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Review Article

An insight into the plantar pressure distribution of the foot in clinical practice: Narrative review



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ABSTRACT

Introduction: In clinical practice and within the scope of research studies, foot pressure distribution as measured by plantar pressure analysis is widely used to diagnose foot pathologies. Although plantar pressure data have been recognized as an important element in the assessment of patients with various foot problems, an in-depth knowledge of the plantar pressure distribution of the foot is lacking in literatures.

Aim: This article presents a review of literature on plantar pressure distribution and factors that may affect plantar pressure among patients with foot pathologies and healthy population. **Material and methods:** A literature search was conducted in Science Direct and PubMed databases for articles published from January 2000 to August 2012. Medical Subject Headings (MeSH) and other keywords for search were plantar pressure, age, body weight, gender, reliability, instrument and healthy subjects.

Results and discussion: This paper reviews on the factors influencing plantar pressure distribution. Factors such as the gender, age, body weight, foot type and footwear proved to have a significant effect on plantar pressure distribution of the foot. The paper also reports on the plantar pressure distribution of the foot and the reliability of the measurement. Studies were excluded from this narrative review if they did not meet the above criteria.

Conclusions: This review has added sufficient knowledge on plantar pressure distribution of the foot in clinical practice. Data obtained from a plantar pressure distribution can be used by the physical therapist in the evaluation and management of patients with a wide variety of foot and lower extremity disorders.

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1. Introduction

The human foot plays an important role in maintaining the biomechanical function of the lower extremities which includes provision of balance and stabilization of the body during gait.^{1,2} The anatomical and physiological characteristics of the foot not only change with gait development, motor control of the lower limb and age related skeletal growth but can also lead to alteration in foot pressure distribution during gait.^{3,4} In clinical practice and research studies, foot pressure distribution as measured by plantar pressure analysis is widely used to diagnose foot pathologies. The altered plantar pressure distribution of the foot can also provide additional insight into the etiology of various lower limb musculoskeletal problems.^{2,5} However, the interpretation of plantar pressure distribution is confounded by various factors such as age, gender, body weight, etc.

Studies have reported that factors such as gender, body weight and foot joint range of motions can affect plantar pressure distributions of foot.^{4,6,7} Furthermore, past studies postulated that the distribution of pressure under the foot varies between walking speed and anatomical regions of the foot.^{7,8} In normal gait, the ground reaction force must be equal to the body weight of the subject.⁹ However, in abnormal gait pattern, inadequate force and pressure is distributed on the foot.^{2,6,10} In addition, higher ground impact force and load at heel strike has been reported among older subjects compared to younger subjects.⁴ Thus, several of the above said factors could influence the interpretation of plantar pressure analysis. Therefore, a knowledge of the factors that influences the plantar pressure distribution is important for clinicians and researchers for meaningful interpretation of the plantar pressure analysis. However, published in-depth review of literature on plantar pressure is lacking. This article provides vital information on plantar pressure distribution with regard to the factors affecting the measurements in patients with foot pathological problems and healthy populations. In addition, this paper reports on the reliability of plantar pressure measurement and the clinical usefulness of the techniques.

2. Aim

This review aimed to substantiate knowledge for the researchers and clinicians on the plantar pressure distribution of the foot in clinical practice. Such knowledge may be helpful to apply and analyze the plantar pressure distribution of foot to choose an appropriate treatment strategy.

3. Material and methods

3.1. Data sources

A literature search of published articles from January 2000 to August 2012 in Science Direct and PubMed databases was conducted. Medical subject headings keywords for search were [(plantar pressure) OR (foot pressure) OR (foot load)] AND [(measurement) OR (assessment) OR (evaluation) OR

(distribution)] AND age AND body weight AND [(gender) OR (sex)] AND patient AND healthy subject AND [(repeatability) OR (reliability)]]. The search strategy attempted to retrieve all relevant studies in a conventional review manner.

3.2. Article selection

Articles were included for review if they met the following inclusion criteria. Firstly, articles were included if the studies presented foot pressure distribution using plantar pressure analysis. Secondly, studies that reported on the relationship between plantar pressure distribution and age, gender, body weight, foot type and footwear was considered. Thirdly, studies that had reported on the reliability of the measurement was also included. Only those articles which were published in the English language were considered.

3.3. Data extraction

Reference lists of literatures identified were examined to see if further literature existed. Identification of full article was conducted if literatures are relevant to the study. Titles and abstracts of all identified studies were examined. Full copies of the articles were gathered and examined if the study was appropriate.

4. Results

The literature search identified 32 relevant studies. Among the 32 studies, 19 assessed the factors influencing plantar pressure distribution. Among the remaining 13 studies, 4 studies reported on the standard parameter used in plantar pressure analysis,¹⁰⁻¹³ 5 studies specifically looked at the reliability of plantar pressure measurements¹⁴⁻¹⁸ and 4 studies reported on the clinical implications.^{2,3,6,19}

Among the 19 studies conducted on the factors, 3 studies observed gender influence,^{11,20,21} 2 studies observed the influence of age on plantar pressure distribution,^{4,22} 4 studies observed the influence of body weight,^{5,23-25} 5 studies observed the effect of walking speed,^{8,9,26-28} 3 studies reported on the foot type²⁹⁻³¹ and 2 studies reported on the footwear.^{32,33} The particulars of the study findings are stated in Tables 1 and 2.

5. Discussion

The plantar pressure distribution is a common aspect that clinicians look among patients with foot pathological problems. By understanding the plantar pressure distribution, the foot function and the pressure distribution at foot can be addressed in clinical practice.

5.1. Factor influencing the plantar pressure distribution

There are several factors that may influence the plantar pressure distribution. Clinicians have to carefully consider these factors for a better interpretation of the results from the plantar pressure distribution. The discussion below suggests

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