Minimally Invasive Plate Fixation (MIF) of distal tibia

VASU PAI

Hawke’s Bay District Health Board
HASTINGS
FRACTURE TIBIA

- Diaphyseal fractures: IM rod fixation
- Metaphyseal fractures: Not ideal for rod
- Minimally invasive Fixation is a preferred procedure (AO advanced course 2002, Queenstown)
<table>
<thead>
<tr>
<th>Classic Open Fixation</th>
<th>Minimal Invasive Fixation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Direct fracture exposure &amp; Direct reduction</td>
<td>• Untouched fracture exposure &amp; Indirect reduction</td>
</tr>
<tr>
<td>• Subperiosteal dissection</td>
<td>• Epiperiosteal dissection</td>
</tr>
<tr>
<td>• Anatomic reduction</td>
<td>• Anatomic alignment</td>
</tr>
<tr>
<td>• Rigid fixation</td>
<td>• Stable but not rigid fixation</td>
</tr>
<tr>
<td>• Primary bone healing</td>
<td>• Healing by callus formation</td>
</tr>
</tbody>
</table>
MIF: Why “Biological”? 

Classic fixation: Interrupts 80% of perforating arteries

MIF: None of these arteries are damaged

Farouk: J Orthop Trauma 13:401-6, 1999
MIF

Advantages:  Low Non-union, Delayed Union
             Low infection

Disadvantages:  Technically demanding
                 Image intensifier
                 Radiation
Materials and Methods

- Jan 2000- March 2002, 18 cases
- Single surgeon (Pai)
- Age: 41 (16-72 yrs)
- Male : Female 12:6
Mechanism of Injury

- Slip & fall 7
- Object falling on the leg 1
- MVA 4
- Fell off a bike 1
- Rugby 2
- Fall from a height 2
- Assault 1
Fracture Personality

- Soft tissue injury (Tscherne & Gotzen)
  - I 15
  - II 3

- Displacement
  - <30 3
  - 30-50 12
  - >50 3

- Comminution: A = 3
  - B = 12
  - C = 3
Classification of fracture tibia

- Transitional fracture (M-D jn)
- Distal Half of the Distal Third

Transition fracture: Johner and Wruhs classification (9 patients)

Distal tibial fractures: AO Classification (9 patients)
FRACTURE DISTAL END OF THE TIBIA
(AO comprehensive classification)

A1 = 0
A2 = 1
A3 = 5
B1 = 0
C1 = 3

A1 A2 A3
B1 B2 B3
C1 C2 C3
Johner and Wruhs classification: Of Transition fracture

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (No comminution)</td>
<td>2</td>
</tr>
<tr>
<td>B (With a butterfly)</td>
<td>5</td>
</tr>
<tr>
<td>C (Grossly comminuted)</td>
<td>2</td>
</tr>
</tbody>
</table>
Technique

- Soft tissue consideration
- Pre-operative planning
- Role of EF or distractor: Not used
- Tourniquet used; cephamandol 1g at induction
Technique

Step 1: Stabilization of fibula (Fracture distal end of tibia)

* Gives the correct length
* Acts as a fulcrum for tibial alignment
II: Stabilization of Tibia:

*Plate length (at least 4 bicortical fixation)

- AO (Bent & twisted) / Zimmer plate
- (Contoured)
Stabilization of Tibia (cont.)

Skin incision

Tunnel is created

Plate is passed
Stabilization of Tibia (cont.)

• I  Distal screws: Most distal

• II  Reduction by axial traction +/- Reduction clamp

• III  Alignment check: Valgus/varus/rotation

• III  3 proximal

• IV  Rest of the distal screws

• V  IFS: when reduction is perfect
Surgery

• Fixation:
  - Tibia only  8
  - Tibia and Fibula  10

• Type of fixation
  - AO  DCP plate  4
  - AO periarticular plate  2
  - Zimmer Periarticular plate  12

• Additional fixation
  - IFS  11
  - Supplemental fixation  4
Post-Operative

• Average duration: 65min (45 to 90)
• Radiation time: 50 s
• Average Hospital stay: 5 days (3-10)

• Post-Op:
  Back slab 2 weeks
  ROM Brace (TWB) 6 weeks
  ROM Brace (PWB to FWB) 6-8 weeks
Follow-up

Average 12 months (6-24)

Included for study: 16/18

2 were excluded:

• Transferred to PN
• Refused to participate in the study
### Clinical Criteria (Johner, CORR 1985:178:9)

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pain</strong></td>
<td>None</td>
<td>Occasional</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td><strong>Gait</strong></td>
<td>Normal</td>
<td>Normal</td>
<td>Minimal limp</td>
<td>Significant limp</td>
</tr>
<tr>
<td><strong>ROM: Knee, Foot</strong></td>
<td>Normal</td>
<td>&gt;80%</td>
<td>&gt;75%</td>
<td>&lt;75%</td>
</tr>
<tr>
<td><strong>Work</strong></td>
<td>Possible</td>
<td>Limited</td>
<td>Severely limited</td>
<td>Impossible</td>
</tr>
<tr>
<td><strong>Hobbies</strong></td>
<td>Possible</td>
<td>Limited</td>
<td>Severely limited</td>
<td>Impossible</td>
</tr>
</tbody>
</table>
## Radiological Criteria

<table>
<thead>
<tr>
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<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varus/valgus</td>
<td>None</td>
<td>2-5*</td>
<td>6-10*</td>
<td>&gt;10*</td>
</tr>
<tr>
<td>Anterior/Post</td>
<td>0-5*</td>
<td>5-10*</td>
<td>11-20*</td>
<td>&gt;20*</td>
</tr>
<tr>
<td>Shortening</td>
<td>&lt;5mm</td>
<td>6-10mm</td>
<td>11-20mm</td>
<td>&gt;20mm</td>
</tr>
</tbody>
</table>
Clinical (N = 16)

- Excellent: 9 (56%)
- Good: 5 (31%)
- Fair: 1 (6%)
- Poor: 1 (6%)
Results

• A. PAIN : Minimal or No Pain 15 (96%)
  Moderate pain 1

• B. MOBILITY: Walk unlimited 9 (55%)
  Walk slightly limited 7

• C. WORK (20 WKS) 14 (87%)

• D. HOBBIES 13 (81%)
E. ROM: Knee/Ankle/Subtalar

Normal movement: 10/16

Slight limitation of ankle: 4/16

Moderately stiff hindfoot: 2/16

D. Rotational deformity: 10-20° 2

>20° 1 (Poor)
Failure: Revised to rod fixation

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>&lt;10°</td>
<td>15</td>
</tr>
<tr>
<td>10-20°</td>
<td>2</td>
</tr>
<tr>
<td>&gt;20°</td>
<td>1</td>
</tr>
</tbody>
</table>
Radiological

- Valgus-Varus alignment
  - Excellent: 12
  - Good: 6
Excellent alignment

N = 12

Valgus-Varus  0º
Ant-Post    0º
Good alignment

Valgus-varus  $< 5^\circ$

Ant-Posterior  $< 5^\circ$

$N = 6$
# Healing time (16/17)

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 wks</td>
<td>1</td>
</tr>
<tr>
<td>8 wks</td>
<td>4</td>
</tr>
<tr>
<td>16 wks</td>
<td>9</td>
</tr>
<tr>
<td>20 wks</td>
<td>2</td>
</tr>
<tr>
<td>24 wks</td>
<td>1</td>
</tr>
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</table>
### Complication

- **Delayed union**  
  1/18  

- **Mal-alignment (Rotational)**  
  3/18 (one > 20*)

- **Stiffness**  
  2/17

- **Saphenous N irritation**  
  1/18

- (None had: Deep infection, DVT, Non-union, compartment syndrome)
Conclusion

• Majority of cases healed well within 4 months

• Clinical and radiological results were excellent-good in 15/16 patients
• Both AO and Zimmer plates work well.

• AO plate: Needs proper bend and twist to prevent external rotation deformity

• Complications: Wound problem, infection and nonunion are negligible
Conclusion (Cont.)

• Minimally invasive plate is an ideal treatment for the complex distal tibial fractures