Article published online: 2023-12-26

Update on Treatment of Trochlear Chondral Lesions Based on a Clinical Case

Actualización en el tratamiento de las lesiones condrales trocleares a propósito de un caso clínico

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Rev Chil Ortop Traumatol 2023;64(3):e150–e156.

Abstract

The management of osteochondral lesions of the femoral trochlea is complex and controversial. Treatment options include the microfracture technique, which is widely used and presents good short-term outcomes despite evident long-term deterioration. As a result, different augmentation techniques have been developed to favor a better quality of the new fibrocartilage to improve medium- and long-term outcomes.

This case report presents a 44-year-old patient with an osteochondral lesion of the femoral trochlea managed with a combined microfracture and augmentation technique with a cartilage allograft matrix, with good clinical and image outcomes at an 18-month follow-up. Next, we show an updated review of the literature regarding this topic.

Keywords
- chondral lesion
- femoral trochlea
- microfractures
- augmentation

Resumen

Las lesiones osteocondrales de la tróclea femoral son lesiones de difícil y controvertido tratamiento. Dentro de las opciones de manejo, la técnica de microfracturas es una de las más utilizadas, con buenos resultados reportados a corto plazo, no obstante un deterioro evidente al largo plazo. Debido a esto, se han desarrollado distintas técnicas de aumentación que favorecerían una mejor calidad del fibrocartílago formado, para así mejorar los resultados a mediano y largo plazo.

En este reporte se presenta un caso de un paciente de 44 años con una lesión osteocondral en la tróclea femoral manejada con técnica combinada de microfracturas y aumentación con matriz de aloinjerto de cartílago, con buenos resultados clínicos e imagenológicos a 18 meses de seguimiento, y posteriormente se realiza una revisión actualizada de la literatura respecto al tópico.

Palabras clave
- lesión condral
- tróclea femoral
- microfracturas
- aumentación

received
July 28, 2023
accepted
November 30, 2023

DOI https://doi.org/10.1055/s-0043-1777826.
ISSN 0716-4548.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

Introduction

Osteochondral lesions (OCL) are a common cause of knee pain and disability. OCLs can occur in isolation or with other conditions.[1] OCLs of the femoral trochlea are rare injuries compared to other anatomical locations in the knee. Different studies have shown the percentage of OCL during routine knee arthroscopy is high, mainly in the medial femoral condyle (34% to 58%), followed by the patella (11% to 36%), lateral tibial plateau (6% to 11 %), lateral femoral condyle (9% to 11%), trochlea (6% to 8%), and medial tibial plateau (5% to 9%).[2–4] Femoral trochlear OCLs are highly complex lesions due to their unspecific clinical presentation, anatomical location, and spatial configuration. These injuries may result from patellofemoral instability, poor patellar tracking, patellar malalignment, acute or repetitive trauma, osteochondritis dissecans, or idiopathic degenerative changes. As such, an osteochondral defect is often a sign of an associated underlying condition that may require additional surgical intervention.[5–7] Unfortunately, concomitant condition and procedure reports across studies lack consistency and may not represent their actual incidence.[8]

Although the literature describes several treatments, the surgical management of these injuries falls into two large groups: 1. Cartilage restoration techniques, mostly allo- or osteochondral autografts (OAT) and autologous chondrocyte implantation (ACI), or 2. Cartilage repair techniques, such as microfracture (MFX), are mainly performed in small, full-thickness lesions, usually less than 2 cm^2. The MFX technique creates channels through the subchondral bone, allowing bone marrow cell migration toward the defect, covering the lesion with low-quality fibrocartilage.[9]

MFX usually has good short-term functional outcomes, but its clinical effectiveness declines after 2 to 4 years.[1] In contrast to restorative techniques, the main advantage of MFX lies in its non-invasive nature, high reproducibility, and low cost. MFX's short durability over time led to the introduction of augmentation techniques to promote the formation and improve the quality of this fibrocartilage.[9–14] These techniques include cartilage allograft matrix (CAM®) combined with platelet-rich plasma (PRP) to provide better structural support that would facilitate the arrival of bone marrow cells and chondroinductive and chondroprotective factors, favoring the fibrocartilage formation in greater volume and better quality.[9]

Fig. 1 Sagittal section of a left knee magnetic resonance imaging showing a trochlear chondral lesion.

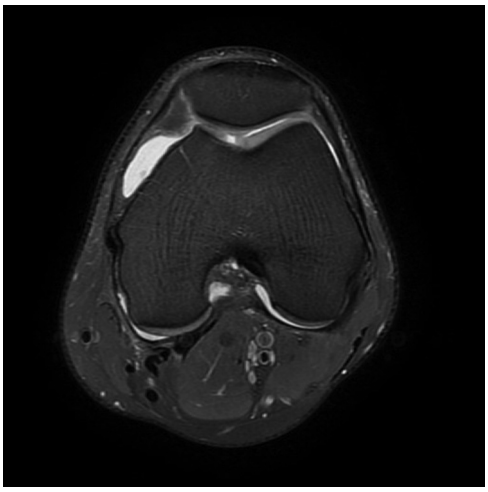

Fig. 2 Axial section of a left knee magnetic resonance imaging showing a trochlear chondral lesion.

Clinical case

A 44-year-old male patient with no relevant medical history presented pain in the anterior aspect of the left knee with no previous trauma. The physical examination revealed only knee pain and anterior crunching.

Plain radiographs did not demonstrate signs of patellar malalignment or other relevant pathological findings. The weight-bearing teleradiograph of the lower extremities revealed a bilateral varus mechanical axis of 8° with no evident rotational alterations. Magnetic resonance imaging (MRI) showed a full-thickness OCL with an approximate area of 13 × 9 mm (►**Fig. 1** and ►**Fig. 2**) at the central level of the trochlear groove.

A conservative management course consisting of analgesia and kinesiology was unsuccessful after six months. As a result, we decided on surgical resolution with a bone marrow stimulation technique using MFX and biological therapy.

Arthroscopy revealed a grade IV OCL per the International Cartilage Repair Society (ICRS), measuring 15 × 15 mm in size on the central trochlear surface (►**Fig. 3**). Using the proper instruments, we regularized the lesion, stabilized the edges, and performed the curettage, removing the calcified layer as described by Steadman.[15] For microfracture, we used a punch (►**Fig. 4**).

Next, we did a 2-cm lateral parapatellar arthrotomy and filled the chondral defect with CAM® and PRP in a 0.8:1 ratio (►**Fig. 5** and ►**Fig. 6**). Finally, we covered the defect with a fibrin plug (Beriplast®) (►**Fig. 7**).

During the postoperative period, cryotherapy is indicated during the first 24 hours, associated with kinesiology, using a range of motion (ROM) splint of 0° to 30° and walking with two

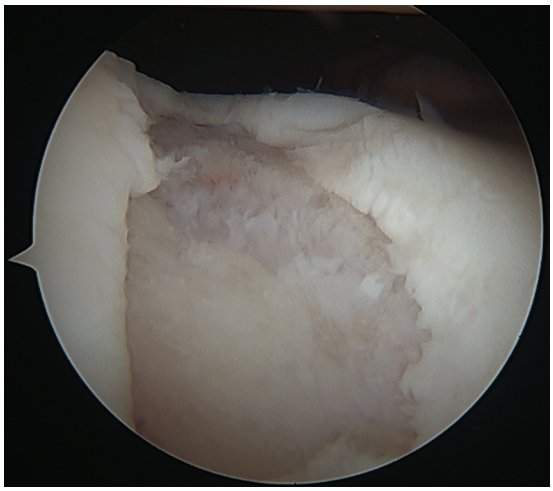

Fig. 3 Osteochondral lesion at the femoral trochlea.

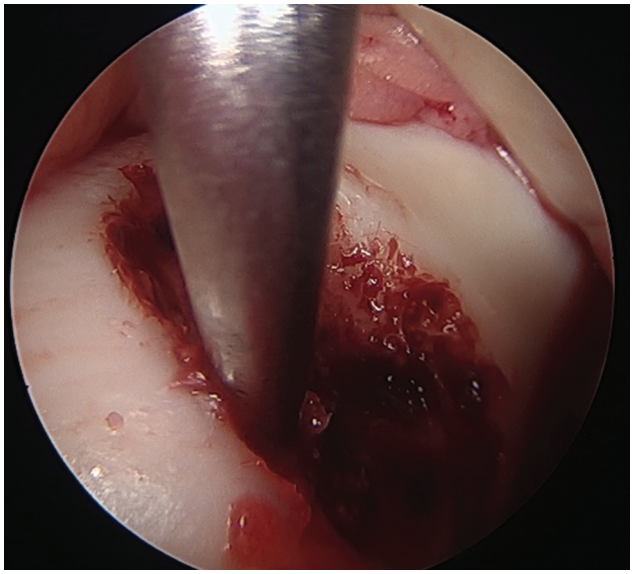

Fig. 4 Injury microfractures.

Fig. 5 Defect filling with cartilage allograft matrix (CAM®)

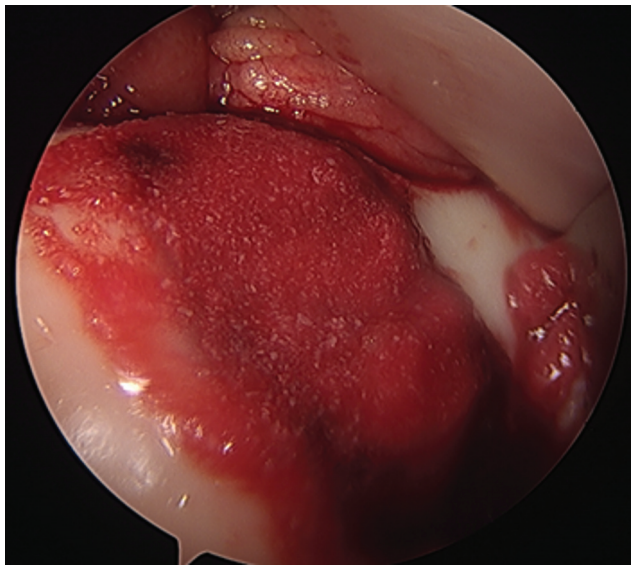

Fig. 6 Arthroscopic view of the cartilage allograft matrix (CAM®)-filled defect.

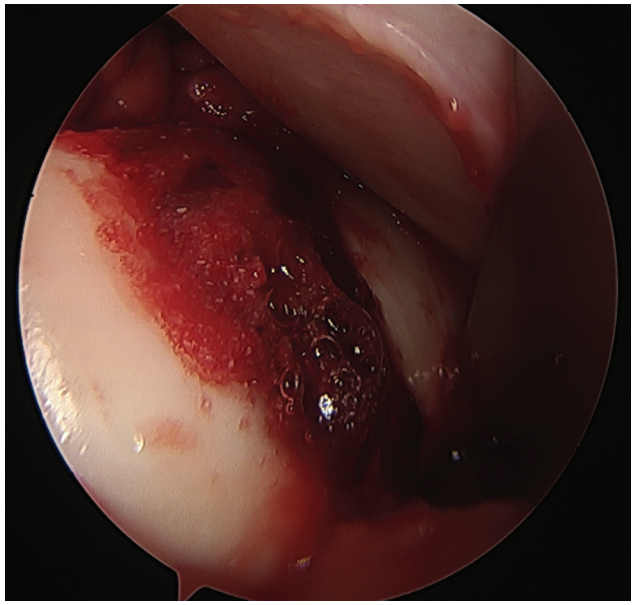

Fig. 7 Coverage with fibrin plug (Beriplast®).

canes with load tolerance. During the first month of rehabilitation, ROM increases from 0° to 60°, allowing a full ROM two months after surgery. In six months, a follow-up MRI showed reparative, hypertrophic fibrocartilage with partially homogeneous edges at the defect site (►**Fig. 8**, **9**, and **10**).

The patient answered the International Knee Documentation Committee (IKDC) functional scores for subjective knee evaluation and the Kujala score before and after surgery. Before surgery, the IKDC and Kujala scores were 56.3 and 75.0 points, respectively. At 18 months of follow-up, outcomes were very good, with an IKDC score of 86.2 points and a Kujala score of 97 points. At this time, the patient performed sports activities 1 to 2 times a week without discomfort.

Fig. 8 Sagittal section of a follow-up magnetic resonance imaging.

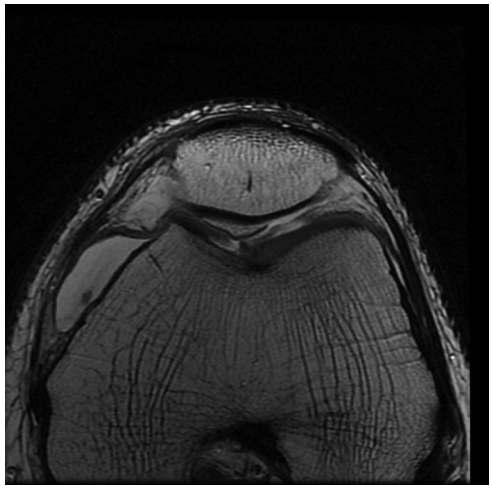

Fig. 9 Axial section of a follow-up magnetic resonance imaging.

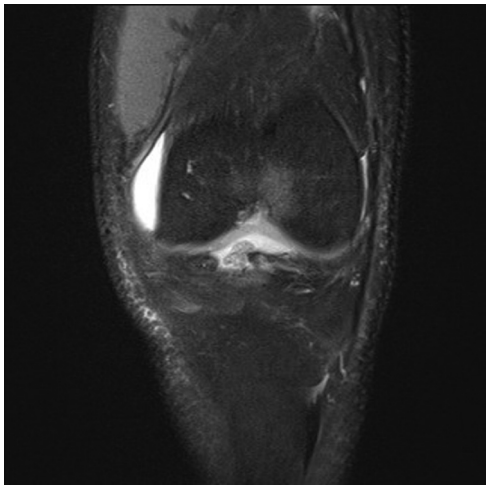

Fig. 10 Coronal section of a follow-up magnetic resonance imaging.

Discussion and literature review

The first description of an injury to the articular cartilage of the femoral trochlea dates from 1912.[16] Since then, the literature regarding these injuries has been scarce since the most widely described lesions are at the level of the femoral condyles and patellar cartilage. Isolated femoral trochlear OCL is rare, with an incidence ranging from 6% to 8%[2,3] in arthroscopies and 25% to 25,9%[17,18] in MRI.

Pathogenesis may be acute or chronic according to the mechanism of injury. Acute injuries result from direct impact of the patella on the trochlea, as is patella dislocations or knee contact against the dashboard in traffic accidents. Chronic injuries result from repetitive overload, associated or not with other concomitant conditions, mainly patellar malalignment.[19]

Trochlear OCL symptoms are not very specific. Anterior knee pain is the most common symptom, followed by joint effusion and clicking mainly in activities involving knee flexion.[20–22] Due to patellofemoral biomechanics, OCL is symptomatic mostly in periods of maximum loading in the patellofemoral compartment, between 30° and 90° of knee flexion.[23]

Regarding imaging, plain radiographs help rule out other injuries, such as loose bodies in patellar dislocation or a potential osteochondritis dissecans.[22] Computed axial tomography (CAT) would be indicated in the context of poor alignment. MRI is the study of choice to evaluate these lesions as it defines their location, depth, and chronicity.[24] Muhle et al.[25] described that the sensitivity for detecting trochlear lesions with contrast-enhanced MRI ranges from 17% to 50% in medial injuries and 17% to 67% in lateral injuries.

Today, there is no standardized protocol to manage OCLs since most studies do not clearly describe the location of the injuries or the associated procedures in patients with abnormal mechanics.[26] Surgical treatments include debridement, microfracture, allo- or auto-osteochondral graft, ACI, and associated procedures such as distal realignment and biological therapy. Microfracture often represents the first line of surgical treatment. Clinical improvement has been documented for up to 18 months of follow-up for trochlear defects.[27,28] However, studies tend to show clinical deterioration 2 to 4 years after treatment. Furthermore, trochlear injuries have worse clinical and functional outcomes compared with lesions at the femoral condyle level.[27,28] In turn, the fibrocartilage provided by microfractures has poor biomechanical properties. This resulted in the development of different augmentation techniques to improve clinical outcomes.[10,29] An alternative augmentation technique is the application of cartilage extracellular matrix allograft. This matrix would serve as a scaffold for the mesenchymal cells coming from the subchondral bone exposed by microfractures, resulting in better-quality reparative tissue.[11]

Cole et al.[11] described the performance of microfractures associated with an extracellular cartilage matrix allograft mixed with PRP in 48 patients, including 25 trochlear lesions smaller than 1 cm^2. These authors describe good functional outcomes at a 2-year follow-up, with only one

reintervention. Nevertheless, the authors do not report the injury location when showing their results. Brusalis et al.[9] published outcomes from the same technique on ten patients, including five trochlear lesions with defects ranging from 0.7 cm^2 to 5 cm^2. These authors reported 85% good outcomes in terms of satisfaction at the 2-year follow-up. Another augmentation alternative uses chitosan, which functions as a scaffold similar to the cartilage matrix, giving stability to the mesenchymal cells and showing effectiveness in defect filling and symptomatic improvement.[13,14] Calvo et al.[12] described an 80% medium-term satisfaction rate in 11 patients with trochlear lesions treated with microfractures and chitosan.

It is worth mentioning the use of nanofracture as a technique providing more precise subchondral stimulation by performing a deeper and thinner microdrilling in the subchondral bone than the standard microfracture technique.[30] This deeper drilling into the subchondral bone would produce less trabecular fragmentation and compaction compared with microfracture. The resulting communication with a large number of trabecular canals allows better access to the bone marrow and, therefore, greater recruitment of pluripotent mesenchymal cells for the restoration of subchondral bone architecture.[30–32] This technique has also been associated with different scaffolds, such as cartilage matrix with promising results.[33] However, the literature has shown that regardless of the bone marrow stimulation technique, the general quality of tissue regeneration does not reach the characteristics of the native hyaline cartilage.[30]

Arthroscopic chondroplasty or debridement is a technique that, although questioned, can provide temporary symptomatic relief, with good short-term outcomes reported in 50% to 78% of patients.[34,35]

The use of osteochondral autograft transplantation/mosaicplasty in trochlear lesions is limited. Even though it has shown a significant increase in functional scores compared to other techniques in knee chondral defects,[36] no study specifically evaluated this location but only patellar and condylar defects. Some technical considerations make mosaicplasty technically more difficult in trochlear lesions: typical donor sites are adjacent to the load-bearing areas of the trochlea, and the variable chondral curvature and thickness make it difficult for an osteochondral autograft to match the trochlear defect.[37] Melugin et al.[38] presented 19 patients with patellofemoral osteochondral lesions treated with osteochondral allograft, including three femoral trochlea lesions. These authors demonstrated good outcomes at a 2-year follow-up, with a reintervention rate of 21.1% (two patients required a patellofemoral prosthesis). One of the limitations of this work is the presentation of results with no subdivision by injury location; as a result, it is not possible to know exactly the results specifically for the femoral trochlea.

In the femoral trochlea, AIC is a technically complex procedure, expensive, and poorly available in some countries. The higher technical complexity of other surgical procedures in this location and the frequently large size of these lesions have made this technique an attractive alternative, with good and excellent outcomes.[39–41] However, one feared complication of ACI is the growth of a "bony protuberance" potentially altering the patellar tracking.[42]

Among other surgical techniques, Fulkerson, in 1990,[43] described the transfer of the anterior tibial tubercle (ATT) and managed to reduce the contact forces of the lateral aspect of the patella. The effectiveness of this technique in treating isolated trochlear injuries remains unknown.[26] In a cadaveric study, Beck et al.[44] determined that ATT anteromedialization would reduce total trochlear contact pressures, mainly on the lateral slope. Rue et al.[45] also described in a cadaveric study with ten knees that ATT anteriorization alone decreases trochlear contact pressures. Despite the above, the current literature has no clinical study confirming the effectiveness of these techniques.[26]

A combination of techniques, like distal realignment and biological therapy, would probably be the optimal treatment. However, the evidence on this topic is scarce, limited to distal realignment with ACI alone.[46]

Chilean reality

Chile has a wide range of treatments available for knee osteochondral injuries, specifically in the femoral trochlea. Arthroscopic debridement and chondroplasty are common procedures in our clinical practice, with a high number of knee arthroscopies performed daily nationally. MFX and nanofractures isolated or associated with different scaffolding methods, including chitosan, cartilage matrices, collagen membranes, or hyaluronic acid, are widely available in Chile. In addition, osteochondral autograft transplantation is a widely used technique in our country, and different companies provide the instruments to perform them. Although less used due to their high cost and availability, fresh or frozen osteochondral allografts are available in multiple Chilean medical centers. ATT transfer techniques do not require specific instruments and are available in Chile for selected patients. ACI and matrix-induced chondrocyte implantation (MACI) are currently very high-cost procedures and not yet available in our country.

Conclusion

Femoral trochlear cartilage injuries are highly complex lesions due to their anatomical location and spatial configuration.

Due to the limited evidence available, there is no clear treatment guideline, and most of the available management techniques have poor long-term outcomes. Likewise, current evidence leans towards a combined joint restoration strategy, obtaining short-term good to excellent outcomes.

Microfractures associated with chondral allograft matrix present promising results, but long-term studies are lacking to evaluate the success of this technique in terms of clinical outcomes reported by the patients and the survival of this "new" fibrocartilage.

Conflict of Interest
None declared.

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