International Journal of Surgery 21 (2015) 162–167

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Original research

A prospective comparative study of clinical and functional outcomes between anatomic double bundle and single bundle hamstring grafts for arthroscopic anterior cruciate ligament reconstruction

Vivek M. Morey [a], Hira Lal Nag [a], Buddhadev Chowdhury [a], Sukesh Rao Sankineani [b], Sameer M. Naranje [c, *]

[a] Department of Orthopaedics, All India Institute of Medical Sciences, New Delhi, India
[b] Malabar Orthopaedic Clinic and The Avenue Hospital, Windsor, Melbourne, Victoria 3181, Australia
[c] Forrest City Medical Center, 1601 New Castle Road, AR 72335, USA

HIGHLIGHTS

- Study population from developing country.
- Prospective study with 4 year followup.
- Double bundle ACL reconstruction group had statistically significant higher subjective scores.
- Graded stability tests results were found better in double bundle ACL reconstruction patient group.

ARTICLE INFO

Article history:
Received 4 August 2014
Received in revised form
11 July 2015
Accepted 22 July 2015
Available online 5 August 2015

Keywords:
Anatomical double bundle anterior cruciate ligament reconstruction
Anterior cruciate ligament (ACL) reconstruction
Single bundle anterior cruciate ligament reconstruction

ABSTRACT

Background: Despite a number of studies comparing postoperative stability and function after anatomic single bundle and double bundle anterior cruciate ligament reconstruction, it remains unclear whether double bundle reconstruction has better functional outcome than single bundle anterior cruciate ligament reconstruction.

Purpose: To compare the subjective functional outcome as well as clinical stability in patients treated with either anatomic single bundle or anatomic double bundle anterior cruciate ligament (ACL) reconstruction. We hypothesized that there would be no difference in the postoperative functional outcome and clinical stability between anatomical double bundle anterior cruciate ligament reconstructions when compared to single bundle anterior cruciate ligament reconstructions.

Methods: We prospectively followed 40 patients out of which, 20 patients were operated for anatomic single bundle ACL reconstruction and other 20 patients underwent anatomic double bundle ACL reconstruction. Patient evaluation using the laxity tests and outcome scales was done preoperatively and at 12, 24 and 48 months after the surgery. Clinical stability was assessed by Lachman test, Pivot shift test and Delhi active test. Functional outcome was assessed by International Knee Documentation Committee (IKDC), Lysholm and Modified Cincinnati scores. Patients in both groups were evaluated at regular intervals for a minimum period of 48 months (mean 51 months, range 48–56 months).

Results: For all subjective scores, double bundle group patients reported statistically significant higher scores compared to single bundle group patients. Graded stability results of the Lachman, and Pivot shift tests were significantly higher in the anatomically reconstructed double bundle patient group.

Conclusion: We suggest that functional outcome and clinical stability may be better with anatomical double bundle anterior cruciate ligament reconstruction as compared to anatomical single bundle anterior cruciate ligament reconstruction.

* Corresponding author.
E-mail address: sameernaranje@gmail.com (S.M. Naranje).

http://dx.doi.org/10.1016/j.ijsu.2015.07.699
1743-9191/

1. Introduction

Although the exact anatomy of the anterior cruciate ligament (ACL) of the knee remains controversial, it is widely accepted that it consists of two functionally distinct bundles: anteromedial (AM) and posterolateral (PL) bundles [1,2]. During non-weight bearing, the anteromedial (AM) and posterolateral (PL) bundles display reciprocal tension patterns. However, during weight bearing, both the AM and PL bundles are maximally elongated at low flexion angles and shorten significantly with increasing knee flexion [3]. Injury to the ACL is a common injury especially in young active adults and is usually diagnosed based on the clinical examination, MRI or diagnostic arthroscopy. Conventional single-bundle (SB) reconstruction techniques involve placing single bundle of graft in tunnel whereas double-bundle (DB) reconstruction involves reconstructing both the bundles and is considered more anatomic [3]. Single-bundle anterior cruciate ligament reconstruction has been the gold standard to treat symptomatic ACL-deficient knees. However a cadaveric study by Woo et al. [4] has reported residual instability following the surgery. According to a recent kinematic study [5], the single-bundle reconstruction did not show any significant effects on the rotatory instability during walking or more active activities. The concept of double-bundle ACL reconstruction was initially described in the 1980s [6] based on the biomechanical theory that, it is crucial to re-establish the double bundle anatomy of the ACL in order to obtain a better restoration of the normal biomechanics of the knee and to improve the rotational stability [7]. Several studies [7–13] have reported the comparison of functional outcomes of both these procedures without any definitive conclusion. Some studies have demonstrated superiority of double bundle ACL as regards to rotational stability [14,15]. Moreover, several meta-analysis studies have been published reporting no significant differences in outcome between both the techniques [16–18].

The aim of our study was to compare clinical outcomes of the anatomical double bundle ACL reconstruction with that of the single bundle ACL reconstruction in a prospective trial. We hypothesised that postoperative functional outcome and clinical stability would be no better with anatomical double bundle anterior cruciate ligament reconstruction as compared to that of single bundle anterior cruciate ligament reconstruction.

2. Patients and methods

We operated 106 patients for ACL reconstructive surgeries between August 2009 and February 2010. The patients were initially randomized using envelope method into two surgical technique groups. However, we decided to use SB reconstruction technique in patients in whom the harvested semitendinosus and gracilis grafts were not thick enough for DB reconstruction technique and in knees with narrow femoral intercondylar notch (width < 12 mm). Thus, we used SB reconstruction technique in 70 patients and DB reconstruction technique in 36 patients. We included only patients younger than 40 years with unilateral isolated ACL injuries, without any arthritic changes, deformity or previous surgeries in the knee to be operated, as an attempt to reduce the potential outcome confounders. Thus, a total of 56 patients (SB, n = 45 and DB, N = 11) were excluded from the study in view of multiligament injuries (SB, n = 9), meniscal injuries (SB, n = 26 and DB, n = 11) and preoperative arthritic changes (SB, n = 10) in the knee to be operated. The rest 50 patients were included in the study and followed up. However, 8 patients (4 patients in each group) were lost to follow up due to several reasons including difficulty in the transport (n = 5), adequate satisfaction resulting in second opinions (n = 2) and death unrelated to surgery (n = 1). One patient in each group with missing data was not considered for the analysis. Thus, data from 20 patients in each group were available for the final analysis. The entire research protocol was approved by our Institute's Ethics Committee and was conducted according to the principles established in Declaration of Helsinki. All patients provided informed consent for the use of medical records.

2.1. Surgical technique

All the surgeries were performed by a single senior surgeon. A standard arthroscopic examination was done via anteromedial and anterolateral portals. Presence of a torn ACL was confirmed arthroscopically. The tibial footprints were left intact because of their proprioceptive and vascular contributions.

Standard steps in graft harvest and graft insertion were followed for single and double bundle reconstructions. In both the groups, a paramedian incision of 2–3 cm long was made at the insertion of hamstrings 2 cm medial and distal to tibial tubercle. The prepared grafts were hooked and looped to Endobutton close loops (Smith & Nephew, Andover, Massachusetts) which were used for femoral side fixation. The tendons were pretensioned with 10 lbs tension using a commercially available graft board until they are implanted. Bioabsorbable interference screws (Arthrex, Naples, Fl) were used for tibial side fixation in either group. Staples were used for tibial side fixation in every case.

2.2. Double bundle ACL reconstruction

2.2.1. Tunnel preparation

Keeping knee flexed at 90°, the guide wire was passed at 55°–60° through the centre of AM bundle footprint on tibia using the special tibial aimer (Smith & Nephew, Andover, USA). The AM tibial tunnel drilled to the diameter equal to the AM graft. Using the same aimer and putting the long bullet of same diameter as that of the AM tunnel into the AM tunnel, guide pin was passed through the centre of the PL footprint on tibia. Then PL tunnel was made using drill of required diameter.

Guide wires for femoral drill holes were passed through the anteromedial portals. With the knee flexed at 110°, an endofemoral aimer was inserted through anteromedial portal and a 2.4 mm guide wire was passed through it. A 4.5 mm cannulated endodrill was used to ream over the guide wire until it exited the lateral femoral cortex. Using a cannulated drill matching the desired graft diameter, femoral tunnel was drilled up to 20 mm–30 mm of depth.

Using the posterolateral femoral aimer (Smith & Nephew, Andover, Massachusetts) for posterolateral bundle, a posterolateral tunnel was made in a similar manner through accessory anteromedial tunnel. It was ensured that at least 2–3 mm bony bridge was intact between AM and PL tunnels.

2.3. Graft passage and fixation

The PL graft was then passed through tibia into the femur and the Endobutton was flipped to establish femoral fixation of the PL graft. The AM graft was then passed through the tibia and fixed to the femur in similar way. Preconditioning of the grafts is performed by flexing and extending the knee through a range of motion from 0 to 120° approximately 20–30 times. The PL bundle was tensioned and fixed at near full extension and the AM bundle graft was tensioned and fixed at 50–60° of flexion (Fig. 1). On tibial side, two bioabsorbable interference screws (Arthrex, Naples, Fl) were used for fixation. Knee was tested for stability and full ROM. A mini suction drain was put intra-articularly before closure of operating wound.