Lengthening and Then Nailing (LATN) with Conventional Intramedullary Nail in Limb Lengthening

Dong Hoon Lee, MD, Ph.D, Keun Jung Ryu MD

Limb Lengthening and Deformity Correction Service
Department of Orthopaedic Surgery, CHA Bundang Medical Center
CHA university, Korea, Republic of.
Limb Lengthening and Then Insertion of an Intramedullary Nail

A Case-matched Comparison

S. Robert Rozbruch MD, Dawn Kleinman BA, Austin T. Fragomen MD, Svetlana Ilizarov MD

Table 3. Clinical results

<table>
<thead>
<tr>
<th>Variable</th>
<th>LATN</th>
<th>Classic</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Followup (months)</td>
<td>40 (8–74)</td>
<td>41 (12–88)</td>
<td>0.9</td>
</tr>
<tr>
<td>Time in frame (weeks)</td>
<td>12 (3–27)</td>
<td>29 (14–55)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ED to frame removal (days)</td>
<td>9.6 (0–35)</td>
<td>130 (45–278)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>EFI (months/cm)</td>
<td>0.5 (0.3–1.1)</td>
<td>1.9 (1–4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BHI (months/cm)</td>
<td>0.8 (0.4–1.3)</td>
<td>1.9 (1–4)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

ED = end distraction; EFI = external fixation index; BHI = bone healing index.
Advantages of LATN over Ilizarov

- **Healing ↑**
- **Full length – diameter nail; stability ↑**
- **Lengthening of deformed bone**
- **Difficult lengthening by impingement ↓**
- **No concomitant use of IF; deep infection ↓**

*Rozbruch SR, CORR, 2008*
LATN: original technique

- ‘Custom made IM nail’ in the original article can limit surgeons to use this technique

- There has been limited reports on the LATN procedure
PURPOSE

1. Describe how we used the conventional IM nail in the LATN procedure
PURPOSE

2. Report the clinical results of LATN

LATN technique with Conventional IM nail (48 segments)

- External fixator index
- Full weight-bearing index
- Time to consolidation
- Callus shape and type
- Alignment
- Complications
MATERIALS and METHODS

- Patients selection

  - Inclusion criteria
    - Familial short stature
    - Skeletally mature
    - No history of medical illness, fracture, soft tissue compromise, bony deformities or infection

  - Exclusion criteria
    - Insufficient preoperative radiographic evaluation
    - Loss of follow up

- 26 patients (52 segments)
- Bilateral tibial lengthening
- Apr 2010 – Jan 2011 (min 2 years f.u.)

- 24 patients (48 segments)
## MATERIALS and METHODS

- **Demographics**

<table>
<thead>
<tr>
<th></th>
<th>LATN technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of tibia (segments)</td>
<td>48</td>
</tr>
<tr>
<td>Age (years)</td>
<td>23 (17-35)</td>
</tr>
<tr>
<td>Sex (M:F)</td>
<td>46:2</td>
</tr>
<tr>
<td>Preoperative height (cm)</td>
<td>157 (145-165)</td>
</tr>
<tr>
<td>BMI (kg/cm²)</td>
<td>22.1 (18.7-27.0)</td>
</tr>
<tr>
<td>Smoking history (Yes:No)</td>
<td>22:26</td>
</tr>
<tr>
<td>Duration of follow up (months)</td>
<td>28.2 (24.8-34.3)</td>
</tr>
<tr>
<td>(after the 1st stage surgery)</td>
<td></td>
</tr>
</tbody>
</table>
Surgical Protocol

The 1st stage surgery

• Direction of pins: similar to the original tech.

• Proximal: 2 pins & 1-2 half pins
  - avoiding the pathway of the nail

• Distal: 3 pins / or 2 pins & 1 half pin

• Osteotomy: Multiple drill hole tech.

• Tibiofibular screw: prox & distal
ETN (EXPERT™ Tibial nail, Synthes)

- Oblique screw holes are within 20mm distal to the nail tip/most distal hole is at 57mm from the tip.

- Every pin (Ilizarov) is inserted below 3cm from the joint line to avoid pathway of oblique interlocking screws.

- Prefer to locate all pins between 3-5cm from joint line.
After the length achieved, correction of the alignment using six-pod fixators

Ortho SUV

Hexapod
2\textsuperscript{ND} STAGE: IM nailing

Larger diameter of proximal aiming arm is necessary to perform IM nailing over EF
Prevention of deep infection

‘IM nailing over long standing EF is at risk of deep intramedullary infection’

1. Preoperative condition

No pin-site infection
ESR/CRP within normal range
Preop Antibiotics
Prevention of deep infection

2. Betadine scrub: betadine spraying and wrapped with the sterilized sheet, one day before the surgery
Prevention of deep infection

3. During the surgery, EF is completely sealed, never touch the EF directly - "No touch technique"
Postoperative protocol

- Full weight bearing was allowed with one cortical consolidation
Evaluations

**Evaluation**

- Final length achieved (mm)
- Distraction rate (mm/days)
- External fixator index (months/cm)
- Deformities during distraction
- Days spent for deformity correction
- Consolidation index (months/cm)
- Callus shape*
- Alignment: during lengthening/after correction
- Full weight-bearing index (months/cm)

**Complications**

Problems, obstacles, and complications#

*Li R, J Orthop Res 2006

# Paley D. Clin Orthop 1990
### RESULTS

- **Radiographic results**

<table>
<thead>
<tr>
<th>Radiographic Evaluations</th>
<th>LATN technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latent periods (days)</td>
<td>7.5 (7-9)</td>
</tr>
<tr>
<td>Distraction rate (mm/days)</td>
<td>0.80 (0.59-1.14)</td>
</tr>
<tr>
<td>Final length achieved (mm)</td>
<td>63 (44-77)</td>
</tr>
<tr>
<td>External fixator index (months/cm)</td>
<td>0.56 (0.39-0.78)</td>
</tr>
<tr>
<td><strong>Consolidation index (months/cm)</strong></td>
<td></td>
</tr>
<tr>
<td>Anterior cortex</td>
<td>0.81 (0.57-1.32)</td>
</tr>
<tr>
<td>Posterior cortex</td>
<td>0.76 (0.57-1.01)</td>
</tr>
<tr>
<td>Medial cortex</td>
<td>0.76 (0.57-1.01)</td>
</tr>
<tr>
<td>Lateral cortex</td>
<td>0.65 (0.47-0.94)</td>
</tr>
<tr>
<td>Full weight-bearing index (months/cm)</td>
<td>0.65</td>
</tr>
</tbody>
</table>
- Radiographic results

Callus shape

<table>
<thead>
<tr>
<th>Shape</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusiform</td>
<td>19 tibiae</td>
</tr>
<tr>
<td>Cylindrical</td>
<td>29 tibiae</td>
</tr>
<tr>
<td>Concave</td>
<td>None</td>
</tr>
<tr>
<td>Lateral</td>
<td>None</td>
</tr>
<tr>
<td>Central</td>
<td>None</td>
</tr>
</tbody>
</table>
## Radiographic results

<table>
<thead>
<tr>
<th>Alignment</th>
<th>Before the 1\textsuperscript{st} stage op.</th>
<th>Maximal deformity</th>
<th>After the 2nd stage op.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPTA</td>
<td>85.6 (81-90)</td>
<td>91.5 (85-96)</td>
<td>87.4 (84-91)</td>
</tr>
<tr>
<td>Procurvatum</td>
<td>-</td>
<td>7.3 (0-18)</td>
<td>-</td>
</tr>
<tr>
<td>Coronal alignment</td>
<td>2.5 varus</td>
<td>-</td>
<td>1.5 valgus</td>
</tr>
<tr>
<td></td>
<td>(10 varus-3 valgus)</td>
<td></td>
<td>(3 varus – 3 valgus)</td>
</tr>
</tbody>
</table>

**Deformities aggravated during lengthening**
- **m/c:** Valgus and Procurvatum
- by computer assisted six-pod system (Ortho SUV\textsuperscript{®}, Hexapod\textsuperscript{®})
- correction period: **ave. 15 days (0-30)**
Radiographic results

- **Valgus deformity** caused during the distraction phase

MPTA 93°

Correction (MPTA 88°)

MPTA 89° (after 2nd stage op)
## Complications – All treated successfully

<table>
<thead>
<tr>
<th>Cx. in details (no. of cases)</th>
<th>Treatments</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impending compartment SD (1)</td>
<td>Emergency fasciotomy</td>
<td>Completely relieved</td>
</tr>
<tr>
<td>Deep infections (2)*</td>
<td>I&amp;D, curettage</td>
<td>No intramedullary</td>
</tr>
<tr>
<td>Superficial infections (8)</td>
<td>IV antibiotics</td>
<td></td>
</tr>
<tr>
<td>Peroneal n Sx (2)</td>
<td>IV antibiotics</td>
<td>Transient</td>
</tr>
<tr>
<td>Fibular-related (1)</td>
<td>Conservative</td>
<td>Superior migration</td>
</tr>
<tr>
<td>Fracture of regenerate</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>IM nail breakage</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

* half pin site(1)/distal interlocking screw site(1)
Conclusion

- The LATN technique can be performed successfully with the conventional IM nail

- Strength & Weakness

  **Strength**
  
  ✓ Fast bone healing
    : healing index, callus type/shape
  
  ✓ Fast full-weight bearing
    : safe FWB with one-cortical consolidation

  ✓ Can gain good alignment

  **Weakness**
  
  ✓ Require ability to correct deformity before the 2nd stage surgery
  
  ✓ Need some technical considerations in IM nailing with the EF in place

  ✓ Need meticulous attention to prevent deep infection during the 2nd stage surgery
Thank you for your attention!