“Sagittal Subtalar and Ankle Joint Assessment with Weight-bearing Fluoroscopy during Shod Ambulation”

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My disclosure is in the Final AOFAS Mobile App.
I have no potential conflicts with this presentation.
Introduction

Goal: develop a fluoroscopic system suitable for assessment of *in vivo* intra-foot kinematics during shod ambulation

- Analyze ankle and subtalar joint motion in the sagittal plane.
- Quantify sagittal plane ankle and subtalar motion during shod ambulation in a cohort of normal subjects.
Purpose

• Differentiating the motion of the ankle and subtalar joints is of clinical relevance in foot and ankle conditions including pes planovalgus, arthritis, and tarsal coalitions. It is also important in the post-operative evaluation of arthrodesis and arthroplasty.

• In addition, assessment of intra-foot kinematics in custom orthoses or shoe modifications would assist in the evaluation of their efficacy and prescription.
Purpose

- Current external marker models **cannot** isolate ankle or subtalar motion; rather, they **combine** the talocrural and subtalar components within a single “joint.”

- Bone pin methodologies are **inappropriate** for use during shod ambulation.

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Segment 1: Tibia and fibula
Segment 2: Talus and calcaneus
Segment 3: Distal tarsals and metatarsals
Segment 4: Hallux

Meyers et al. (2004)

Nester et al. (2007)
Methods
System configuration

- A reconfigured OEC 9000 fluoroscopy unit was mounted to a custom built walkway with an embedded AMTI force platform within an existing 14 camera Vicon motion analysis system allowing simultaneous collection of motion, fluoroscopic, and ground reaction force data.
**Methods**

**Kinematic Model**

- A sagittal plane ankle and subtalar joint specific fluoroscopic kinematic model was developed (McHenry, 2013).*
- The model tracks calcaneal and talar points of interest (POI) in collected fluoroscopic images and translates their pixel locations to global (motion analysis system) coordinates.
- These translated POI in conjunction with standard external marker positions are used to quantify ankle & subtalar motion in the sagittal plane.

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Methods

- Thirteen normal M subjects (mean age 22.9 ± 3.0 yr, mean weight 77.2 ± 6.9 kg, mean height 178.2 ± 3.7 cm)
- Five trials per subject, walking at a self selected pace while wearing athletic shoes.
- All subjects donned a circumferential lead apron during fluoroscopic assessment.
- Effective radiation doses were estimated at 10 μSv per trial.
Results

- Talocrural (L) and Subtalar (R) plantar/dorsiflexion angles. Solid: mean angle of all subjects; Dashed: mean ± 1 SD.
- Missing data at the end of stance corresponds to the foot vacating the field of view.
Discussion/Conclusion

• It is possible to track hindfoot kinematics of the subtalar and ankle joints of the shod foot.
• This allows kinematic evaluation in the shod condition, lending to the evaluation of various foot and ankle orthoses and shoe modifications.
• Evaluation at the level of the ankle and subtalar joints is possible, allowing for further evaluation of hindfoot arthritis, tarsal coalition, arthrodesis, arthroplasty, and adjacent joint degeneration.
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References

