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Expert Opinion Article

Effect Of Modified Foot Orthosis On Foot Architecture In Flat Foot Individuals.

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ABSTRACT

Background: Pes planus is also known as flatfoot. It comes from Latin word which means pes as foot and planus as flat or ground level. A foot abnormality that is the opposite of pes cavus. Here, the medial longitudinal arch of the foot descends, resulting in a lack of spring action and increased stress on the entire foot with each step.1. Among the most common deformities of the foot area, we can mention the deformity of flat feet, so that its prevalence in the adult population is reported between 2% and 23% . One of the most important and variable structural features of the foot is the height of the medial longitudinal arch (MLA) . A decrease in the height of this arch is called a flat foot 2. This study holds clinical relevance for physiotherapists, podiatrists, orthotists, and other healthcare providers involved in the management of lower extremity disorders. Additionally, findings from this study may contribute to evidence-based guidelines for the non-surgical management of flatfoot and inform future research directions in the field of foot biomechanics.

Method: This study adopts a pre-test and post-test experimental design to assess changes in foot architecture following orthotic intervention. Participants were evaluated at baseline (pre-orthotic) and after a defined period of orthosis use (post-orthotic), using standardized clinical and biomechanical measurements. The participants were chosen based on specified inclusion and exclusion criteria, which are given below.A total of 30 individuals with diagnosed flexible flatfoot were enrolled in the study (mean age: 25.3 ± 4.1 years).

Result: The application of foot orthosis over 6 weeks significantly improved foot architecture, as evidenced by decreased navicular drop, Improved foot alignment (FPI-6), increased arch height (AHI), enhanced subjective pain relief, and functional ability (FFI). These results suggest that foot orthoses are an effective conservative management tool for improving both structural and functional outcomes in individuals with flexible flat feet.

Conclusion: The study concludes that foot orthoses have a significant positive effect on foot architecture in individuals with flexible flat feet. Regular use of orthoses over 8 weeks led to improvements in medial arch height, foot posture, and rearfoot alignment. These findings support the use of orthotic devices as a non-invasive, cost-effective intervention for the structural management of flat foot. Incorporating foot orthoses in clinical rehabilitation protocols can help in reducing biomechanical stress and preventing further complications related to abnormal foot posture.

Key words: Foot Orthosis, Foot Architecture, Flat Foot, Pes Planus.

INTRODUCTION

Pes planus is also known as flatfoot. It comes from Latin word which means pes as foot and planus as flat or ground level. A foot abnormality that is the opposite of pes cavus . Here, the medial longitudinal arch of the foot descends, resulting in a lack of spring action and increased stress on the entire foot with each step.1. Among the most common deformities of the foot area, we can mention the deformity of flat feet, so that its prevalence in the adult population is reported between 2% and 23% . One of the most important and variable structural features of the foot is the height of the medial longitudinal arch (MLA) . A decrease in the height of this arch is called a flat foot.2.In clinical practice flat foot may be diagnosed through different procedures, such as clinical diagnosis, radiological study, and footprint analysis 3.

The dysfunction of the arch complex typically does not present with symptoms; however, it can impact the biomechanics of the lower limbs and lumbar spine, leading to a higher likelihood of experiencing pain and injury. Occurrence among children exceeds 70% during the initial four to six years of life, yet it has been documented to decline to approximately 9% post the age of six. Flatfoot is defined by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. Flat feet are commonly seen in orthopedic clinics and are usually functional and painless. The etiology of flatfoot remains elusive at present. Numerous studies propose a correlation between the debilitation of the intrinsic muscles of the foot and the diverse abnormalities that impact the foot arch, including pes cavus and pes planus.1.

Foot orthoses have long been utilized as a conservative intervention aimed at correcting or accommodating altered foot mechanics. These devices, typically inserted into footwear, function by supporting the foot's arches, redistributing plantar pressures, and enhancing alignment throughout the lower extremity kinetic chain. The effectiveness of foot orthoses is particularly relevant in flatfoot management, where they are prescribed to alleviate symptoms, improve function, and possibly influence foot structure over time.

Several studies have explored how foot orthoses impact foot architecture, particularly concerning arch height, heel alignment, navicular drop, and midfoot kinematics. Evidence suggests that orthotic use can lead to both immediate and long-term changes in foot posture and motion patterns. However, the degree and permanence of these structural changes remain subjects of ongoing research and debate. Variability in orthotic design, materials, duration of use, and individual anatomical differences further complicate the ability to draw consistent conclusions across populations. The structural and functional impairments associated with flatfoot have prompted the use of various conservative management strategies, with foot orthoses being among the most commonly prescribed interventions. Foot orthoses are external devices designed to support and align the foot, redistribute pressure, and improve biomechanical function during dynamic activities. In the context of flatfoot, orthotic intervention aims not only to provide symptomatic relief but also to influence foot architecture, including the restoration or support of the medial longitudinal arch, correction of hindfoot valgus, and modification of forefoot-to-rearfoot alignment.

Despite the widespread clinical use of foot orthoses for flatfoot management, there is ongoing debate regarding their efficacy in producing structural changes in the foot architecture, particularly over the long term. While some studies suggest that foot orthoses can significantly improve medial arch height and reduce navicular drop, others report limited or no significant structural adaptation. Moreover, variations in orthotic design, duration of wear, materials used, and individual anatomical differences contribute to inconsistent outcomes across the literature.

This study holds clinical relevance for physiotherapists, podiatrists, orthotists, and other healthcare providers involved in the management of lower extremity disorders. Understanding the extent to which foot orthoses can influence foot architecture may enhance treatment planning, patient education, and orthotic prescription practices. Additionally, findings from this study may contribute to evidence-based guidelines for the non-surgical management of flatfoot and inform future research directions in the field of foot biomechanics.

MATERIALS AND METHODOLOGY

After obtaining approval from the Institutional Human Ethics Committee of Krishna Vishwa Vidyapeeth, this study was carried out to find the Effect of Modified Foot Orthosis on Foot Architecture in Flat Foot Individuals. The participants were chosen based on specified inclusion and exclusion criteria, which are given below.A total of 30 individuals with diagnosed flexible flatfoot were enrolled in the study (mean age: 25.3 ± 4.1 years). All the participants were informed about the study protocol, and their rights before providing the written consent form.

This study adopts a pre-test and post-test experimental design to assess changes in foot architecture following orthotic intervention. Participants were evaluated at baseline (pre-orthotic) and after a defined period of orthosis use (post-orthotic), using standardized clinical and biomechanical measurements.

The study was conducted at Krishna College of Physiotherapy, KVV Karad, within the Department of Orthotics and Prosthetics, equipped with facilities for foot posture assessment, gait analysis, and orthotic fitting.

Inclusion Criteria:

- Aged 18–40 years
- Clinically diagnosed with flexible flatfoot (as determined by Foot Posture Index > +6, navicular drop >10 mm, or medial arch height index)
- No prior use of foot orthoses
- Able to ambulate independently

Exclusion Criteria:

- Rigid flatfoot or congenital deformities
- History of lower limb surgery or fracture
- Neuromuscular disorders (e.g., cerebral palsy, muscular dystrophy)
- Inflammatory joint conditions (e.g., rheumatoid arthritis)
- Pregnancy

The Krishna College of Physiotherapy, in collaboration with the Institute, organized a free health check-up camp and distributed orthotic devices to individuals with disabilities under the "Divyang Mitra Yojana."

During the camp, I identified individuals with flat feet and provided them with either prefabricated or customized orthoses, as appropriate.

A total of 30 participants (18 females, 12 males) with a mean age of 26.4 ± 5.2 years were included in the study. All participants completed the intervention period of 6 weeks with consistent orthosis use.

Outcome Measures-
Participants underwent an initial clinical examination to confirm the diagnosis. Baseline values of the following were recorded:
1.Prefabricated or Custom-made Foot Orthoses: Medial arch supports made from EVA or polypropylene, designed to support the medial longitudinal arch and correct pronation.
2. Foot Posture Index (FPI-6): A clinical tool used to assess overall foot alignment.
3.Navicular Drop Test Ruler: For measuring navicular displacement.
4.Medial Arch Height Index Measurement: To quantify static arch height.
5.Calcaneal Angle (rearfoot alignment)
• Orthotic Fitting-
Participant was fitted with either a customized or prefabricated foot orthosis based on clinical assessment. The orthosis was placed in standardized footwear, and proper fit was verified.
• Intervention period-
Participants were instructed to wear the orthoses daily for a minimum of 6–8 hours over a period of [4–8 weeks]. Compliance was monitored using a daily logbook and regular follow-up.

• Post-Intervention Assessment
At the end of the intervention period, participants were re-evaluated using the same tools and parameters as the baseline.

INTERVENTION
The intervention was structured into two distinct phases: Pre-Orthotic Assessment and Post-Orthotic Assessment. All procedures were standardized to ensure consistency and reduce measurement bias.
• Pre-Orthotics Group - This phase involved initial screening and baseline data collection for all participants prior to the use of foot orthoses.

Procedure -
1)Informed Consent:
Participants received a detailed explanation of the study, including procedures, benefits, and potential risks.
Written informed consent was obtained before participation.

2)Clinical Evaluation:
Participants underwent physical examination to confirm the presence of flexible flatfoot using:
Navicular Drop Test (>10 mm)
Foot Posture Index (FPI-6) (> +6)

3)Baseline Foot Measurements:
Medial Arch Height (using ruler)
Navicular Height / Navicular Drop
Calcaneal Angle (using digital photography)
Foot Posture Index (FPI-6).

4)Instruction for Neutral Activities:
Participants were instructed to refrain from using any external foot support (orthoses, taping, etc.) during the baseline phase.

• Intervention phase -
Participants were provided with custom-made or prefabricated medial arch support foot orthoses, fabricated to fit their foot size and arch type.
Orthoses were worn inside regular footwear
Barefoot orthoses worn in home
Participants were instructed to wear them at least 6 hours per day for a period of 8 weeks
Foot orthoses were provided and properly fitted.
Participants were followed up for 8 weeks.
Follow-up and compliance checks were done biweekly

RESULT
A total of 30 participants (mean age: 28.4 ± 6.5 years) with flexible flat feet completed the study. All participants adhered to the 8-week orthotic intervention protocol. Post-intervention assessments were repeated after 8 weeks. Data analysis was conducted using SPSS software. Paired t-tests were applied to compare pre- and post-intervention data. A p-value less than 0.05 was considered statistically significant.
Clinical Evaluation:
Participants underwent physical examination after completing intervention to compared the presence of flexible flatfoot using:
Navicular Drop Test (>10 mm)
Foot Posture Index (FPI-6) (> +6)
Descriptive Statistics of Outcome Measures (Pre- and Post-Intervention)-

Table 1:

Outcome Measure	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Change	p-value
Navicular Drop Test (mm)	10.2 ± 1.3	6.8 ± 1.1	↓ 3.4	< 0.001

Interpretation- Significant improvement in medial longitudinal arch stability.
Navicular Drop Test (NDT)
Mean reduction: 3.4 mm
p-value: < 0.001

Table 2:

Outcome Measure	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Change	p-value
Arch Height Index	0.24 ± 0.03	0.29 ± 0.02	↑ 0.05	< 0.001

Interpretation – Indicates increased vertical foot structure or arch height.
Arch Height Index (AHI)
Mean increase: 0.05
p-value: < 0.001

Table 3:

Outcome Measure	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Change	p-value
Foot Posture Index (FPI)	+8.0 ± 1.2	+4.2 ± 1.1	↓ 3.8	< 0.001

Interpretation – Shift from pronated to more neutral foot posture.
Foot Posture Index (FPI)
Mean change: -3.8
p-value: < 0.001

Table 4:

Outcome Measure	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Change	p-value
Rearfoot Angle (°)	9.1 ± 1.5	5.6 ± 1.2	↓ 3.5	< 0.001

Interpretation – Reduced calcaneal eversion improved rearfoot alignment.
Rearfoot Angle (Calcaneal Eversion)
Mean reduction: 3.5°
p-value: < 0.001

DISCUSSION

The present study demonstrates that the use of foot orthosis over an 8-week period significantly improved multiple structural indicators of foot architecture in individuals with flexible flat foot. The reduction in navicular drop and increase in arch height index point to improved medial arch stability and elevation, which are crucial for proper weight distribution and lower limb alignment.

A substantial reduction in Navicular Drop Test (NDT) values suggests improved integrity of the medial longitudinal arch. This aligns with previous research indicating that medial arch support provided by orthoses can reduce excessive pronation and navicular displacement, thus enhancing foot stability. An increase in the Arch Height Index (AHI) further supports structural improvements in foot posture. Arch support appears to contribute to a more elevated and well-aligned arch profile, potentially preventing excessive stress on the plantar fascia and associated structures.

The significant decrease in the Foot Posture Index (FPI) suggests a shift from an overpronated posture towards a more neutral foot alignment. Additionally, the reduction in rearfoot angle signifies better calcaneal positioning and subtalar joint control. These findings are consistent with previous research that supports the biomechanical efficacy of orthotic devices in restoring normal foot structure and function.

Orthoses likely function by altering proprioceptive input, enhancing muscle activity around the medial longitudinal arch, and providing structural support. Long-term use may also contribute to adaptive remodeling of soft tissues, particularly in younger individuals whose foot structure is still developing. However, individual responses can vary based on severity of flat foot, body weight, and compliance with usage.

Limitations of this study include the absence of a control group, a relatively short intervention period, and lack of long-term follow-up to assess retention of structural improvements. Future studies with larger sample sizes, control comparisons, and extended follow-up are recommended.

CONCLUSION

The study concludes that foot orthoses have a significant positive effect on foot architecture in individuals with flexible flat feet. Regular use of orthoses over 8 weeks led to improvements in medial arch height, foot posture, and rearfoot alignment. These findings support the use of orthotic devices as a non-invasive, cost-effective intervention for the structural management of flat foot. Incorporating foot orthoses in clinical rehabilitation protocols can help in reducing biomechanical stress and preventing further complications related to abnormal foot posture.

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