



# Comparing the Role of Different Treatment Modalities for Plantar Fasciitis: A Double Blind Randomized Controlled Trial

Ravi Gupta<sup>1</sup> · Anubhav Malhotra<sup>1</sup> · Gladson David Masih<sup>1</sup> · Tanu Khanna<sup>1</sup> · Harsimranjit Kaur<sup>2</sup> · Parmanand Gupta<sup>1</sup> · Shweta Kashyap<sup>1</sup>

Received: 26 December 2019 / Accepted: 31 December 2019 / Published online: 20 January 2020  
© Indian Orthopaedics Association 2020

## Abstract

**Introduction** Although many treatment modalities including rest, stretching, strengthening, change of shoes, arch supports, orthotics, night splints and anti-inflammatory agents have been advocated for plantar fasciitis, there is no report in the literature which compares the independent effectiveness of each treatment modality without the concomitant use of any other one.

**Methods** A double blind, randomized controlled study was undertaken where 140 patients of plantar fasciitis were divided into four groups with 35 patients each. Patients in four groups received analgesics, hot water fomentation and silicon heel pads, plantar fascia stretching and calf stretching exercises, respectively. Heel pain was evaluated using Foot Function Index (FFI) and disability using Foot and Ankle Disability Index (FADI). Clinical evaluation was done weekly up to a period of 4 months and then at 6 months, 8 months, 10 months and 12 months.

**Results** Mean age of patients was  $43.4 \pm 10.6$  years with average duration of symptoms being 27.26 weeks (range 4–200 weeks). Both FFI and FADI showed statistically significant improvement at 12 months in all the four groups ( $p$  value  $< 0.0001$  for all groups). However, groups 2, 3 and 4 were observed to show statistically better results in terms of heel pain reduction (FFI) as compared to group 1 (ANOVA,  $p$  value  $< 0.0001$  for group 1 vs. 2, group 1 vs. 3 and group 1 vs. 4). In terms of disability (FADI), best results were observed in group 3.

**Conclusion** Plantar fascia stretching exercises resulted in most significant improvement in both the scores (FFI and FADI), followed by treatment with heat and silicone heel pad and calf stretching exercises.

**Keywords** Plantar fasciitis · Plantar fascia stretching · Calf stretching · Analgesics · Silicone heel pad and moist heat

✉ Ravi Gupta  
ravikgupta2000@yahoo.com

Anubhav Malhotra  
anubhavmalhotra88@gmail.com

Gladson David Masih  
gladsondavid32@gmail.com

Tanu Khanna  
tanu488khanna@gmail.com

Harsimranjit Kaur  
singh.dwl@gmail.com

Parmanand Gupta  
drpgupta123@rediffmail.com

Shweta Kashyap  
shwetakashyap580@gmail.com

<sup>1</sup> Department of Orthopaedics, Government Medical College Hospital, Chandigarh, Chandigarh 160030, India

<sup>2</sup> Department of Physical Medicine and Rehabilitation, Government Medical College Hospital, Chandigarh, Chandigarh 160030, India

## Introduction

The plantar fascia is a broad band of fibrous tissue forming the medial longitudinal arch of the foot [1]. Plantar Fasciitis is an inflammatory condition which results in pain at the inferior aspect of the heel, affecting 10–15% of the general population [2]. It is the most common cause of heel pain in the population aged above 40 years [3, 4]. It accounts for 10% of injuries in runners and is seen in both sedentary and athletic individuals [5, 6]. Patients with plantar fasciitis experience sharp or knife-like pain in the morning which subsides with a few initial steps [7]. However, the symptoms may also arise with prolonged standing which is sometimes accompanied by stiffness and in chronic case, the pain worsens by the end of the day limiting patient's daily activities [8].

Although the exact etiology of plantar fasciitis remains controversial, in the studies, it has been recognized to be

associated with repeated trauma, overuse injury, improper footwear, weak intrinsic muscles, tightness and weakness in calf muscles, poor foot bio-mechanics and acquired conditions such as pes planus or cavus or congenital dysfunction [1, 8, 9].

Till date, several conservative treatment strategies are known to improve symptoms of the condition including rest, night splints [7], shoe modification [10], silicone insoles [10–16], stretching of the plantar fascia and calf muscle [5, 17–19], cold treatment [20] heat treatment [20, 21], non-steroidal anti-inflammatory medications [6, 20, 22] and corticosteroids [22, 23]. However, there is no single universally accepted treatment modality which can be used independently for effectively treating the plantar fasciitis.

Studies have suggested the use of oral non-steroidal anti-inflammatory drugs (NSAIDs) in reducing inflammation and providing pain relief [6, 22], but their efficacy in chronic cases still remains obscure. Some authors have studied that heat treatment also showed positive results, specifically moist heat [20, 21] but the effectiveness of heat treatment in isolation remains uncertain as it is always used in conjunction with other treatment modalities [21].

Silicone insole is a non-invasive modality that works by providing cushioning and add comfort to the sole as it absorbs 42% of shock while walking [23, 24]. Studies have suggested that prefabricated shoe inserts, specifically, the silicone inserts provide better relief to the patients than the custom made orthotics and stretching exercises alone and is found to be an effective conservative treatment for reducing pain and improving functional outcome [13, 15].

Calf muscle and plantar fascia stretching exercises have been observed to be one of the effective treatment modality for plantar fasciitis [2, 5, 17]. These exercises are commonly administered to relieve stress and pressure from the tight and inflamed plantar fascia to restore normal range of motion. Numerous studies have shown that stretching exercises, when combined with other treatment modalities decrease the symptoms [5, 17–19] but no study has determined the independent efficacy of these exercises in treating plantar fasciitis.

To our knowledge, there is no study in the literature which has evaluated and compared the independent efficacy of the commonly used treatment modalities like analgesics, silicone heel pad with hot fomentation, plantar fascia stretching exercises, and calf stretching exercises to treat plantar fasciitis. Thus, the aim of the present study is to assess the response of the patients to different treatment modalities when given in isolation which may help to establish a definitive treatment strategy for treating the plantar fasciitis.

## Materials and Methods

This was a prospective; double blind randomized controlled trial (Level I) which was carried out in a tertiary care centre over a period of 4 years and registered with the Clinical Trial Registry-India (CTRI/2015/07/006029). Patients diagnosed with plantar fasciitis who satisfied the inclusion criteria were enrolled in our study.

Both male and female patients with age ranged between 25 and 65 years, having symptoms of moderate to severe intensity with minimum duration of 6 weeks were included in the study. Patients were excluded if they had any history of steroid injection, history of any surgery in the affected lower limb and any other pathological disorder that can cause pain in the heel. Patients having painful hip or knee, any psychosocial dysfunction or having Body Mass Index (BMI) > 25 were also excluded from the study. Only those patients who were willing to participate and agreed to omit any other treatment were included in the study.

Prior to the participation, written and informed consent was taken from each subject. If a patient is found to be having plantar fasciitis in both the feet, the foot with the maximum intensity of pain was considered the study foot. Using computer-generated method, the subjects underwent randomized allocation into four treatment groups: Group 1 ( $n = 35$ )—conventional treatment (patients with analgesics), Group 2 ( $n = 35$ )—heat treatment with silicone heel pad, Group 3 ( $n = 35$ )—active plantar fascia stretching with sham calf stretching and Group 4 ( $n = 35$ )—active calf muscle stretching with sham plantar fascia stretch.

Each patient was assessed using Foot Function Index (FFI) [25] and The Foot and Ankle Disability Index (FADI) [26] to know the baseline scores of pain, disability, and restrictions in activities of daily living. FFI consists of 3 sub-scales: pain, disability, and activity restriction [25], each item evaluated on a scale of 0–10. FADI is composed of a 26-item activities of daily living, with each item scored on a scale of 0–5. Treatment was considered to be failed if the pain of the patient did not improve or got worsened after 3 weeks of treatment.

The subjects in Group 1 were given 75 mg Indomethacin once a day for the maximum period of 3 weeks. Patients allergic to Indomethacin SR were prescribed Diclofenac 100 mg.

The subjects in Group 2 were prescribed the moist heat to the affected foot for 20 min at night and inserted silicone heel rubber pad in shoes while performing routine activities.

The subjects in Group 3 performed plantar fascia stretching exercises. Patients were asked to sit comfortably by crossing the affected leg over the opposite leg, then pulling the toes of the affected foot back towards the shin

using the hand on the affected side until a stretch was felt in the arch of the foot [5].

The subjects in Group 4 performed calf stretching exercises. The exercises were performed in standing position. Subjects were asked to lean into the wall with unaffected leg placed in front of the affected leg, then the front knee bent while keeping the back knee straight and heel fixed on the ground until a stretch is felt in the Achilles tendon [17]. Subjects of both the groups; Group C and Group D were asked to maintain the stretch for 10 s with 15 repetitions in each session and the exercises have to be performed twice daily.

To incorporate blindness between groups 3 and 4, they were given sham exercise. Group 3 patients were given a sham exercise in standing position. The exercise was performed while leaning into the wall without actually stretching the Achilles tendon. Whereas, the patients of Group 4 were given the sham exercise in sitting position, in which they had to cross the affected leg over the unaffected leg, holding the affected side with hand but without actually stretching the fascia.

Follow-up was done every week using FFI and FADI index till first 4 months and then at 6 months, 8 months, 10 months and 12 months to assess the individual effectiveness of each treatment module in improving the functional outcome and in preventing the recurrence of symptoms.

## Statistical Analysis

Data were analyzed using SPSS version 20.0. Intragroup comparison of differences between pre and post intervention scores of FFI and FADI was analyzed using Student's *t* Test. One-way analysis of variance (ANOVA) was applied to evaluate whether significant difference existed between pre and post intervention scores of different groups. If significant difference was found between the groups, post-hoc Tukey HSD test was applied to reveal which groups differ significantly from each other. The results were considered statistically significant if *p* values were less than 0.05.

## Results

Out of 156 enrolled patients, 140 patients completed 1 year follow-up. There were 35 patients in group 1, 35 patients in group 2, 35 patients in group 3 and 35 patients in group 4 who completed the study. The mean age of the patients was  $43.4 \pm 10.6$  years. There were 105 females and 51 males. The average duration of symptoms before treatment was 27.26 weeks (range 4–200 weeks). The mean BMI was  $23.5 \pm 1.2$ . 43 patients presented with right and 53 patients presented with left foot involvement; 60 patients had bilateral plantar fasciitis. The demographic details of the patients in each group are given in Table 1. Since no significant

**Table 1** Demographic data of four groups

Groups	Mean age (years)	Mean BMI	Mean duration of symptoms (weeks)
1	$44.4 \pm 9.4$	$23.8 \pm 1.3$	$23.0 \pm 27.4$
2	$41.5 \pm 10.9$	$24.1 \pm 1.1$	$27.4 \pm 39.4$
3	$46.4 \pm 11.9$	$24.2 \pm 1.1$	$32.5 \pm 46.1$
4	$41.5 \pm 10.3$	$23.7 \pm 1.4$	$26.2 \pm 35.2$
' <i>p</i> ' value	0.149	0.198	0.737

**Table 2** Foot Function Index (FFI) score of 4 groups

Group	Mean pre-intervention score	Mean post-intervention score (1 year)	' <i>p</i> ' value
Group 1	69.5	42.1	0.0001**
Group 2	64.5	6.6	$p < 0.0001^{**}$
Group 3	70.6	1.7	$p < 0.0001^{**}$
Group 4	66.6	10.4	$p < 0.0001^{**}$

\* $p < 0.05$ ; \*\* $p < 0.0001$

difference was found between all the groups with respect to demographic variables, all the groups were matched for age, BMI and duration of symptoms.

Sixteen patients withdrew from the study due to various reasons; experienced medical problems unrelated to plantar fasciitis (7 patients), unavailability for weekly evaluation (3 patients), having administered corticosteroid injection without informing investigator (3 patients), and due to unfortunate tragic event at home (3 patients). Three, five, three and five patients were lost to follow-up in group 1, 2, 3, and 4, respectively.

17 patients in the pain killer group had their treatment terminated after a minimum period of 3 weeks. The mean recurrence time was 11.3 weeks (range 4–18 weeks).

The pain and disability score (FFI and FADI) improved within all the groups as significant difference existed within the groups on unpaired '*t*' test. The details of pre intervention score and post intervention score for FFI and FADI are given below in Tables 2 and 3.

No statistically significant difference was observed in pre-intervention score between the groups on FFI ( $p = 0.59$ ) and FADI ( $p = 0.239$ ), but, statistically significant difference was observed between all the groups on post intervention score with respect to FFI ( $p < 0.0001^{**}$ ) and FADI ( $p < 0.0001^{**}$ ) as analyzed by One-way analysis of variance (ANOVA) test. The details are given in Tables 4 and 5.

To assess the superiority of one treatment group over another treatment group, post-hoc Tukey test was applied which has shown statistically significant difference between group 1 and 2 ( $p < 0.001^{**}$ ), group 1 and 3 ( $p < 0.001^{**}$ ),

**Table 3** The Foot and Ankle Disability Index (FADI) score of 4 groups

Group	Mean pre-intervention score	Mean post-intervention score (1 year)	'p' value
Group 1	61.9	78.6	0.0002**
Group 2	66.5	95.1	$p < 0.0001$ **
Group 3	61.5	98.3	$p < 0.0001$ **
Group 4	64.4	90.9	$p < 0.0001$ **

\* $p < 0.05$ ; \*\* $p < 0.0001$

**Table 4** One-way ANOVA analysis of pre and post intervention FFI scores of 4 groups

Pre-intervention score ('p' value)	0.59
Post-intervention score ('p' value)	$p < 0.0001$ **

\* $p < 0.05$ ; \*\* $p < 0.0001$

**Table 5** One-way ANOVA analysis of post intervention FADI scores of 4 groups

Pre-intervention score ('p' value)	0.239
Post-intervention score ('p' value)	$p < 0.0001$ *

\* $p < 0.05$ ; \*\* $p < 0.0001$

**Table 6** Post-hoc Tukey HSD test for the four groups on mean difference FFI score

Contrast	'p' value
Group 1 versus Group 2	0.001**
Group 1 versus Group 3	0.001**
Group 1 versus Group 4	0.001**
Group 2 versus Group 3	0.26
Group 2 versus Group 4	0.89
Group 3 versus Group 4	0.15

Group 3 > Group 1; Group 2 > Group 1; Group 4 > Group 1; Group 2 ~ Group 3; Group 2 ~ Group 4; Group 3 ~ Group 4

\* $p < 0.05$ ; \*\* $p < 0.0001$

group 1 and 4 ( $p < 0.001$ \*\*), and non-significant difference was found between group 2 and 3 ( $p = 0.26$ ), group 2 and 4 ( $p = 0.89$ ) and group 3 and 4 ( $p = 0.15$ ) on FFI score (Table 6). This means that the improvement was seen in pain and disability symptoms of patients in both the stretching groups and hot fomentation plus silicone heel pad groups more than in the pain killer group.

Statistically significant difference was found between group 1 and 2 ( $p = 0.001$ \*\*), group 1 and 3 (0.001\*\*), group 1 and 4 ( $p = 0.001$ \*\*), and group 3 and 4 ( $p = 0.03$ ) and,

**Table 7** Post-hoc Tukey HSD test for the four groups on mean difference FADI score

Contrast	'p' value
Group 1 versus Group 2	0.001**
Group 1 versus Group 3	0.001**
Group 1 versus Group 4	0.001**
Group 2 versus Group 3	0.09
Group 2 versus Group 4	0.90
Group 3 versus Group 4	0.03*

Group 3 > Group 1; Group 2 > Group 1; Group 4 > Group 1; Group 3 > Group 4, Group 2 ~ Group 3; Group 2 ~ Group 4

\* $p < 0.05$ ; \*\* $p < 0.0001$

non-significant difference was found between group 2 and 3 ( $p = 0.09$ ), and group 2 and 4 ( $p = 0.90$ ) on FADI score (Table 7). This shows that pain and disability improved in group 3 as compared to all other treatment groups.

Statistical power analysis was performed using G\* Power (version 3.1) software. The power of the study was calculated on the basis of the FADI scale among the 4 groups, which was 0.95 with an effect size  $f$  of 0.49,  $\alpha$  err prob of 0.05, Power ( $1 - \beta$  err prob) of 0.95. The power of the study was also calculated on the basis of the FFI among the 4 groups, which was 0.96 with a effect size  $f$  of 0.81,  $\alpha$  err prob of 0.05, Power ( $1 - \beta$  err prob) of 0.95.

## Discussion

Plantar fasciitis is an inflammatory condition resulting in pain at the inferior aspect of the heel, especially in the morning with first few steps [7]. Many non-operative treatment modalities have been used in the past to treat this condition in conjunction with other modalities [5–7, 10–16, 18–22, 27], but to the best of our knowledge, no study has compared the effect of these modalities when used alone. Thus, in the present study, the individual effectiveness of four different modalities; the analgesics, silicone heel pad with hot fomentation, plantar fascia stretching exercises, and calf stretching exercises was assessed.

In the present study, we have observed the predominance of female patients over male patients. This is in accordance with the study by Davis et al. [28], where there were 74 female patients and 31 male patients who had plantar fasciitis and in another study by Yucel et al. [29], the heel pain was seen to be more prevalent in the female population (76.6% in females vs. 23.3% in males). This discrepancy between male: female ratio in our study may be ascribed to certain factors like prolonged standing hours, more common usage of flat or high heel footwear and habit of bare foot walking in women population in our region.

In our study, in the analgesic group, out of 35 patients, 17 patients had their treatment failure after 3 weeks of treatment (mean treatment failure time 11.3 weeks) and 18 patients successfully completed 1 year follow-up with improved pain and disability score on FFI and FADI ( $p < 0.001$ ). This is in agreement with the study by Biswas et al. [22], in which symptoms of plantar fasciitis recur after discontinuation of oral NSAIDs after 2 months which was significantly higher (33/60, i.e., 55%). Another study which incorporated the use of oral NSAIDs in the treatment of plantar fasciitis, showed that the symptoms of the patients improved with NSAIDs [6], but this disparity of results could be due to the small sample size of the their study and incorporation of other modalities in conjunction with oral NSAIDs.

Results of the present study depict that the plantar fascia stretching group showed more reduction in pain (FFI score) and improvement in activities (FADI score) as compared to the silicone heel pad plus hot fomentation group as observed from mean difference, although no statistical difference was found between them on FFI ( $p = 0.8073$ ), and FADI score ( $p = 0.9632$ ). In a randomized controlled trial by Pfeffer et al. [13] on 236 patients, the comparison was made between three prefabricated shoe inserts (a rubber heel cup, a felt insert and a silicone heel pad) along with Achilles tendon and plantar fascia stretching and stretching alone. Only 190 patients completed the 8 week follow-up, the response rates were found to be better in the silicone insert group than in the stretching-only group ( $p = 0.019$ ). Although, the silicone insert group was shown to improve more on FFI as compared to stretching alone, but there was no significant difference ( $p = 0.54$ ). In another study conducted by Yucel et al. [29], it was established that the condition of 80% of patients resolved after using full-length insoles with statistically significant difference between mean pain scores at  $p < 0.05$ . The discrepancy between the results could be attributed to the short-term follow-up and use of silicone heel insert in conjunction with other treatment modalities in these studies.

Petrofsky et al. [20] studied that heat and moist heat used at night was found to be helpful in reducing pain. But, the limitation of their study was that heat was not used alone for the treatment of plantar fasciitis but in combination with or without Advil. Ours is the only study which has incorporated heat treatment along with the silicone heel pad.

Plantar fascia stretching exercises were shown to have more improvement in patients as compared to all other groups in the present study. In a retrospective study by Davis et al. [28],

conducted on 105 patients, 89% of patients were shown to improve significantly with non-operative treatment which included rest, NSAIDs, Achilles tendon and plantar fascia stretching exercises, and heel cushions. However, stretching exercises were found to be the most effective treatment of plantar fasciitis in their study. Various authors have also advocated the use of stretching exercises in the treatment of plantar fasciitis for better outcome [2, 5, 17–19]. In the recent literature, the superiority of one stretching exercises over another was not established as stretching exercises were rarely used in isolation. Ours is the first study which has studied the effects of these exercises in isolation with long-term follow-up period of 1 year.

We have also observed that the patients in the plantar fascia stretching group showed better results when compared with calf stretching group. Although no significant improvement was seen between these groups on FFI score ( $p = 0.15$ ) and also found on FADI score ( $p = 0.03$ ). This result is consistent with the findings of the study carried by Digiovanni et al. [17], in which the effect of plantar fascia and calf stretching exercises was seen in 101 patients suffering from chronic plantar fasciitis in phase one of clinical trial for 8 weeks of treatment. Along with the stretching exercises, the treatment plan also included prefabricated soft insoles and a 3-week course of celecoxib. After 8 weeks, the patients in plantar fascia stretching group showed significant improvement on the pain score of FFI with respect to worst pain;  $p = 0.02$  and first steps in the morning;  $p = 0.006$ , but no significant improvement was seen when all the components of FFI were compared. The patients in calf stretch group were instructed to perform plantar fascia stretching exercises after 8 weeks of treatment. In phase two of the clinical trial [5], at 2 years of follow-up, both the groups improved significantly with respect to pain and the visual analog scale scores from baseline on FFI score ( $p < 0.0001$ ). Thus, these studies also suggest that plantar fascia stretching exercises provide better relief symptomatically in cases of plantar fasciitis. A summary of certain important papers on the subject with their relevant findings is provided in Table 8.

## Conclusion

Plantar fascia stretching exercises resulted in most significant improvement in both the scores (FFI and FADI), followed by treatment with heat and silicone heel pad and calf stretching exercises.

**Table 8** Summary of certain important papers on the subject with their relevant findings

Study	Remarks
Biswas et al. [22]	Pain relief was significant after steroid injection ( $p < 0.001$ ) and the improvement was sustained The recurrence of heel pain was significantly higher in the oral NSAIDS group ( $p < 0.001$ )
Donley et al [6]	Pain and disability mean scores improved significantly over time in both groups, although there was no statistically significant difference between the placebo and NSAID groups at 1, 2, or 6 months
Petrofsky et al. [20]	Heat and moist heat all caused a significant reduction in pain ( $p < 0.05$ ) Heat at night was just as effective as cold in the morning and there was no significant difference between the two ( $p > 0.05$ )
Pfeffer [13]	Results showed that using the Bauerfeind ViscoSpot or other prefabricated insert along with stretching exercises was better than stretching alone or using a custom orthosis along with stretching The authors concluded that, when used with a stretching program, a prefabricated shoe insert is more likely to produce improvement in symptoms as part of the initial treatment of proximal plantar fasciitis than a custom polypropylene orthotic device
Di Giovanni et al. [17]	The pain subscale scores of the Foot Function Index showed significantly better results for the patients managed with the plantar fascia stretching program Analysis of the response rates to the outcome measures also revealed significant differences with respect to pain, activity limitations, and patient satisfaction, with greater improvement seen in the group managed with the plantar fascia-stretching program A program of non-weight-bearing stretching exercises specific to the plantar fascia is superior to the standard program of weight-bearing Achilles tendon-stretching exercises for the treatment of symptoms of proximal plantar fasciitis
Rompe et al. [19]	A program of manual stretching exercises specific to the plantar fascia is superior to repetitive low-energy radial shock-wave therapy for the treatment of acute symptoms of proximal plantar fasciopathy
Di Giovanni et al. [5]	At the end of 8 weeks, both groups reported significant improvement on the Foot Function Index, but those in the plantar fascia stretching group had significantly greater improvement with respect to worst pain and pain with first steps in the morning The plantar fascia stretching group also had a higher percentage of positive responses to an outcomes survey in terms of pain, activity and satisfaction After 8 weeks, patients from both groups were instructed to continue with plantar fascia stretching At 2-year follow-up, both groups continued to show improvement on the pain subscales of the FFI compared to baseline. However, no group differences were observed The study suggests that plantar fascia stretches provide better symptom relief for chronic plantar fasciitis

**Acknowledgements** We are thankful to Indian Council of Medical Research (ICMR), New Delhi, India (Grant No. 5/4-5/3/ORTHO/2013-NCD-1 DATED 26.03.2015) for funding this study.

## Compliance with Ethical Standards

**Conflict of Interest** There are no conflicts of interest.

## References

- Roxas, M. (2005). Plantar fasciitis: Diagnosis and therapeutic considerations. *Alternative Medicine Review*, 10(2), 83–93.
- Sharma, N., & Singh, G. (2010). Splinting and stretching for plantar fasciitis pain. *Lower Extremity Review*, 10, 15–19.
- Furey, J. G. (1975). Plantar fasciitis. The painful heel syndrome. *Journal of Bone and Joint Surgery. American Volume*, 57(5), 672–673.
- Lapidus, P. W., & Guidotti, F. P. (1965). Painful heel: Report of 323 patients with 364 painful heels. *Clinical Orthopaedics and Related Research*, 39, 178–186.
- Digiovanni, B. F., Nawoczenski, D. A., Malay, D. P., Graci, P. A., Williams, T. T., Wilding, G. E., et al. (2006). Plantar fascia-specific stretching exercise improves outcomes in patients with chronic plantar fasciitis. A prospective clinical trial with two-year follow-up. *Journal of Bone and Joint Surgery. American Volume*, 88(8), 1775–1781.
- Donley, B. G., Moore, T., Sferra, J., Gozdanovic, J., & Smith, R. (2007). The efficacy of oral nonsteroidal anti-inflammatory medication (NSAID) in the treatment of plantar fasciitis: A randomized, prospective, placebo-controlled study. *Foot and Ankle International*, 28(1), 20–23.
- Martin, J. E., Hosch, J. C., Goforth, W. P., Murff, R. T., Lynch, D. M., & Odom, R. D. (2001). Mechanical treatment of plantar fasciitis A prospective study. *Journal of the American Podiatric Medical Association*, 91(2), 55–62.
- Young, C. C., Rutherford, D. S., & Niedfeldt, M. W. (2001). Treatment of plantar fasciitis. *American Family Physician*, 63(3), 467–474.
- Stuber, K., & Kristmanson, K. (2006). Conservative therapy for plantar fasciitis: A narrative review of randomized controlled trials. *The Journal of the Canadian Chiropractic Association*, 50(2), 118–133.
- Mizel, M. S., Marymont, J. V., & Trepman, E. (1996). Treatment of plantar fasciitis with a night splint and shoe modification consisting of a steel shank and anterior rocker bottom. *Foot and Ankle International*, 17(12), 732–735.
- Gross, M. L., Davlin, L. B., & Evanski, P. M. (1991). Effectiveness of orthotic shoe inserts in the long-distance runner. *American Journal of Sports Medicine*, 19(4), 409–412.
- Cornwall, M., & McPoil, T. (1997). The effect of foot orthotics on the initiation of plantar surface loading. *Clinical Biomechanics (Bristol, Avon)*, 12(3), S4.

13. Pfeffer, G., Bacchetti, P., Deland, J., Lewis, A., Anderson, R., Davis, W., et al. (1999). Comparison of custom and prefabricated orthoses in the initial treatment of proximal plantar fasciitis. *Foot and Ankle International*, 20(4), 214–221.
14. Goske, S., Erdemir, A., Petre, M., Budhabhatti, S., & Cavanagh, P. R. (2006). Reduction of plantar heel pressures: Insole design using finite element analysis. *Journal of Biomechanics*, 39(13), 2363–2370.
15. Garrett, T. R., & Neibert, P. J. (2013). The effectiveness of a gastrocnemius-soleus stretching program as a therapeutic treatment of plantar fasciitis. *Journal of Sport Rehabilitation*, 22(4), 308–312.
16. Niazi, N. S., Khan Niazi, S. N., Khan Niazi, K. N., & Iqbal, M. (2015). Effect of the silicone heel pad on plantar fasciitis. *Journal of Pakistan Medical Association*, 65(11 Suppl 3), S123–S127.
17. Di Giovanni, B. F., Nawoczenski, D. A., Lintal, M. E., Moore, E. A., Murray, J. C., Wilding, G. E., et al. (2003). Tissue-specific plantar fascia-stretching exercise enhances outcomes in patients with chronic heel pain. A prospective, randomized study. *Journal of Bone and Joint Surgery. American Volume*, 85(7), 1270–1277.
18. Radford, J. A., Landorf, K. B., Buchbinder, R., & Cook, C. (2007). Effectiveness of calf muscle stretching for the short-term treatment of plantar heel pain: A randomised trial. *BMC Musculoskeletal Disorders*, 8, 36.
19. Rompe, J. D., Cacchio, A., Weil, L., Jr., Furia, J. P., Haist, J., Reiners, V., et al. (2010). Plantar fascia-specific stretching versus radial shock-wave therapy as initial treatment of plantar fasciopathy. *Journal of Bone and Joint Surgery. American Volume*, 92(15), 2514–2522.
20. Petrofsky, J. S., Laymon, M. S., Alshammari, F., & Khowailed, I. A. (2014). Evidence based use of heat, cold and NSAIDS for plantar fasciitis. *Clinical Research on Foot & Ankle*, 2, 1–7.
21. Gill, L. H., & Kiebzak, G. M. (1996). Outcome of nonsurgical treatment for plantar fasciitis. *Foot and Ankle International*, 17(9), 527–532.
22. Biswas, C., Pal, A., & Acharya, A. (2011). A comparative study of efficacy of oral nonsteroidal antiinflammatory agents and locally injectable steroid for the treatment of plantar fasciitis. *Anesthesia: Essays and Researches*, 5(2), 158–161.
23. Tisdell, C. L., Donley, B. G., & Sferra, J. J. (1999). Diagnosing and treating plantar fasciitis: A conservative approach to plantar heel pain. *Cleveland Clinic Journal of Medicine*, 66(4), 231–235.
24. Singh, D., Angel, J., Bentley, G., & Trevino, S. G. (1997). Fortnightly review. Plantar fasciitis. *The BMJ*, 315(7101), 172–175.
25. Budiman-Mak, E., Conrad, K. J., & Roach, K. E. (1991). The Foot Function Index: A measure of foot pain and disability. *Journal of Clinical Epidemiology*, 44(6), 561–570.
26. Hale, S. A., & Hertel, J. (2005). Reliability and sensitivity of the Foot and Ankle Disability Index in subjects with chronic ankle instability. *Journal of Athletic Training*, 40(1), 35–40.
27. Blockey, N. J. (1956). The painful heel; a controlled trial of the value of hydrocortisone. *British Medical Journal*, 1(4978), 1277–1278.
28. Davis, P. F., Severud, E., & Baxter, D. E. (1994). Painful heel syndrome: Results of nonoperative treatment. *Foot and Ankle International*, 15(10), 531–535.
29. Yucel, U., Kucuksen, S., Cingoz, H. T., Anliacik, E., Ozbek, O., Salli, A., et al. (2013). Full-length silicone insoles versus ultrasound-guided corticosteroid injection in the management of plantar fasciitis: A randomized clinical trial. *Prosthetics and Orthotics International*, 37(6), 471–476.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.