. There is no uniform consensus about, whether single bundle ACL reconstruction or double bundle ACL reconstruction scores better one over the other. Yagi et al. [9] in a cadaveric study comparing single-bundle ACL reconstruction and double-bundle ACL reconstruction stated that double-bundle reconstruction produces a better result biomechanically and outstanding rotational capability. Seibold et al. [10], in a prospective, randomized control trial of 70 patients undergoing double-bundle ACL reconstruction or single-bundle ACL reconstruction showed that anterior stability assessed by KT-1000, pivot-shift test, and objective IKDC score were significantly better in the double bundle ACL reconstruction group than in the single-bundle ACL reconstruction group. Yasuda et al. [11] and Muneta et al. [12] also reported significantly better anterior stability in their double-bundle ACL reconstruction groups as compared to single bundle ACL reconstruction groups.

In contrast, Adachi et al. [7] in a prospective, randomized study comparing single bundle ACL reconstruction and double bundle ACL reconstruction did not find any advantage in terms of stability or proprioception. Wang et al. [8] in a prospective, randomized controlled study stated that double-bundle ACL reconstruction has no obvious clinical advantage over single-bundle ACL reconstruction and the operative time for double-bundle ACL reconstruction was longer than that for single-bundle ACL reconstruction. Lewis PB, et al. [13] in 3 year follow up of 60 patients who underwent either single-bundle anterior cruciate ligament reconstruction or double bundle ACL reconstruction stated that double-bundle

Available online: http://saspublisher.com/sjams/
ACL reconstruction did not improve function or stability compared with single-bundle ACL reconstruction. Young Bok Jung et al. in a 4 year follow up study of 324 patients showed no statistical difference between single bundle ACL reconstruction and double bundle ACL reconstruction groups [14].

The present study shows that there is no difference in rotational and translational instability at the end of 12 months follow up, as compared with the IKDC score, Modified Lysholm Score and the clinical parameters like Anterior drawer test, Lachman test and Pivot shift test. Our study is comparable with many other studies [7, 8, 13, 14] which state that there is no significant difference in rotational and transitional stability, whether done via single bundle technique arthroscopic ACL reconstruction technique or Double bundle arthroscopic ACL reconstruction technique.

The present study concludes that double bundle ACL reconstruction does not give added advantage. Moreover, the cost incurred in double bundle Arthroscopic ACL reconstruction group increased by 30-40% because of increase in operating time, increased risk of infections and the cost of implants. But, as our study follow up is for 1 year only we suggest a longterm follow up to have a better understanding of the outcome of both the groups.

REFERENCES


