ARE ORTHOSES EFFECTIVE IN THE MANAGEMENT OF HEEL PAIN?

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In a systematic review assessing the frequency of running-related musculoskeletal injuries (8 studies; pooled n = 3500 runners), the incidence of plantar fasciitis ranged from 4.5% to 10%, with the prevalence ranging from 5.2% to 17.5% (1).

In a prospective assessment of non-traumatic foot and lower-limb injuries in 166 runners involved in various running specialties, 98 (59%) indicated they had developed an overuse injury, with 30 (31%) reporting plantar fasciitis. (2)

Approximately 10% of the United States general population experiences bouts of heel pain, which results in 1 million visits per year to medical professionals for treatment of plantar fasciitis. (3)

Risk Factors

- Limited dorsiflexion ROM
- High BMI
- Running
- Rearfoot varus
- Cavus foot, High arch configuration, Low Medial longitudinal arch in females
- Work related conditions: assembly line work, prolonged standing, hard surfaces, in and out of vehicles
- Hamstring tightness
- Limb length discrepancy (long leg > short leg)
- Decreased intrinsic muscle strength
Diagnosis

- Plantar medial heel pain: most noticeable with initial steps after a period of inactivity but also worse following prolonged weight bearing
- Heel pain precipitated by a recent increase in weight-bearing activity
- Pain with palpation of the proximal insertion of the plantar fascia
- Positive windlass test
- Negative tarsal tunnel tests
- Limited active and passive talocrural joint dorsiflexion range of motion
- Abnormal Foot Posture Index score
- High body mass index in nonathletic individuals
Causes of Medial Heel Pain

- **Plantar Fascia**
  - Plantar fasciitis - pain with first steps of the day
  - Plantar fascia tear/rupture - sudden, acute, knife-like pain, ecchymosis

- **Soft Tissues**
  - Fat pad syndrome - atrophy of heel pad
  - Heel bruise - history of acute impact injury
  - Bursitis - swelling and erythema of posterior heel
  - Tendonitis - pain with resisted motions
Causes of Medial Heel Pain

- **Skeletal**
  - Bony point tenderness
  - Calcaneal stress fracture - pain with weight-bearing; worsens with prolonged weight bearing
  - Paget's disease - bowed tibias, kyphosis, headaches
  - Tumor - deep bone pain; constitutional symptoms late in the course
  - Calcaneal apophysitis (Sever's disease) - posterior heel pain in adolescents

- **Neurological**
  - Radiating burning pain, numbness and tingling, especially at night
  - Tarsal tunnel syndrome - diffuse nerve symptoms over plantar surface
  - Posterior tibial nerve entrapment - medial plantar heel symptoms
  - Abductor digiti quinti nerve entrapment - burning pain in heel pad area
Localized Muscle Power Deficit

DF mobility Restriction

Localized Muscle Power Deficit

Elevated BMI

Pronatory Foot Stress

Plantar Fasciitis
Validated Outcomes Measures

- Foot and Ankle Ability Measure (FAAM)
- Foot Health Status Questionnaire (FHSQ)
- Foot Function Index (FFI)
- Lower Extremity Functional Scale (LEFS)
- Validated self-report questionnaires before and after interventions
Pronation the Root of All Evil!

New Techniques For Treating Plantar Fasciitis by Thomas C. Michaud, D.C.,
Published Jun. 6, 2014, Updated Nov. 16, 2016
In a case-control study in which 80 individuals with chronic plantar heel pain were matched with 80 control participants, the chronic plantar heel pain group had a more pronated foot posture than the controls when assessed with the Foot Posture Index (FPI-6).
Pronation

- Pronation does not necessarily lead to lower extremity problems. Donatelli et al analyzed the static and dynamic foot postures of 74 professional baseball players. Although 43% of subjects demonstrating excessive pronation reported previous lower extremity injuries, the remaining 57% with similar pronatory patterns experienced no difficulties.

- These researchers concluded that excessive pronators were no more likely to be injured than those without excessive pronation. Other researchers similarly reported that excessive pronation, in and of itself, did not result in lower extremity abnormalities.

Powers CM, Chen PY, Reischl SF, Perry J. Foot Ankle Int. 2002 Jul; 23(7):634-40

“ankle dorsiflexion, obesity, and work-related weight bearing were reported to be independent risk factors, reduced ankle dorsiflexion appeared to be the most important.”
Equinus IS the Root of all EVIL
Plantar Fasciosis

• Largest predictive factors for plantar fasciitis: Lack of DF and Obesity

• Limited Evidence to support “foot type” as a predictor for Plantar fasciitis

• Lack of ankle DF mobility = Increased mid-tarsal pronation / “pronatory Stress”

• “Fasciosis” probably a better term
  • 50 samples following following plantar fascia surgery
  • ZERO showed evidence of inflammatory process

Excessive Motion

- Cornwall stated that difficulties result when the joints of the foot are continually functioning beyond a normal end range.
- Plantar fasciitis results from the duration of excess motion and not merely from the motion itself.

Plantar Fascia Unhappy Triad
The Hardest Heel Pain Patient to Treat

Cavus / Supinated Foot

Full Dorsiflexion ROM

Runner / High Impact
Heel Pain—Plantar Fasciitis: Revision 2014

Robroy L. Martin, Todd E. Davenport, Stephen F. Reischl, Thomas G. McPoil, James W. Matheson, Dane K. Wukich, Christine M. McDonoughRoy D. Altman, Paul Beattie, Mark Cornwall, Irene Davis, John DeWitt, James Elliott, James J. Irrgang, Sandra Kaplan, Stephen Paulseth, Leslie Torburn, James ZachazewskiJoseph J. Godges
HEELE PAIN—PLANTAR FASCIITIS: REVISION 2014

<table>
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<tr>
<th>GRADES OF RECOMMENDATION BASED ON</th>
<th>STRENGTH OF EVIDENCE</th>
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<tr>
<td>A</td>
<td>Strong evidence</td>
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<td>B</td>
<td>Moderate evidence</td>
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<td>C</td>
<td>Weak evidence</td>
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<td>D</td>
<td>Conflicting evidence</td>
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<td>E</td>
<td>Theoretical/foundational evidence</td>
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<tr>
<td>F</td>
<td>Expert opinion</td>
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| 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 (e.g., weaker diagnostic criteria and reference standards, improper randomization, no blinding, less than 80% follow-up) |
| III | Case-control studies or retrospective studies |
| IV | Case series |
| V | Expert opinion |
Summary of Recommendations

E. INTERVENTIONS: MANUAL THERAPY

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 to support the use of prefabricated or custom foot orthoses for long-term (1 year) pain management or function improvement.

F. DIFFERENTIAL DIAGNOSIS

Clinicians should consider diagnostic classifications other than heel pain (plantar fasciitis) when the patient's reported functional limitations or physical impairments are not consistent with those presented in the diagnosis/classification section of this guideline. If the patient's symptoms are not resolving with interventions aimed at normalization of the patient's physical impairments.

A. INTERVENTIONS: ORTHOTIC DEVICES

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.

B. INTERVENTIONS: NIGHT SPLINTS

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 types of night splints used (i.e., posterior, anterior, essex sock type) do not appear to affect the outcome.
**Summary of Recommendations**

**INTERVENTIONS – PHYSICAL AGENTS**

**D** Electrotherapy: clinicians should use manual therapy, stretching, and foot orthoses instead of electrotherapeutic modalities, to promote intermediate and long-term (1-6 months) improvements in clinical outcomes for individuals with heel pain/plantar fasciitis. Clinicians may or may not use iontophoresis with dexamethasone or acetic acid to provide short-term (2-4 weeks) pain relief and improved function.

**C** Low-level laser: clinicians may use low-level laser therapy to reduce pain and activity limitations in individuals with heel pain/plantar fasciitis.

**C** Phonophoresis: clinicians may use phonophoresis with ketoprofen gel to reduce pain in individuals with heel pain/plantar fasciitis.

**C** Ultrasound: the use of ultrasound cannot be recommended for individuals with heel pain/plantar fasciitis.

**INTERVENTIONS – FOOTWEAR**

**C** To reduce pain in individuals with heel pain/plantar fasciitis, clinicians may prescribe (1) a rocker-bottom shoe construction in conjunction with a foot orthosis, and (2) shoe rotation during the work week for those who stand for long periods.

**INTERVENTIONS – EDUCATION AND COUNSELING FOR WEIGHT LOSS**

**E** Clinicians may provide education and counseling on exercise strategies to gain or maintain optimal lean body mass in individuals with heel pain/plantar fasciitis. Clinicians may also refer individuals to an appropriate health care practitioner to address nutrition issues.

**INTERVENTIONS – THERAPEUTIC EXERCISE AND NEUROMUSCULAR RE-EDUCATION**

**F** Clinicians may prescribe strengthening exercises and movement training for muscles that control pronation and attenuate forces during weight-bearing activities.

**INTERVENTIONS – DRY NEEDLING**

**F** The use of trigger point dry needling cannot be recommended for individuals with heel pain/plantar fasciitis.

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

- **2008:** 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.

- **2014:** Clinicians should use foot orthoses, either prefabricated or custom fabricated/fitted, to support the medial longitudinal arch and cushion the heel in individuals with heel pain/plantar fasciitis to reduce pain and improve function for short- (2 weeks) to long-term (1 year) periods, especially in those individuals who respond positively to antipronation taping techniques.

- Clinicians should prescribe a 1- to 3-month program of night splints for individuals with heel pain/plantar fasciitis who consistently have pain with the first step in the morning.
Recommended Therapies

- **A_Level Evidence**
  - Manual Therapy – Soft tissue and joint mobilization
  - Stretching – fascia and gastro-soleus complex
  - Taping – Anti-pronation taping
  - Foot Orthoses – no preference for CFO or PFO, short or long term
  - Night Splints – 1-3 months for patients with AM 1st step pain

- **C & D Level Evidence**
  - Physical Agents – (C) - US, Phonophoresis, Low Level Laser (D)
  - Electrotherapy
  - Footwear – (C) – Rocker soles, Cushion sole, Shoe rotations
Antiinflammatory vs Mechanical Tx

- A randomized clinical trial of 103 patients. 3 treatment categories: corticosteroid injections; viscoelastic heel cups, and low-Dye taping for one month followed by rigid custom orthotics for two months.
- After three months of treatment, 70 percent of participants in the mechanical treatment group rated their outcome as "excellent" or "fair" compared to the anti-inflammatory (33%) and accommodative treatment (32%) groups (p=0.005)

There is limited evidence supporting the effectiveness of 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. 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.
140 patients with symptomatic knee osteoarthritis with features of synovitis received injections in the joint with the corticosteroid triamcinolone (n = 70) or saline (n = 70) every 12 weeks for two years.

Injections with triamcinolone resulted in significantly greater cartilage volume loss than did saline (average change in cartilage thickness of -0.21 mm vs -0.10 mm) and no significant difference on measures of pain.
The SOOTHE Trial

A pragmatic, parallel-group assessor-blinded randomized trial (Steroid injection versus foot orthoses (SOOTHE) heel pain trial). One hundred participants with plantar heel pain will be randomly allocated (i.e. two groups of approximately 50) to receive either an ultrasound-guided corticosteroid injection or prefabricated foot orthoses. Outcome measures will be obtained at baseline, 4, 8 and 12 weeks, with two primary endpoints at 4 and 12 weeks to reflect the hypothesized temporal effects of each intervention. The primary outcome measure will be the foot pain domain of the Foot Health Status Questionnaire.

CFO – custom foot orthosis  
CSI – corticosteroid injection  
ABII – autologous blood intralesional injection  
ESWT – Extracorporeal shockwave therapy  
PFA – Electrophysical agents

<table>
<thead>
<tr>
<th>Study Investigators</th>
<th>Study Type</th>
<th>Study Size (n)</th>
<th>Treatment Modalities</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roos et al.‎³</td>
<td>3-arm RCT</td>
<td>43</td>
<td>CFO, night splints or CFO with night splints</td>
<td>Pain relief and improved function reported for all groups with significantly reduced pain at 52 weeks for the combined group.</td>
</tr>
<tr>
<td>Landorf et al.⁴</td>
<td>3-arm RCT</td>
<td>136</td>
<td>Prefabricated orthotic, CFO or placebo “sham” orthotic.</td>
<td>Both prefabricated orthotics and CFOs significantly improved function at 3 mo. compared to placebo. No significant improvement in pain compared to placebo.</td>
</tr>
<tr>
<td>Baldassin et al.³</td>
<td>2-arm RCT</td>
<td>142</td>
<td>Prefabricated orthotic or CFO</td>
<td>Pain relief and improved function was similar for both study groups at 8 weeks.</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Sample Size</td>
<td>Intervention</td>
<td>Results</td>
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<tr>
<td>Porter and Shadbolt³</td>
<td>3-arm RCT</td>
<td>125</td>
<td>CSI with stretching, ESWT with stretching, and stretching alone.*</td>
<td>Both CSI + stretching and ESWT + stretching provided superior pain relief at 12 mo. compared to stretching alone.</td>
</tr>
<tr>
<td>Lee and Ahmad³</td>
<td>2-arm RCT</td>
<td>64</td>
<td>CSI or ABII. site pain for up to 7 days caused by CSI</td>
<td>CSI provided superior pain relief to ABII at 3 mo. but the differences were not significant at 6 mo.</td>
</tr>
<tr>
<td>Dimou et al.²,⁵</td>
<td>2-arm RCT</td>
<td>40</td>
<td>Manipulative chiropractic treatment or CFO</td>
<td>Manipulative chiropractic treatment significantly superior for reducing pain at 8 wk. compared to CFO.</td>
</tr>
<tr>
<td>Cleland⁵</td>
<td>2-arm RCT</td>
<td>60</td>
<td>Manipulative chiropractic treatment or EPA and exercise</td>
<td>Manipulative chiropractic therapy significantly reduced pain at 4 wk.. compared with EPA and exercise. No significant differences at 6 mo.</td>
</tr>
</tbody>
</table>

Conclusions

- Results from this literature review indicate that patients with known acute symptomatic plantar fasciitis can be treated with a variety of non-surgical modalities that improve symptoms in the short term. Studies demonstrated adding orthotics, night splints, manipulation chiropractic, physical therapy, and/or corticosteroid injections offer improved symptom relief when conventional treatment options (NSAIDs, stretching and lifestyle change) are inadequate for reducing pain and improving function. Many studies indicate that orthotics and corticosteroid injections are the best treatments for plantar fasciitis. Orthotics, customized or prefabricated, have been shown to improve pain and function within 1 to 3 months with little to no risk. A recent study indicated that patients were compliant with both prefabricated and custom orthotics and that prefabricated orthotics were cost-effective. Current evidence suggests that the addition of orthotics to the treatment regimen for non-recalcitrant plantar fasciitis either alone or in conjunction stretching if conventional therapy fails to bring symptom relief. Manipulative therapy might also be considered.
The CFO group had significantly improved total FFI-R scores (Revised Foot Function Index short form) (77.4 versus 57.2; P = .03) without group differences for FFI-R pain, SF-36 (36-Item Short Form Health Survey), and morning or evening pain. The PFO and CFO groups reported significantly lower morning and evening pain. For activity, the CFO group demonstrated significantly longer episodes of walking over the sham (P = .019) and PFO (P = .03) groups, with a 125% increase for CFOs, 22% PFOs, and 0.2% sham. Postural transition duration (P = .02) and balance (P = .05) improved for the CFO group. There were no gait differences. The CFO group reported significantly less stretching and ice use at 3 months.

- Seventy-seven patients with plantar fasciitis for less than 1 year were included
- Revised Foot Function Index short form (FFI-R)
- 36-Item Short Form Health Survey (SF-36)
- CFO Custom Foot Orthosis, PFO Pre-Fabricated Foot Orthosis

CFO group demonstrated 5.6-fold greater improvements in spontaneous physical activity versus the PFO and sham groups
152 patients with chronic plantar fasciopathy treated with low-energy radial shock-wave therapy without local anesthesia, administered weekly for three weeks (Group 1, n = 73) or the identical shock wave treatment and to perform an eight-week plantar fascia-specific stretching program (Group 2, n = 79).

A program of manual stretching exercises specific to the plantar fascia in combination with repetitive low-energy radial shock-wave therapy is more efficient than repetitive low-energy radial shock-wave therapy alone for the treatment of chronic symptoms of proximal plantar fasciopathy.
Manual therapy and exercise is a superior management approach over electrophysical agents (US, Iontophoresis and Ice) and exercise in management of patients with plantar heel pain (4 week and 6 month follow-up)

FIGURE 2. Mean Lower Extremity Functional Scale score at each assessment point. Abbreviations: MTEx, manual physical therapy and exercise; EPAX, electrophysical agents and exercise. * Indicates a significant difference between groups (P < 0.05).

FIGURE 3. Mean Foot and Ankle Ability Measure score at each assessment point. Abbreviations: MTEx, manual physical therapy and exercise; EPAX, electrophysical agents and exercise. * Indicates a significant difference between groups (P < 0.05).

FIGURE 4. Mean Numeric Pain Rating Scale scores at each assessment point. Abbreviations: MTEx, manual physical therapy and exercise; EPAX, electrophysical agents and exercise. * Indicates a significant difference between groups (P < 0.05).
RESTORE DF = Posterior Glide


Dananberg 2004 JAPMA – 3 case series using the manipulation previously described for DF ROM return.
Lateral Glide
Pressure pain threshold (PPT): minimal pressure when the sensation of pressure changes to pain, assessed with a mechanical pressure algometer.
Instrument Assisted Soft Tissue Mobilization (IASTM)

....Lets use some STEEL to HEAL the HEEL

Self mobilization

IASTM

- Derived from Gua Sha
  - “scrape skin”
  - Repeated pressured strokes over lubricated skin with a smooth edged instrument placed against the oiled skin surface, pressed down firmly, and then moved down the muscles—hence the term tribo-effleurage (i.e., friction-stroking)—

- THEORY
  - Color and rate of fading are diagnostic and prognostic
  - May cause bruising or petechia... NOT A GOAL!!!!
    - Theory: increased amount and duration of erythema= indicative of severity of problem
  - Quicker petechiae/erythema seem to have more myofascial pain, poorer tissue quality
  - Response tends to decrease over time
Theories as to how it works:

- Expands and exploits principles of Transverse Friction Massage made popular by James Cyriax M.D.
- Limited research to date (RCTs)
- Mostly Case Studies and Animal Models

Microtrauma to tissue creates inflammation

- Facilitates healing tendinopathies
  - Same reason eccentrics are used

- Facilitation of connective tissue healing
- Promotes Fibroblastic proliferation (Ultimate Goal of Tx)
  - Laying down of collagen fibers in tendon, ligament after injury
Plantar Fascia-Specific Stretching Exercise Improves Outcomes in Patients with Chronic Plantar Fasciitis

A Prospective Clinical Trial with Two-Year Follow-up

By Benedict F. DiGiovanni, MD, Deborah A. Nawoczenski, PhD, PT, Daniel P. Malay, MSPT, Petra A. Graci, DPT, Taryn T. Williams, MSPT, Gregory E. Wilding, PhD, and Judith F. Baumhauer, MD

Investigation performed at the Center for Foot and Ankle Research, Department of Physical Therapy, Ithaca College, University of Rochester Campus, Rochester, New York

Conclusions: This study supports the use of the tissue-specific plantar fascia-stretching protocol as the key component of treatment for chronic plantar fasciitis. Long-term benefits of the stretch include a marked decrease in pain and functional limitations and a high rate of satisfaction. This approach can provide the health-care practitioner with an effective, inexpensive, and straightforward treatment protocol.

Level of Evidence: Therapeutic Level II. See Instructions to Authors for a complete description of levels of evidence.

No significant difference in Ankle Dorsiflexion ROM gains when stretching with foot in supination or pronation

Investigators did not attempt to investigate the effects of STJ position and “stress” or joint reaction forces at other joints---clinical judgment should prevail
1) Incorporate manual techniques of lateral STJ glides, STM gastroc and Cross Friction to fascia

2) Restore DF mobility to decrease mid tarsal pronatory stress

3) Control Pronation with taping and Orthotics

4) Improve Eccentric strength of the Posterior tibialis if pronation is a concern!!!!!