

Evaluating the Effectiveness of Arch Supports for Plantar Fasciitis: Insights from Patient-Reported Outcomes, Advanced Imaging, and Finite Element Analysis

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INTRODUCTION: Plantar fasciitis (PF) is a prevalent condition that causes heel pain and functional impairment. Arch support insoles, both prefabricated and custom, are commonly prescribed to alleviate PF symptoms by providing structural support. Despite their widespread use, evidence regarding their efficacy remains inconclusive. This study aims to evaluate the effectiveness of arch support insoles in PF treatment by integrating inputs from clinical outcomes, advanced imaging, and finite element analysis (FEA).

METHODS: A single-arm, prospective study was conducted with patients aged 18–65 years who were clinically diagnosed with PF at a tertiary center in Boston, Massachusetts. Participants were given prefabricated partial-length arch support insoles (Good Feet, Dr.'s Own, LLC) at baseline and evaluated for pain, foot alignment, and plantar pressure distribution. Pain outcomes were measured using the Patient-Reported Outcome Measurement Information System (PROMIS) scores for pain intensity and interference at baseline, 4th, 8th, and 12th weeks. Weight-Bearing Computed Tomography (WBCT) and X-rays were performed at baseline to assess foot alignment with and without arch support insoles. FEA was conducted using baseline WBCT scans to analyze heel plantar pressure distribution. Statistical analysis included Friedman and Wilcoxon Signed-Rank tests, with significance set at $P = 0.05$. Results are reported as medians with interquartile ranges (IQR).

RESULTS: A total of 29 patients with a median age of 36 years (IQR 30.5–49.5) were included in the study. PROMIS pain intensity scores decreased from 46.8 (IQR 44.75–52.3) to 44.93 (IQR 41.57–47.15) by week 4 ($P < 0.001$). Pain interference improved from 56.7 (IQR 53.9–59.8) to 52.4 (IQR 41–58.15). These changes persisted, reaching 42.6 (IQR 40.3–46.35) and 48.6 (IQR 41–54) at the 12th week ($P < 0.001$). WBCT revealed a significant increase in navicular height ($P = 0.003$), while X-ray analysis showed increases in Meary's angle, calcaneal inclination angle, and first metatarsal declination angle ($P = 0.002$, 0.007 , and < 0.001 , respectively). FEA was conducted for 12 patients and demonstrated reductions in both peak and average heel pressures when using insoles (Figure 1).

DISCUSSION: The effectiveness of arch support insoles appears to stem from two key mechanisms: anatomical foot realignment, as evidenced by changes in radiological measures, and pressure redistribution in the heel area. Both of these factors contribute to the observed clinical improvements in pain and function.

SIGNIFICANCE/CLINICAL RELEVANCE: Our findings underscore the clinical efficacy of arch support insoles in the treatment of PF.

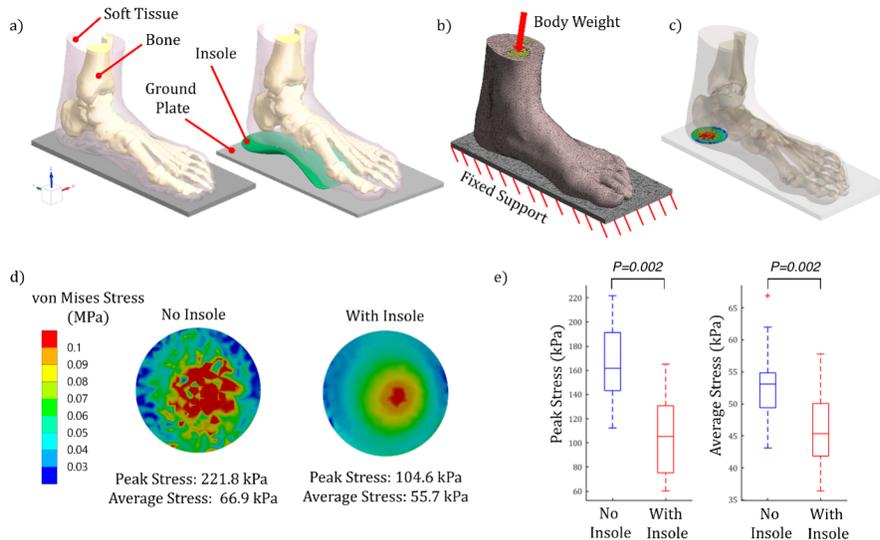


Figure 1. (a) Three-dimensional foot model generated from Weight-Bearing CT scan with and without the insole, (b) The mesh model and boundary conditions for the finite element analysis, (c) Heel pressure obtained from computational analysis, (d) Comparison of heel stress distribution results for a single patient, (e) Wilcoxon Signed-Rank test results for the peak and average stress differences across 12 patients.