Fractures of the Radial Head: Excision, fixation or replacement?

Andreas Panagopoulos, MD, PhD
Assistant Professor
Patras University Hospital
Objectives

- Anatomy and biomechanics
- Epidemiology & classification
- Complex patterns of injury
- Treatment algorithm
- Long term outcomes
Overview

Historically, the radial head was believed to be expendable.

..... is universally appreciated as a vital elbow structure for forearm and elbow stability
Anatomy

Lateral

Medial
Stability

- Ulnohumeral articulation
- Radiohumeral articulation
- FLEXOR tendons
- EXTENSOR tendons

AMCL

ULCL
Epidemiology

2-5% of all fractures
33% of elbow fractures
15-20% involve the neck
50% is associated with another injury

10% of RH associated with elbow dislocation
Biomechanics

• **Force transmission**
  - 60% of load applied to hand

• **Stability**
  – 30% resistance to valgus stress
  – *Secondary stabilizer in MCL deficiency*

• **Rotational motion of the forearm**
Biomechanics

- RH resection overloads the coronoid process

- the elbow then depends on the MCL to prevent valgus deformity

- if interosseous membrane is disrupted the radius is proximally migrate

- for each mm of radial shortening, the distal ulnar load increases by approximately 10%.
Kinematics and stability of the fractured and implant-reconstructed radial head

James A. Johnson, PhD, a,b,c Daphne M. Beingessner, MD, c Karen D. Gordon, PhD, c Cynthia E. Dunning, PhD, a,b,c Rebecca A. Stacpoole, MSc, c and Graham J. W. King, MD, a,b,c London, Ontario, Canada

(J Shoulder Elbow Surg 2005;14:195S-201S.)
Fixation Versus Replacement of Radial Head in Terrible Triad

Is There a Difference in Elbow Stability and Prognosis?

Tyler Steven Watters MD, Grant E. Garrigues MD, David Ring MD, PhD, David S. Ruch MD

HANGING ARM TEST
Proximal radial drift following radial head resection

Alison Schiffert, MD\textsuperscript{a}, Stephen P. Bettwieser, BA\textsuperscript{a}, Christina A. Porucznik, MSPH, PhD\textsuperscript{b,c}, Julia R. Crim, MD\textsuperscript{a}, Robert Z. Tashjian, MD\textsuperscript{a,c,*}

J Shoulder Elbow Surg (2011) 20, 426-433

Medial drift

Posterior drift
13 pt with RH excision
72 m postoperative
mean resection length 18 mm
significant migration both medially & posteriorly
> 2 cm of radial resection > posterior drift

Only with **dislocation** there were worse functional outcomes
Classification

- Another fracture
- Ligamentous injury
Classification

Mason
Radial head fractures — update on classification and management

ORTHOPOEDICS AND TRAUMA 26:2

Vinod Kumar
William Angus Wallace

The modified Mason classification of radial head fractures

Mason type

Type 1  Minimally displaced fracture, no mechanical block to forearm rotation, Intra-articular displacement < 2 mm

Type 2  Fracture displaced > 2 mm or angulated, possible mechanical block to forearm rotation

Type 3  Severely comminuted fracture, mechanical block to motion

Type 4  Radial head fracture with associated elbow dislocation

\(^a\) As modified by Hotchkiss.
Comminuted radial head fractures: aspects of current management

Charalambos P. Charalambous, MSc, FRCS (Tr & Orth)\(^a,\^\ast\),
John K. Stanley, Mch Orth, FRCS Ed, FRCSE\(^b\), Simon P. Mills, MBChB\(^c\),
Mike J. Hayton, FRCS (Tr & Orth)\(^b\), Anthony Hearnden, FRCS (Tr & Orth), FFSEM\(^b\),
Ian Trail, MD, FRCS\(^b\), Olivier Gagey, MD, PhD\(^d\)

J Shoulder Elbow Surg (2011) 20, 996-1007
Documentation of Associated Injuries Occurring With Radial Head Fracture

Roger P. van Riet MD, PhD, Bernard F. Morrey MD

Table 2. Comprehensive classification of radial head fracture with description of associated injuries*

<table>
<thead>
<tr>
<th>Radial head fracture (Mason) type</th>
<th>Associated injury suffixes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I–III</td>
<td>c = coronoid fracture</td>
</tr>
<tr>
<td>Articular injuries</td>
<td>o = olecranon fracture</td>
</tr>
<tr>
<td>Ligamentous injuries</td>
<td>m = medial collateral ligament</td>
</tr>
<tr>
<td></td>
<td>l = lateral collateral ligament</td>
</tr>
<tr>
<td></td>
<td>d = distal radioulnar disruption</td>
</tr>
</tbody>
</table>

*For detailed description of injuries, please refer to the original article.
Imaging

Greenspan-Norman radiocapitellar view

CT scan
Magnetic resonance imaging findings in 46 elbows with a radial head fracture

Laurens Kaas¹,², Jeroen L Turkenburg³, Roger P van Riet⁴, Jos P A M Vroemen⁵, and Denise Eygendaal¹

<table>
<thead>
<tr>
<th>Associated injury</th>
<th>Mason type I (n = 17)</th>
<th>Mason type II (n = 23)</th>
<th>Mason type III (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCL</td>
<td>8</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>MCL</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Capitellar injury</td>
<td>-</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Loose osteochondral fragment</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Bone bruise lateral epicondyyle</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Coronoid fracture</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Any type of associated injury</td>
<td>12</td>
<td>17</td>
<td>6</td>
</tr>
</tbody>
</table>
Patterns of Traumatic Elbow Instability With Fracture

Dislocation Injuries

Dislocation

Terrible Triad

Dislocation + radial head fracture

Olecranon fracture - Dislocation

Varus posteromedial rotational instability

Disruption Injuries

Anterior

Posterior
RH resection + dislocation

65% severe elbow arthrosis in 14 yrs. *Josefsson; CORR 246, 1989*

92% elbow arthrosis (30% severe), 10yrs *Morrey CORR, 216, 1989*
Treatment options

- Non-operative treatment
- Fragment excision
- Radial head excision
- Internal fixation
- Allograft implantation
- Arthroplasty
Decision-making

fragment number,
displacement,
articular surface,
age & bone quality,
dislocation,
associated ligamentous injury,
associated elbow fractures
Non-operative treatment

Mason type I fractures

Mason type II, without block or articular incongruity

Fractures >1/3 of the articular surface: later displacement
Management of Mason type 1 radial head fractures: a regional survey and a review of literature

Samer S. S. Mahmoud · Abdul Nazeer Moideen · Rahul Kotwal · Khitish Mohanty

- aspiration within 6 h of injury
- immobilization in broad arm sling for 48 h
- active mobilization and extension stretching exercises
- follow up at 1 week: discharged to physiotherapy
- clinical and radiological review in 6 weeks (if no improvement)
Fragment excision

**mechanical block**
(RH fragments or cartilagenous pieces)

Not always visible in plain x-rays

Fragments < 1/3 of the radial head

Fragments 1/4 to 1/3 of the capitellum

Radial head excision

Avoid acute excision

No in ligamentous injury

3 or more fragments

Comminution of the RH neck

Elderly, low demand patients

As salvage procedure

Maintenance of radial head height is important in allowing ligamentous healing at the correct length
Radial head excision

Chronic ulnar wrist pain,
Instability,
Elbow stiffness,
Loss of strength,
**Degenerative arthritis**
Cubitus valgus,
Heterotopic calcification,
Myositis ossificans,
Resection arthroplasty for radial head fractures: Long-term follow-up

Petrea P. Iftimie, MD*, Jaume Calmet Garcia, MD, PhD, Ignacio de Loyola Garcia Forcada, MD, PhD, Jose Eduardo Gonzalez Pedrouzo, MD, PhD, Josep Giné Gomà, MD, PhD

51 RH excisions
27 pt (20 m, 7 f)
mean age 37 (18-61)
5 type II, 16 type III, and 6 type IV.
mean follow-up 17 years (10-24)
Mayo & DASH scores

22 patients excellent (81%)
4 patients good (15%)
1 patient fair (4%)
Radial head fixation

Mason II & III fractures

Lateral approach

No more than 3 fragments

Small screws, Hebert screws

Low profile special plates

“Safe” zone

Ligament repair, associated injuries
Implant selection
Anatomic Fit of Six Different Radial Head Plates: Comparison of Precontoured Low-Profile Radial Head Plates

Klaus Josef Burkhart, MD, Tobias E. Nowak, MD, Yoon-Joo Kim, MD, Pol M. Rommens, PhD, Lars P. Müller, PhD
110° arc on the posterolateral aspect of the radial head

With the wrist in neutral, the zone lies between 2 longitudinal lines drawn from Lister’s tubercle and the radial styloid proximally.
Complications

**Early**
- inadequate fixation,
- hardware malposition,
- injury to the PIN
- Head misshapen
- Delayed healing - non union
- Osteonecrosis

**Late**
- hardware prominence
- elbow stiffness
- Need for plate removal (~ 6 months)
- LCL repair NO supination for 4-6 weeks
- Loss of terminal extension
16 patients Mason II
average 22 years postop
screws (11 patients) or plates (5 patients)
2 infections
2 patients excessive screw length,
1 transient PIN palsy
second surgery (14 patients).
Mayo Index = Excellent (9), good (4), fair (2), poor (1)

The long-term results demonstrate no appreciable advantage over the long-term results of non-operative treatment
10 patients
mean age 42 (24 to 71).
Mason type III (3)
Mason type IV (7)
Mean follow-up of 28.5 months
All fractures had
9/10 plate removal
Mean Morrey score 90.7/100
1 fair result
On-table reconstruction of comminuted fractures of the radial head

Adrian Businger a,b, Thomas P. Ruedi a,c, Christoph Sommer a,*

2 Mason type-III
4 Mason type-IV
‘on-table’ reconstruction
low-profile mini-plates
mean follow-up of 112 months
Morrey score 97.0 points,
Mayo Index was 99.2
1 pt degenerative changes,
Allograft reconstruction
Partial allograft replacement of the radial head in the management of complex fracture-dislocations of the elbow

Robert G. Turner, MBBCh, FRCS, Damian Rispoli, MD, Francisco M. Lopez-Gonzalez, MD, Shawn W. O’Driscoll, PhD, MD, FRCS(C) *
Radial head arthroplasty

Mason III, IV
> one third of the head
not amenable to fixation
associated ligamentous injury
coronoid or olecranon fractures

Late reconstruction
nonunion, fixation failure,
loss of forearm rotation
Radial head arthroplasty

**Silicone rubber** prostheses are no longer used

not sufficiently rigid

prone to fragmentation

late inflammatory synovitis
Radial head arthroplasty

Modern implants
unipolar or bipolar,
monoblock or modular,
anatomical or non-anatomical,
cemented or press-fit

Correct diameter, height, medial offset
and cervico-cephalic angle

Bipolarity permits an “automatic”
positioning of the radial head with
respect to the neck and the opposite
articular surfaces
Tips

Radius pull test
change in Ulnar variance > 3 mm: rupture of the IM
> than 6 mm, both TFCC and IM are disrupted

RH should be in line with the proximal edge of the lesser sigmoid notch to avoid overstuffing
A comparative study of internal fixation and prosthesis replacement for radial head fractures of Mason type III

Hong-Jiang Ruan · Cun-Yi Fan · Jun-Jian Liu · Bing-fang Zeng

12 fresh & two old cases
Mason type III radial head fracture
Cement stem and bipolar prosthesis

Control group: 8 cases ORIF with screws

Good or excellent
92.9% of prosthesis
12.5% in ORIF
Open reduction and internal-fixation versus radial head replacement in treatment of Mason type III radial head fractures

Ning Li · Shaoying Chen

Systematic review & meta-analysis
67 patients with 67 cases
Mason type III radial head fractures

Complication rate
13.9 % RHR
58.1 % ORIF

Satisfactory rate 91.7 % / 51.6
Clinical results after different operative treatment methods of radial head and neck fractures
A systematic review and meta-analysis of clinical outcome

841 clinical studies with 1264 pt

Mason II best treatment option = ORIF (overall success rate 98%)

Mason III 92% success of ORIF (better than resection and replacement)

Mason IV best results after ORIF followed by resection and implantation of a prosthesis

primary implantation showed better outcomes in type III (87%) and IV (82%) compared to secondary implantation
With modern implants and techniques, fragment excision, ORIF, and arthroplasty all offer good results.

Radial head excision has become a less favorable treatment option.

Individualized treatment in complex cases with ligamentous injuries or associated fractures.

Diagram:
- Radial Head fracture
  - Undisplaced
    - Early mobilisation
    - Excision
  - Comminuted / Displaced
    - Elderly / Low demand
    - Replacement
    - 1. Are fragments large enough for fixation?
    - 2. Is fixation in safe-zone possible?
    - 3. Is early mobilisation possible after fixation?
    - No
    - Yes
      - ORIF +/- soft tissue reconstruction