Mechanical Axis Deviation of the Lower Extremity: Does Ground Reaction Point Better Estimate Weight-bearing Axis for Operative Planning?

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My disclosure is in the Final AOFAS Program Book. I have no potential conflicts with this presentation.

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Introduction

• Mechanical axis deviation from anatomic axis used in operative planning to improve alignment in tx of ankle and knee deformity and associated osteoarthritis

• Though no predictable relationship between ankle and knee malalignment identified, significant number of patients with knee malalignment also have some degree of hindfoot deformity

• Precise alignment important for implant success as even minor deviation can lead to increased loading, implant wear and early failure or subluxation
Introduction

- Conventional mechanical axis deviation (MADC) is measured from the center of femoral head to center of ankle.

- A more accurate measurement of the actual weight bearing axis would account for hindfoot deformity.

- Ground mechanical axis deviation (MADG) is measured from the center of the femoral head to the ground reaction point, thereby accounting for hindfoot deformity.
Methods

- Three cadaveric lower extremity specimens used in study: 1 normal arch, 1 pes planus and 1 cavovarus foot
- Designed a biomechanical testing jig using a hydraulic jack to apply load to the femoral head
- Baseline measurements of MADG contact area were recorded for all specimens
- Load and contact area (CA) through the center of the ankle joint (A) and the heel (ground reaction point, G) of the calcaneus measured using K-scan pressure sensor 4050 and 6900 testing strips (Tekscan, Boston, MA)
Methods

- Deformities at the level of the hindfoot, a progressive pes planus created by an orthopaedic surgeon to simulate typical physiologic malalignments.

- Posterior tibial tendon released followed by release of the spring ligament.

- Load transmissions re-measured to compare load transmitted through the center of ankle and ground reaction point of calcaneus in the context of hindfoot deformity.
Normal arch specimen

- No change in ankle contact area (CA) after release of posterior tibial tendon and spring ligament

- 9% decrease in heal CA after release of spring ligament
Results

Pes planus specimen

• No change in ankle CA after release of posterior tibial tendon and 29% increase in CA after spring ligament

• 33% decrease in heal CA after release of posterior tibial tendon
Results

Cavovarus specimen

- Little change in ankle CA after release of posterior tibial tendon and spring ligament.
- 34% decrease in heel CA after release of posterior tibial tendon and additional 23% decrease after spring ligament release.
Conclusions

- Specimens with a pre-existing deformities demonstrated the largest % change in heel CA post-release of the posterior tibial tendon and spring ligament

- MADG used for operative planning may reduce the risk of postoperative malalignment and subsequently increase implant longevity

- Limitations: small sample size, potential errors associated with area measurements in testing jig

- Future work: expansion of study size for further subgroup analyses