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Magnetic resonance imaging abnormalities after lateral ankle trauma in injured and contralateral ankles

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ABSTRACT

Purpose: To compare the prevalence of abnormal MRI findings associated with lateral ankle trauma in injured and contralateral ankles to identify lesions that may be pre-existent.
Material and methods: The study was approved by the institutional review board and informed consent was obtained from all subjects. 195 patients (mean age 37.5 + 14.7 years; 43% male) who visited their general practitioner 6–12 months earlier with an ankle sprain were selected. All patients completed a standardized questionnaire and underwent MRI (1.5T) of both ankles. Structural MRI abnormalities in the injured and contralateral ankle were compared using the McNemar test (for paired samples).
Results: Bone marrow edema was frequently seen in the injured and contralateral ankle at the talocrural joint (25.1% versus 14.8%) and subtalar joint (24.6% versus 8.7%), but significantly more frequently in the injured ankle. Anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL) lesions were frequently found in both ankles, in 55.9% and 37.4% of injured ankles respectively and in 17.9% and 5.6% of contralateral ankles respectively. Fractures, anterior and posterior tibiofibular ligament lesions, deltoid ligament lesions and signs of talonavicular osteoarthritis were almost exclusively found in injured ankles. Peroneal ligament lesions were not frequently found in both ankles.
Conclusions: The prevalence of structural MRI abnormalities in patients presenting with a previous ankle sprain in primary care is very high. However, especially bone marrow edema and lateral ligament lesions can also be found in a substantial percentage of contralateral ankles and may be either pre-existent or due to increased stress on the contralateral ankle after an ankle injury Correlation with clinical findings is essential.

1. Introduction

Acute ankle sprains are one of the most common musculoskeletal injuries [1–4]. In the Netherlands, an estimated 600,000 people sustain an ankle injury each year [5]. Approximately half of these patients present for medical care, either at their general practitioner or a hospital emergency department [5]. The majority of these injuries involve the lateral ankle ligament complex [6,7] as inversion injuries are the most common trauma mechanism. Several treatment options for lateral ankle injuries have been published [8–10]. Although non-operative treatment is successful in most patients, residual symptoms do occur and may lead to chronic ankle instability when complaints last for at least 6 months. A systematic review showed that at 1-year follow-up after conservative treatment, 5% to 33% of the patients still experience pain and instability, 34% of patients reported at least one recurrent sprain and 15% to 64% reported incomplete recovery from their initial injury [11]. 20–40% of patients with chronic ankle instability have associated injuries, including osteochondral lesions, peroneal tendon tears or intra-articular loose bodies, which may be an important cause of long term problems [1,13]. Additional MR imaging could be of value in patients with chronic ankle instability to guide appropriate treatment.

Given the frequency of ankle sprains, the prevalence of structural abnormalities in patients with persistent complaints has been well documented [12–15]. Ochten et al. recently reported that structural abnormalities on radiography and MRI after

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lateral ankle sprain in patients consulting their GP are not associated with persistent complaints [16]. Data on the prevalence of structural abnormalities in contralateral (asymptomatic) ankles are scarce; however they are essential for clinical decision making to avoid overinterpreting the significance of injuries not causing the patient's actual symptoms. Only two studies reported data on structural MRI abnormalities in asymptomatic ankles [17,18], but in both studies patients were not truly asymptomatic and underwent MRI examination for "non-lateral ankle pain" in a secondary or tertiary care setting.

The purpose of this study was to determine the prevalence of abnormal MRI findings associated with lateral ankle trauma in a primary care setting and compare these to MRI findings in the contralateral ankle to identify lesion types that may be preexistent.

2. Methods

The study was approved by the Institutional Review Board of the hospital and written informed consent was obtained from each patient.

2.1. Patients

We used data from patients included in an observational case-control study on persistent symptoms after lateral ankle trauma presenting in Dutch general practice [16]. Patients were selected from the files of 84 participating general practitioners (GP) using the diagnostic code 'ankle sprain' according to the International Classification of Primary Care (ICPC) and with the search terms: 'ankle', 'distortion', and 'sprain'. Patients aged 16–65 years were considered eligible if they had presented themselves at their GP with an inversion trauma of the ankle 6–12 months before start of the study. Patients with known systemic diseases that affect the functioning of the musculoskeletal system (i.e. amyotrophic lateral sclerosis, multiple sclerosis; auto-immune disorders such as rheumatoid arthritis and psoriatic arthritis etc.) as well as patients with insufficient knowledge of the Dutch language were excluded.

Potentially eligible patients received a letter with a response card for participation on behalf of their GP. Interested patients forwarded their contact details to the researchers. On the response card, several questions were asked regarding general patient characteristics and persistent symptoms. Researchers contacted the patients to further inform them of the study and to verify whether the inclusion criteria were met. After signing informed consent, patients were included and asked to fill in an online questionnaire and were invited for a standardized physical examination of both ankles (data not used for present study) and radiological examination, consisting of radiography of the injured ankle and MRI of both ankles.

The self-administered questionnaire contained questions on patient characteristics (age, gender, body mass index (BMI) and education level), the initial ankle sprain (side, history of previous injuries and activity causing the sprain), local symptoms and current complaints. Pain severity was assessed using the Numeric Rating Scale (NRS-11), an 11–point scale for patients self-reported pain [19]. The mean ankle function score was determined based on 5 categories: pain, stability, weight bearing, swelling, and gait pattern. All categories were summed to a total score (range 0–100, with 0 representing the worst possible and 100 representing the best possible function [20].

195 patients have been previously reported [16]. This prior article dealt with the associations between structural abnormalities on radiography and MRI and persistent complaints after lateral ankle trauma. The data of the contralateral ankle were not reported in this study.

2.1. Magnetic resonance imaging (MRI)

MRI of both ankles was performed on a 1.5 Tesla MRI scanner (Magnetom Essenza, Siemens Healthcare, Erlangen, Germany) with a head-neck coil. The ankles were placed in neutral position. In Table 1 the MRI acquisition protocol for the injured ankle is shown. A field of view of 20 cm for most sequences and a slice thickness of 3 mm were used for all sequences. The total acquisition time was approximately 20–30 min. For feasibility reasons, in the contralateral ankle only the coronal and axial sequences were obtained, using the same scan parameters.

2.3. MRI: assessment and definitions

MR images of the injured and contralateral ankle were evaluated by one radiologist (3 years of experience in musculoskeletal MR imaging) using a standardized scoring form. A random sample of 35 MRIs was also scored by a second musculoskeletal radiologist (6 years of experience in musculoskeletal MR imaging) to assess interobserver reliability. The interobserver reliability was calculated for the different MRI items scored using Cohen's kappa and in case of variables with >2 categories using the intraclass correlation coefficient (ICC) resulting in a range of 0.653–1. The percentage agreement was 98,8% (5883 of 5952 items). Because of high agreement, the remainder of the MRIs was primarily scored by one observer, but difficult cases were interpreted together and decision was based on consensus. Both readers were blinded to the patients' characteristics and clinical data.

Osseous structures were scored for the presence or absence of the following abnormalities: fractures, bone marrow edema, osteochondral lesions, osteophytes, subchondral cysts, cartilage loss (diffuse and/ or focal) and sclerosis. These items were scored separately for the medial and lateral malleolus, inferior articular surface of the tibia at the tibiotalar joint, medial and lateral talus, the talus and calcaneus at the subtalar joint, and the talus and navicular bone at the talonavicular joint. Bone marrow edema was dichotomized as absent or subchondral versus present (including <25%, 25–50%, 50–75% and >75% bone marrow edema). Presence of osteophytes was dichotomized as absent or small versus definite. Osteoarthritis of the ankle was evaluated using an adapted Kellgren and Lawrence scale [21]. This scale was originally developed for conventional radiography. Because no MRI specific scale for osteoarthritis exists for the ankle, we adapted and dichotomized this scale into grade $\geq$1 indicating minimal signs of osteoarthritis versus grade 0 and grade $\geq$2 indicating definite osteoarthritis versus grade <2. Both thresholds were used in the analyses. For the purpose of the analyses, the large numbers of items scored were clustered for the talocrural joint, subtalar joint and talonavicular joint.

Tendons (in particular peroneus longus and brevis tendon) and ligaments, including the anterior and posterior tibiofibular ligaments, anterior and posterior talofibular ligaments, calcaneofibular ligament, deltoid ligament and the spring ligament complex, were scored for signs of post-traumatic injury and classified as normal, old lesion/ thickened, partial tear, complete tear and (in case of the peroneus brevis tendon) split tendon. For the analyses, we dichotomized the MRI appearance of tendons and ligaments into normal versus abnormal.

The presence of joint effusion, soft tissue edema, and loose bodies was assessed for the talocrural joint. Synovitis was also scored for the talocrural joint and was present when nodular/ thickened synovium was seen (there was no administration of contrast agent in this study). We also recorded peri-articular calcifications as well as the presence or absence of anterolateral impingement, indicated by a proliferative synovitis and fibrotic scar tissue at the lateral gutter.