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3D assessment of residual deformity in adult clubfoot patients treated with the Ponseti technique and its relationship with patient-reported outcomes

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Introduction: The gold-standard treatment for clubfoot deformity (CFD) is the Ponseti technique, but few studies have assessed its long-term outcomes. This study aims to elucidate residual three-dimensional (3D) weight-bearing computed tomography of foot deformities in CFD patients treated with the Ponseti technique, and to compare them with healthy patients. We also assessed how these deformities may influence patient-reported outcomes (PROs).

Methods: In this prospective, comparative, and controlled study, 37 CFD patients (57 feet) treated with the Ponseti technique with no additional surgical procedures were recruited. Fourteen healthy volunteers (28 feet) were also included. All patients underwent WBCT, the tarsal bones were semi-automatically segmented, and several automatic measurements assessing cavus, varus, adductus, and overall 3D deformity were performed (FAO). PROs were collected, and multivariate regression analysis was used to assess the relationship between residual deformities and outcomes.

Results: There was no significant overall residual 3D deformity observed in CFD patients when compared to controls (mean FAO: CFD 2.4% vs. controls 4.0%; $p = 0.49$). CFD patients had increased varus (TCA: $p < 0.0001$; HMA: $p = 0.02$) and adduction (TNCA: $p < 0.0001$), while presenting with decreased cavus (sagittal TFMA: $p = 0.03$; CIA: $p < 0.001$) compared with controls. Sagittal TFMA was correlated with VAS ($R^2 = 0.19$, $p = 0.012$; 2.93 + [0.09*TFMA]) and EFAS ($R^2 = 0.27$, $p = 0.0025$; 15.26 + [-0.26*TFMA]), while TCA correlated with PROMIS-PI ($R^2 = 0.14$, $p = 0.038$; 62.5 + [-0.29*TCA]) and PROMIS-PF ($R^2 = 0.32$, $p = 0.0007$; 31.3 + [0.44*TCA]).

Conclusion: This study highlights the efficacy of the Ponseti technique in treating the overall 3D foot and ankle deformity in CFD patients, realigning the ankle joint and the weight-bearing foot tripod. However, residual CFD components were identified, including overcorrection of the cavus and undercorrection of the adductus and varus deformities, which negatively influenced PROs.

Keywords: Orthopedic procedures; Clubfoot; Tomography, X-Ray Computed.

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