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Category: Bunion; Midfoot/Forefoot

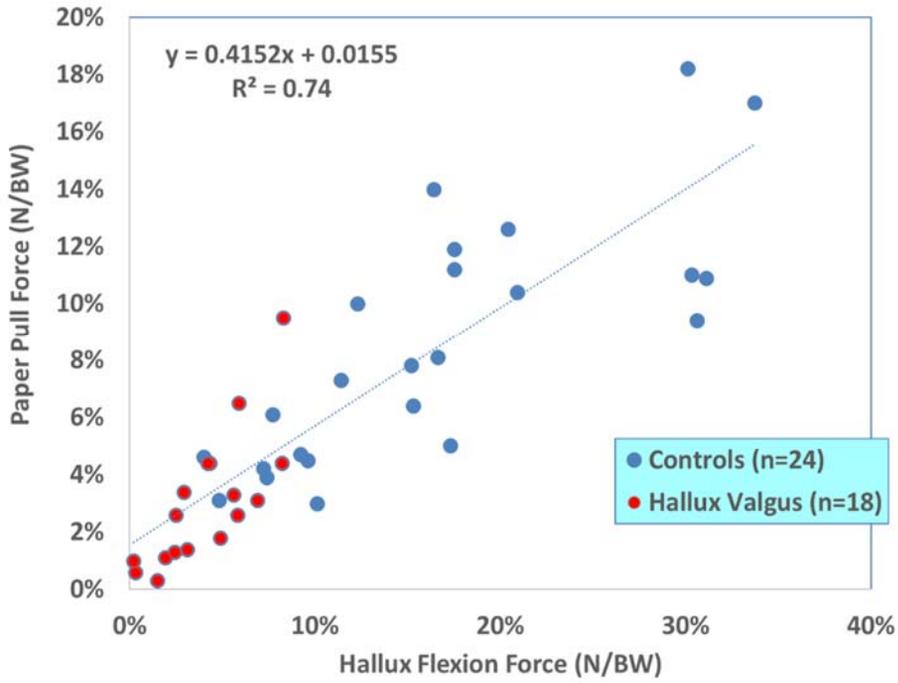
Keywords: Hallux Valgus; Bunion; Functional Rehabilitation

Introduction/Purpose: The purpose of this study was to explore validity of the paper pull test (PPT) to assess hallux flexion strength and function in persons with hallux valgus (HV). The following hypotheses were tested: 1) The PPT is valid for inferring 1st MTP flexion strength and heel rise (HR) performance (e.g. heel height). 2) A specified threshold of force during the PPT can be identified that discriminates patients with HV. 3) Muscle activity (abductor hallucis [AH], flexor hallucis brevis [FHB]), in patients with HV will be distinct from controls across three tasks: 1) PPT, 2) lowering phase of a HR, and 3) rising phase of a HR.

Methods: Participants (24 controls, 22 with HV) performed: 1st MTP flexion, PPT, and heel rise. A force transducer in a jig assessed 1st MTP flexion. The same transducer recorded force during the PPT. Electromyography (EMG) was used to record FHB/AH muscle activity during 1st MTP flexion, PPT, and heel rising. 3D movement analysis was used to measure heel height and divide the HR into an up (HR-Up) and down (HR-Dwn) phase. One practice and 3 maximum 1st MTP flexion efforts were recorded. Manchester Scale of hallux deformity was used; 63.6% were classified as C or D. Validity was assessed with Pearson correlation's between force during the PPT and 1st MTP flexion and PPT and HR height. Assessment of a threshold value for discriminating participants with HV from controls was determined using receiver operator curve (ROC) analysis. A two-way ANOVA for muscle groups and tasks were used to assess muscle activation.

Results: The correlation between PPT force and maximum 1st MTP force was high ($r=0.87$, $p<0.01$) and the correlation with HR height was significant ($r=-0.41$, $p<0.01$). The ROC analysis yielded a high area under the curve (0.88(0.05)) for discriminating HV participants. Participants with HV that were below a threshold of 4.5% BW (44.1 N for a 100 kg person) on the PPT showed an 88% specificity/80% sensitivity in distinguishing HV participants from control participants (control average 64.1(37.3) N) versus HV (average 21.8 (16.4) N). Muscle activity was significantly higher across tasks for the AH ($p=0.02$) but was similar for the FHB ($p=0.22$).

Conclusion: This data validates the PPT as simple, effective, clinical evaluation of 1st MTP flexion strength in patients with HV. This data also documents that patients with HV (surgery or not) may avoid using 1st MTP flexion explaining their significant weakness. The importance of this weakness on function is supported by the correlation with the heel rise test. The abnormal EMG findings suggests altered muscle control contributes to a lower PPT. The threshold of 1st MTP strength may assist with clinical decisions regarding whether rehabilitation or advice on increasing physical activity might benefit patients with various degrees of HV.



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