CHAPTER 7

Posttraumatic subchondral bone contusions and fractures of the talotibial joint: Occurrence of "kissing" lesions

Elizabeth S. Sijbrandij[1], Ad P.G. van Gils[1], Jan Willem K. Louwerens[2], Eduard E. de Lange[3]

From the Departments of Radiology[1] and Orthopaedic Surgery[2]
University Hospital Utrecht and Central Military Hospital, Utrecht.
From the Department of Radiology[3]
University of Virginia Health Sciences Center, Charlottesville, USA.

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Abstract

Objective. To determine the presence and location of subchondral bone contusions, fractures and kissing lesions of the talotibial joint after sprain of the ankle visualized by MR imaging.

Materials and methods. We retrospectively reviewed the images of all consecutive patients who underwent MR imaging of the ankle after acute or recurrent sprain occurring between January and December 1997. The number and location of subchondral contusions or fractures visualized by MR imaging were recorded and a comparison was made with the radiographs obtained in each case.

Results. Of the 146 ankles, 42 osteochondral lesions were identified by MR in 26 (18%) ankles involving 23 patients. Twenty-three lesions were localized in the dome of the talus and 19 in the tibia plafond. In 16 (11%) of the 146 ankles, the lesions were present in the opposing bones of the joint ("kissing" lesions). Only six of the 12 talar fractures and none of the tibial fractures involving the 26 ankles were visualized by conventional radiography.

Conclusion. Subchondral lesions in talus and tibia are relatively common after ankle trauma occurring in 18% of our series. Kissing lesions were present in more than half of these.

Introduction

A ligamental sprain is one of the most common sports-related injuries of the ankle [1]. When the pain persists, the possibility of an osteochondral contusion or fracture of the dome of the talus should be considered [1]. Studies have shown that patients with disability after an ankle sprain show an osteochondral fracture of the talus more often than expected [2,3]. Repeated trauma can lead to more severe osteochondral injury which, in turn, may result in progressive disability [4]. The osteochondral lesions, particularly when minor, are generally not visualized by conventional radiography [1,2,5].

The most widely accepted classification of osteochondral talar injury introduced by Berndt and Harty and based on research on cadavers, is as follows:

Stage 1- localized area of subchondral trabecular compression

Stage 2 - incomplete separation of transchondral fragment

Stage 3 - fragment is completely separated but not displaced

Stage 4 - fragment is displaced or inverted in its fracture bed [5].

The first two stages are difficult to visualize by conventional radiography, and the lesions may go undetected when radiographs are obtained for evaluation. MR imaging has been shown to demonstrate the lesions with high sensitivity allowing early detection and treatment of the abnormalities [1].

It has been noted that in patients with traumatic osteochondral contusions of the dome of the talus similar lesions can be seen occasionally on the opposite site of joint, the tibio-fibular plafond. Lundeen (1990), using arthroscopy, was one of the first to postulate that the tibial lesions were the result of the talus impinging on the cartilage of the tibia plafond at the time of injury [6]. Similar findings, referred to as “kissing” contusions, have also been described in the knee [7]. Bone bruises are not uncommon after severe ankle sprain. To our knowledge, there have been no detailed studies on bone bruises associated with osteochondral fractures in the ankle. Canosa was the first to describe the CT appearances of the kissing lesions in the ankle in a patient who had an osteochondral fracture of the talus and a “mirror” image fracture of the adjacent tibia plafond [8].

We have noted in our patient group undergoing MR examination of the ankle after injury a relative high incidence of subchondral bone contusions, fractures and kissing lesions involving the talus and tibio-fibular plafond. The purpose of our study was to determine the presence and location of subchondral bone contusions, fractures and kissing lesions of the talo-tibial joint after sprain of the ankle visualized by MR imaging.

Materials and Methods

We retrospectively reviewed 146 MR images of all consecutive patients who had undergone MR imaging of the ankle at our institution for sustained acute or recurrent injury to the ankle between January 1997 to December 1997. Abnormalities of the subchondral bones were found in 26 ankles, involving 23 patients. Twenty of these were males and three were females with ages ranging between 12 and 51 years (mean, 30 years). Seventeen of the 23 patients were military recruits. All patients could relate the symptoms to acute or recurrent sprains of the ankle. Time between injury and imaging varied from one to 43 weeks (mean, 14 weeks). In all cases there were persisting symptoms after an episode of trauma such as stiffness, swelling and pain aggravated by weight bearing or activity [2,3]. The indication for performing a MR imaging examination was the clinical suspicion of osteochondral injury established by an experienced orthopaedic foot surgeon.

MR imaging was performed at 0.5 Tesla (Philips, Best, the Netherlands) with the ankle placed in a dedicated receive-only extremity coil. Conventional T1-weighted SE (TR/TE, 600/23), and T2-weighted SE (2000/100) images were obtained in sagittal and coronal orientation in all patients. Short tau inversion recovery (STIR) images (3600/20; inversion time, 150) were obtained in coronal orientation. Image section thickness ranged between 3 and 5 mm with an interslice gap between 0 and 1.5 mm. Matrix size was 256 x 256, and the field-of-view was 16 cm. All patients also underwent radiographic examination of the ankle in anteroposterior, lateral and mortise view projections.

The MR images were reviewed with special attention for bony abnormalities suggestive of osteochondral contusions or fractures. Associated ligamentous injuries were not evaluated in this study. Two radiologists reviewed the images in consensus and the diagnosis of a contusion was based on the criteria described by Kaplan and Magee: the presence of a subchondral, well-defined, semi-circular area of decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted and STIR images [7,9]. An osteochondral fracture was considered to be present when disruption of the subchondral bone plate was identified on T2-weighted images extending through the cortical surface. After review of each MR imaging study, the reviewers analyzed the ankle radiographs of each case with knowledge of the MR imaging findings. In addition, all MR examinations and radiographs of the ankle obtained during the two years following the initial injury were also reviewed.

Results

Of the 146 consecutive MR examinations of the ankles performed for persistent symptoms following sprain, 42 abnormalities of the subchondral bones were found in 26 (18%) ankles, involving 23 patients. The 42 subchondral lesions were present in 17 right and nine left ankles, with 23 of the lesions in the talus and 19 in the tibia. In 13 of the 42 lesions, the MR imaging findings were consistent with fractures and the remaining 29 were contusions. Twelve of the fractures were located in the talus and one in the tibia. Seven of the 23 talar and three of the 19 tibia plafond lesions were present on only one side of the joint. We found no significant difference in time between the injury and imaging in patients with and without bone contusions or fractures. In 16 ankles, the subchondral lesions involved the two opposing bones of the talo-tibial joint (kissing contusions). In six of those, the subchondral lesions were diametrically opposed to each other and involved the weightbearing area (Fig. 1 and 2). In the remaining 10, the lesions were not directly opposed (Figs. 3 and 4). All, except one of the 16 kissing lesions involving the tibia were contusions. Only 7 contusions were seen in the talus, while a majority (9) of the talar

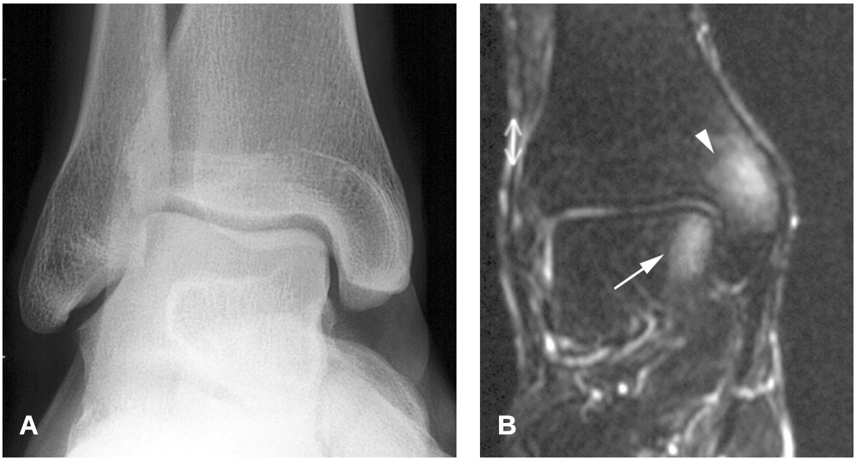


Figure 1.
31-year-old man two weeks after sprain.
A, Anteroposterior radiograph of the right ankle shows no abnormalities.
B, Coronal short tau inversion recovery (STIR, TR/TE/TI 3600/20/150) shows bone contusions in opposing areas of medial tibia (arrowhead) and medial talar dome (arrow). Contusions are recognized by demonstration of areas of increased signal intensity.
C, Coronal T1-weighted spin-echo (TR/TE 600/23) MR image shows decreased signal intensity (arrow) in medial talar dome.

lesions were osteochondral fractures. Only six of the 12 talar fractures and none of the tibial fractures involving the 26 ankles were visualized by conventional radiography.

Of the 23 patients, arthroscopy with drilling through the subchondral bone was performed in four patients with a subchondral fracture of the talus, within two months of the injury. In 16, conservative treatment was given and in three the treatment was unknown.

Twenty of the 23 patients had follow up imaging evaluation. MR imaging performed in two patients with kissing contusion showed persistence of the tibial lesion in one after one month follow-up and complete resolution in another one after 10 months. MR imaging performed in two patients both with kissing lesions (an osteochondral fracture of the talus and a contusion of the tibia), showed complete healing in one patient 11 months after the

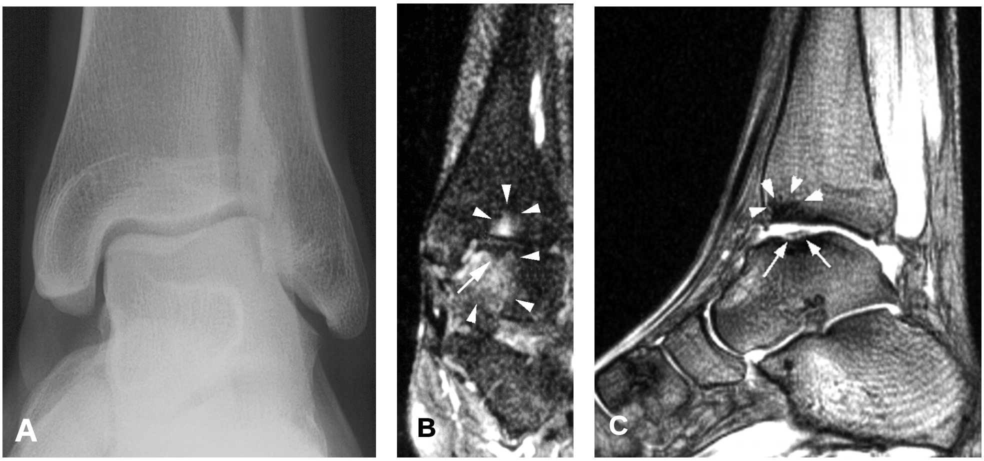


Figure 2. 22-year-old male six weeks after distorsion of left ankle.
A, Anteroposterior radiograph demonstrates no abnormalities.
B, Coronal short tau inversion recovery (STIR, TR/TE/TI 3600/20/150) shows bone contusion in opposing areas of medial tibia plafond (arrowheads) and osteochondral fracture in medial talar dome (arrow).
C, Sagittal T1-weighted spin-echo (TR/TE 600/23) MR image shows osteochondral fracture in medial talar dome (arrows) and bone contusion in tibia plafond (arrowheads).

initial injury, and in the other patient, minimal residual edema in the talus after 17 months. CT arthrography obtained in one patient with a solitary talus fracture showed that the fracture was still visible after 7 months. Radiography in 15 patients with 12 kissing and three solitary lesions showed osteochondral fractures of the talus in three and no evidence of subchondral injury in the others between one month and two years after the initial injury.

Discussion

MR imaging has been shown to be a highly sensitive modality for evaluating the subchondral tissues after injury [4,9]. A variety of changes can occur after trauma ranging from bone bruises or contusion to frank osteochondral fractures. The bone bruises are thought to represent trabecular microfractures associated with hemorrhage, edema and hyperemia [7]. On MR images, they present as relatively ill-defined semi-circular areas of abnormal signal intensity in the subcortical bone that do not extend through the cortex [7]. When a fracture is also present, there is disruption of the cortical bone visualized as a low signal

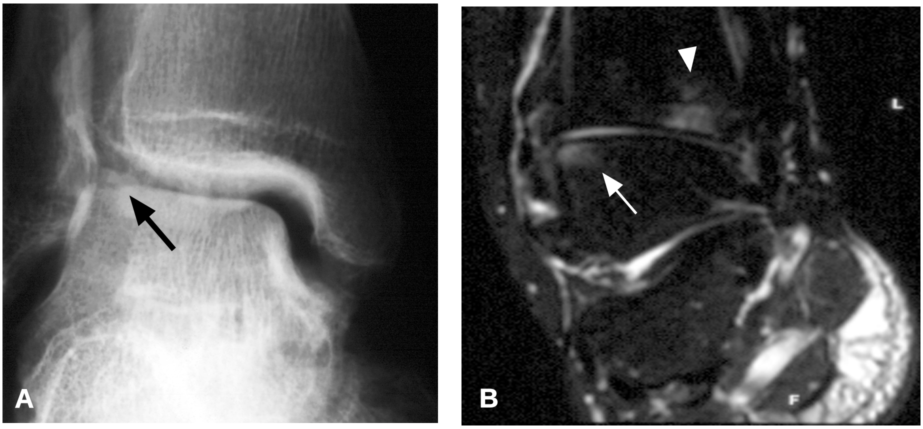
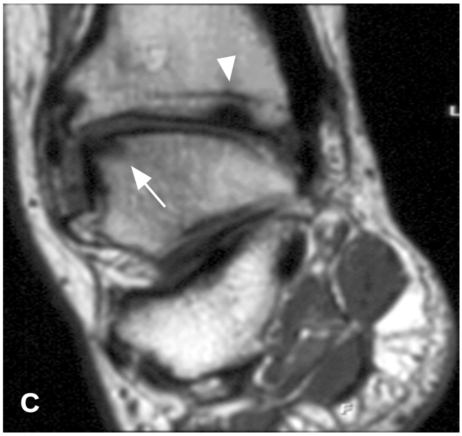


Figure 3. 42-year-old man with persistent pain after recurrent sprains of right ankle.
A, Anteroposterior radiograph of ankle shows osteochondral defect in lateral aspect of talus (arrow).
B, Coronal short tau inversion recovery (STIR, TR/TE/TI 3600/20/150) with osteochondral lesion in lateral talus (arrow) and osteochondral lesions in medial tibia plafond (arrowhead). Lesions are not diametrically opposed probably as result of rotation during injury.
C, Coronal T1-weighted SE (TR/TE 600/23) MR image shows osteochondral fracture in lateral talus (arrow) and osteochondral contusion in medial tibia plafond (arrowhead).



intensity line by T2-weighted imaging extending through the cortical surface. The subchondral abnormalities are believed to be caused by trauma that causes impaction of the bones. In the ankle, there may be additional rotational forces contributing to the mechanism of injury [10]. It has been reported that bone bruises occurred in 7% of the ankles following first-time sprain [11]. The higher incidence of bone bruises following recurrent sprains suggests that re-injuries may play an important role in their occurrence [11]. Bone contusions in the ankle are often associated with ligamentous injury [12]. But on the other hand they may occur in the absence of major ligament disruptions [11]. Knee bone contusions are known to resolve in 1-4 months after injury. We found some cases of edema in the ankle persisting for a longer period of time. This may suggest that the time necessary for healing in the ankle is longer. On the other hand ankle instability

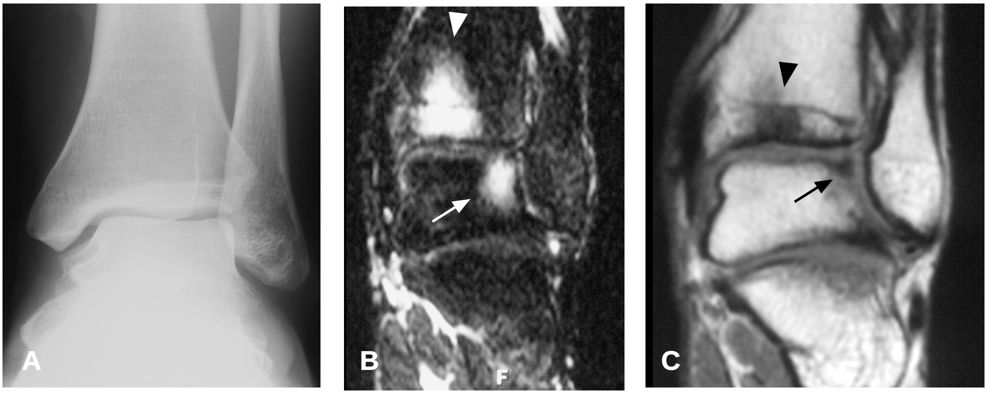


Figure 4. 25-year-old male 7 weeks after severe sprain of left ankle.
A, Anteroposterior radiograph of left ankle shows no abnormalities.
B, Coronal short tau inversion recovery (STIR, TR/TE/TI 3600/20/150) shows bone contusions in opposing areas of medial tibia plafond (arrowhead) and lateral talar dome (arrow). Contusions are recognized by demonstration of areas of increased signal intensity.
C, Coronal T1-weighted spin-echo (TR/TE 600/23) MR image shows osteochondral contusions in lateral talar dome (arrow) and tibia plafond (arrowhead). Contusions are not diametrically opposed probably as result of rotation.

due to ligamentous injury and recurrent sprains may also be responsible for the persisting bone marrow edema in the ankle. The healing period of the osteochondral injury in the ankle therefore still remains unknown [11,13].

We found 42 osteochondral lesions in our series of 146 patients. Of those, there were 36 bone contusions. The frequency of the findings is well within the range (6.5%-39%) reported in the literature [13,14]. However, the number of patients with kissing lesions (11%) was much higher than that reported by others. For instance, Labovitz and Schweitzer found kissing lesions in only 5 (5%) of 109 subjects [13]. It is unclear why the number of kissing lesions was relatively high in our series. However, a large proportion (17 of 23) of the patients with subchondral injury consisted of personnel of the military forces, subjects in whom it is known that osteochondral lesions are more likely to occur [5,14]. We found in the patients with kissing lesions that all osteochondral fractures were located in the talus while the contusions were predominantly seen in the tibial plafond. There are several possible explanations for the higher occurrence of the subchondral fractures in the talus than the tibio-fibular plafond. First, osteochondral lesions are more commonly observed at the convex surface of a joint, while the concave surface is generally spared. The convex surface is believed to transmit the forces (convergence of force) toward a central focus, whereas a concave surface dissipates the forces. As a result, the concave joint surface, such as that of the talus is likely to be more severely damaged by trauma than the tibial plafond [10]. Second, the cartilage of the tibia is stiffer than that of the talus due to differences in composition [15]. In six of the 16 kissing lesions, the abnormalities were directly opposite of each other making it likely that the lesions of the tibio-fibular plafond were the result of direct impaction of the talar bone onto the opposing tibial bone. In the remaining 10 the lesions were not diametrically opposed probably because rotation occurred during the injury [7].

A shortcoming of our study is that there was limited follow-up with MR imaging. In the one case where CT was obtained no changes were noted of the osteochondral fractures after seven months. No osteochondral lesions were seen in any of 15 patients who had radiographic follow-up. However, the latter technique is insensitive in detecting these lesions. Thus, the changes over time of bone contusions in the ankle remain uncertain. Nevertheless, the clinical significance of bone contusions in the ankle has not been established and it has been suggested that these contusions do not need treatment [9]. Osteochondral fractures, on the other hand, do need to be treated with reduced weight bearing for an extended period of time [11]. A further shortcoming of our study is the retrospective study design. Because of the large number of military recruits, our study is subject to selection bias. This bias makes it difficult to extrapolate these findings to a general orthopaedic practice.

In conclusion, we found a relatively high number (11%) of subchondral injury involving the subchondral bone of both the talus and tibia. Of these kissing lesions, bone contusions were most commonly seen in the tibia plafond and osteochondral fractures in the talar dome. The kissing lesions are most likely caused by impaction of the talus onto the tibia with or without torsion.

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