Morphology of the Hindfoot in Pes Cavus: A Weightbearing 3D CT Study

Presenting Author:
Timo Schmid, MD

Additional Authors:
Manuel Roth, Steffen Schumann, PhD, MSc, Fabian Krause, MD

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Introduction/Purpose: The characteristic cavovarus deformity includes an adducted forefoot, an elevated longitudinal arch, and a hindfoot varus. However, little is known whether the deformity simply reflects pathologic joint orientations caused by muscular imbalance or whether it is rather provoked by alterations of the bony morphology. The purpose of the study was to further evaluate the source of the neurogenic and idiopathic cavovarus deformity by weightbearing 3D CT.

Methods: Weightbearing CT scans of 12 patients with neurogenic and 17 patients with idiopathic cavovarus deformity were compared to neutrally aligned feet of 19 volunteers.

AMIRA® software was employed to segment individual bones and to generate a 3D model. The 3D joint surface vector (JSV) with its 3 components in the transverse, coronal, and sagittal plane was computed for each joint surface of the talus, calcaneus, navicular and distal tibia.

The positions of the ankle, subtalar and talonavicular joints were compared among the groups using the JSVs of the corresponding joint surfaces.

The relative orientations of the joint surfaces on each individual bone were compared using the JSVs of head, trochlea and posterior facet for the talus; posterior facet and anterior process for the calcaneus; and anterior and posterior surfaces for the navicular.

ANOVA tests were used for statistical analyses. Only statistically significant results (p < 0.05) are reported in this abstract.
**Results:** Regarding the joint orientations, the talonavicular joint revealed 9° more adduction in idiopathic cavovarus feet than in control feet.

In the neurogenic and idiopathic cavovarus groups the talar head exposed 34° and 20°, respectively, more adduction relative to the trochlea and 19° and 25°, respectively, more adduction relative to the subtalar joint than in the control group. Neurogenic cavovarus feet had 11° and 16°, respectively, more talar head internal rotation in the coronal plane relative to the subtalar joint than idiopathic cavovarus and control feet.

In the idiopathic cavovarus group the anterior calcaneal process showed 9° more adduction relative to the posterior calcaneal facet and the anterior navicular surface had 8° more plantar flexion relative to the posterior navicular surface than in the control group.

**Conclusion:** Alterations of bone morphology were more pronounced in the neurogenic group and mainly related to the talar head, whereas the idiopathic group also exposed changes of calcaneal and navicular bone morphology and talonavicular joint orientation.

This indicates that the idiopathic cavovarus deformity is more induced by pathologic joint orientations due to muscular imbalance (or "forefoot-driven") than the neurogenic deformity. Thus, neurogenic more so than idiopathic cavovarus deformities entail bone morphology changes of the hindfoot ("hindfoot-driven"), too. Therefore, to fully address the deformity corrective osteotomies, i.e. talar head realignment for neurogenic cavovarus feet, should be taken into consideration.