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Introduction. Enthesopathy refers to the pathology involving the attachment of a tendon, ligament or fascia to the bone. Inflammation of the attachment, i.e. enthesitis, is a distinctive feature of spondyloarthropathies (SpA), one of the rheumatic diseases group. Heel enthesitis is an auxiliary axial SpA and main peripheral SpA diagnostic criterion (along with arthritis and dactylitis) according to the ASAS (*Assessment of Spondyloarthritis Society*) classification. Clinical manifestations of enthesitis include pain reproduced by palpation, which is triggered by loading, activity, swelling of the site of entheses and stiffness aggravating at prolonged rest. To confirm the initial diagnosis of enthesitis ultrasonography (US) has been used in clinical practice. However, the literature is inconclusive regarding the role of the US in the diagnosis of enthesitis. Especially, its ability to differentiate primary enthesitis from posttraumatic microdamage and degeneration.

The current study aims to determine the diagnostic relevance of US in the diagnosis of heel entheses inflammation in patients with clinically suspected enthesitis. The detailed objectives were:

1. To define the spectrum of the enthesitis features in the evaluated heel entheses of the Achilles tendon, plantar fascia and flexor digitorum brevis.
2. To determine the criteria of *enthesitis* based on demonstrated pathologies.
3. To assess the value of clinical examination in patients with suspected enthesitis.

Material and methodology. A retrospective evaluation of the Achilles tendon, plantar fascia and flexor digitorum brevis entheses' US examinations was carried out in 86 patients (209 entheses in total) with clinical suspicion of enthesitis and a prospective evaluation of the control group of 20 patients with rheumatic diseases other than spondyloarthropathies and healthy volunteers (120 entheses in total). Exclusion criteria included current or previous

anti TNF- α treatment, hindfoot surgery or trauma, associated endocrinopathies and an additional criterion for control group - diagnosed or suspected spondyloarthritis. The study and the control groups did not differ statistically significantly in terms of age ($p=0.674$) and sex ($p=0.903$). US examinations of the Achilles tendons, plantar fascias and flexors digitorum brevis, including their calcaneal attachments, were performed. The following features of enthesitis, according to the definition of the OMERACT working group (*Outcome Measures in Rheumatology*) were evaluated: thickening / edema of the enthesis, its decreased echogenicity, delaminated tears / loss of the fibrillar structure due to microdamage, increased vascularity, presence of calcifications and scars at various stages of mineralization (including ossified enthesophytes), subchondral cysts / geodes and erosions in the bony part of the enthesis. In the current study at least one of the abnormality listed was consistent with enthesopathy. Increased vascularity on Doppler imaging was obligatory to diagnose enthesitis. Cross tables and χ^2 or χ^2 with Yates modification tests were used for statistical analysis. Owing to the comparison of several elements, levels of statistical significance were set according to the Bonferonni correction at $p<0.008$ for the Achilles tendon and adjacent tissues (6 comparisons; $0.05/6=0.008$) and $p<0.017$ for plantar aponeurosis and flexor digitorum brevis (3 comparisons; $0.05/3=0.017$). Very rare occurrence of enthesitis in the US (one case) precluded carrying out a multidimensional statistical analysis. The compliance between clinical and ultrasonographic assessment was evaluated with Cohen's Kappa coefficient at 95% confidence interval. To interpret the value of the Kappa coefficient in the range of [0-1], the scale proposed by Landis and Koch was adopted.

Results. The US appearance of the significant part of the evaluated heel entheses was intact: in the study group they amounted to 46%, and in the control group to 40% of Achilles tendon entheses ($p=0.548$), 63% and 50% ($p=0.179$) for the plantar fascia entheses and 84% and 90% ($p=0.348$) attachments of flexors digitorum brevis, respectively. Amongst 209 examined

entheses in the study group (63 of Achilles tendons, 73 of plantar fascias, 73 of flexors digitorum brevis), enthesopathy was present in 73 cases (35%). Only one case of increased vascularization in the plantar aponeurosis enthesis was detected (18-year-old women). Amongst 120 evaluated entheses (40 of Achilles tendons, 40 of plantar fascias, 40 of flexors digitorum brevis) in the control group, 48 (40%) showed pathologic changes; increased vascularity was not present in any case.

In the study group, with clinically suspected enthesitis, quite more often than in the control group, yet without statistical significance, the following pathologies were recorded:

1. Achilles tendon: erosions in the bony part of the enthesis (14% vs 10%, $p=0.523$), calcaneal bursa effusion with thickened synovium and increased vascularity (14% vs 5%, $p=0.246$), Kager's fat pad edema with increased vascularity present (13% vs 0%, $p=0.049$) and infiltration of vessels into the Achilles tendon on corresponding levels (both 10% vs 0% $p=0.114$).
2. Plantar fascia: increased vascularity of the enthesis and adjacent medial band of plantar fascia (1% vs 0%, $p=0.759$) and tendinopathy the plantar fascia, predominantly of its medial band (42% vs 30%, $p=0.192$).
3. Flexor digitorum brevis: enthesophytes (16% vs 10%, $p=0.348$).

The current study has shown that the value of clinical assessment in making the diagnosis of enthesitis is low: the compliance rate between clinical and ultrasonographic evaluations was as low as 27%, while Cohen's Kappa coefficient amounted to 0.0039 (very poor agreement).

Conclusions. The conducted research confirmed that ultrasonography is a valuable diagnostic tool in the evaluation of calcaneus pathology, including its entheses, adjacent soft tissue and to a lesser extent bony cortex.

Moreover:

1. In the group of patients with clinically suspected enthesitis most frequently observed were the following enthesopathic features: enthesophytes and erosions in the bony part of the Achilles tendon enthesis and delaminated tears and thickening of the plantar aponeurosis enthesis, whereas in the control group without SpA and enthesitis clinical suspicion: enthesophytes and delaminated tears of the Achilles tendon enthesis and, similarly to the former group, delaminated tears and thickening of the plantar aponeurosis enthesis. Enthesophytes of flexor digitorum brevis were seen at a similar frequency.
2. The conducted study did not show the capability of the US to unequivocally differentiate enthesitis from chronic enthesopathic changes. None of the investigated, published criteria were statistically seen more frequent in the study group compared to the controls. More often, yet with no statistical significance, the study group presented with erosions in the bony part of the enthesis and thickening of the plantar fascia enthesis. Considering the clinical picture, laboratory tests and excluding traumatic events, the presence of these features may be indicative of enthesitis.
3. Ultrasonographic evaluations in most cases did not confirm the clinical suspicion of enthesitis. Heel pain and enthesopathy did not coexist in many cases, even in the control group. In the study group, i.e. in patients with suspected enthesitis, active inflammation of the calcaneal bursa and Kager's fat pad with penetration to the adjacent levels of the Achilles tendon and plantar aponeurosis tendinopathy were seen more frequently than in the control group. These results indicate, despite no statistical significance that clinical suspicion should not be limited to enthesitis only, but include also other sites of potential pathology, encompassing calcaneal bursa, Kager's fat pad and adjoining to the entheses parts of the Achilles tendon and plantar aponeurosis.