A Comparison Between Focal Dome Osteotomies and Opening Medial Wedge Osteotomies for Extrinsic/Intrinsic Ankle Varus: A Theoretical Algorithm to Treatment

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PURPOSE

Asymmetric ankle arthritis is a multifactorial condition, which may be the result of both intrinsic and extrinsic pathology of the ankle joint. Classically, asymmetric ankle arthritis has been treated without reference to the cause, utilizing various osteotomies, which help to rebalance the joint. Our team recognizes a distinct pathomechanical need seen in patients who present with intrinsic versus extrinsic ankle varus. For the purposes of this study we have defined extrinsic ankle varus as deformity existing in the bone, above or below the level of the ankle joint. These patients often present following distal tibia trauma, infection or congenital deformity. Intrinsic ankle deformity is recognized as deformity of the ankle that is generated through osseous or soft tissue etiologies and is propagated at the level of the joint. These patients often present following neglected chronic lateral ankle instability. As it stands, numerous therapeutic modalities have been described for the treatment of mild to moderate asymmetric ankle arthritis, one of which is the supramalleolar osteotomy. Several variations to this osteotomy have been presented within the literature as a method to balance the joint, reestablish ankle joint symmetry and restore the mechanical axis of weight bearing. Through our experience, correction of intrinsic ankle varus is significantly limited when utilizing a classic opening medial wedge osteotomy. We propose, instead, the use of focal dome osteotomies as a superior method of rebalancing the joint in patients with lateral collateral ankle insufficiency. We believe that the focal dome more closely re-approximates the mechanical weight-bearing axis, reduces supinatory forces at the level of the ankle joint, and places less reliance on the collateral ligament for deformity correction. The aim of this study is to identify the difference between intrinsic and extrinsic ankle varus, highlight the different pathomechanical demands of each type, present our algorithm of treatment and review what we believe to be limitations of the opening medial wedge osteotomy in patients with intrinsic varus.

METHODOLOGY

To establish our premise we introduce two corrective osteotomies and compare the pre and post correction in both intrinsic and extrinsic deformity states. To isolate our population we did an intra-system CPT code search utilizing Tibia osteotomy, Focal Dome, and supramalleolar osteotomy from January 1, 2013 to January 1, 2016. In this search we found a total of 26 patients. These records were pulled and divided into the scheme shown below (Figure 1). 6 patients met our procedural inclusion criteria. Data variable of interest included age, cause of deformity, arthritis stage and pre and post-operative TAS.

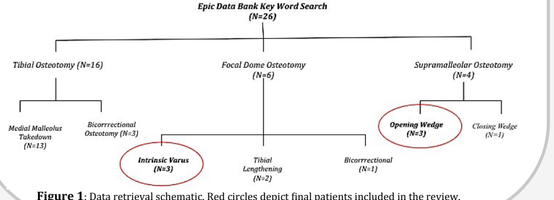

Figure 1: Data retrieval schematic. Red circles depict final patients included in the review.

PROCEDURE

Figure 2: (A) A medial osteotomy is created 5c, above the level of the medial malleolus with care not to invade the distal cortex. **(B)** The osteotomy site is opened and packed with bone graft material. **(C)** A medial plate is applied to the osteotomy site.

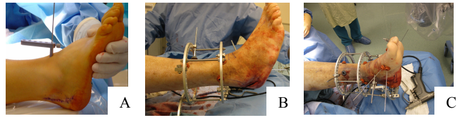

Figure 3: **(A)** A medial incision is made for creation of osteotomy utilizing a 4 hole post and 3.5mm driil bit. **(B and C)** An external fixator is applied for fixation of the osteotomy. **(C)** Ankle joint distraction is applied to the fixator for improvement of ROM.

RESULTS

Patient	Age	Pre-Op Dx	Procedure	Arthritis Grade	TAS Pre-Op (nrml= 88-90)	TAS Post-Op (nrml= 88-90)
1	60	Instrinsic Ankle Varus	Focal Dome	IIIa	83	93
2	39	Intrinsic Ankle Varus	Focal Dome	II	80	93
3	44	Instrinsic Ankle Varus	Focal Dome	IIIa	80	91
4	65	Instrinsic Ankle Varus	Opening Wedge	IIIb	79	86*
5	59	Extrinsic Ankle Varus	Opening Wedge	II	83	95
6	46	Extrinsic Ankle Varus	Opening Wedge	IIIa	79	90

Table 2: Data collected for patients of both intrinsic and extrinsic deformity. * Signifies readings that only marginally corrected to normal. All patients with intrinsic varus underwent primary repair of ligaments.

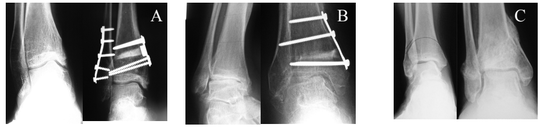

Figure 4: (Series A) Demonstrates the pre-op (79) and post-op (93) alignment of a patient who underwent MOW for the treatment of extrinsic varus. **(Series B)** Demonstrate the Pre-op (79) and post-op (86) alignment of patients who underwent MOW for the treatment of intrinsic varus. **(Series C)** Demonstrates the pre-op (80) and post-op (91) alignment of a patient who underwent FDO for the treatment of intrinsic ankle varus.

ALGORITHM

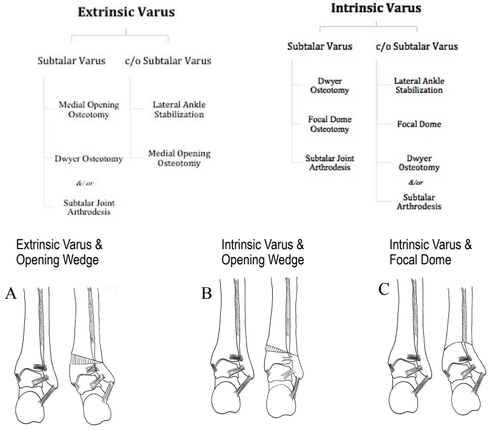

Figure 5: (Series A) Depicts deformity correction utilizing an OMW in Extrinsic varus ankle. Notice the intact lateral collateral ligaments allow for rotation of the talus. **(Series B)** Depicts deformity correction utilizing an OMW in intrinsic varus ankle. Notice the the attenuated lateral collaterals 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.

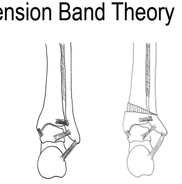

Figure 6: Depicts tension band theory. The deltoid ligament tethers the medial talus to the medial malleolus while the attenuated lateral collaterals allow for persistent varus deformity. .

DISCUSSION

Focal dome osteotomies were first described in the knee literature for the benefits on unloading uni-compartmental asymmetric arthritis. It has been touted as a neutralization osteotomy, which does not interfere with collateral ligament balance. Additionally, this osteotomy appears to be more powerful at realigning the mechanical axis in intrinsic deformity. The results of this study identify a limitation in the current protocol for joint sparing procedures. To our knowledge, no current study identifies the disparities or pathomechanical needs of intrinsic versus extrinsic ankle deformity. Tension Band theory recognizes the synergistic effect that the joint capsule has on the reduction of the joint during distal tibia wedge osteotomy. First recognized by Knupp et al. who found no reduction in pathologic joint pressures when the deltoid and interosseous ligaments remained intact. Theoretical correction to this limitation have been suggested but not definitively proven effective. Which include: collateral ligament rebalancing, Tendon transfers, fibular osteotomies. In contrast to the initial work of Knupp, we recognize a tension band effect which tethers the medial shoulder of the talus to the medial malleolus. Without apposition of the lateral collateral ligaments this tension band is unopposed, rocking the talus into varus and limiting reduction of the ankle joint varus. Despite primary repair of lateral collateral ligaments our patient treated with wedge osteotomy noticed failure of the procedure. This study is not meant to represent best practices for treatment of intrinsic deformity of the ankle however it is meant to identify potential future avenues of research regarding rebalancing asymmetric ankle varus.

CONCLUSIONS

- Intrinsic and extrinsic ankle varus presents with different pathomechanic needs.
- Intrinsic ankle varus is defined at deformity propagated at the level of the joint which is caused by insufficiency in lateral joint capsule .
- Extrinsic ankle varus is defined as deformity which propagated above or below the level of the joint which is cause by osseous angulation .
- Wedge osteotomies work through angulation. They asymmetrically load a joint and work synergistically with surrounding soft tissues for deformity reduction.
- Wedge osteotomies should be performed at the level of the deformity. Given there inability to translate when not performed at the level of the deformity.
- Focal dome osteotomies are considered a neutral osteotomy with regard to soft tissue balancing.

REFERENCES