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Ruth L. Chimenti

Peter C. Chimenti

Mark R. Buckley

Jeff R. Houck

A. Samuel Fleminster

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Utility of Ultrasound for Imaging Osteophytes in Patients with Insertional Achilles Tendinopathy

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Ruth L. Chimenti, DPT, PhD[a,*],
Peter C. Chimenti, MD[b],
Mark R. Buckley, PhD[a],
Jeff R. Houck, PT, PhD[c],
A. Samuel Flemister, MD[b]

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Abstract

Objectives

To examine (1) the validity of ultrasound imaging to measure osteophytes and (2) the association between osteophytes and insertional Achilles tendinopathy (IAT).

Design

Case-control study.

Setting

Academic medical center.

Participants

Persons with chronic unilateral IAT (n=20; mean age, 58.7±8.3y; 10 [50%] women) and age- and sex-matched controls (n=20; mean age, 57.4±9.8y; 10 [50%] women) participated in this case-control study (N=40).

Interventions

Not applicable.

Main Outcome Measures

Symptom severity was assessed using the Foot and Ankle Ability Measure, the Victorian Institute of Sport Assessment-Achilles questionnaire, and the numerical rating scale. Length of osteophytes was measured bilaterally in both groups using ultrasound imaging, as well as on the symptomatic side of the IAT group using radiography. The intraclass correlation coefficient was used to examine the agreement between

ultrasound and radiograph measures. McNemar, Wilcoxon signed-rank, and Fisher exact tests were used to compare the frequency and length of osteophytes between sides and groups. Pearson correlation was used to examine the association between osteophyte length and symptom severity.

Results

There was good agreement (intraclass correlation coefficient, ≥.75) between ultrasound and radiograph osteophyte measures. There were no statistically significant differences (*P*>.05) in the frequency of osteophytes between sides or groups. Osteophytes were larger on the symptomatic side of the IAT group than on the asymptomatic side (*P*=.01) and on the left side of controls (*P*=.03). There was no association between osteophyte length and symptom severity.

Conclusions

Ultrasound imaging is a valid measure of osteophyte length, which is associated with IAT. Although a larger osteophyte indicates tendinopathy, it does not indicate more severe IAT symptoms.

Keywords

Achilles tendon;
Foot deformities;
Osteophyte;
Rehabilitation;
Ultrasonography

List of abbreviations

ADL, activities of daily living;
FAAM, Foot and Ankle Ability Measure;
IAT, insertional Achilles tendinopathy;
NRS, numerical rating scale;
VISA-A, Victorian Institute of Sport Assessment-Achilles questionnaire

Osteophytes at the Achilles' tendon insertion are believed to contribute to insertional Achilles tendinopathy (IAT) pain and impede healing. Insertional debridement, which removes bony deformity and abnormal tissue, is effective in reducing IAT symptoms.[1 and 2] However, other interventions that do not remove osteophytes, such as

isolated gastrocnemius recession, are also effective.[3] To better inform theory driving operative management, research is needed to examine the association of osteophytes and IAT.

The role of osteophytes in foot pain is a topic of debate. Some evidence suggests that osteophytes are a normal response to mechanical loading.[4] Yet when comparing patients with IAT with persons with radiographs for a different type of foot pain, patients with IAT are nearly 4 times more likely to have osteophytes.[5] and [6] Because radiation exposure limits testing in controls, estimating the prevalence of osteophytes in people without pain is unclear. A better matched comparison group is the asymptomatic side of persons with unilateral pain, which would account for demographic factors that may be associated with the development of osteophytes. If sonographic evaluation is as effective as radiographs in defining osteophytes, ultrasound could be used to make side-by-side comparisons of the presence and length of osteophytes in patients with IAT. It may be that the development of osteophytes is normal, but there is a certain length at which they contribute to pain.

The objectives of the present study were to examine (1) the validity of ultrasound imaging to measure osteophytes compared to radiographs and (2) the association between osteophytes and IAT. The hypothesis of the study was that osteophytes would be more common and larger on the symptomatic side than on the asymptomatic side of persons with IAT and in controls. It was also hypothesized that a larger osteophyte would be associated with greater symptom severity.

Methods

Forty individuals participated in this case-control study (table 1). Twenty individuals with chronic (defined as symptoms ≥3mo) unilateral IAT were recruited over a 10-month period. Participants were clinically diagnosed with chronic IAT by an orthopedic surgeon on the basis of tenderness at the Achilles' tendon insertion and report of symptoms aggravated by activity. Twenty age-matched controls without a history of Achilles tendinopathy were recruited from local community centers. For both groups, exclusion criteria were a history of foot or ankle surgery, pregnancy, or comorbidities that may alter tendon structure (eg, diabetes and neurological conditions). All participants were informed of the study procedures and signed a consent form approved by our institution's research subjects review board.

Table 1.

Demographic information for the IAT group and the age- and sex-matched control group

Characteristic	IAT Group	Control Group
Age (y)	58.7±8.3	57.4±9.8
No. of females/males	10/10	10/10
Weight (kg)	84.4±15.7	81.1±15.8
Height (m)	1.7±0.1	1.7±0.1
Duration of symptoms (mo)	8 (4–24)	NA
VISA-A	53.2±24.1	100±0.0

NOTE. Values are mean ± SD, n (%), or median (interquartile range).

Abbreviation: NA, not applicable.

Table options

The Foot and Ankle Ability Measure (FAAM) was used to quantify self-reported function. The FAAM has 2 subscales: (1) activities of daily living (ADL), which quantifies difficulty with functional activities and pain; and (2) sports, which quantifies difficulty with higher level activities needed for sports participation. Each subscale is separately scored from 0% to 100%, with a higher score indicating a higher level of function.[7] On average, participants reported slight difficulty with ADLs and moderate difficulty with sports (FAAM: ADL, 71.7%±17.6%; sports, 51.6%±27.1%). Symptom severity was quantified with the Victorian Institute of Sport Assessment-Achilles questionnaire (VISA-A). The VISA-A has been validated for use in persons with Achilles tendinopathy[8] and has been shown to correlate with severity of tendon abnormality in persons with IAT.[9] Participants quantified their worst pain in the past week using the numerical rating scale (NRS). Reliability and validity of the NRS have been demonstrated in various chronic pain conditions.[10, 11 and 12]A sample size of 20 individuals with IAT was needed to detect statistically significant Pearson correlations ($r \geq 0.6$).

Brightness-mode ultrasound images were acquired with the participant in the prone position and foot perpendicular to the floor on both the symptomatic and asymptomatic sides. The physical therapist who acquired the images was trained in musculoskeletal ultrasound and has experience obtaining reliable images of the foot and ankle.[9] Images were acquired using a Philips HD11 ultrasound machine with a linear array probe (L-12-3 transducer),[a] which was used at a frequency of 10 to 12MHz. Ultrasound images were stored and coded digitally by another research team member to de-identify the data before analysis by the physical therapist using Image.[b] From these images, a physical therapist, blinded to side, measured the length of osteophytes (fig 1). Standing lateral radiographs of the foot and ankle of the symptomatic side were also acquired as part of routine care. A physician measured the length of osteophytes (see fig 1).

Fig 1.

Osteophyte length in 2 participants with unilateral IAT on the asymptomatic side on the ultrasound image (A and F), symptomatic side on the ultrasound image (B and E), and symptomatic side on the radiograph (C and D).

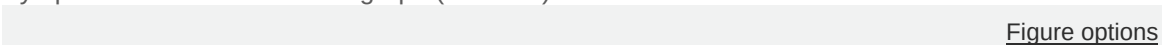

Figure options

Cohen's kappa and the Kendall τ rank correlation coefficient between ultrasound and radiograph measures were used to examine the validity of using ultrasound to measure osteophyte presence and length, respectively. McNemar and Wilcoxon signed-rank tests, respectively, indicated that there were no differences in the presence (P=1.00) or length of osteophytes (P=.11) between the left and right sides of controls. Therefore, the left side of controls was arbitrarily chosen for group comparisons. The McNemar test was used to compare the frequency of osteophytes between sides (IAT symptomatic side vs asymptomatic side), and the Fisher exact test was used to compare frequency of osteophytes between groups (IAT symptomatic side vs controls, IAT asymptomatic side vs controls). The Wilcoxon signed-rank test was used to examine differences in osteophyte length between the symptomatic and asymptomatic sides of participants with IAT. The Mann-Whitney U test was used to examine differences in osteophyte length between the control group and the IAT groups (symptomatic and asymptomatic sides). The Kendall τ rank correlation coefficient was used to examine the correlation of osteophyte length with symptom severity (FAAM, VISA-A, NRS). Statistical significance was defined as a 2-tailed P value of ≤.05.

Results

There was good agreement between ultrasound and radiograph measures of osteophyte presence (κ=.59) and length (r=.87) on the involved side of participants with IAT. There was no statistically significant difference in the frequency of osteophytes between sides or groups (IAT symptomatic vs asymptomatic: P=.73; IAT symptomatic vs controls:P=.11; IAT asymptomatic vs controls: P=.34) (table 2). Osteophyte length on the symptomatic side of participants with IAT was larger than that on the asymptomatic side (P=.01) (see table 2) and controls (P=.03). There was no statistically significant difference in osteophyte length between the asymptomatic side of the IAT group and controls (P=.25) (see table 2). There were low correlations between osteophyte length and IAT symptom severity (FAAM: ADL, r=−.15, P=.41; sports, r=−.07, P=.73; VISA-A:r=.05, P=.77; NRS: r=−.14, P=.45).

Table 2.

Frequency and size of osteophytes stratified by measurement type and side

Variable	Radiograph	Ultrasound	
IAT group (n=20)		Symptomatic	Asymptomatic
Osteophyte present (%)	11 (55)	13 (65)	11 (55)
Osteophyte length (mm)	18.0±9.0	12.9±8.9	8.0±7.0
Control group (n=20)		Left side	Right side
Osteophyte present (%)	NA	7 (35)	7 (35)
Osteophyte length (mm)	NA	3.5±2.1	3.4±1.5

NOTE. Values are mean ± SD or n (%).

Abbreviation: NA, not applicable.

Table options

Discussion

The agreement between radiograph and ultrasound measures supports the validity of using ultrasound to evaluate osteophytes at the tendon insertion. To our knowledge, this is the first study to report that the length, rather than the presence, of osteophytes is associated with foot and ankle pain. The interpretation of many clinical tests depends on the comparison of the results obtained from the symptomatic side with those from the asymptomatic side, which is considered “normal” for that individual. Given that ultrasound is becoming more readily available in the clinic and does not expose the patient to radiation, this imaging modality may be particularly useful in the longitudinal evaluation of patients with IAT (ie, development of osteophytes).

The validity of ultrasound to measure osteophyte length is supported by the agreement with radiograph measures of the presence (κ=.59) and length (r=.87) of osteophytes. In our experience it was difficult to capture the entire 3-dimensional osteophyte with ultrasound imaging. This may have contributed to a slight underestimation of osteophyte length with ultrasound (12.9±8.9mm) compared to radiographs (18.0±9.0mm). To compensate, care should be taken to rotate the transducer from the most medial aspect of the Achilles' tendon insertion to the most lateral. Despite this limitation, ultrasound is fast, safe, and relatively inexpensive. Moreover, ultrasound has the added benefit of being able to assess soft tissue changes associated with tendinopathy. [9]
Contrary to the hypothesis, the frequency of osteophytes did not differ between the symptomatic (65%) and asymptomatic (55%) sides of the IAT group or between the asymptomatic side of the IAT group (55%) and controls (35%). This indicates that the presence of osteophytes is not unique to IAT. Yet there was a trend for the symptomatic side of the IAT group to more frequently have osteophytes than controls (P=.11). Similar

to previous findings obtained using radiographs, [5] and [6] osteophytes measured with ultrasound were nearly twice as common on the symptomatic side of persons with IAT as on controls. There was a similar trend for the asymptomatic side of the IAT group to more frequently have osteophytes than controls (*P*=.34). Although not statistically significant, together these findings indicate that patients with IAT may have a slightly increased chance of having osteophytes bilaterally than do controls. This study was powered to detect a marked (proportion in the IAT group was >2 times that in controls) difference in proportions between groups; therefore, the lack of statistical significance in the present study was due to a lack of power to detect a more subtle differences in proportions. Further research including a larger sample size is needed to determine whether the prevalence of osteophytes differs between sides and groups. Nonetheless, the frequency of osteophytes in controls without a history of foot or ankle pain suggests that just the presence of osteophytes does not indicate the presence of IAT.

As hypothesized, larger osteophytes were associated with the symptomatic side of the IAT group. The osteophyte length on the symptomatic side of the IAT group was ∼1.5 and 3.5 times larger, respectively, than that on the asymptomatic side of the IAT group (*P*=.01) and controls (*P*=.03). Therefore, although the presence of osteophytes may be considered a normal response to loading, larger osteophytes likely indicate either excessive loading or an abnormal response to loading. Surprisingly, in participants with IAT, a larger osteophyte did not indicate lower functional ability or greater pain. There was wide variability in the length of osteophytes in participants with IAT, which likely contributed to the lack of a statistically significant difference in osteophyte length between the asymptomatic side of the IAT group and controls (*P*=.25). Future research should investigate whether osteophyte length on the asymptomatic side is predictive of the development of bilateral IAT symptoms. In summary, a larger osteophyte was associated with IAT but not necessarily more severe IAT symptoms.

Study limitations

The small sample is representative of patients seen in clinical practice, but is heterogeneous in terms of the duration of symptoms and severity of IAT symptoms. A larger prospective study is needed to examine whether there is a causal relation between IAT and osteophytes. Similar to clinical practice, the physical therapist was not blinded when acquiring ultrasound images. This could have resulted in a bias toward more commonly identifying larger osteophytes on the symptomatic side of participants with IAT. Yet the high correspondence between radiograph and ultrasound findings indicates that this was not a strong effect in the present study.

Conclusions

Ultrasound imaging is a valid measure of the presence and length of osteophytes. The presence of osteophytes on an ultrasound examination of the Achilles' tendon insertion does not indicate the presence of IAT. Yet the symptomatic side of patients with IAT had larger osteophytes than did the asymptomatic side of the IAT group and controls. Interestingly, there was a lack of correlation between osteophyte length and severity of IAT symptoms. Therefore, it can be expected that patients with IAT will have relatively large osteophytes, yet a large osteophyte does not necessarily indicate more severe symptoms.

Suppliers

a. Philips Electronics N.V.
b. National Institutes of Health.

References

1. K.W. Johnson, C. Zalavras, D.B. Thordarson
   Surgical management of insertional calcific Achilles tendinosis with a central tendon splitting approach
   Foot Ankle Int, 27 (2006), pp. 245–250

2. W.C. McGarvey, R.C. Palumbo, D.E. Baxter, B.D. Leibman
   Insertional Achilles tendinosis: surgical treatment through a central tendon splitting approach
   Foot Ankle Int, 23 (2002), pp. 19–25

3. V.K. Tallerico, R.M. Greenhagen, C. Lowery
   Isolated gastrocnemius recession for treatment of insertional Achilles tendinopathy: a pilot study

4. M. Benjamin, A. Rufai, J.R. Ralphs
   The mechanism of formation of bony spurs (enthesophytes) in the Achilles tendon
   Arthritis Rheum, 43 (2000), pp. 576–583

5. S. Kang, D.B. Thordarson, T.P. Charlton
   Insertional Achilles tendinitis and Haglund’s deformity
   Foot Ankle Int, 33 (2012), pp. 487–491

6. P.P. Sundararajan, T.S. Wilde
Radiographic, clinical, and magnetic resonance imaging analysis of insertional Achilles tendinopathy
J Foot Ankle Surg, 53 (2014), pp. 147–151

7. R.L. Martin, J.J. Irrgang, R.G. Burdett, S.F. Conti, J.M. Van Swearingen
Evidence of validity for the Foot and Ankle Ability Measure (FAAM)
Foot Ankle Int, 26 (2005), pp. 968–983

8. J.M. Robinson, J.L. Cook, C. Purdam, *et al.*
The VISA-A questionnaire: a valid and reliable index of the clinical severity of Achilles tendinopathy
Br J Sports Med, 35 (2001), pp. 335–341

9. R.L. Chimenti, A.S. Flemister, J. Tome, *et al.*
Altered tendon characteristics and mechanical properties associated with insertional Achilles tendinopathy
J Orthop Sports Phys Ther, 44 (2014), pp. 680–689

10. P.W. Stratford, G. Spadoni
The reliability, consistency, and clinical application of a numeric pain rating scale
Physiother Can, 53 (2001), pp. 88–91

11. M.P. Jensen, C.A. McFarland
Increasing the reliability and validity of pain intensity measurement in chronic pain patients
Pain, 55 (1993), pp. 195–203

12. J.T. Farrar, J.P. Young Jr., L. LaMoreaux, J.L. Werth, R.M. Poole
Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale
Pain, 94 (2001), pp. 149–158

Corresponding author Ruth L. Chimenti, DPT, PhD, Department of Physical Therapy and Rehabilitation Science, University of Iowa, 2116 Westlawn, Iowa City, IA 52242.