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ORIGINAL RESEARCH

Clinical analysis and baropodometric evaluation in diagnosis of abnormal foot posture: A clinical trial

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Summary Foot posture involves the integration of sensory information from the periphery of the body. This information generates precise changes through fine adjustments that compensate for the continuous, spontaneous sway of the body in the standing position. Orthopedic insoles are one of the therapeutic resources indicated for assisting in this process. Evaluation of these podal influences, by clinical examination and/or the assistance of baropodometry becomes crucial. Thus, the aim of the present study was determine the combination of the components of orthopedic insoles using two different evaluation methods. Forty healthy female volunteers between 18 and 30 years participated in the study. The volunteers were submitted to two different evaluations: clinical analysis and baropodometry. During the exams, different insole components were tested. The statistical analysis of the two evaluations revealed differences regarding the normalization of posture following the application of the insole components and in the determination of the combination of these components. The findings suggest that the clinical analysis is a fast and accurate method for determining the immediate benefits of the postural insole components and is therefore the more indicated method for the

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evaluation of foot posture, but does not present a concrete foundation to differentiate it with respect to baropodometric evaluation in the assessment and diagnosis of foot posture, however, a greater difficulty was encountered in achieving posture normalization when using information obtained through baropodometry.

Introduction

Human balance is determined by a multi-sensory process involving the visual, somatosensory, vestibular and cerebellar systems. To maintain postural control in a variety of environmental situations, these systems must be closely integrated (Ying-Shuo, 2009). Postural orientation is linked to the position and alignment of the different parts of the body in relation to each other and to the environment through coordinated movements (Barela and Freitas, 2006; Bankoff et al., 2006; Ferreira et al., 2007).

Foot posture involves the integration of sensory information from the periphery of the body, especially mechanoreceptors in the sole of the foot, related to gravitational acceleration, the environment and the position of the segments of the body (Oliveira et al., 2009). According to Bricot (1999) and Gagey and Weber (2000), this sensory information generates precise changes through postural fine adjustments that compensate for the continuous, spontaneous sway of the body in the standing position.

The study of foot posture assists in the evaluation of overall posture. Thus, there is a need to correct abnormalities and instabilities in foot posture for a better control of postural tone (Gagey and Weber, 2000). The early diagnosis of abnormal foot posture is of extreme importance to avoiding postural problems, excessive joint loads, cumulative micro-traumas and gait disorders (Pantanali et al., 2005; Bianchi et al., 2005; Azevedo and Nascimento, 2009; Tokars et al., 2003). For such, orthopedic insoles are indicated (Almeida et al., 2009). The aim of these devices is to correct the distribution of plantar loads in contact with a hard surface, favoring a better distribution of body mass on the plantar region and providing better alignment of the knees, hips, pelvis and spinal column (Almeida et al., 2009).

According to Bricot (1999), these effects occur due to the fact that orthopedic insoles reorganize the tonus of muscle chains and exert an influence over posture correction reflexes. These insoles affect muscle proprioception, leading to changes in the ascending proprioceptive chains (Bricot, 1999). According to Gagey and Weber (2000), the stimulation of specific regions of the sole of the foot leads to a change in postural tonus and a repositioning of the pelvis and muscle asymmetries along the spinal column. Postural reprogramming occurs when mechanoreceptors in the plantar region are activated by deformation of the skin due to the topographic relief of the support surface, as occurs with posture-control insoles (Przysiezny and Salgado, 2002).

The components of orthopedic insoles are made of ethylene vinyl acetate in different shapes. According to Moraes and Przysiezny (2004), clinical analysis based on the references points of arm length, level of the iliac crest and paravertebral muscle tension is indicated for the determination of the combination of postural insole components. Described these clinical tests are able to analyze the rising influence of foot posture in postural control and therefore you can select the ideal postural reprogramming insole.

Another important factor in the diagnosis of abnormal posture is knowledge regarding plantar pressure through baropodometry, which allows an understanding of the physiopathology of postural alterations (Martinez et al., 2007). The principle is to map the pressure of the plantar surface, which, indirectly, indicates important postural abnormalities (Bellizzi et al., 2011; Kaercher et al., 2011). Computerized baropodometry furnishes useful information on the positioning of the foot. It also provides the stabilometric parameters derived from the spatial and temporal behavior of the center of pressure, similar to a force plate (Menezes et al., 2012). However, data on plantar pressure patterns are difficult to analyze and interpret when compared to clinical evaluation, but provide important information regarding plantar pressure and balance. Mean plantar pressure is generally used to detect imbalances in the anteroposterior and mediolateral directions (Keijsers et al., 2009). Therefore, this method is very important to understand the adaption of a modified orthostatic position which could result in/from an erratic postural adaptation, secondary to certain diseases that affect, or can be affected by posture (Kaercher et al., 2011; Bricot, 2008).

The aim of the present study was to compare two forms of evaluating foot posture (clinical analysis based on reference points and baropodometry) for the determination of the combination of the postural insole components.

Materials and methods

Volunteers

Forty volunteers fulfilled the eligibility criteria and participated in the present study. Because it is an analysis of ways of assessing foot posture, the inclusion criteria were the female gender, age between 18 and 30 years, adequate health status and body mass index (BMI) between 20 and 25 kg/m^2 (Who, 2003), without any kind of illness or musculoskeletal injury. The exclusion criteria were a history of musculoskeletal injury in the previous 12 months, neurological condition or metabolic-endocrine disease.

Ethical considerations

The present study was carried out in compliance with the ethical standards of the Declaration of Helsinki and received approval and registry from the Human Research Ethics Committee of the Plataforma Brasil under process number 14117113.3.0000.5511/2013. All participants were