POSTERIOR MALLEOLAR FRACTURE FRAGMENT MAL-REDUCTION AND ITS CONTRIBUTION TO ANKE ARTHRITIS

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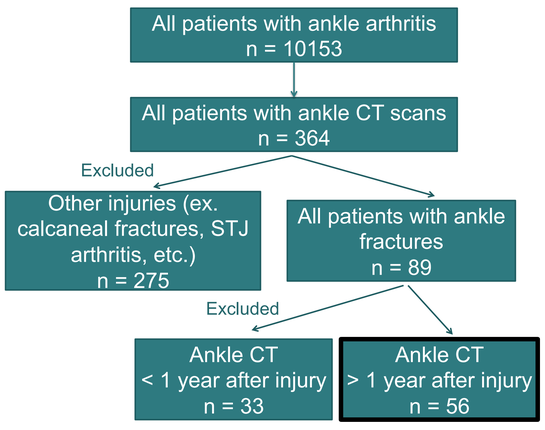
Introduction

- Management of posterior malleloar fracture fragments (PMFF) remains controversial.
- Traditionally fragments involving >25% of the joint surface require fixation.[1]
- Prior studies have primarily measured PMFF size and step-off on radiographs; however, literature shows that conventional x-rays poorly assess PMFF size.[2,3]
- The purpose of this study was to determine whether size and mal-reduction of PMFF, as well as the congruity of the tibiofibular joint, as evaluated on CT scan, contributes to the development of post-traumatic arthritis

Methodology

- A retrospective chart review was conducted between 2008-2019, using our institutional database, to find patients with post-traumatic arthritis after an ankle fracture using appropriate ICD-9 and ICD-10 codes

Figure 1: Study Population



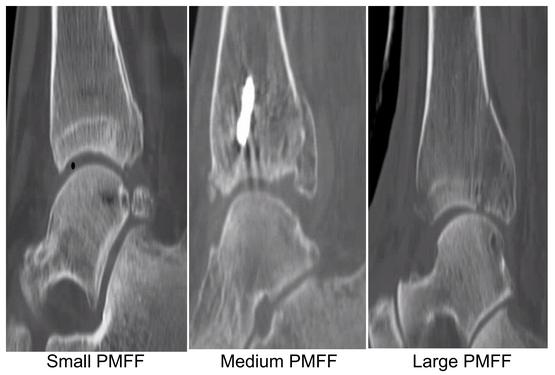
- CT scans were used for radiographic assessment.
- Size of the PMFF was classified as small (<5%), medium (5-25%), or large (>25%) based on the involvement of the articular surface on sagittal CT (Figure 3)
- Mal-reduction was determined by comparing the distance between the PMFF and the tibial plafond, with >1 mm step off increasing the risk of post-traumatic arthritis on sagittal CT.[2] (Figure 4)
- Congruity of the tibiofibular joint was evaluated by examining the anterior and posterior distances of the fibula within the incisura, differences >2 mm were considered incongruous.[3] Measurements were made on an axial CT cut 1 cm proximal to the ankle joint (Figure 5)
- Multivariate logistic regression analysis was performed for correlation, with statistical significance set to p<0.05. The Mann Whitney test was used for continuous variables and the Fisher exact test was used for categorical variables.

Results

Figure 2: Demographics

n	56
Years from injury to CT, median	2 Range: 1-25
Male	14 (25%)
Age, median	55
Diabetes	15 (27%)
Smoking	14 (25%)
BMI, median	32.3 Range: 18.8-62.3
Type of Fracture Trimalleolar Equiv. Trimalleolar	 17 (30.4%) 39 (69.6%)

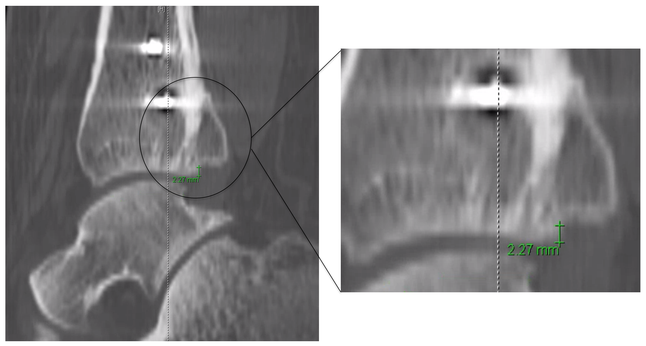
Figure 3: PMFF Size (Percentage of Articular Surface)



Small PMFF | Medium PMFF | Large PMFF

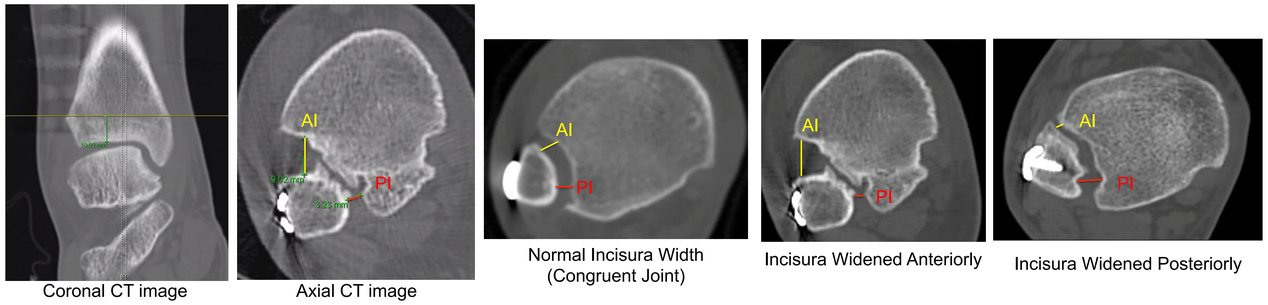
n	56
No PMFF	7 (13%)
Small PMFF (<5% surface)	24 (43%)
Medium PMFF (5-25% surface)	22 (39%)
Large PMFF (>25% surface)	3 (5%)

Figure 4: Mal-reduction / Step Off of PMFF



Step Off on Sagittal CT	Small PMFF n = 24	Medium PMFF n = 22	Large PMFF n = 3	P-value
> 1 mm	21 (87.5%)	20 (90.9%)	3 (100%)	1.0
≤ 1 mm	3 (12.5%)	2 (9.1%)	0	1.0

Figure 5: Fibular Incongruity Within the Incisura as Measured on Axial CT



Coronal CT image | Axial CT image | Normal Incisura Width (Congruent Joint) | Incisura Widened Anteriorly | Incisura Widened Posteriorly

	No PMFF n=7	Small <5% n=24	Medium 5-25% n=22	Large >25% n=3	P-value
Anterior Incisura (AI), median (IQR) mm [yellow]	3.30 (2.78 – 5.11)	3.37 * (2.11 – 5.89)	3.59 * (2.26 – 4.48)	4.80 (2.76 – 7.32)	0.857
Posterior Incisura (PI), median (IQR) mm [red]	3.89 (3.67 – 5.51)	5.09 (3.86 – 6.30)	4.32 (3.06 – 5.34)	2.60 * (0.66 – 5.05)	0.123
AI – PI, in absolute value, median (IQR) mm	0.54 (0.4 – 1.11)	2.67 ** (2.15 – 3.38)	2.58 ** (2.24 – 3.08)	2.20 ** (2.10 – 2.27)	< 0.001 **
# of incongruity of fibula within incisura	0	22 (91.7%)	20 (90.9%)	3 (100%)	< 0.001 **

* Anterior measurements were smaller than posterior measurements in the small and medium groups
** There was a high degree of fibular incongruity in the small, medium, and large groups

Discussion

Should any size PMFF be reduced and fixed?

- There was a high incidence of a mal-reduced PMFF in patients with post traumatic ankle arthritis
  - 46/56 (82%) patients who developed post traumatic arthritis in our study population had small or medium PMFF that would not have traditionally been surgically managed
  - Small or medium PMFF may be missed on radiographs; therefore, ordering CT scans for all preoperative ankle ORIFs should be considered
- Previous studies have demonstrated that the posterior inferior tibiofibular ligament (PITFL) is intact and attached to PMFF of all sizes.[4]
  - Direct reduction of PMFF, independent of size, may stabilize the syndesmosis through an intact PITFL, resulting in improved anatomic reduction of the tibiofibular articulation.[2]

Can a mal-reduced PMFF cause incongruity of the fibula within the incisura?

- 45/56 (80%) patients with post traumatic ankle arthritis and a mal-reduced PMFF had an incongruent tibiofibular joint; however, a confounding factor is both patients with and without syndesmotic fixation were evaluated
  - Our study population included 19/56 patients with syndesmotic repair (9/19 wider posteriorly and 10/19 wider anteriorly)
- It is postulated that without the anatomic restoration of the PMFF and the posterior incisura, the fibula may rotate out of the tibiofibular articulation, increasing the incidence of post traumatic arthritis

Conclusion

- Size is not the only consideration in the fixation of PMFF and a mal-reduced PMFF may contribute to the incongruity of the tibiofibular joint
- Future studies
  - Retrospective study comparing pre-op CT with one year post-op CT to evaluate progression of arthritis
  - Prospective randomized study evaluating long term functional outcomes in ankle fractures with PMFF
    - Group I: Ankle ORIF; PMFF/PITFL fixation
    - Group II: Ankle ORIF; trans-syndesmotic screw fixation
- Anatomic restoration of the joint is key to reduce the incidence of post traumatic arthritis

References

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