INTERCONDYLAR DISTAL HUMERUS FRACTURE TECHNIQUES

Mark A. Mighell, MD

DJO Surgical
Royalties, Speakers Bureau, Paid Consultation, Research Support as PI

Stryker
Paid Consultation

OBJECTIVES

Review historic and modern literature to develop an evidence-based approach to intraarticular distal humerus fractures.

Review illustrative case complications to guide treatment plan.

DISCLOSURES

DJO Surgical
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Stryker
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Anatomic Considerations

- The medial and lateral columns of the distal humerus are fastened by the articular distal humerus.
- Repair of distal humerus fractures follows this columnar concept.

Anatomic Considerations

- The articular portion of the distal humerus is tilted into 4-8 degrees of valgus and approximately 40 degrees of flexion.

Anatomic Considerations

- [Reference to the Journal of Bone and Joint Surgery article on the anatomy of the adult elbow]
Anatomic Considerations

» Posterior circulation of the elbow

» Coronal section of vasculature demonstrating zone of hypovascularity within the trochlear groove

The radial nerve pierces the lateral intermuscular septum approximately 10 cm proximal to the articular surface (9.4 cm women, 10.0 cm men).

The distance from the articular surface to the radial nerve within the spiral groove measures approximately 15 cm.

Before 1960, non-operative management was the recommended treatment.

"Bag of bones" treatment – sling with early mobilization.
Over the last 25 years rigid internal fixation has been advocated to restore painless, functional elbow motion.

O’Driscoll JSES 2005;14:186S-194S.

Patient position is either lateral decubitus or prone (pictured) depending on preference.

Multiple approaches have been described
- Olecranon Osteotomy, the “work-horse” of intraarticular fixation [MacAusland JAMA 1915.]
- Triceps splitting [Van Gorder JBJS 1940.]
TREATMENT

Exposure was independent of elbow side (Mann-Whitney test, P < .05).

Visualization of the capitellar surface was best achieved with the olecranon osteotomy approach and was very limited with the other 2 approaches. None of the approaches provided good access to the anterior articular surface of the trochlea or the radial head (Figure 3). All 3 approaches provided sufficient exposure to the medial and lateral columns of the distal humerus to allow plate osteosynthesis.
TREATMENT

- No difference between triceps splitting and olecranon osteotomy in effect on extensor strength
- Both approaches lead to extensor strength measuring 75% of uninvolved extremity.

McKee et al. JBJS 2000;82:1701-7.

TREATMENT

- Low rates of olecranon nonunion have been reported with use of trans-olecranon approach
  - 1/34 [Jupiter et al. JBJS 1985]
  - 2/33 [Henley et al. JOT 1987]
  - 1/72 [Wildburger et al. JOT 1991]
  - 0/44 [Ring et al. JOT 2004]
  - 0/67 [Coles et al. JOT 2006]
  - 1/5 [Sanchez-Sotelo et al. JBJS 2007]

Tenets of Fixation

Intercondylar Fractures of the Humerus

An Operative Approach

By Jesse B. Jupiter, M.D., URS Meff, M.D., Peter Holzach, M.D., and Martin Huguenin, M.D., Basel, Switzerland
Tenets of Fixation

Anatomic reduction of the trochlea based on its relationship to the olecranon.

Temporary K-wire fixation of the supracondylar region is converted to rigid fixation with plate and screw construct.

Internal Fixation of the Distal Humerus: A Biomechanical Comparison of Methods

David L. Heft and *Robert N. Hotchkiss

Department of Orthopedic Trauma, University of South Florida, Florida Orthopedic Institute, Tampa, Florida, and Department of Orthopedic Surgery, University of Texas at San Antonio, San Antonio, Texas, U.S.A.
Tenets of Fixation

- Two orthogonal plates provided more rigid fixation than Y-plate or crossed-screw configuration.
- Approximately 75% of nonunions are due to inadequate internal fixation.
- This study did not compare parallel plate configuration.

Helfet and Hotchkiss JOT 1990
Tenets of Fixation

- A 23-year-old female fell rollerblading, sustaining an open distal humerus fracture. She had undergone ORIF, and was referred due to pain and failed fixation.

Tenets of Fixation

- Revision ORIF was complicated by wound dehiscence requiring I&D.
A 57 y male sustained injuries including an open distal humerus fracture in a parachute accident. He was referred approximately 5 months post-op for non-union and failure of fixation.

At most recent follow up 32 months after the injury he reports no pain and has ROM 10-120 degrees.
Tenets of Fixation

Orthogonal plating more rigid than dual posterior plates.

No significant difference between standard compression plating versus locked plating.

Korner et al. JOT 2004

Complex Distal Humeral Fractures: Internal Fixation with a Principle-Based Parallel-Plate Technique

By Joaquim Sanchez-Sotelo, MD, PhD, Michael S. Teipen, MD, and Vincent W. O’Brien, MD, MS

Inquiries should be referred to the Department of Orthopaedic Surgery, Maine Medical Center, Portland, Maine.
**Tenets of Fixation**

- Based on principle of restoration of the keystone of an arch.
- Standard AO/ASIF fixation with 90/90 plating often leads to inadequate fixation of the articular fragments.

*Sanchez-Sotelo et al. JBJS 2007*

**Principle-Based Fixation Techniques**

- Eight technical objectives derived from two principles
  - Maximizing fixation in the distal fragments
  - Ensuring that all fixation in the distal segment contributes to stability at the supracondylar level

**Eight Technical Objectives**

**Articular Segment**

1. Screws should pass through the plate
2. Each screw should engage a fragment in the opposite side that is also fixed to a plate
3. An adequate number of screws should be placed in the distal fragments
4. Each screw should be as long as possible
5. Each screw should engage as many articular fragments as possible
6. The screws should lock together by interdigitation

*Therefore creating a fixed-angle structure and linking the columns together*
Eight Technical Objectives

Plate Selection

7. Plates should be applied such that compression is achieved at the supracondylar level for both columns

8. Plates used must be strong enough to resist breaking or bending before union occurs at the supracondylar level

Precontoured Parallel Plate Fixation of AO/OTA Type C Distal Humerus Fractures

- 32 OTA Type C Dist Hum Fxs
- ORIF – Precontoured bicolumn parallel plating system
- Mean Results @ 27 months:
  - Arc of elbow flexion/extension 97°
  - Mayo Elbow Performance Score: 82 points
  - DASH: 24 points

24 Total Complications!
- 17 Patients (That’s 53%)
- 5 were Post-Op Nerve Injuries (16%)
Reporting of clinical follow-up has not followed a uniform grading system, making comparison difficult.

### Clinical Results

<table>
<thead>
<tr>
<th>Study</th>
<th>#Pts</th>
<th>#Open</th>
<th>Avg f/u (mo)</th>
<th>#IW Failure</th>
<th>Motion Arc</th>
<th>Result/Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jupiter (JBJS 1985)</td>
<td>34</td>
<td>14</td>
<td>68</td>
<td>1</td>
<td>108°</td>
<td>79%</td>
</tr>
<tr>
<td>Henley (JOT 1987)</td>
<td>33</td>
<td>14</td>
<td>18.3</td>
<td>5</td>
<td>107°</td>
<td>92%</td>
</tr>
<tr>
<td>Wildburger (JOT 1991)</td>
<td>72</td>
<td>21</td>
<td>46.8</td>
<td>5</td>
<td>NR</td>
<td>89%</td>
</tr>
<tr>
<td>McKee (JBJS 2000)</td>
<td>25</td>
<td>Excl</td>
<td>37</td>
<td>NR</td>
<td>108°</td>
<td>NR</td>
</tr>
<tr>
<td>Pajarinen (JSES 2002)</td>
<td>18</td>
<td>5</td>
<td>24.7</td>
<td>2</td>
<td>107°</td>
<td>55.6%</td>
</tr>
<tr>
<td>Russell (JOT 2006)</td>
<td>24</td>
<td>8</td>
<td>48.5</td>
<td>0</td>
<td>98°</td>
<td>NR</td>
</tr>
<tr>
<td>Sanchez-Sotelo (JBJS 2007)</td>
<td>32</td>
<td>14</td>
<td>24</td>
<td>0</td>
<td>98°</td>
<td>59%</td>
</tr>
<tr>
<td>Steinmann (JOT 2009)</td>
<td>33</td>
<td>10</td>
<td>27</td>
<td>0</td>
<td>97°</td>
<td>69%</td>
</tr>
</tbody>
</table>
In our study, despite the superimposed comorbidities, patients treated with TEA scored higher (as determined by the Mayo Elbow Performance score) than the 75% of patients successfully treated with osteosynthesis.

Case Example

14 year old female injured while wakeboarding.

Low transcondylar fracture with nondisplaced intracondylar split

Strategy:

1. Stabilize nondisplaced intracondylar split.
Case Example

Strategy:
2. Reduce column with the least amount of comminution & best key to allow for stability

Case Example

Treated with ORIF of distal humerus

Case Example

Postoperative Range of Motion
**Conclusions**

» Adherence to general principles of rigid fixation is key in treating intraarticular distal humerus fractures.

» While 90/90 plating has been the guideline recommended by AO, parallel plating has been shown to be an effective method of fixation.

**Conclusions**

» Patients with rheumatoid arthritis who present with a distal humerus fracture and pre-existing inflammatory arthropathy are best treated with primary TEA.

» In women over the age of 65, primary TEA should be considered, especially if rigid fixation proves difficult to achieve.

**Thank You**