The Use of Foot Pressure Data for Classification of Varus and Valgus Foot Deformities

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Introduction: Varus and valgus foot deformities result from an imbalance of the foot and ankle invertor and evertor muscles (2), subluxations at the talonavicular and calcaneocuboid joints (2), and/ or ligamentous laxity (7). Numerous treatments have been proposed to address these deformities including bracing, botulinum toxin A injections, and surgery (1,3,4,5). The magnitude of deformity is a pertinent factor in selecting treatment (7). At present, there is no universally accepted classification of foot deformity. Several methods using foot pressure data have been used to describe foot deformities, including use of a binomial table to categorize improvement (8), measurement of contact and peak pressure within masked areas (9), and quantification of the path of center of pressure (10). All are useful, but may require software or time not readily available. We propose a simple five-category clinical classification of stance phase foot varus and valgus deformity based solely on the foot pressure plot and key. The purpose of the study was to test reliability of the deformity classification among raters.

Statement of Clinical Significance: Varus or valgus foot deformities may prevent normal heel-to-toe gait, impair stance phase stability, and compromise foot clearance and pre-positioning of the foot during swing phase. A classification system to objectively describe the deformity is useful in clinical discussion, diagnosis, and outcome analysis.

Methodology: We developed a five-category classification of stance phase varus and valgus foot deformity based on foot pressure data analysis (Fig 1). Forty-eight static composite foot pressure plots, representing a spectrum of deformity, were selected for review. Eight raters (two physicians, four physical therapists, one engineer, and one kinesiologist) categorized each foot pressure plot according to our classification system. The foot pressure plots were reorganized for two additional trials of categorization. Kappa statistic was applied to determine the inter-rater and intra-rater reliability.

Fig. 1

Varus II	Peak pressure shifted towards lateral met heads and/ or base of 5^{th} met Pressure under lateral midfoot $\geq$ 75% of max peak pressure
Varus I	Peak pressure shifted towards lateral met heads and/ or base of 5^{th} met
Neutral	Peak pressure centered under 2^{nd} through 4^{th} met heads
Valgus I	Peak pressure shifted towards medial met heads No pressure, or < 25% of max peak pressure, under navicular
Valgus II	Peak pressure shifted towards medial met heads and/ or under navicular Pressure under medial midfoot $\geq$ 25% max peak pressure

Results: Excellent inter-rater reliability (kappa= 0.96) was found between the classification authors. The overall inter-rater reliability between all eight raters was substantial (kappa= 0.67). Intra-rater reliability was excellent (kappa= 0.70-1.00).

Discussion: Classification of stance phase varus and valgus foot deformity can be performed by foot pressure analysis. Inter-rater and intra-rater reliability was excellent and appeared to correlate with familiarity of our proposed system. The ability to classify stance phase deformity should improve clinical communication between colleagues, improve objectivity of pre-treatment assessment, and allow for objective outcome analysis of various treatments.

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