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High incidence of osteochondral lesions after open reduction and internal fixation of displaced ankle fractures: Medium-term follow-up of 100 cases

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ABSTRACT

Background: The incidence of osteochondral lesions (OCLs) in association with displaced ankle fractures has only been examined in two previous studies. In both studies magnetic resonance imaging (MRI) was performed prior to open reduction and internal fixation (ORIF). Because MRI may overdiagnose or overestimate the extent of OCLs in an acute trauma setting the aim of this study was to determine the incidence of OCLs after ORIF of displaced ankle fractures using MRI at medium-term follow-up, and to analyse if the severity of fracture or the clinical outcome correlates with the incidence of OCLs.
Patients and methods: Following institutional review board approval a total of 100 patients (mean age, 41.3 years; range, 17.9–64.3 years) with a displaced ankle fracture who had undergone ORIF according to the AO principles were included in this study. The American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score was used to quantify the clinical outcome and MR images were evaluated for OCLs of the talus and distal tibia after a mean of 34.5 months (range, 17.5–54.1 months).
Results: OCLs were found in 40.4% of the patients. Logistic regression revealed a significant correlation between the severity of fracture and the incidence of OCLs. Patients with a trimalleolar fracture ($p = 0.04$) or an ankle fracture dislocation ($p = 0.003$) had a significantly higher risk for developing an OCL compared to those with a type B fracture. Logistic regression also demonstrated a significant correlation between the clinical outcome (AOFAS score) and the incidence of OCLs ($p = 0.01$). The risk for developing an OCL increases up to 5.6% when the AOFAS score decreases by one point.
Conclusion: OCLs were frequently found in association with acute ankle fractures at medium-term follow-up, and the severity of fracture was associated with an increased number of OCLs. Considering the disadvantages of MRI including the high cost and limited availability, the results of this study may help to explain why anatomic surgical realignment of displaced ankle fractures may still be associated with poor clinical outcomes.

Introduction

Ankle fractures are one of the most common lower extremity injuries, especially in athletes [1–4]. Anatomic surgical realignment of these fractures treated by open reduction and internal fixation may still be associated with poor clinical outcomes [5]. Factors that are considered to play a role are ligamentous instability, posttraumatic arthritis, arthrofibrosis, chondral and osteochondral lesions [6–11]. Osteochondral lesions (OCLs) of the ankle are known to be a common source of ankle pain [2]. Although the exact pathophysiology of this condition has not been clearly established, it is likely that a variety of etiological factors play a role, with trauma, being the most common [2,11].

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On clinical examination signs are often lacking. Plain radiographs may miss up to 50% of osteochondral lesions even in combination with history taking and physical examination [2,12,13]. Computed tomography lacks the ability to assess cartilage, although it is useful in obtaining greater detail about the bony injury [2,14]. Technological advancements in magnetic resonance imaging (MRI) and ankle arthroscopy, have improved diagnostic capabilities for detecting osteochondral lesions of the ankle [2]. Ankle arthroscopy has the advantage of direct visualisation of the lesion; however, it focuses on the cartilage insult and the underlying bony component of the lesion may not be assessed [2,11]. Currently, the most satisfactory non-invasive diagnostic technique for identifying an osteochondral lesion is magnetic resonance imaging [13,15,16]. MRI has been shown to detect chondral and subchondral bone integrity accurately, can delineate the size and location of osteochondral lesions, and correlates closely with arthroscopic findings [2,11,14,17].

The orthopaedic literature is replete with studies implicating traumatic osteochondral lesions as one of the causes for chronic ankle pain; however, there is a paucity of literature describing osteochondral lesions in the setting of ankle fractures [11,18]. The incidence of osteochondral lesions of the talus in patients with acute ankle fracture has only been examined in two studies using MRI [11,18]. In both studies preoperative MRI was performed in patients with acute ankle fracture who underwent open reduction and internal fixation. Because of the large degree of signal change that can arise secondary to edema after even mild ankle injuries, some authors believe MRI may overdiagnose or overestimate the extent of osteochondral lesions in an acute trauma setting [2,19]. OCLs of the distal tibia were not analysed in association with acute ankle fractures in previous studies.

The objectives of this study were to (1) determine the incidence of osteochondral lesions of the distal tibia and talus after open reduction and internal fixation of displaced ankle fractures using MRI at medium-term follow-up, (2) classify these lesions according to the MRI staging system of Dipaola et al. as grade 1–4, (3) analyse if the severity of fracture, as classified with use of the AO-Danis-Weber criteria, correlates with the incidence of OCLs, and (4) verify if the clinical outcome at follow-up (AOFAS score) correlates with the incidence of osteochondral lesions [20–22]. The work has been approved by the appropriate ethical committee and all patients provided written informed consent.

Materials and methods

Following institutional review board approval, we analysed the medical records and radiographs of all patients with an acute displaced ankle fracture who had undergone open reduction and internal fixation according to the AO principles between February 2009 and February 2011 at our department. The patient's age and gender, date of injury and date of surgery were recorded. Based on radiographs the fractures were categorised according to the AO-Danis-Weber classification [21]. Postoperative radiographs and surgical reports were screened to evaluate the success of open reduction and type of internal fixation. Exclusion criteria were defined as followed: type A fracture; open ankle fracture; patients younger than 18 years or older than 70 years; systemic inflammatory disease; osteochondral lesions or signs of osteoarthritis at the time of injury; history of any ankle injury before or after the index ankle fracture; complaints of the affected ankle prior to the index fracture; poor reduction of the fracture; complications after surgery including infection and impaired wound healing; fracture non-union; subsequent surgical treatment after the index operation except implant removal; contraindications for MRI. Beside the review of the medical records and radiographs we designed a special telephone questionnaire to check the exclusion criteria. A total of one hundred patients were included in this study. These patients met the inclusion criteria, were available for follow-up and provided written informed consent.

Clinical examination and MRI

This study was conducted between May 2012 and October 2013. The exclusion criteria were rechecked at presentation and the date of implant removal was recorded for each patient. The American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score was used to quantify the clinical outcome [22]. The clinical results were evaluated by an independent orthopaedic surgeon without knowledge of the MRI data. For MRI, either a 1.5 T (Achieva, Philips Medical Systems, Best, the Netherlands) or 3 T scanner system (Intera, Philips Medical Systems, Best, the Netherlands) was used. All patients were placed in the supine position. The ankle was scanned with a dedicated send-receive extremity coil. T1-weighted and T2-weighted images were obtained in all three imaging planes. MR scans were separately evaluated by an experienced musculoskeletal radiologist for osteochondral lesions of the talus and distal tibia, without knowledge of the patients' history and outcome. The osteochondral lesions were classified according to the MRI staging system of Dipaola et al. as grade 1–4 [20]. The width of the osteochondral lesion was also recorded.

Statistical analysis

Statistical analyses were done by a professional statistician using IBM (R) SPSS (R) Statistics 21. Descriptive statistics were given as percentage or mean and range. Logistic regression analyses were used to evaluate the impact of prognostic variables on the probability of developing osteochondral lesions. Results are presented as odds ratios with corresponding 95% confidence intervals (CI) and p values. All variables were tested in univariate models. Two-sided p-values below 0.05 were considered statistically significant.

Results

The mean patient age was 41.3 years (range, 17.9–64.3 years) at the time of injury. One patient was excluded retrospectively because of an ipsilateral fracture of the calcaneus. Fifty-three patients (53.5%) were male, and forty-six (46.5%) were female. The right ankle was involved in fifty-three (53.5%) of the cases. The mean duration from injury to clinical examination and MRI was 34.5 months (range, 17.5–54.1 months). Patient age averaged 44.1 years (range, 20.5–67.6 years) at follow-up.

According to the AO-Danis-Weber classification there were 72 type B fractures (72.7%) and 27 type C (27.3%). The fractures were subdivided into six different types. The distribution of the fractures was as follows: 48.5% type I (type B fracture), 11.1% type II (type C fracture), 7.1% type III (bimalleolar fracture; type B/C fracture + medial malleolar fracture), 7.1% type IV (trimalleolar fracture; type B/C fracture + medial malleolar fracture + posterior malleolar fracture), 5.1% type V (maisonneuve fracture), and 21.2% type VI (ankle fracture dislocation) [23]. Open reduction and internal fixation was performed after a mean of 6.8 days (range, 1–22 days) according to the AO principles. Patients with type B and C fractures received a one-third tubular plate and one syndesmotic screw if required (DePuy Synthes, Umkirch, Germany). Two screws or a combination of a screw and a Kirschner-wire were used to fix medial malleolar fractures. Posterior malleolar fractures were stabilised with two screws if necessary. Two syndesmotic screws were applied to treat maisonneuve fractures. Ankle fracture