Clin Orthop Relat Res (2016) 474:1017–1018 / DOI 10.1007/s11999-016-4694-6

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

Published online: 12 January 2016

CORR Insights

CORR Insights®: How Do Hindfoot Fusions Affect Ankle Biomechanics: A Cadaver Model

Judith F. Baumhauer MD

Where Are We Now?

Arthrodesis is currently the lone surgical option for end-stage arthritis of the subtalar and Chopart's joints. By contrast, alternative approaches to arthrodesis are available for the ankle, including total ankle replacement, which has gained popularity during the past decade. This resurgence was driven by the clinical findings of progressive joint arthritis of the subtalar joint after ankle fusion [4].

The current study by Hutchinson and colleagues turns the tables and examines the impact of an isolated subtalar arthrodesis, as well as double (subtalar and talo-navicular) or triple arthrodesis (double and calcaneocuboid) on ankle joint load, including force, contact area, contact stress, and external rotation.

In this biomechanical model, the authors are attempting to answer what force and contact stress does the ankle joint experience after various combinations of hindfoot fusions in a neutral and uneven surface model (varus and valgus positions). This cadaveric study uniquely examines the impact of neutral, and simulated uneven surfaces on the ankle joint after hindfoot stabilization and demonstrates decrease force and contact area, while ultimately determining that contact stress was unchanged. Although there is limited information on this question from a biomechanical standpoint, there are a number of long-term retrospective clinical series that have demonstrated radiographic changes in the ankle joint after triple arthrodesis [2, 5]. Interestingly, these clinical studies reported 30% to 40% of radiographic changes of the ankle approximately 25 years after a triple arthrodesis. However, the clinical impact to the patient of this finding seemed to be minimal. This leaves clinicians questioning the importance of isolated radiographic findings.

Where Do We Need To Go?

Although the current study supports results from the clinical case series indicating that ankle joint radiographic wear occurs at long-term followup, the clinical importance of all this work remains unknown. For example, we still have considerable uncertainty about how we might manage a patient with severe hindfoot arthritis and mild ankle symptoms; should this patient undergo a triple arthrodesis and risk worsening the ankle symptoms? What about the patient with both ankle and

This *CORR* Insights® is a commentary on the article " How Do Hindfoot Fusions Affect Ankle Biomechanics: A Cadaver Model" by Hutchinson and colleagues available at: DOI: 10.1007/s11999-015-4671-5.
The author certifies that she, or any member of her immediate family, have no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.
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This *CORR* Insights® comment refers to the article available at DOI: 10.1007/s11999-015-4671-5.

J. F. Baumhauer MD (✉)
University of Rochester School of Medicine and Dentistry, 601 Elmwood Avenue, Box 665, Rochester, NY 14642, USA
e-mail: judy_baumhauer@urmc.rochester.edu

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subtalar arthritis; we know that pantalar arthrodesis can leave patients with substantial disability, but would a subtalar arthrodesis performed in concert with an ankle replacement put the arthroplasty at risk of premature failure? One way to ascertain which biomechanical and radiographic changes matter is to correlate them with patient-reported outcomes (PROs). Generally, this has not been done. Future research needs to assess the importance of these radiographic changes over time to our patients.

How Do We Get There?

Since this study used a cadaveric model, verifying the altered forces with an in vivo human model would be helpful. There is promising science using ultrasound to look at the material properties of cartilage in vivo [3]. Concurrently, large, multicenter, prospective, observational studies should be performed to examine various patient groups, including those with isolated hindfoot fusion and no ankle symptoms, hindfoot fusion and ankle symptoms, hindfoot fusion and ankle replacement, and a control group of no arthritis or ankle arthritis only and no hindfoot arthritis. Standardized PROs such as the Patient Reported Measurement Information System could be obtained. The American Orthopaedic Foot and Ankle Society has begun an initiative (Orthopaedic Foot and Ankle Research) [1] working toward a common database for data collection for studies such as these. A common data collection suppository can allow large data to be obtained from diverse sources for generalizability. This data can enable research opportunities such as data analytics, comparative effectiveness, population management, physician performance, and quality assessment on common and uncommon patient diagnoses and surgeries to educate patients, providers, and payers. It would allow for the clinical foot and ankle medical community to determine whether the smaller surface area loading in the ankle, demonstrated in the current study after hindfoot fusion, has a clinical impact on our patients with concurrent mild ankle arthritis or leads to lower longevity of an implant after total ankle replacement.

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