The Relationship Between the Distal Nail Target and Alignment of Distal Tibia Fractures

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Disclosures

- Elyse Brinkmann MD, Hobie Summers MD, William Lack MD
  - No disclosures

- Mitchell Bernstein MD
  - Consultant: Ellipse, Smith and Nephew, Synthes
Background / Purpose

- Intramedullary nailing (IMN) of distal tibia fractures has been reported to result in rates of malalignment up to 50%, with valgus being the most common deformity (Janssen 2007, Vallier 2011)

- **Purpose**: to assess the relationship between the distal nail target and alignment for distal tibia fractures treated with IMN
Methods

Retrospective chart review & radiographic review

Inclusions:
- All distal tibia fractures treated with IMN at a single level 1 trauma center from 2005 to 2015

Exclusions:
- Insufficient postoperative imaging
- Adjunctive fixation of the tibia

Alignment was assessed on immediate postoperative radiographs
- Lateral distal tibia angle (LDTA)
- Anterior distal tibia angle (ADTA)

Paley Principles of Deformity Correction 2002
Methods

- The distal nail target was defined as the extrapolated intersection between the nail and the plafond.
Methods

- The **distal nail target** was defined as the extrapolated intersection between the nail and the plafond
  - Recorded as the relative position of the nail (x/y)
  - Grouped into quintiles based on the relationship of the nail target to the joint center on both views
Statistical Analysis

- **Student’s t-test analysis** was used to assess differences in **absolute alignment (ADTA and LDTA)**
  - By distal nail target and surgeon subspecialty

- **Chi-square analysis** was used to assess differences in **incidence of angular deformity >5°**
  - By distal nail target and surgeon subspecialty

- **Statistical significance** was reported for **p < 0.05**
Results

- 135 cases total included in study group
  - 167 cases met all inclusion criteria
  - 32 cases excluded
- 41 cases of any angular deformity > 5° (30.4%)

<table>
<thead>
<tr>
<th>Deformity</th>
<th># of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valgus &gt; 5°</td>
<td>27 (20.0%)</td>
</tr>
<tr>
<td>Valgus &gt; 10°</td>
<td>4 (3.0%)</td>
</tr>
<tr>
<td>Procurvatum &gt; 5°</td>
<td>19 (14.1%)</td>
</tr>
<tr>
<td>Procurvatum &gt; 10°</td>
<td>2 (1.5%)</td>
</tr>
<tr>
<td>Varus &gt; 5°</td>
<td>0</td>
</tr>
<tr>
<td>Recurvatum &gt; 5°</td>
<td>0</td>
</tr>
</tbody>
</table>

* 5 cases (3.7%) had combined valgus and procurvatum
Coronal Alignment

<table>
<thead>
<tr>
<th></th>
<th>Far Medial</th>
<th>Medial</th>
<th>Slight Medial</th>
<th>Joint Center</th>
<th>Slight Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean LDTA</td>
<td>83.7° ± 4.6°</td>
<td>87.0° ± 4.4°</td>
<td>88.1° ± 2.5°</td>
<td>88.9° ± 2.1°</td>
<td>89.6° ± 2.3°</td>
</tr>
<tr>
<td># Valgus &gt;5°</td>
<td>14 (51.9%)</td>
<td>11 (40.7%)</td>
<td>2 (7.4%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td># Valgus &gt;10°</td>
<td>4 (14.8%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- **Nails directed medial to joint center**
  - Demonstrated relative valgus
    - mean LDTA 86.3° vs 89.3°, p < 0.01
  - Demonstrated a higher incidence of valgus >5°
    - 27/81 (33.3%) vs 0/54 (0%), p < 0.01
- **Nails directed far medial**
  - Demonstrated a higher incidence of valgus >10°
    - 4/27 (14.8%) vs 0/108 (0%), p < 0.01
Distal Nail Target and Coronal Malalignment

- Incidence (%)

- Quintiles of Nail Target (Medial to Lateral)
  - Far Medial
  - Medial
  - Slight Medial
  - Joint Center
  - Slight Lateral

- Valgus > 5°
- Valgus > 10°
# Sagittal Alignment

<table>
<thead>
<tr>
<th></th>
<th>Far Anterior</th>
<th>Anterior</th>
<th>Slight Anterior</th>
<th>Joint Center</th>
<th>Slight Posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ADTA</td>
<td>83.9° ± 5.4</td>
<td>82.8° ± 2.7</td>
<td>81.8° ± 1.9</td>
<td>81.1° ± 2.9</td>
<td>80.7° ± 2.7</td>
</tr>
<tr>
<td># Procurvatum &gt;5°</td>
<td>8 (29.6%)</td>
<td>7 (25.9%)</td>
<td>1 (3.7%)</td>
<td>2 (7.4%)</td>
<td>1 (3.7%)</td>
</tr>
<tr>
<td># Procurvatum &gt;10°</td>
<td>2 (7.4%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- **Nails directed anterior to joint center**
  - Demonstrated relative procurvatum
    - Mean ADTA 82.8° vs 81.0°, p < 0.01
  - Demonstrated a higher incidence of procurvatum >5°
    - 16/81 (19.8%) vs 3/54 (5.6%), p = 0.02
- **Nails directed far anterior**
  - Demonstrated a higher incidence of procurvatum >10°
    - 2/27 (7.4%) vs 0/108 (0%), p = 0.04
Distal Nail Target and Sagittal Malalignment

Incidence (%)

- Far Anterior
- Anterior
- Slight Anterior
- Joint Center
- Slight Posterior

- Procurvatum > 5°
- Procurvatum > 10°

Quintiles of Nail Target (Anterior to Posterior)
Secondary Analysis

- 103 out of 135 total cases (76.3%) were performed by one of 5 fellowship-trained orthopaedic traumatologists

<table>
<thead>
<tr>
<th></th>
<th>Traumatologists</th>
<th>Non-Traumatologists</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Total cases</td>
<td>103</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Any deformity &gt;5°</td>
<td>27 (26.2%)</td>
<td>14 (43.8%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Valgus &gt;5°</td>
<td>17 (16.5%)</td>
<td>10 (31.3%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Procurvatum &gt;5°</td>
<td>14 (13.6%)</td>
<td>5 (15.6%)</td>
<td>0.77</td>
</tr>
<tr>
<td>Average LDTA</td>
<td>87.6 ± 3.7</td>
<td>87.1 ± 4.5</td>
<td>0.55</td>
</tr>
<tr>
<td>Average ADTA</td>
<td>81.9 ± 3.1</td>
<td>82.6 ± 3.0</td>
<td>0.30</td>
</tr>
</tbody>
</table>
Discussion / Conclusions

- Our findings parallel those which guide the proximal starting point for IMN of proximal tibia fractures (Buehler 1997, McConnell 2001)

- For IMN of distal tibia fractures, central and slightly posterolateral distal nail targets are associated with low rates of coronal (0%) and sagittal plane (5.6%) deformity >5°
  - The authors recommend avoiding medial and anterior deviation of the distal nail target
We also treat the human spirit.