

Investigating Injuries

Achilles Tendinopathy



Introductions



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Agenda

- Introduction
- Understanding Achilles Tendinopathy
 - Clinical Presentations & Mechanism of Injury
 - Common Causes and Risk Factors
 - Anatomical Overview
- Clinical Assessment
 - ROM: Ankle Dorsiflexion
 - MMT: Gastrocnemius & Soleus
- Case Study
 - Data Review and Analysis
- Treatment & Rehabilitation Strategies
- Q&A

Achilles Tendinopathy



Achilles Tendinopathy

It refers to a combination of pathological changes affecting the Achilles tendon, usually due to overuse and excessive chronic stress upon the tendon.





Achilles Tendinopathy

Tendinopathy (Degenerative vs inflammation):

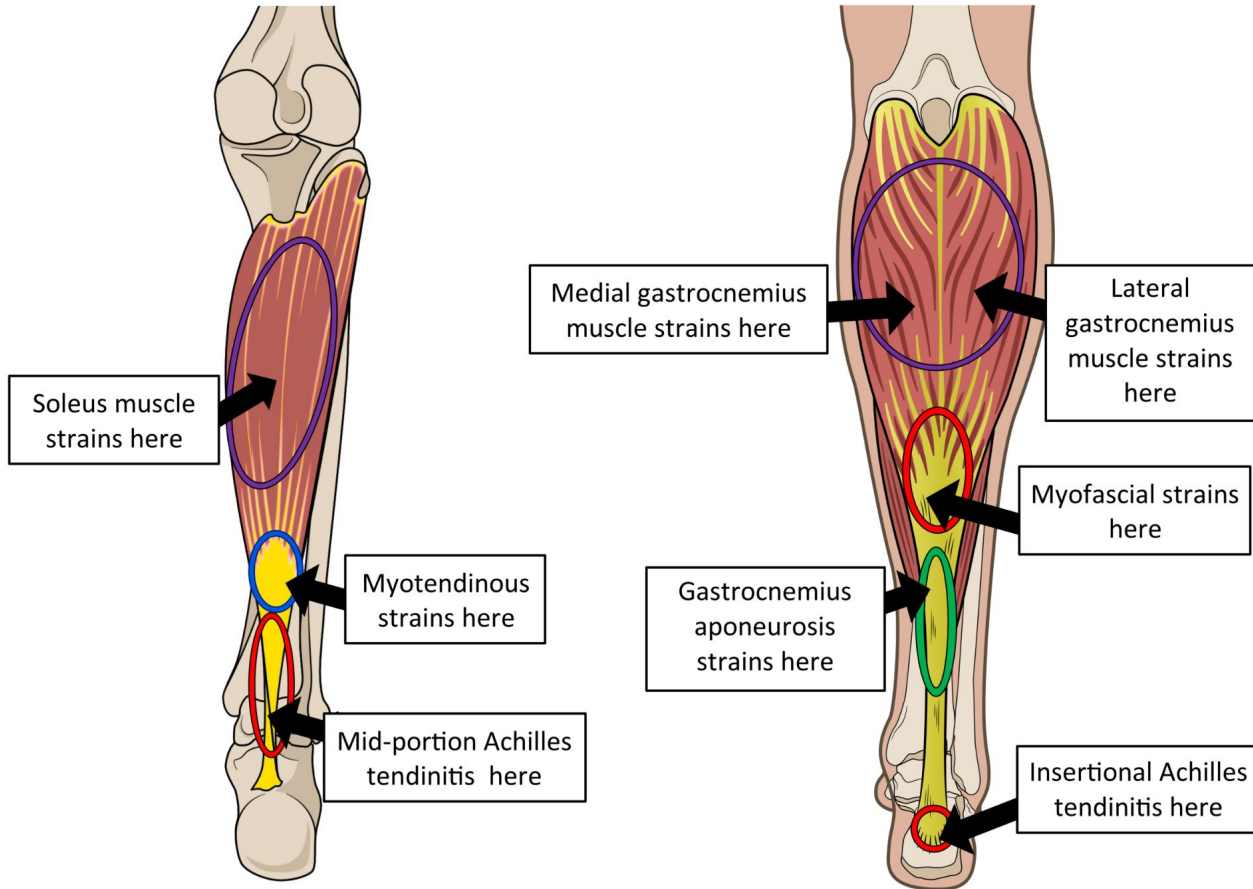
Primarily involves structural changes (collagen disorganization, neovascularization) with minimal inflammation, shifting treatment focus from anti-inflammatories towards tendon healing, remodeling, and load management.





Clinical Presentations

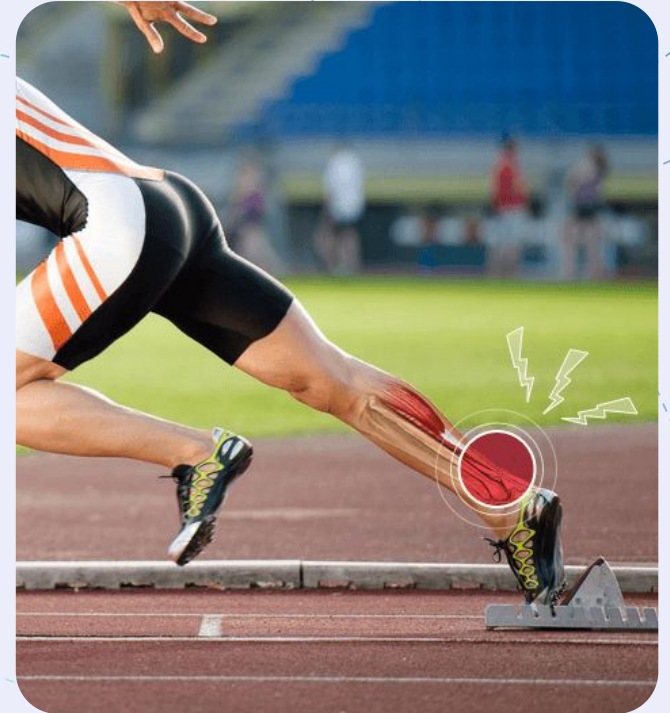
- **Distinct Anatomical Locations:** Achilles tendinopathy typically presents in two main locations, each with slightly different considerations.
 - **Mid-portion Achilles Tendinopathy:** This occurs 2-6 cm proximal to (above) the tendon's insertion point onto the calcaneus (heel bone). This is the most common type.
 - **Insertional Achilles Tendinopathy:** This affects the tendon right where it attaches to the calcaneus. It can sometimes be associated with bony changes (like Haglund's deformity or heel spurs) and retrocalcaneal bursitis (inflammation of the bursa sac between the tendon and bone). Differentiating the location is crucial as treatment, particularly certain loading exercises, may need modification.





Mechanism of Injury

- **Load Exceeding Capacity:** Occurs when mechanical stress placed on the tendon surpasses its ability to adapt and repair.
- **Repetitive Microtrauma:** Repeated loading, especially without adequate recovery, causes microscopic damage to collagen fibers.
- **Common Triggers:**
 - Sudden increases in activity intensity, duration, or frequency (e.g., starting a new running program too quickly).
 - Abrupt changes in footwear or training surfaces (e.g., switching to minimalist shoes, adding hill workouts).
 - Insufficient rest/recovery between high-load activities.





Mechanism of Injury



- **Failed Healing Response:** Continuous overload prevents proper repair, the healing process becomes disorganized, leading to the characteristic degenerative changes of tendinosis (collagen disarray, increased ground substance, neovascularization).
- **Initiating Factor:** While systemic factors influence susceptibility, mechanical overload is typically the primary initiating event that triggers the pathological process in the tendon.



Risk Factors

Beyond Mechanics: Risk isn't solely due to mechanical overload; systemic factors play a significant role.

Associated Metabolic Conditions: Increased risk linked to:

- Dyslipidemia (abnormal blood lipids, e.g., high cholesterol)
- Hypertension (high blood pressure)
- Diabetes Mellitus
- Obesity



Risk Factors

Other Contributing Factors:

- Potential genetic predispositions
- Certain medications (e.g., fluoroquinolone antibiotics)

Clinical Relevance: Underscores that overall systemic health influences tendon health and susceptibility to tendinopathy.



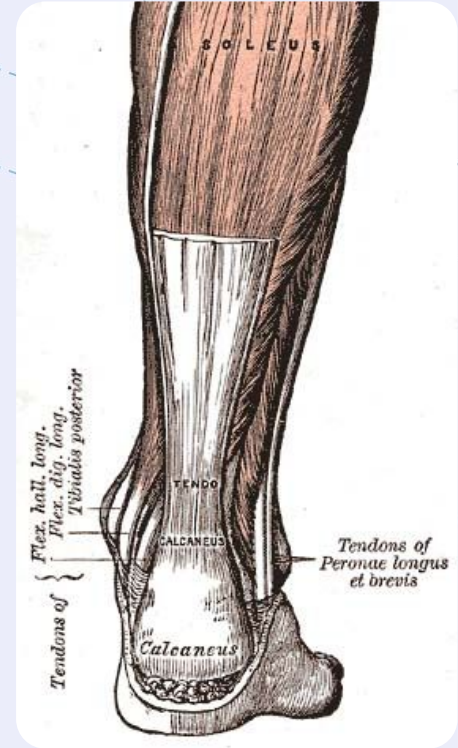
Anatomical Overview

Collagen Fiber Alterations:

- Loss of the normal parallel, tightly-packed arrangement.
- Fibers become disorganized, separated, and may show signs of degeneration.
- Changes in collagen fibril size and shape (less uniform).

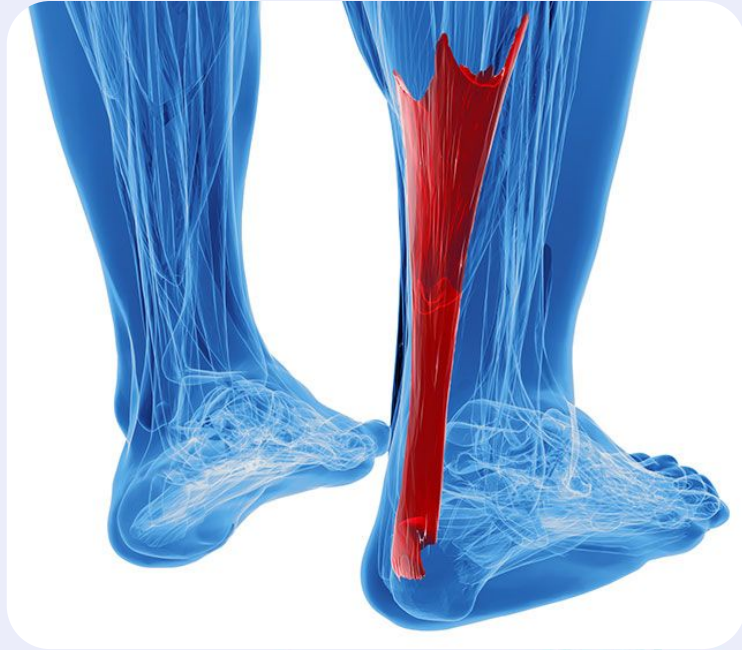
Increased Ground Substance:

- Accumulation of proteoglycans and glycosaminoglycans (GAGs) in the matrix between fibers.
- Leads to increased water content within the tendon.





Anatomical Overview



Cellular Changes:

- Hypercellularity: Increase in the number of tenocytes (tendon cells).
- Tenocytes may appear more rounded (chondroid metaplasia) rather than their usual elongated shape.

Neovascularization:

- Ingrowth of new, often abnormal, blood vessels into the tendon substance.
- These vessels may be accompanied by sensory nerve endings, potentially contributing to pain.



Anatomical Overview

Minimal Inflammation - important to consider! Not an “itis”

- Unlike acute tendinitis, chronic tendinosis typically shows a lack of significant inflammatory cells (e.g., neutrophils, macrophages).

Macroscopic Changes:

- Often results in visible or palpable tendon thickening (fusiform swelling, particularly in mid-portion).
- Loss of the distinct fibrillar pattern sometimes seen on imaging.

Clinical Assessments





Clinical Assessments



- Ankle Dorsiflexion Mobility - easily measured in standing or lunge with ActivForce
- Place ActivForce on the front of the tibia, have them lunge forward knees over toes until heel comes up. Control for knee going over 2nd MT



Muscle Testing: Gastrocnemius & Soleus





Muscle Testing: Gastrocnemius

Standing Single Leg Calf Raise (Knee Straight)

- Important to cue the following
 - Use a full range of heel drop and heel raise
 - Use a metronome to control cadence/timing of the heel drop and raise
 - Control for heel dropping medially or laterally
 - Goal is 25-30 reps for healthy athletes/individuals
 - Controlling above variables, one study showed athletes on average did 8+ less reps than when non controlled.



Muscle Testing: Soleus

Seated Calf Raise Test

- Test side to side differences, RFD, plus in runners/athletes should be able to produce 1.5x body weight for both legs
- Place AF on the distal thigh, patient sitting hips/knees 90/90
- Cue them to push on the device with a seated calf raise. This can be done handheld or strapped if you cannot overcome the patient's generated force.





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Original Research

Inter-rater reliability and validity of angle measurements using smartphone applications for weight-bearing ankle dorsiflexion range of motion measurements

Takeori Awatani^{a b}  , Taisuke Enoki^c, Ikuhiro Morikita^{b d}



Participants:

- 18 healthy volunteers (9 males, 9 females)
- Mean age: 25.3 ± 2.8 years
- No lower extremity injuries within the last 6 months

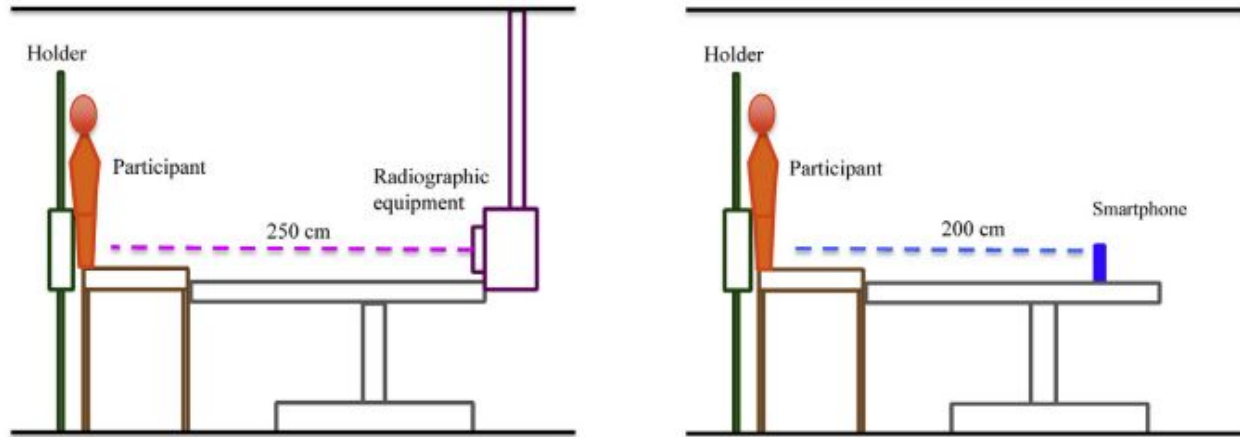


Fig. 1. Setup for the radiograph and the smartphone photograph.

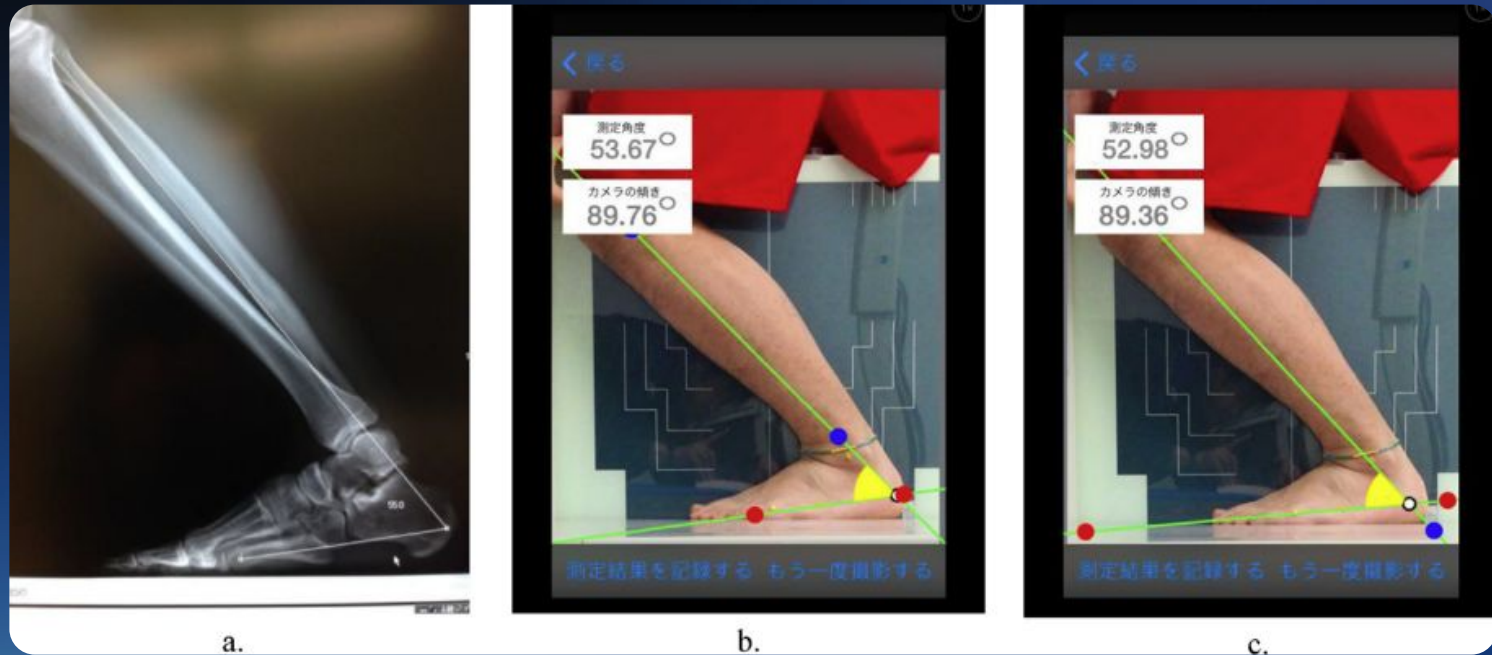


Fig. 3. Radiographic and smartphone application measurements.

a. Radiographic measurement was measured using the fibula and the fifth metatarsal bone as landmarks.

b. Angle measurements using a smartphone applications was performed using a body part as a landmark (application measurements using the markerless method [APPmarkerless]).

c. Angle measurements using an app was performed using a tape marker as a landmark (application measurements using the marker method [APPmarker]).

**Table 1**

Inter-rater reliability for ankle dorsiflexion range of motion measurements using smartphone application.

	mean (SD)	ICC _{2,1} (95%CI)	SEM (SEM%)
Radiographic measurements	29.2° (7.1)		
APP _{markerless}	30.0° (7.0)	0.945 (0.559–0.984)	1.6° (5.5%)
Examiner 1	28.6° (6.8)		
Examiner 2	29.8° (7.0)		
Examiner 3	31.6° (7.0)		
APP _{marker}	27.3° (7.5)	0.995 (0.991–0.998)	0.5° (1.9%)
Examiner 1	27.6° (7.6)		
Examiner 2	27.2° (7.5)		
Examiner 3	27.2° (7.7)		

APP_{markerless} = application measurements using the markerless method; APP_{marker} = application measurements using the marker method; SD = standard deviation; ICC = interclass correlation coefficient; 95%CI = 95% confidence interval; SEM = standard error of measurement.



Table 2
Validity and measurement errors for ankle dorsiflexion range of motion measurements using smartphone application.

Radiographic measurements vs Smartphone application measurements	Pearson's correlation mean (95%CI)	ICC2,1 Mean (95%CI)	Value of measurement error				Bland–Altman analysis			
			Difference (LOA)	Absolute difference (Rate fo absolute difference)	Absolute difference upper 95% CI (Rate of absolute difference upper 95%CI)	SEM (SEM %)	95%CI	Fixed bias	Regression	Proportional bias
Radiographic measurements vs APP_{markerless}										
vs Examiner 1	0.947 (0.976–0.994)	0.944 (0.888–0.994)	0.6° (–3.9–5.1)	1.9° (6.7%)	2.4° (8.4%)	1.6° (5.7%)	–0.2–1.5	No	p = 0.489	No
vs Examiner 2	0.944 (0.887–0.972)	0.942 (0.886–0.971)	–0.6° (–5.2–4.1)	2.1° (7.0%)	2.5° (8.5%)	1.7° (5.7%)	–1.4–0.3	No	p = 0.863	No
vs Examiner 3	0.94 (0.88–0.971)	0.892 (0.462–0.964)	–2.3° (–7.1–2.4)	2.7° (8.7%)	3.4° (11.2%)	2.3° (7.6%)	–3.2–1.5	Yes	p = 0.697	No
Radiographic measurements vs APP_{marker}										
vs Examiner 1	0.84 (0.695–0.92)	0.822 (0.65–0.912)	1.7° (–6.5–9.9)	3.5° (12.2%)	4.5° (15.8%)	3.1° (10.9%)	0.2–3.2	Yes	p = 0.53	No
vs Examiner 2	0.825 (0.669–0.912)	0.798 (0.594–0.901)	2.0° (–6.5–10.5)	3.8° (13.4%)	4.8° (17.1%)	3.3° (11.7%)	0.4–3.6	Yes	p = 0.599	No
vs Examiner 3	0.826 (0.671–0.912)	0.798 (0.591–0.901)	2.1° (–6.5–10.6)	3.8° (13.5%)	4.9° (17.2%)	3.3° (11.8%)	0.5–3.6	Yes	p = 0.49	No

APP_{markerless} = application measurements using the markerless method; APP_{marker} = application measurements using the marker method; ICC = interclass correlation coefficient; 95%CI = 95% confidence interval; LOA = 95% limits of agreement; SEM = standard error of measurement.



Conclusion:

- Smartphone apps (especially APPmarkerless) are reliable and valid for weight-bearing ankle dorsiflexion ROM measurement
- Radiographic correlation: Very high for APPmarkerless ($r > 0.9$)
- Lower measurement error supports clinical use without radiation exposure

Implications:

- Validates smartphone applications as low-cost, non-invasive alternatives
- Emphasizes importance of anatomical knowledge in reducing errors

Case Study



Mid Achilles Case: 24 Year Old Runner

- 24-year-old runner presents with right Achilles pain.
- Mid-portion Achilles tenderness noted on palpation.
- Reports increased training intensity recently.
- Limited ankle dorsiflexion mobility observed.
- Gastrocnemius and soleus strength tests conducted.



Findings:

- Painful side: gastroc testing 15 reps, uninvolved 30 reps
- Peak Force less on involved side, RFD 1.7 vs 5.0 but still slower for the demands of running
- Abnormal shoe wear on heel of involved side, shoes 1.5 years old
- Great toe extension severely limited on painful side, WNL on uninvolved side
- Averages 6 hours of sleep a night



Treatment & Rehabilitation Strategies



Treatment & Rehabilitation Strategies

- Improve ankle mobility - MMT Resets
 - Lateral tibial glide
 - Ankle plantarflexion and inversion
- Improve great toe mobility - often limited when ankle df is limited
 - Great reset is repeated great toe flexion
- The dosage makes the difference!



Treatment & Rehabilitation Strategies

- Strengthening
 - Start with lengthened isometrics at 70% MVC for mid portion Achilles Tendinopathy
 - For Insertional - if lengthened irritates the condition, perform isometrics at neutral and not in “heel drop” position - less compressive loads distally or against a spur
 - Aim for 3 reps of 1 min, tid- 9 min of time under tension



Treatment & Rehabilitation Strategies

- Strengthening
 - Progress to concentric reps to fatigue heel drop to raise (aiming for 30 reps for athletes)
 - Gradual return to activities/workout/sport
 - Guidelines for return don't exceed 4/10 in discomfort
- Recovery
 - Address sleep - minimum 7 hours 5-6 nights/week
 - Avoid processed/inflammatory foods, prioritize fiber



Want to Learn More?

- Modern Manual Therapy: The Eclectic Approach to UQ and LQ Assessment and Tx
 - Fully online - 13 hours, 20+ modules
 - Full Eval, Reset, and Stabilize system to learn Clinical Practice Patterns, pain free and simple manual therapy assessments and Tx techniques
 - Emphasis is on empowering the patient with simple Recovery Plans
 - modmt.com/levelup1



Questions?



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