Surgical Outcomes of Indirect Reduction and Anterior to Posterior Fixation for Posterior Fragment in Trimalleolar Ankle Fracture

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My disclosure is in the Final AOFAS Program Book. I have no potential conflicts with this presentation.
Introduction

- **Trimalleolar Fracture**
  - 7~40 % of Ankle Fracture
    - Incidence of Ankle Fracture: 0.01~0.02%/year
  - High Rate of Post-Traumatic Ankle OA

- **Controversies for Post. Malleolar Fragment**
  - Indications for Operative Treatment
    - Suggestion of Some Clinical Studies
    - ≥ 25~33% of articular surface
  - Fixation Methods
    - Ant. To Post. Screws / Post. Plate / Post. To Ant. Screws
  - Reduction Techniques
    - Direct Open / Indirect (Ligamentotaxis, Percutaneous by Clamp or Others)
Purpose

- To evaluate & compare the results of post. Malleolar fragment whether it is fixed Ant. to Post. or Not fixed
- To evaluate & compare the outcomes according to the articular surface congruency

Study Design

- Retrospective comparative study
- Period: March 2004 ~ July 2010
- Single Surgeon Series
- Exclusion Criteria
  - Pathologic Fx. / Open Fx. / Pilon Fx.
  - Post. → Ant. Fixation of Post. Malleolar Fragment
Materials and methods

- **Patients Demographics**
  - 28 Males / 24 Females
  - Mean Age : 54.4 years (20~86)
  - Mean F/U : 54.7 months (12~89)

- **Operative Technique**
  - Anatomical Reduction & Stable Fixation of Med. & Lat. Malleolar Fragment
  - Post. Malleolar Fragment Reduction
    - Indirect Reduction (Ligamentotaxis or Percutaneous)
  - Cannulated Screw Insertion from Ant. to Post.
Materials and methods

- **Clinical Evaluations**
  - American Orthopaedic Foot & Ankle Society (AOFAS) hindfoot-ankle score
  - Olerud & Molander (O&M) score
  - Recovery Time to Pre-Injury State
  - Subjective Satisfaction
    - Excellent/Good/Fair/Poor

- **Radiologic Evaluations**
  - Post. Malleolar Fragment Size (%)
  - Reduction Status
    - Displace $\leq$ 2mm $\rightarrow$ Congruent
  - OsteoArthritis (OA) score
    1. Osteophytes
    2. Joint Space Narrowing
    3. Deformity

- **Statistical Analysis**
  - SAS version 9.1 (SAS Institute Inc, Cary, NC, USA)
  - Mann-Whitney U-test
  - $P < 0.05 \rightarrow$ Statistically Significant
Results

Clinical results of the patients for fixated group (A) and non-fixated (B).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group A</th>
<th>Group B</th>
<th>p-value(&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AOFAS hind-foot Score</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain score</td>
<td>35.00 (20~40)</td>
<td>35.63 (20~40)</td>
<td>0.879</td>
</tr>
<tr>
<td>Function score</td>
<td>45.20 (30~50)</td>
<td>46.06 (32~50)</td>
<td>0.899</td>
</tr>
<tr>
<td>Total score</td>
<td>89.90 (65~100)</td>
<td>91.69 (62~100)</td>
<td>0.825</td>
</tr>
<tr>
<td><strong>Olerud &amp; Molander Score</strong></td>
<td>88.50 (55~100)</td>
<td>92.03 (25~100)</td>
<td>0.286</td>
</tr>
<tr>
<td><strong>Osteoarthritis Score</strong></td>
<td>0.85 (0~2)</td>
<td>0.78 (0~2)</td>
<td>0.695</td>
</tr>
<tr>
<td><strong>Recovery Time (weeks)</strong></td>
<td>22.60 (8~48)</td>
<td>18.25 (8~48)</td>
<td>0.214</td>
</tr>
</tbody>
</table>
### Subjective satisfaction of the patients for fixated group (A), non-fixated (B).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group A (n=20)</th>
<th>Group B (n=32)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>9</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>Good</td>
<td>6</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Fair</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Poor</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

### Clinical results of the patients according to the postoperative reduction status

<table>
<thead>
<tr>
<th>Postoperative reduction</th>
<th>&lt; 2mm (n=41)</th>
<th>≥ 2mm (n=11)</th>
<th>p-value(&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>16</td>
<td>4</td>
<td>0.568</td>
</tr>
<tr>
<td>Group B</td>
<td>25</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>AOFAS hind-foot Score</td>
<td>92.12 (62~100)</td>
<td>86.81 (70~100)</td>
<td>0.568</td>
</tr>
<tr>
<td>Olerud &amp; Molander Score</td>
<td>91.59 (25~100)</td>
<td>87.27 (55~100)</td>
<td>0.077</td>
</tr>
<tr>
<td>Osteoarthritis Score</td>
<td>0.73 (0~2)</td>
<td>1.09 (0~2)</td>
<td>0.099</td>
</tr>
<tr>
<td>Fragment size (%)</td>
<td>31.00 (7.27~55.56)</td>
<td>29.32 (17.63~48.93)</td>
<td>0.568</td>
</tr>
<tr>
<td>Recovery Time (weeks)</td>
<td>18.54 (8~48)</td>
<td>25.46 (12~48)</td>
<td>0.048</td>
</tr>
</tbody>
</table>
Discussion

- Posterolateral Approach, Direct Reduction, & Buttress Plate
  ➔ Good Anatomic Reduction, But, No Clinical Outcomes
    - Abdgelgawad et al. JFAS, 2011

- Increasing trend to direct ORIF of Post. Malleolar fractures
  ← Focus on Anatomic Reductions of all Periarticular fragments
    - Gardner et al. FAI, 2011

- Restore Med. & Lat. Constraints > Articular Surface
  ← Provide the Majority of Ankle Stability
    - Van den Berkerome et al. J trauma, 2009
    - Stiehl et al. J trauma, 1993
    - Harper et al. JBJS Am, 1988

- Anatomic reduction patients did not have better clinical results than non-anatomic reduction patients
  - Mingo-Robinet et al. JFAS, 2011

- Anatomic reduction & rigid fixation of posterior malleolar fragment did not entirely return the dynamic contact stress distribution to normal
  - Fitzpatrick et al. JOT, 2004
After Less Invasive Indirect Reduction, Ant. to post. fixation might be sufficient fixation method for significant posterior malleolar fragment.

Clinical outcomes were not affected by the reduction status of post. malleolar fragments.


