Surgical Correction of Diabetic Foot Ulcers

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Objective

• To discuss the benefits of preserving foot structure in persons with diabetes
  – Ulcer healing
  – Ulcer recurrence
  – Complications
“The whole problem is really one of mechanics, not of medicine....”

Foot type does not play a role!
What are the prerequisites?

- **Local Factors**
  - Failed conservative therapy
  - Recurrent ulcer
  - Rigid deformities...

- **Systemic factors**
  - Compliance
  - Perfusion
  - Tobacco
  - Diabetes control
Digital deformities
Flexor tenotomy
Flexor tenotomies

• Rasmussen A- Percutaneous flexor tenotomy for preventing and treating toe ulcers in people with diabetes mellitus. 
  *J Tissue Viability. 2013*

• Laborde JM- Neuropathic toe ulcers treated with toe flexor tenotomies. 
  *Foot Ankle Int. 2007*

• Netten- The effect of flexor tenotomy on healing and prevention of neuropathic diabetic foot ulcers on the distal end of the toe. 
  *J Foot Ankle Res 2012*

• Tamir E- Outpatient percutaneous flexor tenotomies for management of diabetic claw toe deformities with ulcers: a preliminary report. 
  *Can J Surg 2008*

• Kearney TP- Safety and effectiveness of flexor tenotomies to heal toe ulcers in persons with diabetes. 
  *Diabetes Res ClinPract 2010*  
  
  **Recurrence ~12%** 
  **Healing 26-40 days**
Hammer toe correction

- 31 persons with diabetes
  - All with neuropathy + deformity
  - Half with history of ulcer

- 33 persons without diabetes

Armstrong, DG: J Foot Ankle Surg, 1996
Long-Term Results

- One re-ulcerated 40 months following surgery
- Postoperative Infection
  - Non-Diabetic Patients: 0%
  - Neuropathy + Deformity: 0%
  - History of Ulcer: 14% (p < 0.04)

Armstrong, DG: J Foot Ankle Surg, 1996
Hammertoe correction
Interphalangeal arthroplasty of the great toe
Evaluation of Hallux Interphalangeal Joint Arthroplasty Compared With Nonoperative Treatment of Recalcitrant Hallux Ulceration

Table 2
Comparison of outcomes by treatment group (N = 26 patients)

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Treatment Group</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIPJ Arthroplasty (n = 13)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard Therapy (n = 13)</td>
<td></td>
</tr>
<tr>
<td>Interval to heal (wk)</td>
<td>3.5 (2, 17.29)</td>
<td>.033*</td>
</tr>
<tr>
<td></td>
<td>9 (4.25, 25)</td>
<td></td>
</tr>
<tr>
<td>Patients with recurrence</td>
<td>1 (7.69)</td>
<td>.031†</td>
</tr>
<tr>
<td></td>
<td>7 (53.85)</td>
<td></td>
</tr>
<tr>
<td>Patients with amputation</td>
<td>0 (0)</td>
<td>.063†</td>
</tr>
<tr>
<td></td>
<td>5 (38.46)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: HIPJ, hallux interphalangeal joint.
Data presented as median (minimum, maximum) or n (%).
* Wald test from Cox proportional hazards regression.
† Exact McNemar test.
IPJ Arthroplasty
Sesamoidectomy

Giurini et al JAPMA 81(4), 1991

- 26 sesamoidectomies
  - 13 tibial
  - 13 tibial and fibular
- Average return to activity at 5 weeks
- Complications:
  - 1 infection
  - 4 re-ulcerated
Forefoot ulcers
Consider the power of equinus

- Limited ankle dorsiflexion has been implicated as a contributing factor to plantar ulceration of the forefoot
Achilles Tendon Lengthening

Ankle joint ROM effected by tissue glycosylation

- Decreased ankle DF
- Increased plantar pressure

Percutaneous TAL to ↑ ankle DF and reduce forefoot pressure
Achille’s tendon lengthening
Effect of Achilles Tendon Lengthening on Neuropathic Plantar Ulcers: A Randomized Clinical Trial

<table>
<thead>
<tr>
<th></th>
<th>TCC n=33</th>
<th>TAL n=31</th>
</tr>
</thead>
<tbody>
<tr>
<td>% healed</td>
<td>88% (n=29)</td>
<td>100%</td>
</tr>
<tr>
<td>Average healing</td>
<td>41 ± 28</td>
<td>58 ± 47</td>
</tr>
<tr>
<td>Ankle dorsiflexion</td>
<td>&lt;1 °</td>
<td>15°</td>
</tr>
<tr>
<td>Heel ulcer</td>
<td>0</td>
<td>13%</td>
</tr>
<tr>
<td>Recurrence 7 mos</td>
<td>59% (n=16)</td>
<td>15% (n=4)</td>
</tr>
<tr>
<td>Recurrence 24 mos</td>
<td>81% (n=21)</td>
<td>38% (n=10)</td>
</tr>
</tbody>
</table>

Heel Ulcer
Metatarsal Head Resection
End Result
Analysis of transfer lesions in patients who underwent surgery for diabetic foot ulcers located on the plantar aspect of the metatarsal heads

- Avg. F/u 13 months
- 41 pts (41%) re-ulcerated
- 1 pt recurrence
- Kaplan–Meier analysis showed that the variables retinopathy, nephropathy, a history of digital or contralateral amputation, resection of the 1st MTH, and the 5th MTH were risk factors for re-ulceration.

Barroso-Molines et.al.: Diab Med 30, 2013
Pan Metatarsal Head Resection
Clinical efficacy of the pan metatarsal head resection as a curative procedure in patients with diabetes mellitus and neuropathic forefoot wounds

<table>
<thead>
<tr>
<th></th>
<th>No Surgery N=46</th>
<th>Surgery N=46</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amputation</td>
<td>13.0%</td>
<td>6.5%</td>
<td>NS</td>
</tr>
<tr>
<td>Infection</td>
<td>64.5%</td>
<td>35.5%</td>
<td>odds ratio = 2.4; CI = 1.0-6.0</td>
</tr>
<tr>
<td>Time to heal</td>
<td>84.2 ± 39.9 days</td>
<td>60.1 ± 27.9 days</td>
<td>P = .003</td>
</tr>
<tr>
<td>Ulcer recurrence</td>
<td>39.1%</td>
<td>15.2%</td>
<td>odds ratio = 3.6; CI = 1.3-9.7</td>
</tr>
</tbody>
</table>

Trajectory

S/P 3 weeks

S/P 5 weeks
• 41 patients UT grade 1A/2A plantar aspect of hallux IPJ using case control model

• Surgery group healed significantly faster than patients in the standard therapy group (standard 67.1 +/- 17.1 vs surgery 24.2 +/- 9.9 days p+0.0001)

Armstrong DG et.al.: Diabetes Care 2003 Dec;26(12):3284-7
Recurrence

- Fewer recurrent ulcers
  38.1% vs. 4.8%
- \( p<0.02 \) odds ratio 7.6, 95% CI 1.1 - 261.7

Armstrong DG et.al.: Diabetes Care 2003 Dec;26(12):3284-7
Infection & Amputation Rates

- Both groups had similar rates of infection (standard 38.1% vs. surgery 40.0% \( p=0.9 \))
- Amputation (standard 10% vs. surgery 4.8% \( p=0.5 \))

Armstrong DG et.al.: Diabetes Care 2003 Dec;26(12):3284-7
Conclusion

- Patient selection is important for a good outcome
- Procedures to preserve foot structure has low complication rate
- The role of activity and foot type is unknown
- Isolated or complete metatarsal head resection still an alternative to amputation
Thank you!
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