

## Morphometric Measurements of the Calcaneus in Adults with Stage IIb, Posterior Tibial Tendon Dysfunction: Is the Lateral Column Short?

Kempland Walley, BS, Evan Roush, Chris Stauch, Allen Kunselman, MA, Kaitlin Saloky, BS, Gregory Lewis, PhD, Michael Aynardi, MD

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**Introduction/Purpose:** The pathophysiology of adult-acquired flatfoot deformity (AAFD) is not fully explained by degeneration of the posterior tibial tendon alone. While a shortened or dysplastic lateral column has been implicated in flatfoot deformity in pediatric population, there is no study that has quantified the degree of shortening or dysplasia in adults with a stage IIb flatfoot deformity, or if any exists at all. The purpose of this study was to use reconstructive 3D modeling from computed tomography (CT) scans of the calcaneus in order to perform three-dimensional morphometric measurements of the lateral column in patients with stage IIb posterior tibial tendon dysfunction (PTTD) compared to controls in an effort to better understand the morphology of patients with AAFD.

**Methods:** After IRB approval, an institutional radiology database was queried for patients with PTTD who had CT performed between January 2011 and June 2016. Controls were patients receiving CT scan for an intraarticular distal tibia fracture without preexisting foot or calcaneal pathology. Clinical office notes, physical examination, and weight-bearing radiographs were used to identify patients that met clinical criteria for stage IIb PTTD. A 1:1 match was performed using age, laterality, gender, and BMI. Morphometric measurements of the calcanei were performed involving the length of the calcaneal axis (LCA), height of the anterior process (HAP), and length of the anterior process (LAP) (Figure 1). Linear mixed-effects models were used to assess the differences between control and PTTD patients with respect to LAP, HAP, and LCA measurements, with also considering measurements from 3 independent observers. We considered a difference of  $\pm 4$  mm as our threshold of clinical significance.

**Results:** Of the 3586 CT within our institutional database, a total of 14 patients were available for reconstruction and analysis. There were no statistical differences detected between patient characteristics or demographics between these groups. On average, the long axis of the calcaneus (LCA) was 3.1 mm shorter (95% confidence interval: 0.43-5.76 mm) in patients with stage IIb PTTD compared to controls ( $p < 0.05$ ). Additionally, the distance from the articular margin of the posterior facet to the anterior process (LAP) was shorter in PTTD patients compared to controls 3.35 mm ( $p < 0.001$ ; 95% confidence interval: 1.82-4.88). Comparison of observers demonstrated high agreement between LCA and LAP measurements, as illustrated by satisfactory concordance correlation coefficients.

**Conclusion:** Our results support the hypothesis that the calcaneus of adult patients with stage IIb AAFD is, indeed, dysplastic when compared to healthy controls, which further supports the utility of LCL. Analysis of these results, taken together with previous literature, may suggest the use of a smaller graft between 4-6 mm as ideal when performing this procedure.

**Figure 1.**  
3D measurement of the length of the calcaneal axis (LCA), length of the anterior process (LAP) and the height of the anterior process (HAP).

