Pressure Analysis Comparing Focal Dome Osteotomy and Wedge Osteotomy In Varied Subtypes of Ankle Varus

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Purpose:

Asymmetric ankle varus has different etiologic causes (intrinsic/ extrinsic). Previous studies have demonstrated variations in pressure distribution across the tibiotalar joint based upon etiology. It is the aim of this study to identify the unique treatment requirements for each subtype of asymmetric ankle varus.

Methods:

Intrinsic Varus Deformity: Limbs were skeletonized with exception of foot and tibiotalar joint capsule. The lateral collateral ligaments were released including the peroneal tendons. The syndesmosis was not dissected. Photo paper was then applied to the joint and loaded. Once pathologic joint loading was recorded, a focal dome or closing wedge will be placed and fixated with external fixator.

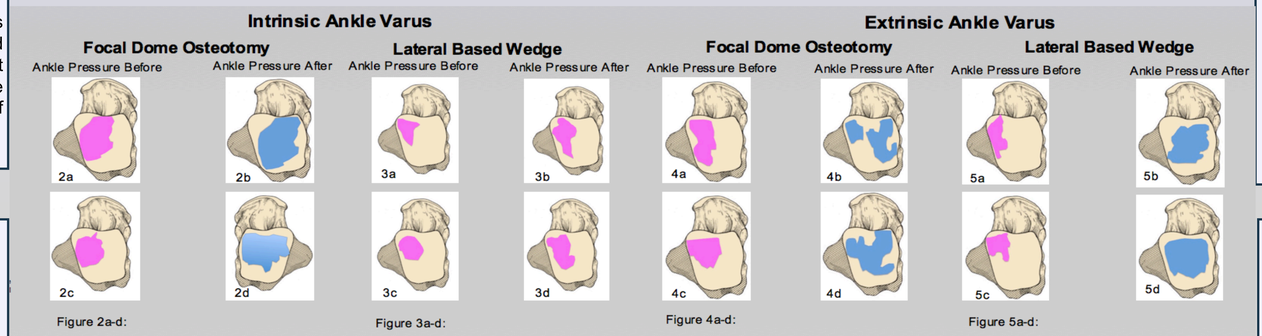
Extrinsic Varus Deformity: Limbs were skeletonized with exception of foot and tibiotalar joint capsule. A varus deformity was made in the proximal 1/3 of the tibia. Photo paper was then applied to the joint and loaded. Once pathologic joint loading was recorded, a focal dome or closing wedge will be placed and fixated with external fixator.

Constrained STJ:

For mechanical testing of the Tiobiotalar joint, the subtalar joint will be tested in a constrained state. With the use of two 7.0mm screws the Subtalar joint was fixated into place. both cohorts.

Pressure Testing:

Pre scale photo paper was applied to the tibiotalar joint and the foot was axially loaded into a Instron device and loaded to 450N. Film was removed from the apparatus and analyzed for contact area and gradient.



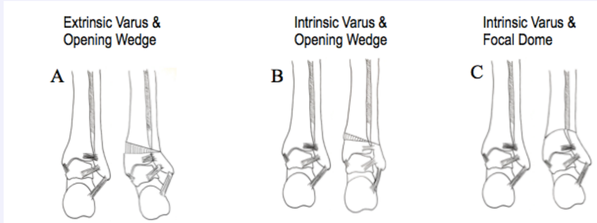
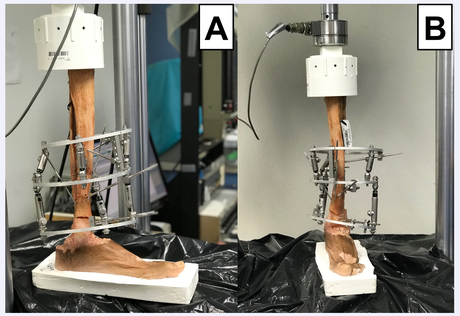


Figure 1: **(Series A)** Depicts deformity correction utilizing an OMW in Extrinsic varus ankle. Notice the intact lateral collateral ligaments allow for rotation of the talus. **(Series B)** Depicts deformity correction utilizing an OMW in intrinsic varus ankle. Notice the the attenuated lateral collaterals fail to reduce the talus resulting in residual varus deformity of the ankle, known as *"Tension Band Theory"*. **(Series C)** Depicts deformity correction utilizing FDO in intrinsic varus ankle. Notice the "neutral" rebalance of the joint without need for collateral ligament tensioning.

Figure A and B: Skeletonized extremities were potted in fast fixing in acrylic resin in a fixed cavovarus limb with intrinsic or extrinsic deformity placed in limb. The limb was loaded to 450N for before prints. A corrective osteotomy was applied and the limb was reloaded for "corrective pressure". Fixation was performed with a combination of Steinmann pins and 3 ring external fixation which allowed for loading of the osteotomy to high loads.



Results:

Pressure analysis was compared between both subtypes of asymmetric ankle varus indicating a significant difference in contact pressures. Focal dome osteotomy demonstrated significant improvement in rebalancing the joint pressures in patients with intrinsic ankle varus when compared to extrinsic, while wedge osteotomy was nearly comparable to focal dome when performed in extrinsic ankle varus.

Discussion:

Focal dome osteotomies were first described in the knee literature and have been touted as a neutralization osteotomy. Evidence from this study suggests that focal dome osteotomy may better realign the mechanical axis in intrinsic deformity despite the absence of intact collateral ligaments. We recognize a tension band effect, which tethers the medial shoulder of the talus to the medial malleolus. A focal dome appears to better neutralize the force acting upon the joint without relying on deficient ligaments for reduction. A study performed by Hintermann et al. discussed the concept of the tension band effect of the lateral collateral ligaments in varus malalignment. (Figure 1) It is there conclusion that opening medial wedge osteotomies may limit the adjustments of the talus within the mortise. They believe that the insufficiency of the lateral collaterals in the face of an intact syndesmosis and deltoid are enough to produce asymmetric stability of the ankle joint. Similar to these findings we recognize the importance of collateral ligaments in the reduction of tibiotalar Varum. Without the addition of an intact soft tissue complex, focal dome osteotomies would be beneficial to produce more anatomic joint pressures.

References:

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