Correlation of a non-weight bearing foot position to the neutral calcaneal stance position in an adult population

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Introduction

To correctly assess abnormalities within the foot, reliable and accurate measurements are necessary for clinicians to prescribe foot orthoses that effectively manage malalignment (Elveru et al. 1988). However, it has been highlighted that the clinical measurements used in podiatry to quantitatively classify foot type and distinguish abnormalities have inadequate reliability and validity (Menz 1998).

In 1971, Root and colleagues revolutionized foot biomechanics by assessing the level of deformity against an 'ideal' foot position (Root et al. 1971). In clinical practice, the 'ideal' position is weight bearing and is known as the Neutral Calcaneal Stance Position (NCSP) (Root et al. 1971; Root et al. 1977). Clinicians compare the NCSP to a relaxed stance position (RSP) allowing compensations to be determined. (Root et al. 1971; Root et al. 1977). NCSP requires subjective positioning of the subtalar joint, by theoretically placing it in neutral. Subsequently, authors have identified concerns relating to the Root paradigm's reliability and validity (McPoil et al. 1995; Menz 1998). As a consequence, researchers have proposed improved or alternative techniques for clinical, research or both purposes. Improvements in terms of reliability and validity with the proposal of the Navicular Drop Test and navicular drift test by Brody (1982) and Menz (1998), respectively, led to McPoil et al.(2008 & 2009) introducing the Foot Mobility Magnitude (FMM). This involved the assessment of Dorsal Arch Height (DAH) and Midfoot Width (MFW) with the foot in RSP and a non-weight bearing (NWB) position (McPoil et al. 2008; McPoil et al. 2009). In comparison to the Root Paradigm, reliability and validity had significantly improved (McPoil et al. 2008; McPoil et al. 2009). By using the NWB position in comparison to a relaxed weight bearing position, the issues confronting the Root paradigm may potentially provide an alternative 'ideal' position. Enabling the NWB position to replace the NCSP and enhance the efficacy and accuracy of lower limb interventions

Purpose of the study

The purpose of this study was to determine whether a significant correlation between the NCSP and NWB foot position exists for the measurements of DAH and MFW.

Methods

Eighty healthy university students participated in this study. Apparatus used was constructed as described by McPoil et al. (2009). The NCSP was obtained by an

experienced clinician (RS), and confirmed by a third experienced clinician. A second examiner (HW) conducted NWB measures by using a height adjustable plinth, to allow the foot to just be in contact with the surface of the apparatus. Measures of total foot length (TFL) and 50 percent TFL were recorded and marked on the left foot only. Using a digital caliper, measures of DAH (vertical arch height) and MFW (arch width) where obtained at the 50 percent TFL mark in NCSP and NWB positions. Reliability was assessed for the NWB position on 9 participants by 3 examiners of varying clinical experience (0-30 years). Statistical analysis involved ICC (one-way random) for reliability and a Pearson Product-Moment Correlation Coefficient for correlational analysis (alpha$\leq$ 0.05).

Results

High intra-rater reliability was found for DAH and MFW with results of 0.90-0.99 (ICC) and 0.96-0.99 (ICC), respectively. Inter-rater reliability also had high reliability, with results of 0.90 (ICC) and 0.96 (ICC) for DAH and MFW, respectively. Analysis indicated a highly significant correlation between NCSP and NWB for the measures of DAH and MFW, with coefficient results of 0.820(r) and 0.86(r), respectively (significance=0.000)

Discussion and conclusion

Results indicated NCSP and NWB positions, were significantly correlated when the measures of DAH and MFW were conducted. The high reliability indicates that these operator dependent measures are reliable irrespective of examiner clinical experience. Validation of DAH has been investigated, with criterion validation via radiographs, however MFW validity is yet to be established (McPoil et al. 2008). Clinical significance of these findings indicates that the NWB could potentially replace the NCSP as an 'ideal' position in comparison to a resting. By replacing an unreliable and invalidated measure and clinicians would be able to provide more accurate and consistent treatment strategies and improve the individuals overall outcome.

Future investigations should investigate the criterion validity of MFW and normal values for different populations and ages.

References

Elveru R.A. (2003). Phys Ther. **68(5),** 672-677.

Menz H.B. (1998). J Am Podiatr Med Assoc. **88(3),** 119-129.

Root M.L. et al. (1971). Biomechanical Examination of the Foot. Los Angeles.

Root M.L. et al. (1977). Normal and abnormal function of the foot. Los Angeles.

McPoil T.G and Hunt G.C. (1995). J Orthop Sports Phys Ther. **21(6),** 381-388.

Brody D. (1982). Orthop. Clin. North Am. **13(3),** 541-558.

McPoil T.G. et al. (2008). J Foot Ankle Res. **1(3).**

McPoil T.G. et al. (2009). J Foot Ankle Res. **2(1).**