



● Original Contribution

SONOGRAPHIC AND ANATOMIC DESCRIPTION OF THE SUBTALAR JOINT

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Abstract—Our study provides a detailed anatomic and sonographic description of the subtalar joint, a single joint that, anatomically, is divided into the anterior subtalar joint (ASTJ) and the posterior subtalar joint (PSTJ). Cadaver specimens of the ankle and foot were examined in detail by ultrasound (US), and the subtalar joints of all the specimens were injected with colored latex of a contrasting color under US guidance. Compatible with other studies, examination of the sections revealed lack of communication between the ASTJ and the PSTJ and communication between the PSTJ and the posterior recess of the tibiotalar joint. A recommended list of standardized ultrasound scans was developed using a Delphi consensus process, which allows sonographers to evaluate both the ASTJ and PSTJ from the medial, lateral and posterior aspects. The recommended ultrasound scans were found to be applicable based on a test of agreement between images acquired in cadaver specimens and images acquired in four centers using healthy patients. (E-mail: peter.mandl@meduniwien.ac.at) © 2017 World Federation for Ultrasound in Medicine & Biology. All rights reserved.

Key Words: Subtalar joint, Cadaver, Ultrasound, Anatomy.

INTRODUCTION

Pain localized to the area of the ankle may arise from inflammation or degenerative changes affecting the ankle (tibiotalar joint), the talonavicular joint or the subtalar joint, but may also be caused by lesions of the tendons, bursae, nerves and ligamentous structures. The subtalar joint is commonly affected in many rheumatic and musculoskeletal diseases (RMDs), particularly in rheumatoid arthritis (RA) and juvenile idiopathic arthritis. Subtalar involvement generally precedes that of the talocrural joint (Belt et al. 2001) and commonly leads to foot pain, deformity and gait abnormalities (Jernberg et al. 1999; Turner et al. 2003, 2006; Vidigal et al. 1975).

Subtalar joint involvement, however, is often neglected or missed during clinical examination because the joint is difficult to examine and most clinicians have a limited understanding of its anatomy. The subtalar joint

is functionally a single joint that, anatomically, is divided into the anterior subtalar (or talocalcaneonavicular) joint (ASTJ) and the posterior (or talocalcaneal) subtalar joint (PSTJ) (Tracy 1974). The ASTJ is formed by the posterior facet of the navicular bone and the convex head of the talus anteriorly and the anterior and middle facets of the talus and the calcaneus inferiorly. Supporting the joint medio-inferiorly is the spring ligament. The ASTJ is in direct communication with the talonavicular joint (Lopez-Ben 2015). The PSTJ is composed of the posterior facets of the talus and the calcaneus (Ballehr 2015).

Ultrasound examination was found to be useful in illustrating ankle and subtalar joint involvement, especially for patients who complain of ankle pain but lack clinical findings in RA (Suzuki et al. 2009; Toyota et al. 2017). It has also been found to be a useful tool in the management of ankle involvement in juvenile idiopathic arthritis (JIA) (Laurell et al. 2011).

Despite, or perhaps because of its anatomic complexity, there is an apparent lack of data on the detailed sonographic examination of the subtalar joint, which is particularly puzzling considering that it is clinically difficult

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to examine. Of note, the two components of the subtalar joint are not included in the European League against Rheumatism (EULAR) Guidelines for Musculoskeletal Ultrasound in rheumatology (Backhaus et al. 2001). The aim of this study was to address this deficiency by developing a detailed sonographic description and a list of recommended scans of the subtalar joint using cadaveric specimens and to evaluate its applicability in healthy patients. The project was developed on behalf of the EULAR Study Group: Anatomy for the Image.

METHODS

Development of the standardized ultrasound examination

Cryopreserved intact ankle-foot cadaver specimens from three male and three female patients (two right and four left; mean age [range]: 74 [66–80] y) were studied. After the specimens were left to completely thaw at room temperature for 12 h, the cadaver specimens were first examined in detail with ultrasound (US) by two rheumatologist experts in musculoskeletal ultrasound using a LOGIQ P6 US system (GE Ultrasound Korea, Seongnam, Korea) with a high-frequency linear transducer (6–15 MHz) before sectioning. The aim of these examinations was to develop a standardized scanning technique that allows sonographers to evaluate both portions of the subtalar joint. The specimens were evaluated from the medial, lateral and posterior aspects using a multitude of positions and scanning planes to develop a recommended list of scans optimized to provide the best visualization of the both the ASTJ and PSTJ. None of the evaluated specimens contained pathologic changes, such as joint effusion, synovial hypertrophy, bone erosions or osteophytes involving the subtalar or tibiotalar joint. Based on the examinations and images acquired from the cadavers, a list of recommended

scans allowing the visualization of the ASTJ and PSTJ were developed.

Assessment of agreement and applicability

Descriptions of the recommended scans were circulated among the authors, and a consensus Delphi process, as used in previous studies (Roth et al. 2015), was performed. The authors were instructed to rate each scan (*i.e.*, the descriptions) on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). To agree on a definition, at least 80% of the authors needed to score the respective definition/component as either 4 or 5 on the Likert scale. To test the applicability of the definitions, four authors performed a scanning exercise of the recommended scans on healthy individuals in their respective centers using high-end ultrasound machines (ESAOTE Mylab 70 and GE Logiq E9 with multifrequency linear transducers, frequency ranges: 6–18 and 6–15 MHz). The acquired images were then sent to one of the authors who did not participate in the development of the definitions or the examination of the cadavers and who assessed and rated each image on a Likert scale according to the following factors: appropriate magnification, clearly displayed bone contours and identification of the target as well as all required structures. This study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee of the Medical University of Vienna. Written informed consent was obtained from all patients before the study.

Latex injection and evaluation of intra- and inter-articular communication

Cadaveric specimens were injected with latex of a contrasting color under sonographic guidance (Fig. 1). The PSTJ was injected by an anterolateral approach described

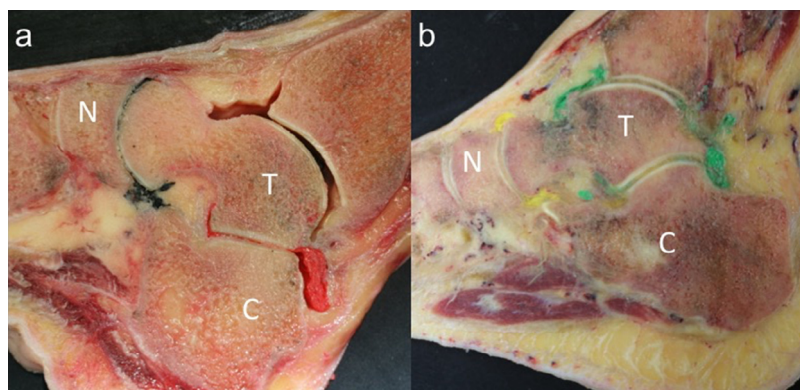


Fig. 1. (a) Anatomic specimen showing the anterior subtalar joint (filled with dark-green latex) and the posterior subtalar joint (filled with dark-red latex). (b) Anatomic specimen showing the anterior subtalar joint (filled with bright-yellow latex) and communication between the posterior subtalar joint and the tibiotalar joint (both filled with bright-green latex). C = calcaneus; N = navicular, T = talus.

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