10:20 – 11:05 am
SESSION 3:
CALCANEAL FRACTURES

Moderators:
Bruce E. Cohen, MD
(Charlotte, North Carolina)

Robert D. Santrock, MD
(Morgantown, West Virginia)
1. Introduction
   a. Calcaneus Fracture ORIF-Extensile Approaches
      i. High Complication Rates
         1. Wound-healing- 11-25%
         2. Infection
         3. Hematoma formation
   b. Alternative techniques emerged
      i. External Fixation
      ii. Arthroscopic-assisted
      iii. Percutaneous techniques
      iv. Minimal Incision techniques

2. Minimal Incision Approaches
   a. Goals
      i. Minimize soft tissue trauma
      ii. Minimize operative risk
      iii. Allow adequate reduction
   b. Approach
      i. Medial
      ii. Lateral
      iii. Posterior
      iv. Combined
      v. My preference- limited sinus tarsi approach
   c. Fracture Type
      i. Essex Lopresti
         1. Original type for limited incision
      ii. Sanders II or II
   d. Patient Selection
      i. High-risk patient
         1. Poor candidate for extensile approach
         2. Age->50
         3. Smoking
         4. Diabetes
         5. Other risk factors
      ii. Timing
         1. Needs to be performed within first 7-10 days
            a. Difficult to restore length and axial alignment
            b. If later, would recommend extensile approach
3. Surgical Technique
   a. Limited Sinus Tarsi approach
      i. As described by Holmes
      ii. 2-4 cm incision
         1. Along line from tip of fibula to base of fourth met
   b. Place Schanz pin in tuberosity
      i. Allows correction of shortening and varus
      ii. Restore alignment of medial wall of calcaneus
         1. Best Visualized in Axial view
      iii. Place 2 guide pins from large cannulated screw set
           1. Placed into distal portion of calcaneus
   c. Reduce posterior facet fragment(s)
      i. Direct visualization
      ii. Fluoroscopic verification
      iii. Stabilize with cannulated screw(s)
   d. Place fully threaded screws in tuberosity fragment over guide pins
   e. Place fully threaded “kick-stand” screw to support posterior facet fragment
   f. Postoperative
      i. Splint 2 weeks- NWB
      ii. Boot-4 weeks-NWB
      iii. Boot 4-6 weeks WBAT

4. Results
   a. Kline et al- AOFAS 2010
      i. Extensile vs Minimal approach
         1. 31 extensile vs 16 minimal
         2. Sanders II and III
         3. Wound Comp- 29.1% vs 6.1%
         4. Secondary surgery- 20% vs 2%
         5. No differences in functional results, union, satisfaction
   b. Ebraheim et al- FAI 2000
      i. 106 pts- transarticular pin fixation
      ii. 8.5% infection
      iii. one case of osteomyelitis
   c. Hospodar et al- Orthopedics 2008
      i. 16 pts-screw fixation
      ii. no wound complications
      iii. 88% successful reduction
      iv. Return to work by 6 months- 75%
      i. Extensile vs minimal
      ii. 26 vs 24 pts
      iii. Higher complication rate in extensile group
         1. Delayed wound healing
         2. Hematoma formation
         3. Sural nerve injury
         4. CRPS
5. **Conclusions**
   a. Excellent technique for “high risk” patient
   b. Minimized operative complications
   c. Equivalent functional results
   d. Must select appropriate fracture type
   e. Operative timing is critical
   f. Learning curve for technique

6. **References**
Calcaneus fracture management by open reduction and internal fixation has become increasingly more common in the last quarter century. The mainstay of this surgical treatment has been the lateral extensile approach. Originally described by Palmer in 1948, it would take nearly 40 years of experience till the technique was understood well enough to produce acceptable results. Many surgeons abandoned ORIF all together throughout the last century because of the devastating complications associated with the delicate approach. The technique in itself has not really changed over the past 70 years, and it remains the most widely used approach to calcaneus fracture reduction and fixation.

However, many things have changed. Now with the experience of many who have come before us, we now have a better appreciation of the nuances and pitfalls of the lateral extensile approach. Among these would be: (1) understanding the complex anatomy of the calcaneus, (2) respecting the natural progression of the injury and the subsequent swelling, (3) protecting the delicate tissue of the lateral foot, (4) employing technology to reduce risks, and (5) acknowledging co-morbid conditions that may affect outcomes.

An understanding of the complex anatomy of the calcaneal is crucial in producing good outcomes with ORIF. The use of CT imaging has developed a 3-dimensional visualization of the fracture. This preoperative planning helps the surgeon with the efficiency of the procedure, and better prepares the team for the operative needs.

The timing of surgery has perhaps been one of the greatest contributions to successful surgical treatment of the calcaneal fracture. Understanding the natural progression of the post-injury swelling, and anticipation of skin compromise by fracture blisters will be invaluable in treating these fractures.
Employing the “no touch technique” when dealing with the surgical flap is a must. There are many ways to avoid injury to the flap during surgery. This begins with an understanding of the anatomy, so one can have a well-placed incision and avoid the sural nerve when making a full thickness surgical incision. And during the procedure, no retractors should be placed, as this simple traction on the flap may cause damage to the delicate tissues.

Advancements in technology such as: low-profile hardware, incisional wound V.A.C., and cold therapy units may aid in protection of the post-operative incision. Although, the literature is limited, the anecdotal experiences among our colleges show promise for these technologies.

The lateral extensile approach may not be for every patient. Acknowledging co-morbid conditions, such as smoking, immune-suppression, diabetes, and peripheral vascular disease is vitally important when deciding on using the lateral extensile approach. A full understanding of this approach includes knowing its limits. And therefore, a broad armamentarium should be available in treating calcaneus fractures surgically.

References:


SESSION 3:  CALCANEAL FRACTURES

Moderators:
Bruce E. Cohen, MD  Robert D. Santrock, MD
(Charlotte, North Carolina)  (Morgantown, West Virginia)

SESSION 3:  10:40 am


Presenting
Mr. Paul Harnett, BSc, MBChB, FRCS (Tr&Orth) (London, United Kingdom)
Mr. Peter F. Rosenfeld, MBBS, FRCS (Tr&Orth); Mr. Charles Willis-Owen, MBBS, FRCS (Tr&Orth)

Abstract:
We present a case series of 11 patients treated with P.A.C.O (percutaneous arthroscopic calcaneal osteosynthesis); a novel technique to address the fixation of calcaneal fractures. Sub-talar arthroscopy allows direct visualisation of the accuracy of reduction of the posterior facet intra-articular fracture, percutaneous fixation ensures minimal wound complications. All Sanders type 2 and 3 fractures were included in the study. Two lateral sub-talar portals were placed into the depressed cavity of the posterior facet, created by the fracture. Elevation of the posterior facet is performed through direct and indirect methods, the reduction is seen arthroscopically and confirmed using an image intensifier. The percutaneous screws are inserted from lateral towards the constant sustentaculum tali.

The patients were followed up for a minimum of 3 months.

The Bohler’s angle improved from an average of 9.9(7 - 18) to 27.7 (23 - 32), P <0.001. 63% of the patients were wearing the same size shoes as pre injury. The mean foot function index score was 89.9 % (75%-98%). The mean time to surgery was 5.7 days. There were no significant wound complications. Our patients have a short time to operation from injury and a short hospital stay. The small wounds allow this technique to be used on a wide number of patients with multiple co-morbidities.
Calcaneal fractures
- High energy injury – usually from an axial load
- Incidence increasing as trauma survivorship increases
- Difficult fractures to treat (delay to surgery, comorbidities, soft tissue management, fixation)

Treatment options

New surgical technique
- An external fixation device to stabilize calcaneal fractures, employing two transfixion pins, two half pins, and medial and lateral rails for fixation
- Two transfixion pins: one in the talar neck, and one in the calcaneal tuberosity
- Two half pins: one beneath the posterior facet and one in the anterior neck
- Fracture reduction is achieved through ligamentotaxis, and manipulation of the sidecars
- Bone graft or void fillers may be used as clinically indicated

Case series
- Case series of 7 calcaneus fractures treated in the past two years with external fixation
- All comers with displaced calcaneus fractures treated
- No exclusions secondary to comorbidities

Comorbidities
- Smoking: 57.1%
- Obesity: 42.9% (defined as BMI > 30)
- Diabetes: 28.6%
- Immunosuppressed: 14.3%
- Multiple comorbidities: 42.9%

Operative time
- Average OR time 37 minutes (20 - 59 minutes)

Time to WBAT
- Average time to WBAT: 37 days (immediate - 71 days)
Time to removal
  • Average time to removal: 63 days (42 - 116 days)

Complications
  • 3 out of 42 pins became superficially infected and treated with oral antibiotics
  • No other wound complication, nonunion, symptomatic DJD, need for bracing, need for fusion, nor amputation reported at this time

Summary
  • Calcaneus fractures are difficult injuries to treat, and lend themselves to complications (especially in high-risk populations)
  • No ideal treatment method exists
  • The studied external fixator is a rigid, less invasive surgical option
  • Decreased operative time and fewer wound complications compared with standard ORIF
  • External fixation is a viable, new treatment option for displaced calcaneus fractures – especially in patients with high-risk comorbidities

References

Buckley R. et al. Operative compared with nonoperative treatment of displaced intra-articular fractures; a prospective, randomized, controlled multicenter trial. JBJS Am. 2002:84:1733-44


Outcome of Displaced Intra-articular Calcaneal Fractures Treated Operatively Using a Lateral Plate and Screw Construct: Long-Term Results

Presenting
Zachary M. Vaupel, MD (Tampa, Florida)
Murat Erdogan, MD; Roy W. Sanders, MD

Summary
This long-term, observational study supports the treatment of displaced intra-articular calcaneal fractures using a lateral extensile approach and ORIF with a lateral plate and screw construct as the best chance for the patient to attain a good long-term functional result.

Introduction
Displaced intra-articular calcaneus fractures (DIACF’s) were historically treated nonoperatively. Advancements in operative techniques resulted in improved outcomes. These fractures occur in younger patients. It is, therefore, important to know the long-term results of operative fixation. The purpose of this study was to determine the long-term outcomes of DIACF’s treated with ORIF with a plate and screw construct through an extensile lateral approach.

Methods
Patients with DIACF’s treated with ORIF between January 1, 1990 and December 31, 2000 by a single surgeon were identified from our database. Initial Sanders classification was documented. Reduction of the posterior facet of the calcaneus, Böhler’s angle and the angle of Gissane were measured postoperatively. At final follow-up, each patient underwent a physical and radiologic exam, including CT scans. All patients completed a Medical Outcomes Study Short Form-36 (SF-36), American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score, Maryland Foot Score, Ankle Osteoarthritis Scale (AOS), and the Visual Analog Scale (VAS) at the time of follow-up. All complications and/or subsequent surgeries were noted.

Results
Of 638 fractures, 209 were eligible for inclusion in this study. Of these, 95 fractures (85 patients) were available for follow-up (45%). The average patient age was 60 (33-88). The average length of follow-up was 15.04 years (10-21.4). There were 59 Sanders Type II fractures and 26 Sanders Type III fractures. All fractures reviewed had excellent articular reduction (0-1 mm) and restoration of the anatomic shape of the body. The postoperative Böhler’s angle and angle of Gissane were restored to an average of 27 and 117 degrees, respectively. Subtalar motion was reduced in all cases. 82/85 patients had either no or only slight gait disturbance. The average SF-36 PCS and MCS were 45 and 53, respectively. The average AOFAS ankle-hindfoot score was 72. The average Maryland Foot Score was 79. The average AOS-D and AOS-P were 27 and 28, respectively. Importantly, the average VAS (pain scale 0-10) was only two.

Conclusion
Anatomic reconstruction of both the body and the articular surface are critical to a good outcome. Using a lateral extensile incision with a plate and screw construct is a reproducible procedure. If anatomic restoration can be attained, essentially normal function, normal gait, regular shoe wear, lack of narcotic use, and return to previous or modified employment is possible in many cases for a prolonged period of time. Based on our observations, once a fracture can be reproducibly and anatomically reconstructed, the functional outcome will be determined by the amount of cartilage damage. We believe this long-
term observational study supports the treatment of displaced intra-articular calcaneal fractures using a lateral extensile approach and ORIF with a lateral plate and screw construct, as the best chance for the patient to attain a good long-term functional result.