JPOST Journal of Prosthetics Orthotics and Science Technology
Volume 5, Number 1 Year 2026
ISSN (online): 2962-8016
DOI: 10.36082/jpost.v5i1.2237

Design and Development of a Cost-Effective Pes Podoscope

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Abstract

Background: There are various clinical and radiological methods used in clinical practices to identify foot deformity like high arch and flat feet, but there is no simple and affordable method to identify the issue.
Aims: The objective of this study was to make it easier for the clinical practitioners in the field of prosthetics and orthotics to identify the person having flat feet or high arch.
Methods: Subject was asked to stand on the podscope with a clean foot so that the image formed on the mirror can be examined.
Results: The result showed that the impression of the foot clearly reflects whether the foot is having normal, high arch or flat feet.
Conclusion: The results of this study concludes that this device will help practitioners to diagnose and prescribe the best suitable intervention for the person affected with flat foot or high arch.

Keywords: Flat foot, High arch, Pes podscope.

Article History

Received date: 27-03-2025
Revised date: 29-12-2025
Accepted date: 31-05-2026

Journal Prosthetics Orthotics and Science Technology (JPOST)
e-ISSN 2962-8016
Organized by Department of Prosthetics and Orthotics
Published by Poltekkes Kemenkes Jakarta I
email: jpost@poltekkesjakarta1.ac.id

Introduction

There are a wide variety of measurement systems available to evaluate the patients' foot pressure. These systems use different sensors depending on their assessment technology. (Heravi H, Ebrahimi A, Nikzad S, *et al*. 2020). Traditional methods for assessing foot posture involve visual inspection, palpation, measuring navicular height, footprint analysis, and radiographic techniques. Although radiographs are considered the gold standard for assessing skeletal alignment, but they are costly and expose patients to radiation.
To overcome these challenges, fabricating an affordable PES podoscope solves problem faced by clinical practitioners during the evaluation of foot deformities.

The main goal of this study is to design and develop a cost-effective PES podoscope that can be easily used in clinical settings. This device is designed to generate complete pressure distribution of the feet, thereby guiding clinicians in the precise classification of foot posture and the identification of Pes Planus and Pes Cavus. This approach eliminates the necessity for costly and invasive radiographic techniques.

Methods

The materials been used in the fabrication of this pes podoscope are wooden box, mirror, glass, LED strip light, LED adapter, wires, plug and wooden sticker. Firstly, three wooden planks, each measuring 16.5 inches by 8 inches, were taken and attached together using nails. This created a sturdy frame with three walls, leaving one side open. The open side made it easier to place and assemble other components inside.



***Figure 1**. Glass*

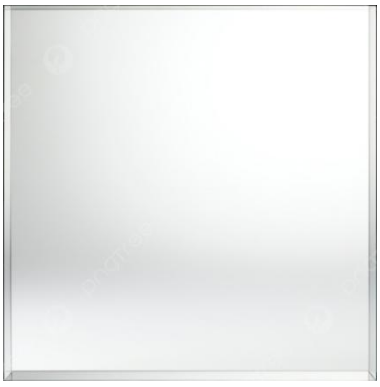


***Figure 2**. Mirror*

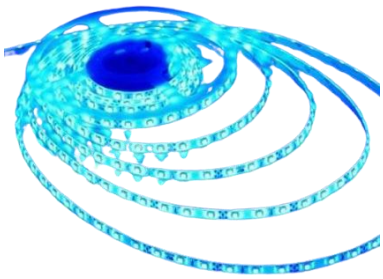


***Figure 3**. LED strip light*



***Figure 4**. Wooden box*



***Figure 5**. LED strip adapter*



***Figure 6**. Wires*



***Figure 7**. Two-pin plug*



***Figure 8**. Wooden sticker*



***Figure 9**. Camera*

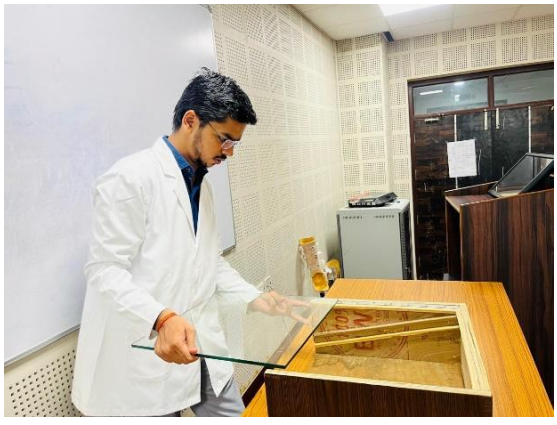


***Figure 10**. Placing the glass*



***Figure 11**. Placing the mirror*

Then, a base was built using 2mm wooden sticks. The base was positioned along the inner edges of the frame walls, about 8mm from the bottom. This base supported an 8mm glass panel, which was placed on top. The glass played a crucial role as it provided the reflective surface needed to capture images. To improve visibility, LED strip lights were stuck on the walls of the section where the glass was placed. The lights were positioned to face outward, ensuring proper illumination of the area.



***Figure 12**. Applying LED strip*



***Figure 13**. Connecting adapter*

For the electrical setup, the LED strip lights were connected to an adapter, and a 2-pin plug was attached at the end of the wire to complete the circuit. This allowed the lights to be powered efficiently. Then, a 2mm-wide wooden bid was placed at a 45-degree angle on the plank. This acted as a support for the mirror, which was carefully placed on top. To keep the mirror secure and prevent it from sliding out, a locking mechanism was attached to the front.



***Figure 14**. Placing camera*



***Figure 15**. Applying wooden sticker*

A camera was then placed in the middle of the glass at the outer edge, facing the mirror. This positioning ensured that the camera captured a clear reflection of whatever was placed on the mirror. The camera was adjusted as needed to get a sharp and accurate image. It was then connected to a computer or system using a USB cable, where the captured images could be displayed. To give the podoscope a more polished and professional look, the outer walls were covered with wooden wallpaper. This added a stylish touch to the device. Finally, the device was plugged into a socket, and the switch was turned on to test the LED strip lights. Once everything was working correctly, the setup was complete, and the podoscope was ready for use.



***Figure 16**. Rub the feet on mat*

Before starting the assessment, the subject's consent was obtained by making them fill out a consent form. This step ensured that the subject fully understood the procedure, its purpose. Once consent was secured, the assessment process began. To maintain accuracy and prevent contamination, the subject was instructed to rub both feet on a mat. This step helped remove any dust particles from the plantar surface of the sole, ensuring a clear and precise image without any external interference. After cleaning the feet, the subject was asked to stand on a glass surface while the LED strip was switched on. This setup improved visibility and provided an optimal view of the plantar surface. The lighting from the LED strip played a key role in enhancing the details of the foot's structure and condition.

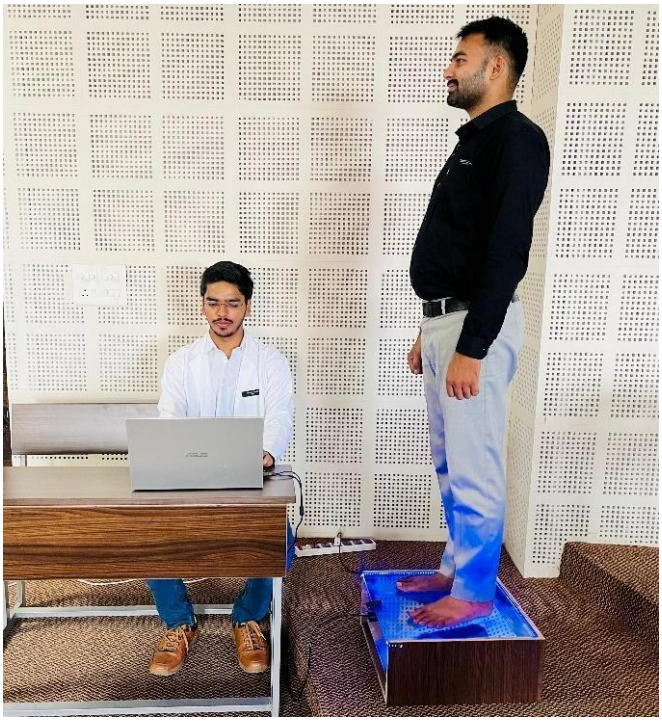


***Figure 17**. Subject standing on the podoscope*



***Figure 18**. Image of the foot impression*

A camera connected to the system captured the image formed on the mirror beneath the glass. This shows real-time visuals of the plantar surface, allowing for accurate assessment and documentation of the subject's foot condition. The captured image shows a clear and detailed view of the plantar surface, allowing for the identification of any irregularities, pressure points, or conditions that required further attention. This method proved to be a non-invasive and effective way to analyze the plantar surface with precision.

Result

The darker areas on the mirror indicate higher pressure. This visualization helped identify conditions such as normal arches, flat feet, or high arches. By examining the image formed on the mirror, practitioners could assess the extent of arch collapse or elevation while the patient was standing, leading to more accurate diagnoses and treatment interventions.



***Figure 20**. Foot Impression (a)*



***Figure 20**. Foot Impression (b)*

Furthermore, the podoscope helped in identifying structural deformities such as bunions, hammertoes, or claw toes. In addition to diagnostics, the podoscope played a vital role in orthotic and treatment planning.

Discussion

Podoscope mirror impressions helped detect foot abnormalities such as flat feet and high arches. They allowed for targeted interventions, including specific exercises, appropriate footwear recommendations, and even surgical planning when necessary. The podoscope also played a crucial role

in monitoring treatment progress by enabling comparisons of foot impressions over time. This made it easier to assess improvements or detect worsening conditions, ensuring changes to treatment plans.

Conclusion and Recommendation

The design and development of a foot podoscope required careful planning to ensure accurate and comprehensive diagnostics. Ergonomic considerations were taken into account to make the device user-friendly for both patients and healthcare providers. But during this study I faced some problems like portability and the designing of insoles directly after the impressions taken but later on, I'll be rendering the image formed.

Table 1. Cost of the materials used in the fabrication of Pes Podoscope

MATERIAL	COST
Wooden Box	300
Toughened Glass (8mm)	250
Mirror	100
LED Strip Light	70
LED Adapter	50
Wooden Sticker	130
Camera	700
Wire and Plug	50
	TOTAL:1650

Source: Research data

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