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LITERATURE REVIEW

A review of the utilization of baropodometry in postural assessment

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Summary Postural deviations have been linked to a series of different kinds of pain and dysfunction. Since the human foot is the basis of support and propulsion for gait, and baropodometric analysis assesses dysfunctions of the feet, it may be valuable in terms of postural assessment. Therefore, the aim of this literature review was to investigate which studies have used this baropodometric equipment and how the equipment was used, as well as to discuss the scientific problems and solutions associated with the study and clinical practice of baropodometry. Twenty-eight of the 48 articles found in the Pubmed and Lilacs databases were used. The baropodometer has the potential to provide excellent research in the postural field and related areas. However, baropodometry requires standardization and an improved calibration system. Further significant scientific papers, using properly calibrated equipment, are important in order to improve the quality of the technique and display evidence of its clinical and scientific value.

Introduction

Postural deviations have been linked to a series of different kinds of pain and dysfunction. Posture is not an easy subject to study, mainly because postural assessments are still scientifically inaccurate (photography), or expensive (Magnetic Resonance Imaging), while others (X-ray) involve radiation problems (Rosário et al., 2012; Suzuki et al., 2010; Berthonnaud et al., 2009; Steffen et al., 2010).

There is scientific evidence that associates posture and equilibrium problems with orthopedic and rheumatologic diseases such as knee osteoarthritis, ankle instability, neck tension and back pain (Missaoui et al., 2008). According to Bellizzi et al. (2011), a problem in the postural system generates a state of imbalance, leading to functional overload, dysfunction, degeneration, and the onset of pathological

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clinical problems, sometimes associated with intense, disabling pain.

It seems that neurological control of posture and locomotion are interdependent at different levels of the central nervous system (Mazzocchi et al., 2012). The structures involved provide the appropriate spatial frameworks required for postural adjustments. For example, specific areas of the hypothalamus or brain stem trigger changes in posture when stimulated (Mazzocchi et al., 2012). The same authors stated that there are numerous factors modulating these afferent inputs, including mood state and anxiety. Bellizzi et al. (2011) postulated that the postural system maintains balance when standing (static) and during motor activities (dynamic), such as the gait. This information is sent from the peripheral afferent structures (ears, eyes, muscles, tendons, viscera) to the cerebral cortex for processing, the outcome of which causes the body to adapt, assuming the relative postures and movements (Bellizzi et al., 2011).

The human foot is the basis of support and propulsion for gait. It provides support and flexibility for effective weight transfer (Vianna and Greve, 2006; Orlin and McPoil, 2000). A proper biomechanics of the foot is responsible for the maintenance of body posture and symmetrical distribution of plantar pressure (Vianna and Greve, 2006). Furthermore, it exerts an important effect on postural control in terms of the orthostatic position and gait (Lafond et al., 2004).

High plantar pressures may be a causal factor for several diseases and deformities that affect the feet such as pain, stress fractures, callosities and neuropathic ulcerations. Thus, the analysis of these pressures is important in terms of a proposal to prevent diseases, pain and postural disorders, especially in the feet (Menz and Morris, 2006; Zammit et al., 2010). Furthermore, according to Bricot (2008), non-antalgic postural problems can begin in the foot (ascendant) or the head (descendent: eyes; temporo-mandibular joint or vestibular system). However, even when the problem comes from the head, the feet are affected and also require treatment (Bricot, 2008).

Baropodometric analysis assesses dysfunctions of the feet. 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 baropodometric analysis records plantar imprints and ground reaction forces during upright quiet standing. This is divided into the right and left feet and subdivided into the forefoot, midfoot and hindfoot. This allows the determination of the percentage of weight supported by each foot and the symmetry ratio between them. Moreover, it can also calculate an arch index informing the type of foot: normal; cavus or flat (Menezes et al., 2012). 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). Therefore, this method is very important to understand the adoption 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).

Based on a correct assessment of the feet, a number of authors suggest treating postural problems through strengthening and stretching postural muscles (Bricot, 2008; Rosário, 2011) and/or the use of insoles (Bricot, 2008; Mafinski and Cordeiro, 2005).

The aim of this literature review was to investigate which studies have used this baropodometric equipment and how the equipment was used, as well as to discuss the scientific problems and solutions associated with the study and clinical practice of baropodometry.

Materials and methods

Search methods

The Medline and Lilacs databases were consulted for relevant articles from 2003 to 2013 using the keywords "baropodometer" and "baropodometry". Articles needed to be in English, Portuguese, French, Italian or Spanish.

Inclusion and exclusion criteria

All articles that assessed posture with a baropodometer were considered. Reviews of postural assessment and articles that discussed the equipment in some manner that could help the discussion were also included.

Empirical research, letters to the editor and conference proceedings were excluded.

Study selection

The titles, keywords and abstracts of all research articles identified during the search were read to confirm if they satisfied the inclusion criteria. Full text copies of all articles that met the inclusion criteria were obtained for analysis and data extraction. Preference was given to recent reviews on postural assessment and studies with new or unusual forms of assessment. Older articles that contained the same information as the newer ones were excluded.

Results

Forty-eight articles were found that had used the baropodometer to assess human posture in some way. There was no review study among them. Twenty-eight articles were selected to be part of this review.

Discussion

Plantar pressure measurement is a tool that is not commonly used in clinics. Even in research environments, this device is seldom utilized, although its potential is highly recognized in the specific scientific literature (Putti et al., 2008). One reason for this may be a certain lack of accuracy in baropodometers. Among the causes that may lead to significant differences in the overall accuracy are the following: sensor technology; matrix spatial resolution; pressure range; sampling rate; calibration procedures; raw data post-processing and ageing (Giacomozzi, 2010a).

There are very few papers that used this equipment. Furthermore, a considerable number of the papers do not report the acquired absolute pressure values. Among those which report absolute values, there are significant