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Original research

Standardized pain mapping for diagnosing Achilles tendinopathy

Tjerk S.O. Sleeswijk Visser [a,b], Eline M. van Es [a], Duncan E. Meuffels [a], Jan A.N. Verhaar [a], Robert-Jan de Vos [a,*]

[a] Department of Orthopaedic Surgery and Sports Medicine, Erasmus MC University Medical Center, the Netherlands
[b] Leiden University Medical Center, the Netherlands

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ABSTRACT

Objectives: To assess the level of agreement between patient-reported pain using a standardized pain map and the physician-determined clinical diagnosis of Achilles tendinopathy.
Design: Cross-sectional study.
Methods: Eligible patients were adults visiting a sports physician for symptoms in the Achilles tendon region. Patients completed a digital questionnaire and indicated one location on a pain map where they experienced their pain. The primary outcome measure was level of agreement (% and Kappa coefficient) between patient-reported pain on the pain map and the physician-determined clinical diagnosis (defined as localized pain associated with tendon-loading activities and pain on palpation with or without tendon thickening). The secondary outcome measure was the agreement between the location on the pain map (midportion/insertional region) with the clinical diagnosis of midportion/insertional Achilles tendinopathy.
Results: 110 patients (mean (SD) age 48 (13), 61% men) with pain in the Achilles region were included. In 102 (93%, Kappa = 0.86, CI 0.78–0.95) patients who indicated pain in the Achilles tendon region on the pain map, the clinical diagnosis of Achilles tendinopathy was made by the sports physician. 82% of the patients had the clinical diagnosis of tendinopathy in the specific region of the tendon they marked on the pain map (Kappa = 0.67, CI 0.54–0.79).
Conclusions: There is almost perfect agreement between patient-reported pain on a pain map and a physician-established clinical diagnosis of Achilles tendinopathy. There was substantial agreement between the localization of the pain that was selected by the patient and the diagnosis of insertional/midportion Achilles tendinopathy by the physician. This tool could potentially aid in adequate triage for specialized care and for researchers performing large epidemiological studies.

Practical implications

- There is an almost perfect agreement between patient-selected pain on a standardized pain map and the physician-determined diagnosis of Achilles tendinopathy. The pain map therefore has a good utility in clinical care and clinical studies.
- The standardized pain map of the Achilles tendon could potentially aid as a screening tool for potentially eligible patients in clinical studies, for triage in clinical care, as outcome measure in large epidemiological studies or for clinicians in virtual consultations.
- There is higher agreement between patient-selected pain on a standardized pain map and the physician determined diagnosis of midportion Achilles tendinopathy compared to insertional Achilles tendinopathy.

1. Introduction

Achilles tendinopathy is a tendon disorder with a substantial socio-economic impact and is characterized by persistent localized Achilles tendon pain related to mechanical loading.[1,2] It can affect both the insertional and midportion (2–7 cm proximal of the calcaneal insertion) region of the tendon.[3] Achilles tendinopathy is mainly a clinical diagnosis, with imaging being a supportive method.[4,5] The most frequently used diagnostic criteria of Achilles tendinopathy are localized Achilles tendon pain associated with tendon-loading activities, pain on Achilles tendon palpation and localized tendon thickening.[4] These three findings can be assessed reliably.[6] Experts agree that the clinical diagnosis can be established when there is localized pain associated with tendon-loading activities and pain on Achilles tendon palpation, as the presence of tendon thickening is not always necessary to make the clinical diagnosis.[4,5] While there remain challenges in the diagnosing of Achilles tendinopathy, there is agreement among experts about the above-mentioned criteria.[4,5,7]

* Corresponding author.
E-mail address: r.devos@erasmusmc.nl (R.-J. de Vos).

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The location of pain is a key diagnostic criterion and it is important to distinguish between the insertional and midportion region of the Achilles tendon. This location affects prognosis and initial treatment.[6,8] Because the clinical sign of subjective self-reported pain is one of the criteria for establishing the diagnosis it is important to know if patients with pain in the Achilles region can adequately localize their pain.[5]

Pain mapping is a tool for patients to indicate the location where they experience most of their pain and could assist in the diagnosis of musculoskeletal conditions.[9–12] Researchers previously suggested a self-administered pain map to be a useful and effective way to diagnose patients with patellar tendinopathy in a large group of subjects.[13] Knowing the reliability of using a self-administered standardized pain map for diagnosing Achilles tendinopathy could help clinicians with adequate triage. Additionally, in the near future it could be very helpful using digital support in first line care for the effective implementation of targeted treatment advices and in large epidemiological studies. The level of agreement between patient-reported pain using a pain map and the physician-determined clinical diagnosis of Achilles tendinopathy is currently unknown.

The primary objective of this study was to assess the level of agreement between patient-reported pain on a standardized pain map with the physician-determined clinical diagnosis of Achilles tendinopathy (defined as localized pain associated with tendon-loading activities and pain on palpation with or without tendon thickening). The secondary objective was to assess the level of agreement between the patient-reported location (midportion or insertional region) of the pain, marked on the standardized pain map with the physician-determined clinical diagnosis of midportion or insertional Achilles tendinopathy.

2. Methods

This cross-sectional study was designed at the Department of Orthopaedic Surgery and Sports Medicine, Erasmus MC University Medical Center (Rotterdam, the Netherlands). The study received exemption for comprehensive application from the Medical Ethical Committee (MEC-2021-0033) of the Erasmus MC University Medical Center Rotterdam, the Netherlands. All patients provided digital informed consent for this study. We adhered to the STROBE guideline for reporting of cross-sectional studies and to the minimum reporting standards for tendinopathy studies according to the international consensus (ICON) statement.[14,15]

Adult patients were eligible when they were referred to the Orthopaedic Surgery and Sports medicine outpatient department of the Erasmus MC University Medical Center with symptoms in the region of the Achilles tendon. General practitioners or medical specialists referred these patients using a referral letter, where the region of the pain was stated. The inclusion period was between September 2018 and September 2020. Patients were included if they provided informed consent and if they completed the digital (baseline) questionnaire before their appointment. Patients were excluded if: (1) they did not record the location of their symptoms on the pain map, (2) the pain was not located in the Achilles tendon region or (3) the symptoms changed in the interval between completion of the digital questionnaire and the consultation with the sports physician.

Patients were consecutively enrolled and asked to complete a digital questionnaire before their outpatient appointment. This questionnaire was send to patients using a software package (GEneric Medical Survey Tracker, GemsTracker) for secure distribution of questionnaires during clinical research. The baseline questionnaire consisted of questions on demographics, lifestyle, work, sports activity and injury characteristics. Based on this information, the Ankle Activity Score (0–10 points) was also established.[16] The baseline questionnaire also inquired the region where patients experienced most of their symptoms and patients were asked to indicate this on a standardized digital pain map. If patients had bilateral symptoms they were asked to mark the region of the tendon of the side where they experienced most pain. Fig. 1 shows the pain map. Patients could choose one of three options (inferior side of the heel, posterior side of the heel in the insertional region of the Achilles tendon or the midportion region of the Achilles tendon). There was also one option stating 'none of these regions'. Patients were also asked about the severity of pain during activities of daily living and sports activities (when applicable). Severity of pain was assessed using a Visual Analogue Scale (VAS, 0–10). The validated Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire was also completed. This questionnaire evaluates pain score and activity level and ranges from 0 to 100 (with lower scores corresponding with more pain and decreased activity).[17]

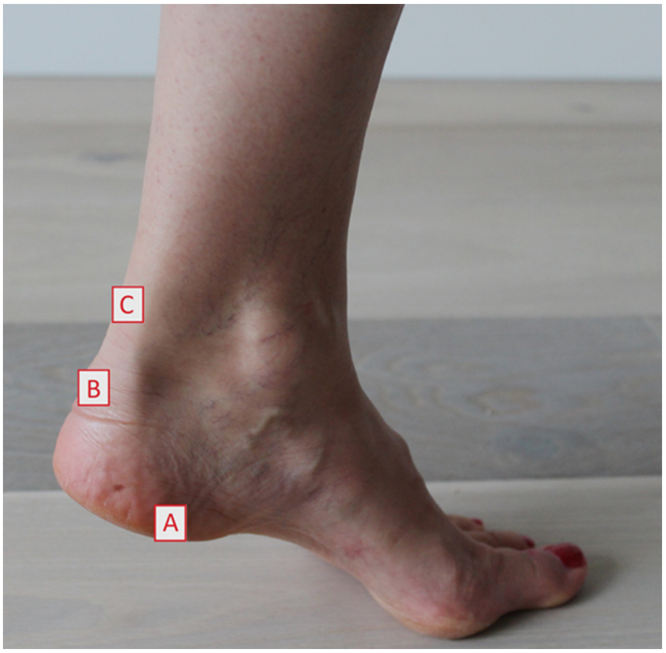

Fig. 1. The standardized pain map included in the baseline questionnaire. The standardized pain map in the way it was provided to the patients. Descriptions in laymen terms in the way it was provided to the patients. A = bottom of the heel (attachment plantar tendon to the heel bone), B = back of the heel (attachment of the Achilles tendon to the heel bone), C = middle part of the Achilles tendon (2–7 cm above the attachment of the Achilles tendon to the heel bone). Patients indicating their symptoms to entail region A were excluded from the analysis as the pain was not located to the Achilles tendon region.

All patients then had a complete history-taking and clinical examination by a single senior sports medicine physician (Details omitted for review). The outpatient appointment was scheduled between one and maximal 7 days after the completion of the digital questionnaire. A study flow chart is presented in Fig. 2. History-taking included whether patient's symptoms were associated with (sports) activities. Physical examination included assessing tendon thickening and pain on tendon palpation. Palpation of the tendon was performed by gently squeezing the Achilles tendon between the index finger and thumb, hereby palpating the entire length of the tendon from the musculotendinous junction to the distal calcaneal insertion. Patients were asked whether they experienced recognizable pain on palpation.[18] The location (midportion/insertion) of recognizable pain was recorded by the clinician. Presence of tendon thickening was assessed by the clinician on palpation.[6] Based on patient history and physical examination, a clinical diagnosis was made.

The clinical diagnosis of Achilles tendinopathy was established by the clinician if pain in association with Achilles tendon-loading activities and localized pain on Achilles tendon palpation were present. This could be with or without Achilles tendon thickening.

Data of history-taking and findings on physical examination, including the location of the diagnosis (insertional or midportion Achilles tendinopathy), were documented by the sports medicine physician using a standardized electronic format, to ensure consistency in data

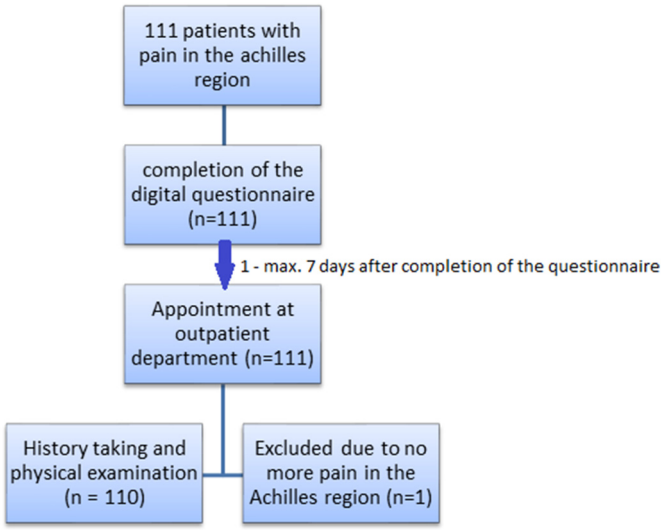

Fig. 2. Study flow chart.

collection. All data were collected prospectively and analyzed after extraction from electronic medical records. From all patients the presence or absence of the diagnostic criteria were recorded.

Primary outcome was the agreement between presence of patient-reported pain in the Achilles region on the standardized pain map and the physician-determined clinical diagnosis of Achilles tendinopathy.

The secondary outcome measure was the level of agreement between the marked patient-reported location of the pain (midportion region or insertional region of the Achilles tendon) on the standardized pain map with the physician-determined clinical diagnosis of midportion or insertional Achilles tendinopathy.

We assessed data for having a normal distribution using the Shapiro Wilk test. Normally distributed data are presented as mean with standard deviation (SD) and non-normally distributed data as median with interquartile range (IQR). We evaluated the utility of the pain map by determining the level (%) of agreement between the presence of patient-reported pain on the pain map and the physician-determined diagnosis. The level of agreement between the patient-reported pain map results and the physician-determined diagnosis was also calculated using the Cohen's Kappa coefficient and 95% confidence intervals (CI). We calculated both percent agreement and kappa based on recommendations in existing literature.[19] We interpreted a Kappa coefficient of 0–0.20 as slight, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial and 0.81–1.0 as almost perfect agreement.[20] The same procedure was done for the location of the pain and the location of the diagnosis. We used SPSS software (V.24.0.0.1; SPSS, USA) for statistical analysis.

3. Results

111 patients were referred to the outpatient department of the Erasmus MC because of symptoms in the region of the Achilles tendon. All referred patients received a digital questionnaire and completed the questionnaire before their appointment. One patient was excluded due to the fact that there was no pain in the Achilles tendon region anymore at the time of the appointment with the sports physician. The mean (SD) age in our study population was 48 (13) years with the majority (61%) being male. The mean (SD) Body Mass Index (BMI) was 26.2 kg/m^2 (4.5). The majority of the patients (76%) practiced one or more sports. Unilateral symptoms were reported in 65% of the patients. 38 of the 39 patients with bilateral symptoms had symptoms in the same region (midportion/insertional) of the tendon on both sides. Consequently, the same clinical diagnosis was made for both Achilles tendons in 38 of these 39 patients (97%). The patient characteristics are displayed in Table 1.

The main clinical diagnostic criteria were present in the majority of the patients. The presence of pain associated with tendon-loading activities (100%) and recognizable pain on tendon palpation (95%) were very frequent, while the presence of localized tendon thickening had a lower frequency (70%).

In 102 (93%) of the patients who indicated pain in the Achilles tendon region on the standardized pain map, the clinical diagnosis of Achilles tendinopathy was made (Kappa = 0.86, 95% CI 0.78–0.95) .

In 6 (5%) patients another diagnosis was established, as there were none or 1 criteria present for the clinical diagnosis of Achilles tendinopathy (4 patients) or there were 2 criteria for Achilles tendinopathy but the clinical picture was more consistent with another diagnosis (2 patients). The list of these other diagnoses is provided in Table 2.

Two patients (2%) did not fulfil the predefined criteria for the clinical diagnosis of Achilles tendinopathy. One only had localized activity-related pain and the other one had localized activity-related pain and Achilles tendon thickening. These patients were not diagnosed with Achilles tendinopathy.

2 patients were clinically diagnosed with combined midportion and insertional Achilles tendinopathy and could therefore not be included in the analysis of the location specific (midportion/insertional) part. A total of 82% (89/108) of the patients had the clinical diagnosis of Achilles tendinopathy in the specific region of the tendon they marked on the pain map (Kappa = 0.67, CI 0.54–0.79).

Table 1
Descriptive characteristics of the included patients.

Characteristics (n = 110)	Mean (SD), median[IQR]
Personal characteristics	
Age (years)	48.1 (13.3)
Sex (Male/Female; n)	67/43
BMI (kg/m^2)	26.2 (4.5)
Injury-related factors	
Symptom duration (weeks)	20 [8–52]
VISA-A score (0−100)	44.1 (19.4)
Pain location (unilateral/bilateral); n	71/39
Marked pain location on pain map (insertional/midportion); n	52/58
Prior history of Achilles tendinopathy; yes (%)	8 (7.2%)
Prior history tendinopathy on other locations; yes (%)	50 (46%)
Pain during ADL (VAS 0–10)	4.8 (2.3)
Sports-related factors	
Participation in sports activities before injury; yes (%)	83 (76%)
Adaptation of sports activities due to the injury (none/reduced/stopped; n)	19/24/67
Pain during sports (VAS 0–10)	5.6 (3.0)
Ankle Activity Score; mean (SD)	5.1 (2.4)
Lifestyle-related factors	
Smoking (never/stopped/yes; n)	66/38/6
Alcohol use (units/week)	4.9 (4.3)
Current medication use; yes (%)	45 (41%)
Presence of comorbidities[a]; n(%)	46 (42%)
Work-related factors	
Type of work (active/sedentary/not applicable); n	42/60/8
Limitations in work; yes (%)	54 (49.1%)
Absenteeism from work; yes (%)	27 (24.5%)
Clinical findings	
Presence of tendon thickening; n (%)	77 (70%)
Presence of pain in association with Achilles tendon-loading activities; n (%)	110 (100%)
Presence of pain on tendon palpation; n (%)	104 (95%)

Abbreviations: SD: standard deviation, BMI: Body Mass Index, ADL: Activities of daily living, VISA-A: Victorian Institute of Sport Assessment Achilles.[17].

[a] Specific registered comorbidities in the digital questionnaire were: Diabetes, Hypertension, Hypercholesterolemia, Cardiac and blood vessel disease, Ankylosing spondylitis, Psoriasis, Uveitis, Thyroid disease and Inflammatory bowel disease.

Table 2
List of other diagnoses.

	Number of patients
None or only 1 criteria present for the clinical diagnosis of Achilles	
Soleus muscle strain	2
Posterior ankle impingement	1
2 criteria for Achilles tendinopathy but the clinical picture was more consistent with another diagnosis	
Retrocalcaneal bursitis without Achilles tendon pathology	1
Achilles midportion paratendinopathy	1
Neglected full-thickness Achilles tendon rupture	1

In 36 of the 50 (72%) patients who indicated their symptoms in the insertional Achilles tendon region (marked this region on the pain map) the clinical diagnosis of insertional Achilles tendinopathy was made by the physician.

Out of the 58 patients who marked the midportion region on the pain map as the origin of their symptoms, 53 (92%) had the clinical diagnosis of midportion Achilles tendinopathy.

Patients who marked the bottom of the heel (location A on the pain map), were excluded from the analysis as they did not have symptoms located to the Achilles tendon region. Out of these 5 patients, 1 patient did have insertional Achilles tendinopathy. Six patients chose the option 'none of the displayed regions'. Two of these patients were diagnosed with insertional Achilles tendinopathy. One patient was diagnosed with posterior ankle impingement syndrome. The 3 remaining patients had a combination of diagnoses (insertional Achilles tendinopathy + retrocalcaneal bursitis and in two cases insertional Achilles tendinopathy + plantar fasciopathy).

4. Discussion

This is the first study to explore the utility of a patient-administered standardized pain map for the diagnosis of Achilles tendinopathy. This study showed that in 9 out of 10 patients who reported pain in the Achilles tendon region on a pain map the clinical diagnosis of Achilles tendinopathy was made. The Kappa coefficient of 0.86 was considered to be almost perfect. There was also substantial agreement (82%, kappa = 0.67) between the location of most pain on the pain map and the location of symptoms that was established by the sports physician. This level of agreement was higher in patients who marked the midportion region compared to patients who marked the insertional region (92% vs. 72%). Overall, approximately 4 out of 5 patients selected the same region as the sports physician. These findings show that a patient-administered standardized pain map could aid clinicians and researchers in estimating the likelihood of the diagnosis Achilles tendinopathy. This is important information for the development of future self-management programs in first line healthcare and for accurate diagnosis in large epidemiological studies. The pain map could also be used as a screening tool for potentially eligible patients in clinical studies or for triage in clinical care.

Self-reported injury locations are frequently used as an outcome measure in epidemiological studies.[21–24] These locations are often interpreted as self-reported diagnoses, but for many injuries the agreement between pain location and a specific diagnosis is unknown. Several studies on Achilles tendinopathy did not use a pain map when assessing the location of the pain.[21,23,24] Other studies did use a pain map, but without knowledge of the agreement between this outcome measure and the diagnosis. It is therefore important that the level of agreement between self-reported outcome measures, such as a pain map, and specific diagnoses are known.

We compared the use of pain mapping in the current study with previous studies on this subject. A previous study used a self-administered pain map to classify participants with patellar tendinopathy.[13] 45 participants who were diagnosed with patellar tendinopathy with this method were asked to take part in a randomized control trial. In order to confirm eligibility to participate in this trial, participants were assessed by a senior sports medicine physician who confirmed the diagnosis of patellar tendinopathy in 44 of the 45 (97%) participants. This suggests the level of agreement between patient reported pain and the diagnosis of patellar tendinopathy to be similar compared to Achilles tendinopathy (97% vs 93%). In a recent randomized controlled trial, the same method was used for screening purposes.[25] While the pain map suggested the diagnosis of patellar tendinopathy in 101 subjects, this could only be confirmed in 76 subjects (75%) using clinical examination and ultrasound as confirmation.

Patients with knee osteoarthritis were able to adequately identify different pain locations on a pain map, with good test-retest reliability.[26] Trained researchers could reliably record these locations, but the reported pain locations varied widely.[26] This heterogeneity of pain locations made it impossible to assess the level of agreement between pain map location and final diagnosis in patients with knee osteoarthritis.[26,27] Children aged 10–17 years with an orthopaedic condition of the lower leg had a high level of agreement between the identified pain location on a pain map and the physician-determined location of the pain.[28] This level of agreement was similar compared to the current study (76% respectively vs. 82%). The diagnostic site was confirmed by an orthopaedic surgeon, but because this study only focused on the pain location and diagnostic site and not on the exact diagnosis, a valid comparison between the two studies cannot be made.

The strengths of this study are the relatively large sample size and the inclusion of a homogenous group of patients with pain in the Achilles region. Data was collected prospectively and complete for our primary and secondary outcome measures and was obtained in a consistent way by a single sports medicine physician. There are some limitations to this study. These include the academic setting of the study, which may have led to the study population not being representative of the general population of patients with Achilles tendinopathy symptoms. Next to this, patients who do not localize pain to the Achilles region (e.g. to the bottom of the heel) may still have Achilles tendinopathy. In the current study, this was the case in 1 out of 5 patients who reported pain in the inferior heel region. There were also patients who chose the option 'none of the displayed regions' and were diagnosed with Achilles tendinopathy, either with or without the presence of another diagnosis (e.g. plantar fasciopathy). There may even be other regions that we did not evaluate, which could be representative for the diagnosis Achilles tendinopathy. Patients were referred by a medical doctor because of pain in the Achilles tendon region, which might have caused selection bias. An additional limitation is the amount of patients with bilateral symptoms, which could have led to inaccuracy in the results if symptoms entailed different regions (midportion/insertional) on both tendons or if a different diagnosis was made on both sides. In the current study this played a minor role as a large majority of these patients (97%) had symptoms in the same region and the same diagnosis was made on both sides. Another limitation is that this study was based on the clinical findings of a single sports physician and was not confirmed by a second examiner. However, several studies demonstrated that the clinical tests used in this study are reliable.[6]

Future research could focus on further developing the self-administered standardized pain map for patients with pain in the Achilles tendon region and the optimization of agreement between the pain map and physician-determined diagnosis. The figure used in this study could be improved by marking the specific regions on the Achilles tendon. Furthermore, patients could be asked about presence of tendon thickening. This could further improve the reported agreement. Hereafter, the self-administered pain map could be used in epidemiological studies on Achilles tendinopathy and as a screening tool for clinical studies. It could also be used in virtual consultation which may become necessary in the current Covid-19 pandemic. Finally, the implementation of the pain map in primary care could be evaluated, where the pain map could be used for self-reported pain location and initial self-care.

5. Conclusion

This study demonstrates that a self-administered pain map could be useful for diagnosing Achilles tendinopathy. There was almost a perfect agreement between patient-reported pain on a standardized pain map and a physician-established clinical diagnosis of Achilles tendinopathy. There was also substantial agreement between the patient-selected location of the pain and the location-specific diagnosis (insertional or midportion Achilles tendinopathy) as determined by the physician. This self-reported outcome measure should be further developed, especially for the location-specific element of diagnosing Achilles tendinopathy (insertional versus midportion). This tool could aid healthcare providers and researchers for screening purposes and for performing large epidemiological studies.

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Declaration of interest statement

The authors declare there is no conflict of interest.

Confirmation of ethical compliance

The study received exemption for comprehensive application from the Medical Ethical Committee (MEC-2021-0033) of the Erasmus MC University Medical Centre Rotterdam, the Netherlands.

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