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## ORIGINAL ARTICLE

# A new arthroscopic technique for lateral meniscal allograft transplantation: Cadaver feasibility study

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### KEYWORDS

Lateral meniscus;  
Meniscectomy;  
Meniscal allograft;  
Arthroscopy;  
Meniscal anchors

### Summary

**Introduction:** The three prerequisites for a successful meniscal allograft are fixation, graft sizing and precise positioning. The goal of this study was to demonstrate that lateral meniscal allografts can be reliably positioned using a fully arthroscopic technique.

**Hypothesis:** This surgical technique is feasible and results in good positioning of the meniscal graft.

**Material and methods:** Twelve fresh cadavers were used in the study. The meniscal graft implantation procedure was performed entirely by arthroscopy. The meniscal horns were fixed with screw-in suture anchors and the meniscal border was fixed to the capsule by arthroscopic meniscus-capsule sutures. The main outcome measure of good implant positioning was based on the distance between the implanted location of the posterior horn of the lateral meniscus (PHLM) and its original location. To accomplish this, aerial photographs of the tibial plateau were used to compare the insertion zones and to calculate the distance between them. These measurements were performed by two surgeons and then compared.

**Results:** Eleven of the 12 procedures (92%) were performed successfully. The posterior horn of the lateral meniscus was positioned an average of 4.3 mm in the medial–lateral axis and 1.7 mm in the anterior–posterior axis away from its original location. Thus the position of the implanted PHLM was on average 4.6 mm away from its original location.

**Discussion:** This fully arthroscopic technique is feasible. It offers the advantages associated with minimally-invasive surgery and results in good positioning of the posterior horn of the allograft. Two limitations of this study are that the size of the implant was not matched and the chosen fixation method was not subjected to biomechanical evaluation. The lack of a tibial tunnel will make it easier to combine this procedure with ACL reconstruction. In these conditions, the clinical application of this technique seems to be timely.

**Level of proof:** IV – Controlled experimental study.

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## Introduction

The structure and biomechanical properties of the meniscus have been thoroughly studied [1–4]. Meniscal injuries require various treatments aimed at preserving the bulk of the meniscal tissue, either by leaving the injured tissue as is or by repair it. When this is not possible, partial meniscectomy is inevitable. Meniscal allograft transplantation may be a treatment alternative to partial or total meniscectomy, which has a poor prognosis. Meniscal replacement is used for very specific indications: patient below 40 years of age, normal alignment, stable knee, maximum Grade 3 cartilage injury. It provides satisfactory clinical and functional results, but does not ensure the cartilage is protected over the long-term [5,6].

Numerous open and arthroscopic techniques have been described. Many agree on the importance of anatomical position and appropriate sizing of the graft, which are essential criteria for restoring the mechanical properties of the meniscus [7–10]. One controversial but crucial aspect is the fixation of the meniscal horns of the graft to make sure they can withstand loading [11,12]. Bone anchoring of the meniscal horns provides greater biomechanical properties and better stability than fixation to soft tissues [7,11]. The most common methods involve the use of bone plugs or bone bridges into the tibial plateau. Thus the three prerequisites for a meniscal allograft are precise positioning, graft sizing and fixation.

The goal of this study was to demonstrate that lateral meniscal allografts can be reliably positioned using a fully arthroscopic technique where the anterior and posterior horns are fixed to bone using interference anchors, without the need for a tibial tunnel. The purpose of the study was to validate the feasibility of this technique, but not to validate the mechanical quality of the fixation or the sizing of the graft.

## Materials and methods

Twelve fresh cadavers were used. Knees had to be injury-free to be included. Knees were excluded if a scar was visible or the knee was too stiff to allow the procedures to be performed. The subjects were paired into Subjects A-B based on comparable morphological criteria (in-seam length and knee width) to obtain appropriate graft sizes from Subject A to Subject B, and vice-versa from Subject B to Subject A for the contralateral knee. Thus for the right knee, if the recipient was subject A (RA), the donor was subject B (DB). The right recipient knee, RA, was prepared arthroscopically to remove all meniscal tissue from the lateral tibiofemoral compartment. The right donor knee, DB, was disarticulated so the lateral meniscus could be collected as a whole (Fig. 1a). Immediately before the collection, an aerial view photograph of the tibial plateau with the menisci intact in DB was performed as a control for the position of the posterior horn of the lateral meniscus (PHLM) of Subject B (Fig. 1a and b). The allograft collected from the right knee of DB was implanted into the right knee of RA (Fig. 1c). This sequence was inverted for the left knee. In all, each subject acted as the donor for one knee and as the recipient for the other.

## Surgical technique

The two meniscal horns and the popliteal hiatus were located and marked on the lateral meniscal allograft collected from the donor subject. The two meniscal horns were prepared in an identical manner with two FiberWire sutures (Arthrex, Naples, FL, USA) of different colors. On each horn, a ‘‘hemi-Kessler’’ suture pattern was performed with the sutures coming out on the tibial side of the allograft. A horizontal mattress suture was placed at the popliteal hiatus with the suture ends coming out of the meniscus wall (Fig. 2). For the implantation, each subject was placed in dorsal decubitus with the knee flexed and the extremity free of any movement. Two standard anteromedial (AM) and anterolateral (AL) arthroscopy portals were made. The graft was introduced through the AL portal into the previously prepared lateral tibiofemoral compartment. The graft was inserted with grasping forceps and positioned into the lateral tibiofemoral compartment. The sutures facing the popliteal hiatus were retrieved using a relay suture that had been introduced with a highly curved needle (Banana SutureLassoTM, Arthrex, Naples, FL, USA) and went outside-in through the popliteal hiatus of the recipient subject. This traction suture was used to temporarily stabilize the graft while the PHLM was being fixed. The PHLM position was determined by using the residual meniscal tissue and the lateral tibial spine as guides. A third portal located about 2 cm outside and above the AL portal was made to allow the anchor to be inserted while aiming at the PHLM with an attack angle to the tibial surface of at least 30° (Fig. 3). The PHLM sutures were retrieved through this accessory AL portal and armed onto a knotless suture anchor (Swive-Lock FT, 4.75 × 19 mm, Arthrex), which was used to anchor the sutures to the tibial plateau (Fig. 4). Once the PHLM had been fixed, ‘‘all-inside’’ suturing was performed on the posterior segment using four or five dedicated arthroscopic sutures (Meniscal Cinch, Arthrex). The viewing camera was then introduced by the accessory AL portal. The sutures on the anterior horn of the graft were retrieved by the AM portal and then also armed onto a second knotless suture anchor that was used to attach this horn to the tibial plateau (Fig. 5). In some cases, the anterior segment required outside-in suturing for final stabilization.

## Measurements

The innovative aspect of this technique is the PHLM implantation. A successful outcome was defined as the achievement of a relevant PHLM position.

Once the procedure was completed, the recipient knee was disarticulated to take an aerial view photograph of the tibial plateau with the graft in place. Thus for one subject, we had two aerial view photographs of the tibial plateau (Fig. 6):

- one photograph that was flipped horizontally of the Donor knee with the original lateral meniscus (control photograph) (equivalent to the horizontally flipped photograph of DB on Fig. 1d);
- one photograph of the recipient knee with the allograft in place (equivalent to the RB photograph on Fig. 1d).

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