

CLINICAL GUIDELINES

**ROBROY L. MARTIN, PT, PhD • TODD DAVENPORT, DPT  
STEPHEN REISCHL, DPT • THOMAS G. MCPOIL, PT, PhD • JAMES W. MATHESON, DPT  
DANE K. WUKICH, MD • CHRISTINE M. MCDONOUGH, PT, PhD**

**Heel Pain —Plantar Fasciitis: Revision 2014**

*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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**Reviewers:** Roy D. Altman, MD • Paul Beattie PT, PhD • Mark Cornwall, PT, PhD  
Irene Davis, PT, PhD • John DeWitt, DPT • James Elliott PT, PhD • James J. Irrgang, PT, PhD  
Sandra Kaplan, PT, PhD • Stephen Paulseth, DPT, MS • Leslie Torburn, DPT • James Zachazewski, DPT

For author, coordinator, contributor, and reviewer affiliations see end of text. ©2014 Orthopaedic Section American Physical Therapy Association (APTA), Inc, and the *Journal of Orthopaedic & Sports Physical Therapy*. The Orthopaedic Section, APTA, Inc., and the *Journal of Orthopaedic & Sports Physical Therapy* consent to the reproducing and distributing this guideline for educational purposes. Address correspondence to: Joseph Godges, DPT, ICF-based Clinical Practice Guidelines Coordinator, Orthopaedic Section, APTA Inc., 2920 East Avenue South, Suite 200; La Crosse, WI 54601. Email: icf@orthopt.org

**HEEL PAIN –PLANTAR FASCIITIS: CLINICAL PRACTICE GUIDELINES REVISION  
2014**

**ROBROY L. MARTIN, PT, PhD • TODD DAVENPORT, DPT  
STEPHEN REISCHL, DPT • THOMAS G. MCPOIL, PT, PhD • JAMES W. MATHESON, DPT  
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**SUMMARY OF RECOMMENDATIONS\***

	<b>Risk Factors</b>
<b>B</b>	Clinicians should consider limited ankle dorsiflexion range of motion and a high body mass index in nonathletic populations and may consider running and work-related weight bearing activities, particularly under conditions with poor shock absorption, as factors predisposing individuals to develop heel pain/plantar fasciitis.
	<b>Diagnosis/Classification</b>
<b>B</b>	<p>Pain in the plantar medial heel region; most noticeable with initial steps after a period of inactivity but also worse following prolonged weight bearing; and often precipitated by a recent increase in weight bearing activity are useful clinical findings for classifying an individual with heel pain into the ICD category of plantar fasciitis and the associated ICF impairment-based category of heel pain (b28015 Pain in lower limb; b2804 Radiating pain in a segment or region).</p> <p>In addition, the following physical examination measures may be useful in classifying an individual with heel pain into the ICD category of plantar fasciitis and the associated ICF impairment- based category of heel pain (b28015 Pain in lower limb; b2804 Radiating pain in a segment or region).</p> <ul style="list-style-type: none"> <li>• Palpation of proximal plantar fascia insertion</li> <li>• Active and passive talocrural joint dorsiflexion range of motion</li> <li>• The tarsal tunnel test</li> <li>• The windlass test</li> <li>• The longitudinal arch angle</li> <li>• Foot Posture Index</li> </ul>
	<b>Differential Diagnosis</b>
<b>C</b>	Clinicians should consider diagnostic classifications other than heel pain/plantar fasciitis when the individual’s reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the individual’s symptoms are not resolving with interventions aimed at normalization of the individual’s impairments of body function.
	<b>Examination – Outcome Measures</b>
<b>A</b>	Clinicians should use validated self-report questionnaires, such as the Foot and Ankle

	Ability Measure (FAAM), Foot Health Status Questionnaire (FHSQ), or the Foot Function Index (FFI), before and after interventions intended to alleviate the physical impairments, functional limitations, and activity restrictions associated with heel pain/plantar fasciitis.
	<b>Examination - Activity Limitation and Participation Restriction Measures</b>
F	Clinicians should utilize easily reproducible activity limitation and participation restriction measures to assess the changes in the patient's level of function associated with heel pain/plantar fasciitis over the episode of care
	<b>Interventions: Manual Therapy</b>
A	Clinicians should use manual therapy consisting of joint and soft tissue mobilization procedures to treat relevant lower extremity joint mobility and calf flexibility deficits and improve function in individuals with heel pain.
	<b>Interventions: Night Splints</b>
A	Clinicians should prescribe a 1 to 3 month program of night splints for individuals with heel pain/plantar fasciitis who have not responded to other interventions and who consistently have pain with the first step in the morning.
	<b>Interventions: Foot Orthoses</b>
A	Clinicians should use foot orthoses that provide support to the medial longitudinal arch and cushion to the heel area as an intervention to reduce pain and improve function for short (2 weeks) to long-term (1 year) periods in individuals with heel pain/plantar fasciitis.
	<b>Interventions: Taping</b>
A	Clinicians should use anti-pronation taping for immediate (up to 3 weeks) pain reduction and improved function for individuals with heel pain/plantar fasciitis. Additionally, clinicians may use kinesiotaping applied to the gastrocnemius and plantar fascia for short term (1 week) pain reduction.
	<b>Interventions: Stretching</b>
A	Clinicians should use plantar fascia-specific and gastrocnemius/soleus stretching to provide short-term (1 week to 4 months) pain relief for individuals with heel pain/plantar fasciitis. Heel pads may be used to increase the benefits of stretching. Transient pain associated with stretching should be carefully weighed on an individual basis against the likelihood of beneficial effects.
	<b>Interventions: Physical Agents</b>
D	<i>Electrotherapy:</i> Clinicians can use iontophoresis to provide short-term (2 to 4 weeks) pain relief and improved function. However, clinicians should use manual therapy, stretching, and orthoses, instead of electrotherapeutic modalities, to promote intermediate and long-term (1 month to 6 months) improvements in clinical outcomes for individuals with heel pain/plantar fasciitis.

C	<i>Low Level Laser:</i> Clinicians may use low level laser therapy to reduce pain and activity limitations in individuals with heel pain/plantar fasciitis.
C	<i>Phonophoresis:</i> Clinicians may use phonophoresis with ketoprofen gel to reduce pain in individuals with heel pain/plantar fasciitis.
C	<i>Ultrasound:</i> Clinicians may or may not utilize ultrasound for individuals with heel pain/plantar fasciitis.
	<b>Interventions: Footwear</b>
C	Clinicians can prescribe a rocker-bottom shoe construction in conjunction with a foot orthoses for managing heel pain/plantar fasciitis.
	<b>Interventions: Education and Counseling</b>
E	Clinicians can provide education and counseling on exercise strategies to gain or maintain optimal lean body mass in individuals with heel pain/plantar fasciitis.
	<b>Interventions: Dry Needling</b>
F	Clinicians may utilize trigger point dry needling to reduce the duration of care in individuals with heel pain/plantar fasciitis.

\*These recommendations and clinical practice guidelines are based on the scientific literature published prior to January 2013.

## **INTRODUCTION**

### **AIM OF THE GUIDELINES**

The Orthopaedic Section of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based practice guidelines 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).<sup>90</sup>

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 in light of the clinical data presented by the patient, the diagnostic and treatment options available, 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 Heel Pain-Plantar Fasciitis 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 concepts associated with heel pain or plantar fasciitis in articles published from 2007 related to classification, examination, and intervention strategies for heel pain or plantar fasciitis consistent with previous guideline development methods related to ICF classification.<sup>91</sup> Briefly, the following databases were searched from 2007 to between December 13, 2012 and December 19, 2012: MEDLINE (PubMed; 2007 to date); Cochrane Library (Wiley; 2007 to date); Web of Science (Web of Knowledge; 2007 to date); CINAHL (EBSCO; 2007 to date); ProQuest Dissertations and Abstracts (ProQuest; 2007 to date); PEDro (Centre of Evidence-Based Physiotherapy; 2007 to date); ProQuest Nursing and Allied Health Source. (ProQuest; 2007 to date) [See Appendix A for full search strategies and Appendix B for search dates and results, available at [www.orthopt.org](http://www.orthopt.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 clinical practice guideline (CPG) development team for travel to training and CPG development training and expenses. 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 heel pain/plantar fasciitis. 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.orthopt.org](http://www.orthopt.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.orthopt.org](http://www.orthopt.org)]. For selected relevant topics that were not appropriate for the development of recommendations, such as shockwave therapy, injection and imaging, articles were not subject to systematic review process and were not included in the flow chart.

This guideline was issued in 2014 based on the published literature up to December 2012. This guideline will be considered for review in 2017, 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>59</sup> In 3 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 evidence table and details on procedures used for assigning levels of evidence, available at [www.orthopt.org](http://www.orthopt.org)]. An abbreviated version of the grading system is provided below.

I	Evidence obtained from high quality diagnostic studies, prospective studies, or randomized controlled trials
II	Evidence obtained from lesser-quality diagnostic studies, 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 and heel pain/plantar fasciitis population. In developing their recommendations, the reviewers 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
A	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	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C	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
D	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

## REVIEW PROCESS

The Orthopaedic Section, APTA also selected content experts and stakeholders to serve as reviewers of the early drafts of these clinical practice guidelines. The draft was posted for comment on the website of the Orthopaedic Section of the American Physical Therapy Association. The authors used the feedback from the reviewer and website comments to inform final revisions.

## CLASSIFICATION

The primary ICD-10 code and condition associated with heel pain is **M72.2 Plantar Fascial fibromatosis/Plantar fasciitis**.<sup>91</sup> Other, secondary ICD-10 codes and conditions associated with heel pain are **G57.5 Tarsal tunnel syndrome** and **G57.6 Lesion of plantar nerve/Morton's metatarsalgia**.<sup>91</sup>

The primary ICF body function codes associated with plantar fasciitis, tarsal tunnel syndrome, and plantar nerve lesions are the sensory functions related to pain. These body function codes are **b28015 Pain in lower limb** and **b2804 Radiating pain in a segment or region**.

The primary ICF body structure codes associated with plantar fasciitis are **s75023 Ligaments and fasciae of ankle and foot** and **s75028 Structures of ankle and foot, neural**.

The primary ICF activities and participation codes associated with plantar fasciitis are **d4500 Walking short distances**, **d4501 Walking long distances**, and **d4154 Maintaining a standing position**.

A comprehensive list of codes was published in the previous guideline.<sup>55</sup>



For each topic, we first present the summary recommendation from the 2008 guideline with its grade of recommendation at that time, followed by the 2014 recommendation with its grade. Finally, we provide the syntheses of the recent literature supporting the recommendation and indicate the corresponding evidence levels.

## **CLINICAL GUIDELINES**

### **Impairment/Function-Based Diagnosis**

#### **PREVALANCE**

##### **2008 Summary**

Plantar fasciitis is the most common foot condition treated by healthcare providers. It has been estimated that plantar fasciitis occurs in approximately 2 million Americans each year and affects as much as 10% of the population over the course of a lifetime. In 2000, the Foot and Ankle Special Interest Group of the Orthopaedic Section, APTA, surveyed over 500 members and received responses from 117 therapists. Of those responding, 100% indicated that plantar fasciitis was the most common foot condition seen in their clinic. Rome et al<sup>65</sup> reported that plantar fasciitis accounts for 15% of all adult foot complaints requiring professional care and is prevalent in both nonathletic and athletic populations. Taunton et al<sup>77</sup> conducted a retrospective case-control analysis of 2002 individuals with running-related injuries who were referred to the same sports medicine center. They reported that plantar fasciitis was the most common condition diagnosed in the foot and represented 8% of all injuries.

##### **2007 to 2013 Update**

The prevalence of pain in the hindfoot or heel region is high in both non-athletic and athletic populations. In athletic populations, plantar fasciitis is a common injury reported by both high school, competitive, and recreational distance runners.

#### **II**

A systematic review of ankle and foot overuse injuries that occurred in numerous sporting activities (54,851 athletes in total) found that soccer, running, gymnastics and dance accounted for 50% of all studies included in review.<sup>71</sup> In this review, Achilles tendinopathy, plantar fasciitis, and stress fractures were the most commonly reported injuries.<sup>71</sup>

#### **II**

In a systematic review assessing the frequency of running-related musculoskeletal injuries, 8 studies (pooled n = 3500 runners) were included in the review.<sup>49</sup> The incidence of plantar fasciitis ranged from 4.5% to 10% with the prevalence ranging from 5.2% to 17.5%.<sup>49</sup>

#### **III**

In a 2-year longitudinal cohort study involving 3,206 individuals ranging from 20 to 75 years of age and older living in southern Australia, 17.4% reported having foot pain.<sup>33</sup> Of these individuals, hindfoot pain was the second most common site of pain with the highest prevalence noted in the 20 to 34 year and greater than 75 year old groups.<sup>33</sup>

### III

In a retrospective assessment of previous overuse injuries in 748 high school runners between 13 and 18 years, 481 runners reported a previous injury.<sup>78</sup> Plantar fasciitis accounted for 8% of the reported previous injuries with the incidence greater in female runners.<sup>78</sup>

### III

In a prospective assessment of non-traumatic foot and lower limb injuries in 166 runners, involved in various running specialties, 59% (98) indicated they had developed an overuse injury with 31% (30) reporting plantar fasciitis.<sup>19</sup>

## PATHOANATOMICAL FEATURES

### 2008 Summary

Clinicians should assess for impairments in muscles, tendons, and nerves, as well as the plantar fascia, when a patient presents with heel pain.

### 2007 to 2013 Update

Increased plantar fascia thickness was found to relate to symptoms<sup>22, 86, 92</sup> with altered compressive properties of the fat pad in those with plantar heel pain.<sup>87</sup> Changes in plantar fascia thickness was found to positively correlate to changes in pain levels for individuals with plantar fasciitis receiving treatment.<sup>51</sup> In persons with general foot and ankle related disability, pain-related fear of movement was the strongest single contributor to disability.<sup>47</sup> An area of future research may look at fear avoidance behaviors and their role in disability in patients with plantar fasciitis.<sup>47, 74</sup>

## CLINICAL COURSE

### 2008 Summary

Based on long-term follow-up data in case series comprised primarily of patients seen in an orthopaedic outpatient setting, the clinical course for most patients was positive, with 80% reporting resolution of symptoms within a 12-month period.<sup>54, 89</sup>

### 2007 to 2013 Update

Additionally, heel pain/plantar fasciitis usually presents as a chronic condition with symptom duration being greater than 1 year on average prior to seeking treatment. In 2 retrospective cohort studies involving 432 individuals diagnosed with chronic plantar heel pain, the mean duration of symptoms ranged from 13.3 to 14.1 months.<sup>39, 93</sup> In one study that divided individuals (n=182) with plantar heel pain based on an acute (less than 6 months) versus chronic (6 months or more) classification, the mean duration of symptoms for the acute group was 3.1 months and was 25.7 months for the chronic group.<sup>39</sup>

## **RISK FACTORS**

### **2008 Recommendations**

#### **B**

Clinicians should consider limited ankle dorsiflexion range of motion and a high body mass index in nonathletic populations as factors predisposing patients to the development of heel pain/plantar fasciitis.

### **2007 to 2013 Update**

#### **II**

Running was found to be a risk factor for developing plantar fasciitis.<sup>49,71</sup> Street running, spiked shoes, cavus foot and hind foot varus were related to the onset of plantar fasciitis in a group of runners.<sup>19</sup>

#### **III**

Other studies have also found plantar fasciitis to be common among runners<sup>78</sup> with increase arch height as a potential risk factor.<sup>64</sup> Greater rates of vertical ground reaction forces and a lower medial longitudinal arch were found in females runners with a history of plantar fasciitis.<sup>60</sup>

#### **III**

A systematic review found a strong association between increased body mass index and chronic plantar heel pain in a non-athletic population.<sup>7</sup> Two additional studies found body mass index to be a risk factor for developing plantar fasciitis,<sup>36,39</sup> however, did not find a difference in body mass index between those with an acute or chronic condition.<sup>39</sup>

#### **III**

In assembly line worker, risk factors for plantar fasciitis included time spent standing on hard surfaces, time spent walking, times jumping in and out of the vehicle (for the truck/forklift drivers), and 4-7 years of factory work. Shoe rotation during the work week was found to reduce the risk of plantar fasciitis.<sup>88</sup>

#### **IV**

A high arch foot type<sup>68</sup> and decreased ankle dorsiflexion range of motion<sup>57</sup> were identified as risk factors for developing plantar fasciitis. Also, a correlation was found between decrease hamstring flexibility,<sup>41</sup> leg length discrepancy (with pain in the longer limb)<sup>50</sup> and plantar fasciitis.

#### **IV**

An area of future research may include the role of intrinsic muscle strength<sup>9</sup> as well as the fall risk in elderly.<sup>8,81</sup>

### **2014 Recommendations**

#### **B**

Clinicians should consider limited ankle dorsiflexion range of motion and a high body mass index in nonathletic populations and may consider running and work-related weight bearing

activities, particularly under conditions with poor shock absorption, as factors predisposing patients to develop heel pain/plantar fasciitis.

## **DIAGNOSIS/CLASSIFICATION**

### **2008 Recommendations**

#### **B**

Pain in the plantar medial heel region; most noticeable with initial steps after a period of inactivity but also worse following prolonged weight bearing; and often precipitated by a recent increase in weight bearing activity are useful clinical findings for classifying a patient with heel pain into the ICD category of plantar fasciitis and the associated ICF impairment-based category of heel pain (b28015 Pain in lower limb; b2804 Radiating pain in a segment or region).

In addition, the following physical examination measures may be useful in classifying a patient with heel pain into the ICD category of plantar fasciitis and the associated ICF impairment-based category of heel pain (b28015 Pain in lower limb; b2804 Radiating pain in a segment or region).

- Palpation of proximal plantar fascia insertion
- Active and passive talocrural joint dorsiflexion range of motion
- The tarsal tunnel test
- The windlass test
- The longitudinal arch angle

### **2007 to 2013 Update**

#### **III**

In a case control study in which 80 individuals with chronic plantar heel pain (CPHP) were matched with 80 control participants, the CPHP group had a more pronated foot posture than the controls when assessed with the Foot Posture Index (FPI-6). The mean FPI-6 score for the CPHP group was  $2.4 \pm 3.3$  versus  $1.1 \pm 2.3$  for the controls.<sup>36</sup> The FPI-6<sup>15</sup> was based on 6 criteria to assess foot posture in individuals with chronic plantar heel pain.<sup>62</sup>

#### **IV**

A leg length discrepancy<sup>50</sup> and limitation in hamstring flexibility<sup>41</sup> were present in individuals diagnosed with plantar fasciitis.

### **2014 Recommendations**

#### **B**

Pain in the plantar medial heel region; most noticeable with initial steps after a period of inactivity but also worse following prolonged weight bearing; and often precipitated by a recent increase in weight bearing activity are useful clinical findings for classifying a patient with heel pain into the ICD category of plantar fasciitis and the associated ICF impairment-based category of heel pain (b28015 Pain in lower limb; b2804 Radiating pain in a segment or region).

In addition, the following physical examination measures may be useful in classifying a patient with heel pain into the ICD category of plantar fasciitis and the associated ICF impairment-

based category of heel pain (b28015 Pain in lower limb; b2804 Radiating pain in a segment or region).

- Palpation of proximal plantar fascia insertion
- Active and passive talocrural joint dorsiflexion range of motion
- The tarsal tunnel test
- The windlass test
- The longitudinal arch angle
- Foot Posture Index

## **DIFFERENTIAL DIAGNOSIS**

### **2008 Recommendations**

#### **F**

Clinicians should consider diagnostic classifications other than heel pain/plantar fasciitis when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

### **2007 to 2013 Update**

#### **III**

In a retrospective study of 250 individuals with signs and symptoms of plantar heel pain, 53.2% were diagnosed with plantar fasciitis and 15% with fat pad atrophy. The individuals with fat pad atrophy were more likely to have pain aggravated by prolonged standing (odds ratio = 20.91), night pain (odds ratio = 20.94), and bilateral pain (odds ratio = 24.95) without first-step pain in the morning.<sup>93</sup>

#### **IV**

Individuals with unilateral plantar heel pain had a reduction in the energy dissipation properties of the heel pad when compared to the uninvolved side.<sup>87</sup>

#### **IV**

In a retrospective study of 275 individuals diagnosed with spondyloarthritis, plantar heel pain was reported in 47.1% and plantar heel pain was the first symptom reported by 15.7% of all individuals.<sup>40</sup>

#### **IV**

In a retrospective study of 100 pathology specimens from 97 individuals diagnosed with recalcitrant plantar fasciitis, 25% of the specimens had a histological appearance of plantar fibroma.<sup>30</sup>

## **2014 Recommendations**

### **C**

Clinicians should consider diagnostic classifications other than heel pain/plantar fasciitis when the patient's reported activity limitations or impairments of body function and structure are not consistent with those presented in the diagnosis/classification section of this guideline, or, when the patient's symptoms are not resolving with interventions aimed at normalization of the patient's impairments of body function.

## **IMAGING STUDIES**

### **2008 Summary**

Imaging studies are typically not necessary for the diagnosis of plantar fasciitis. Imaging would appear to be most useful to rule out other possible causes of heel pain or to establish a diagnosis of plantar fasciitis if the healthcare provider is in doubt. Plantar fascia thickness and fat pad abnormalities observed from radiographs are the 2 best factors for group differentiation of plantar fasciitis.<sup>56</sup> Evidence of calcaneal spurs is not a key radiographic feature to distinguish differences in individuals with plantar fasciitis in comparison to controls.<sup>56</sup>

### **2007 to 2013 Update**

#### **III**

Diagnostic ultrasound may be used to assess plantar fascia thickness because a decrease in plantar fascia thickness has been associated with a reduction in heel pain symptoms. In a case control prospective study, 30 individuals with plantar fascia pain who underwent a diagnostic ultrasound examination had a significantly thicker fascia in comparison to a control group of 33 individuals. In addition, individuals with plantar fascia pain that reported an improvement in symptoms demonstrated a decrease in the fascia thickness.<sup>22</sup> In a case series of 30 individuals (39 feet) diagnosed with plantar fasciitis, 29 feet (74.4%) demonstrated a decrease in subjective pain that was associated with a reduction in the thickness of the plantar fascia as determined by diagnostic ultrasound.<sup>51</sup>

# CLINICAL GUIDELINES

## Examination

### OUTCOME MEASURES

#### 2008 Recommendations

##### A

Clinicians should use validated self-report questionnaires, such as the Foot Function Index (FFI), Foot Health Status Questionnaire (FHSQ), or the Foot and Ankle Ability Measure (FAAM), before and after interventions intended to alleviate the physical impairments, functional limitations, and activity restrictions associated with heel pain/plantar fasciitis. Physical therapists should consider measuring change over time using the FAAM as it has been validated in a physical therapy practice setting.

#### 2007 to 2013 Update

##### III

A computer-adaptive version of the Lower Extremity Functional Scale (LEFS) was found to have evidence of validity, reliability, and responsiveness using 10,287 patients with foot and ankle related impairments (46% were missing diagnoses).<sup>31</sup> Seven items were found to produce a precise estimate of functional status on average and a change score of 8 functional units (0-100 scale) represented a minimal clinically important improvement.<sup>31</sup>

##### III

Minimal important difference (MID) values for FSHQ and Visual Analogue Scale (VAS) for pain levels were defined in 2 interventional studies for patients with plantar fasciitis.<sup>43, 44</sup> The MID values for the FSHQ were as follows: pain subscale 13 points,<sup>44</sup> 14 points<sup>43</sup>, function subscale 7 points,<sup>43, 44</sup> footwear domain -2 points,<sup>44</sup> and general foot health domain points 0 points.<sup>44</sup> The MID on the VAS was -8mm<sup>44</sup> and -9mm<sup>43</sup> for average pain and -19mm<sup>44</sup> for pain on first step.

##### III

A review found the FAAM and FHSQ to have evidence for content validity, construct validity, reliability, and responsiveness for patients with plantar fasciitis in orthopaedic physical therapy.<sup>53</sup>

#### 2014 Recommendations

##### A

Clinicians should use validated self-report questionnaires, such as the Foot and Ankle Ability Measure (FAAM), Foot Health Status Questionnaire (FHSQ), or the Foot Function Index (FFI), before and after interventions intended to alleviate the physical impairments, functional limitations, and activity restrictions associated with heel pain/plantar fasciitis.

## **ACTIVITY LIMITATION MEASURES**

### **2008 and 2014 Recommendations**

#### **F**

Clinicians should utilize easily reproducible activity limitation and participation restriction measures to assess the changes in the patient's level of function associated with heel pain/plantar fasciitis over the episode of care

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# CLINICAL GUIDELINES

## Interventions

### MANUAL THERAPY

#### 2008 Recommendations

##### E

There is minimal evidence to support the use of manual therapy and nerve mobilization procedures short-term (1 to 3 months) for pain and function improvement. Suggested manual therapy procedures include: talocrural joint posterior glide, subtalar joint lateral glide, anterior and posterior glides of the first tarsometatarsal joint, subtalar joint distraction manipulation, soft tissue mobilization near potential nerve entrapment sites, and passive neural mobilization procedures.

#### 2007 to 2013 Update

##### I

Data from a randomized clinical trial supports the effectiveness of exercise and multimodal manual therapy directed to lower extremity joints to reduce symptoms and disablement, particularly within the first 4 weeks of treatment. Brantingham and colleagues<sup>6</sup> conducted a systematic review of studies that documented the clinical effect of manual therapy on various lower quarter conditions. The authors included a study by Cleland and colleagues<sup>12</sup> that compared the effects of iontophoresis and manual therapy, respectively, combined with exercise on clinical outcomes associated with plantar heel pain. The home exercise program consisted of calf and plantar fascia stretching. All patients received a total of 6 treatment sessions over a 4-week period. Patients randomized to receive manual therapy (n=30) underwent assertive calf soft tissue mobilization, followed by pragmatically applied manual therapy to the hip, knee, ankle, and/or foot combined with a specific follow-up home exercises for self-mobilization. Numeric pain rating scale (0-10), self-reported foot and ankle function measured using the Lower Extremity Functional Scale and the Foot and Ankle Ability Measure, and a global patient self-rating (Global Rating of Change) each were obtained at before treatment, as well as 4 weeks and 6 months following enrollment. Small but significant between-groups difference favoring the manual therapy group in numeric pain rating scores were found at 4 weeks (-1.5; 95% confidence interval: -0.4, -2.5) but were not present at 6 months. However, clinically and statistically significant between-groups differences in self-reported function and global patient self-rating that favored the manual therapy group were noted at both 4 weeks and 6 months.<sup>12</sup>

##### I

Evidence from a randomized clinical trial found that soft tissue mobilization techniques directed to musculature of the lower leg were associated with improved disability and pain pressure threshold measurements in individuals with plantar heel pain. Renan-Ordine and colleagues<sup>63</sup> randomized 60 individuals with plantar heel pain to receive either a self-stretching protocol (n=30) or soft tissue mobilization pragmatically directed to gastrocnemius and soleus trigger points in addition to the self-stretching protocol. All patients received intervention 4 times weekly for 4 weeks. Outcome measures were assessed before and immediately after intervention, including the Medical Outcome Survey Short Form-36 (SF-36), Physical Function and Bodily Pain subscales and mechanical pressure algometry over the gastrocnemius, soleus,

and calcaneus of the affected foot. Both groups demonstrated significant improvement in SF-36 subscale scores immediately following 4 weeks of intervention in disability and mechanical pressure algometry, with a significant group by time effect favoring the group receiving self-stretching and trigger point manual therapy. However, the 95% confidence interval for change in disability measures in each group included the minimal clinical important difference (MCID), so the clinical relevance of the documented change in disability should be interpreted with caution. Pain pressure threshold measurements demonstrated significant improvement in both groups, with a significant group by time interaction effect favoring the group that received self-stretching and trigger point manual therapy.<sup>63</sup>

## **2014 Recommendations**

### **A**

Clinicians should use manual therapy consisting of joint and soft tissue mobilization procedures to treat relevant lower extremity joint mobility and calf flexibility deficits and improve function in individuals with heel pain.

## **NIGHT SPLINTS**

### **2008 Recommendations**

#### **B**

Night splints should be considered as an intervention for patients with symptoms greater than 6 months in duration. The desired length of time for wearing the night splint is 1 to 3 months. The type of night splint used (ie, posterior, anterior, sock-type) does not appear to affect the outcome.

### **2007 to 2013 Update**

#### **I**

Lee et al<sup>46</sup> randomized patients with plantar fasciitis into 2 groups: foot orthoses and night splint versus foot orthoses alone. At 8 weeks following intervention, the group with the combination of night splint and orthoses had greater reduction in mean pain visual analogue score and greater improvement in self-reported function, as measured by the Foot Function Index, than the group with foot orthoses alone.<sup>46</sup>

#### **I**

Sheridan et al,<sup>70</sup> randomized patients with plantar fasciopathy into a control group receiving nonsteroidal anti-inflammatory medication, foot orthoses, and corticosteroid injections and an experimental group that had the same intervention with the addition of an ankle dorsiflexion dynamic splint. There was a significant positive difference in the mean change pain/disability scores in the group treated with the ankle dorsiflexion dynamic splint when compared to the control group.<sup>70</sup>

#### **II**

Beyzadeoglu and Becker<sup>4</sup> used a prospective non-randomized design to study the effect of the addition of the night splint to a program of heel cushions, medication, and stretching in patients with plantar fasciitis. This study compared a group of patients who did not want to use a night splint versus those that agreed to use the splint for 8 weeks. The results show that the patients

with the night splint had significantly better improvement compared to those that did not chose to use the night splint.<sup>4</sup>

## **II**

Attard and Singh<sup>3</sup> compared posterior versus anterior night splints in 15 patients with heel pain. Each patient used both devices for a 6-week period. Both devices reduced pain via the VAS, but the posterior night splint was tolerated less with more complaints of sleep disruption.<sup>3</sup>

## **II**

A systematic review by Landorf and Menz<sup>42</sup> did not find a benefit for the addition of night splints over oral NSAID for individuals with heel pain and plantar fasciitis. Comparing patients using casted foot orthoses versus casted foot orthoses and night splint also showed no difference.<sup>42</sup>

### **2014 Recommendations**

#### **A**

Clinicians should prescribe a 1 to 3 month program of night splints for individuals with heel pain/plantar fasciitis who have not responded to other interventions and who consistently have pain with the first step in the morning.

## **FOOT ORTHOSES**

### **2008 Recommendations**

#### **A**

Prefabricated or custom foot orthoses can be used to provide short term (3 months) reduction in pain and improvement in function. There appear to be no differences in the amount of pain reduction or improvement in function created by custom foot orthoses in comparison to prefabricated orthoses. There is currently no evidence to support the use of prefabricated or custom foot orthoses for long term (1 year) pain management or function improvement.

### **2007 to 2013 Update**

#### **I**

The Cochrane Review by Hawke et al<sup>32</sup> found the following results regarding individuals diagnosed with plantar fasciitis: custom orthoses were more effective than sham orthoses in improving function but not for reducing pain after 3 and 12 months; custom orthoses were not more effective than non-custom foot orthoses in reducing pain or improving function after 8-12 weeks or 12 months; custom orthoses were not more effective than night splints but increased the effectiveness of night splints in reducing pain and improving function after 6-12 weeks; custom orthoses did not increase the effectiveness of Achilles' tendon and plantar fascia stretching or night splints intervention in reducing pain after 6-8 weeks; custom orthoses were less effective than a combined treatment of manipulation, mobilization, and/or stretching in reducing pain after 2 weeks, but not after 4-8 weeks.<sup>32</sup> Similar conclusions were reported by others,<sup>42, 45</sup> including a meta-analysis that noted short, intermediate, and long-term period improvements occur regardless of specific orthotic design<sup>45</sup> and findings that custom may be no better than prefabricated orthoses in those with heel pain/ plantar fasciitis.<sup>42</sup>

### **I**

The review by Hume et al<sup>34</sup> found prefabricated semi-rigid foot orthoses to have a moderately beneficial effect compared to sham orthoses in reducing pain and improving function over a 3 to 12 month period in individuals with plantar fasciitis. Customized rigid orthotics were found to have moderately beneficial effect compared with anti-inflammatories and when compared with stretching for a positive final assessment and perceived better outcome, respectively.<sup>34</sup> Similar findings were noted in the systematic review by Uden et al<sup>82</sup> who concluded that a customized functional foot orthoses can lead to a decrease in pain and increase functional ability in those with plantar fasciitis.<sup>82</sup>

### **I**

In individuals with plantar fasciitis, Lee et al<sup>46</sup> found an accommodative pressure relieving orthoses when combined with night splint intervention reduced pain and improved function at 2 and 8 week follow-up periods.

### **I**

Al-Bluwi et al<sup>2</sup> noted a foot orthoses that supported medial arch and cushioned heel when combined with NSAID produced a decrease in pain at the 6 month follow-up period when compared to NSAID and physical therapy and NSAID, physical therapy, and local injection.

### **II**

Marabha et al<sup>52</sup> reported that a silicon heel pad combined with plantar fascia stretching, intrinsic foot strengthening, and steroid injection reduced pain at 1 and 3 month follow-up periods in patients with plantar fasciitis.

### **II**

In patients with plantar fasciitis Stratton et al<sup>73</sup> noted the use of plantar fascia-specific stretching and prefabricated foot orthoses provided pain relief and improvement in function at the 3 month follow-up.

### **II**

Drake et al<sup>21</sup> found first-step heel pain decreased and function improved at 2, 4, and 12 weeks follow-up periods in individuals with plantar fasciitis treated with a temporary custom foot orthosis used for 2 weeks, followed by a stretching program.

### **III**

In patient with plantar fasciitis, Chia et al<sup>11</sup> reported that both pre-fabricated and custom orthoses were useful in distributing rearfoot pressure while heel pads increased rearfoot pressure. Bonanno et al<sup>5</sup> found that prefabricated foot orthoses were more effective at reducing pressure under the heel when compared to a silicon heel cup, soft foam heel pad, and heel lift in older people (>65 years of age) with heel pain.

### **III**

Van Lunen et al<sup>84</sup> noted that a heel pain orthosis (heel cup with rearfoot control) produced immediate decrease in walking mean plantar pressure and pain when walking and jogging compared with the controls.

### **IV**

A systematic review and meta-analysis performed by Collins et al<sup>13</sup> supported the use of foot orthoses in the prevention of overuse conditions but found no difference between the use of custom and prefabricated foot orthoses. Cheung et al<sup>10</sup> performed a meta-analysis and found custom to be more effective than prefabricated foot orthoses but not as effective as taping in controlling rearfoot motion.

### **IV**

Ferber and Benson<sup>23</sup> studied healthy individuals and found that plantar fascia strain was reduced by 34% when walking in either the molded or non-molded semi-custom orthoses. However, they did not find differences in peak rearfoot eversion, tibial internal rotation, or medial longitudinal arch angles between no orthoses, molded or non-molded semi-custom orthoses.<sup>23</sup> In those with common foot complaints, an insole created specifically for foot complaint and arch height did not produce any difference in plantar pressure redistribution. Therefore, it was concluded that basic insoles may be sufficient for all patient groups.<sup>72</sup> Improvement in economy of gait was found with both prefabricated and custom foot orthoses. However, only the custom orthoses maintained this improvement over 4 weeks.<sup>79</sup>

## **2014 Recommendations**

### **A**

Clinicians should use foot orthoses that provide support to the medial longitudinal arch and cushion to the heel area as an intervention to reduce pain and improve function for short (2 weeks) to long-term (1 year) periods in individuals with heel pain/plantar fasciitis.

## **TAPING**

## **2008 Recommendations**

### **C**

Calcaneal or low-Dye taping can be used to provide short-term (7 to 10 days) pain relief. Studies indicate that taping does cause improvements in function.

## **2007 to 2013 Update**

### **I**

The results of a systematic review looking at the efficacy of taping on plantar heel pain (fasciosis) performed by van de Water and Speksnijder<sup>83</sup> noted strong evidence for decreasing pain at 1 week follow-up, inconclusive results for change in level of disability, and evidence that taping can have an additional benefit when added to a stretching program. Similar results were found in the systematic review by Landorf and Menz<sup>42</sup> as they found moderate evidence that taping was more effective than no taping at 1 week for reducing pain with first-step and taping

was more effective than sham taping at improving pain at 1 week. However, taping was not more effective than no treatment at 1 week for improving function.<sup>42</sup>

## **I**

Tsai et al<sup>80</sup> found that kinesiotaping applied to the gastrocnemius and plantar fascia improved pain scores and reduced plantar fascia thickness when compared to ultrasound and electrotherapy alone at 1 week follow-up in patient with plantar fasciitis.

## **II**

In patients with plantar fasciitis anti-pronation (low-Dye) taping was found to reduce pain and improve function over a 3-week period. Taping was not more effective than a medial longitudinal arch support.<sup>1</sup> Also, anti-pronation taping (augmented low-dye) produced an immediate decrease in mean walking plantar pressure and pain when walking and jogging compared with the controls.<sup>84</sup>

## **IV**

Anti-pronation taping was found to reduce calcaneal eversion,<sup>10</sup> increase arch height,<sup>25, 27, 28, 94</sup> increase plantar pressures in the lateral midfoot, decrease pressure in the medial forefoot and rearfoot,<sup>85</sup> reduce tibialis posterior and tibialis anterior muscle activity,<sup>27-29</sup> decrease foot motion, and limit ankle abduction and plantar flexion.<sup>29</sup> These changes were diminished 48 hours after application.<sup>94</sup> Also, low-Dye taping was less effective than the other taping techniques, such as high-Dye and stirrups taping.<sup>10</sup> These findings were consistent with a review performed by Franettovich et al.<sup>26</sup>

## **2014 Recommendations**

### **A**

Clinicians should use anti-pronation taping for immediate (up to 3 weeks) pain reduction and improved function for individuals with heel pain/plantar fasciitis. Additionally, clinicians may use kinesiotaping applied to the gastrocnemius and plantar fascia for short term (1 week) pain reduction.

## **STRETCHING**

## **2008 Recommendations**

### **B**

Calf muscle and/or plantar fascia-specific stretching can be used to provide short-term (2 to 4 months) pain relief and improvement in calf muscle flexibility. The dosage for calf stretching can be either 3 times a day or 2 times a day utilizing either a sustained (3 minutes) or intermittent (20 seconds) stretching time, as neither dosage produced a better effect.

## **2007 to 2013 Update**

### **I**

Evidence from 2 systematic reviews suggests stretching of the ankle and foot provides short-term clinical benefit for individuals with heel pain/plantar fasciitis.<sup>42, 75</sup> Landorf and Menz<sup>42</sup> found no

studies that compared the effect of stretching to no stretching in individuals with plantar heel pain. The review by Landorf and Menz<sup>42</sup> reported results that found the addition of a heel pad to a gastrocnemius/soleus and plantar aponeurosis stretching could improve clinical outcomes<sup>58</sup> and plantar fascia stretching may be of more benefit than Achilles stretching.<sup>20</sup> A more recent systematic review by Sweeting and colleagues<sup>75</sup> concluded the main pain-relieving benefits of stretching appear to occur within the first 2 weeks to 4 months but could not support one method of stretching over another as being more effective for reducing pain or improving function. This review did include a study by Radford et al<sup>61</sup> that noted adverse effects, which included increased pain in the heel, calf and other areas of the lower limb, in 10 out of 46 participants within the stretching group.

## **II**

In 102 patients with proximal plantar fasciopathy, Rompe et al<sup>66</sup> reported significantly improved Foot Function Index scores when comparing plantar fascia-specific stretching to shock-wave therapy at 2 and 4 month follow-up ( $P < .002$ ). However, at 15 month follow-up no significant between-group difference was found.<sup>66</sup>

### **2014 Recommendations**

#### **A**

Clinicians should use plantar fascia-specific and gastrocnemius/soleus stretching to provide short-term (1 week to 4 months) pain relief for individuals with heel pain/plantar fasciitis. Heel pads may be used to increase the benefits of stretching. Transient pain associated with stretching should be carefully weighed on an individual basis against the likelihood of beneficial effects.

## **PHYSICAL AGENTS**

### **Electrotherapy**

#### **2008 Recommendations**

#### **B**

Dexamethasone 0.4% or acetic acid 5% delivered via iontophoresis can be used to provide short-term (2 to 4 weeks) pain relief and improved function.

#### **2007 to 2013 Update**

#### **I**

Data from a randomized clinical study failed to support the use of iontophoresis over manual therapy for patients with plantar heel pain. Cleland and colleagues<sup>12</sup> compared the effects of iontophoresis and manual therapy, respectively, combined with exercise on clinical outcomes associated with plantar heel pain. All patients received a home exercise program that consisted of calf and plantar fascia stretching. Patients who were randomized to receive iontophoresis ( $n=30$ ) underwent therapeutic ultrasound (3 MHz, 1.5 W/cm<sup>2</sup>, 100-Hz frequency, 20% duty cycle for 5 minutes) to enhance transdermal permeability followed by iontophoresis with dexamethasone (40 mA-min total dose). All patients received a total of 6 treatment sessions over a 4-week period. Numeric pain rating scale (0-10), foot and ankle function (Lower Extremity Functional Scale and Foot and Ankle Ability Measure), and global patient self-rating (Global

Rating of Change) measures were obtained before treatment, as well as 4 weeks and 6 months following enrollment. A small but significant between-groups difference in numeric pain rating scores was present at 4 weeks (-1.5; 95% confidence interval: -0.4 to -2.5) favoring the manual therapy group, but this difference in pain scores was not present at 6 months. However, clinically and statistically significant between-groups differences in self-reported foot and ankle function and global patient self-rating that favored the manual therapy group were noted at both 4 weeks and 6 months.<sup>12</sup>

## **I**

A randomized trial by Stratton et al<sup>73</sup> found the addition of low-frequency electrical stimulation did not provide any benefit to the effectiveness of plantar fascia-specific stretching and prefabricated foot orthoses over a 3 month period. Stratton and colleagues<sup>73</sup> provided prefabricated foot orthoses and plantar fascia-specific stretching to patients with plantar fasciitis (n=26). These interventions were to be used daily in the context of a home-based program. In addition, the authors randomized patients with plantar fasciitis (n=13) to receive either low frequency electrical stimulation (10-Hz frequency for 20 minutes) in the context of home-based program or no additional treatment (n=13). Outcome measurements consisted of visual analogue pain ratings, Foot and Ankle Ability Measure - Activities of Daily Living subscale, which were collected before intervention, after 4 weeks of intervention, and at the 3-month follow-up. Both treatment groups demonstrated significant reductions in visual analogue pain measurement and significant improvements in function measurements over time, there were not significant between-groups differences in either pain reduction or function improvement.<sup>73</sup>

## **2014 Recommendations**

### **D**

Clinicians can use iontophoresis to provide short-term (2 to 4 weeks) pain relief and improved function. Clinicians should use manual therapy, stretching, and orthoses, instead of electrotherapeutic modalities, to promote intermediate and long-term (1 month to 6 months) improvements in clinical outcomes for individuals with heel pain/plantar fasciitis.

## **Low Level Laser Therapy**

### **2008**

No recommendation.

### **2007 to 2013 Update**

#### **I**

A randomized and placebo-controlled study provided evidence for using low level laser therapy for pain reduction but not for altering plantar fascia morphology in individuals with heel pain/plantar fasciitis. Kiritsi and colleagues<sup>38</sup> studied the effects of gallium-arsenide infrared diode laser and placebo irradiation, respectively, on visual analogue scale pain rating and sonographic measurements of plantar fascia morphology. Study treatments were completed 3 times weekly for 6 weeks. Data for 25 patients who completed the entire study protocol were analyzed. Pain measurements demonstrated statistically significant but clinically small effects favoring low level laser therapy for night rest pain (laser group:  $21 \pm 24.3$ , placebo group:



38±10.3) and daily activities (laser group: 28±24.3, placebo group: 50±15.9). Pre- and post-treatment plantar fascia thickness measurements were not significantly different between groups, although both groups demonstrated significant improvement on the post-treatment plantar fascia thickness measurements.

## **2014 Recommendations**

### **C**

Clinicians may use low level laser therapy to reduce pain and activity limitations in individuals with heel pain/plantar fasciitis.

*Supplemental note regarding low level laser therapy:*

### **I**

Data from one randomized study that was published outside the review timeframe for this guideline revision failed to support the clinical effectiveness of low-level laser therapy to address symptoms in individuals with plantar fasciitis. Basford and colleagues analyzed data from 31 patients with plantar heel pain who were randomized to receive either gallium arsenide infrared diode laser or placebo irradiation 3 times weekly for 4 weeks. Dependent measures included morning pain, pain with toe walking, tenderness to palpation, windlass test response, medication consumption, and orthotic use. All dependent measures were obtained before the study, at the treatment midpoint, at the end of treatment, as well as 1 month following the last study treatment. In addition, data regarding potential adverse effects were collected. No significant difference between treatment groups was documented for any measures at any study time point. The active low-level laser therapy treatment was well-tolerated, with 96% of patients reporting no adverse effects.

## **Phonophoresis**

### **2008**

No recommendation

### **2007 to 2013 Update**

### **II**

Data from 1 small, randomized study supports the use of phonophoresis compared to ultrasound. Jasiak-Tyrkalska and colleagues<sup>37</sup> randomized patients with plantar heel pain and plantar calcaneal spur (n=40) to receive a warm whirlpool bath, orthopedic shoe inserts, and exercise followed by either phonophoresis (n=20; ketoprofen gel - dose was undocumented) or ultrasound (n=20; 1 MHz frequency, 1 W/cm<sup>2</sup> maximum power, 20% pulsed duty cycle). Treatments were performed for 6-8 minutes on 5 days per week for 3 consecutive weeks. Outcome measurements included visual analog scale pain rating, range of motion measurements of ankle plantar flexion and supination, and muscle strength of the ankle plantar flexor and foot supinator muscle groups using the Lovett scale. Measurements were taken at the beginning of the study and immediately following the final intervention. Small but significant improvements in pain intensity, range of motion, and muscle strength were observed in both groups. A between-group comparison only

was reported for post-intervention pain intensity, which was small but statistically significant difference (mean difference: 2.1; 95%CI: 1.4 to 2.8) in favor of phonophoresis.

#### **2014 Recommendation**

**C**

Clinicians may use phonophoresis with ketoprofen gel to reduce pain in individuals with heel pain/plantar fasciitis.

#### **Ultrasound**

**2008**

No recommendation.

#### **2007 to 2013 Update**

**III**

A review by Shanks et al<sup>69</sup> concluded that there is currently no high quality evidence available to support therapeutic ultrasound in the treatment of musculoskeletal conditions of the lower limb. This review included a study by Crawford and Snaith<sup>18</sup> who found ultrasound (0.5 W/cm<sup>2</sup> power, 3 MHz frequency, 1:4 pulsed duty cycle) delivered for 8, 8-minute sessions at a frequency of twice weekly for 4 weeks no more effective than a sham treatment in treating those with heel pain.

#### **2014 Recommendation**

**C**

Clinicians may or may not utilize ultrasound for individuals with heel pain/plantar fasciitis.

#### **FOOTWEAR**

**2008**

No recommendation.

#### **2007 to 2013 Update**

**III**

Ryan and colleagues<sup>67</sup> randomized 21 patients with chronic plantar fasciitis to receive a standardized exercise program and either ultraflexible running shoes or conventional training shoes. Two-way analysis of variance for footwear and time demonstrated significant main effects for reduction in pain but no significant footwear by time interaction. Two patients (17%) who received ultra-flexible shoes dropped out of the study secondary to increased pain. These findings indicate significant improvement in both groups, but improvement did not favor either type of footwear.<sup>67</sup>

**III**

Fong et al<sup>24</sup> reported that the combination of rocker shoes and foot orthoses produced an immediate lower visual analog scale pain score (9.7 mm) when compared to rocker shoes (30.9

mm) and foot orthoses (29.5 mm) alone. The combination of rocker shoes and foot orthoses also significantly reduced medial heel pain when compared to rocker shoes and foot orthoses alone.<sup>24</sup>

#### **IV**

Cheung and colleagues<sup>10</sup> in their systematic review of motion control interventions found foot orthoses, motion control footwear, and taping all controlled rearfoot eversion with taping being the most effective. In healthy individuals, plantar heel pressures are positively associated with shoe heel height.<sup>14</sup> In addition, rocker shoes reduced loading of the plantar aponeurosis.<sup>48</sup>

### **2014 Recommendations**

#### **C**

Clinicians can prescribe a rocker-bottom shoe construction in conjunction with a foot orthoses for managing heel pain/plantar fasciitis.

## **EDUCATION FOR WEIGHT LOSS**

### **2008**

No recommendation.

### **2007 to 2013 Update**

#### **IV**

In a systematic review by Butterworth et al,<sup>7</sup> 12 of the 25 articles in their search results were related to chronic plantar heel pain conditions. These authors reported a strong association between greater body mass index and chronic plantar heel pain in non-athletic populations. Limited, weak level of evidence showed some change in pain following weight loss.<sup>7</sup>

#### **IV**

Tanamas et al<sup>76</sup> reported higher body mass index, and specifically fat mass as opposed to muscle mass, to be strongly associated with generalized foot pain and disability in their cohort.

### **2014 Recommendations**

#### **E**

Clinicians can provide education and counseling on exercise strategies to gain or maintain optimal lean body mass in patients with heel pain/plantar fasciitis.

## **DRY NEEDLING**

### **2008**

No recommendation.

### **2007 to 2013 Update**

#### **III**

A recent systematic review indicates there is limited evidence to support the clinical benefit of trigger point dry needling for patients with plantar heel pain to reduce treatment duration.<sup>16</sup>

Included in the systematic review, Imamura and colleagues<sup>35</sup> conducted a non-randomized study, in which they compared a group receiving trigger point dry needling with a group receiving a standardized program of physical agents and home exercises. Trigger point dry needling consisted of repetitive insertion of 22-25 gauge needles into the medial head of gastrocnemius, soleus, tibialis posterior, popliteus, abductor hallucis, fibularis longus, and flexor digitorum brevis followed by 0.1% lidocaine injection into the identified trigger points. Outcome measurements included pain rating on the visual analog scale (0-10) and pain pressure threshold by way of algometry, which were obtained at discharge, 6 months after discharge, and 2 years after discharge. Duration of treatment was significantly less in the trigger point dry needling group ( $3.2 \pm 2.2$  visits) compared to the physical agents and exercise group ( $21.1 \pm 19.5$  weeks). At discharge, significant improvement in relative pain intensity was documented in both groups (trigger point dry needling group: 58.4% improvement; physical agents/exercise group: 54.9% improvement). However, between groups differences were not substantially different for discharge pain ratings, and unreported at 6 months and 2-year time points. Between-groups differences for pressure pain algometry were unreported at all measurement time points.<sup>35</sup>

## **2014 Recommendations**

### **F**

Clinicians may utilize trigger point dry needling to reduce the duration of care in individuals with heel pain/plantar fasciitis.

### ***Supplemental note regarding trigger point dry needling recommendation:***

#### **I**

One noteworthy randomized clinical trial was published after the inclusive search dates for this clinical practice guideline. Cotchett and colleagues<sup>17</sup> investigated the effect of trigger point dry needling compared to sham dry needling intervention on symptoms and disablement associated with plantar heel pain. The authors randomized 84 patients with a clinical diagnosis of plantar fasciitis to receive one 30-minute treatment per week for 6 weeks of either penetrating needles (n=41) or non-penetrating needles (n=41) over pragmatically assessed myofascial trigger points in the ankle, foot, and lower leg. Primary outcome measures included, which VAS rating of pain with the first step out of bed in the morning (0-100 mm), and patient global foot health rating on a scale from 0 (worst foot health) to 100 (best foot health), and Foot Health Status Questionnaire (FHSQ) score, which were assessed at baseline and 2, 4, 6, and 12 weeks after enrollment into the study. There was a significant effect of decreased pain and improved FHSQ score over time in the study, and the difference between groups was significant at 6-week follow-up but at no other time point. The clinical relevance of the observed statistically significant mean difference in FHSQ score between groups remains questionable, because the mean difference did not meet the minimal clinical important difference (MCID). Overall, the observed number needed to treat to achieve the MCID on VAS 'first step' pain rating and FHSQ score was 4 (95% CI: 2-12). Adverse events were noted in approximately one-third of patients in the dry needling group. Harms were minor and transient in nature, including immediate needle insertion pain, increased plantar heel pain symptoms, and delayed bruising. The observed number needed to harm for immediate and delayed adverse events was 3 (95% CI: 1-3).<sup>17</sup>

## **INTERVENTIONS: OTHER**

Patients may seek advice from clinicians regarding the potential efficacy of medications and extracorporeal shockwave therapy as part of a comprehensive non-surgical management plan for heel pain/plantar fasciitis. In particular, intra-lesional corticosteroid injections (ICSI) are a widespread practice for the management of heel pain/plantar fasciitis. This section is intended to assist physical therapists, patients, and other stakeholders in effective multi-disciplinary management of heel pain/plantar fasciitis.

### **Corticosteroid Injections**

#### **2007 to 2013 Update**

##### **I**

There is limited evidence supporting the effectiveness of intra-lesional corticosteroid injections (ICSI) as a first-tier intervention for heel pain/plantar fasciitis, because the benefits do not offset the risk for harms including long-term disablement. The results of 2 systematic reviews failed to yield evidence favoring any substantive clinical benefit of ICSI for patients with heel pain/plantar fasciitis.<sup>42, 82</sup> Potential harms associated with ICSI may include injection site pain, infection, subcutaneous fat atrophy, skin pigmentation changes, plantar fascia rupture, peripheral nerve injury, and muscle damage.<sup>42, 82</sup>

### **Extracorporeal Shockwave Therapy**

#### **2007 to 2013 Update**

##### **I**

Extracorporeal shock wave therapy does not appear to be more effective in reducing pain than stretching and therapeutic ultrasound. The systematic review by Landorf and Menz<sup>42</sup> found 6 randomized control trials and noted the better-quality studies did not favor ESWT and identified the potential for adverse effects as a result of treatment.

## AFFILIATIONS & CONTACTS

### Authors:

**RobRoy L. Martin, PT, PhD**  
Professor  
Department of Physical Therapy  
Duquesne University  
Pittsburgh, PA  
martinr280@duq.edu  
and  
Staff Physical Therapist  
Center for Rehab Services  
University of Pittsburgh Medical Center  
Pittsburgh, PA

**Todd Davenport, DPT**  
Associate Professor  
Department of Physical Therapy  
University of Pacific  
Stockton, CA  
tdavenport@pacific.edu

**Stephen Reischl, DPT**  
Adjunct Associate Professor of Clinical  
Physical Therapy  
Division of Biokinesiology and Physical  
Therapy at Herman Ostrow School of Dentistry  
University of Southern California  
Los Angeles, CA  
reischl@usc.edu

**Thomas G. McPoil, PT, PhD**  
Professor  
School of Physical Therapy  
Rueckert-Hartman College of Health  
Professions  
Regis University  
Denver, CO  
tmcpoil@regis.edu

**James W. Matheson, DPT**  
President and Clinic Director  
Catalyst Sports Medicine  
Hudson, WI  
jw@eipconsulting.com

**Dane K. Wukich, MD**  
Chief, Division of Foot and Ankle Surgery  
Assistant Professor of Orthopaedic Surgery

### Reviewers

**Roy D. Altman, MD**  
Professor of Medicine  
Division of Rheumatology and Immunology  
David Geffen School of Medicine at UCLA  
Los Angeles, CA  
journals@royaltman.com

**Paul Beattie PT, PhD**  
Clinical Professor  
Division of Rehabilitative Sciences  
University of South Carolina  
pbeattie@gwm.sc.edu

**Mark Cornwall, PT, PhD**  
Professor  
Department of Physical Therapy  
Northern Arizona University  
Flagstaff, Arizona  
markcornwall@nau.edu

**Irene Davis, PT, PhD**  
Director, Spaulding National Running Center  
Department of Physical Medicine and Rehabilitation  
Harvard Medical School  
Spaulding-Cambridge Outpatient Center  
isdavis@partners.org

**John DeWitt, DPT**  
Director of Physical Therapy Sports & Orthopaedic  
Residencies  
The Ohio State University  
Columbus, OH  
john.dewitt@osumc.edu

**James M. Elliott, PT, PhD**  
NUPTHMS, Feinberg School of Medicine  
Northwestern University  
Chicago, IL  
j-elliott@northwestern.edu

**James J. Irrgang, PT, PhD**  
Associate Professor and Director of Clinical Research  
Department of Orthopaedic Surgery  
University of Pittsburgh School of Medicine  
Pittsburgh, PA  
jirrgang@pitt.edu

University of Pittsburgh Comprehensive Foot  
and Ankle Center  
Pittsburgh, PA  
wukichdk@upmc.edu

**Christine M. McDonough, PT, PhD**  
Research Assistant Professor  
Health & Disability Research Institute  
Boston University School of Public Health  
Boston, MA  
cmm@bu.edu  
and  
Adjunct Clinical Assistant Professor  
Department of Orthopaedic Surgery  
Geisel School of Medicine at Dartmouth  
Dartmouth-Hitchcock Medical Center  
Lebanon, NH  
and  
ICF-based Clinical Practice Guidelines  
Revisions Coordinator  
Orthopaedic Section, APTA Inc.  
La Crosse, WI

**Sandra Kaplan, PT, PhD**  
Professor of Physical Therapy  
Rutgers University  
kaplansa@shrp.rutgers.edu

**Stephen Paulseth, DPT, MS**  
Paulseth and Associates Physical Therapy  
Los Angeles, CA  
and  
Clinical Faculty  
Orthopedic Physical Therapy Residency Program  
Division of Biokinesiology and Physical Therapy  
University of Southern California  
Los Angeles, CA  
paulsethpt@yahoo.com

**Leslie Torburn, DPT**  
Principal and Consultant  
Silhouette Consulting, Inc.  
Redwood City, CA  
torburn@yahoo.com

**James Zachazewski, DPT**  
Clinical Director  
Department of Physical and Occupational Therapy  
Massachusetts General Hospital  
Boston, MA  
jzachazewski@partners.org

Coordinator

**Joseph J. Godges, DPT, MA**  
ICF-based Clinical Practice Guidelines Coordinator  
Orthopaedic Section, APTA Inc.  
La Crosse, WI  
icf@orthopt.org  
and  
Associate Professor  
Division of Biokinesiology and Physical Therapy  
University of Southern California  
Los Angeles, CA

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## REFERENCES

1. Abd El Salam MS, Abd Elhafz YN. Low-dye taping versus medial arch support in managing pain and pain-related disability in patients with plantar fasciitis. *Foot Ankle Spec.* 2011;4:86-91.
2. Al-Bluwi MT, Sadat-Ali M, Al-Habdan IM, Azam MQ. Efficacy of EZStep in the management of plantar fasciitis: a prospective, randomized study. *Foot Ankle Spec.* 2011;4:218-221.
3. Attard J, Singh D. A comparison of two night ankle-foot orthoses used in the treatment of inferior heel pain: a preliminary investigation. *Foot and ankle surgery : official journal of the European Society of Foot and Ankle Surgeons.* 2012;18:108-110.
4. Beyzadeoglu T, Gokce A, Bekler H. [The effectiveness of dorsiflexion night splint added to conservative treatment for plantar fasciitis]. *Acta orthopaedica et traumatologica turcica.* 2007;41:220-224.
5. Bonanno DR, Landorf KB, Menz HB. Pressure-relieving properties of various shoe inserts in older people with plantar heel pain. *Gait Posture.* 2011;33:385-389.
6. Brantingham JW, Bonnefin D, Perle SM, et al. Manipulative therapy for lower extremity conditions: update of a literature review. *J Manipulative Physiol Ther.* 2012;35:127-166.
7. Butterworth PA, Landorf KB, Smith SE, Menz HB. The association between body mass index and musculoskeletal foot disorders: a systematic review. *Obesity reviews : an official journal of the International Association for the Study of Obesity.* 2012;13:630-642.
8. Chaiwanichsiri D, Janchai S, Tantisiriwat N. Foot disorders and falls in older persons. *Gerontology.* 2009;55:296-302.
9. Chang R, Kent-Braun JA, Hamill J. Use of MRI for volume estimation of tibialis posterior and plantar intrinsic foot muscles in healthy and chronic plantar fasciitis limbs. *Clinical biomechanics (Bristol, Avon).* 2012;27:500-505.
10. Cheung RT, Chung RC, Ng GY. Efficacies of different external controls for excessive foot pronation: a meta-analysis. *Br J Sports Med.* 2011;45:743-751.
11. Chia KK, Suresh S, Kuah A, Ong JL, Phua JM, Seah AL. Comparative trial of the foot pressure patterns between corrective orthotics, formthotics, bone spur pads and flat insoles in patients with chronic plantar fasciitis. *Annals of the Academy of Medicine, Singapore.* 2009;38:869-875.
12. Cleland JA, Abbott JH, Kidd MO, et al. Manual physical therapy and exercise versus electrophysical agents and exercise in the management of plantar heel pain: a multicenter randomized clinical trial. *J Orthop Sports Phys Ther.* 2009;39:573-585.
13. Collins N, Bisset L, McPoil T, Vicenzino B. Foot orthoses in lower limb overuse conditions: a systematic review and meta-analysis. *Foot Ankle Int.* 2007;28:396-412.
14. Cong Y, Cheung JT, Leung AK, Zhang M. Effect of heel height on in-shoe localized triaxial stresses. *J Biomech.* 2011;44:2267-2272.
15. Cornwall MW, McPoil TG, Lebec M, Vicenzino B, Wilson J. Reliability of the modified Foot Posture Index. *J Am Podiatr Med Assoc.* 2008;98:7-13.
16. Cotchett MP, Landorf KB, Munteanu SE. Effectiveness of dry needling and injections of myofascial trigger points associated with plantar heel pain: a systematic review. *J Foot Ankle Res.* 2010;3:18.
17. Cotchett MP, Munteanu SE, Landorf KB. Effectiveness of Trigger Point Dry Needling for Plantar Heel Pain: A Randomized Controlled Trial. *Phys Ther.* 2014. 10.2522/ptj.20130255.
18. Crawford F, Snaith M. How effective is therapeutic ultrasound in the treatment of heel pain? *Ann Rheum Dis.* 1996;55:265-267.
19. Di Caprio F, Buda R, Mosca M, Calabro A, Giannini S. Foot and lower limb diseases in runners: assessment of risk factors. *Journal of sports science & medicine.* 2010;9:587-596.
20. Digiovanni BF, Nawoczinski DA, Malay DP, et al. Plantar fascia-specific stretching exercise improves outcomes in patients with chronic plantar fasciitis. A prospective clinical trial with two-year follow-up. *J Bone Joint Surg Am.* 2006;88:1775-1781.



21. Drake M, Bittenbender C, Boyles RE. The short-term effects of treating plantar fasciitis with a temporary custom foot orthosis and stretching. *J Orthop Sports Phys Ther.* 2011;41:221-231.
22. Fabrikant JM, Park TS. Plantar fasciitis (fasciosis) treatment outcome study: plantar fascia thickness measured by ultrasound and correlated with patient self-reported improvement. *Foot (Edinb).* 2011;21:79-83.
23. Ferber R, Benson B. Changes in multi-segment foot biomechanics with a heat-mouldable semi-custom foot orthotic device. *J. Foot Ankle Res.* 2011;4.
24. Fong DT, Pang KY, Chung MM, Hung AS, Chan KM. Evaluation of combined prescription of rocker sole shoes and custom-made foot orthoses for the treatment of plantar fasciitis. *Clin Biomech (Bristol, Avon).* 2012;27:1072-1077.
25. Franettovich M, Chapman A, Blanch P, Vicenzino B. Continual use of augmented low-Dye taping increases arch height in standing but does not influence neuromotor control of gait. *Gait Posture.* 2010;31:247-250.
26. Franettovich M, Chapman A, Blanch P, Vicenzino B. A physiological and psychological basis for anti-pronation taping from a critical review of the literature. *Sports Med.* 2008;38:617-631.
27. Franettovich M, Chapman A, Vicenzino B. Tape that increases medial longitudinal arch height also reduces leg muscle activity: a preliminary study. *Med Sci Sports Exerc.* 2008;40:593-600.
28. Franettovich M, Chapman AR, Blanch P, Vicenzino B. Augmented low-Dye tape alters foot mobility and neuromotor control of gait in individuals with and without exercise related leg pain. *J Foot Ankle Res.* 2010;3:5.
29. Franettovich MM, Murley GS, David BS, Bird AR. A comparison of augmented low-Dye taping and ankle bracing on lower limb muscle activity during walking in adults with flat-arched foot posture. *J Sci Med Sport.* 2012;15:8-13.
30. Hafner S, Han N, Pressman MM, Wallace C. Proximal plantar fibroma as an etiology of recalcitrant plantar heel pain. *J Foot Ankle Surg.* 2011;50:153-157.
31. Hart DL, Wang YC, Stratford PW, Mioduski JE. Computerized adaptive test for patients with foot or ankle impairments produced valid and responsive measures of function. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation.* 2008;17:1081-1091.
32. Hawke F, Burns J, Radford JA, du Toit V. Custom-made foot orthoses for the treatment of foot pain. *Cochrane Database Syst Rev.* 2008. 10.1002/14651858.CD006801.pub2CD006801.
33. Hill CL, Gill TK, Menz HB, Taylor AW. Prevalence and correlates of foot pain in a population-based study: the North West Adelaide health study. *J Foot Ankle Res.* 2008;1:2.
34. Hume P, Hopkins W, Rome K, Maulder P, Coyle G, Nigg B. Effectiveness of foot orthoses for treatment and prevention of lower limb injuries : a review. *Sports Med.* 2008;38:759-779.
35. Imamura M, Fischer AA, Imamura ST, Kaziyama HS, Carvalho AE, Salomao O. Treatment of myofascial pain components in plantar fasciitis speeds up recovery: Documentation by algometry. *Journal of Musculoskeletal Pain.* 1998;6:91-110.
36. Irving DB, Cook JL, Young MA, Menz HB. Obesity and pronated foot type may increase the risk of chronic plantar heel pain: a matched case-control study. *BMC Musculoskelet Disord.* 2007;8:41.
37. Jasiak-Tyrkalska B, Jaworek J, Franczuk B. [Efficacy of two different physiotherapeutic procedures in comprehensive therapy of plantar calcaneal spur]. *Fizjoterapia Polska [Internet].* 2007;2:145-154.
38. Kiritsi O, Tsitias K, Malliaropoulos N, Mikroulis G. Ultrasonographic evaluation of plantar fasciitis after low-level laser therapy: results of a double-blind, randomized, placebo-controlled trial. *Lasers in medical science.* 2010;25:275-281.
39. Klein SE, Dale AM, Hayes MH, Johnson JE, McCormick JJ, Racette BA. Clinical presentation and self-reported patterns of pain and function in patients with plantar heel pain. *Foot Ankle Int.* 2012;33:693-698.

40. Koumakis E, Gossec L, Elhai M, et al. Heel pain in spondyloarthritis: results of a cross-sectional study of 275 patients. *Clinical and experimental rheumatology*. 2012;30:487-491.
41. Labovitz JM, Yu J, Kim C. The role of hamstring tightness in plantar fasciitis. *Foot Ankle Spec*. 2011;4:141-144.
42. Landorf KB, Menz HB. Plantar heel pain and fasciitis. *Clinical evidence*. 2008;2008.
43. Landorf KB, Radford JA. Minimal important difference: values for the Foot Health Status Questionnaire, Foot Function Index and Visual Analogue Scale. *Foot*. 2008;18:15-19.
44. Landorf KB, Radford JA, Hudson S. Minimal Important Difference (MID) of two commonly used outcome measures for foot problems. *Journal of foot and ankle research*. 2010;3:7.
45. Lee SY, McKeon P, Hertel J. Does the use of orthoses improve self-reported pain and function measures in patients with plantar fasciitis? A meta-analysis. *Phys Ther Sport*. 2009;10:12-18.
46. Lee WC, Wong WY, Kung E, Leung AK. Effectiveness of adjustable dorsiflexion night splint in combination with accommodative foot orthosis on plantar fasciitis. *J Rehabil Res Dev*. 2012;49:1557-1564.
47. Lentz TA, Sutton Z, Greenberg S, Bishop MD. Pain-related fear contributes to self-reported disability in patients with foot and ankle pathology. *Archives of physical medicine and rehabilitation*. 2010;91:557-561.
48. Lin SC, Chen CP, Tang SF, Wong AM, Hsieh JH, Chen WP. Changes in windlass effect in response to different shoe and insole designs during walking. *Gait Posture*. 2013;37:235-241.
49. Lopes AD, Hespanhol Junior LC, Yeung SS, Costa LO. What are the main running-related musculoskeletal injuries? A Systematic Review. *Sports Med*. 2012;42:891-905.
50. Mahmood S, Huffman LK, Harris JG. Limb-length discrepancy as a cause of plantar fasciitis. *J Am Podiatr Med Assoc*. 2010;100:452-455.
51. Mahowald S, Legge BS, Grady JF. The correlation between plantar fascia thickness and symptoms of plantar fasciitis. *J Am Podiatr Med Assoc*. 2011;101:385-389.
52. Marabha T, Al-Anani M, Dahmashe Z, Rashdan K, Hadid A *The relation between the conservative treatment and heel pain duration in plantar fasciitis*. Kuwait Medical Journal, 2008. 130-132.
53. Martin RL, Irrgang JJ. A survey of self-reported outcome instruments for the foot and ankle. *J Orthop Sports Phys Ther*. 2007;37:72-84.
54. Martin RL, Irrgang JJ, Conti SF. Outcome study of subjects with insertional plantar fasciitis. *Foot Ankle Int*. 1998;19:803-811.
55. McPoil TG, Martin RL, Cornwall MW, Wukich DK, Irrgang JJ, Godges JJ. Heel pain--plantar fasciitis: clinical practice guidelines linked to the international classification of function, disability, and health from the orthopaedic section of the American Physical Therapy Association. *J Orthop Sports Phys Ther*. 2008;38:A1-A18.
56. Osborne HR, Breidahl WH, Allison GT. Critical differences in lateral X-rays with and without a diagnosis of plantar fasciitis. *J Sci Med Sport*. 2006;9:231-237.
57. Patel A, DiGiovanni B. Association between plantar fasciitis and isolated contracture of the gastrocnemius. *Foot & ankle international / American Orthopaedic Foot and Ankle Society [and] Swiss Foot and Ankle Society*. 2011;32:5-8.
58. Pfeffer G, Bacchetti P, Deland J, et al. Comparison of custom and prefabricated orthoses in the initial treatment of proximal plantar fasciitis. *Foot Ankle Int*. 1999;20:214-221.
59. Phillips B, Ball C, Sackett D, et al. *Levels of Evidence*. 2009 March 2009 [cited 2009 August 4]; Available from: <http://www.cebm.net/index.aspx?o=4590>.
60. Pohl MB, Hamill J, Davis IS. Biomechanical and anatomic factors associated with a history of plantar fasciitis in female runners. *Clin J Sport Med*. 2009;19:372-376.
61. Radford JA, Landorf KB, Buchbinder R, Cook C. Effectiveness of calf muscle stretching for the short-term treatment of plantar heel pain: a randomised trial. *BMC Musculoskelet Disord*. 2007;8:36.

62. Redmond AC, Crosbie J, Ouvrier RA. Development and validation of a novel rating system for scoring standing foot posture: the Foot Posture Index. *Clin Biomech (Bristol, Avon)*. 2006;21:89-98.
63. Renan-Ordine R, Albuquerque-Sendin F, de Souza DP, Cleland JA, Fernandez-de-Las-Penas C. Effectiveness of myofascial trigger point manual therapy combined with a self-stretching protocol for the management of plantar heel pain: a randomized controlled trial. *J Orthop Sports Phys Ther*. 2011;41:43-50.
64. Ribeiro AP, Trombini-Souza F, Tessutti V, Rodrigues Lima F, Sacco Ide C, Joao SM. Rearfoot alignment and medial longitudinal arch configurations of runners with symptoms and histories of plantar fasciitis. *Clinics (Sao Paulo, Brazil)*. 2011;66:1027-1033.
65. Rome K, Howe T, Haslock I. Risk factors associated with the development of plantar heel pain in athletes. *Foot* 2001;11:119-125.
66. Rompe JD, Cacchio A, Weil L, Jr., et al. Plantar fascia-specific stretching versus radial shock-wave therapy as initial treatment of plantar fasciopathy. *J Bone Joint Surg Am*. 2010;92:2514-2522.
67. Ryan M, Fraser S, McDonald K, Taunton J. Examining the degree of pain reduction using a multielement exercise model with a conventional training shoe versus an ultraflexible training shoe for treating plantar fasciitis. *Phys Sportsmed*. 2009;37:68-74.
68. Sahin N, Ozturk A, Atici T. Foot mobility and plantar fascia elasticity in patients with plantar fasciitis. *Acta orthopaedica et traumatologica turcica*. 2010;44:385-391.
69. Shanks P, Curran M, Fletcher P, Thompson R. The effectiveness of therapeutic ultrasound for musculoskeletal conditions of the lower limb: A literature review. *Foot (Edinb)*. 2010;20:133-139.
70. Sheridan L, Lopez A, Perez A, John MM, Willis FB, Shanmugam R. Plantar fasciopathy treated with dynamic splinting: a randomized controlled trial. *Journal of the American Podiatric Medical Association*. 2010;100:161-165.
71. Sobhani S, Dekker R, Postema K, Dijkstra PU. Epidemiology of ankle and foot overuse injuries in sports: A systematic review. *Scand J Med Sci Sports*. 2013;23:669-686.
72. Stolwijk NM, Louwerens JW, Nienhuis B, Duysens J, Keijsers NL. Plantar pressure with and without custom insoles in patients with common foot complaints. *Foot Ankle Int*. 2011;32:57-65.
73. Stratton M, McPoil TG, Cornwall MW, Patrick K. Use of low-frequency electrical stimulation for the treatment of plantar fasciitis. *J Am Podiatr Med Assoc*. 2009;99:481-488.
74. Sutton Z, Greenburg S, Bishop M. Association of pain related beliefs with disability and pain in patients with foot and/or ankle pain: a case series. *Orthopaedic Physical Therapy Practice*. 2008;20:200-207.
75. Sweeting D, Parish B, Hooper L, Chester R. The effectiveness of manual stretching in the treatment of plantar heel pain: a systematic review. *J Foot Ankle Res*. 2011;4:19.
76. Tanamas SK, Wluka AE, Berry P, et al. Relationship between obesity and foot pain and its association with fat mass, fat distribution, and muscle mass. *Arthritis care & research*. 2012;64:262-268.
77. Taunton JE, Ryan MB, Clement DB, McKenzie DC, Lloyd-Smith DR, Zumbo BD. A retrospective case-control analysis of 2002 running injuries. *Br J Sports Med*. 2002;36:95-101.
78. Tenforde AS, Sayres LC, McCurdy ML, Collado H, Sainani KL, Fredericson M. Overuse injuries in high school runners: lifetime prevalence and prevention strategies. *PM R*. 2011;3:125-131; quiz 131.
79. Trotter LC, Pierrynowski MR. Changes in gait economy between full-contact custom-made foot orthoses and prefabricated inserts in patients with musculoskeletal pain: a randomized clinical trial. *Journal of the American Podiatric Medical Association*. 2008;98:429-435.
80. Tsai CT, Chang WD, Lee JP. Effects of short-term treatment with kinesiotaping for plantar fasciitis. *Journal of Musculoskeletal Pain*. 2010;18:71-80.

81. Turhanoglu AD, Guler H, Kalici A, Inanoglu D, Ozer C. CAN FOOT PAIN AND MUSCULOSKELETAL DISORDERS BE COUNTED AS RISK FACTORS FOR FALLS IN THE ELDERLY? *Turk. J. Geriatr.* 2010;13:225-230.
82. Uden H, Boesch E, Kumar S. Plantar fasciitis - to jab or to support? A systematic review of the current best evidence. *Journal of multidisciplinary healthcare.* 2011;4:155-164.
83. van de Water AT, Speksnijder CM. Efficacy of taping for the treatment of plantar fasciitis: a systematic review of controlled trials. *J Am Podiatr Med Assoc.* 2010;100:41-51.
84. Van Lunen B, Cortes N, Andrus T, Walker M, Pasquale M, Onate J. Immediate effects of a heel-pain orthosis and an augmented low-dye taping on plantar pressures and pain in subjects with plantar fasciitis. *Clin J Sport Med.* 2011;21:474-479.
85. Vicenzino B, McPoil T, Buckland S. Plantar foot pressures after the augmented low dye taping technique. *J Athl Train.* 2007;42:374-380.
86. Wearing SC, Smeathers JE, Sullivan PM, Yates B, Urry SR, Dubois P. Plantar fasciitis: are pain and fascial thickness associated with arch shape and loading? *Physical therapy.* 2007;87:1002-1008.
87. Wearing SC, Smeathers JE, Yates B, Urry SR, Dubois P. Bulk compressive properties of the heel fat pad during walking: a pilot investigation in plantar heel pain. *Clin Biomech (Bristol, Avon).* 2009;24:397-402.
88. Werner RA, Gell N, Hartigan A, Wiggerman N, Keyserling WM. Risk factors for plantar fasciitis among assembly plant workers. *PM & R : the journal of injury, function, and rehabilitation.* 2010;2:110-116; quiz 111 p following 167.
89. Wolgin M, Cook C, Graham C, Mauldin D. Conservative treatment of plantar heel pain: long-term follow-up. *Foot Ankle Int.* 1994;15:97-102.
90. World. International Classification of Functioning, Disability, and Health. Geneva, Switzerland: 2010.
91. World. World Health Organization: International Classification of Disease. ICD-10; Geneva, Switzerland: 2005.
92. Wu CH, Chang KV, Mio S, Chen WS, Wang TG. Sonoelastography of the plantar fascia. *Radiology.* 2011;259:502-507.
93. Yi TI, Lee GE, Seo IS, Huh WS, Yoon TH, Kim BR. Clinical characteristics of the causes of plantar heel pain. *Annals of rehabilitation medicine.* 2011;35:507-513.
94. Yoho R, Rivera JJ, Renschler R, Vardaxis VG, Dikis J. A biomechanical analysis of the effects of low-Dye taping on arch deformation during gait. *Foot (Edinb).* 2012;22:283-286.