

CLINICAL PRACTICE GUIDELINES

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Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis- Revision 2017

*Clinical Practice Guidelines*

*Linked to the International Classification  
of Functioning, Disability, and Health  
from the Orthopaedic Section of the  
American Physical Therapy Association*

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## SUMMARY OF RECOMMENDATIONS\*

### DIAGNOSIS/CLASSIFICATION

#### C

In addition to the arc sign and Royal London Hospital test,<sup>104</sup> a subjective report of pain located 2-6 cm proximal to the Achilles tendon insertion and pain with palpation of the mid-portion of the tendon appear helpful in diagnosing Achilles tendinopathy.

### DIFFERENTIAL DIAGNOSIS

#### F

Clinicians should consider diagnostic classifications other than Achilles tendinopathy, including involvement of the plantaris tendon, when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification/clinical course section of this updated guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

The following conditions should be considered in the differential diagnosis of patients presenting with posterior ankle pain: acute Achilles tendon rupture<sup>4, 134</sup>, partial tear of the Achilles tendon<sup>84</sup>, retrocalcaneal bursitis<sup>82</sup>, posterior ankle impingement<sup>138</sup>, irritation or neuroma of the sural nerve<sup>4</sup>, os trigonum syndrome<sup>109</sup>, accessory soleus muscle<sup>102</sup>, Achilles tendon ossification<sup>129</sup>, systemic inflammatory disease<sup>5</sup>, or insertional Achilles tendinopathy.

### EXAMINATION - OUTCOME MEASURES

#### ACTIVITY LIMITATION - SELF-REPORT MEASURES

#### A

Clinicians should utilize either the VISA-A or FAAM when collecting patient-reported outcome measures in patients with a diagnosis of Achilles tendinopathy. The VISA-A has been cross culturally adapted to multiple languages.

#### EXAMINATION - ACTIVITY LIMITATION – PHYSICAL PERFORMANCE MEASURES

#### B

Clinicians should use physical performance measures including hop and heel-rise endurance tests, as appropriate, to assess a patient's functional status and document findings.

## **INTERVENTIONS – IONTOPHORESIS**

### **B**

Clinicians should use iontophoresis with dexamethasone to decrease pain and improve function in patients with Achilles tendinopathy.

## **INTERVENTION – MANUAL THERAPY**

### **F**

Clinicians may use joint and soft tissue mobilization to reduce pain and improve mobility and function in patients with Achilles tendinopathy.

## **INTERVENTION – HEEL LIFTS**

### **D**

No recommendation can be made because contradictory evidence exists for the use of heel lifts in patients with Achilles tendinopathy.

## **INTERVENTION – EXERCISE**

### **A**

Clinicians should use either eccentric or a heavy load slow speed exercise program for Achilles tendinopathy to decrease pain and increase function. Because specific factors (e.g. frequency, load, and speed) are not controlled for in studies, the optimum parameters for exercise are yet to be identified. However, patients should exercise at least twice weekly within their pain tolerance.

## **INTERVENTION – STRETCHING**

### **C**

Clinicians may use plantar flexor stretching with the knee flexed and extended to reduce pain and improve satisfaction with outcome in patients with Achilles tendinopathy who exhibit limited dorsiflexion range of motion.

## **INTERVENTION - PATIENT EDUCATION AND COUNSELING**

### **E**

Patient education and counseling recommending strategies to gain or maintain optimal lean body mass in nonathletic individuals with a high body mass index and the use of shock absorbing insoles to mitigate commonly occurring weight loading stresses may be appropriate given identified risk factors.

## **INTERVENTION – NIGHT SPLINTS**

### **C**

Night splints cannot be recommended to reduce pain in patients with Achilles tendinopathy.

## **INTERVENTION – LOW LEVEL LASER THERAPY**

### **D**

Clinicians may use low level laser therapy in patients with midportion Achilles tendinopathy after recommended interventions have failed to improve pain, stiffness or function.

## **INTERVENTION - ORTHOTICS**

### **B**

Clinicians may use orthotics for documented foot impairments in patients with mid portion Achilles tendinopathy after the use of recommended interventions has failed to improve pain and/or function.

## **INTERVENTION - TAPING**

### **F**

Therapeutic elastic tape cannot be recommended to reduce pain or improve functional performance in patients with Achilles tendinopathy.

### **F**

Clinicians may use rigid taping to decrease strain on the Achilles tendon and/or alter foot posture in patients with Achilles tendinopathy.

## **INTERVENTION - NEUROMUSCULAR RE-EDUCATION**

### **F**

Clinicians may use neuromuscular exercises targeting lower extremity impairments that may lead to abnormal kinetics and/or kinematics, specifically eccentric overload of the Achilles tendon during weight-bearing activities.

## **INTERVENTION - DRY NEEDLING**

### **F**

Individuals with mid portion Achilles tendinopathy for greater than 3 months and increased tendon thickness may be treated using combined therapy of dry needling with injection under ultrasound guidance and eccentric exercise to decrease pain

**\*These recommendations and clinical practice guidelines are based on the scientific literature published prior to April 2016**

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## **List of Acronyms**

APTA: American Physical Therapy Association

BMI: Body Mass Index

CI: Confidence Interval

CPG: Clinical Practice Guideline

DECT: Dual-energy Computed Tomography

ESWT: Extracorporeal Shockwave Therapy

FAAM: Foot and Ankle Ability Measure

ICF: International Classification of Functioning, Disability and Health

ICD: International Classification of Disease

J: Joules

JOSPT: Journal of Orthopaedic and Sports Physical Therapy

K: Kappa

LEFS: Lower Extremity Function Scale

LLLT: Low Level Laser Therapy

LOINC: Logical Observation Identifiers Names and Codes

mRNA: Messenger ribonucleic acid

MRI: Magnetic Resonance Imaging

MSU: Monosodium Urate

mW: Milliwatt

N: Number of subjects or patients

nM: Nanometer

NPRS: Numeric Pain Rating Scale

PRP: Platelet Rich Plasma

US: Ultrasound

VAS: Visual Analogue Scale

VISA-A Victorian Institute of Sports Assessment

## INTRODUCTION

### **AIM OF THE GUIDELINES**

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based clinical practice guidelines (CPGs) for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization's International Classification of Functioning, Disability, and Health (ICF).

The purposes of these clinical guidelines are to:

- Describe evidence-based physical therapy practice including diagnosis, prognosis, intervention, and assessment of outcome for musculoskeletal disorders commonly managed by orthopaedic physical therapists
- Classify and define common musculoskeletal conditions using the World Health Organization's terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure as well as in activity and participation of the individual
- Provide a description to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
- Provide information for payers and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

### **STATEMENT OF INTENT**

These guidelines are not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made based on clinician experience and expertise in light of the clinical presentation of the patient, the available evidence, available diagnostic and treatment options, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines should be documented in the patient's medical records at the time the relevant clinical decision is made.

## Methods

Content experts were appointed by the Orthopaedic Section, APTA to conduct a review of the literature and to develop an updated Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis: Clinical Practice Guideline as indicated by the current state of the evidence in the field. The aims of the revision were to provide a concise summary of the evidence since publication of the original guideline and to develop new recommendations or revise previously published recommendations to support evidence-based practice. The authors of this guideline revision worked with research librarians with expertise in systematic review to perform a systematic search for articles related to classification, examination, and intervention strategies for Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis.<sup>17</sup> Briefly, the following databases were searched from 2009 to 2016: MEDLINE; CINAHL; Cochrane Library; and PEDro [See **APPENDIX A** for full search strategies and **APPENDIX B** for search dates and results, available at [www.jostpt.org](http://www.jostpt.org).].

The authors declared relationships and developed a conflict management plan, which included submitting a Conflict of Interest form to the Orthopaedic Section, APTA, Inc. Articles that were authored by a reviewer were assigned to an alternate reviewer. Funding was provided to the CPG development team for travel and expenses for CPG development training. The CPG development team maintained editorial independence.

Articles contributing to recommendations were reviewed based on specified inclusion and exclusion criteria with the goal of identifying evidence relevant to physical therapist clinical decision-making for adult persons with Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis. The title and abstract of each article were reviewed independently by 2 members of the CPG development team for inclusion. [See **APPENDIX C** for Inclusion and Exclusion criteria, available at [www.jospt.org](http://www.jospt.org)]. Full text review was then similarly conducted to obtain the final set of articles for contribution to recommendations. The team leader (RLM) provided the final decision for discrepancies that were not resolved by the review team. [See **APPENDIX D** for flow chart of articles and **APPENDIX E** for articles included in recommendations by topic, available at [www.jospt.org](http://www.jospt.org)]. For selected relevant topics that were not appropriate for the development of recommendations, such as incidence and imaging, articles were not subject to systematic review process and were not included in the flow chart. Evidence tables for this CPG are available on the Clinical Practice Guidelines page of the Orthopaedic Section of the APTA website: [www.orthopt.org](http://www.orthopt.org).

This guideline was issued in 2017 based on the published literature up to 2016. This guideline will be considered for review in 2021, or sooner if new evidence becomes available. Any updates to the guideline in the interim period will be noted on the Orthopaedic Section of the APTA website: [www.orthopt.org](http://www.orthopt.org)

### **LEVELS OF EVIDENCE**

Individual clinical research articles were graded according to criteria adapted from the Centre for Evidence-Based Medicine, Oxford, United Kingdom for diagnostic,



prospective, and therapeutic studies.<sup>120</sup> In teams of 2, each reviewer independently assigned a level of evidence and evaluated the quality of each article using a critical appraisal tool. [See **APPENDIX F** and **G** for Levels of Evidence table and details on procedures used for assigning levels of evidence, available at [www.jospt.org](http://www.jospt.org)]. The evidence update was organized from highest level of evidence to lowest level. An abbreviated version of the grading system is provided below.

I	Evidence obtained from high quality diagnostic studies, prospective studies, systematic reviews, or randomized controlled trials
II	Evidence obtained from lesser-quality diagnostic studies, systematic reviews, prospective studies, or, randomized controlled trials (eg, weaker diagnostic criteria and reference standards, improper randomization, no blinding, less than 80% follow-up)
III	Case controlled studies or retrospective studies
IV	Case series
V	Expert opinion

### GRADES OF EVIDENCE

The strength of the evidence supporting the recommendations was graded according to the previously established methods for the original guideline and those provided below. Each team developed recommendations based on the strength of evidence, including how directly the studies addressed the question of Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis. In developing their recommendations, the authors considered the strengths and limitations of the body of evidence and the health benefits, side effects, and risks of tests and interventions.

GRADES OF RECOMMENDATION		STRENGTH OF EVIDENCE
<b>A</b>	Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study
<b>B</b>	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
<b>C</b>	Weak evidence	A single level II study or a preponderance of level III and IV studies, including statements of consensus by content experts, support the recommendation
<b>D</b>	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies

E	Theoretical/ foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion
F	Expert opinion	Best practice based on the clinical experience of the guidelines development team

### **GUIDELINE REVIEW PROCESS AND VALIDATION**

Identified reviewers who are experts in Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis management and rehabilitation reviewed the clinical practice guideline draft for integrity, accuracy, and to ensure that it fully represents the current evidence for the condition. The guideline draft was also posted for public comment and review on [www.orthopt.org](http://www.orthopt.org) and a notification of this posting was sent to the members of the Orthopaedic Section, APTA, Inc. In addition, a panel of consumer/patient representatives and external stakeholders, such as claims reviewers, medical coding experts, academic educators, clinical educators, physician specialists, and researchers also reviewed the guideline. All comments, suggestions, and feedback from the expert reviewers, public, and consumer/patient representatives were provided to the authors and editors for consideration and revisions. Guideline development methods policies, and implementation processes are reviewed at least yearly by the Orthopaedic Section, APTA’s ICF-based Clinical Practice Guideline Advisory Panel, including consumer/patient representatives, external stakeholders, and experts in physical therapy practice guideline methodology.

### **DISSEMINATION AND IMPLEMENTATION TOOLS**

In addition to publishing these guidelines in the Journal of Orthopaedic and Sports Physical Therapy (JOSPT), these guidelines will be posted on clinical practice guideline areas of both the JOSPT and the Orthopaedic Section, APTA websites, which are free access website areas, and submitted to be available free access on the Agency for Healthcare Quality and Research’s website ([guideline.gov](http://guideline.gov)). The implementation tools planned to be available for patients, clinicians, educators, payors, policy makers, and researchers, and the associated implementation strategies are:

<u>Tool</u>	<u>Strategy</u>
“Perspectives for Patients”	Patient-oriented guideline summary in available on <a href="http://jospt.org">jospt.org</a> and <a href="http://orthopt.org">orthopt.org</a>
Mobile app of guideline based exercises for patient/clients and healthcare practitioners	Marketing and distribution of app using <a href="http://orthopt.org">orthopt.org</a> and <a href="http://jospt.org">jospt.org</a>
Clinician’s Quick-Reference Guide	Summary or guideline recommendations available on <a href="http://orthopt.org">orthopt.org</a>
Read-for-credit continuing education units	Continuing Education Units available for physical therapists and athletic trainers from JOSPT

Webinars educational offering for healthcare practitioners	Guideline-based instruction available for practitioners on orthopt.org
Mobile and web-based app of guideline for training of healthcare practitioners	Marketing and distribution of app using orthopt.org and jospt.org
Physical Therapy National Outcomes Data Registry	Support the ongoing usage of data registry for common musculoskeletal conditions of the foot and ankle
Logical Observation Identifiers Names and Codes mapping	Publication of minimal data sets and their corresponding LOINC codes for the foot and ankle region on orthopt.org
Non-English versions of the guidelines and guideline implementation tools	Development and distribution of translated guidelines and tools to JOSPT’s international partners and global audience via jospt.org

## CLASSIFICATION

The terminology used to describe Achilles tendon disorders varies, with “tendinitis,” “tendonitis,” or “paratenonitis” commonly being used and therefore suggestive of an inflammatory condition. Because inflammation and degeneration are usually not mutually exclusive,<sup>78, 79, 90, 96, 122</sup> “Achilles tendinopathy” will be the focus of this clinical guideline unless otherwise stated.

"The ICD-10 code associated with Achilles tendinopathy is **M76.6 Achilles Tendinitis/Achilles bursitis**. The corresponding primary ICD-9 CM code, commonly used in the USA, is **726.71 Achilles bursitis or tendinitis**. The primary ICF body function codes associated with Achilles tendinopathy are **b28015 Pain in lower limb**, **b7300 Power of isolated muscles and muscle groups**, and **b7800 Sensation of muscle stiffness**. The primary ICF body structures codes associated with Achilles tendinopathy are **s75012 Muscles of lower leg** and **s75028 Structure of ankle and foot, specified as Achilles tendon**. The primary ICF activities and participation codes associated with Achilles tendinopathy are **d4500 Walking short distances**, **d4501 Walking long distances**, **d4552 Running**, **d4553 Jumping**, and **d9201 Sports**. The primary and secondary ICD-10 and ICF codes associated with Achilles tendinopathy are provided in

**TABLE 3** on the following page.

## ICD-10 and ICF Codes Associated With Ankle Pain and Stiffness

### INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND RELATED HEALTH PROBLEMS

ICD-10	M76.6	Achilles tendinitis/Achilles bursitis
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### INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY, AND HEALTH

#### PRIMARY ICF CODES

Body functions	b28015 b7300 b7800	Pain in lower limb Power of isolated muscles and muscle groups Sensation of muscle stiffness
Body structure	s75012 s75028	Muscles of lower leg Structure of ankle and foot, specified as Achilles tendon
Activities and participation	d4500 d4501 d4552 d4553 d9201	Walking short distances Walking long distances Running Jumping Sports

#### SECONDARY ICF CODES

Body functions	b7100 b7101 b7301 b7400 b7401 b770	Mobility of a single joint Mobility of several joints Power of muscles of one limb Endurance of isolated muscles Endurance of muscle groups Gait pattern functions (antalgic gait)
Body Structure	s7502 s75022	Structure of ankle and foot Muscles of ankle and foot
Activities and participation	d2302 d4350 d4551 d4600 d4601 d4602	Completing daily routine Pushing with lower extremities Climbing Moving around within the home Moving around within buildings other than home Moving around outside the home and other buildings

## **ORGANIZATION OF THE GUIDELINE**

For each topic, the summary recommendation and grade of evidence from the 2010 guideline are presented followed by a synthesis of the recent literature with the corresponding evidence levels. Each topic concludes with the 2017 summary recommendation and its updated grade of evidence.

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# CLINICAL PRACTICE GUIDELINES: ACHILLES PAIN, STIFFNESS, AND MUSCLE POWER DEFICITS ACHILLES TENDINOPATHY - REVISION 2017

## Impairment/Function-Based Diagnosis

### PREVALANCE

#### 2010 Summary

Disorders of the Achilles tendon rank among the most frequently reported overuse injuries in the literature.<sup>20, 94, 105, 107</sup> The majority of those suffering from Achilles tendinopathy are active individuals, often involved in recreational or competitive sports.<sup>92</sup> Estimates of the annual incidence of Achilles tendinopathy in runners range between 7 - 9%.<sup>81, 92</sup> However, cases have been reported in sedentary groups as well.<sup>73, 132</sup> Although runners appear to be the most commonly affected cohort,<sup>92, 94, 95, 116</sup> Achilles disorders have been reported in a wide variety of sports.<sup>46, 49, 92, 94, 168</sup> Athletes are more likely to become symptomatic when training as opposed to during competitive events.<sup>81, 168</sup> While there is an increased prevalence of Achilles injury as age increases,<sup>46, 91</sup> the mean age of those affected by Achilles disorders is between 30 and 50 years.<sup>107, 119, 135</sup> While gender has not been directly studied, data from multiple works suggest males are affected to a greater extent than females.<sup>94, 116, 135</sup>

#### Evidence Update

##### I

The prevalence of Achilles tendinopathy in elite male soccer players during one season ranged between 2.1–5.1%.<sup>57</sup>

##### I

In a large prospective cohort of novice runners, 7% went on to develop Achilles tendinopathy.<sup>113</sup>

##### II

A systematic review by Sobhani et al<sup>148</sup> found Achilles tendinopathy to be one of the most common over-use foot and ankle injuries in sports. The prevalence of Achilles tendinopathy in the general running and ultra-marathon populations ranged between 6.2%-9.5% and 2.0%-18.5%, respectfully, in a systematic review focusing on running injuries.<sup>99</sup>

##### II

Achilles tendinopathy was diagnosed in 1.8% of adolescent athletes at a pre-sports participation annual health examination.<sup>37</sup>

##### II

The incidence of Achilles tendinopathy was found to be 1.85 per 1,000 patients<sup>27</sup> and 2.16 per 1,000 person years<sup>3</sup> in Dutch general practice populations.

### III

Achilles tendinopathy was found to occur in 12.5% of rock climbers.<sup>15</sup>

#### 2017 Summary

Achilles tendinopathy continues to be a relatively common over-use injury for individuals who are active and participate in sports.

### PATHOANATOMICAL FEATURES

#### 2017 Summary and Update

The major complaint of those with Achilles tendinopathy is pain that limits activity. Pain is preceded by an excessive mechanical stressor, such as tensile loading and/or shearing, which initiates pathological changes in the tendon.<sup>100, 106</sup> These pathological changes can include tenocyte proliferation with tendon thickening,<sup>10, 37</sup> neovascularity,<sup>28, 121</sup> collagen fibril thinning and disorganization,<sup>106</sup> increase of noncollagenic and fibrocartilage matrix,<sup>16, 30</sup> fat deposition<sup>48, 54, 59, 72</sup> altered fluid movement,<sup>66</sup> and overproduction of nitric acid with tissue apoptosis.<sup>117</sup> Failure to control hyperthermia that results during exercise, as tendons convert some of the stored energy to heat, can also contribute by causing local cell death.<sup>106</sup> Tendon changes associated with the pathological process weaken the mechanical and material properties of the tendon, leading to a decrease in tendon stiffness and strength,<sup>6, 7, 65, 66</sup> and in turn ineffective force transfer.<sup>18</sup> This may support the use of eccentric or a heavy load slow speed exercise program to potentially increase tendon stiffness. Inflammation and degeneration are usually not mutually exclusive but can exist together in varying degrees throughout this process.<sup>78, 79, 90, 96, 122</sup>

The extent and/or severity of tendon abnormalities are not consistently related to the severity of clinical presentation.<sup>21, 26, 28, 31, 39, 40, 45, 60, 66</sup> Also, pre-symptomatic tendon thickening has been documented<sup>21, 80</sup> and bilateral tendon changes have been found in those with unilateral symptoms.<sup>40, 66</sup> The plantaris tendon may be involved in those with chronic Achilles tendonopathy.<sup>106, 150</sup> A thickened plantaris tendon and associated peritendinous nerve structures may result in impingement on the medial aspect of the thickened Achilles tendon, contributing to pain and limited activity.<sup>106, 150, 151</sup>

Systematic reviews have identified genetic variants as an important factors in the pathogenesis of tendinopathy.<sup>35, 106</sup> An abnormal neuronal phenotype can disrupt normal tendon homeostasis and healing after injury.<sup>35</sup> The neuronal response to tendon injury involves nerve in-growth, increase sensitivity to neuronal pain mediators, and receptor activation for these mediators<sup>13, 19, 35, 63, 80</sup> Neuronal changes activate the nociceptive pathways to higher centers and are responsible for the sensation of pain. Therefore, altered central pain processing may also be an important factor in persistent tendon pain.<sup>64, 70, 147, 159</sup> Genetic variants, such as those associated with mRNA stability, can predispose individuals' to abnormalities in collagen production.<sup>2, 29, 56, 69, 124, 139, 141, 145, 146</sup> This abnormal collagen may negatively affect the mechanical and material properties of the tendon leading to ineffective force transfer.<sup>29, 44, 124</sup> The relationship between

genotype, abnormal collagen, mechanical stress, and symptom presentation is multifactorial and not well understood.<sup>9, 53, 125, 131, 140</sup>

## **RISK FACTORS**

### **2010 Summary**

For specific groups of individuals, clinicians should consider abnormal ankle dorsiflexion range of motion, abnormal subtalar joint range of motion, decreased ankle plantar flexion strength, increased foot pronation, and abnormal tendon structure as intrinsic risk factors associated with Achilles tendinopathy. Obesity, hypertension, hyperlipidemia, and diabetes are medical conditions associated with Achilles tendinopathy. Clinicians should also consider training errors, environmental factors, and faulty equipment as extrinsic risk factors associated with Achilles tendinopathy.

### **Evidence Update**

#### **I**

A systematic review by Dowling et al<sup>42</sup> investigating dynamic foot function as a risk factor for lower limb overuse injuries included only one study related to Achilles tendinopathy. This prospective study found altered posterior-anterior force displacement and an increase in laterally directed force distribution underneath the forefoot as risk factors for developing Achilles tendinopathy in runners who were noted to be 'heel-strikers'.<sup>163</sup>

#### **II**

Franceschi et al<sup>50</sup> identified obesity as a risk factor for developing tendinopathies in their systematic review.

#### **II**

In athletes, increased tendon thickness<sup>80</sup> and sonographic abnormalities (moderate or severe hypoechoic defects)<sup>21</sup> were identified as risk factors for the development of Achilles tendinopathy.

#### **II**

A retrospective study investigated injuries in military recruits who were given either a rigid (n=1,416) or shock absorbing (n=1,338) insole when issued combat boots. The recruits issued a shock absorbing insole had a 50% reduction in Achilles tendinopathy rate, with an incidence of 4% compared to 8% with the rigid insoles.<sup>74</sup>

#### **III**

A systematic review identified intrinsic risk factors for Achilles tendinopathy to include increasing age, male gender, increased body weight, poor tendon temperature regulation, presence of systemic diseases, decreased muscle strength, decreased flexibility, previous injuries, poor blood supply, and genetic variants.<sup>106</sup> One study in this review found those with a family history of tendinopathy have five times the risk of developing Achilles tendinopathy.<sup>89</sup> Studies outside of the review by Magnan et al<sup>106</sup> also found that gene



variants to influenced the development of Achilles tendinopathy.<sup>2, 44, 56, 69, 124, 139, 141, 145</sup> Specifically, genes associated with the collagen production pathway may functionally effect tendon strength and stiffness, leading to an abnormal tendon response to loading.

### III

A systematic review by Lorimer and Hume<sup>100</sup> found a posterior directed center of force when landing combined with reduced eccentric strength as potential risk factors for Achilles injury while having a high arch and generating high propulsion forces to be protective against injury. Other studies not included in this review have identified neuromuscular deficits in the gluteus medius,<sup>51</sup> gluteus maximus,<sup>51</sup> rectus femoris,<sup>174</sup> tibialis anterior,<sup>174</sup> lateral gastrocnemius,<sup>174</sup> and triceps surae muscle complex,<sup>166</sup> altered hip, knee, and ankle moments,<sup>85</sup> increased lower limb stiffness,<sup>36</sup> and abnormal lower extremity kinematics during dancing push-off manovers<sup>93</sup> as intrinsic risk factors. In a sample of 24 elite, female soccer players, a sport-specific proprioception training program over 2.5 years decreased the rate of Achilles tendinopathy and days lost from play due to injury.<sup>88</sup>

### III

One study in the review by Franceschi et al<sup>50</sup> identified a potential interaction between age and obesity with degenerative tendon changes.<sup>143</sup> Those with dyslipidemia and fat deposition in the Achilles may be at risk for developing tendon pain.<sup>54</sup> This finding is consistent with a systematic review that found elevated adiposity was frequently associated with general tendon injuries.<sup>55</sup>

### III

A study of master track and field athletes did not find any influence of age, gender, weight, height, or participation in high versus low impact activities on the development of Achilles tendinopathy.<sup>98</sup> However, elderly individuals with diabetes who participate in sports were found to be at increased risk for Achilles tendinopathy.<sup>1</sup>

### III

The review by Magnan et al<sup>106</sup> also identified extrinsic factors in the development of Achilles tendinopathy to include environmental conditions, shoes, equipment, surfaces, and physical activity/sport participation. One study of professional ballet dancers noted overuse injuries to be more common in females and in more technically demanding ballet techniques.<sup>149</sup>

### III

Systematic reviews have specifically identified an increased risk of tendon injury with use of fluoroquinolone antibiotic therapy.<sup>97, 106, 153</sup>

### IV

A study included in above reviews found mitochondrial damage to tenocytes during fluoroquinolone treatment to be potentially involved in tendinitis and tendon rupture.<sup>101</sup>

## **2017 Summary**

The risk of developing Achilles tendinopathy is multifactorial and likely related to an interaction of intrinsic and extrinsic factors that lead to abnormal tendon loading. The body's response to loading will be influenced by health conditions and genetic factors. An individual with any number of lower extremity impairments that lead to abnormal kinetics and/or kinematics and specifically produce an eccentric overload of the Achilles tendon may be at risk for Achilles tendon injury. The use of a shock absorbing insole may help prevent Achilles tendinopathy.

## **CLINICAL COURSE**

### **2010**

No summary

### **Evidence Update**

#### **I**

In elite male soccer players, missed participation because of symptoms related to Achilles tendinopathy was relatively short (median 10 days; average 23 days). However, recurrence rate was high (27%) with a greater risk of re-injury for players resting less than 10 days. In those with severe tendinopathies (>28 days lost), 38% required surgical intervention.<sup>57</sup>

#### **I**

In a large prospective cohort of runners the median time to recovery was 82 days (minimum 21; maximum 479).<sup>113</sup>

#### **II**

The lack of uniformity in Achilles tendon structure on ultrasonography (hyper-and/or hypo-echogenicity) is not a consistent prognosticator for outcome.<sup>10, 26</sup>

#### **II**

Gender may influence response to conservative treatment as females suffering from Achilles tendinopathy perceived more pain and less of an improvement in function compared to males following 12 weeks of eccentric training.<sup>87</sup>

#### **II**

Good long term outcomes were noted in a 4.2-year<sup>60</sup> and 5 year<sup>162</sup> follow-up studies of subjects that completed a 3 month heavy load eccentric calf-muscle training program. However, mild pain persisted in some<sup>162</sup> and there was considerable variability treatment outcome.<sup>52, 107, 136</sup>

#### **III**

Conflicting evidence related to BMI was identified. The systematic review by Franceschi et al<sup>50</sup> found that increased BMI played a role in the development of Achilles

tendinopathy. However, one study in this review revealed that BMI did not influence response to conservative treatment.<sup>86</sup>

#### **IV**

A case series by Silbernagel et al<sup>147</sup> found 80% (27/34) of subjects who completed a 12 week to 6 month progressive Achilles tendon–loading strengthening program were fully recovered at 5 year follow-up.

#### **2017 Summary**

In athletes with Achilles tendinopathy missed participation can be expected to be short. However, if not properly rested, symptoms may return. Recovery can be expected, but it may take months and be influenced by intrinsic factors, such as gender. While most patients will improve, mixed levels of recovery can be anticipated.

### **DIAGNOSIS/CLASSIFICATION**

#### **2010 Recommendation**

##### **C**

Self-reported localized pain and perceived stiffness in the Achilles tendon following a period of inactivity (e.g. sleep, prolonged sitting), lessens with an acute bout of activity and may increase after the activity. Symptoms are frequently accompanied with Achilles tendon tenderness, a positive arc sign, and positive findings on the Royal London Hospital test. These signs and symptoms are useful clinical findings for classifying a patient with ankle pain into the ICD category of Achilles bursitis or tendinitis and the associated ICF impairment based category of Achilles pain (b28015 Pain in lower limb), stiffness (b7800 Sensation of muscle stiffness), and muscle power deficits (b7301 Power of muscles of lower limb).

#### **Evidence Update**

##### **II**

Hutchison et al<sup>75</sup> examined 21 participants with and without Achilles tendinopathy who underwent an ultrasound scan followed by ten clinical tests for mid-portion Achilles tendinopathy. Subjective reporting of pain 2–6 cm proximal to the Achilles insertion extending to the calcaneus (sensitivity 84%, specificity 73%, and K = 0.74–0.96) and pain with palpation of the mid-portion of the tendon (sensitivity 78%, specificity 77%, and K = 0.75–0.81) were found to be accurate and reliable in diagnosing Achilles tendinopathy.

##### **III**

Reiman and colleagues<sup>128</sup> performed a systematic review and meta-analysis of the utility of current clinical measures for the diagnosis of Achilles tendon injuries. Because only 2 studies met the inclusion criteria the authors determined further high-quality studies are needed.

## **2017 Recommendation**

### **C**

In addition to the arc sign and Royal London Hospital test,<sup>104</sup> a subjective report of pain located 2-6 cm proximal to the Achilles tendon insertion and pain with palpation of the mid-portion of the tendon appear helpful in diagnosing Achilles tendinopathy.

## **DIFFERENTIAL DIAGNOSIS**

### **Evidence Update**

#### **IV**

Using ultrasound scans in patients with Achilles tendon, Morton and colleagues<sup>111</sup> described the echographic features of tears in connective tissue that divide the leg into its compartments.

#### **IV**

The plantaris tendon may play a role in chronic mid-portion Achilles regional pain. A recent retrospective study examined the incidence of plantaris injuries in track and field athletes and found that plantaris injury occurred with an annual incidence of 3.9 to 9.3%.<sup>123</sup>

#### **V**

Dalbeth and colleagues<sup>23</sup> reported on the frequency and patterns of monosodium urate (MSU) crystal deposition in tendons and ligaments of patients with gout using dual-energy computed tomography (DECT). Ninety-two people with tophaceous gout had DECT scanning of both feet with the Achilles tendon being the most common site of MSU crystal deposition.

## **2010 and 2017 Recommendation**

### **F**

Clinicians should consider diagnostic classifications other than Achilles tendinopathy, including involvement of the plantaris tendon, when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification/clinical course section of this updated guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

The following conditions should be considered in the differential diagnosis of patients presenting with posterior ankle pain:

- Acute Achilles tendon rupture<sup>4, 134</sup>
- Partial tear of the Achilles tendon<sup>84</sup>
- Retrocalcaneal bursitis<sup>82</sup>
- Posterior ankle impingement<sup>138</sup>
- Irritation or neuroma of the sural nerve<sup>4</sup>
- Os trigonum syndrome<sup>109</sup>
- Accessory soleus muscle<sup>102</sup>

- Achilles tendon ossification<sup>129</sup>
- Systemic inflammatory disease<sup>5</sup>
- Insertional Achilles tendinopathy

## **IMAGING**

### **2010 Summary**

When a diagnosis of Achilles tendinopathy is not clear from the history and physical examination, imaging studies are warranted. Ultrasound and magnetic resonance imaging (MRI) are of assistance when clinical exam results are not sufficient to arrive at a diagnosis.

### **2017 Update and Summary**

Ultrasound (US) imaging and magnetic resonance imaging (MRI) may be useful in assessing for differential diagnoses and identifying co-existing pathology, such as partial ruptures, bursitis, paratendonitis, plantaris involvement, and/or fascial tears.<sup>43, 110, 111</sup>

Research studies on patients with midportion Achilles tendinopathy commonly use imaging techniques to examine the severity of tendinopathy, with signs including increased tendon thickness (e.g. anterior-posterior diameter or cross-sectional area), altered composition (e.g. echogenicity on US and signal intensity on MRI) and/or neovascularization (e.g. location and extent of activity on Doppler ultrasound).<sup>7, 59, 114, 121, 155, 164, 169</sup>

However, there is conflicting evidence on the correlation between severity of tendon abnormalities and symptoms.<sup>10, 14, 26, 28, 34, 40, 45, 48, 61, 67, 114, 115, 130, 144, 152, 157, 164, 170,</sup>

<sup>171</sup> There are techniques currently being developed using ultrasound elastography to estimate tissue mechanical properties (e.g. strain and stiffness), which may provide greater insight into tendon pathology.<sup>58, 71</sup>

## **EXAMINATION**

### **OUTCOME MEASURES**

#### **ACTIVITY LIMITATION - SELF-REPORT MEASURES**

### **2010 Recommendation**

#### **A**

Clinicians should incorporate validated functional outcome measures, such as the Victorian Institute of Sport Assessment (VISA-A) and the Foot and Ankle Ability Measure (FAAM). These should be utilized before and after interventions intended to alleviate the impairments of body function and structure, activity limitations, and participation restrictions associated with Achilles tendinopathy

## **Evidence Update**

### **I**

Iversen et al. provided evidence of validity and reliability for the VISA-A questionnaire in Danish-speaking individuals.<sup>77</sup>

### **II**

The VISA-A has been validated for Turkish<sup>41</sup> and French<sup>83</sup> speaking patients with Achilles tendinopathy. The validity and reliability findings in these studies are consistent with the results reported in the previously published Achilles Tendinopathy guideline<sup>17</sup>

## **2017 Recommendation**

### **A**

Clinicians should utilize either the VISA-A or FAAM when collecting patient-reported outcome measures in patients with a diagnosis of Achilles tendinopathy. The VISA-A has been cross culturally adapted to multiple languages.

## **ACTIVITY LIMITATION - PHYSICAL PERFORMANCE MEASURES**

## **2010 Recommendation**

### **B**

When evaluating functional limitations over an episode of care for those with Achilles tendinopathy, measures of activity limitation and participation restriction can include objective and reproducible assessment of the ability to walk, descend stairs, perform unilateral heel raises, single-limb hop, and participate in recreational activity.

## **Evidence Update**

### **V**

A review by Macdermid and Silbernagel<sup>103</sup> summarized physical performance measures for selected upper and lower extremity tendinopathies and recommended the hop tests and the heel-rise endurance test in the evaluation of functional performance in patients with Achilles tendinopathy.

## **2017 Recommendation**

### **B**

Clinicians should use physical performance measures including hop and heel-rise endurance tests, as appropriate, to assess a patient's functional status and document findings.

## **PHYSICAL IMPAIRMENT MEASURES**

Recommended impairment measures and their properties are provided in the 2010 CPG.<sup>17</sup>

## **INTERVENTIONS**

A systematic search of the literature did not reveal articles to alter the 2010 recommendations for iontophoresis, manual therapy, or heel lifts in the treatment of Achilles tendinopathy. Updated recommendations are provided for exercise, which includes eccentric and heavy load slow speed protocols, stretching, night splints, low level laser therapy (LLLT), orthotics, taping neuromuscular re-education, and dry needling. Although corticosteroid injection, extracorporeal shockwave therapy (ESWT), and platelet-rich plasma injections (PRP) are used as intervention for those with Achilles tendinopathy, they are outside the scope of physical therapy practice and therefore only summaries are provided for patient education purposes.

### **IONTOPHORESIS**

#### **2010 and 2017 Recommendation**

##### **B**

Clinicians should use iontophoresis with dexamethasone to decrease pain and improve function in patients with Achilles tendinopathy.

### **MANUAL THERAPY**

#### **2010 and 2017 Recommendation**

##### **F**

Clinicians may use joint and soft tissue mobilization to reduce pain and improve mobility and function in patients with Achilles tendinopathy.

### **HEEL LIFTS**

#### **2010 and 2017 Recommendation**

##### **D**

No recommendation can be made because contradictory evidence exists for the use of heel lifts in patients with Achilles tendinopathy.

### **EXERCISE**

#### **2010 Recommendation**

##### **A**

Clinicians should consider implementing an eccentric loading program to decrease pain and improve function in patients with midportion Achilles tendinopathy.

## Evidence Update

### I

In a systematic review by Sussmilch- Leitch et al<sup>156</sup> nine randomized controlled trials directly studied eccentric exercise. This systematic review found support for the use of eccentric exercise. It should be noted all studies were completed prior to 2009, the date of the last clinical practice guideline.

### I

Beyer et al<sup>12</sup> found similar outcomes for a heavy load slow speed exercise and an Alfredson eccentric training protocol. The heavy load slow speed exercise protocol included 3 bilateral full range of motion heel rise exercises performed at a speed of 6 seconds per repetition as follows: 1) flexed knee on a seated calf raise machine, 2) extended knee with the barbell on shoulders, and 3) extended knee on a leg press machine. The 12-week program included increasing weight with progressively decreasing repetitions (reps). The dosages per week were: week 1 included 3 sets x 15 reps, weeks 2-3 included 3 sets x 12 reps, weeks 4-5 included 4 sets x 10 reps, weeks 6-8 included 4 sets x 8 reps, and weeks 9-12 included 4 sets x 6 reps. Notable findings at 52-week follow-up included lower visual analog scale (VAS) during running in both groups (VAS change 0-52 weeks: eccentric training = 38, CI 25.6 to 49.9; heavy slow resistance = 49, CI 35.5 to 62.8), lower VISA-A in both groups (VISA - A change 0-52 weeks: eccentric training = -27.0, CI -35.6 to -18.0; heavy slow resistance = -34 C,I -41.8 to -26.5), decreased tendon anterior to posterior width and decreased Doppler signal. Although at 52 weeks patients in both groups continued to have pain with running (VAS running eccentric exercise = 12, CI 3.2 to 19.8; heavy slow resistance = 5, CI -0.5 to 9.8), patients in both groups expressed high levels of satisfaction (eccentric exercise = 76 %; heavy slow resistance= 98%).

### II

Although several systematic reviews supported eccentric exercises, heterogeneity across exercise protocols was identified with factors including maximum load, speed of contraction, and frequency of sessions not being adequately controlled.<sup>52, 68, 107, 136</sup> Malliaras et al<sup>108</sup> noted that trials often did not isolate eccentric from concentric contractions and therefore questioned the need for an eccentric-only exercise protocol. However, Frizziero et al<sup>52</sup> found eccentric training to be more effective than concentric exercises, general therapeutic exercise, and ESWT. It should be noted that compliance with eccentric training (27 to 72 %),<sup>68</sup> and outcomes were found to vary considerably across studies.<sup>52, 68, 107, 136</sup>

### II

A randomized trial (n=80, 20/group) examined daily eccentric exercise (twice per day, 7 days per week) compared to twice weekly eccentric exercise (once per day, twice per week).<sup>160</sup> At 12 weeks the differences in the VISA-A score between the daily exercise and twice weekly eccentric exercise groups were not significant.



## II

Stevens and Tan<sup>154</sup> compared two intensities of the Alfredson protocol in a small sample (13-15 per group) of patients; 1) a “do as tolerated” group which completed an average of 112 repetitions daily and 2) a “protocol” group that averaged 166 repetitions. No significant differences between groups were found on pain VAS or VISA-A scores.

## IV

This case series study by Ram et al<sup>126</sup> evaluated the responses of 16 of 20 participants with chronic midportion Achilles tendinopathy who had tried at least one other treatment, to a 12 week eccentric training program. Despite experiencing improved scores on the VISA-A, pain VAS, and Tegner Activity Scale only 2 participants were satisfied with treatment. The low satisfaction may have to do with the fact that patients had a chronic condition and had tried other treatments as compared to other studies.<sup>12</sup>

## IV

A study by de Vos et al<sup>31</sup> examined changes in tendon structure using a specific ultrasonic tissue characterization approach before and after a 16-week eccentric exercise program. The changes defined by the ultrasonic tissue characterization approach found no association between collagen type and VISA-A at any time point.

## IV

There were several randomized controlled trials that compared eccentric exercise combined with other interventions to eccentric exercise alone.<sup>25, 32, 33, 118, 133, 161, 172, 175</sup> Summarized is the improvement of the control arm (eccentric exercise alone) to provide a description of the observed changes. Improvement in symptom severity (VISA-A) across studies varied from 2.4% at 8 weeks,<sup>175</sup> 13% at 12 weeks,<sup>118</sup> 22.6% at 16 weeks,<sup>133</sup> 20.5% at 24 weeks,<sup>33</sup> and 25-30% at 52 weeks.<sup>25, 161</sup> When eccentric exercise was combined with Platelet enriched plasma,<sup>25, 32, 33</sup> autologous blood injections,<sup>118</sup> and prolotherapy<sup>172</sup> the results were equivalent to eccentric exercise alone. However, when eccentric exercise was combined with low level laser,<sup>160</sup> extracorporeal shock wave therapy (ESWT)<sup>133</sup> and acupuncture<sup>175</sup> studies favored the combined treatments.

## 2017 Recommendation

### A

Clinicians should use either eccentric or a heavy load slow speed exercise program for Achilles tendinopathy to decrease pain and increase function. Because specific factors (e.g. frequency, load, and speed) are not controlled for in studies, the optimum parameters for exercise are yet to be identified. However, patients should exercise at least twice weekly within their pain tolerance.

## **STRETCHING**

### **2010 Recommendation**

**C**

Stretching exercises can be used to reduce pain and improve function in patients who exhibit limited dorsiflexion range of motion with Achilles tendinopathy

### **Evidence Update**

**IV**

A study by Verrall et al<sup>165</sup> evaluated a 6-week stretching program that was described as an “eccentric stretching” protocol. One set required participants to perform 9 plantar flexor stretches (6 with knee straight and 3 with knee bent) off the end of a step. Each “heel drop” stretch was held for 15-20 seconds. Participants increased from one set to three and from bilateral to the involved side over a 6 week period. Pain decreased on 0-10 VAS scale from 7.2 at baseline to 2.9 at 12 weeks. Eighty two percent of participants reported 7 out of 10 or greater level of satisfaction with treatment.

### **2017 Recommendation**

**C**

Clinicians may use plantar flexor stretching with the knee flexed and extended to reduce pain and improve satisfaction with outcome in patients with Achilles tendinopathy who exhibit limited dorsiflexion range of motion.

## **PATIENT EDUCATION AND COUNSELING**

### **2010 No recommendation**

### **2017 Recommendation**

**E**

Patient education and counseling recommending strategies to gain or maintain optimal lean body mass in nonathletic individuals with a high body mass index and the use of shock absorbing insoles to mitigate commonly occurring weight loading stresses may be appropriate given identified risk factors.

## **NIGHT SPLINTS**

### **2010 Recommendation**

**C**

Night splints are not beneficial in reducing pain when compared to eccentric exercise in patients with Achilles tendinopathy.

## **Evidence Update**

### **I**

A systematic review by Sussmilch- Leitch et al<sup>156</sup> found two studies with conflicting results on the additional effect of night splints added to an eccentric exercise program. A pooled meta-analysis found that a night splint provided no significant additional improvement in patient reported symptoms (VISA-A) at 12 weeks.

### **II**

A one-year follow-up study of a randomized controlled trial found no additional benefit of a night splint to eccentric exercise.<sup>24</sup> There were no significant differences in symptom severity (VISA-A) between groups at baseline, 3 or 12 month follow-ups. There were also no significant differences between groups in morning stiffness or patient satisfaction at one-year follow-up.

## **2017 Recommendation**

### **C**

Night splints cannot be recommended to reduce pain in patients with Achilles tendinopathy.

## **LOW LEVEL LASER THERAPY**

## **2010 Recommendation**

### **B**

Clinicians should consider the use of low-level laser therapy to decrease pain and stiffness in patients with Achilles tendinopathy.

## **Evidence Update**

### **II**

Tumilty and colleagues<sup>161</sup> compared low-level laser therapy (LLLT) to placebo laser treatment while both groups concurrently participated in an eccentric exercise program. The laser parameters included an 810 nm, 100-mW infrared probe at 3.0 J per point (18 J per session). The LLLT group did not have clinically or statistically greater improvement in the Numerical Pain Rating Scale (NPRS) or symptom severity (VISA-A) at baseline, 4, 12, and 52 weeks

### **II**

Hutchison et al<sup>76</sup> compared LLLT to a placebo laser treatment using a laser probe, with a spectrum of 530 nm to 1100 nm, to administer a single pulse of 39 J. There were no differences between groups in symptom severity (VISA-A), pain (VAS), or function (LEFS) at baseline, 6 or 12 weeks. In addition, at 12 weeks neither group demonstrated a significant difference from baseline in patient-reported outcome measures (95% CI of difference from baseline: VISA-A, -7.2 to 7.2; VAS, -15.8 to 9.6; LEFS, -4.44 to 7.33).

## **II**

This randomized trial (n=80, 20/group) examined two different exercise regimens and the ability of laser to augment these programs so it is also described in the exercise section.<sup>160</sup> The four arms of the study included placebo + daily exercise, LLLT + daily exercise, placebo + twice weekly exercise, and LLLT + twice weekly exercise. The key significant finding at 12 weeks was that the combination of LLLT + twice weekly exercise resulted in the greatest improvement in symptom severity over the 12 week period as measured by the VISA-A (18.5% (95 % CI 9.1 to 27.9%) achieving an average score near the ceiling of the VISA-A (score = 99). In addition, the differences between the placebo + daily exercise and LLLT + daily exercise, although not significant, favored LLLT + daily exercise by 8.2% (95 % CI -1.3 to 17.7). Although only the LLLT + twice weekly exercise was significant, the study was under powered to determine if laser was better than no laser. Leaving open the possibility that laser may have significant effects not just for specific exercise protocols but across different exercise protocols.

### **2017 Recommendation**

#### **D**

Clinicians may use low level laser therapy in patients with midportion Achilles tendinopathy after recommended interventions have failed to improve pain, stiffness or function.

## **ORTHOTICS**

### **2010 Recommendation**

#### **C**

A foot orthosis can be used to reduce pain and alter ankle and foot kinematics while running in patients with Achilles tendinopathy.

### **Evidence Update**

#### **II**

Two systematic reviews noted no effect of orthotics for patients with mid portion Achilles tendonopathy.<sup>107, 136</sup>

#### **I**

Munteanu et al<sup>112</sup> examined the effects of a custom orthotic compared with a sham orthotic. All subjects also participated in an eccentric exercise program. No difference was found in VISA-A scores at baseline, 1, 3, 6, and 12 months between the two groups.

### **2017 Recommendation**

#### **B**

Clinicians may use orthotics for documented foot impairments in patients with mid portion Achilles tendinopathy after the use of recommended interventions has failed to improve pain and/or function.

## **TAPING**

### **2010 Recommendation**

**F**

Taping may be used in an attempt to decrease strain on the Achilles tendon in patients with Achilles tendinopathy.

### **Evidence Update**

**IV**

A systematic review noted that one of two low level studies supported taping for mid portion Achilles tendonopathy.<sup>136</sup>

**IV**

A case-control study<sup>47</sup> examined the immediate effects of therapeutic elastic tape applied to the Achilles tendon and found application of tape did not improve hop distance or decrease pain.

### **2017 Recommendation**

**F**

Therapeutic elastic tape cannot be recommended to reduce pain or improve functional performance in patients with Achilles tendinopathy.

**F**

Clinicians may use rigid taping to decrease strain on the Achilles tendon and/or alter foot posture in patients with Achilles tendinopathy.

## **NEUROMUSCULAR RE-EDUCATION**

### **2010 No recommendation**

### **Evidence Update**

**IV**

Neuromuscular control among runners with midportion Achilles tendinopathy has been examined in several case-control studies.<sup>8, 11, 51</sup> Running studies identified patterns of decreased lower extremity muscle activity in participants with midportion Achilles tendinopathy compared to a control group.<sup>8, 11, 51</sup> However, it is unclear whether decreased muscle activity is a cause or a result of midportion Achilles tendinopathy and whether an intervention targeting these altered patterns of muscle activity improve outcomes.

### **2017 Recommendation**

**F**

Clinicians may use neuromuscular exercises targeting lower extremity impairments that may lead to abnormal kinetics and/or kinematics, specifically eccentric overload of the Achilles tendon during weight-bearing activities.

## **DRY NEEDLING**

### **2010 No recommendation**

#### **Evidence Update**

##### **IV**

In a case series study by Yeo et al<sup>173</sup> subjects received tendon injection of marcaïne (tendon decompression) followed by dry needling in conjunction with a 4-week eccentric exercise program. Pain VAS scores (0-100) during rest and activity decreased by 24 and 39.1% respectively at 6 weeks post-procedure. At 12 and 24 months, 77% and 76% had high or very high satisfaction levels.

### **2017 Recommendation**

##### **F**

Individuals with mid portion Achilles tendinopathy for greater than 3 months and increased tendon thickness may be treated using combined therapy of dry needling with injection under ultrasound guidance and eccentric exercise to decrease pain.

## **INTERVENTIONS OUTSIDE THE SCOPE OF PHYSICAL THERAPY**

Summaries were not provided in 2010 for corticosteroid injection, extracorporeal shockwave therapy, and platelet-rich plasma Injections.

## **CORTICOSTEROID INJECTION**

### **2017 Summary**

A systematic review of randomized controlled trials of corticosteroid injections for all types of tendinopathy concluded that an initial short-term benefit is not maintained at intermediate and long-term follow-up.<sup>22</sup> Although the risk of a tendon rupture is low, other minor complications are more common including post injection pain, subcutaneous atrophy, and skin depigmentation.<sup>22</sup> Wetke et al<sup>167</sup> found positive short-term benefits of glucocorticosteroid injections in an observational study of patients with Achilles tendinopathy (Midportion: n=75, Insertional: n=18) who did not respond to exercises alone. The combination of exercises and glucocorticosteroid injections resulted in good long-term outcomes (94% reported improvement and 77% reported excellent or good result).<sup>167</sup>

## **EXTRACORPOREAL SHOCKWAVE THERAPY**

### **2017 Summary**

Extracorporeal shockwave therapy (ESWT) when combined with eccentric exercise for Achilles tendinopathy is supported in some systematic reviews with improvement in VISA-A, pain, and functional improvement.<sup>52, 62, 107, 136, 156</sup> The only systematic review to perform a meta-analysis noted no effect favoring ESWT alone, however, qualitative evidence favors ESWT when combined with eccentric exercise.<sup>156</sup> Two case series studies also provide low level evidence in support of the use of ESWT.<sup>142, 158</sup> Saxena et al<sup>142</sup> demonstrated significant improvement with ESWT on a ranking of daily and recreational activities at 1 year follow up with a total of 78% of the patients considering themselves improved. Taylor et al<sup>158</sup> studied ESWT in patients that failed initial therapy

(average length of symptoms of 20 months) with mid portion Achilles tendinopathy. At 2 year follow up patients demonstrated an improvement in the VISA-A from 40 at baseline to 66.<sup>158</sup> However, there was no difference in pain VAS between baseline and the 2-year follow up. In summary, there is high and low level evidence that ESWT benefits patients when combined with eccentric exercise and some evidence specific to patients with chronic Achilles tendinopathy. Evidence supporting ESWT alone and optimal dosage (e.g. high versus low energy) is unclear.

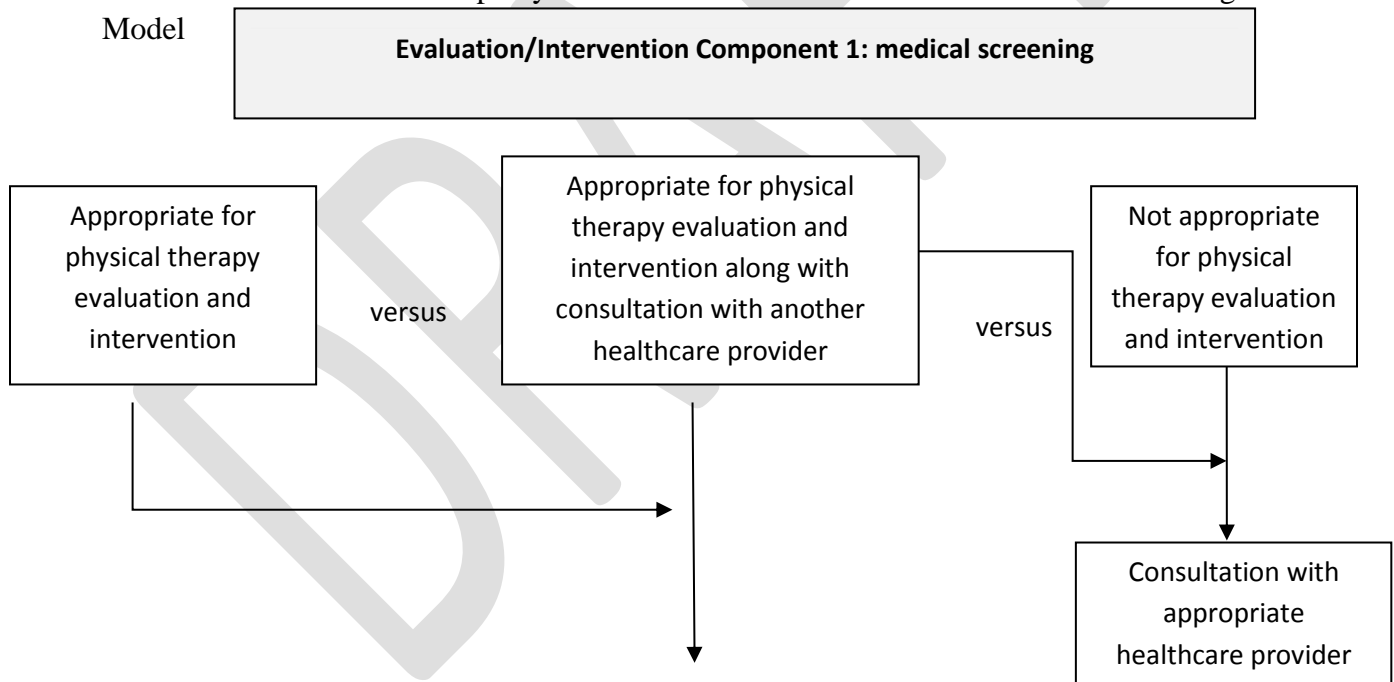
## PLATELET-RICH PLASMA INJECTION

### 2017 Summary

Systematic reviews determined high level evidence does not support the use of platelet-rich plasma injections for a variety of outcomes including, VISA-A, return to sport, ultrasound measures, function (eg. FAAM) for individuals with mid portion Achilles tendonopathy.<sup>38, 127, 137</sup>

A model to guide clinical decisions regarding evaluation, diagnosis, and treatment planning for individuals with Achilles Tendinopathy is provided below:

**FIGURE 1.** Achilles tendinopathy Evaluation/Intervention Guidelines Decision Making Model



### Key Clinical Findings of Achilles tendinopathy:

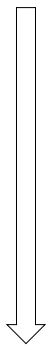
- Subjective report of pain located 2-6 cm proximal to the Achilles tendon insertion<sup>C</sup>
- Pain with palpation of the mid-portion of the tendon<sup>C</sup>
- Positive arc sign<sup>C</sup>
- Positive Royal London Hospital test<sup>C</sup>
- Negative examination findings that would suggest lumbopelvic region referred or radiating pain including reports of low back pain, provocation of lumbar and pelvic girdle structures, lower limb nerve tension, and neurological status examination<sup>F</sup>



**Measures to Assess Level of Functioning, Presence of Associated Physical Impairments to Address with Treatment, and Response to Treatment:**

- The VISA-A as a measure of symptom severity and FAAM as a measure of self-reported activity limitation and participation restriction<sup>A</sup>
- Pain Visual Analog Scale to assess pain<sup>F</sup>
- Active and passive talocrural dorsiflexion range of motion<sup>F</sup>
- Flexibility of the gastrocnemius and soleus muscle complex<sup>F</sup>
- Body mass index in nonathletic individuals<sup>F</sup>
- Clinical performance measures, such as hop and heel-rise endurance tests<sup>B</sup>
- Lower quarter musculoskeletal and biomechanical assessment, to include the following required elements of gait:<sup>F</sup>
  - 1<sup>st</sup> metatarsophalangeal joint range of motion and accessory mobility - to attain 65° of extension at pre-swing
  - Rearfoot /Talocalcaneal range of motion and accessory mobility - to attain 4° to 6° of eversion at loading response
  - Tibialis posterior strength and movement coordination to control mid-tarsal joint motion at loading response
  - Fibularis longus strength and movement coordination to control mid-tarsal joint motion at terminal stance
  - Talocrural dorsiflexion range of motion, accessory mobility, gastrocnemius/soleus muscle length and tissue mobility to attain 10° of dorsiflexion at terminal stance
  - Gastrocnemius/soleus strength and movement coordination to control tibial advancement at mid stance and propulsion at terminal stance
  - Knee joint and thigh muscle flexibility to attain 0° of extension at terminal stance and 60° of flexion at initial swing
  - Quadriceps femoris strength and movement coordination to control knee flexion at loading response
  - Hip joint mobility and muscle flexibility to attain 10° of extension at terminal stance
  - Trunk, buttock, and thigh strength and movement coordination to control lower limb internal rotation at loading response and hip adduction at loading response and mid stance





**Interventions- targeted to directly address physical impairments related to Achilles tendinopathy:**

- Eccentric or a heavy load slow speed exercise<sup>A</sup>
- Application of iontophoresis with dexamethasone<sup>B</sup>
  - Application is appropriate for individuals that present with acute pain
- Stretching plantar flexors with knee flexed and extended<sup>C</sup>
- Patient Education and Counseling<sup>E</sup>
  - Address/discuss strategies to gain or maintain optimal lean body mass, especially in nonathletic individuals with a high body mass index
  - Address/discuss shock absorbing insoles to mitigate commonly occurring weight loading stresses
- Manual Therapy<sup>F</sup>
  - Joint mobilization and manual stretching procedures to restore normal 1<sup>st</sup> metatarsophalangeal joint, tarsometatarsal joints, talocalcaneal, talocrural, knee, and hip mobility Soft tissue mobilization of gastrocnemius and soleus myofascial areas of soft tissue restriction
- Rigid Taping<sup>F</sup>
  - The primary focus is to decrease strain on the Achilles tendon and/or alter foot posture in patients with Achilles tendinopathy.
- Neuromuscular Re-education<sup>F</sup>
  - Strengthening and training of the muscles addressing lower extremity impairments that may lead to abnormal kinetics and/or kinematics, specifically produce an eccentric overload of the Achilles tendon during weight-bearing activities. The primary focus is to reduce walking and running gait abnormalities, as well as relevant and lower quarter musculoskeletal / biomechanical assessment findings.
- Dry needling<sup>F</sup>

A- Guidelines based on strong evidence

B- Guidelines based on moderate evidence

C- Guidelines based on weak evidence

D – Conflicting evidence

E- Guidelines based upon theoretical/foundational evidence

F- Guidelines based on expert opinion

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DRAFT

## APPENDIX A: SEARCH STRATEGIES FOR ALL DATABASES SEARCHED

Limits: 2009 to present (05/11/2015); human; English (published CPG search included articles published from February 1 2009 to present)

### Pubmed

History: 05/12/2015

Search	Add to builder	Query	Items found	Time
#21	Add	Search (#18 not #2) Filters: Publication date from 2009/01/01; English	601	12:50:43
#19	Add	Search (#18 not #2)	1424	12:50:43
#18	Add	Search (#16 or #17)	1515	12:49:05
#17	Add	Search ("achilles tendon"[MeSH Terms] OR ("achilles"[All Fields] AND "tendon"[All Fields]) OR "achilles tendon"[All Fields] OR "achilles"[All Fields]) AND ("tendinopathy"[MeSH Terms] OR "tendinopathy"[All Fields])	1425	11:31:17
#16	Add	Search ("achilles tendon"[MeSH Terms] OR ("achilles"[All Fields] AND "tendon"[All Fields]) OR "achilles tendon"[All Fields] OR "achilles"[All Fields]) AND ("tendinopathy"[MeSH Terms] OR "tendinopathy"[All Fields] OR "tendinitis"[All Fields])	1515	11:30:50
#2	Add	Search (animal not human)	3735987	09:46:42

### Cochrane

Search Name: Achilles CPG Cochrane 05122015 with Heather

Date Run: 12/05/15 16:09:42.256

Description:

ID Search Hits

#1 achilles and (tendinitis or tendino\* or tendono\* or paratendino\* or paratendono\* or pantendino\* or Pantendono\*):ti,ab,kw Publication Year from 2009 to 2015 (Word variations have been searched)

**CINAHL:**

Tuesday, May 12, 2015 11:48:18 AM

#	Query	Limiters/Expanders	Last Run Via
S4	S1 OR S2	Limiters - Published Date: 20090101-; English Language; Human Search modes - Find all my search terms	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL
S3	S1 OR S2	Search modes - Find all my search terms	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL
S2	achilles AND tendono* OR tendino* OR pantendino* OR pantendono* OR paratendino* OR paratendono*	Search modes - Find all my search terms	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL
S1	(MH "Achilles Tendinopathy")	Search modes - Find all my search terms	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL

**PEDro:**

Achilles AND tend\* from 2009 forward

**“Update” search strategies (May 15, 2015-April 12, 2016)****PEDro search run on 4/12/2016**

Achilles AND tend\* from 13/5/2016 forward

### PubMed search run 4/12/2016

Search	Query
<a href="#">#5</a>	Search (#2 NOT #1) AND 2015/05/12:2016 [edat] Filters: English
<a href="#">#4</a>	Search (#2 NOT #1) Filters: English
<a href="#">#3</a>	Search (#2 NOT #1)
<a href="#">#2</a>	Search (("achilles tendon"[MeSH Terms] OR ("achilles"[All Fields] AND "tendon"[All Fields]) OR "achilles tendon"[All Fields] OR "achilles"[All Fields]) AND ("tendinopathy"[MeSH Terms] OR "tendinopathy"[All Fields] OR "tendinitis"[All Fields]))
<a href="#">#1</a>	Search animal NOT human

### CINAHL search run on 4/12/2016

#	Query	Limiters/Expanders
S3	(S1 OR S2) AND EM 20150513-	Limiters - English Language; Human Search modes - Find all my search terms
S2	achilles AND ( tendono* OR tendino* OR pantendino* OR pantendono* OR paratendino* OR paratendono* )	Search modes - Find all my search terms
S1	(MH "Achilles Tendinopathy")	Search modes - Find all my search terms

### Cochrane search run on 4/12/2016

achilles and (tendinitis or tendino\* or tendono\* or paratendino\* or paratendono\* or pantendino\* or Pantendono\*):ti,ab,kw Publication Year from 2015 to 2016

## APPENDIX B: Search Results

Database	Platform	Original: Date conducted	Original: # results	Update: Date conducted	Update: # results
MEDLINE	PubMed	05/12/2015	601	04/12/2016 (From Entrez date of May 13, 2015)	112
Cochrane Library	Wiley	05/12/2015	69 Cochrane Reviews (4) Other Reviews (12) Trials (52) Economic Evaluations (1)	04/12/2016	10
CINAHL	EBSCO	05/12/2015	392	04/12/2016	9
PEDro	CEBP	05/12/2015	45	04/12/2016 (New records added from May 13, 2015 to current)	9
<b>Total</b>			1107		140
<b>Total with duplicates removed</b>			993 (duplicates=114)		129 (duplicates=11)

## Appendix C: Article Inclusion and Exclusion Criteria

### I. Article Characteristics:

#### Include:

- English
- Published from 2009 to present (published CPG search included articles published up to February 1 2009)
- Articles reporting analysis of data: systematic reviews, meta-analyses, experimental and quasi-experimental, cohort, case series (n>=10), and cross-sectional studies

#### Exclude (but we'll keep track of relevant ones so we can make sure we have the actual studies):

- Study protocols
- Abstracts, press report, newsletter, editorial letter
- Articles published in non-peer-reviewed publications (for example theses)
- Case reports (one patient/case) and Case-series with less than 10 patients

### II. Patient/Subject Characteristics:

#### Include:

- Studies using data from humans
- Subjects over 16 years of age (if mixed, the mean should be over 16)
- Subjects with Achilles tendinitis, tendinopathy, tendinosis
- If the article reports on Achilles tendinitis along with other conditions there must be at least enough patients (~n=15 each group) with achilles tendinitis AND the results must be reported for Achilles tendinitis separately.

#### Exclude:

- Articles on healthy/normal subjects

### III. Topics Included

#### A. For evidence update:

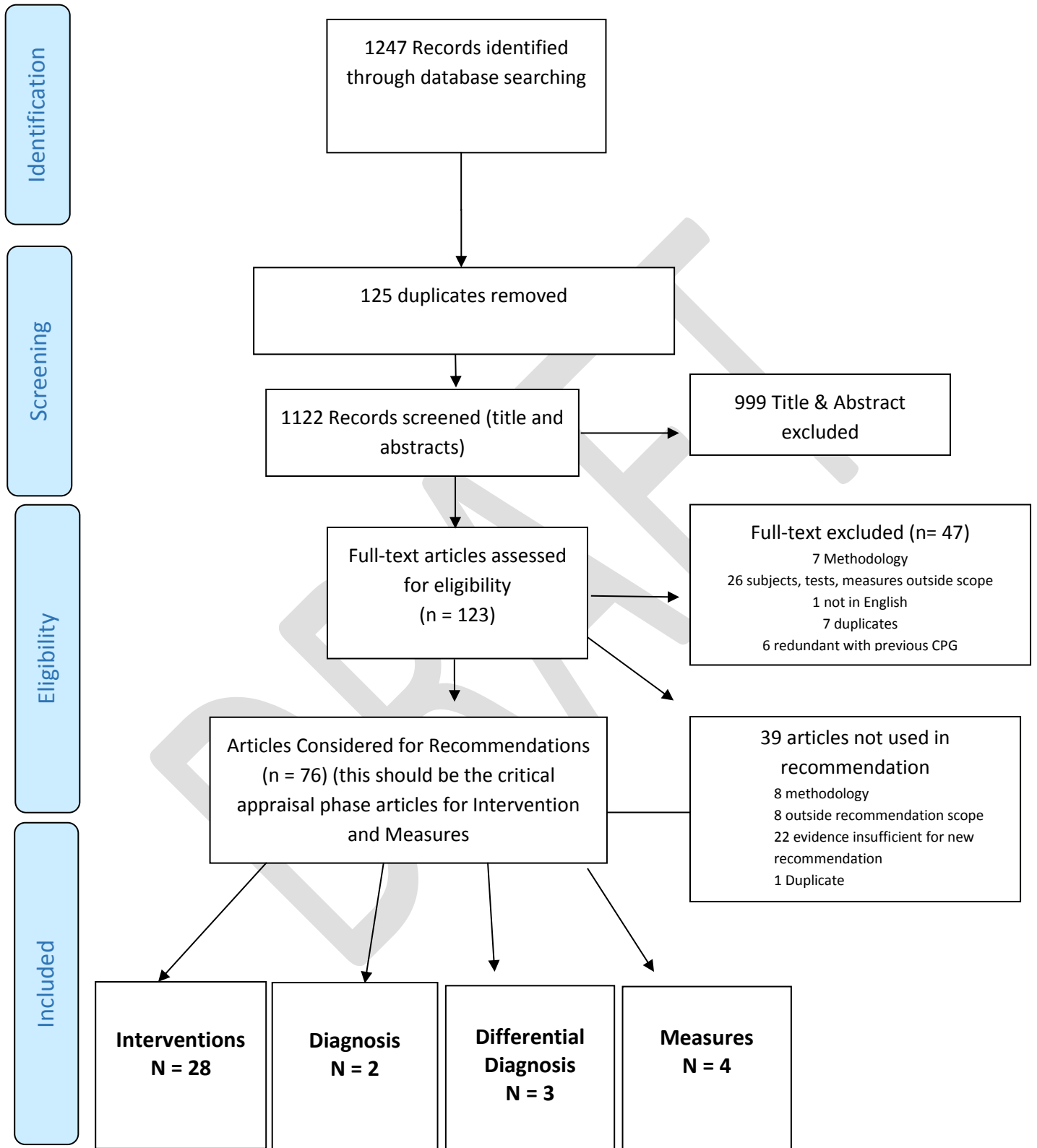
- Prevalence
- Pathoanatomic features: the functional anatomy of the ankle and foot relevant to Achilles tendinitis
- Risk factors
  - Intrinsic - e.g. decreased dorsiflexion range of motion, subtalar motion, plantar flexion strength, pronation, and health conditions/comorbidities such as obesity, hypertension, hyperlipidemia, and diabetes.
  - Extrinsic – e.g. training characteristics, environmental factors, equipment-related factors
- Prognosis
- Imaging studies

#### B. For Formal Systematic Review

- Classification systems including but not limited to Curwin and Stanish, Nirschl Pain Phase Scale of Athletic Overuse Injuries, and Puffer and Zachazewski scale.
- Tests and measures for diagnosis of Achilles tendinitis within the scope of physical therapist practice, including but not limited to Positive Achilles Palpation Test, plantar flexion range of motion, Unilateral Heel Rise Test, the Arc Sign, Victorian Institute of Sport Assessment, Foot and Ankle Ability Measure, Royal London Hospital test .
- Differential diagnosis including but not limited to: acute Achilles rupture, partial Achilles tear, retrocalcaneal bursitis, posterior ankle impingement, sural nerve neuroma or irritation, Os trigonum syndrome, accessory soleus, Achilles tendon ossification, systemic inflammatory disease, and insertional Achilles tendinopathy
- Measurement properties of outcome measures relevant for Achilles tendinitis, including but not limited to measures assessing:
  - Body Structures and Function
    - Truncated Arch Height Ratio
    - Arc Sign
    - Royal London Test
    - Forefoot Alignment
    - Achilles Tendon palpation test
    - Pain
    - Range of motion (dorsi, plantar, inv, ev)
    - Plantar flexion strength
    - Plantar flexion endurance
  - Activity: e.g. the Silbernagel battery
  - Participation
- Interventions within the scope of practice of physical therapists, including but not limited to:
  - Eccentric loading (may change to “exercise mode”)
  - Low level Laser Therapy
  - Iontophoresis
  - Stretching
  - Foot Orthoses
  - Manual Therapy
  - Taping
  - Heel Lifts
  - Shockwave



## APPENDIX D - Flow Diagram of articles leading to Recommendations.



## Appendix E:

### ARTICLES INCLUDED IN RECOMMENDATIONS BY TOPIC

#### Diagnosis

Hutchison AM, Evans R, Bodger O, et al. What is the best clinical test for Achilles tendinopathy? *Foot and ankle surgery : official journal of the European Society of Foot and Ankle Surgeons*. 2013;19:112-117.

Reiman M, Burgi C, Strube E, et al. The utility of clinical measures for the diagnosis of achilles tendon injuries: a systematic review with meta-analysis. *J Athl Train*. 2014;49:820-829.

#### Differential Diagnosis

Dalbeth N, Kalluru R, Aati O, Horne A, Doyle AJ, McQueen FM. Tendon involvement in the feet of patients with gout: a dual-energy CT study. *Annals of the rheumatic diseases*. 2013;72:1545-1548.

Morton S, Chan O, Webborn N, Pritchard M, Morrissey D. Tears of the fascia cruris demonstrate characteristic sonographic features: a case series analysis. *Muscles, ligaments and tendons journal*. 2015;5:299-304.

Pollock N, Dijkstra P, Calder J, Chakraverty R. Plantaris injuries in elite UK track and field athletes over a 4-year period: a retrospective cohort study. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA*. 2016;24:2287-2292.

#### Examination

##### Outcome Measures – Activity Limitations- Self Reported Measures

Dogramaci Y, Kalaci A, Kucukkubas N, Inandi T, Esen E, Yanat AN. Validation of the VISA-A questionnaire for Turkish language: the VISA-A-Tr study. *British journal of sports medicine*. 2011;45:453-455.

Iversen JV, Bartels EM, Jorgensen JE, et al. Danish VISA-A questionnaire with validation and reliability testing for Danish-speaking Achilles tendinopathy patients. *Scandinavian journal of medicine & science in sports*. 2015. 10.1111/sms.12576.

Kaux JF, Delvaux F, Oppong-Kyei J, et al. Validity and reliability of the French translation of the VISA-A questionnaire for Achilles tendinopathy. *Disability and rehabilitation*. 2016. 10.3109/09638288.2016.11385531-7.

##### Activity Limitations – Physical Performance Measures

Macdermid JC, Silbernagel KG. Outcome Evaluation in Tendinopathy: Foundations of Assessment and a Summary of Selected Measures. *The Journal of orthopaedic and sports physical therapy*. 2015;45:950-964.

## Interventions

### Exercise

- Beyer R, Kongsgaard M, Hougs Kjaer B, Ohlenschlaeger T, Kjaer M, Magnusson SP. Heavy Slow Resistance Versus Eccentric Training as Treatment for Achilles Tendinopathy: A Randomized Controlled Trial. *The American journal of sports medicine*. 2015;43:1704-1711.
- de Jonge S, de Vos RJ, Weir A, et al. One-year follow-up of platelet-rich plasma treatment in chronic Achilles tendinopathy: a double-blind randomized placebo-controlled trial. *The American journal of sports medicine*. 2011;39:1623-1629.
- de Vos RJ, Heijboer MP, Weinans H, Verhaar JA, van Schie JT. Tendon structure's lack of relation to clinical outcome after eccentric exercises in chronic midportion Achilles tendinopathy. *Journal of sport rehabilitation*. 2012;21:34-43.
- de Vos RJ, Weir A, Tol JL, Verhaar JA, Weinans H, van Schie HT. No effects of PRP on ultrasonographic tendon structure and neovascularisation in chronic midportion Achilles tendinopathy. *British journal of sports medicine*. 2011;45:387-392.
- de Vos RJ, Weir A, van Schie HT, et al. Platelet-rich plasma injection for chronic Achilles tendinopathy: a randomized controlled trial. *Jama*. 2010;303:144-149.
- Frizziero A, Trainito S, Oliva F, Nicoli Aldini N, Masiero S, Maffulli N. The role of eccentric exercise in sport injuries rehabilitation. *British medical bulletin*. 2014;110:47-75.
- Habets B, van Cingel RE. Eccentric exercise training in chronic mid-portion Achilles tendinopathy: a systematic review on different protocols. *Scandinavian journal of medicine & science in sports*. 2015;25:3-15.
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**APPENDIX F. LEVELS OF EVIDENCE TABLE\***

Level	Intervention/ Prevention	Pathoanatomic/Risk/ Clinical Course/Prognosis/ Differential Diagnosis	Diagnosis/Diagnostic Accuracy	Prevalence of Condition/Disorder	Exam/Outcomes
I	Systematic review of high-quality RCTs High-quality RCT†	Systematic review of prospective cohort studies High-quality prospective cohort study‡	Systematic review of high-quality diagnostic studies High-quality diagnostic study§ with validation	Systematic review, high-quality cross-sectional studies High-quality cross-sectional study	Systematic review of prospective cohort studies High-quality prospective cohort study
II	Systematic review of high-quality cohort studies High-quality cohort study‡ Outcomes study or ecological study Lower-quality RCT¶	Systematic review of retrospective cohort study Lower-quality prospective cohort study High-quality retrospective cohort study Consecutive cohort Outcomes study or ecological study	Systematic review of exploratory diagnostic studies or consecutive cohort studies High-quality exploratory diagnostic studies Consecutive retrospective cohort	Systematic review of studies that allows relevant estimate Lower-quality cross-sectional study	Systematic review of lower-quality prospective cohort studies Lower-quality prospective cohort study
III	Systematic reviews of case-control studies High-quality case-control study Lower-quality cohort study	Lower-quality retrospective cohort study High-quality cross-sectional study Case-control study	Lower-quality exploratory diagnostic studies Nonconsecutive retrospective cohort	Local nonrandom study	High-quality cross-sectional study
IV	Case series	Case series	Case-control study		Lower-quality cross-sectional study
V	Expert opinion	Expert opinion	Expert opinion	Expert opinion	Expert opinion

Abbreviation: RCT, randomized clinical trial.

\*Adapted from Phillips et al62 (<http://www.cebm.net/index.aspx?o=1025>). See also **APPENDIX G**.

†High quality includes RCTs with greater than 80% follow-up, blinding, and appropriate randomization procedures.

‡High-quality cohort study includes greater than 80% follow-up.

§High-quality diagnostic study includes consistently applied reference standard and blinding.

|| High-quality prevalence study is a cross-sectional study that uses a local and current random sample or censuses

Weaker diagnostic criteria and reference standards, improper randomization, no blinding, and less than 80% followup may add bias and threats to validity.

## APPENDIX G. PROCEDURES FOR ASSIGNING LEVELS OF EVIDENCE

- Level of evidence is assigned based on the study design using the Levels of Evidence table (**APPENDIX F**), assuming high quality (eg, for intervention, randomized clinical trial starts at level I)
- Study quality is assessed using the critical appraisal tool, and the study is assigned 1 of 4 overall quality ratings based on the critical appraisal results
- Level of evidence assignment is adjusted based on the overall quality rating:
  - High quality (high confidence in the estimate/results): study remains at assigned level of evidence (eg, if the randomized clinical trial is rated high quality, its final assignment is level I). High quality should include:
    - Randomized clinical trial with greater than 80% follow-up, blinding, and appropriate randomization procedures
    - Cohort study includes greater than 80% follow-up
    - Diagnostic study includes consistently applied reference standard and blinding
    - Prevalence study is a cross-sectional study that uses a local and current random sample or censuses
  - Acceptable quality (the study does not meet requirements for high quality and weaknesses limit the confidence in the accuracy of the estimate): downgrade 1 level
    - Based on critical appraisal results
  - Low quality: the study has significant limitations that substantially limit confidence in the estimate: downgrade 2 levels
    - Based on critical appraisal results
  - Unacceptable quality: serious limitations - exclude from consideration in the guideline
    - Based on critical appraisal results

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