Check for updates

Effect of Lateral Column Lengthening Calcaneal Osteotomy on Radiographic Measurements of Foot Alignment

Chris Anthony, MD, Jessica Goetz, PhD, Adam Kruse, MS, Andrew Kern, PhD, John Femino, MD

Category: Hindfoot

Keywords: flatfoot, biomechanics, calcaneal osteotomy

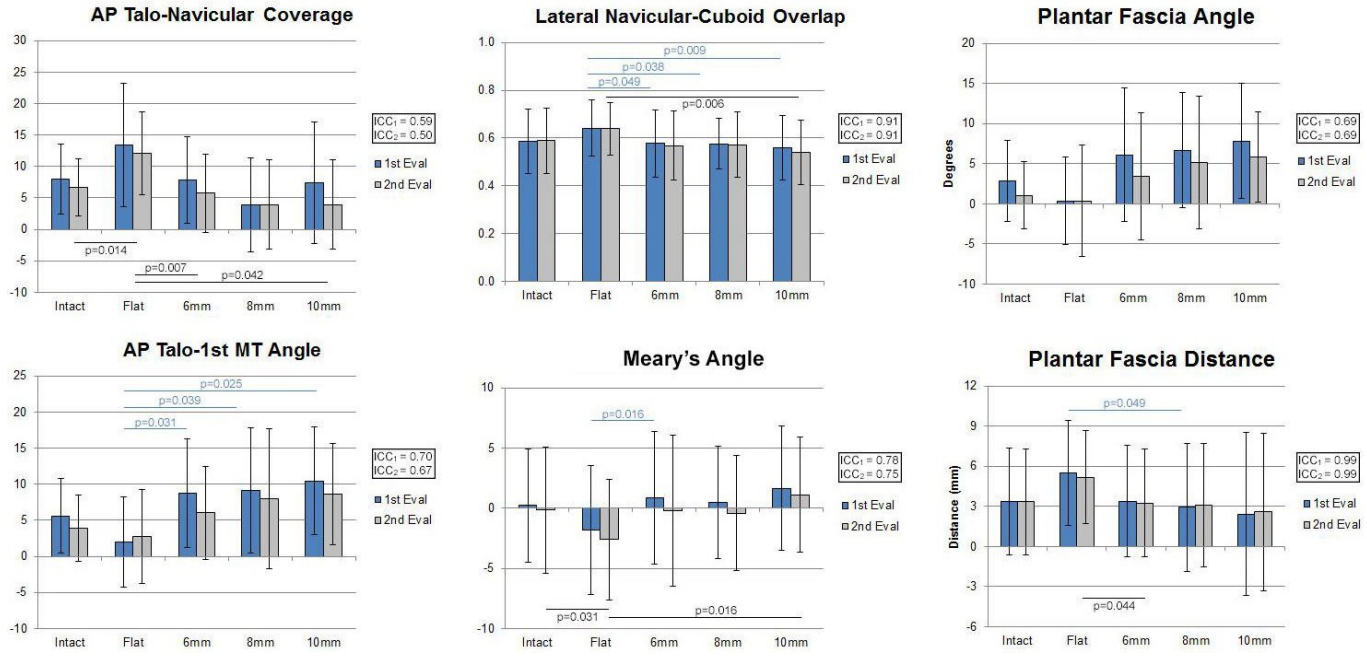
Introduction/Purpose: Lateral column lengthening (LCL) with calcaneal osteotomy has been increasingly used for reconstruction in flexible flat foot reconstruction. The aims of this study were to 1) evaluate the effects of variably sized LCL blocks on the restoration of alignment in an acute flat foot cadaveric model; 2) create a computer algorithm to more objectively measure foot alignment; and 3) develop an acute flat foot model that does not require cyclic loading for creating a type IIB flat foot. Determining if overcorrection with lateral column lengthening can occur would provide guidance surgeons to avoid lateral column overload. A computer guided measurement program could make studies more comparable. An acute flat foot model would clarify the ligament deficiencies necessary to create a type IIB flat foot.

Methods: A type IIB flat foot model was used in which the medial and medial-plantar fibers of the calcaneonavicular (CN), the interosseous talo-calcaneal (ITCL) and the cervical (CL) ligaments were transected. Metallic markers were placed in the PF origin. 3D weightbearing CT scans were obtained with the specimens in a custom jig that permitted loading with 100 lbs. (445 N). The jig allowed full pronation under load. Scans were obtained:intact, flat, and with 6, 8 and 10 mm LCL blocks. Simulated AP and lateral radiographs were created using a custom MATLAB program. A custom ImageJ plugin was created which guided measurement of Meary's angle, naviculo-cuneiform overlap, AP talo-first metatarsal angle, and a novel plantar fascia (PF) distance and PF angle. The program automatically calculated midpoints and perpendicular lines from guided user input. Four observers performed all measurements in blinded and randomized fashion on two occasions greater than 12 weeks apart.

Results: The ligament sectioning model reliably produced a type IIB flat foot as noted by talo-navicular sag, increased talar head uncovering (forefoot abduction) and divergence of the talus and calcaneus as seen on the AP weightbearing view (Figure 1). Cyclic loading was not required in any specimens and the remaining medial column ligaments were not sectioned.
Intraobserver and interobserver comparisons indicated naviculo-cuneiform overlap and plantar fascia distance had excellent interobserver agreement and Meary's and plantar fascia angle had good interobserver agreement (Figure 1). Lateral column lengthening trended toward overcorrection at 10 mm suggesting a possible threshold for over-correction.

Conclusion: The trend toward overcorrection with 10 mm LCL may indicate a threshold for lateral column overload. Computer guided measurement may improve consistency when comparing studies. The PF measurements are not possible in vivo. The use of a heel centering ring might be a surrogate for the implanted metallic beads. The CL sectioning was essential for creating type IIB flat foot without cyclic loading. The CL has been noted to be a main subtalar stabilizer, but has not entered into mainstream discussions regarding flat foot. Changes that occurred with cyclic loading performed in other flat foot studies have not been defined.

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (http://creativecommons.org/licenses/by-nc-nd/4.0/), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For reprints and permission queries, please visit SAGE's Web site at http://www.sagepub.com/journalsPermissions.nav.



Foot & Ankle Orthopaedics, 3(3)
DOI: 10.1177/2473011418S00021
©The Author(s) 2018