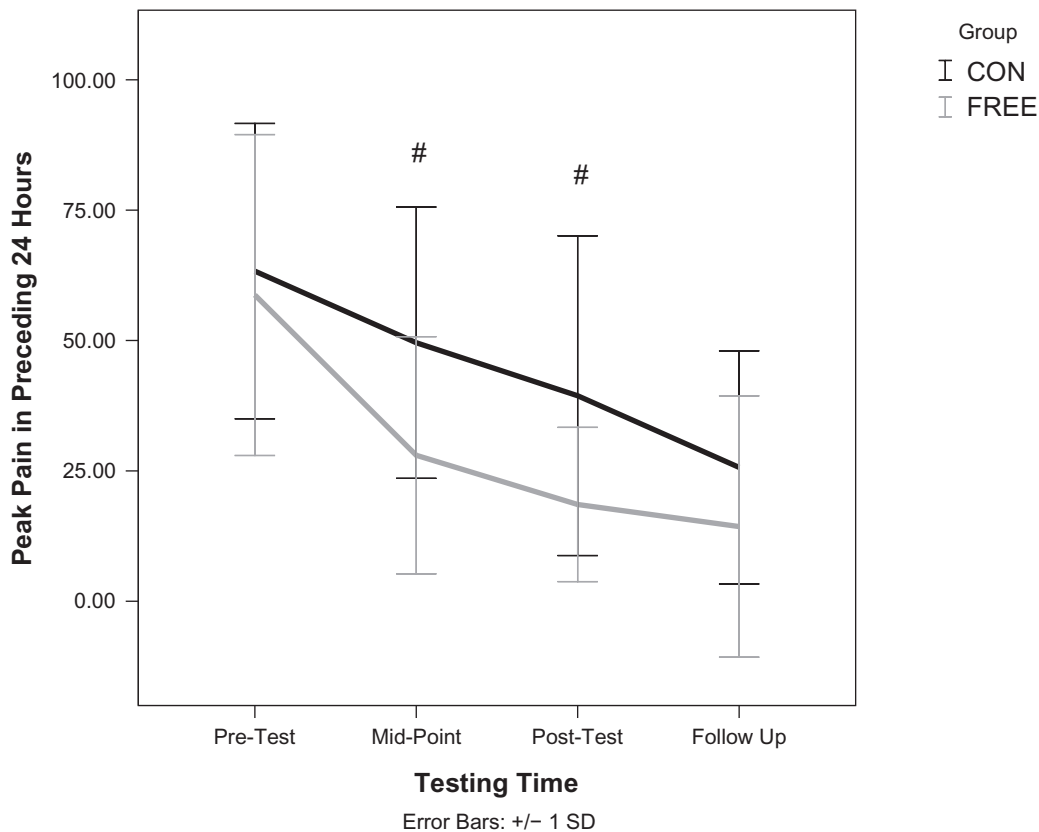


Figure 2. Graph illustrating relationship between the visual analogue scale item for peak pain in the preceding 24 hours across both shoe conditions over time.



#Indicates a trend for a difference between the two shoe conditions at that time point.

Abbreviation: SD, standard deviation.

fascia, there was an 87% reduction in their pain score (VAS from 74.5–10). The implications of pain relief in a population with longstanding (> 6-month symptom duration) plantar fasciitis are sizeable considering half of our study population was required to stand for > 7 hours per day, which is a risk factor often impeding the success of conservative treatments or resulting in a higher degree of injury recurrence.

Although the Nike Free 5.0 is not considered a strict replica for a barefoot condition, the increased flexibility of the sole may contribute to similar stresses being applied to the foot, particularly from the standpoint of allowing increased range of motion at the forefoot compared with conventional running footwear. As a result of the increase in sole flexibility, the foot could better engage its windlass mechanism during toe-off, resulting in greater strain on the intrinsic soft-tissue structures from an increase in the mechanical work of the foot coupled with greater storage and release of elastic components.^{21,22}

Increasing load in a controlled setting has been well documented as a successful treatment option for chronic soft-tissue injuries of the Achilles insertion and midportion, infrapatellar, and common elbow extensor tendons.^{23–27}

We speculate that the clinical success experienced ultimately in both footwear groups performing the multielement exercise regimen in the present study is a result of 1 or a combination of the following 3 therapeutic effects. Firstly, the static and tissue-specific stretching exercises for the calf and plantar fascia provide a stimulus for increases in flexibility, as well as sustained low levels of stress on the relevant tissues. Both exercises have been proven to increase ankle flexibility and decrease pain in this patient population.^{28–30} The second effect comes from a positive tissue remodeling stimulus secondary to the small controlled stresses applied to the plantar intrinsic muscle/tendon/ligament complex through the dynamic range of motion exercises of the foot and ankle. A previous case

report on a directed program of targeted exercises to increase range of motion and progressively increase sport-specific stress on the plantar fascia reported favorable clinical outcomes.³¹ Lastly, 2 exercises were aimed at addressing overall posture and balance to minimize postural contributions to loading of the plantar fascia and increased calf tension (secondary to forward sway). Similar balance exercises incorporating semi-compressible foam rollers have shown to significantly improve dynamic balance.³²

There are several limitations to consider for the present study. An intention-to-treat analysis was not performed, which may be justified in certain circumstances despite the drop outs reported for the following reasons: 1) the baseline values for the pain scores from the excluded subjects were statistically similar to the overall group; 2) the drop outs occurred early in the study before any follow-ups had been conducted; 3) imputation is not justified when missing data would compromise the overall analysis; and 4) the data presented herein are intended to introduce a concept, and should not be interpreted as a definitive trial examining treatment efficacy.³³

The mechanism(s) behind the treatment effect in this study remain speculative. The results of this investigation would be strengthened by including measures to understand the nature of the treatment effect, such as by documenting isokinetic strength at the talocrural, subtalar, and first metatarsophalangeal joints. Balance or agility testing would determine whether there were reported improvements in standing or dynamic posture. Electromyography of such foot and lower leg muscles as gastrocnemius, soleus, flexor hallucis longus and brevis, peroneus longus/brevis, and flexor digitorum longus/brevis to determine whether the increased forefoot extension range of motion, either alone or in combination with the soft durometer midsole, translates into greater strength and/or activation of relevant muscle groups.

Although the absence of any notable recurrence in pain throughout the population at the 6-month follow-up is promising, ultimately a 12- or 24-month follow-up period is needed to confirm the positive long-term treatment benefit. There is a potential for a treatment bias within the present study because only 1 of the 2 groups investigated received a new shoe, which may be mitigated in future projects by providing both groups with new footwear. However, both groups received the same exercise regimen and the same degree of instruction. While the present study is an introductory approach to quantifying a exercise regimen of this nature, future studies

in this area should include additional disease-specific outcome measures, such as the Foot Function Index.³⁴ Diagnostic imaging via ultrasound or magnetic resonance imaging was not conducted prior to subject enrollment, therefore, we can not be certain of the standardization of disease pathology across our population and, in particular, the presence of heel spur.

From a clinical perspective, the 2 individuals who had dropped out because of an increase in foot pain in the FREE group could represent a potential complication from using a flexible soled shoe in this treatment approach. It appears there may be a significant advantage in terms of responsive pain relief wearing a shoe such as the Nike Free 5.0; however, this should be balanced against the relatively lower risk of their symptoms deteriorating.

Conclusion

The outcomes of the present study report that a 12-week multielement exercise regimen that incorporates static and dynamic stretching and balance exercises significantly improves the pain in patients experiencing chronic plantar fasciitis. Furthermore, it appears that carrying out this exercise regimen wearing shoes with a more flexible sole, such as the Nike Free 5.0 shoe, may result in earlier pain relief than conventional running shoes.

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Conflict of Interest Statement

Michael Ryan, PhD and Jack Taunton, MD, MSc disclose conflicts of interest with Nike, Inc. Scott Fraser, BSc, PT and Kymberly McDonald, BSc disclose no conflicts of interest.

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