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[EQUIPMENT REVIEW]

Foot Scan – A revolution in Physiotherapy diagnosis and Treatment

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Introduction :

Feet provide the primary surface of interface with the environment during activities of daily living [1]. One of the most overlooked disorders is that of the foot resulting in a prevalent ailment. Foot dysfunctions may be debilitating at any age, affecting the quality of life and hamper the musculoskeletal growth and socioemotional maturity of adults and children.[2] When we study the human gait biomechanics and evaluation of posture, the foot pressure plays a vital role of examining the understandable information unseen beneath the foot contact with the surface the individual is supported on.[3] This study of foot pressure acting between the contacting surface and the foot is known as the pedobarography[4] Conditions like Platypodia[5], Limb Length Discrepancy[6] causing differences between the pressures of feet leading to instability in posture and the kinetic chain are primarily studied in this.

One of the earliest methods of assessing the foot and pressure it exerts on the supporting surface was analyzing the footwear of the individual. It was only in 1997 that Lavery etal studied the effect of different footwear on mean peak plantar pressures which paved the way for further researches in the related areas.[1,7] Then may it be designing of footwear for individuals without impairments by Muller or methods of reducing the pressures in a neurotic foot, researchers started excavating the iceberg of plantar pressures.[1] This was followed by the wave of Diabetic foot ulcers where primary diagnostic tool was the plantar pressures.[8] Thus, plantar pressures and devices analyzing them have now become a vital aspect of the assessments.

One of the methods of assessing the plantar pressures is the Plantar Platform Systems (PPS). It is a floor rooted rigid system which has sensors embedded into it. When the individual performs activity of standing, walking, running or any other activities, it imprints the pressure areas and generates a report denoting the same. The important point is that the density of sensors per unit area of the device could have a say in determining the accuracy of the readings on the areas of interests.[3] Restricted to research laboratories, PPS is used for both static as well as dynamic activities.

The purpose of this review was to understand the importance of PPS along with understanding the usage of the device and its limitations, advantages and advances seen in the field.

Method and Methodology:

Search engines: Pubmed, Google Scholar, Cochrane

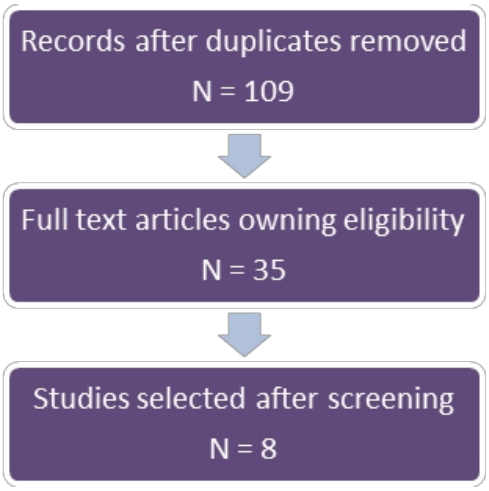
Search Strategy: Advances searches using Boolean terms 'AND' 'OR'

Keywords: Foot Pressure system, Plantar Pressure System, Plantar Platform System, Pedobarography

Types of studies: RCT, Reviews,

Language: English

Time Period: 2012-2022



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Procedure of using:

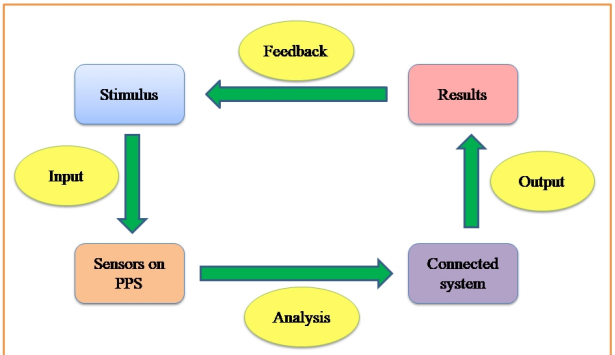

Fig. 1 Explaining the mechanism of Plantar Platform System (PPS)

First step is setting up of the device, where you need to place the platform on a firm surface, preferably a dry and even floor. Connect that device to a system which can be a computer or laptop and then download the required software. Choose a method of assessment in the software and give instructions to the individual accordingly. Then as shown in Fig. 1, when the stimulus or test is performed on the platform, the data is analyzed by the system and displayed on the screen. Now this data can be further used as a feedback for the individual or else can be stored for prognostic purposes. The most important thing in the system is about choosing a test, suppose I have to assess static weight-bearing of the patient, then I will make the patient stand on the center of the platform as seen in Fig. 2, the red dot signifies the same to ease out the process for achieving accurate results.

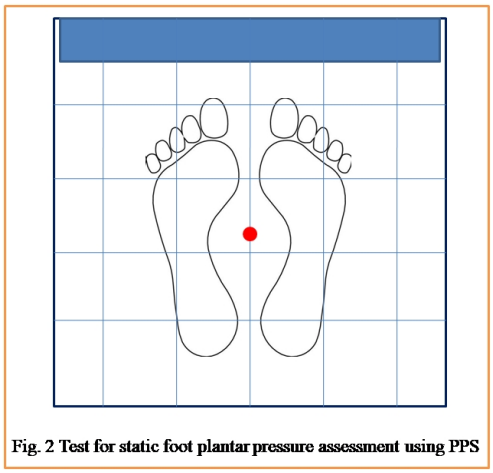

Fig. 2 Test for static foot plantar pressure assessment using PPS

While performing dynamic pressure system assessment, make a patient walk on the platform such that their one foot falls right in the middle of the platform, as seen in Fig. 3. For achieving accurate results make a patient walk through a patch comprising of minimum 2-3 strides and place the platform at the midpoint of the walkway.

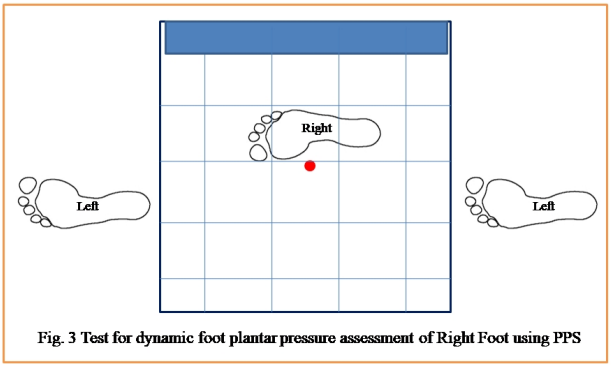

Fig. 3 Test for dynamic foot plantar pressure assessment of Right Foot using PPS

Discussion:

Measurements of plantar pressure helps the therapist to understand the interactions of feet and the surface. The force platform provides important information with respect to both the vertical and shear components of the ground reaction force (GRF). There are primarily three components of a GRF, namely, fore-aft, medial-lateral, and vertical directions and they're measured using a meshwork of sensors embedded in a rigid platform. These sensors absorb the forces and measure the pressure transmitted by the foot. For measuring the pressure, the total force applied is divided by the area of the sensors which are elicited during the activity. The point to note over here is that, PPS, is not just used for standing and walking analysis, but also for aerobic exercises, dance therapy and multiple functional activities.[1,2]

The parameters that are assessed using this tool help us to determine the magnitude of the variables like, peak and average pressure, force and area. The pressure at different areas is depicted using a color palate ranging from lighter shades of blue for areas of minimum pressure to darker shades of red with areas of highest pressure concentrations. The color palate helps in interpreting the data and also helps to measure if a given treatment for example, orthosis has helped in achieving the goal. Now this pressure can be measured while a static activity like standing or during a dynamic activity like walking or brisk walking. For area, it determines the amount of plantar surface in contact with the sensors, similar to a foot print. Some software's help us in plotting a pressure-time or a force- time graph helping us to determine exactly at what phase of a gait cycle which part of foot was having a certain pressure. These values generated by the system play a vital role in analyzing the data giving us a live-time picture and can also be used to maintain the records.

Talking about recent advances, to avoid the hassles of platform, In-shoe systems are being used. The sensors are embedded in the flexible sole which then is inserted into the shoe and patient is made to perform the required activity. As the sensors are closest to the surface, an accurate analysis is achieved using this method. [1]

Advantages:

- Quantifying the data of individual
- Various parameters can be measured at any given point
- Helps in diagnosing musculoskeletal and other disorders, apart from just diabetic ulcers
- A better method than traditional ink-footprint method
- Functional activities can also be assessed
- Helps to observe prognosis of patient using various outcomes like graphs or scans

Limitation:

- It is a bit costly device
- If the sensors are affected then replacing them is difficult
- A lot of time machines are not liquid spill proof
- High pressure activity may or may not be sustained by the plate.

Conclusion:

The review concludes the methods of using a Plantar Platform System for pressure analysis which would help us in diagnosing musculoskeletal and other conditions early. It would also help us in understanding the prognosis of the patient and it is a tool which can also be used as a device to give feedback to the patient and balance training.

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