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LATERAL INVERTED OSTEOCHONDRAL FRACTURE OF THE TALUS: CASE REPORTS AND REVIEW OF THE LITERATURE

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SUMMARY – Lateral inverted osteochondral fracture of the talus (LIFT) is a rare variant of stage IV osteochondral lesion of the talus (OLT), where the fragment is inverted *in situ* by 180°. The management of LIFT lesion is very challenging and early recognition crucial, given that treatment options depend on the articular cartilage condition and sufficiency of the adjacent bone of the displaced fragment. We describe two LIFT cases referred from other institutions after unsuccessful conservative treatment of OLT. They presented with pain, swelling and tenderness over the anterolateral aspect of the right ankle. We recognized the LIFT lesion on the magnetic resonance imaging scans in patient 2, while in patient 1 the orientation of the fragment was recognized upon direct visualization during operative treatment. Both patients underwent arthroscopic procedure. Due to articular cartilage damage and insufficiency of the adjacent bone of the fragment, both patients were treated with excision followed by microfracture. Treatment of the LIFT lesion should start arthroscopically to allow clear evaluation of the osteochondral fragment, assessment of the talar defect and identification, as well as treatment of associated disorders. If the articular cartilage appears intact with sufficient subchondral bone, fixation of the fragment is optimal management, otherwise excision and microfracture can be the treatment of choice.

Key words: *Talus - injuries; Cartilage, Articular; Cartilage Diseases; Conservative Treatment; Magnetic Resonance Imaging; Arthroscopy; Case Reports*

Introduction

Osteochondral lesion of the talus (OLT) can occur in 6.5% of patients sustaining ankle sprain[1,2]. According to the Berndt and Harty radiological classification, OLT can appear in the forms of subchondral compression (stage I) to displaced osteochondral fragment (stage IV)[3]. In rare cases, stage IV OLT of the lateral side of the talar dome is inverted *in situ* by 180°. This is called lateral inverted osteochondral fracture of the talus (LIFT)[4]. Early recognition of LIFT lesion is crucial, given that treatment options depend on the articular cartilage condition and sufficiency of the adjacent bone of the fragment[4]. To date, there have been 9 single case reports and one case series of LIFT lesions described in the literature[3].

Our goal with these case reports is to emphasize the importance of recognizing the orientation of an osteochondral fragment after assessing anterolateral localization of OLT, in order to select optimal treatment modality and achieve good clinical outcome.

Case Reports

Here we present two cases, a 15-year-old boy (patient 1) and 13-year-old girl (patient 2), referred from

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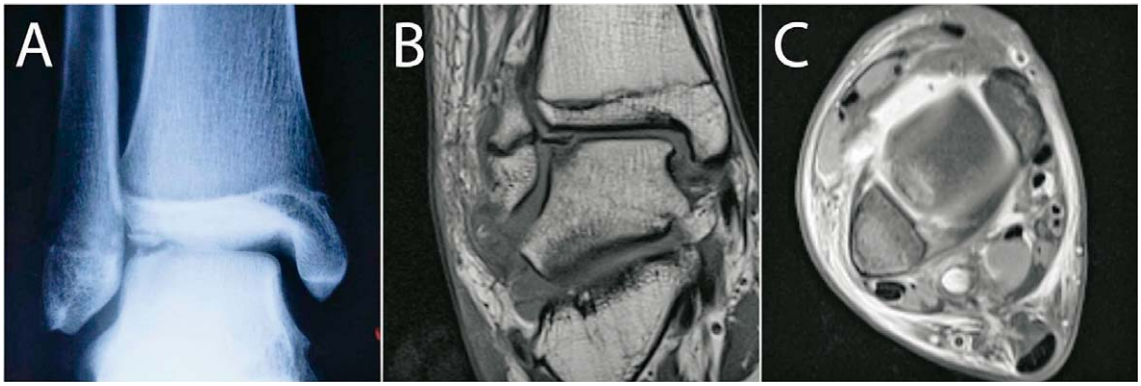

Fig. 1. Preoperative plain radiograph and magnetic resonance imaging scans of the right ankle in patient 1: (A) plain radiograph in the anteroposterior view shows displaced osteochondral fragment in the anterolateral part of the right talus; (B) coronal spin echo T1 image shows lateral inverted osteochondral fracture of the talus (LIFT) on the anterolateral part of the right talus. There is inversion of the subchondral-bone plate crescent, reversal of the subchondral-cancellous bone layers and the presence of a radiolucent gap beneath the fragment; (C) axial fat saturated proton-density turbo spin echo weighted image shows osteochondral lesion of the anterolateral part of the right talus surrounded with bone marrow edema.

Fig. 2. Preoperative plain radiograph and magnetic resonance imaging scans of the right ankle in patient 2: (A) plain radiograph in the anteroposterior view shows displaced osteochondral fragment in the anterolateral part of the talar dome; (B) coronal and (C) sagittal fat saturated proton-density weighted images show lateral inverted osteochondral fracture of the talus (LIFT) on the anterolateral part of the right talus. There is evident inversion of the subchondral-bone plate crescent, reversal of the subchondral-cancellous bone layers and the presence of a radiolucent gap beneath the fragment; (D) axial fat saturated proton-density weighted image shows osteochondral lesion of the anterolateral part of the right talus surrounded with bone marrow edema.

other institutions after unsuccessful conservative treatment of OLT. They sustained an inversion injury of the right ankle during football training and skateboarding, respectively. Patient 1 had one-month and patient 2 five-month history of persistent pain in the lateral aspect of the right ankle. Physical examination of both patients revealed swelling and tenderness over the anterolateral aspect of the right ankle with limited range of motion (ROM). Anterior drawer test was also positive. Plain radiographs at the examination, as well as the magnetic resonance imaging (MRI) scans from the referring physicians showed displaced lateral osteochondral fragment (Figs. 1 and 2). On the MRI scans of patient 2, we noticed that the fragment was actually inverted *in situ* by 180°, thereby showing the LIFT lesion (Fig. 2).

Parental permission was obtained for publication of data concerning these cases.

Surgical technique

In both patients, operation was performed by the senior author (I. B.) using the same protocol. The patients were under spinal anesthesia, placed supine, and a thigh tourniquet was applied to the affected limb

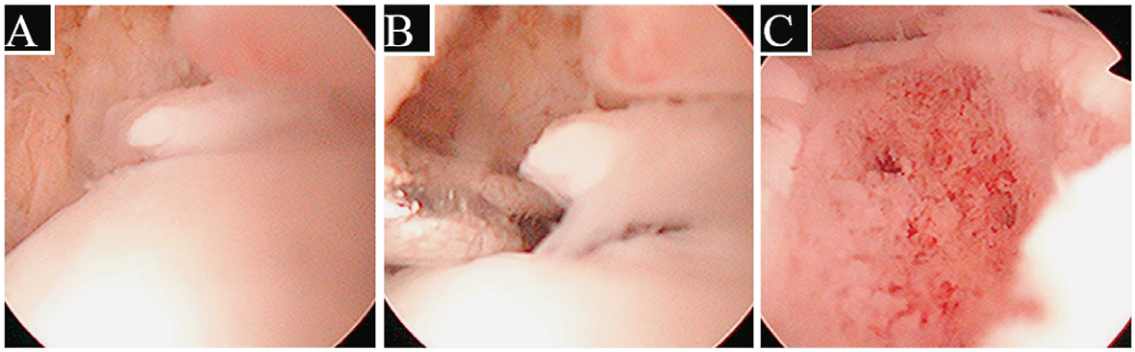

Fig. 3. Arthroscopic views of the right ankle joint in patient 2: (A) inverted osteochondral fracture of the talus (LIFT lesion) in the anterolateral part of the right talus; (B) inverted osteochondral fragment being elevated by a small probe; (C) the remaining crater after excision of the osteochondral fragment and curettage of the talar defect.

throughout the operation. Standard anteromedial and anterolateral portals were used for arthroscopic access[5,6]. No distraction device was used during the operative procedure. In both patients, OLT was situated on the anterolateral site of the talar dome. Closer examination revealed subchondral bone on the top of the fragment with the articular cartilage facing the defect, suggesting inversion of the fragment *in situ* by 180° (Fig. 3). The articular cartilage was significantly damaged in both patients, as a result of the non-anatomic orientation. In addition, there was insufficient amount of the adjacent bone, so the fragment was completely excised. Excision was followed by curettage of the defect surface to remove debris and devitalized tissue. Care was taken to preserve and create a circumferential, perpendicular rim of healthy cartilage. The subchondral base of the defect was then picked by a microfracture awl to a depth of 4 mm, starting at the periphery to improve edge integration. Care was taken to place the holes 3 to 4 mm apart to avoid becoming confluent and destabilizing the microfracture area.

Rehabilitation

The patients started with active and passive ROM exercises from the first postoperative day[7]. A posterior night splint for the ankle in the neutral position was used for 3 weeks after surgery. During the first 6 weeks, both patients were kept on crutch-assisted touch-down weight-bearing (no more than 10 kg). In the next 4 weeks, the patients still used crutches and gradually increased the weight-bearing by 1/3 of their body weight in the first 2 weeks of this period and by 2/3 in the second 2 weeks. This was followed by full weight-bearing with gradual removal of crutches over a period of 2 weeks.

Clinical outcomes

At the final follow up visit, 2 years postoperatively in patient 1 and 1 year postoperatively in patient 2, neither patient complained of foot and ankle pain or swelling, nor reported giving way or instability with the operated foot. Both patients had normal ROM of the operated foot, with no side-to-side difference compared to the non-operated foot. Both patients continued to participate in sports activities at the desired activity level. Postoperative plain radiographs of patient 1 are shown in Figure 4.

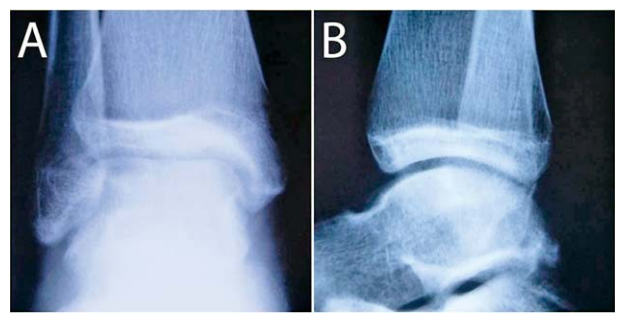

Fig. 4. Postoperative plain radiographs of the right ankle in patient 1: plain radiographs of the right ankle in the anteroposterior (A) and lateral (B) views showing congruency of articular surface of the talar dome after arthroscopic microfracture.

Discussion

Lateral inverted osteochondral fracture of the talus represents an acute OLT of the lateral talar dome that is the result of an inversion injury in which the forces are strong enough, so that the 'flip of the coin' phenomenon occurs, causing the fragment to rotate *in situ* by 180°. Such a completely inverted fragment cannot heal by itself and remaining in the non-anatomical position it will undoubtedly lead to damage to the articular cartilage and adjacent bone. Therefore, clinicians should be aware that the most important thing when dealing with LIFT lesion is early recognition of this condition. Studies report that LIFT lesion usually occurs during sports activities, putting especially younger patients under a major risk[1,4,8]. The main symptoms are nonspecific, mainly a combination of pain, swelling and tenderness over the lateral part of the ankle.

The LIFT lesions should be visible on plain radiograph as a displaced osteochondral fragment or stage IV OLT according to the Berndt and Harty radiological classification[3]. However, recognizing LIFT is not simple because the orientation of the fragment is rarely obvious. In some LIFT lesions, osteochondral fragment may seem as non-displaced, while it is actually displaced, inverted and impacted into the defect[9,10]. By using radiographs alone, the diagnosis of OLT can be missed in up to 43% of patients[11]. Therefore, in the case of lateral OLT seen after acute trauma, MRI or computed tomography (CT) scans should always be performed. Signs suggestive of fragment inversion are inversion of the subchondral-bone plate crescent, reversal of the subchondral-cancellous bone layers, and the presence of a radiolucent gap beneath the fragment[1,10]. On MRI scans, there will be a marked degree of edema within the talus surrounding the osteochondral fragment[8]. However, this can be seen in other OLT lesions as well. Namely, in the case report by Wade and Bustillo, MRI scans showed edema beneath the fragment, but the fragment appeared non-displaced[8]. On the operation, they found the fragment actually to be rotated *in situ* by 180°, which made them change the preoperatively planned procedure of fragment fixation into arthroscopic excision and drilling[8]. In the case of our patient 1, inversion of the fragment was not noticed preoperatively on MRI scans either.

Once the LIFT is diagnosed, decision on which technique to use for the treatment depends mostly on the condition of the inverted osteochondral fragment. Although this assessment is usually possible preoperatively by using MRI or CT scans, definitive decision will be made under direct visualization during the operative procedure. Starting the treatment arthroscopically allows clear evaluation of the osteochondral fragment, assessment of the talar defect and identification, as well as treatment of associated disorders[4]. If arthroscopic examination of the ankle reveals damaged articular cartilage or insufficient subchondral bone of the osteochondral fragment, excision followed by microfracture has proven to be a good surgical choice[8,12]. On the other hand, if viability of the articular cartilage and sufficiency of the adjacent subchondral bone is maintained, fixation of the fragment is the treatment of choice. Different fixation techniques have been described, but bioabsorbable pins are most frequently used (Table 1)[1,4,11,13,14]. These implants provide the same support as metal fixation for protection against shear and rotational forces[14]. They are not demanding for use, can be adopted for a variety of lesions, and removal is not required. A potential complication is a foreign body reaction, which, however, can be reduced with the use of poly-p-dioxanon compared to polyglycolide products[15]. Kristensen *et al*. reported in 1990 a case of a 42-year-old active woman with LIFT lesion, treated arthroscopically by use of bioabsorbable pins. Fifteen months after the operation, she had no pain, had normal ROM, and CT scans showed the fragment to have healed in place[16]. Other studies where bioabsorbable pins were used for LIFT lesion also revealed good to excellent clinical results after early- to mid-term follow-up[1,4,11,13,14]. However, besides the case report by Kristensen *et al*.[16], where fixation was performed arthroscopically, in all other LIFT studies fixation was always done by using arthrotomy, or by switching arthroscopic procedure to an open approach[1,4,11,13,14]. Unlike the satisfying clinical results obtained with fixation, it seems that at the same time radiological findings are not as good. In a recent and most comprehensive study on LIFT lesion published by Dunlap *et al*., radiographs revealed some evidence of osteoarthritis in all patients after the mean follow up of 9.3 years[4]. In the same study, MRI scans also indicated limitations in the ability to completely repair the lesion with fixation technique, while showing moderate surface and subchondral plate irregularities with some residual cystic formation in most patients[4].

Table 1. Summary of literature reports on patients undergoing surgical treatment due to LIFT lesion

Authors, year	No. of LIFT cases	Preoperative diagnostics	LIFT lesion recognized preoperatively	Ankle instability	Time span from injury to operation	Operation technique
Berndt and Harty, 1959	1	Plain radiographs	Yes	Yes	2 days	Arthrotomy: simple impaction
Canale and Bending, 1980	1	Plain radiographs	No	Unknown	Unknown	Arthrotomy: unknown technique
Kenny, 1981	1	Plain radiographs	Yes	No	Several days	Arthrotomy: excision and curettage
Kristensen *et al.*, 1990	1	Plain radiographs	Yes	Yes	2 days	Arthroscopy: fixation (bioabsorbable pins)
Verzin and Henderson, 2004	1	Plain radiographs, CT, MRI	Yes	Yes	1 day	Arthrotomy: simple impaction, ligament repair
Zelent and Neese, 2006	1	Plain radiographs, MRI	No	Yes	1 day	Arthrotomy: fixation (bioabsorbable pins), ligament repair
Chandran *et al.*, 2007	1	Plain radiographs, CT	No	Unknown	1 day	Arthrotomy: fixation (bioabsorbable pins)
Wade and Bustillo, 2010	1	Plain radiographs, MRI	No	No	84 days	Arthroscopy: excision and microfracture
Schepers *et al.*, 2011	1	Plain radiographs, CT	Yes	Yes	9 days	Arthrotomy: fixation (bioabsorbable pins), ligament repair
Dunlap *et al.*, 2013	10	Plain radiographs, CT, MRI	Yes	Yes	Mean 15.4 (range 3-65) days	Arthroscopy (2): excision and microfracture arthrotomy (8): fixation (bioabsorbable pins), ligament repair (10)

LIFT = lateral inverted osteochondral fracture of the talus; CT = computed tomography; MRI = magnetic resonance imaging

Seeing that LIFT is a consequence of an acute inversion injury of the ankle, a variable degree of the anterior talofibular ligament (ATFL) damage is usually present[3]. If ankle instability is recorded, there is the possibility to combine fixation techniques of the osteochondral fragment with ligament repair, thereby avoiding two separate procedures. In the reported LIFT studies where ATFL was torn, repairing of the ligament was done in an open manner[1,4,11,13]. However, advancements in ankle arthroscopy have enabled repairing of ligaments by arthroscopic approach[17-19]. Thus, it is reasonable to expect that in the case of LIFT lesion associated with ankle instability, definitive treatment could be performed during the single arthroscopic procedure.

The management of the LIFT lesion is very challenging due to its rarity, nonspecific radiographic features, and time-dependent treatment possibilities. LIFT can be successfully managed only if recognized acutely. Care must be taken to carefully inspect the condition of the articular cartilage and the adjacent subchondral bone of the displaced fragment. If the articular cartilage appears intact with sufficient subchondral bone, fixation of the fragment is optimal management, otherwise excision and microfracture can be the treatment of choice.

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Sažetak

OKRENUTI KOŠTANOHRSKAVIČNI FRAGMENT NA LATERALNOJ PLOHI TALUSA: PRIKAZI SLUČAJEVA I PREGLED LITERATURE

A. Jurina, V. Delimar, D. Dimnjaković i *I. Bojanić*

Okrenuti koštanohrskavični fragment na lateralnoj plohi talusa (engl. *lateral inverted osteochondral fracture of the talus*, LIFT) je rijedak oblik IV. stupnja koštanohrskavičnog oštećenja talusa (engl. *osteochondral lesion of the talus*, OLT), pri čemu je koštanohrskavični fragment okrenut u ležištu za 180°. Rano prepoznavanje LIFT-a je od presudne važnosti, jer liječenje ovisi o očuvanosti zglobne hrskavice i pripadajuće kosti okrenutog koštanohrskavičnog fragmenta. U našem radu prikazujemo dva slučaja LIFT-a koji su upućeni iz drugih ustanova nakon neuspješnog liječenja OLT-a konzervativnim metodama. Kod oba bolesnika simptomi su bili bol, oteklina i osjetljivost anterolateralnog dijela desnog gležnja. Oštećenje LIFT je kod drugog bolesnika prepoznato tek na snimkama magnetne rezonance u našoj ustanovi, dok je kod prvog bolesnika orijentacija fragmenta prepoznata tek za vrijeme operativnog zahvata. Oba bolesnika podrvgnuta su artroskopskom zahvatu. Budući da su kod oba bolesnika zglobna hrskavica i pripadajuća kost koštanohrskavičnog fragmenta bile znatno oštećene, odlučili smo se za njihovo odstranjenje. Potom smo očistili nastali defekt na talusu i načinili mikrofrakture. Danas se savjetuje operativno liječenje LIFT-a započeti artroskopski, jer se na taj način omogućava točna procjena očuvanosti koštanohrskavičnog fragmenta te se mogu liječiti pridružena unutarzglobna oštećenja. Ako je zglobna hrskavica fragmenta očuvana i ima dovoljno pripadajuće kosti, metoda izbora je fiksacija koštanohrskavičnog fragmenta, dok je u suprotnom moguće odstraniti koštanohrskavični fragment i načiniti mikrofrakture.

Ključne riječi: *talus – ozljede; hrskavica, zglobna; hrskavica, bolesti; konzervativno liječenje; magnetska rezonancija, snimanje; artroskopija; prikazi slučaja*