Management of Diabetic Ankle Fractures

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Complication Rate

- **2.75 times greater risk**
  - 21 DM vs 46 control
  - Blotter 1999

- **14% overall complication rate**
  - 84 ORIF
  - Costigan 2007

- **25% major complication rate**
  - 15 DM
  - Jani 2003

- **42% DM vs 0% control**
  - 26 matched
  - McCormack 1998
DM with Comorbidities

- No significant difference in DM without comorbidities vs control

- DM with comorbidities 47% complication rate vs 14% for control
  - Jones et al 2004 JBJS

- 3.8 times increased risk of overall complications

- 5 times increased risk for revision surgery
  - Wukich et al 2011 FAI
Infection

- 4 times higher in DM
- 4/6 DM casted $\rightarrow$ infection
- 4/19 DM operatively treated $\rightarrow$ infection
  - Flynn et al 2000
- 26 patients reviewed with post-op infection, 5 DM
  - Zalavras et al 2009
Amputation Rate

- 9.5% BKA
  - Blotter et al 1999
- 3.6% BKA
  - Costigan et al 2007
- 12.5% BKA
  - Jani et al 2003
- 8.7% complicated DM vs 3.4% uncomplicated
  - Wukich et al 2011
Risk Factors for Complications

• Peripheral neuropathy
• Surgery duration
• HbA1c>7
  • Shibuya et al 2013
  • 165 DM arthrodesis/osteotomy/ORIF
• HbA1C in diabetic ankle fractures
  • Poor radiological outcome, revision, complications, higher with HbA1c>6.5
  • Liu et al 2013
  • 21 DM ankle ORIF
Nonoperative Treatment

• Increased risk for loss of reduction/malunion
  • McCormack & Leith 1998

• 50% incidence of skin breakdown
  • Zinar and Brown 1994

• Significant complications with casting, advocate early surgical intervention
  • Connolly and Csencsitz 1998

• 21 fold increased odds of complication for nonop treatment vs operative tx
  • Lovy et al 2016 FAI

Johnson and Yoon 2010, 57yo DM 3 wk casting
Charcot as a complication?

- 17 ankle fractures casted 7.5 weeks → Charcot
- TCC 11 weeks then ankle fusion
- 82.4% achieved a stable ankle
- 17.6% BKA
  - Ayoub 2008
- 68yo male
- DM, HTN, Hypercholesterolemia, RA, sciatica, CAD, PAD, Afib
- s/p cardiac stenting, fem-pop bypass
- HbA1C: 9.6
- Vit D: 32.9
Operative Treatment Options

- Multiple Syndesmotic Screws
- Locking Plates
- K-wire + Plate
- External Fixation (combined or alone)
- Primary Arthrodesis
- Transarticular Fixation
- Bicortical Medial Malleolar Fixation
- Fibular Nailing
- Minimally Invasive Approach
Multiple Syndesmotic Screws

- Cadaver biomechanical investigation
- Augmented fixation construct stiffer, stronger, more resistant to axial deformation
- Osteopenia not quantified
  - Dunn et al 2004
Transarticular Fixation

- 15 DM with neuropathy treated surgically
- 25% major complication rate
- 13% amputation rate
- Combination of transarticular fixation/prolonged protected WB = successful protocol
  - Jani et al 2003 FAI
Bicortical Medial Malleolar Fixation

- 23 ankle fx with comorbidities
  - 4 DM
  - 7 neuropathy
- All bicortical medial mal fixation
- 17.39% complication rate
  - King et al 2012
Minimally Invasive Surgery

- Bazarov et al, JFAS 2018
  - 44 “high risk”
  - 52% DM
  - 27% complication rate, 25% wound dehiscence, 9% infection

- Abdelgaid et al, JFAS 2018
  - 47 “high risk”
  - 57% DM
  - 1 superficial infection
  - 36% excellent outcome AOFAS

- Ebraheim et al, FAS 2018
  - 67 comorbidity group (BMI>30 or DM) vs 43 noncomorbid
  - Fewer infections than ORIF (0 vs 11)
ORIF - plus

<table>
<thead>
<tr>
<th>Method</th>
<th>Patients (n=105)</th>
<th>Complications (n=36)</th>
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<tbody>
<tr>
<td>Nonoperative Treatment</td>
<td>8 (7.6%)</td>
<td>2 (5.7%)</td>
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<tr>
<td>Open Reduction Internal fixation</td>
<td>35 (33.3%)</td>
<td>7 (20%)</td>
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<tr>
<td>ORIF Plus</td>
<td>24 (22.8%)</td>
<td>2 (5.7%)</td>
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<tr>
<td>ORIF and External Fixation</td>
<td>32 (30.5%)</td>
<td>19 (54.3%)</td>
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<tr>
<td>Plain External Fixation</td>
<td>6 (5.8%)</td>
<td>6 (17.1%)</td>
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- Wukich et al 2011
Other Pearls...

- Avoid bone reduction clamps
  - Schon and Marks 1995
- Monitor more frequently post-op
  - Dellenbaugh et al 2011
- Incisional Vac
WB Status?

- NWB increased 2 to 3 fold with neuropathy
  - Marks et al 2001

- 12 weeks all patients with neuropathy
- Ex-fix if not able to comply with NWB protocol
  - Wukich et al 2011

- Protected WB in cast/boot 2 weeks after injury/surgery
  - 73 DM patients
  - Complication rate lower than that published with prolonged NWB
  - Bazarov et al 2017
What about the cost??
Regan et al 2015

- 2010-2011 NY – 58,748 ankle fractures
- 12.8% had DM
- 1098/7501 “complicated DM”
  - Ketoacidosis
  - Hyperosmolarity
  - Coma
  - Renal/Optho/Neuro
  - PVD
- 2.4 days longer LOS
- C-DM $6895 more costly than DM
- Higher in hospital mortality rate
Conclusions

**TABLE I Clinical Recommendations**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Grade of Recommendation</th>
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<tr>
<td>Isolated stable, nondisplaced fractures may be successfully treated with nonoperative management</td>
<td>B</td>
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<td>Operative management of an unstable ankle fracture in a diabetic patient is more likely than nonoperative management to result in a stable, functional lower extremity</td>
<td>B</td>
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<tr>
<td>In diabetic patients without comorbidities (vasculopathy, neuropathy, or a history of Charcot arthropathy) who sustain an unstable ankle fracture, standard open reduction and internal fixation techniques can yield results comparable with those in nondiabetic controls</td>
<td>B</td>
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<td>There is a trend toward the use of supplemental fixation techniques for patients with neuropathy and an ankle fracture</td>
<td>I</td>
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<td>The postoperative management of ankle fractures should include a prolonged period of non-weight-bearing followed by protected weight-bearing</td>
<td>B</td>
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References


Ebraheim NA, Dailey M, Huff BA, White E, Liu J. Minimally invasive fixation can decrease infection rates in diabetic and obese patients with severe ankle fracture and syndesmotic injury. FAS, 2017


