Precision of the New Remote Controlled Internal Lengthening Nail
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Introduction
- Indications for bone lengthening
  limb length discrepancy (LLD) due to congenital shortening, growth plate arrest, open fractures with bone loss, fracture nonunions, tumor or osteomyelitis excision, achondroplasia etc.
- Problems with external ring & rod fixators
  - Superficial pins site infections
  - Cumbersome
- Problems with previous internal lengthening nails (ILN; e.g. Albizzia, Fit Bone, ISKD) [1, 2]
  - distraction activated by limb movements
  - inaccurate & unreliable
  - high complication rates (nonunion, premature consolidation, nerve injury, joint contractures etc.)
- Precice® ILN (Ellipse Technologies Inc., Irvine, CA Figure 1) [3]
  - magnet-operated
  - recent FDA approval
  - clinical efficacy not established

Materials and Methods
- Ten femur and seven tibia lengthening cases using the Precice® nail were selected.
- Medical records were reviewed for etiology, patient characteristics, surgery details, distraction process, bone alignment, adjacent joint range of motion (ROM) and any complications.
- Distraction distance measurements were done at every follow up visit using a calibrated digital radiology system (PACS, OnePacs LLC, New York, NY)
- Accuracy of distraction = Distraction measured / Distraction done X 100

Results
A) Accuracy of distraction
At 13.5 weeks follow-up (range, 4-30 weeks), the lengthening was 33.65 mm (range, 14mm-61mm) with an accuracy of 100.7% ± 0.23%

B) Bone alignment

<table>
<thead>
<tr>
<th>BONE</th>
<th>ANGLE</th>
<th>ABSOLUTE CHANGE (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tibia</td>
<td>Proximal femoral angle (PFA)</td>
<td>3</td>
</tr>
<tr>
<td>Proximal femoral angle (PFA)</td>
<td>3</td>
<td>1-5</td>
</tr>
</tbody>
</table>

Note: In five patients with pre-operative anterior femoral bow, the sagittal plane angle was intentionally reduced from 14° (range, 7°-24°) to 7° (range, 3°-13°) to facilitate nail insertion.

C) Maximal temporary loss of joint ROM in early postoperative period

<table>
<thead>
<tr>
<th>MOTION</th>
<th>ABSOLUTE LOSS (degrees)</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Knee Flexion</td>
<td>13</td>
</tr>
<tr>
<td>Knee Extension</td>
<td>0</td>
</tr>
<tr>
<td>Ankle Dorsiflexion</td>
<td>3</td>
</tr>
<tr>
<td>Ankle Plantarflexion</td>
<td>6</td>
</tr>
</tbody>
</table>

D) Complications/ Implant Failures
- All femur cases had excellent bone healing. Two tibia cases required insertion of bone marrow concentrate for delayed bone healing.
- There were no implant failures or major complications.

Conclusions & Discussion
- The new Precice® internal lengthening nails have an accuracy of distraction close to 100%.
- The use of external magnetic controller was straightforward and easy to explain to patients.
- There were no implant failures in our initial series.
- In several patients, realignment of the pre-existing deformity was possible through an osteotomy at the apex of the deformity.
- The hip, knee and ankle ROM were well maintained.
- Iliotibial band release and gastrocnemius recession were helpful in maintaining knee and ankle ROM respectively during lengthening.
- Tibia lengthening was associated with more difficulties than femur.
- A tendency of varus-procurvatum deformity of the femur and valgus-procurvatum deformity of the tibia was successfully prevented by inserting blocking screws into the concavity of the potential deformity.
- Consideration must be given to the length of the thicker nail segment beyond the osteotomy to ensure adequate stability and to prevent iatrogenic deformities.

References
2. Eclipse Technology - Precice nail system [http://www.ellipse-tech.com/?q=ip]