Simultaneous Acute Femoral Deformity Correction and Gradual Limb Lengthening Using the Retrograde Precice Femoral Nail

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LLRS
Multi-Center Study
14 y Female

- fracture to the right distal femoral physis
- Developed varus deformity and shortening of the right lower extremity
Deformities

- MAD 41mm varus
- mLDFA 102 degrees
- MPTA 88 degrees
- LLD = 24 mm
Fixator Assisted Nailing for Correction of Varus Distal Femoral Deformity

• Blocking screw
2 weeks post op showing initial distraction
3 months post op
Introduction

• Intramedullary lengthening nails have changed the field of limb lengthening
• Lengthen without external fixation
• BUT...Don’t have the capacity to perform deformity correction
Fixator Assisted Nailing

Hypothesis

Question: In patients presenting with femoral deformity and leg length discrepancy:

• What are the results of a fixator assisted retrograde femoral Precice nail?
• What technical considerations will improve accuracy?
Methods

• Retrospective multi-center study (Orlando, New York City, Loma Linda)
• 4 LLRS Surgeons
• Acute deformity correction - fixator assisted
• Gradual lengthening retrograde ILN
Technique
Technique
Technique
Technique
Technique
Results
Results

- 27 patients
- Average patient age = 28 years
- Average BMI = 27
- LLRS-AIM score = 4.6
- Average length of follow-up = 13 months (range 8-28 months)
Results

• **Primary Deformity Type** *(all have Leg Length Discrepancy)*
  – 15 patients with distal femoral valgus
  – 10 patients with distal femoral varus
  – 1 patient with external rotation deformity of femur
  – 1 patient with apex anterior distal femoral deformity
Results

- Mechanical axis deviation = 22 mm
- 7.6 degrees of deformity
- Leg length discrepancy = 31 mm
- PDFA averaged 82 degrees
Results

- Average blood loss = 117.4 ml
- Average surgical time = 167.4 minutes
- 5 mm half pins used in 12 patients
- 6 mm half pins used in 15 patients
- Average number of blocking screws = 1.3
- Average latency 5 days (range 4-10 days)
Results

- Post-op LLD = 0.8 mm
- 25/27 patients corrected within 3 mm (93%)
- Two patients had 6 mm residual LLD
- Average amount of lengthening = 30 mm
- No regenerate bone healing issues
Results

- Average MAD = 6 mm
- 22/27 (81%) had mechanical axis restored to normal (<10 mm)
- 7 degree angular correction (max 15 degrees)
- LDFA = 88 degrees
- PDFA = 84
Knee Range of Motion

• Average Pre Op Extension = 2.4 degrees
• Average Post Op Extension = 1 degree
  – All 27 patients had less than 5 degree flexion contracture
• Average Pre Op Flexion = 126 degrees
• Average Post Op Flexion = 124 degrees

• Mean arc of knee motion = 123 degrees
Results

• Average time to full weight bearing = 89 days
• Paley score:
  – 26 excellent (96%)
  – 1 good
• No infections, fractures, or insufficient regenerate
• No mechanical failure or hardware breakage
• No joint dislocations
Complications

- 4 patients (15%)
  - Premature consolidation (1)
  - Knee flexion contracture (1)
  - Apex ant deformity (1)
  - Posterior tibial subluxation (1)
    - Valgus with one inch LLD (posterior subluxation of tibia resolved with soft tissue releases)
• Compare valgus patients to varus patients
• Pre-op

<table>
<thead>
<tr>
<th></th>
<th>Valgus</th>
<th>Varus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>LDFA (degrees)</td>
<td>81.5</td>
<td>96.7</td>
</tr>
<tr>
<td>LLD (mm)</td>
<td>31.3</td>
<td>30.3</td>
</tr>
<tr>
<td>MAD</td>
<td>23.7</td>
<td>24.1</td>
</tr>
<tr>
<td>LLRS AIM</td>
<td>4.06</td>
<td>4.7</td>
</tr>
</tbody>
</table>
## Results

- **Post-op**

<table>
<thead>
<tr>
<th></th>
<th>Valgus</th>
<th>Varus</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAD (mm)</td>
<td>6</td>
<td>7.3</td>
</tr>
<tr>
<td>LDFA (degrees)</td>
<td>87.3</td>
<td>90.1</td>
</tr>
<tr>
<td>% Desired Length</td>
<td>99.1</td>
<td>100</td>
</tr>
<tr>
<td>Paley Score</td>
<td>93% excellent</td>
<td>100% excellent</td>
</tr>
<tr>
<td># Blocking Screws Used</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Return to OR</td>
<td>3 (20%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>
Results

• Mechanical Axis Deviation 10 mm or more:
  • MAD = 20.4 mm
    – Series average = 23 mm
  • LLD = 30.4 mm
    – Series average = 31 mm
• LLRS AIM score = 3.85
  – Series average = 4.6
• Surgical time = 158 minutes
  • Series average = 167 minutes
Results

• For Mechanical Axis Deviation 10 mm or more:
  – Half pin size:
    • 5 mm half pins used: 4/12
    • 6 mm half pins used: 1/15
  – Number of blocking screws = 0.71
    • 4/17 patients with 0 or 1 blocking screw (24%)
    • 1/10 cases that used 2 or more blocking screws (10%)
Results

• Mechanical Axis Deviation 10 mm or more:
  – Nail Size
    • ½  8.5 mm nails (50%)
    • 3/15 10.7 nails (20%)
    • 1/10 12.5 nails (10%)
  – Nail lengths
    • 215, 230, 230, 330, 355
  – Average time to full weight bearing = 77 days
    • Series average = 89 days
Discussion
Discussion

• Technique allows successful combination of acute and gradual correction without the need for post-operative external fixation with minimal complications

• Paley score: 96% excellent outcomes
Discussion

• All patients had leg lengths restored within normal limits
  – 100% within 6 mm
  – 93% within 3 mm
• No hardware failures
• No regenerate bone healing issues
• Knee range of motion maintained
Discussion

• Mechanical Axis Deviation corrected from 24 mm to 6 mm
  – 81% to normal range

• 85% accuracy of external fixation mediated correction of femoral varus and valgus deformity
Discussion

• Varus or valgus deformity correction demonstrates similar results except return to OR rate

• 3 patients require return to the operating room (11%) for knee flexion contractures – 1 patient developed knee subluxation
Discussion

- Potential technical tips identified to improve outcomes:
  - 6 mm half pins
  - Multiple blocking screws should be used
  - Use the largest nail size possible
  - Avoid over-aggressive return to full weight bearing