Meniscal Preservation Surgery and Genu Valgum Correction through Guided Growth in Patients with Discoid Meniscus

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ABSTRACT
The discoid meniscus and genu valgum can combine to cause significant joint dysfunction in the knees of pediatric patients. This paper presents a surgical technique that simultaneously addresses discoid meniscus preservation and genu valgum correction through guided growth (GG). The meniscal preservation technique aims to conserve functional meniscal tissue, improving joint biomechanics in the long term. At the same time, GG is used to realign the mechanical axis of the limb. This combined approach could optimize meniscal function and improve long-term outcomes in skeletally immature patients with a discoid meniscus.
Keywords: Meniscus; discoid; children; meniscal preservation; guided growth.
Level of Evidence: IV

Cirugía de preservación meniscal y corrección del genu valgo mediante el crecimiento guiado en pacientes con menisco discoideo

RESUMEN
El menisco discoideo y el genu valgo pueden combinarse para causar una disfunción articular importante en la rodilla de los niños. En este artículo, se presenta una técnica quirúrgica que aborda simultáneamente la preservación del menisco discoideo y la corrección del genu valgo mediante el crecimiento guiado. La técnica de preservación meniscal busca conservar tejido funcional y mejorar la biomecánica articular a largo plazo. Al mismo tiempo, se utiliza el crecimiento guiado para realinear el eje mecánico de la extremidad. Este abordaje combinado podría optimizar la función meniscal y mejorar los resultados a largo plazo en pacientes esqueléticamente inmaduros con menisco discoideo.
Palabras clave: Menisco discoideo; niños; preservación meniscal; crecimiento guiado.
Nivel de Evidencia: IV

INTRODUCTION

The discoid meniscus is a congenital variant of the meniscus, most commonly found in the lateral compartment, with a prevalence of 3-5% in the general population.[1] Its abnormal histological composition and absence of normal peripheral insertions may predispose patients to tears and other biomechanical issues that increase the risk of long-term osteoarthritis.

Over the years, advancements in arthroscopic surgical techniques have enabled surgeons to more effectively address the pathologies associated with discoid meniscus, thereby reducing the risk of progressive joint deterioration. However, despite these improvements, the postoperative revision rate remains high,[2,3] suggesting a need for further innovations to enhance long-term outcomes in these patients.

Guided growth via transient inhibition of a portion of the physis is an established technique for the correction of angular deformities in children, and it has progressively replaced more invasive osteotomies.[4] This method has

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proven to be a versatile tool with multiple applications in pediatric sports medicine, including patellofemoral instability, osteochondritis dissecans, and anterior cruciate ligament injuries.[5,6] This approach has been successfully used to correct angular deformities and may offer a promising strategy to optimize joint loading in patients with discoid meniscus. The application of guided growth techniques in the treatment of discoid meniscus may reduce compartmental overload and thereby decrease the risk of re-tears.

In this article, we present a surgical technique combining arthroscopic meniscal preservation surgery with guided growth in patients with open physes, which may optimize meniscal function and improve long-term outcomes in patients with discoid meniscus.

SURGICAL TECHNIQUE

Indications

The authors' current indications for discoid meniscus preservation surgery combined with guided growth in patients with open physes are: 1) Complete or incomplete symptomatic discoid meniscus, with or without peripheral instability; and 2) Genu valgum, with the mechanical axis positioned in the lateral compartment (normally just medial to the center of the knee) and a lateral distal femoral angle ≤84°.

Description of the procedure

The patient is placed in the supine position following the administration of spinal anesthesia. A leg support is positioned to allow sufficient space for meniscal repair. A single dose of 1 g of cefazolin is administered prior to the start of the procedure. Asepsis and antisepsis are performed, and the surgical fields are prepared according to standard technique. After exsanguinating the affected limb using an Esmarch bandage, a hemostatic cuff is applied to the thigh and inflated to 250 mmHg. Prior to arthroscopy, anatomical landmarks are marked with a sterile marker, including the planned arthroscopic portals and the incisions for the inside-out sutures, to ensure precise placement—since these could be distorted following joint insufflation. The anterolateral portal is established to perform the initial diagnostic arthroscopy of the knee. All intra-articular structures are explored, and a second anteromedial arthroscopic portal is created. A probe is introduced through this portal to evaluate the characteristics of the discoid meniscus and to assess for tears or peripheral instability. A hook probe, approximately 5 mm in diameter, is used as a rough guide to measure the peripheral meniscal segment to be preserved after saucerization.

The tear pattern of the discoid meniscus is assessed using the hook probe, with particular attention to identifying peripheral instability. The hook is placed in the popliteal hiatus to apply traction to the posterior horn and confirm the degree of instability. If the tear site is easily accessible, meniscal repair is performed before saucerization to more precisely identify the areas of the meniscus that require resection. This approach is typically employed when there is anterior or posterior meniscal migration (Figure 1). If access is hindered due to the bulk of the discoid meniscus, which obstructs visualization of the lesion or area of instability, a limited central resection may be carried out first to improve exposure.

Saucerization begins with an arthroscopic scalpel to resect the most anterior portion of the meniscus. Resection of the central portion is completed using arthroscopic punch forceps of various diameters and a shaver, shaping the meniscus into a half-moon shape to improve congruency while preserving a 10–15 mm peripheral rim. After saucerization, meniscal stability is re-evaluated.

Meniscal stabilization is performed using inside-out, outside-in, or all-inside techniques, depending on the tear pattern. For posterior horn lesions, inside-out sutures are preferred and are combined with a posterolateral approach to expose the interval between the posterior capsule. A medium-sized speculum is used as a meniscal retractor to facilitate suture retrieval and protect posterior neurovascular structures. With the arthroscope in the anterolateral portal, a posterior-specific cannula is inserted through the anteromedial portal. The assistant introduces vertical meniscal suture needles through this cannula, starting at the posterior horn and progressing toward the meniscal body at 3–5 mm intervals, securing the meniscus to the posterior capsule. Sutures are retrieved through the lateral incision and tied over the capsule.

For anterior horn lesions, outside-in sutures are primarily used, or combined with inside-out techniques if the tear extends into the meniscal body. Discoid menisci often exhibit central degeneration and horizontal tears, which become evident during saucerization. These horizontal lesions can be repaired using an all-inside tech-

nique with the Knee Scorpion™ Suture Passer (Arthrex®, Naples, FL, USA) or the FirstPass Mini (Smith & Nephew, Memphis, TN, USA; London, England). After completing the repair, a microfracture punch is used at the intercondylar notch to release bone marrow elements into the joint space, promoting a healing environment.[7]

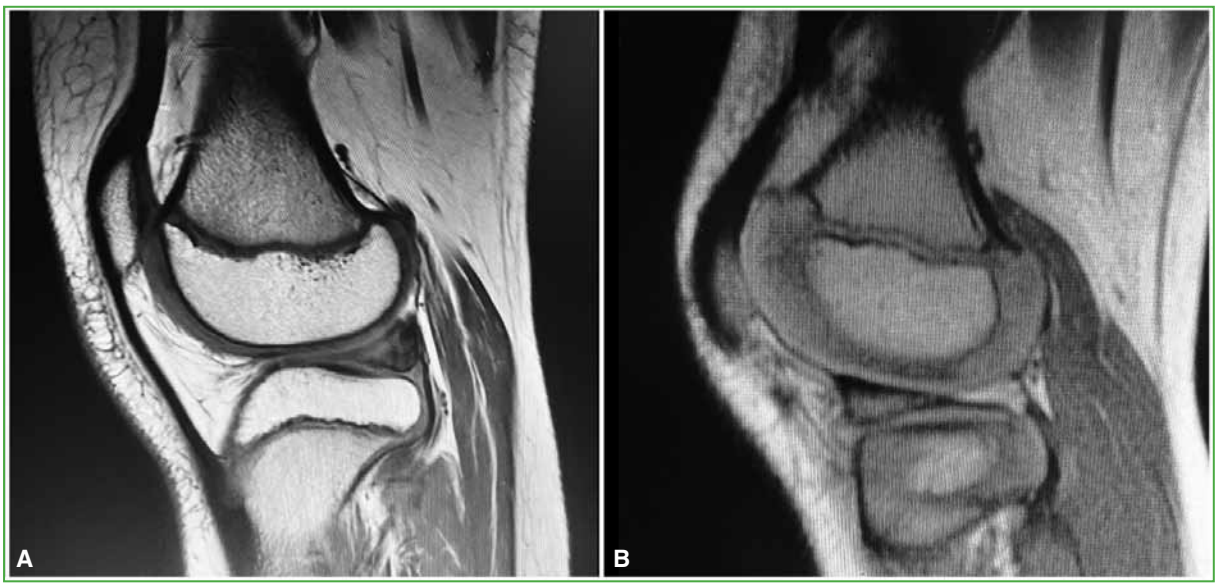

Figure 1. Knee MRI of a patient with anterior instability (**A**) and posterior instability (**B**). Note the direction of meniscal migration and the absence of the anterior (**A**) or posterior (**B**) horns.

After the arthroscopic procedure, guided growth is performed. If the estimated remaining growth exceeds two years, tension band plates are used;[8] if less growth remains, transphyseal screws are employed (Figure 2).[9]

Figure 2. Surgical technique of guided growth with tension band plates (**A**) and transphyseal screw (**B**).

Skeletal maturity is calculated with the FELS method.[10] Tension band plates are placed under fluoroscopic guidance. A 1.6 mm guide pin is inserted into the epiphyseal region of the distal femur, approximately 6–8 mm distal to the physis (the distance between the proximal and distal holes of a 12 or 16 mm plate). The plate is then advanced along the guidewire into the subcutaneous tissue to allow placement of the second guide pin proximally into the metaphysis in a divergent orientation. Proper positioning is verified fluoroscopically. The trial plate is removed, and a skin incision (typically 2–3 mm) is made between the two guide pins, extending as needed. The plate is then dissected down to the periosteum, positioned in place, and 4.5 mm cannulated screws are inserted over both guide pins using standard technique. For transphyseal screws, a guide pin is placed obliquely from distal to proximal under fluoroscopic control.

After confirming position, the tract is reamed from proximal to distal, and a 7.0 mm fully threaded cannulated screw is inserted percutaneously. Screw length is selected to ensure at least three threads engage the epiphysis. A washer is used to facilitate future removal. Finally, all incisions are closed in layers, and a sterile dressing is applied to the surgical wounds.

Postoperative Management

Patients undergoing saucerization combined with guided growth only are allowed full weight-bearing immediately, with no restriction in the range of motion. At 2 weeks postoperatively, sutures are removed, and physical therapy is initiated, continuing until knee swelling subsides and full range of motion and strength comparable to the contralateral leg are achieved.

For patients who underwent saucerization with meniscal repair and guided growth, a knee immobilizer and crutches are prescribed. Non-weight-bearing is maintained for 4 weeks. During this period, the immobilizer may be removed intermittently, and passive motion from 0° to 60° is allowed.

Between weeks 4 and 6, progressive partial weight-bearing (approximately 50%) is introduced, along with a range of motion from 0° to 90°. Physical therapy is initiated, focusing on strengthening the knee. From week 6 onward, patients are allowed full weight-bearing and gradual progression to full range of motion. Finally, return to sports is authorized after 6 months.

The mechanical axis is assessed at follow-up visits every 3 months. Once a slight overcorrection is achieved (Stevens zone -1),[11] removal of the hardware is scheduled. One year after removal, a telemetric assessment is performed to rule out a rebound effect (loss of axis correction due to remaining skeletal growth) (Figure 3).

Figure 3. A. 12-year-old patient with right unstable discoid meniscus and homolateral genu valgum. **B.** Saucerization, peripheral repair of anterior instability and guided growth with tension band plate. **C.** Mechanical axis one year after material removal.

DISCUSSION

This article provides information on the surgical technique used by the authors for discoid meniscus preservation surgery in combination with guided growth in patients with open physes. The surgical technique described involves saucerization of the external discoid meniscus, its repair in the presence of injury or peripheral instability, as well as the incorporation of guided growth during the same surgical procedure, using either tension band plates or transphyseal screws.

Surgical treatment of the discoid meniscus has evolved significantly. Prior to the advent of arthroscopy, subtotal or total meniscectomy was the treatment of choice for symptomatic patients. However, medium-term outcomes were often poor. With the development and refinement of arthroscopic techniques, meniscal preservation through saucerization (resection of the central portion of the discoid meniscus) has improved outcomes by preserving more meniscal tissue. Nonetheless, some patients exhibit peripheral instability due to capsulomeniscal insertions or tears. Arthroscopic repair techniques have addressed the instability associated with the discoid meniscus, demonstrating excellent short-term results and a low complication rate. However, medium- and long-term studies have shown that results tend to deteriorate over time, with a high reoperation rate. This trend is exemplified in the study by Lins et al., in which patients reported favorable outcomes following preservation surgery, although 44% required a second surgery on the ipsilateral limb during a mean follow-up of 19.5 years (range, 16-27 years).[2]

Genu valgum is an angular deformity that may initially present in association with a discoid meniscus or may develop following surgical treatment of this condition. Several studies have observed a significant increase in knee valgus following partial resection of the external discoid meniscus in patients with otherwise normal lower limb alignment.[12-14] A greater increase in the angle of deviation appears to correlate with the extent of meniscus resected, suggesting increased load distribution in the lateral compartment.[9] The effect of lower limb alignment on the risk of developing osteoarthritis has been studied and identified as an independent long-term risk factor.[15] Overloading of the lateral compartment increases stress on joint structures, which may accelerate articular degeneration and contribute to symptom recurrence. In the context of discoid meniscus—an abnormally shaped meniscus with histological alterations that predispose it to injury—[16]induced or aggravated genu valgum following surgery not only compromises normal knee biomechanics but may also contribute to surgical failure. Therefore, correction of lower limb alignment may be important for improving postoperative outcomes and reducing the reintervention rate.

Historically, angular limb deformities have been corrected by osteotomy. Although effective, osteotomy is an invasive procedure requiring prolonged recovery and carrying risks of complications such as infection, delayed bone healing, and the need for postoperative immobilization.[17] In recent decades, the development of guided growth techniques has revolutionized the management of these deformities in patients with open physes. Techniques such as the use of extraphyseal tension band plates[18]or transphyseal screws[9] allow the natural growth of the limb to be modulated, gradually guiding it into correct alignment. Unlike osteotomy, guided growth is minimally invasive, reducing recovery time, postoperative discomfort, and the risk of complications. Consequently, guided growth has become the treatment of choice for angular deformities in the pediatric population, minimizing the need for invasive interventions and offering a safe and effective alternative.[4]

In summary, this article discusses the current indications and technical aspects of arthroscopic discoid meniscus preservation surgery combined with guided growth for coronal axis realignment in patients with open physes.

We consider the combination of both techniques to be a promising and useful option; however, further studies are required to validate the clinical outcomes and assess potential complications in this patient group.

Conflict of interest: The authors declare no conflicts of interest.

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