# Clinical evaluation of foot disability in patients with axial spondyloarthritis

**Bilgic Adnan[1], Altan Lale[2]**

*[1]Yalova State Hospital, Department of Physical Medicine and Rehabilitation, Yalova, Turkey;*
*[2]Uludag University Medical Faculty Physical Medicine and Rehabilitation Department*
*[1]Yalova State Hospital. İsmetpasa mahallesi. İzmit Karayolu 3. km 77100 Yalova /TURKEY;*
*[2]Uludag University Medical Faculty Görükle Kampusu 16240 Nilüfer /BURSA/TURKEY*

***Objective:*** *To evaluate foot disability both ultrasonographically and by using the Foot Function Index (FFI) in patients with axial spondyloarthritis (SpA) and to investigate its effects on patients' quality of life and functional capacity by determining the factors that may affect the level of disability.*
***Patients and methods.*** *A total of 100 patients were included in the study. Enthesis sites in the feet were assessed for tenderness and swelling. Ultrasonographic examination of the Achilles tendon and plantar fascia was made and the findings were scored according to Glasgow Ultrasound Enthesitis Scoring System (GUESS). The Foot Function Index (FFI) was used to investigate the effects of foot disorders on disability and activity limitation. The correlation between GUESS and FFI scores, and relationship of GUESS and FFI scores with age, disease duration, body mass index (BMI), smoking and disease activity parameters were investigated.*
***Results and discussion.*** *Physical examination revealed signs of enthesitis in 13 (13%) patients, while ultrasonographic (USG) evaluation – in 36 (36%) patients. A statistically significant correlation was found between all FFI and GUESS scores except between FFI for the right foot and GUESS for right Achilles tendon enthesitis. A positive correlation was found between age and BMI and FFI ($p<0.05$). There was no correlation between disease duration and smoking and FFI scores. While there was a statistically significant correlation between all scores of GUESS and age, disease duration, and BMI, no correlation was found between smoking and GUESS scores. No significant difference was found in either FFI or GUESS scores between patients with or without / diabetes and patients who were smokers or non-smokers. All FFI and GUESS scores significantly correlated with BASDAI, ASDAS, BASFI, and ASQoL ($p<0.05$).*
***Conclusion.*** *Enthesitis may lead to decreased functional capacity and loss of quality of life in ax-SpA patients. Subclinical enthesitis in the feet of patients with SpA is not rare and may be detected by USG.*

***Keywords:*** *ankylosing spondylitis; axial spondylitis; enthesitis; foot disability; functional capacity; quality of life; ultrasonography; foot function index.*
***Contact:*** *Lale Altan;* ***lalealtan@uludag.edu.tr***
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Spondyloarthritis (SpA) is a group of inflammatory rheumatological diseases characterized by axial and / or peripheral joint and extra-articular organ involvement, with common genetic, radiological, and clinical manifestations [1].

Enthesis is the insertion site of a tendon, ligament, fascia or joint capsule into the bone or cartilage. They are target tissues of SpA. Since these insertion points are numerous, any part of the human skeleton may be affected by the pathological processes in the entheses. The incidence of enthesitis has been reported to be 35% in non-radiographic axial SpA (nr-ax SpA) and 29% in ankylosing spondylitis (AS) [2].

Insertions of the Achilles tendon and plantar fascia into the calcaneus are the most common points of enthesitis [3]. Enthesitis may lead to disability in daily life activities, causing pain, swelling, and impairment in foot function. Early diagnosis of enthesal involvement in patients with SpA is important for preventing loss of function. Acute edema, inflammatory involvement and micro lesions in the early period may result in endochondral ossification, and bone erosions in the chronic period – in eventual disability [3].

In recent years, ultrasonography (USG) has started to take place in the diagnosis and follow-up of patients with SpA. USG and power Doppler USG are very successful tools in showing early signs of soft tissue inflammation [4]. Particularly in uncertain cases, it allows to recognize inflammation and structural changes in joints and tendons before clinical symptoms become obvious [5]. As a result of the loss of normal fibrillar echogenicity in the affected enthesis, hypoechogenic thickening, bone erosion, edema, and new bone formation in insertion sites are important findings in USG, and these may be accompanied by vascular changes detected by Doppler [6]. It has been shown that especially evaluation of the lower extremity entheses with USG was more sensitive and more specific than the clinical examination [6]. The most important advantages of musculoskeletal USG are that it is inexpensive, easily accessible and free of radiation. USG can easily demonstrate entheses and its sensitivity in showing superficial soft tissues and bone surfaces is similar to MRI [6].

The Foot Function Index (FFI), which is a self-report foot-specific questionnaire, measures pain and disability in the feet and has been widely used to measure foot health for more than twenty years [7]. In recent years there has been an increase in published studies investigating foot disability in patients with AS, but few of them have used the FFI [8–10].

**The aim** of this study is to evaluate the foot disability both ultrasonographically and by using FFI in patients with axial SpA (ax-SpA) and to investigate its effects on patients' quality of life and functional capacity by determining the factors that may affect the level of disability.

**Patients and methods.** A total of 100 patients (74 men, 26 women; mean age 43.69±10.99), who were followed in our Rheumatology Clinic with the diagnosis of ax-SpA according to the ASAS criteria (14), were included in the study. Inclusion cri-

teria were: age18–70 years old and no history of joint surgery in the ankles. Exclusion criteria were: having an inflammatory rheumatologic disease (such as rheumatoid arthritis, gout etc.) other than SpA, foot trauma in the last 3 months, and intraarticular injection in the ankles in the last 3 months. The purpose of the study was explained to all patients and the informed consents form was filled out by the patients. The local ethics committee approval was obtained.

Demographic data, body mass index (BMI), disease duration, smoking and any systemic disease such as diabetes (DM) were recorded.

Enthesis sites were assessed and recorded for tenderness and swelling. Then ultrasonographic examination with an ultrasound instrument (11-MHz linear transducer, GE Healthcare, Logic P5, Japan) of the Achilles tendon and plantar fascia was made bilaterally.

### *Evaluation parameters*

*1. Foot Function Index (FFI)*

FFI was used to investigate the effects of foot disorders on disability and activity limitation [7]. FFI consists of 23 items divided into 3 sub-scales (9 for foot pain, 9 for difficulty, and 5 for incapacity). Participants are asked to score all items with a visual analog scale (VAS) scaled from 0 to10, taking into account their status in the past week. Total score is between 0–100. Higher scores indicate more severe foot disability. Validated native version of this index was used [11]. Pain, difficulty, incapacity scores and total scores were calculated and recorded for each foot.

*2. Glasgow Ultrasound Enthesitis Scoring System (GUESS)*

GUESS is one of the most frequently used scoring systems. It evaluates the quadriceps tendon, patellar tendon, Achilles tendon and plantar aponeurosis. In this system, only morphological evaluation is made on the gray scale, and power Doppler is not used [12].

USG was performed with the patient in the prone position and the ankle in the neutral position. Focal changes (hypo echogenicity), tendon calcifications, bone erosions, enthesophytes, bursitis, and Achilles tendon and plantar fascia thicknesses were evaluated with USG. Achilles tendon and plantar fascia thicknesses were measured from the insertion into the calcaneus. The presence of the parameters in Table 1 was recorded as 1, and the absence as 0 points. Knee enthesitis scores are not included in the total score. The total score was between 0 and 7.

**Table 1: Foot parameters of GUESS**

| |
|---|
| Superior pole of the calcaneus – Achilles tendon enthesis<br>• Achilles tendon thickness ⩾5.29 mm<br>• Retrocalcaneal bursitis<br>• Posterior pole of calcaneus erosion<br>• Posterior pole of calcaneus enthesophyte |
| Inferior pole of the calcaneus – plantar aponeurosis enthesis<br>• Plantar aponeurosis thickness ⩾4.4 mm<br>• Inferior pole of calcaneus erosion<br>• Inferior pole of calcaneus enthesophyte |
| Each item scores one point. Total possible score on both feet is 7 |

*3. Bath Ankylosing Spondylitis Disease Activity Index (BASDAI)*

BASDAI was used to evaluate disease activity [13]. BASDAI is an index consisting of six items questioning patient's fatigue (Q1), severity of neck, back and hip pain (Q2), severity of peripheral joint pain (Q3), tenderness on pressure and palpation (Q4), and severity of morning stiffness (Q5 and Q6). Total score ranges between 0–10. The native language version of this index has been shown to be valid and reliable [13].

*4. Ankylosing Spondylitis Disease Activity Score (ASDAS)*

ASDAS was used to assess disease activity besides BASDAI. ASDAS is a composite index to assess disease activity in Ankylosing Spondylitis [14]. The score includes patient-reported assessments of pain, morning stiffness duration, peripheral joint pain and/or swelling, global well-being, and a serologic marker of inflammation (erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP)). ASDAS CRP was used in our study. The score was calculated with the formula below.

ASDAS = 0.12 x low back pain + 0.06 x morning stiffness duration + 0.11 x patient global assessment + 0.07 x peripheral joint pain and/or swelling + 0.58 x Ln (CRP mg/L + 1)

*5. Bath Ankylosing Spondylitis Functional Index (BASFI)*

BASFI was used to assess physical functioning [15]. The index contains 10 items concerning activities referring to the functional anatomy of the patients and the patients' ability to cope with daily life. Total score is between 0–10. Higher scores indicate the worst functional capacity. Native version of BASFI has been shown to be valid and reliable [15].

*6. Ankylosing Spondylitis Quality of Life Scale (ASQoL)*

The native version of ASQoL, the validity and reliability of which has previously been shown, was used to evaluate the quality of life of patients [16]. The questionnaire contains 18 items assessing the effect of the disease on sleep, mood, motivation, coping, daily life activities, independence, relationships and social life. The patient is asked to answer each question in the form of yes and no, 0 scored for "no" and 1 scored for a "yes" for each item. Total score is between 0 and 18. Higher scores reflect greater impairment of quality of life.

### *Statistical analysis*

The data analysis was performed with IBM SPSS 22.0 statistics software package. The normality of the parameters was tested by Shapiro–Wilk test. Descriptive statistics were expressed as mean ± standard deviation or median (minimum-maximum) according to the values normally distributed or not, whereas categorical data were expressed by n (number) and percent (%).

First, the correlation between GUESS and FFI scores, then the relationship of GUESS and FFI scores with age, disease duration, BMI, smoking and disease parameters (BASDAI, ASDAS, BASFI, ASQoL) were investigated. Lastly, GUESS and FFI scores were compared between the groups, smoker/non-smoker and with or without DM.

When the data were normally distributed, an independent samples t-test was used for between-group comparisons, and when the data were distributed abnormally, a Mann–Whitney U test was used for the comparison of two independent groups. The relationship between clinical and US findings was analyzed by Spearman correlation coefficient. P value <0.05 was accepted as statistically significant.

**Results.** Demographic data, disease duration, and evaluation parameters of the patients are summarized in Table 2.

Physical examination revealed signs of enthesitis in 13 patients (right Achilles tendinitis in 4 patients, left Achilles tendinitis in 6 patients, right plantar fasciitis in 7 patients, and left

**Table 2: Demographic data, disease duration and evaluation parameters of patients**

| | |
|---|---|
| Age (years) | 43.69±10.99 |
| Disease duration (years) | 15 (2–55) |
| BMI (kg/cm$^2$) | 26.9 (19.6–45.8) |
| ASQoL | 4 (0–18) |
| BASDAI | 2.45 (0–9.8) |
| ASDAS | 1.85 (0.8–4.4) |
| BASFI | 1.6 (0–7.8) |
| Smoking (packet/years) | 6.5 (0–100) |
| DM (present/absent) | 13/87 |
| Smoking (present/absent) | 42/58 |

plantar fasciitis in 5 patients). According to USG evaluation, 36 patients (36%) had evidence of enthesitis. GUESS and FFI scores of the patients are summarized in Table 3.

When the relationship between FFI and GUESS scores of the patients was investigated, a positive correlation was found between all FFI and GUESS scores except FFI for the right foot and GUESS for right Achilles tendon enthesitis scores. The scores of both indexes are summarized as a total and separately in Table 4.

The relationship of FFI and GUESS scores with disease duration, age, smoking, and presence of DM are shown in Table 5. A positive correlation was found between age and BMI and FFI scores for both feet and bilateral total FFI scores ($p<0.05$). There was no correlation between the duration of the disease and smoking (evaluated as the number of cigarette packs / year) and FFI scores ($p>0.05$). While there was a correlation between all scores of GUESS and age, disease duration, and BMI ($p<0.05$), no correlation was found between smoking and GUESS scores ($p>0.05$). No significant difference was found in either FFI or GUESS scores between patients with or without / diabetes and patients who were smokers or non-smokers ($p>0.05$). All FFI and

**Table 3: GUESS and FFI scores of the patients**

| | |
|---|---|
| GUESS Right | 0 (0–5) |
| GUESS Left | 0 (0–5) |
| GUESS bilaterally | 0 (0–9) |
| FFI-A Right | 0.43 (0–31.42) |
| FFI-Y Right | 0.95 (0–36.66) |
| FFI-AK Right | 0 (0–13.33) |
| FFI-Total Right | 1.42 (0–81.41) |
| FFI-A Left | 0.215 (0–25.21) |
| FFI-Y Left | 0.945 (0–32.60) |
| FFI-AK Left | 0 (0–12.85) |
| AFİ Total Left | 1.42 (0–69.98) |
| AFİ-A bilaterally | 0.94 (0–46.18) |
| AFİ-Y bilaterally | 1.9 (0–63.33) |
| AFİ-AK bilaterally | 0 (0–25.7) |
| AFİ Total bilaterally | 3.56 (0–129.03) |

**Table 4: The relationship between FFI and GUESS scores**

| | GUES-right Achilles tendon enthesis | GUES-right plantar aponeurosis enthesis | GUES-right total | GUES-left Achilles tendon enthesis | GUES-left plantar aponeurosis enthesis | GUES-left total | GUES-total bilaterally |
|---|---|---|---|---|---|---|---|
| FFI-A right | 0.15 | 0.373* | 0.327* | – | – | – | – |
| FFI-Y right | 0.202 | 0.45* | 0.425* | – | – | – | – |
| FFI-AK right | 0.185 | 0.486* | 0.421* | – | – | – | – |
| FFI-Total right | 0.18 | 0.43* | 0.395* | – | – | – | – |
| FFI-A left | – | – | – | 0.301* | 0.343* | 0.427* | – |
| FFI-Y left | – | – | – | 0.287* | 0.423* | 0.47* | – |
| FFI-AK left | – | – | – | 0.419* | 0.427* | 0.552* | – |
| FFI-Total left | – | – | – | 0.307* | 0.397* | 0.472* | – |
| FFI-A bilaterally | – | – | 0.392* | – | – | 0.415* | 0.386* |
| FFI-Y bilaterally | – | – | 0.455* | – | – | 0.455* | 0.457* |
| FFI-AK bilaterally | – | – | 0.453* | – | – | 0.545* | 0.497* |
| FFI-Total bilaterally | – | – | 0.435* | – | – | 0.453* | 0.436* |

* $p<0.01$.

**Table 5: FFI and GUESS scores relationship with disease duration, age, smoking, presence of DM and disease parameters**

| | Age | Disease duration | Smoking | BMI | BASDAI | ASDAS | BASFI | ASQoL |
|---|---|---|---|---|---|---|---|---|
| FFI-Total right | 0.275** | 0.108 | -0.032 | 0.258** | 0.514** | 0.431** | 0.429** | 0.450** |
| FFI-Total left | 0.291** | 0.136 | 0.035 | 0.257* | 0.492** | 0.404** | 0.391** | 0.414** |
| FFI-Total bilaterally | 0.261** | 0.096 | -0.008 | 0.252* | 0.519** | 0.441** | 0.433** | 0.461** |
| GUESS-right total | 0.428** | 0.283** | 0.047 | 0.272** | 0.309** | 0.327** | 0.433** | 0.390** |
| GUESS-left total | 0.374** | 0.246* | 0.111 | 0.268** | 0.394** | 0.447** | 0.516** | 0.449** |
| GUESS -total bilaterally | 0.444** | 0.301** | 0.136 | 0.323** | 0.358** | 0.425** | 0.45** | 0.400** |

* $p<0.01$; ** $p<0.05$.

GUESS scores significantly correlated with BASDAI, ASDAS, BASFI, and ASQoL ($p<0.05$) (Table 5).

**Discussion.** Foot pain is seen in 8–70% of SpA patients and enthesitis is an important cause of this complaint [17]. However, it can often be overlooked at the beginning and during the later course of the disease and sometimes may lead to confusion with other inflammatory processes such as arthritis. The enthesis areas may be painful on palpation but they may also show no symptoms. In a study evaluating subclinical entheseal involvement using GUESS in psoriasis patients, at least one finding of enthesitis was detected in all patients who had no symptoms or signs [18].

In our study, we found involvement in at least one region in 13% of patients with clinical examination and in 36% of patients with USG. In a study which investigated the lower extremity enthesis areas in 119 SpA patients, abnormalities were detected in 22% on clinical examination while in 56% with ultrasound [19]. E. Mesci et al. [10] reported these rates as 32.5% and 75%, respectively, in their study comparing 40 AS patients and 30 healthy volunteers, while P. Borman et al. [9] reported 56% with USG. H. Sahli et al. [17] reported foot involvement as 52% in their study. Our scores are slightly lower than in these studies but variations in the number of patients and clinical manifestations may have led to this result. For example, only 19 of SpA patients assessed by P. Borman et al. [9] had ax-SpA whereas in the study by H. Sahli et al. [17] 24 of 60 patients were in the ax-SpA group. The number of ax-SpA patients in our study is significantly higher than in the above studies. However, the main characteristic of all studies, including ours, is that the rates of enthesopathies detected with USG were significantly higher than those detected with clinical examination. In SpA, enthesitis may cause structural damage and impaired function over time. For this reason, with the early diagnosis and treatment of enthesitis using inexpensive and easily accessible imaging methods such as USG, structural changes may be prevented and the quality of life of the patients can be improved.

In our study, besides detection of enthesitis with clinical examination and USG, we used FFI to evaluate the effect of these enthesopathies on foot function and showed that there was a significant correlation between FFI and GUESS scores and the findings obtained by USG. This indicates that enthesopathies detected by USG may affect foot function, even in the absence of clinical symptoms. In a recent study, T.T. Koca et al. [8] compared AS patients with healthy volunteers and found that FFI total and sub scores were higher in the AS group. They did not employ ultrasonographic evaluation. In the literature, we found a single study examining the correlation of FFI and GUESS scores. In this study, E. Mesci et al. [10] found that FFI and GUESS scores were correlated.

The relationship between disease activity and enthesitis in AS has been shown in several studies [20]. In our study, we found a positive correlation between ASDAS and BASDAI scores and FFI and GUESS scores. In our study, laboratory parameters showing disease activation such as ESR and CRP were not evaluated individually, but CRP was used to calculate ASDAS. The correlation between BASDAI and ASDAS scores and GUESS and FFI scores reveals that the increase in disease activity may be an indicator of enthesopathic changes and foot disability. In the study of E. Mesci et al. [10], there was a moderate correlation between BASDAI and GUESS scores, and a strong correlation between BASDAI and FFI scores. P. Borman et al. [9] found that GUESS and BASDAI were not correlated, but they did not investigate FFI. In a very recent study, where US evaluation was not used, FFI was found to correlate with BASDAI but not with CRP. C.S. Okur et al. [21] did not find any correlation between GUESS scores and BASDAI and ASDAS. However, in this study, the scores obtained from the knee were also included. In our study, since the primary purpose was to investigate foot disability, GUESS scores obtained from enthesitis sites around the knee joint were not included.

In our study, we found that FFI and GUESS scores correlated with BASFI, which is a scale that evaluates the functional status of patients. This scale includes questions about daily life activities related to walking. Questions about similar activities are als_ included in FFI.

In our study, we found a positive correlation between ASQoL and FFI and GUESS scores. Increased foot disability and entheseal changes affect the quality of life of SpA patients negatively. Indeed, in a study where the factors affecting the quality of life in AS were evaluated, enthesitis was found to be the most important negative factor [22]. However, in a study by W. Hamdi et al. [23] foot involvement correlated with BASDAI and BASFI, but not with the quality of life.

In our study, we found that the increase in age was related to an increase in all GUESS scores and all FFI scores other than the activity limitation. Irreversible chronic findings are expected to increase with advancing age in SpA. However, in the study of E. Mesci et al. [10], there was no correlation between age and total scores of GUESS and FFI. One of the reasons for this contradiction may be that the average age of our patients was slightly higher than that of the patients in the above study.

In our study, disease duration correlated with GUESS but not with FFI. Chronic changes in the enthesis are expected to produce ultrasonographic findings with the progress of the

disease, therefore, the lack of any effect of disease duration on FFI in our study was an unexpected result. In the literature, there are variable results in the studies investigating the effect of disease duration on GUESS and FFI scores. In the study by E. Mesci et al. [10], there was no correlation between disease duration and GUESS and FFI scores. In the studies by A. Laatiris et al. [24] using Mander Enthesis Index (MEI) and Maastricht Ankylosing Spondylitis Enthesitis Score (MASES) for the evaluation of enthesitis, the severity of enthesitis was not associated with the disease duration. On the contrary, H. Sahli et al. [17] reported that foot involvement was higher in patients with shorter disease duration.

It has been reported that obesity is a risk factor for heel pain in general population. In our study, we found that an increase in BMI was associated with scores other than activity limitation of FFI and all GUESS scores. This means that an increase in weight causes pain and limitation in the feet of patients, and leads to structural changes in the enthesis areas. In a study by M. Abate et al. [25] an increase in Achilles tendon and plantar fascia thickness in early DM patients was shown to be associated with an increase in BMI. Another study by R.T. Scott et al. [26] showed that BMI was higher in people with Achilles tendinopathy. M. Gutierrez et al. [27] found correlation between BMI and GUESS, albeit at a weak level, while P. Gisondi et al. [18] did not report any such correlation at all.

In our study, we also investigated the effect of smoking and DM, which are two important factors that may cause foot enthesitis and have not been mentioned in most other SpA studies. J.O. Kim et al. [28], in a study including 625 patients with AS, showed that smoking was significantly associated with the presence of peripheral arthritis, including the joints of the foot. Smoking appears to be detrimental for foot architecture and function. It has been demonstrated in recent studies that smoking is one of the factors that cause syndesmophyte formation and, therefore, radiographic progression in SpA patients [29]. However, in our study, there was no difference in FFI and GUESS scores between the groups of smokers and non-smokers, nor was there a relationship between smoking burden and FFI and GUESS scores. This may be due to the lack of specification of the amount (packs per year) and duration of smoking.

Several studies showed that DM patients were more prone to have increased thickness of the Achilles tendon and plantar fascia, hypoechogenicity, and enthesophytes compared with healthy controls [30]. In our study, it was found that the presence of DM had no effect on FFI and GUESS scores in patients with ax-SpA. However, this may have resulted from the small number of DM patients in our study.

The focus of our study was on foot disability, thus, SpA enthesis regions in the knee region included in GUESS were not assessed during the ultrasonographic examination.

The limitations of our study are a relatively wide age range of 18–70 and not having excluded the patients with foot deformities that could cause foot pain and insufficiency.

**Conclusion.** In conclusion, subclinical enthesitis in the feet of patients with SpA is not rare and may be detected with US. Enthesitis may be an important cause of disability in patients with ax-SpA, even when it is asymptomatic. Foot involvement leads to decreased functional capacity and loss of quality of life in those patients. It should be suggested that effective treatment of these often neglected foot problems may significantly improve mobility, functional capacity, and quality of life in ax-SpA patients.

## ЛИТЕРАТУРА / REFERENCES

1. Reveille JD. Spondyloarthritis. In: Rich RR, Fleisher TA, Shearer WT, et al, editors. Clinical Immunology (Fifth Edition) Principles and Practice. Elsevier Ltd.; 2019. P. 769-87.
2. De Winter JJ, van Mens LJ, van der Heijde D, et al. Prevalence of peripheral and extra-articular disease in ankylosing spondylitis versus non-radiographic axial spondyloarthritis: a meta-analysis. *Arthritis Res Ther.* 2016 Sep 1;18(1):196. doi: 10.1186/s13075-016-1093-z.
3. Francois RJ, Braun J, Khan MA. Entheses and enthesitis: a histopathologic review and relevance to spondyloarthritides. *Curr Opin Rheumatol.* 2001 Jul;13(4):255-64. doi: 10.1097/00002281-200107000-00003.
4. Gandjbakhch F, Terslev L, Joshua F, et al. Ultrasound in the evaluation of enthesitis: status and perspectives. *Arthritis Res Ther.* 2011;13(6):R188. doi: 10.1186/ar3516. Epub 2011 Nov 17.
5. Roberts CS, King DH, Goldsmith LJ. A statistical analysis of the accuracy of sonography of the patellar tendon. *Arthroscopy*. 1999 May;15(4):388-91. doi: 10.1016/s0749-8063(99)70056-3.
6. D'Agostino MA. Enthesitis detection by ultrasound: where are we now? *Clin Exp Rheumatol.* 2018 Sep-Oct;36 Suppl 114:127-30
7. Budiman-Mak E, Conrad KJ, Roach KE (1991) The Foot Function Index: a measure of foot pain and disability. *J Clin Epidemiol* 44: 561-70. https://doi:10.1016/0895-4356(91)90220-4.
8. Koca TT, Gögebakan H, Kocyigit BF, et al. Foot functions in ankylosing spondylitis. *Clin Rheumatol.* 2019 Apr;38(4):1083-88. doi: 10.1007/s10067-018-4386-6. Epub 2018 Dec 3.
9. Borman P, Koparal S, Babaoglu S, Bodur H. Ultrasound detection of entheseal insertions in the foot of patients with spondyloarthropathy. *Clin Rheumatol.* 2006 May; 25(3):373-7. doi: 10.1007/s10067-005-0036-x. Epub 2005 Nov 1.
10. Mesci E, Mesci N, Madenci E, Bicakci İi. Foot Disability in Patients with Ankylosing Spondylitis: A Clinical and Ultrasonographic Assessment. *Journal of Clinical and Analytical Medicine*. 2015;6:864-8. doi: 10.4328/JCAM.3879
11. Anaforoglu Kü lü nkoglu B, Fxrat N, Yildiz NT, Alkan A. Reliability and validity of the Turkish version of the Foot Function Index in patients with foot disorders. *Turk J Med Sci.* 2018 Jun 14;48(3):476-83. doi: 10.3906/sag-1705-143.
12. Balint PV, Kane D, Wilson H, et al. Ultrasonography of entheseal insertion in the lower limb in spondyloarthropathies. *Ann Rheum Dis.* 2002 Oct;61(10):905-10. doi: 10.1136/ard.61.10.905.
13. Akkoc Y, Karatepe AG, Akar S, et al. A Turkish version of the Bath Ankylosing Spondylitis Disease Activity Index: reliability and validity. *Rheumatol Int.* 2005 May;25(4): 280-4. doi: 10.1007/s00296-003-0432-y. Epub 2004 Jan 17.
14. Van der Heijde D, Lie E, Kvien TK, et al. ASDAS, a highly discriminatory ASAS-endorsed disease activity score in patients with ankylosing spondylitis. *Ann Rheum Dis.* 2009 Dec;68(12):1811-8. doi: 10.1136/ard.2008.100826. Epub 2008 Dec 5.
15. Yanik B, Guü rsel YK, Kutlay S, et al. Adaptation of the Bath Ankylosing Spondylitis Functional Index to the Turkish population, its reliability and validity: Functional assessment in AS. *Clin Rheumatol.* 2005 Feb;24(1):41-7. doi: 10.1007/s10067-004-0968-6. Epub 2004 Sep 8.
16. Duruö z MT, Doward L, Turan Y, et al. Translation and validation of the Turkish version of the Ankylosing Spondylitis Quality of Life (ASQOL) questionnaire. *Rheumatol Int.* 2013 Nov;33(11):2717-22. doi: 10.1007/s00296-013-2796-y. Epub 2013 Jun 14.
17.Sahli H, Bachali A, Tekaya R, et al. Involvement of foot in patients with spondy-

loarthritis: Prevalence and clinical features. *Foot Ankle Surg.* 2019 Apr;25(2):226-230. doi: 10.1016/j.fas.2017.10.016. Epub 2017 Nov 10.
18. Gisondi P, Tinazzi I, El-Dalati G, et al. Lower limb enthesitis in patients with psoriasis without clinical signs of arthropathy: A hospital-based case-control study. *Ann Rheum Dis.* 2008 Jan;67(1):26-30. doi: 10.1136/ard.2007.075101. Epub 2007 Aug 24.
19. Balint PV, Kane D, Wilson H, et al. Ultrasonography of entheseal insertions in the lower limb in spondyloarthropathy. *Ann Rheum Dis.* 2002 Oct;61(10):905-10. doi: 10.1136/ard.61.10.905.
20. Rezvani A, Bodur H, Ataman S, et al. Correlations among enthesitis, clinical radiographic and quality of life parameters in patients with ankylosing spondylitis. *Mod Rheumatol.* 2014 Jul;24(4):651-6. doi: 10.3109/14397595.2013.850182. Epub 2013 Nov 5.
21. Okur CS, Burnaz Ö, Pekin-Dogan Y, et al. Ankilozan Spondilitte Hastalik Aktivitesi ile Alt Ekstremite Ultrasonografik Entezit Degerlendiriminin İliskisi. *Bakxrköy Txp Dergisi.* 2016;12:124-8.
22. Turan Y, Duruöz MT, Cerrahoglu L. Quality of life in patients with ankylosing spondylitis: A pilot study. *Rheumatol Int.* 2007 Aug;27(10):895-9. doi: 10.1007/s00296-007-0315-8. Epub 2007 Jan 25.
23. Hamdi W, Chelli-Bouaziz M, Ahmed MS, et al. Correlations among clinical, radiographic, and sonographic scores for enthesitis in ankylosing spondylitis. *Joint Bone Spine.* 2011 May;78(3):270-4. doi: 10.1016/j.jbspin.2010.09.010. Epub 2010 Oct 30.
24. Laatiris A, Amine B, Yacoub Y, Hajjaj-Hassouni N. Enthesitis and its relationships with disease parameters in Moroccan patients with ankylosing spondylitis. *Rheumatol Int.* 2012 Mar;32(3):723-7. doi: 10.1007/s00296-010-1658-0. Epub 2010 Dec 15.
25. Abate M, Schiavone C, Di Carlo L, Salini V. Achilles tendon and plantar fascia in recently diagnosed type II diabetes: Role of body mass index. *Clin Rheumatol.* 2012 Jul; 31(7):1109-13. doi: 10.1007/s10067-012-1955-y. Epub 2012 Feb 16.
26. Scott RT, Hyer CF, Granata A. The Correlation of Achilles Tendinopathy and Body Mass Index. *Foot Ankle Spec.* 2013 Aug;6(4):283-5. doi: 10.1177/19386400 13490019. Epub 2013 May 17.
27. Gutierrez M, Filippucci E, De Angelis R, et al. Subclinical Entheseal Involvement in Patients with Psoriasis: An Ultrasound Study. *Semin Arthritis Rheum.* 2011 Apr;40(5):407-12. doi: 10.1016/j.semarthrit.2010.05.009. Epub 2010 Aug 5.
28. Kim JO, Lee JS, Choi JY, et al. The relationship between peripheral arthritis and anticyclic citrullinated peptide antibodies in ankylosing spondylitis. *Joint Bone Spine.* 2013 Jul;80(4):399-401. doi: 10.1016/j.jbspin.2012.10.002. Epub 2012 Nov 7.
29. Poddubnyy D, Haibel H, Listing J, et al. Baseline radiographic damage, elevated acute-phase reactant levels, and cigarette smoking status predict spinal radiographic progression in early axial spondylarthritis. *Arthritis Rheum.* 2012 May;64(5):1388-98. doi: 10.1002/art.33465.
30. Ursini F, Arturi F, D'Angelo S, et al. High Prevalence of Achilles Tendon Enthesopathic Changes in Patients with Type 2 Diabetes Without Peripheral Neuropathy. *J Am Podiatr Med Assoc.* 2017 Mar;107(2):99-105. doi: 10.7547/16-059. Epub 2016 Oct 10.

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Bilgic Adnan https://orcid.org/0000-0003-0460-8577
Lale Altan https://orcid.org/0000-0002-6453-8382