Follow-Up Evaluation of Medial Clear Space Following Open Reduction Internal Fixation Without Primary Deltoid Repair in Bimalleolar Equivalent Ankle Fractures

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STATEMENT OF PURPOSE

- **Aim # 1:**
  - Determine the necessity of primary deltoid repair in bimalleolar equivalent ankle fractures
  - **Study Measure:** Medial Clear Space, Talar Valgus
- **Aim # 2:**
  - Determine mid-term functional outcomes after ORIF of bimalleolar equivalent ankle fractures without primary deltoid repair
  - **Study Measure:** AOFAS Scores
- **Rationale:**
  - No study has quantified medial clear space and talar valgus at longer term follow up after ORIF of bimalleolar equivalent fractures without primary deltoid repair
  - There is no consensus regarding routine primary deltoid repair in literature

METHODOLOGY AND HYPOTHESIS

- **Study Population:**
  - 100 adult patients (age 18-80) who sustained a bimalleolar equivalent fracture and underwent ORIF without deltoid repair
  - Follow up requirement: > 1 year
  - Patients were selected at random from a database of equivalent surgical procedures performed at JPS Hospital from 2013-2017
  - Parameters were controlled for by standard reference values
  - Inclusion: (1) all bimalleolar equivalent fractures with medial clear space >5mm on stress gravity radiograph, that (2) underwent fibula fracture ORIF (+/- syndesmosis repair) without primary deltoid repair, and (3) had follow up weight bearing radiographs > 1 year post-operatively
- **Study Design:**
  - Pre, Initial and >1 year post op AP, and mortise view ankle films were used to evaluate MCS and Talar Valgus Angle.
  - Statistical analysis via paired dependent T-Test to contrast same variable sample means at variable sampling times
  - Pathological markers: MCS >5mm (mortise), valgus tilt in talus in comparison to contralateral limb (AP)
  - AOFAS scores obtained via phone/clinical encounter
- **Hypothesis:**
  - We submit that anatomic fibular fixation (+/- syndesmosis repair) in bimalleolar equivalent fractures is alone sufficient, and primary deltoid repair is not necessary in maintaining MCS or rectus talus long term
  - We also contend that successful long term outcomes can be achieved without primary deltoid repair (AOFAS)

Figure 1 – Stress Gravity Image: Medial clear space widening greater than 5mm is indicative of deep deltoid injury. In combination with fibular fracture, a diagnosis of bimalleolar equivalent fracture can be made.

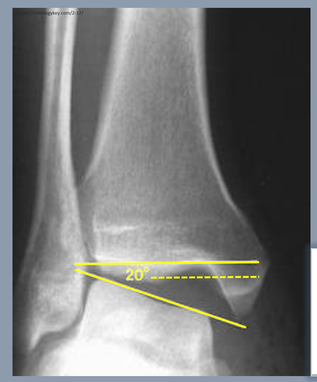

Figure 2 – Talar Tilt: Valgus tilt of the talus is indicative of deltoid rupture, or malreduction of the fibula post-operatively (fibula not out to length)

PROCEDURES

- **Operative Protocol:**
  - Surgical technique for bimalleolar equivalent fractures consists of a supine position, lateral incisional approach, careful dissection down to periosteum which is elevated to expose the fracture. Prior to fracture reduction, the syndesmosis is tested utilizing the hook test under fluoroscopy. Fibula fixation is then imparted with either neutralization or buttress plating depending on the mechanism of injury. Fibula length is often ensured with comparative contralateral intra-operative images. Fixation of the syndesmosis is performed with direct evaluation of reduction utilizing a tri- or quadricortical positional screw (or combination) if required.
  - Routine post-operative protocol includes 2 weeks neutral dorsiflexion in a splint, followed by 4 weeks NWB in CAM boot while allowing for sagittal plane ROM at therapy, followed by 4 weeks progressive WB from CAM boot to supportive tennis shoe. Syndesmotic injuries typically require an additional 2 weeks of NWB in the CAM boot.

Figure 3 – Serial Radiographs: (a) Pre-operative radiograph demonstrating MCS widening and valgus tilt, **(b)** reduced with ORIF without deltoid repair, and **(c)** 12 months post-operatively with no evidence of MCS widening or valgus tilt of the talus.

LITERATURE REVIEW

- Bimalleolar equivalent ankle fractures, specifically fibular fractures with concurrent deep deltoid rupture, are injuries necessitating surgical intervention. The need for surgical repair is attributable to the loss of tibio-talar joint stability following such an injury, where instability predisposes arthritis due to non-uniform joint contact stress and subsequent cartilage degeneration (1-3).
- There are contrasting theories in regards to operative trearment in these injuries, specifically whether direct repair of the deltoid ligament is warranted. Some contend that fibula with or without transsyndesmotic fixation provides restoration of osteoligamentous anatomy laterally, which is sufficient for long term talocrural stability, while others assert that re-approximation without primary deltoid repair does not allow for direct end to end healing, thus leading to instability medially (4). Alternatively, some advocate for intra-operative scrutiny of the medial structures, basing primary repair of the deltoid ligament on either soft tissue impingement within the medial gutter or continued valgus angulation after fibular fixation (5,6).
- Baird et al found a 90% good to excellent result in 24 patients who underwent fracture only fixation in bimalleolar equivalent fractures over a period of 2 years post-operatively (7).
- Hsu, Lareau and Anderson advocate for primary repair of the deltoid in their 12 patient population of NFL athletes explaining return to high level function in 83% of the population (8).
- Stromsoe and colleagues randomized 50 patients with functional bimalleolar fractures into a primary repair group and a fibula fracture only group and found no significant difference in outcomes long term (9).
- No current study to our knowledge assesses pre and long term post op medical clear space and tibotalar valgus in these injuries, though these radiographic markers are indicators for deltoid competency.

RESULTS

- In total, 100 patients were involved in the study, 58% female, for a mean follow up of 2.37 years.
- Paired T-Test was used to determine significant differences in same variable means at pre, initial, and current post-op
- There was a statistically significant improvement in MCS (p=0.0002) and Valgus (p=0.012) from pre- to initial post-operative measurements.
- There was not a statistically significant change between MCS (p=0.43) or Valgus (p=0.076) from initial to final follow up.
- AOFAS score average was 88, with 91/100 (91%) of patients reporting good to excellent outcomes.

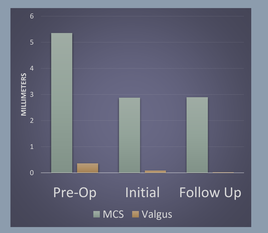

Table 1: Objective Statistics

	N	Min	Max	Mean	STD
Age (yrs)	100	18	80	43.8	14.45
Follow Up (yrs)	100	1.00	4.03	2.37	1.44
Pre-Op MCS (mm)	100	5.0	8.4	5.35	1.31
Post-Op MCS	100	2.0	3.7	2.87	0.72
Follow Up MCS	100	2.1	4.1	2.89	0.70
Pre-Op Valgus (mm)	100	0	1.0	0.36	0.38
Post-Op Valgus	100	0	0.5	0.08	0.15
Follow Up Valgus	100	0	0.1	0.02	0.04
AOFAS	100	67	96	88	7.41

ANALYSIS AND DISCUSSION

- Our study illuminated no significant difference in MCS or tibiotalar valgus when contrasting initial post-operative radiographs and those taken at greater than 1 year follow up, in patients who underwent fibular fracture fixation (+/- syndesmosis repair) without primary deltoid repair in bimalleolar equivalent ankle fractures.
- Furthermore, long term functional outcomes were found to be good to excellent in 91% of patients in our study
- Regarding surgical decision making, the study results concur with the findings suggesting against primary deltoid repair. In accordance with Baird and Stromsoe, not only are long term functional outcomes without significant difference, radiographic parameters such as MCS and tibiotalar valgus, which when pathologic predispose the ankle to complications, are anatomically maintained in lateral fixation alone.

References:
1- Ramsey PL, Hamilton W. Changes in tibiotalar area of contact caused by lateral talar shift. J Bone Joint Surg Am. 1976;58(3):356-7.
2- Thordarson DB, Motamed S, Hedman T, Ebramzadeh E, Bakshian S. The effect of fibular malreduction on contact pressures in an ankle fracture malunion model. J Bone Joint Surg Am. 1997;79(12):1809-15.
3- Gougoulias N, Khanna A, Sakellariou A, Maffulli N. Supination-external rotation ankle fractures: stability a key issue. Clin Orthop Relat Res. 2010;468(1):243-51.
4- Stufkens SA, Van den bekerom MP, Knupp M, Hintermann B, Van dijk CN. The diagnosis and treatment of deltoid ligament lesions in supination-external rotation ankle fractures: a review. Strategies Trauma Limb Reconstr. 2012;7(2):73-85.
5- De Souza L. J., Gustilo R. B., et al. "Results of operative treatment of displaced external rotation-abduction fractures of the ankle." J Bone Joint Surg Am. 1985;67(7):1066–1074.
6- Zeegers A. V., Der Werken C. van. "Rupture of the deltoid ligament in ankle fractures: should it be repaired?" Injury. 1989;20(1):39–41.
7- Baird RA, Jackson ST. Fractures of the distal part of the fibula with associated disruption of the deltoid ligament. Treatment without repair of the deltoid ligament. J Bone Joint Surg 69A:1346 –1352, 1987.
8- Hsu AR, Lareau CR, Anderson RB. Repair of Acute Superficial Deltoid Complex Avulsion During Ankle Fracture Fixation in National Football League Players. Foot Ankle Int. 2015;36(11):1272-8.
9- Stromsoe K, Hoqevold HE, Skjeldal S, Alho A. The repair of a ruptured deltoid ligament is not necessary in ankle fractures. J Bone Joint Surg 77B:920, 1995.