The Comparison of Clinical Assessment Tools for the Foot Posture

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Abstract

It is important to assess foot posture when investigating the relationships between lower extremity dysfunctions and foot types. Although several measurements of static foot posture have been used, there is no consensus regarding clinical measurements for foot posture. The aim of this study is to explore the differences among navicular drift (NDi), foot posture index (FPI), arch index (AI), dorsal arch height ratio (DAHR), normal navicular height truncated (NNHt) and to discover the most effective measurement. After foot types were classified by navicular drop test (NDp), clinical measurements of NDi, FPI, AI, DAHR, and NNHt were performed on 64 subjects’ feet. ANOVA analysis was used for the variance of the difference between the NDp and the five kinds of clinical measurements, and the level of significance was set at α<0.05. The results showed that all five clinical measurements demonstrated significant differences with navicular drop. In post-hoc, FPI and NNHt showed significant differences in all foot types. The five clinical measurements are suitable the classification of foot types through the NDp. Therefore, it could be possible to assess correct and objective foot posture by using FPI and NNHt.

(Key Words: Assessment tool; Foot posture; Pronated foot; Supinated foot.

Introduction

Abnormal foot posture, such as excessive pronation and supination, has been identified as a causative factor in the dysfunction of feet and the lower extremities (Allen and Glaseo, 2000). The height of the medial longitudinal arch (MLA) has been generally considered to be a factor that predicts injury (Williams and McClay, 2000). The MLA plays a role in absorbing shock. Foot types, bony structures, ligamentous stability, and muscular fatigue affect the height of the MLA. Arch height influences the motion of the lower extremities (Nigg et al, 1992; Nigg et al, 1993) and balance ability (Hertel et al, 2002) and abnormal arch height is associated with overuse injuries of the lower extremity (McCory et al, 1997). Thus, the clinical assessment of foot posture is the essential component for the management of foot dysfunction (Power et al, 1996).

Foot types are usually classified as pronated, normal, or supinated feet. Excessive pronation, which is characterized by the flattening of the MLA, causes hypermobility in the mid-foot. Excessive pronation increases the internal rotation of the tibia during the stance phase in gait cycle and alternates the position of the patella, which causes the subluxation of the patella and the imbalance of the quadriceps muscle (Bruktner, 1996). An excessively supinated foot, known as a high-arched foot, causes hypomobility in the mid-foot and absorbs less shock. The movement of the supinated foot causes the lateral rotation of the femur and the tibia opposite to that of the pronated foot (Imman, 1969) and the rigid foot produce varus movement of the knee (Sahrmann, 2011).

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The navicular drop test (NDp) has been widely used in recent studies as a valid method for determining excessive pronation (Albrecht et al., 1999) and has also been known as a method of predicting lower limb pathology (Bennett et al., 2001). The NDp, designed by Brody in 1982, is a method of measuring the vertical change of the navicular tubercle height from the bottom, which shows the amount of movement of the navicular bone in the sagittal plane (Reilly et al., 2009). It appears to be a simple and reliable measurement of foot posture (Shrader et al., 2005). Also, the NDp is a useful clinical measurement of overuse syndrome of the lower limbs. Therefore, in this study, NDp was performed to classify foot posture.

The navicular drift test (NDt) is a method of quantifying this medial-lateral movement of the mid-foot (Menz, 1998). Although there is no reliability study of this test, Menz (1998) suggested that the measurement of navicular drift provides an indicator of the medial prominence of the talonavicular joint when the foot moves from a neutral to a resting position.

The foot posture index (FPI), an observational scoring system has been developed on the basis of measuring positions of anatomical foot landmarks for assessing static foot posture (Redmond et al., 2005). It is a fast and simple method of classifying foot posture based on six different visual foot posture criteria, and it has the advantage of measuring the foot in multiple planes. However, it appeared to be poorly correlated with radiographic measurements (Scharfbillig et al., 2004).

The arch index (AI) was widely reported as a footprint measurement that is defined as the ratio of the total area of the foot, excluding the toes, to the related medial mid-foot area (Cowen et al., 1994). Although AI was considered to be an invalid clinical measurement to classify arch height (Hawes et al., 1992), recent study has shown significant correlations between AI and radiographs (Muller et al., 1993).

The dorsal arch height ratio (DAHR), designed by Williams and McClay (2000), is an alternative to the NDp. It is a method of measuring the vertical change in dorsal arch height and the amount of foot mobility (Scharfbillig et al., 2004), and it showed high validity and reliability when compared to radiographs (McCrorry, 1997).

The criteria validity of the normalized navicular height truncated test (NNHt) was established by the radiographic method (Williams and McClay, 2000) and the height measurement of the navicular has been shown to be an indicator of the mobility of the navicular (Cornwall and McPoil, 1999). However, as there is no generalized value, it is difficult to distinguish between normal and abnormal feet (Menz and Munteanu, 2005).

Although several clinical measurements have been described to classify and quantify static foot postures, the most useful and proper clinical measurement for assessing foot posture is not common. Also, the validity and the reliability of some measurements have been shown, but there have been few studies that compared each measurements to find out the more effective measurements. In addition, although some studies regarding reliability and validity with radiographs have been reported, there is no consensus on the validity and reliability of the measurements. There is little research on the validity of clinical measurements for assessing foot posture.

Thus, the aim of this study is to explore the differences among NDt, FPI, AI, DAHR, NNHt and to discover the most effective measurement.

Methods

Subjects

The feet of sixty-four subjects who were recruited randomly were measured and analyzed. After the examiner sufficiently explained the purpose and method of the study to the subjects, they agreed to take part in this study. Exclusion criteria included a history of congenital deformity in the lower extremities or feet,