

Assessing Reduction Quality of Intra-Articular Calcaneal Fractures Treated via Sinus Tarsi vs Extensile Lateral Approach using Postoperative CT Scans



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Disclosures

- None

Background

- Calcaneal fractures are a devastating injury resulting in high rate of post traumatic arthritis
- Extensile lateral approach with high rate of wound complications (up to 1/3)
 - Apical wound necrosis
 - Wound dehiscence
 - Infections

Background

- Increased interest in minimally invasive approach
 - In attempt to mitigate wound complications ($\approx 5\%$)
- Similar radiographic outcomes
 - Bohler's angle and Angle of Gissane

Background

- Meta-analysis (Bai et al)
 - 4 RCT and 3 cohort studies
 - 2.6% complications via sinus tarsi (ST) vs 19.2% with extensile lateral (EL)
 - No difference in Bohler's angle
 - NO CT to assess reduction
 - NO stratification based on fracture classification
 - Lower level of evidence d/t inclusion of non-RCT

| Study or Subgroup | OR | 95% CI | Total, Events | Total, Events | Total, Weight | M-H, Random, 95% CI | M-H, Random, 95% CI |
|--|------------|------------|---------------|---------------|----------------------|----------------------|---------------------|
| Liou et al 2015 | 2 | 0.12 | 12 | 0 | 8.7% | 0.10 [0.01, 1.01] | |
| Allen et al 2016 | 2 | 0.18 | 18 | 0 | 7.0% | 0.23 [0.01, 1.14] | |
| Comp et al 2017 | 18 | 0.20 | 20 | 0 | 26.8% | 0.20 [0.01, 2.16] | |
| Lowrie et al 2011 | 5 | 0.40 | 1 | 0 | 13.3% | 0.75 [0.08, 26.81] | |
| Wang et al 2017 | 6 | 0.45 | 45 | 0 | 17.2% | 1.01 [0.19, 214.12] | |
| Shang et al 2014 | 8 | 0.04 | 64 | 7 | 7.3% | 20.48 [1.21, 348.48] | |
| Wang et al 2014 | 4 | 0.15 | 15 | 2 | 22.1% | 2.00 [0.36, 11.16] | |
| Zheng et al 2013 | 2 | 0.15 | 15 | 0 | 8.7% | 0.00 [0.00, 96.13] | |
| Total (95% CI) | 208 | 254 | 100.0% | 5.19 | [2.37, 10.83] | | |
| Total events | 43 | 0 | | | | | |
| Heterogeneity: Tau ² = 0.00; I ² = 3.02; df = 7 (P = 0.90); P = 0.76 | | | | | | | |
| Test for overall effect: Z = 4.17 (P < 0.0001) | | | | | | | |

Background

- Meta-analysis (Zeng et al)
 - Only RTC (8 RCT w/ 4/8 published in Chinese language only, 1 F&A Int)
 - Stratified fracture types: Sanders II and III only
 - Wound complications: 2% (ST) vs 17% (EL)
 - No difference in Bohler's angle or angle of Gissane
 - Improved AOFAS scores for type II only
 - Difference disappears for type III
 - NO CT to assess reduction

Background

- Nocewitz et al
 - CT based case series of ST approach
 - 9 type II and 13 type III fractures
 - 14/22 with good or excellent reduction
 - 7/8 fair or poor in type III fractures
- Infection: 14%
- Low numbers
- No comparison group

Table 1: CT Evaluation of Reduction

| | Step (mm) | Defect (mm) | Angulation (degrees) |
|-----------------|-----------|-------------|----------------------|
| Posterior facet | | | |
| Excellent | None | None | None |
| Good | < 1 | < 5 | < 5 |
| Fair | 1-3 | 5-10 | 5-15 |
| Poor | 3 | 10 | 15 |

Purpose

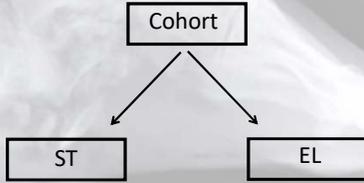
- To evaluate the difference in quality of fracture reduction of calcaneus fractures with postoperative CT scans between sinus tarsi (ST) versus extensile lateral (EL) approach.

Material and Methods

- Retrospective review of surgically treated calcaneal fractures from 2012-2018
- Exclusion criteria:
 - extra-articular fractures
 - malunion repair
 - percutaneous fixation
 - acute fusion
 - no postoperative CT scan

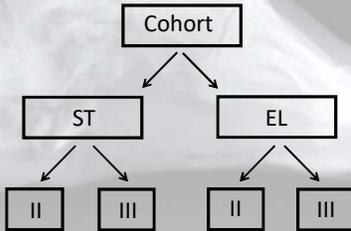
Material and Methods

- Fractures classified and divided into 2 groups based on surgical approach



Material and Methods

- Further subdivided based on Sanders fracture classification

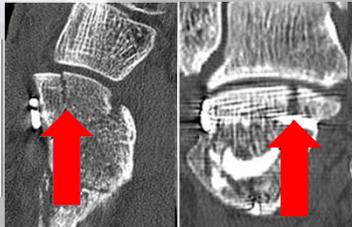


Material and Methods

- Post operative CT used to assess reduction quality as previously described by Nocewitz et, al.
- Post op Bohler's angle and angle of Gissane measured

Table 1: CT Evaluation of Reduction

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|-----------------|-----------|-------------|----------------------|
| Posterior facet | | | |
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| Poor | 3 | 10 | 15 |



Material and Methods

- t-test and Pearson correlations or Wilcoxon Rank Sum and Spearman correlations for continuous variables
- Fisher's exact for categorical variables.
- An adjusted linear regression model was used to evaluate the relationship between surgical approach and degree of joint reduction
- A p-value <0.05 set for statistical significance.

Results

- 77 pts with 83 fractures included
- Mean age 42 years
- Sanders II: 37 pts
- Sanders III: 43 pts
- Sanders IV: 3 pts
- 36 via ST approach (43.4%) vs 47 via EL approach (56.6%)

Results

| OVERALL | Sinus Tarsi | Extensile Lateral |
|---------------------|-------------|-------------------|
| Excellent Reduction | 19.3% | 14.9% |
| Good Reduction | 36.1% | 57.4% |
| Fair Reduction | 22.2% | 25.5% |
| Poor Reduction | 22.2% | 2.1% |

Overall EL better reduction quality p=0.02

Results

| Sanders II | Sinus Tarsi | Extensile Lateral |
|---------------------|-------------|-------------------|
| Excellent Reduction | 35.7% | 26.1% |
| Good Reduction | 50.0% | 69.6% |
| Fair Reduction | 7.1% | 4.3% |
| Poor Reduction | 7.1% | 0% |

No difference in reduction quality p=0.51

Results

| Sanders III | Sinus Tarsi | Extensile Lateral |
|---------------------|-------------|-------------------|
| Excellent Reduction | 9.1% | 4.2% |
| Good Reduction | 27.3% | 45.8% |
| Fair Reduction | 31.8% | 45.8% |
| Poor Reduction | 31.8% | 4.2% |

Trend towards improved reduction with EL p=0.06

Results

| Radiographic Parameters | Sinus Tarsi | Extensile Lateral | p-value |
|---------------------------------|-------------|-------------------|---------|
| Bohler's Angle (20° - 40°) | 91.5% | 77.8% | <0.001 |
| Angle of Gissane (120° - 145°) | 66.7% | 57.4% | 0.5 |

Radiographic measurements are not a good indicator of quality of articular reduction

Results

| Time to OR | Sinus Tarsi | Extensile Lateral | p-value |
|------------|-------------|-------------------|---------|
| Days | 5 | 14 | <0.001 |



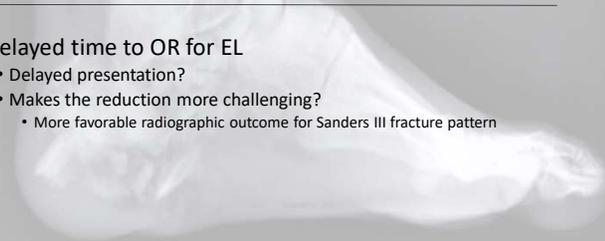
Discussion

- Steep learning curve for Sinus tarsi approach



Discussion

- Delayed time to OR for EL
 - Delayed presentation?
 - Makes the reduction more challenging?
 - More favorable radiographic outcome for Sanders III fracture pattern



Conclusion

- Better overall reduction with EL approach
- No difference between approaches for Sanders II calcaneal fractures
- EL trending towards better reduction for Sanders III fractures

Conclusion

- Sinus tarsi approach is an important adjunct to minimize the risk of complications in Sanders II fractures.
 - steep learning curve for minimally invasive techniques
- Crucially important to have the knowledge of extensile lateral approach as reduction quality is improved for Sanders III fracture.
- Patients with delayed presentation will require extensile approach

THANK-YOU