Enthesitis in Psoriatic Arthritis, the Sonographic Perspective

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Abstract
Purpose of Review To provide an overview of the ultrasound (US) studies focusing on enthesitis in psoriatic arthritis (PsA).
Recent Findings Last-generation US equipment has demonstrated the ability to detect subtle morphostructural and vascular abnormalities at entheseal level. US is able to identify pathologic changes in both “classical” (i.e., the site of attachment of tendons, ligaments, and joint capsules into the bone) and “functional” entheses (i.e., anatomical regions where tendons or ligaments wrap around bony pulleys).
Summary US has the potential to be the first-line method in the assessment of enthesitis. In the present review we critically discussed the current definitions of US enthesitis, the scoring systems, and the main fields of application (i.e., the detection of enthesitis in PsA and psoriasis, the identification of different disease subsets, and the assessment of response to treatment).

Keywords Ultrasonography · Psoriatic arthritis · Seronegative spondyloarthritis · Enthesitis

Introduction

The enthesis is the site of attachment of tendons, ligaments, and joint capsules into the bone [1]. It represents a fundamental link between the soft and force-generating tissues (i.e., muscles) and the hard scaffold of the body (i.e., bones).

Histologically, the entheses are classified as fibrous or fibrocartilaginous. The former are generally located at diaphyses or metaphyses of long bones (e.g., the deltoid insertion into the humerus), while the latter are characteristic of the tendons or ligaments that attach to epiphyses or apophyses (e.g., the Achilles tendon insertion into the calcaneal bone).

Clinically, fibrocartilaginous entheses represent the characteristic target of inflammation in patients with seronegative spondyloarthritis (SpA), including psoriatic arthritis (PsA) [2].

Furthermore, anatomical regions where tendons or ligaments wrap around bony pulleys are considered “functional entheses” albeit devoid of a direct attachment into bone, being sites of relevant mechanical stress leading to fibrocartilage differentiation [3]. Similarly to the fibrocartilaginous entheses, also functional entheses are targets of SpA [4].

Of note, the broad concept of “enthesus organ” highlights the importance of considering the enthesis not just as the focal anchoring site of tendons or ligaments. In fact, several tissues (fibrocartilage, trabecular bone, fat pat and synovial tissue of adjacent bursa/joint) contribute to mechanical stress dissipation [5]. The interplay between these components, in particular between synovial tissue of the adjacent bursa/joint and the enthesis itself (i.e., the “synovio-entheseal complex”), is a crucial element in the pathogenesis of SpA [6].

The term “entheseopathy” refers to any enthesal pathology, independently from the etiology which can be either traumatic, degenerative, inflammatory, or metabolic, while the term “enthesitis” entails the presence of inflammation at the enthesis, mainly in the context of seronegative SpA [1].

Enthesitis is a cardinal feature of PsA with a prevalence of approximately 30% when assessed by clinical examination...
Ultrasound Definition of Enthesitis

Throughout the years, several US abnormalities have been described as part of the sonographic spectrum of enthesitis/enthesopathy in SpA. These include decreased echogenicity of the enthesis, enthesal thickening, enthesophytes, calcifications, bone erosions, cortical bone irregularities, perenthesal bursitis, and intra-tendinous, pre-insertional and intra-bursal power Doppler (PD) signal [28, 29].

In 2018, the following US definition of enthesitis in SpA/PsA was proposed by the Outcome Measures in Rheumatology (OMERACT) US Task Force: “hypoechoic and/or thickened insertion of the tendon close to the bone (within 2 mm from the bony cortex) which exhibits Doppler signal if active and which may show erosions and enthesophytes/calcifications as a sign of structural damage” [24] (Fig 1).

Such a definition, which was undoubtedly a step towards the standardization of entheseal US presents some issues which need to be further addressed.

First, the high prevalence of US pathologic findings at entheseal level in healthy subjects and in patients with metabolic syndrome undermines its specificity. In fact, at least one US abnormality was present in 73.4% of a cohort of 64 healthy subjects, being enthesophyte/calcification of quadriceps tendon and Achilles tendon insertions the most frequent findings [30]. Moreover, in a recent study of our group focusing on the five main lower limb entheses (i.e., the quadriceps tendon and Achilles tendon insertions) the most frequent US abnormality was present in 73.4% of a cohort of 64 healthy subjects, being enthesophyte/calcification of quadriceps tendon and Achilles tendon insertions the most frequent findings [30]. Noteworthy, the prevalence of PD signal was lower than those of entheseal thickening and hypoechogenicity, and PD grades > 1 were found in only one enthesis in a single healthy subject. In this study, our group proposed a new “cut-off” for the definition of “active” enthesis, which should include a combination of gray-scale abnormalities and PD signal (i.e., PD signal ≥ 1 + entheseal thickening and/or hypoechogenicity), as well as considering as pathological only PD grades higher than 1 [32]. Similar results were also found in a study by Bakirci et al. assessing the same set of entheses plus the insertion of triceps tendon in 80 healthy subjects [33].

Finally, in a recent study, the presence of US findings indicative of enthesitis (i.e., entheseal thickening and hypoechogenic areas at the entheseal level) were found in at least one enthesis in 38 (76%) out of 50 dysmetabolic patients [32, 34].

Second, the adoption of the 2-mm cut-off for the identification of entheseal PD signal to favor specificity may lead to the loss of precious information, since PD signal has frequently been detected outside the 2 mm area in patients with SpA [24, 25] (Fig 2). Thus, in the presence of PD signal close to the bone, also PD signal at tendon level may be considered an expression of enthesitis. Moreover, this cut-off has been developed by the OMERACT US Task Force on large entheses, mainly of the lower limb, and may not be applicable to the small entheses of the hands and feet. The entheses of the hands have been recently recognized as important targets in PsA [35–39]. An alternative option could be that the optimal cut-off varies according to the thickness of the tendon examined.
(e.g., PD signal not farther than half the enthesal thickness) (Fig. 3). Furthermore, enthesophytes may disrupt the enthesal line impairing the clear visualization of the site where to place the caliper to measure the distance from the bony edge in order to delimit the area of interest where to detect Doppler signal. We believe that the area where to detect PD should move proximally together with the bony edge (i.e., the 2-mm distance should be measured from the tip of the enthesophyte) (Fig. 1C)

**Ultrasound Scoring Systems for Enthesitis**

Over the last two decades, a number of scoring systems have been proposed for the quantification of enthesal burden of pathology at patient level in SpA and PsA and Table 1 reports a list of the most important indices.

Most of the systems included several morphostructural and Doppler abnormalities and a different set of entheses to examine. The concept of enthesal scoring systems itself implies the need for an extensive number of entheses to be scanned, and this impairs their routine adoption in most clinical settings for reasons of time. One possible solution could be a clinically driven scanning protocol, but this would lead to the loss of relevant information (i.e., subclinical enthesitis). However, during follow-up, the number of entheses to scan may be reduced to those most inflamed at baseline.

The first US scoring system specifically developed for assessing enthesitis in PsA was recently proposed by the GRAPPA US group [43]. They adopted a mixed expert and data-driven approach to define the elementary US abnormalities and enthesal sites to be included in a preliminary proposed US index. The authors tested the performance of this definition “active” enthesitis (not being within 2 mm from the bony attachment). A deep retrocalcaneal bursitis (b) and a normal tendon are shown in A. In A’, hypoechogenicity and thickening (*) can be appreciated compared to the contralateral side. c = calcaneus.
scoring system in distinguishing between 50 PsA patients and 50 age- and sex-matched healthy controls. The area under the ROC curve for the model was 0.93 if all abnormalities were scored as present/absent and 0.94 if PD signal and enthesophytes were scored on a 0–3 scale. This was the first effort to develop a US enthesitis score which included several experts from different research centers. Its main drawback might be the inclusion of the supraspinatus tendon insertion into the humerus greater tuberosity, which is a common site of pathology even in patients without PsA [44].

US assessment of the entheses has been incorporated also in composite sonographic scores, including other domains of the psoriatic disease.

The “Five Targets PD for Psoriatic Disease” score is based on PD US of joints, tendons, entheses, skin, and nails. The target with the highest expression of PD signal, one for each target area, is selected to be scanned at baseline and at follow-up assessments, providing a feasible and reliable approach for multi-target monitoring of psoriatic disease [45, 46].

Two US composite scores were developed by Ficjan et al. assessing 22 bilateral joints/entheses (PsASon22) and 13 unilateral joints/entheses (PsASon13) in patients with PsA [47]. The included entheses were the common extensor tendon origin at the lateral epicondyle of the humerus and the distal insertion of the patellar tendon into the anterior tibial tuberosity.

**The Ultrasound Detection of Enthesitis in Psoriatic Arthritis**

Clinical examination performances in the assessment of enthesitis are poor when compared with US [13]. Some of the clinical signs of inflammation such as swelling, redness, and heat are frequently lacking even in large and superficial entheses (e.g., the Achilles insertion into the calcaneal bone), being rarely helpful. The clinical detection of enthesitis basically relies on tenderness to palpation, which is included in the most popular clinical enthesitis indices [e.g., the Leeds Enthesitis Index (LEI) and the Spondyloarthritis Research Consortium of Canada (SPARCC) Enthesitis Index] [48, 49].
| Author and index name | Year | Developed in patients with | Studied entheses | Scoring system | Time needed | Discriminant validity |
|-----------------------|------|----------------------------|----------------|---------------|-------------|----------------------|
| Balint et al. GUESS [19] | 2002 | SpA | QT, proximal and distal PT, AT, and PF | GUESS score (0 to 36), each item scores 1 point QT enthesis: tendon thickness > 6.1 mm, suprapatellar bursitis, bone erosion, enthesophyte Proximal PT enthesis: tendon thickness > 4 mm, bone erosion, enthesophyte Distal PT enthesis: tendon thickness > 4 mm, infrapatellar bursitis, bone erosion, enthesophyte AT enthesis: tendon thickness > 5.29 mm, retrocalcaneal bursitis, bone erosion, enthesophyte PF enthesis: PF thickness > 4.4 mm, bone erosion, enthesophyte | 15 min | N.A. |
| D’Agostino et al. [21] | 2003 | SpA | CET, CFT, pubis, greater trochanter, QT, proximal PT, A, PF, TAT | Stage 1: Vascularization at the cortical junction without abnormal findings in gray scale Stage 2a: Vascularization associated with swelling and/or decreased echogenicity at the cortical junction in gray scale Stage 3a: Same as stage 2a, plus erosions of cortical bone and/or calcification of enthesis, and optional surrounding bursitis Stage 2b: Abnormal findings in B mode as in stage 2a, but without vascularization Stage 3b: Abnormal findings in B mode as in stage 3a, but without vascularization | 20 min | N.A. |
| De Miguel et al. MASEI [40] | 2009 | SpA | TT, QT, proximal and distal PT, AT, and PF | MASEI score (0 to 136) Calcifications, Doppler signal, and erosions are scored on a semiquantitative score of 0 to 3 Tendon structure, tendon thickness, and bursitis (deep infrapatellar and retrocalcaneal) are either 0 or 1. Tendon structure was defined as pathological if loss of fibrillar pattern, hypoechoic aspect, or fusiform thickening of the enthesis occurred. Of note, enthesophytes and ossifications were included as calcifications | 20 min | SpA vs HS. MASEI 18 points: Se 83.3%, Sp 82.2%, LR+ 4.8 [40]. PsA vs HS. MASEI 20 points: Se 30%, Sp 95%, LR+ 5.8 [41]. |
| Filippucci et al. [23] | 2009 | SpA | AT | Soft tissue inflammation (seven items): tendon hypoechoogenicity, enthesal hypoechoogenicity, bursal effusion, PD signal at tendon level, PD signal at entheseal level, PD signal at bursal level Tissue damage (five items): intratendinous calcifications, enthesal calcifications, enthesophytes, bone erosions, bone irregularities* (not used to calculate total score) Two scores were proposed: [1] a total score for soft tissue inflammation, which resulted from the sum of the scores assigned to the 7 US findings indicative of soft tissue inflammation, ranging from 0 to 7 with presence/absence data and from 0 to 14 with semiquantitative scores [2] a total score for tissue damage, which resulted from the sum of the scores assigned to the 4 US findings indicative of tissue damage, ranging from 0 to 4 with presence/absence data and from 0 to 8 with semiquantitative scores | N.A. | N.A. |
| Milutinovic et al. BUSES [42] | 2015 | SpA | | BUSES score (0 to 132). | N.A. | SpA vs patients with enthesitis symptoms without SpA. BUSES 7 |
However, in the clinical setting of entheseal pain, to distinguish “true” enthesis from central sensitization is often difficult. Of note, while a higher number of tender entheses may be found in fibromyalgia than in PsA (mean Maastricht Ankylosing Spondylitis Enthesitis Score of 4.2 vs 1.9) [50], US signs of entheseal involvement are more frequent in PsA when compared to fibromyalgia (at least one enthesis affected in 90% of PsA patients vs 75% of fibromyalgia patients) [51].

The detection of subclinical enthesis in PsA patients represents another relevant US application on top of clinical examination. Michelsen et al. performed a cross-sectional evaluation to compare clinical and US examination of Achilles enthesis in 141 patients with PsA [52]. Their results showed a lack of association between any of the US elementary findings and clinical enthesitis. Interestingly, the prevalence of subclinical US-detected inflammatory involvement in Achilles entheses without clinical enthesitis was 16%.

Moreover, in the case of unequivocal enthesitis, US can provide further information on the top of clinical examination, allowing for a quantitative assessment of the entity of the inflammation and revealing structural damage at entheseal level.

### Sonographic Enthesitis and Psoriatic Arthritis Severity

PsA is a multi-faceted disease, characterized by a considerable variability in terms of inflammation and consequent damage, ranging from oligosymptomatic involvement to a destructive arthropathy, in which the various domains of the psoriatic disease may be differently combined. Evidence is growing on the possible link between entheseal and joint pathology, in particular US entheseopathy has been correlated with a higher burden of radiographic damage at both axial and peripheral level [53–57].

A cross-sectional analysis conducted by Polacheck et al. in 223 PsA patients revealed a positive correlation between a higher value of MADrid Sonographic Enthesitis Index (MASEI) and hands and feet radiographic joint damage assessed by the modified Steinbrocker score (mSS): a 10-unit increase in MASEI value was associated with a 42% higher mSS. A higher MASEI value was also positively correlated with arthritis mutilans and with spine radiographic damage assessed by the modified Stoke Ankylosing Spondylitis Spine Score (mSASSS) [53]. Furthermore, the same group highlighted that the presence of HLA-B27 was associated with a higher value of MASEI in a cohort of 225 PsA patients [58].

The relationship between axial and entheseal domains was confirmed by Ruyssen-Witrand et al., who found an association between mSASSS and entheseal pathology detected by US at proximal and distal patellar tendon insertions, Achilles
tendon insertion, and lateral epicondyle of the humerus. Interestingly, when analyzing each different structural abnormality, the strongest association was the one between mSASSS and the presence of at least one enthesophyte. The prevalence of syndesmophytes was higher in patients with than in those without US evidence of enthesophytes (26% vs 6%) [54].

Furthermore, a very recent study by Lackner et al. reported that US baseline enthesophytes at the MASEI entheseal sites were predictive of radiographic progression at entheseal level after 12 months in a cohort of 43 PsA patients [55].

The phenotyping of PsA patients is a long-standing dilemma; however, these recent contributes are starting to delineate a potential role for entheseal US to identify PsA subsets with different disease severity and damage, at both axial and peripheral levels.

**Monitoring Response to Treatment**

As previously mentioned, enthesitis is one of the domains to be considered when treating patients with PsA [11]. In the last few years, all randomized controlled trials testing the efficacy of disease-modifying antirheumatic drugs (DMARDs) in PsA have included one or more clinical enthesitis measures as secondary outcomes [59, 60]. However, clinical examination is not sensitive neither specific for the detection of active enthesitis [13, 14].

Even if the vast majority of the published articles have focused on diagnostic or prognostic capabilities, US has also proven to be sensitive to change in SpA patients starting a bDMARD [61, 62]. Aydin et al. demonstrated the sensitivity to change of US inflammatory findings at Achilles enthesis level in 43 ankylosing spondylitis patients 2 months after the start of an anti-TNF treatment [61]. Naredo et al. conducted a prospective study on 327 patients with PsA starting anti-TNF treatment and confirmed that US findings indicative of entheseal inflammation were sensitive to change after 6 months [62].

On the other hand, only few pilot studies have assessed the US ability to detect treatment induced changes at entheseal level in a limited number of PsA patients [63, 64].

Acquacalda et al. performed a gray-scale and PD US assessment of Achilles tendon insertion, plantar fascia insertion, quadriceps tendon insertion, proximal patellar tendon insertion, and brachial triceps tendon insertion at baseline and after 6 months in a mixed cohort composed by 22 psoriasis (PsO) and 12 PsA patients starting a DMARD for a dermatologic indication. The authors found a non-significant improvement of US enthesal pathology, even if this study was underpowered by the low numerosity (only 23 patients completed the follow-up) and by the fact that none of the patients exhibited entheseal PD signal at baseline [63].

Litinsky et al. compared the effect of methotrexate (19 patients) and adalimumab (24 patients) in PsA. The scanning protocol was quite unusual, assessing only tendon thickness and including entheses (Achilles tendon and plantar fascia calcaneal insertions), tendons without synovial sheath (extensor digitorum tendons at the level of 2nd and 3rd metacarpophalangeal joints) and tendons with synovial sheath (flexor digitorum tendons at the level of 2nd and 3rd metacarpophalangeal joints). They found a trend towards a higher reduction in thickness of Achilles tendon and plantar fascia in the adalimumab group, even if the lack of PD examination represents a relevant limitation of this study [64].

Literature data are lacking on the possible differences of efficacy of bDMARDs on enthesitis using US as a reference method, as well as on the asynchrony between clinical and US and between articular and entheseal responses in PsA. It would be crucial to fill this gap of knowledge in order to better understand this multi-faceted disease and to offer a “personalized” treatment to PsA patients.

**Ultrasound Assessment of Functional Entheses**

US has proven to be capable of identifying inflammatory changes not only at “classical entheses.” In fact, several functional entheses, especially at hand level, have been recognized as PsA targets and their morphostructural and vascular abnormalities can be reliably depicted by high-frequency US [36, 37, 65–68] (Fig. 4).

In 2011, Gutierrez et al. for the first time described an extraarticular inflammation detectable by US on the dorsal aspect of the metacarpophalangeal joint in PsA patients. It was named peritenon extensor tendon inflammation (PTI) and defined as “hypoechoic swelling of the soft tissue surrounding the extensor digitorum tendon, with or without peri-tendinous PD signal” [65]. This US finding was later confirmed in further studies and has been interpreted as a functional enthesitis in light of previous anatomical studies demonstrating the presence of fibrocartilage within the extensor tendon at metacarpophalangeal joint level [2, 36, 37, 66, 69]. Interestingly, the “enthesal” hypothesis about the site of this inflammation has been recently reinforced by the fact that a correlation between the presence of PTI and a higher MASEI was found in PsA patients by Macía-Villa and colleagues [70]. Of note, this sonographic pattern, which had traditionally been considered quite characteristic of psoriatic arthritis, has been recently described also in other diseases, such as systemic lupus erythematosus (SLE), rheumatoid arthritis, and palindromic rheumatism [71–73].

Annular pulleys, located on the volar aspect of the fingers in close relationship with finger flexor tendons, are functional entheses, being subjected to repetitive microtrauma and at
least partially composed by fibrocartilaginous tissue [2, 74]. There is evidence of thickening of these structures in PsA patients [75], especially in those with previous history of dactylitis [68], compared with patients with PsO, rheumatoid arthritis, and healthy controls. Moreover, two very recent studies documented by US an inflammatory involvement of annular pulleys, defined as presence of PD signal within a thickened pulley, in PsA patients with and without dactylitis [39, 67].

Thus, a comprehensive US assessment of enthesal involvement in PsA patients should include functional entheses.

Subclinical Enthesitis in Psoriasis

PsA has a prevalence of 6–42% among patients with PsO and skin involvement precedes joint disease in approximately 85% of the cases [76, 77]. There is evidence supporting the existence of a phase prior to the diagnosis of PsA characterized by the presence of nonspecific musculoskeletal symptoms (including heel pain) in PsO patients [78]. Therefore, an US assessment in PsO patients may provide a pictorial insight into the “psoriatic disease continuum”.

US has shown a higher prevalence of subclinical enthesitis in PsO patients compared to healthy controls and patients with other skin diseases [79–83] (Table 2).

Gisondi et al. found a significantly higher Glasgow Ultrasound Enthesitis Scoring System (GUESS) score (7.9 vs 2.9) in 30 patients with PsO compared with 30 age- and sex-matched controls affected by other skin diseases [79]. Of note, this PsO cohort was followed longitudinally for an average period of 3.5 years and baseline thickness of the quadriceps tendon enthesis was found to be an independent predictor of the development of PsA [84].

Gutierrez et al. performed a cross-sectional study in 45 PsO patients and 45 age- and sex-matched healthy controls. The five lower limb entheses included in the GUESS were examined. The authors detected a higher GUESS score in PsO patients than in healthy controls as well as a higher prevalence of enthesal PD signal in PsO. However, PD signal was present in only 4 out of 450 entheses in PsO and in none of the healthy subjects [80].

The subclinical enthesal involvement in PsO was further investigated in a multicenter study conducted by Naredo et al. in 136 patients with plaque PsO and 46 age-matched controls with other skin diseases. The scanning protocol included the insertions of the following tendons: proximal patellar tendon,
distal patellar tendon, Achilles tendon, plantar fascia, and deep flexor tendons of the fingers. Quadriceps tendon insertion was not assessed. The authors found a higher prevalence of enthesopathy, defined as abnormally hypoechoic and/or thickened tendon at its bony insertion, in PsO compared to controls (62.5% vs 39.1%). Entheses PD signal was found in 10 (7.4%) PsO patients and in none of the controls (p=0.5) [81].

Recently, Zuliani et al. performed a PD US assessment in 40 PsO patients and 20 healthy controls at the five enthesal sites included in the GUESS plus the common extensor tendon insertion into the lateral epicondyle of the humerus. Active enthesis, defined as the presence of PD signal within 2 mm from bony attachment and hypoechogenicity, was found only in PsO patients, with a prevalence of 20% at the patient level [82].

The impact of disease-modifying drugs on the subclinical enthesal involvement in PsO patients is an emerging and fascinating field of research. In 2019, Savage and colleagues demonstrated that ustekinumab reduced the US inflammatory burden at enthesal level in 23 PsO patients with at least one inflammatory enthesal change according to OMERACT definitions. The authors performed an extended scanning protocol including the entheses of both upper (i.e., the flexor and extensor pollicis longus, flexor digitorum profundus, extensor digitorum, common extensor and flexor tendons, distal brachial triceps tendon) and lower (i.e., quadriceps tendon, patellar tendon proximal and distal insertions, Achilles tendon, plantar fascia and peroneus brevis tendon) limbs. The percentage of entheses with at least one inflammatory finding decreased from 24.2 to 14.0% by week 24 and to 10.4% by week 52 [85].

Even if data are still scarce, these results might be the first step towards a new strategy of PsO stratification according to subclinical involvement which may eventually lead to the identification of patients “at increased risk” for the future development of PsA [86, 87]. This may have important implications for designing clinical trials on disease prevention.

### Conclusions

In this review, we described the most relevant applications of US in the assessment of enthesitis in PsA, from early diagnosis of enthesitis to assessment of disease severity and treatment response, highlighting the potential predictive value of sub-clinical enthesal inflammation for the development of PsA in patients with PsO.

Several scoring systems and definitions for enthesitis have been proposed by important international US societies, such as GRAPPA and OMERACT. Further research is needed to clarify their impact on diagnosis (including differential diagnosis), prognosis, and therapy monitoring in patients with PsA.

### Abbreviations

- AT = Achilles tendon insertion, CET = common extensor tendon insertion into the lateral epicondyle, PD = power Doppler, PF = plantar fascia insertion, PT = patellar tendon insertion, QT = quadriceps tendon insertion, TT = triceps tendon insertion

### Table 2

Main studies assessing enthesal pathology in psoriasis (PsO) patients without psoriatic arthritis (PsA) by ultrasound (US)

| Authors                   | Year | PsO patients (n) | Control group (n) | Control group characteristics                       | Studied entheses                       | PD mode | Probe frequency |
|---------------------------|------|------------------|-------------------|-----------------------------------------------------|----------------------------------------|---------|-----------------|
| Gisondi et al. [79]       | 2008 | 30               | 30                | Patients with dermatological diseases other than psoriasis | QT, proximal and distal PT, AT, and PF | No      | 10–15 MHz       |
| Gutierrez et al. [80]     | 2011 | 45               | 45                | Healthy controls                                     | QT, proximal and distal PT, AT, and PF | Yes     | 6–18 MHz        |
| Naredo et al. [81]        | 2011 | 136              | 46                | Patients with dermatological diseases other than psoriasis | Deep finger flexor tendons, proximal and distal PT, AT, and PF | Yes     | 8–14 MHz        |
| Zuliani et al. [82]       | 2019 | 40               | 20                | Healthy controls                                     | CET, QT, proximal and distal PT, AT, and PF | Yes     | 6–18 MHz        |

### Conflict of Interest

The authors declare that there is no conflict of interest.

### Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any one of the authors.

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