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# The Short-Term Effects of Treating Plantar Fasciitis With a Temporary Custom Foot Orthosis and Stretching



One million patients visit physicians for plantar heel pain each year.<sup>27,30,32</sup> This condition, known as plantar fasciitis (PF), has been identified as the most common foot condition seen in physical therapy clinics.<sup>27</sup> Ten percent of people in the United States present with heel pain at some time in their lives.<sup>5,32</sup> Patients often complain that the pain

is most noticeable during the first few initial steps after prolonged periods of non-weight bearing, weight bearing, or

a sudden increase in activity.<sup>4,27</sup> PF, once viewed as an inflammatory condition caused by repetitive microtearing of the

plantar fascia,<sup>35</sup> is now thought to be a degenerative condition. Lemont and colleagues<sup>21</sup> discuss noninflammatory pathologic changes, such as thickening and fibrosis of the plantar fascia at

the medial calcaneal tubercle and degeneration of the plantar fascia, with no evidence of histological inflammation. These changes occur as a result of repetitive microtrauma to the plantar fascia at its origin.

The plantar fascia is a thick, fibrous connective tissue that provides dynamic shock absorption and static support of the longitudinal arch. It primarily consists of 3 bands: the central, lateral, and medial. The central band originates from the medial tubercle of the calcaneus and travels across the metatarsal heads to the proximal phalanx of each toe.<sup>27</sup> The lateral and medial bands originate from the abductor digiti minimi and the abductor hallucis, respectively, and are continuous with the central band and the dorsal fascia.<sup>9</sup>

At present, no single intervention has been demonstrated to be effective for all individuals with PF. The many interventions currently in use include electrophysical agents,<sup>13,37</sup> manual therapy,<sup>3,43</sup> stretching,<sup>6,7,30</sup> taping,<sup>29,31</sup> night splints,<sup>24</sup> steroid injections,<sup>39</sup> surgery,<sup>22,28</sup> and orthoses.<sup>1,19,20,24,35</sup> This vast array

● **STUDY DESIGN:** Prospective single-group cohort study.

● **OBJECTIVES:** To identify the effectiveness of a temporary custom foot orthosis (TCFO), followed by a stretching program, for the treatment of plantar fasciitis (PF).

● **BACKGROUND:** PF, a common cause of heel pain, often leads to disability. Optimal treatment for this often challenging clinical condition is still unknown.

● **METHODS:** Fifteen individuals with PF were recruited from the general public. All participants received a TCFO and were instructed to wear it for 2 weeks while weight bearing. Following the initial 2 weeks, participants were weaned off of the TCFO and instructed to begin a daily stretching program. Follow-up appointments occurred at 2, 4, and 12 weeks. The primary outcome measures included first-step heel pain via numeric pain rating scale (NPRS), the Foot and Ankle Ability Measure activities of daily living subscale (FAAM-A), and the Foot and Ankle Ability Measure sports subscale (FAAM-S). Secondary outcome included the global

rating of change (GRC) score.

● **RESULTS:** Individuals with a primary complaint of plantar foot pain entered and completed this study. Repeated-measures ANOVAs for the NPRS, FAAM-A, and FAAM-S showed statistically significant changes ( $P < .001$ ). Post hoc analysis using paired  $t$  tests demonstrated statistically and clinically significant change at all follow-up times, compared to the initial intervention ( $P < .001$ ). Mean GRC scores at 2, 4, and 12 weeks were 4.4, 4.5, and 4.2, respectively.

● **CONCLUSION:** In treating PF, a TCFO used for 2 weeks, followed by a stretching program, provided preliminary evidence that first-step heel pain and foot and ankle function improve in the short term and up to 12 weeks.

● **LEVEL OF EVIDENCE:** Therapy, level 2b. *J Orthop Sports Phys Ther* 2011;41(4):221-231, Epub 2 February 2011. doi:10.2519/jospt.2011.3348

● **KEY WORDS:** foot, heel pain, plantar fascia, shoe inserts

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of treatment options may be due to the belief that the etiology of PF is multifactorial.<sup>24</sup> Etiological factors include pes planus,<sup>36,38,42</sup> pes cavus,<sup>41,42</sup> limited ankle dorsiflexion, obesity,<sup>10,36</sup> weight-bearing activities,<sup>36</sup> inadequate stretching,<sup>2</sup> poor footwear,<sup>36,38</sup> trauma, weak plantar flexor muscles,<sup>12</sup> and excessive subtalar joint pronation.<sup>12,22,38,41</sup> Young and colleagues<sup>43</sup> report implementing rest, calf and plantar fascia stretching, and new foot wear immediately following signs and symptoms consistent with plantar fasciitis. McPoil et al<sup>27</sup> identified moderate evidence in support of calf/plantar fascia stretching combined with iontophoresis, and strong evidence in support of foot orthoses for short-term relief of pain related to PF.<sup>27</sup>

The 3 most common mechanical treatments used for PF include arch taping, over-the-counter foot orthoses, and custom foot orthoses. A number of studies have evaluated both custom and prefabricated foot orthoses designed to provide temporary relief of PF-related pain.<sup>1,19,20,24,27,35</sup> These studies identified no significant differences in comparing these 2 types of orthoses,<sup>19,20,40</sup> which is consistent with the fact that both orthoses are used to limit excessive pronation, optimize biomechanical loading of the foot, and decrease strain placed upon the plantar fascia and longitudinal arch during weight-bearing activities.<sup>14,35</sup> Cadaveric research has found that lateral orthotic wedging, by locking the calcaneocuboid joint and transmitting forces through the lateral structures of the foot, limits excessive strain on the plantar fascia.<sup>15</sup> Taping, often used as a temporary precursor to orthoses, has also been utilized to temporarily unload the plantar fascia. To date, authors have only assessed the effects of temporary orthoses in neutral subtalar joint positioning. The present study investigates the use of a temporary custom foot orthosis (TCFO) cast in a non-weight-bearing position, with the foot in plantar flexion and inversion. During weight bearing, the orthosis will simulate a heel lift and provide

TABLE 1		DEMOGRAPHIC INFORMATION FOR ALL PARTICIPANTS*	
Number of participants		15	
Gender, n (%) female		13 (87)	
Age, y		37.6 (20-70)	
Foot type, n (%)			
Neutral		4 (26.7)	
Pes planus		8 (53.3)	
Pes cavus		3 (20.0)	
Symptoms duration, mo		20.5 (2-84)	
Active ankle range of motion, deg*			
Involved			
Dorsiflexion		3.7 ± 1.5	
Plantar flexion		53.0 ± 2.8	
Inversion		40.0 ± 2.2	
Eversion		21.3 ± 2.7	
Uninvolved			
Dorsiflexion		7.7 ± 1.1	
Plantar flexion		49.1 ± 3.5	
Inversion		34.0 ± 2.7	
Eversion		21.4 ± 2.1	
*Values are mean ± SD, mean (%), or mean (range).			

a stable base medially, which should, theoretically, allow the plantar fascia to rest through the stance phase of gait by preventing excessive foot pronation and decreasing load from heel to forefoot. The aim of this study was to identify the effectiveness of the short-term use of a TCFO, followed with a stretching program, for the treatment of PF.

## METHODS

THE STUDY USED A SINGLE-COHORT design, with a sample of convenience, to investigate the effects of a custom foot orthosis for treatment of PF. The University of Puget Sound Institutional Review Board and Ethics Committee approved the study protocol. Prior to the study, all participants signed a written informed consent, along with a Health Insurance Portability and Accountability Act explanation form, and were able to withdraw from the study at any time.

The most experienced author (R.E.B.) provided a 2-hour training session to educate all investigators and ensure that

they were able to perform the examination and casting and present instructions accurately to the participants. All research took place at, and was performed by investigators associated with, the University of Puget Sound. All of the investigators were trained in the distribution and interpretation of the outcome measures that were used in the study.

## Participant Recruitment

Fifteen individuals responded to recruitment fliers placed in various clinical sites, stores that sold running products, and university campus gathering areas. These flyers asked for volunteers who had heel pain and first-step pain in the morning. Following phone conversations with 18 potential participants, we agreed to evaluate 15 individuals who were experiencing heel pain and first-step pain, for which they had not received treatment in the previous 12 weeks.

## Inclusion/Exclusion Criteria

Inclusion criteria for participants included 18 years of age or older, able to tolerate

the physical examination and treatment procedures, a symptom duration of greater than 4 weeks, able to read, write, and speak sufficient English to complete the outcome tools, and 2 of the following 3 findings: symptom reproduction with palpation of the proximal plantar fascia insertion or midsubstance of the plantar fascia, positive Windlass test, or first-step pain after period of inactivity.<sup>27</sup>

Participants were excluded if they had symptoms consistent with lumbar radiculitis, radiculopathy, or myelopathy, a history of foot or ankle fracture, with or without the presence of hardware from an open reduction internal fixation, known or suspected pregnancy, systemic rheumatic disease, or were undergoing litigation for any medical condition or had a positive sign or symptom for tarsal tunnel syndrome.

Tarsal tunnel syndrome and PF present with similar symptoms, including pain in the sole of the foot that is often worse after prolonged periods of standing or walking. To ensure correct clinical diagnosis of PF in the participants, several factors were considered. Participants with a positive Tinel's tarsal tunnel test, which may indicate nerve pathology, were excluded. Cause of condition was determined, as overuse is a typical cause of PF, while, according to Magee,<sup>11</sup> trauma, space-occupying lesion, inflammation, inversion/pronation, and valgus deformity are typical causes of tarsal tunnel syndrome. The observation of the participant's foot was also completed, to determine if atrophy was present, as motor weakness may be evident in tarsal tunnel syndrome.

### Physical Examination

All participants completed a medical screening questionnaire, followed by a formal physical examination conducted by 1 investigator. The examination included history of the problem, aggravating/easing factors, ankle range-of-motion measures, and special tests to identify or preclude PF, which include Tinel's tarsal tunnel test, palpation of plantar fascia in-

sertion at calcaneus and/or midsubstance of plantar fascia, and Windlass test. Lower quarter screening included a squat test for clearance of hip, knee, and ankle pain, and lumbar clearing tests, including lumbar range of motion with overpressure, quadrant test, and posterior-anterior spring testing, and gross assessment of foot type via general visual observation. Baseline demographic information is reported in **TABLE 1**.

### Common Clinical Tests

Special tests that were used in the study included the following:

1. The weight-bearing Windlass test. This test involves passive extension of the first metatarsophalangeal joint in standing position to cause a Windlass effect of the plantar fascia. Reproduction of heel pain is a positive sign.<sup>27</sup>
2. The Tinel's tarsal tunnel test. This test involves percussion of the tarsal tunnel, located posterior to the medial malleolus. Tingling or paresthesia felt distal to percussion indicates a positive sign.<sup>11</sup>
3. Lumbar quadrant test. This test is completed by guiding participant through combined motion of lumbar extension, sidebending, and rotation. The test is positive if symptoms are reproduced at the lumbar spine or lower extremity.<sup>11</sup>
4. Posteroanterior central vertebral pressure. This test is completed by applying pressure at participants' L1-L5 spinous processes. Reproduction of lower extremity pain, numbness or tingling, including foot pain, is a positive sign for possible low back pathology and not likely related to PF.<sup>11</sup>
5. Foot type determination. Pes planus was defined as when the entire sole of the foot came into complete or near-complete contact with the ground when weight bearing; pes cavus was defined as when the sole of the foot was distinctly hollow when bearing weight; and neutral

was defined as when the foot was neither cavus nor planus in weight bearing. Because foot type was used in our study for observational purposes only, and not for any outcome or statistical measure, we used this expedient observational method for foot type determination.

### Outcome Measures

Prior to any measurements, the participants completed 2 outcome measures to provide baseline data: (1) 2 subscales of the Foot and Ankle Ability Measure (FAAM), the activities of daily living subscale (FAAM-A) and the sports subscale (FAAM-S), and (2) a baseline numeric pain rating scale (NPRS) to assess first-step heel pain. The measurements were repeated again at 2, 4, and 12 weeks following TCFO fabrication. The FAAM is a 29-item self-report measure (**APPENDIX A**) that has been shown to be a valid and responsive outcome measure in a physical therapy setting. Martin<sup>25</sup> reported a minimal clinically important difference (MCID) of 8 points for the FAAM-A and 9 points for the FAAM-S. The FAAM has been shown to be a valid measure of physical function in those with lower leg, foot, and ankle disorders, including PF.<sup>25</sup> The NPRS is an 11-point self-measure of pain, ranging from 0 (no pain) to 10 (worst pain imaginable). This scale has been demonstrated to be reliable, generalizable, and has internal consistency in measures of clinical and experimental pain sensation intensities. The MCID has been reported to be 2 points.<sup>8</sup>

At 2, 4, and 12 weeks, participants were asked to complete the Global Rating of Change (GRC) to measure perceived change in overall improvement (**APPENDIX B**). Juniper et al<sup>11</sup> proposed the following classifications based on a patient's GRC score: 0, 1, or -1 indicates no change;  $\pm 2$  or 3 indicates minimal change;  $\pm 4$  or 5 indicates moderate change; and  $\pm 6$  or 7 indicates a large change in the condition.

### Orthosis and Wear Instructions

Following collection of baseline data, 1

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TABLE 2

## DESCRIPTIVE DATA FOR PRIMARY OUTCOME MEASURES

	Initial	2 wk	4 wk	12 wk
NPRS*	5.5 ± 2.5 (2-10)	2.5 ± 2.1 (0-7)	2.2 ± 2.4 (0-7)	2.7 ± 2.5 (0-9)
FAAM-A, %†	66.3 ± 17.0 (41.2-95.2)	85.1 ± 13.4 (55.9-100.0)	83.2 ± 15.1 (55.9-100.0)	85.3 ± 14.5 (60.0-100.0)
FAAM-S, %†	45.6 ± 24.6 (0.1-81.3)	70.2 ± 22.6 (28.1-100.0)	73.7 ± 26.0 (25.0-100.0)	77.1 ± 15.7 (53.0-100.0)
GRC‡	...	4.4 ± 1.8 (-1, +7)	4.5 ± 1.9 (-1, +7)	4.2 ± 2.3 (-1, +7)

Abbreviations: FAAM-A, Foot and Ankle Ability Measure Activities of daily living subscale; FAAM-S, Foot and Ankle Ability Measure sports subscale; GRC, global rating of change.

\*Values are mean ± SD (range). Score range, 0 to 10, with 0 as no pain and 10 the worst pain imaginable.

†Values are mean ± SD (range). Higher percentages for both FAAM-A and FAAM-S indicate increased abilities to function, while lower percentages indicate decreased abilities to function.

‡Values are mean ± SD (range). Possible score ranges from -7 to +7. Positive (+) changes indicate improvement, while negative (-) changes indicate decline.

TABLE 3

## CHANGE SCORES\*

	2 wk	4 wk	12 wk
NPRS (0-10)	-3.1 (-4.4, -1.7)	-3.3 (-4.6, -2.0)	-2.8 (-4.6, -1.0)
FAAM-A, %	18.8 (10.1, 27.5)	16.9 (7.8, 25.9)	19.0 (10.1, 27.9)
FAAM-S, %	24.6 (14.6, 34.6)	28.1 (15.9, 40.1)	31.5 (14.9, 48.1)

Abbreviations: FAAM-A, Foot and Ankle Ability Measure Activities of daily living subscale; FAAM-S, Foot and Ankle Ability Measure sports subscale; NPRS, numeric pain rating scale.

\*Values are average (95% CI). Data are changes at 2, 4, and 12 weeks compared to baseline data, indicating decreased pain and improved function.

of 2 researchers fabricated a TCFO for the individual examined. Researchers were given a 2-hour training session in TCFO fabrication prior to the study commencement. The TCFO was completed by placing the participant's foot in near-end range plantar flexion and inversion, in a position of comfort, and creating the TCFO from 1/8-in-thick (0.32 cm), solid AquaPlast casting material (instructions and photos provided in **APPENDIX C** and **ONLINE VIDEO**). During the initial 2-week treatment period, participants were asked to wear the TCFO at all times while weight bearing, and received a handout describing the nature of PF and instructions for orthosis use.

### Exercises

After 2 weeks of only receiving the TCFO intervention, participants were weaned off of the TCFO. Weaning-off included decreasing TCFO wear time and initiating a stretching program, which included

plantar fascia stretch, calf stretch, and ankle active range-of-motion exercises. The participants were again provided a handout for the aforementioned guidelines and exercises (**APPENDIX D**). After the weaning-off period, participants were instructed to continue performing the therapeutic exercises 2 times per day for the remainder of the study.

### Follow-up

Participants were seen in the clinic for the initial exam and for follow-ups at 2 and 4 weeks. The final 12-week follow-up was conducted via e-mail, telephone, and postal mail, per the participant's preference.

### Statistical Analysis

Data from all 15 participants were analyzed using SPSS Version 17.0 (SPSS Inc, Chicago, IL). Repeated-measures analyses of variance (ANOVAs) were used to analyze the primary outcome indicators:

NPRS, FAAM-A, and FAAM-S scores across all times. Post hoc testing was conducted using paired *t* tests to compare baseline data with the data collected at 2 weeks, 4 weeks, and 12 weeks. Change scores and 95% confidence intervals (CIs) were also calculated. The mean GRC scores were calculated at the 3 follow-up times.

## RESULTS

**B**ASELINE DEMOGRAPHIC INFORMATION is reported in **TABLE 1**. Thirteen of 15 participants (86.7%) were females with an average age of 37.6 years. No participants had to withdraw from the study due to complications or the inability to tolerate the orthosis. **TABLE 2** shows the mean scores, SDs, and range of scores for the major outcome measures (NPRS, FAAM-A, and FAAM-S) at all time points. **TABLE 3** shows the mean change scores (95% CIs) at each time point, compared to baseline, for all primary outcome measures. Repeated-measures ANOVAs revealed statistically significant changes at all 3 follow-up times compared to baseline for all 3 primary outcomes (NPRS, *P* < .001; FAAM-A, *P* = .001; FAAM-S, *P* < .001). The mean GRC score at 2, 4, and 12 weeks was 4.4, 4.5, and 4.2, respectively. No participants reported adverse effects from wearing the TCFO, and all participants completed the study at the 12 weeks.

## DISCUSSION

**T**HE RESULTS OF THIS STUDY PROVIDE preliminary evidence to suggest that a TCFO, cast while holding the foot in plantar flexion and inversion and worn for 2 weeks, followed by a stretching program, provided relief of symptoms associated with plantar heel pain in a relatively young and healthy population throughout a 12-week period. The results at 2 weeks demonstrated that 80% of participants had moderate to large changes in their condition (shown by the GRC results) and 87% reported a clini-



cally important difference of 8 points or more for the FAAM-A score. At 4 weeks there was a similar trend, with 80% of participants showing moderate to large changes in GRC score and 60% showing a clinically important difference on the FAAM-A score. At 12 weeks, 67% of participants showed moderate to large changes in GRC score and 80% of participants demonstrated a clinically important difference on FAAM-A score.

One plausible reason for this reduction in pain might be due to the plantar flexed and inverted position of the foot of which the TCFO was cast. This position shortens the plantar fascia and slightly raises the heel, transferring pressure from the heel to the forefoot. It has been determined that lifting the calcaneus 3 mm reduces pull on the plantar fascia.<sup>15</sup> Wearing a TCFO during all times of weight bearing for 2 weeks may decrease repetitive tearing at the plantar fascia origin and allow healing to occur.

Another plausible reason for reducing pain may be the sensory changes that occur due to the orthosis making contact with the foot. The TCFO used in the current study was made of a rigid Aqua-Plast material. Previous research has theorized that rigid materials stimulate mechanoreceptors and may provide better feedback, thus altering the mechanics of the foot.<sup>33,34</sup> In excessively pronated feet, mechanoreceptors may alter frontal plane motion,<sup>34</sup> resulting in a decrease of the pronation moment, which relieves excessive stress on the plantar fascia. More than 50% of the participants the current study population had pronated feet (TABLE 1).

Lastly, it has been theorized that first-step morning pain may be caused by the shortening of the plantar fascia during a prolonged position of plantar flexion during sleep, allowing microtears to partially heal and to become aggravated by normal stretching during weight bearing. Wearing a TCFO during all times of weight bearing during the initial 2 weeks might have decreased repetitive tearing at the plantar fascia to allow for healing

to occur.

The present study demonstrates that the greatest change in first-step heel pain and function occurred during the initial 2 weeks, when the only intervention provided was the TCFO. This success rate during the initial 2 weeks may be attributed to the aforementioned mechanoreceptor feedback, the shortened position of the plantar fascia, or the biomechanical change at the foot provided by the TCFO. It is possible that TCFO use of greater duration may provide additional relief.

The stretching program, initiated after the first 2 weeks, might have allowed the plantar fascia to return to, and maintain, normal tissue length. The final 10 weeks did not result in significant changes in pain, which may be due to the healing of the plantar fascia and the use of stretching techniques during that period. It may also be attributed to the relief provided by the TCFO during the first 2 weeks, leaving only the necessity of maintaining plantar fascia extensibility following treatment.

In the literature, both custom and prefabricated foot orthoses have been shown to provide temporary relief for many common foot conditions, including lower extremity tendinopathies.<sup>17-19,24,35</sup> Posterior tibialis and Achilles tendinopathies have been determined to improve from both types of arch-supporting orthoses plus exercise.<sup>17,18,26</sup> Orthoses provide arch support while maximizing tissue-specific strengthening to the muscle.<sup>16</sup> Likewise, the TCFO in the current study was used to provide arch support to offload the plantar fascia, while the stretches were used to restore and maintain normal tissue length. Although evidence of the effectiveness of stretching and exercises in decreasing foot pain and function is mixed, the TCFO followed by stretching has suggested clinically meaningful changes.

Advantages of the TCFO include its fabrication time of less than 10 minutes and completion onsite by a physical therapist, ease of construction, and minimal

cost to the patient (less than \$14 in material costs per orthosis). As the demand for the cost effectiveness of healthcare increases, so may temporary orthoses meet that demand by providing affordable and effective treatment for reducing heel pain and increasing functional activities. Additionally, a TCFO is designed to be worn for a short duration.

Randomized control trials comparing the TCFO versus stretching alone, or another acceptable treatment group, are needed to support the findings of this investigation. Suggested are additional randomized studies comparing the TCFO to custom and over-the-counter orthoses. Lastly, frequency and duration of the stretching program after use of the temporary TCFO should be investigated long term (greater than 1 year), as well as optimal duration of orthosis wear. If a cause-and-effect relationship can be determined, a clinical prediction rule to select the patient population for which TCFO would be best suited would be of clinical value.

## Limitations

The small sample size and lack of a comparison group in this study, by not providing sufficient evidence to make a strong supportive claim that the foot orthoses made the suggested changes, affect the external validity by limiting generalizability and internal validity. Additionally, it is possible that the positive outcomes identified in this study were due to the participants' knowledge that they were a part of a study. Compliance of the participants in wearing their orthosis at all times while weight bearing and in performing their stretching program twice a day was not monitored.

## CONCLUSION

**T**HIS STUDY REPORTS THE EFFECTS OF wearing a TCFO for 2 weeks, followed by a stretching program, in 15 participants diagnosed with PF. Overall, findings suggest that wearing a TCFO for 2 weeks, followed by a stretch-

ing program, decreases overall pain and increases foot and ankle function in participants with PF. These same participants also report perceived improvements over a 12-week period. Future research is needed to determine the reliability, validity, and generalizability to clinical populations. ●

## KEY POINTS

**FINDINGS:** This study provides preliminary evidence that a TCFO cast in a combined plantar flexion and inversion position, followed by stretching, produces positive outcomes in first-step heel pain and foot and ankle function.

**IMPLICATION:** Clinicians should consider the use of temporary foot orthoses for the treatment of plantar heel pain.

**CAUTION:** The use of a single-group design is a limitation of this study.

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## APPENDIX A

### FOOT AND ANKLE ABILITY MEASURE (FAAM)\*

#### Activities of Daily Living Subscale

Please answer **every question** with **one response** that most closely describes your condition within the past week.  
If the activity in question is limited by something other than your foot or ankle, mark **not applicable (N/A)**.

	No Difficulty	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to Do	N/A
Standing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking on even ground	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking on even ground without shoes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking up hills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking down hills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going up stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going down stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking on uneven ground	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stepping up and down curbs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Squatting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coming up on your toes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking initially	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking 5 minutes or less	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking approximately 10 minutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking 15 minutes or greater	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Because of your **foot and ankle**, how much difficulty do you have with:

	No Difficulty at All	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to Do	N/A
Home responsibilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Activities of daily living	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal care	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# [ RESEARCH REPORT ]

## APPENDIX A

Light to moderate work (standing, walking)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heavy work (push/pulling, climbing, carrying)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recreational activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How would you rate your current level of function during your usual activities of daily living from 0 to 100, with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities?

☐☐☐.0%

### Sports Subscale

Because of your **foot and ankle**, how much difficulty do you have with:

	No Difficulty at All	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to Do	N/A
Running	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jumping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Landing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Starting and stopping quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cutting/lateral movements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Low-impact activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ability to perform activity with your normal technique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ability to participate in your desired sport as long as you would like	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How would you rate your current level of function during your sports-related activities from 0 to 100, with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities?

☐☐☐.0%

Overall, how would you rate your current level of function?

☐ Normal   ☐ Nearly normal   ☐ Abnormal   ☐ Severely abnormal

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## APPENDIX B

### PATIENT GLOBAL RATING OF CHANGE SCALE

Compared to your condition prior to treatment, which item on the scale below best describes your condition right now (choose only 1 option):

- |  |  |   |
|--|--|---|
| <input type="checkbox"/> A very great deal worse | <input type="checkbox"/> A little bit worse                  | <input type="checkbox"/> Somewhat better          |
| <input type="checkbox"/> A great deal worse      | <input type="checkbox"/> A tiny bit worse (almost the same)  | <input type="checkbox"/> Moderately better        |
| <input type="checkbox"/> Quite a bit worse       | <input type="checkbox"/> About the same                      | <input type="checkbox"/> Quite a bit better       |
| <input type="checkbox"/> Moderately worse        | <input type="checkbox"/> A tiny bit better (almost the same) | <input type="checkbox"/> A great deal better      |
| <input type="checkbox"/> Somewhat worse          | <input type="checkbox"/> A little bit better                 | <input type="checkbox"/> A very great deal better |

A change in score of 4 rating points served as a reference standard indicating a significant effect.



## APPENDIX C

### FABRICATION OF THE TEMPORARY CUSTOM FOOT ORTHOSIS (ONLINE VIDEO)

1. Cut an 18 × 24-in (standard size) sheet of 1/8-in AquaPlast into 8 pieces (6 × 9 in). This will fit almost all feet.



2. The patient is positioned with the involved limb resting on a padded chair with the knee bent and the foot facing you. The patient must be relaxed.
3. Sit in a chair facing the sole of the patient's foot. The orthosis is cast holding the patient's foot near end range plantar flexion and inversion. In a position of comfort.
4. Place hand lotion on the foot and your hands so that the material won't stick. You may need to remove your watch and rings.



5. Heat the material in about 160° F water. A hydrocollator works fine and a large electric skillet even better. When the AquaPlast turns transparent, it is ready. If you overheat, the material becomes overly soft and harder to work with.
6. Lift it carefully from the pan by sliding an object beneath it and lifting it upward rather than pinching it with a clamp-like device that might deform the material.
7. Drape the material over your forearm to ensure that it isn't too hot for the patient.
8. Place the material over the patient's foot, with the distal edge at about the midline of the metatarsal heads. Carefully drape the material over and around the heel, pulling gently downward. Do not pull too hard, or you will overstretch the material and weaken the orthosis.



## APPENDIX C

9. As the material begins to harden, trace your trim lines using either a fingernail or a grease pencil. The trim line at the heel should begin about 2 to 2.5 cm above the bottom of the heel. Continue drawing the line around the medial foot just below the level of the navicular tuberosity, proximal to the metatarsal heads, and laterally about 2 cm high. The distal trim line should be curved rather than squared off.



10. Before the material becomes too hard, remove the orthosis from the foot keeping it upside down so that the orthosis doesn't deform. Use bandage or straight scissors to cut at your trim lines. Place the material back on the foot until the orthosis hardens. Remove the orthosis from the foot. Stretch the distal orthosis medially and laterally to allow for the expansion of the soft tissue and metatarsals with weight bearing. Be careful not to stretch the heel.



11. Rough edges can be trimmed when the material is still soft by smoothing with a finger. A grinder is helpful to taper the distal edge.



12. When the orthosis is hardened, place it in the shoe (remove any shoe liners). Ensure that it is comfortable. Trim, stretch, or pad the orthosis as needed to make it completely comfortable. Always give the patient plenty of time to make sure it is comfortable. Have the patient return the next day to make any needed changes.



13. If made for only 1 foot, leave the shoe insert in the other shoe to compensate for limb length difference or provide with a 1/8-in heel lift.

14. Ensure that the patient understands that for the orthosis to be effective, it must be worn whenever the patient is weight bearing. When standing in the shower, the patient can stand slightly on the lateral aspect of the foot to avoid pronation and pulling of the plantar fascia.

15. The patient should be seen again in 2 weeks at the latest. The length of time the orthosis must be worn depends on how the patient responds. If the plantar fasciitis is resolving, the insert can be lowered by heating it up so that it becomes a little soft, placing it back in the shoe, and have the person step down on it. If they are asymptomatic, the splint can be discontinued. They should continue to wear supportive shoes. If the symptoms are worse, the patient should be reevaluated. The orthosis can be remolded with a higher arch.

## WEANING-OFF SCHEDULE AND TRAINING

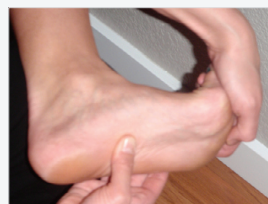
You made it through the first 2 weeks. By now you should be ready to begin weaning your foot off of your foot orthosis. If you are continuing to experience heel pain and you know it has been declining, wear your orthosis for 1 more week. Then begin the weaning-off schedule.

Weaning-off schedule:

- Days 1-4, wear orthosis for a maximum of 8 h/d
- Days 5-8, wear orthosis for a maximum of 4 h/d
- Days 9-12, wear orthosis for a maximum of 2 h/d
- Days 13-14, do not wear orthosis

*Prescribed foot care to be performed 2 times per day:*

- Plantar fascia stretch with soft tissue mobilization. Sit with affected foot crossed over your opposite knee. Next, use the same hand on the side of your involved foot and take your toes and ankle backwards towards the front of your leg until you feel maximal stretch on the plantar fascia. Once in position, continue to hold and apply a deep pressure along plantar fascia from the heel to the toes using your fingers, thumbs, or knuckles. Continue to apply deep massage to fascia for up to 3 minutes. You may feel mild pain and discomfort. This is normal. The purpose of this activity is to stretch the fascia back into its normal functional position and prepare the fascia for return to normal daily activities. If you have 2 involved feet, repeat on opposite foot.



- Gastrocnemius and soleus stretching. The gastrocnemius muscle is a muscle in the upper calf, just below the back of the knee. To stretch it, stand 46 to 61 cm away from a wall (facing the wall). Place hands on wall at shoulder/head level. Bend front knee and move involved foot about 30 cm backwards. Keep back knee straight and keep heel on the floor. Lean gently into the wall (this should not hurt); do not bounce. Hold for 30 seconds. Repeat 4 times. Allow the muscle to relax in the position and begin stretching the muscle by lifting your big toe off of the floor.



- Ankle range of motion. Before getting out of bed and before going to sleep: Move ankle in circular movement clockwise and counter-clockwise, 10 times in each direction.
  - Flex your ankle so that your toes move up toward your nose and then point toes downward like a ballet dancer, 10 times in each direction.
  - Flex toes up, while bending your knee, then point toes, while straightening your knee. Perform 10 times in each direction.

