

Combined medial meniscal transplantation and high tibial osteotomy

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Abstract This study describes a new surgical technique for combined medial meniscal transplantation and opening wedge high tibial osteotomy for meniscal-deficient knees with malalignment. The technique allows wider medial joint opening, better visualization of the medial compartment as well as easier meniscal graft positioning and suturing. This is achieved by transplanting the meniscus after superficial medial collateral ligament release and before osteotomy opening and fixation.

Keywords Knee alignment · Meniscus · Transplant · HTO · Osteotomy · Arthroscopy

Introduction

It has been shown that meniscectomized knees are more likely to undergo overload, osteoarthritis and joint deterioration in the long-term. Meniscal transplant has become a widely accepted procedure in the attempt to restore normal joint biomechanics and to preserve the cartilage in the involved compartment. However, the long-term function of the grafts remains yet to be determined [1]. The importance of limb alignment in cartilage repair/salvage procedures

has been demonstrated [1]. Correct alignment reduces the overload and protects both the articular cartilage and any graft implanted from further damages. Even though combined meniscal transplant and osteotomy have been described [1, 3–6], there are no randomized control trials (RCT) demonstrating the effectiveness of the procedure. Indeed, conducting randomized control trials in this pathology may raise some ethical concerns. Nevertheless, protecting the meniscal allograft by osteotomy in malaligned knees is essential to improve the long-term viability of both graft and cartilage.

The patients amenable to this procedure are young (<40 years old) and compliant, with total meniscectomized knee and with the lower limb mechanical axis lying in the involved compartment. Clinical signs and symptoms of meniscectomized knee should be demonstrated, and these include pain, overload and chondral damage localized to the involved compartment. A correct physical therapy program should be performed before considering surgery. The procedure is contraindicated in older patients, unstable knees and if a severe arthritic degeneration (grade 3 or 4) of the compartment is demonstrated.

Preoperative requirements and operative technique

A thorough work-up is mandatory and must include (1) standing anteroposterior (AP), lateral and Rosenberg views of the knee; (2) bilateral weight-bearing long-leg X-rays; and (3) magnetic resonance imaging (MRI). In addition to surgeon measurement, MRI is also sent to the tissue bank to ensure accuracy in the sizing of the meniscal graft. The preoperative planning of the osteotomy is performed on AP weight-bearing long-leg radiographs (hip to ankle), as previously mentioned [2]. The only difference is that, if an

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associated meniscal transplant is performed, overcorrection is usually not necessary. In osteotomies for unicompartmental arthrosis, many authors advocate overcorrection, therefore, the postoperative mechanical axis should pass through the lateral tibial spine (8° – 10° of valgus). These knees are not arthritic, and with this technique, the authors recommend a neutral alignment.

General or spinal anesthesia is required. The patient is positioned supine with the tourniquet placed on the proximal thigh. Arthroscopy is performed first to assess the overall condition of the knee. Anteromedial and anterolateral portals are used with a third outflow portal. The anteromedial portal should be made vertical in order to include it in the subsequent arthrotomy incision (Fig. 1a). An arthroscopic pump is used. Associated arthroscopic procedures (i.e. loose body removal and cartilage debridement) are carried out as necessary. Then, the medial meniscus posterior root is identified, and the meniscal wall debrided. A stable rim (1–2 mm) should be left in situ to reduce the risk of meniscal graft extrusion. Synovectomy is carried above and below the rim to stimulate bleeding and graft healing.

The allograft is then prepared to obtain a 5-mm posterior root bone plug and a 1-cm² anterior root bone plug. Both plugs are armed with 2–0 fiberwire sutures going through the bony plug and the root tissue of the meniscus (Fig. 2b).

A 3-cm medial parapatellar mini-arthrotomy is performed, including the anteromedial portal in the incision. The incision is prolonged distally for 5 cm over the proximal medial tibia (Fig. 1a). The anterior horn medial meniscus remnant is then removed through the arthrotomy. The pes anserinus and the superficial medial collateral

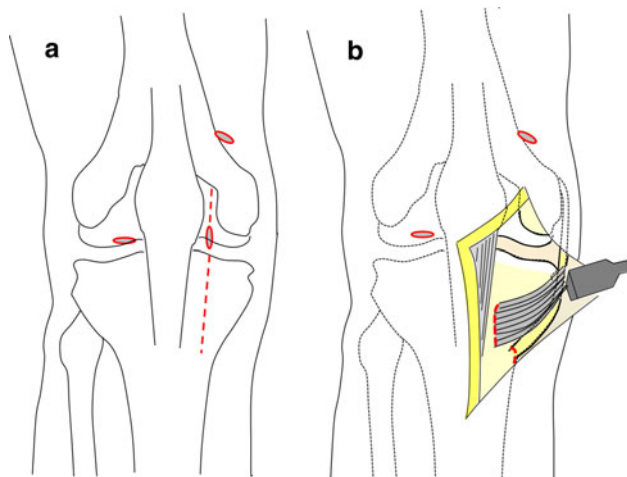


Fig. 1 **a** Arthroscopy is performed first. Anteromedial and anterolateral portals are used, with a third outflow portal (superomedial). The anteromedial portal should be made vertical in order to be included in the subsequent arthrotomy incision. **b** The pes anserinus and the sMCL are then detached (red dashed lines)

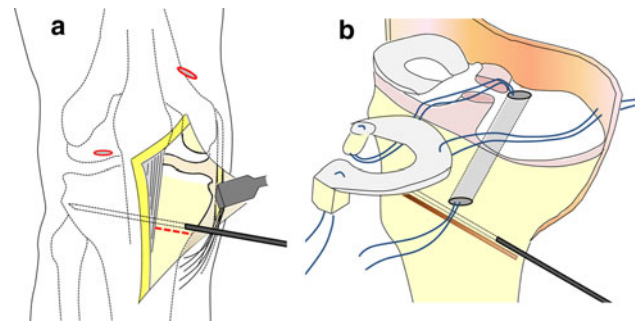


Fig. 2 **a** Under fluoroscopic control, a guide wire is drilled across the proximal tibia from medial to lateral. The wire is positioned at the level of the superior aspect of the tibial tubercle and oriented obliquely to end approximately 1 cm below the joint line at the lateral tibial cortex. Then, only the anterior tibial cortex is cut with an oscillating saw (red dashed line). **b** Then, arthroscopically assisted, a guide wire is positioned from the anteromedial tibia (above the osteotomy line) to the medial meniscus posterior root, using a low profile anterior cruciate ligament (ACL) guide. A 6-mm hole is drilled with a cannulated reamer. A 3-cm incision posterior to medial collateral ligament is then made, as if performing an inside out suturing technique. An additional 2–0 stitch is placed on the posteromedial corner of the meniscal graft to help it seating into the joint

ligament (sMCL) are then detached and the patellar tendon protected (Fig. 1b). Under fluoroscopic control, a guide wire is drilled across the proximal tibia from medial to lateral. The guide is positioned at the level of the superior aspect of the tibial tubercle and oriented obliquely to end approximately 1 cm below the joint line at the lateral tibial cortex (Fig. 2a). Then, only the anterior part of the osteotomy (depth \approx 1 cm) is performed with an oscillating saw. The osteotomy will be completed subsequently (Fig. 2a) so that the proximal tibia remains solid during this phase of the surgery. Then, arthroscopically assisted, a guide wire is positioned from the anteromedial tibia (above the osteotomy line) through the medial meniscus posterior root, using a low profile anterior cruciate ligament (ACL) guide. A 6-mm tunnel is drilled with a cannulated reamer (Fig. 2b).

A 3-cm incision posterior to medial collateral ligament is then made, as if performing an inside out suturing technique. An additional 2–0 stitch is placed on the posteromedial corner of the meniscal graft to help it seating into the joint (Fig. 2b). A spoon retractor is used to retrieve the suture needles, once the meniscus is passed into the joint. The posterior root leading suture is passed into the joint and into the bone tunnel, using a suture passer. With the meniscus seated, the size of meniscus should be checked, ensuring the anterior root is located anterior to the tibial plateau and to the ACL insertion. Sutures are then placed at the periphery of the posterior horn and mid-portion of the meniscal graft with an inside out arthroscopic technique (Fig. 3a). The anterior horn is then fixed

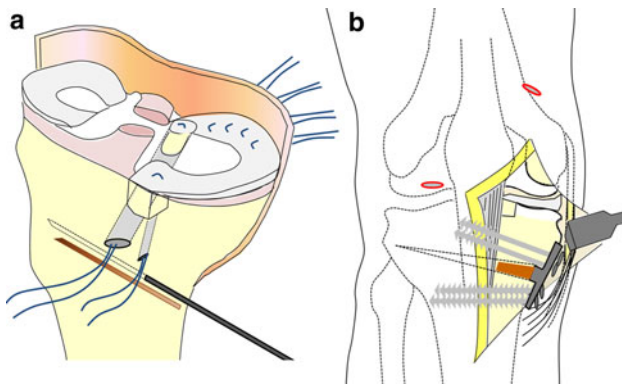


Fig. 3 **a** The anterior horn is then fixed where it fits best, creating its trough with a small osteotome (1 cm^2). A 2.5-mm guide wire is drilled from the anteromedial tibial cortex (above the osteotomy line) to the bottom of the trough, and the anterior horn leading suture is passed through the tunnel, with a suture passer. Pulling the leading suture down, the anterior horn plug is press fit with a tamp into the prepared trough. At this point, the sutures are passed with inside out technique, but not tied yet. **b** The osteotomy is then completed first with an oscillating saw for the remnant cortex and then with osteotomes. The osteotomy is fixed with one wedge plate, two proximal 6.5-mm cancellous screws and two distal 4.5-mm cortical screws. Allograft bone from the donor meniscus hemiplateau is used to bone graft the osteotomy site. Anterior and posterior horn leading sutures are tied together on the anteromedial tibia. All inside out stitches are then tied

where it fits best, creating its trough with a small osteotome (1 cm^2). A 2.5-mm guide wire is drilled from the anteromedial tibial cortex (above the osteotomy line) to the bottom of the trough, and the anterior horn leading suture is passed through the tunnel, with a suture passer and without any reaming. Pulling down the leading suture, the anterior horn plug is press fit with a tamp into the prepared trough. Some sutures are placed around the anterior horn to secure it into the surrounding tissue including the intermeniscal ligament. At this point, the sutures are passed, but not tied yet (Fig. 3a).

The osteotomy is then completed first with an oscillating saw for the remnant cortex and then with flexible and rigid osteotomes, under fluoroscopic guidance. Both saw and osteotomes should be placed below the guide pin to prevent superior migration and intra-articular fractures. Once the osteotomy has been nearly completed, the medial opening is created using an osteotomy wedge placed to the predetermined depth. Intraoperative tibiofemoral alignment is verified by fluoroscopy, and an alignment guide is used to ensure that the mechanical axis is passing between the tibial spines. The posterior tibial slope is also assessed intraoperatively and can be changed by distracting the osteotomy more anteriorly or posteriorly. Before plating the osteotomy, the posterior root leading suture is passed inside the 6-mm cannulated reamer tip and this inserted again in the 6-mm tunnel previously created. This prevents

from damaging the tunnel and the leading suture during plate fixation and proximal screws holes drilling. We usually use a medial opening wedge osteotomy plate (Arthrex, Naples, FL), but any other opening wedge osteotomy fixation device may be adopted. The plate is fixed proximally with 6.5-mm cancellous screws and distally with 4.5-mm cortical screws (Fig. 3b). Allograft bone from the donor meniscus hemiplateau is used to bone graft the osteotomy site. Anterior and posterior horn leading sutures are tied together on the anteromedial tibia. All inside out stitches are now tied and wounds sutured.

Postoperatively, the patient is kept touch-weight-bearing in the hinged knee brace (0° – 90° allowed) for 6 weeks. At 6 weeks, if adequate healing is evident on X-rays, the hinged brace is discontinued, ROM is no longer restricted, and weight bearing may be increased to 50% of body weight. At 10 weeks, new X-rays are obtained and, if consolidation is complete, full weight bearing is allowed. Return to full daily activities is usually after 6 months and to sports after 9–12 months.

Discussion

The most important advantage of the present technique is the wide medial joint opening and consequent easier meniscal graft positioning into the knee. Not many technical notes are reported in the literature for combined meniscal transplant and high tibial osteotomy. The transplant may be done either completely arthroscopic (commonly using a graft without bone plugs) or via a mini-arthrotomy, as we described. Commonly, the meniscal transplant is performed first and the osteotomy second [1]. The present technique binds the two procedures in order to play on the advantages of the osteotomy. The sMCL is released prior to placing the meniscus in the knee, and this allows the surgeon a wider medial joint opening and better visualization, during the meniscal transplant procedure, that is probably the most technically demanding phase. The osteotomy line should be defined (cutting the anterior cortex) prior to drilling the posterior root tunnel in order to have the whole tunnel above the osteotomy line. It is mandatory to complete the osteotomy once the meniscal graft is sutured in the joint. This allows the surgeon to stress the knee in valgus, while seating medial meniscus graft into the joint, without the risk of any fracture starting from the osteotomy line or loss of fixation of the osteotomy. We commonly use a mini-arthrotomy because this implies just a short extension of the incision required for the osteotomy, but the same technique can be performed as well if a totally arthroscopic meniscal transplant is preferred.

In conclusion, the technique described allows greater medial joint opening, better visualization of the medial compartment and easier meniscal graft positioning and suturing. Even though it is more difficult to position in the joint the lateral meniscal graft than the medial one, a wider medial compartment opening makes the procedure easier and keeps the surgeon out of troubles during medial meniscal transplant, especially in tight joints.

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