Knee Realignment with Osteotomy

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Disclosure:
I do have a relevant financial relationship and will be discussing products/services of the commercial interests with which relationships exist:
Consultant for Smith and Nephew Inc.
Consultant and Royalties, Small Bone Innovations inc.
Realignment Osteotomy
End Distraction
70% of force is on medial side in single leg stance
  • Adductor moment during gait

With $4^0-6^0$ varus this increases to 90%

(rigid body spring model)
Hsu et al 1990
Source of MAD

MAD

mLDFA = 87°

JLCA = 7°

MPTA = 82°
Most studies suggest overcorrection is desirable and correlates with better results

- Fujisawa point
- Femorotibial angle 10 degrees valgus
- Yasuda et al 1992,
- Coventry et al, 1979
- Fujisawa, 1979
Goal for realignment

- Fujisawa et al, 1979
  - Point 1/3 of way on lateral plateau
- Jakob & Murphy 1992
  - Modified point depending on level of degeneration
- Anatomic angle goal is limiting
Pressure in the medial and lateral compartment

Shear Stress in the medial and lateral compartment

Reisse et al: Virtual osteotomies. Hillstrom lab 2014
25 y/o, bilat. Knee pain
This should last until forever !?!!?
45 y/o active guy with tibial and some joint convergence
2 level deformity
50 year old, active soccer player
Does the Taylor Spatial Frame Accurately Correct Tibial Deformities?

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Abstract

Background  Optimal leg alignment is the goal of tibial osteotomy. The Taylor Spatial Frame (TSF) and the Ilizarov method enable gradual realignment of angulation and translation in the coronal, sagittal, and axial planes, therefore, the term six-axis correction.

Questions/purposes  We asked whether this approach would allow precise correction of tibial deformities.

Methods  We retrospectively reviewed 102 patients (122 tibiae) with tibial deformities treated with percutaneous osteotomy and gradual correction with the TSF. The proximal osteotomy group was subdivided into two subgroups with a varus deformity and from 96° to 85° in patients with a valgus deformity. In the middle osteotomy group, all patients had less than 5° coronal plane deformity and 15 of 17 patients had less than 5° sagittal plane deformity. In the distal osteotomy group, the lateral distal tibial angle improved from 77° to 86° in patients with a valgus deformity and from 101° to 90° for patients with a varus deformity.

Conclusions  Gradual correction of all tibial deformities with the TSF was accurate and with few complications.

Level of Evidence  Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels.
# Preoperative vs. Postoperative MAD: Proximal Group (mm)

Rozbruch et al.: TSF for Tibial Deformity Correction; CORR 2009

<table>
<thead>
<tr>
<th></th>
<th>Preop MAD</th>
<th>Postop Goal 0</th>
<th>Postop Goal Overcorrection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Medial</td>
<td>Lateral</td>
</tr>
<tr>
<td>MAD Medial</td>
<td>39</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>&lt;0.001</td>
<td>0.03</td>
</tr>
<tr>
<td>MAD Lateral</td>
<td>33</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>0.01</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Flexion contracture

- **Osteotomy**
  - Extend at osteotomy site

- **Uni-knee**
  - Remove osteophytes and will gradually regain flexion
Varus
Flexion
IR
Protocol

- **EBI monolateral frame**
  - Varus deformities less than 10 degrees.

**TSF frame**
- Deformities greater than 10 degrees, or associated sagittal and/or axial plane deformities.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Limbs</th>
<th>TSF</th>
<th>EBI Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>93</td>
<td>57</td>
<td>36</td>
</tr>
</tbody>
</table>
Patients were subdivided into two groups:

- **Neutral** (MAD goal of 0 mm).
- **Overcorrected** (MAD goal 10 mm lateral)
# Preoperative vs Postoperative MAD (EBI)

<table>
<thead>
<tr>
<th></th>
<th>Preop MAD (mm)</th>
<th>Postop Goal (Neutral)</th>
<th>Postop Goal (Overcorrection)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Medial</td>
<td>Lateral</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>10-44</td>
<td>0-12</td>
</tr>
<tr>
<td>N =</td>
<td>36</td>
<td>15</td>
<td>8</td>
</tr>
</tbody>
</table>
## TSF deformity parameters

<table>
<thead>
<tr>
<th></th>
<th>Varus</th>
<th>Apex Anterior</th>
<th>Apex Posterior</th>
<th>Internal Rotation</th>
<th>External Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Avg</strong></td>
<td>13 (4-46)</td>
<td>10 (2-30)</td>
<td>8 (5-15)</td>
<td>16 (10-40)</td>
<td>15 (7-25)</td>
</tr>
<tr>
<td><strong>N= 57</strong></td>
<td>19</td>
<td>8</td>
<td>9</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Preoperative vs Postoperative MAD (TSF)

<table>
<thead>
<tr>
<th>Preop MAD</th>
<th>Postop Goal (Neutral)</th>
<th>Postop Goal (Overcorrection)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medial</td>
<td>Lateral</td>
</tr>
<tr>
<td>Avg</td>
<td>39 (10-75)</td>
<td>4 (0-30)</td>
</tr>
<tr>
<td>N= (57)</td>
<td>(23)</td>
<td>(6)</td>
</tr>
</tbody>
</table>
Poor skin

MAD
Results

- There was no significant change in ankle or knee range of motion.
- There was one complication which was a collapse.
Our treatment algorithm of treating proximal tibial varus deformities of less than 10 degrees with EBI monolateral frames and more than 10 degrees alone or in association with any of the sagittal or axial plane deformity with TSF frame is safe and highly effective.
24 deg deformity
8 deg femur
8 deg joint
8 deg tibia

Osteotomy or TKR
ACL Insufficiency
• Decrease posterior slope

PCL Insufficiency
• Increase posterior slope

LCL Laxity
• Correct varus

MCL laxity
• Correct valgus
35 year old, femur + tibial deformity, LCL laxity, LLD, ACL laxity
65 year old, femur deformity, some joint convergence
25 y/o, valgus, knee pain, lat compt DJD on scope, femur + tibia
46 y/o, bilat, medial knee pain. Uni done 1 yr ago
Pain resolved; uni was poor choice
“Healing is not science but the intuitive art of wooing nature”

Osteotomy is more like gardening than carpentry
Realignment osteotomy

- Alternative to arthroplasty
- Prevent arthrosis when done early
- In presence of arthrosis
  - Improve pain
  - Delay progression
  - Make arthroplasty easier in many cases
- Severe arthrosis
  - Improve pain, gait, balance
Future of joint reconstruction and joint preservation

- Biological solutions
- Mechanical principles
  - “You can’t cheat the laws of physics”
Future

- Knee distraction
- Improved biologics
  - Stem cells
  - Growth hormone
  - Cartilage growth factors
Thank You

www.hss.edu/limblengthening