Beaming in Charcot Arthropathy – Intramedullary Fixation for Complicated Reconstructions: A Cadaveric Study

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Our disclosures are in the Final AOFAS program book. There is a potential conflict with this presentation due to: Consultant, Wright Medical Technologies, Inc. (CFH)
Statement of Purpose

• In the modern treatment of Charcot neuroarthropathy, beam screw fixation is an alternative to plate and screw fixation.
• Exposure is minimized for implantation and this technique supports the longitudinal columns of the foot as a rigid load-sharing construct.
Statement of Purpose

• A literature review identified a paucity of data regarding metatarsal intramedullary canal morphology relevant to beam screw fixation.

• The purpose of the study was to qualitatively and quantitatively describe metatarsal diaphyseal morphology.
Study Methods

- 20 fresh-frozen cadaveric below knee specimens
- Metatarsals were excised, cleaned of soft tissue and axially transected at the point of the most narrow external diameter.

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<table>
<thead>
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<tbody>
<tr>
<td><strong>Number of Specimens</strong></td>
<td>20</td>
</tr>
<tr>
<td><strong>Mean Age at Time of Death (years)</strong></td>
<td>75.8</td>
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<tr>
<td><strong>Female Gender</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Right Side</strong></td>
<td>16</td>
</tr>
<tr>
<td><strong>Mean BMI at Time of Death</strong></td>
<td>20.9</td>
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Table 1: Demographic data of the 20 below knee cadaveric specimens.
Study Methods

• Measured size and shape of the diaphysis of 1st – 4th metatarsals with a digital caliper

• The diaphyseal canal shape was categorized as round, oval, triangular, or pear.

Figure 1: Digital caliper measuring the narrowest external diameter of the 1st metatarsal. Note: the diaphyseal canal of the 1st metatarsal was categorized as oval.
Study Methods

• The widest distance between two endosteal cortical surfaces was measured.

Figure 2: Digital caliper measuring the widest distance between cortical surface of the 1st metatarsal intramedullary canal.
Results

- There were 10 male and 10 female specimens
  - Mean - 75.8 years.
- Triangular endosteal canals were **only found** in the 1st metatarsal
  - Remainder of the canals were largely round or oval.

<table>
<thead>
<tr>
<th></th>
<th>Mean External (mm)</th>
<th>Mean Internal (mm)</th>
<th>Shape</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oval</td>
</tr>
<tr>
<td>1\textsuperscript{st} Metatarsal</td>
<td>14.16</td>
<td>9.08</td>
<td>8</td>
</tr>
<tr>
<td>2\textsuperscript{nd} Metatarsal</td>
<td>8.59</td>
<td>4.72</td>
<td>13</td>
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<tr>
<td>3\textsuperscript{rd} Metatarsal</td>
<td>7.92</td>
<td>4.53</td>
<td>11</td>
</tr>
<tr>
<td>4\textsuperscript{th} Metatarsal</td>
<td>8.31</td>
<td>4.51</td>
<td>9</td>
</tr>
</tbody>
</table>

**Table 1:** The mean external/internal diameters and canal shapes of the 1\textsuperscript{st} – 4\textsuperscript{th} metatarsals.
Conclusions

- Intramedullary fixation in the columns of the foot can provide anatomical alignment with stable fixation.
  - 1st metatarsal avg. diameter ~ 9mm
  - 2nd-5th metatarsals avg. was 4.5-5.0mm
  - This data helps to approximate size of fixation needed to achieve maximal screw-endosteal purchase.
References

12. Grant, W.P. Biomechanics of the Charcot foot collapse and rod the medial column of the foot as a beam to salvage the Charcot foot. in: Annual American College of Foot and Ankle Surgeons Scientific Seminar, Orlando, FL; 1997.