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

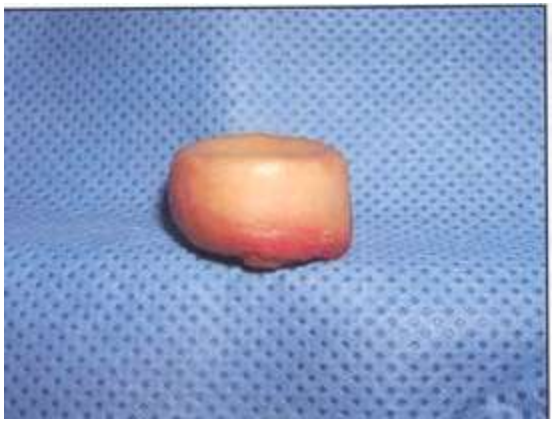
Andreas Panagopoulos, MD, PhD

Assistant Professor

Patras University Hospital

Objectives

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

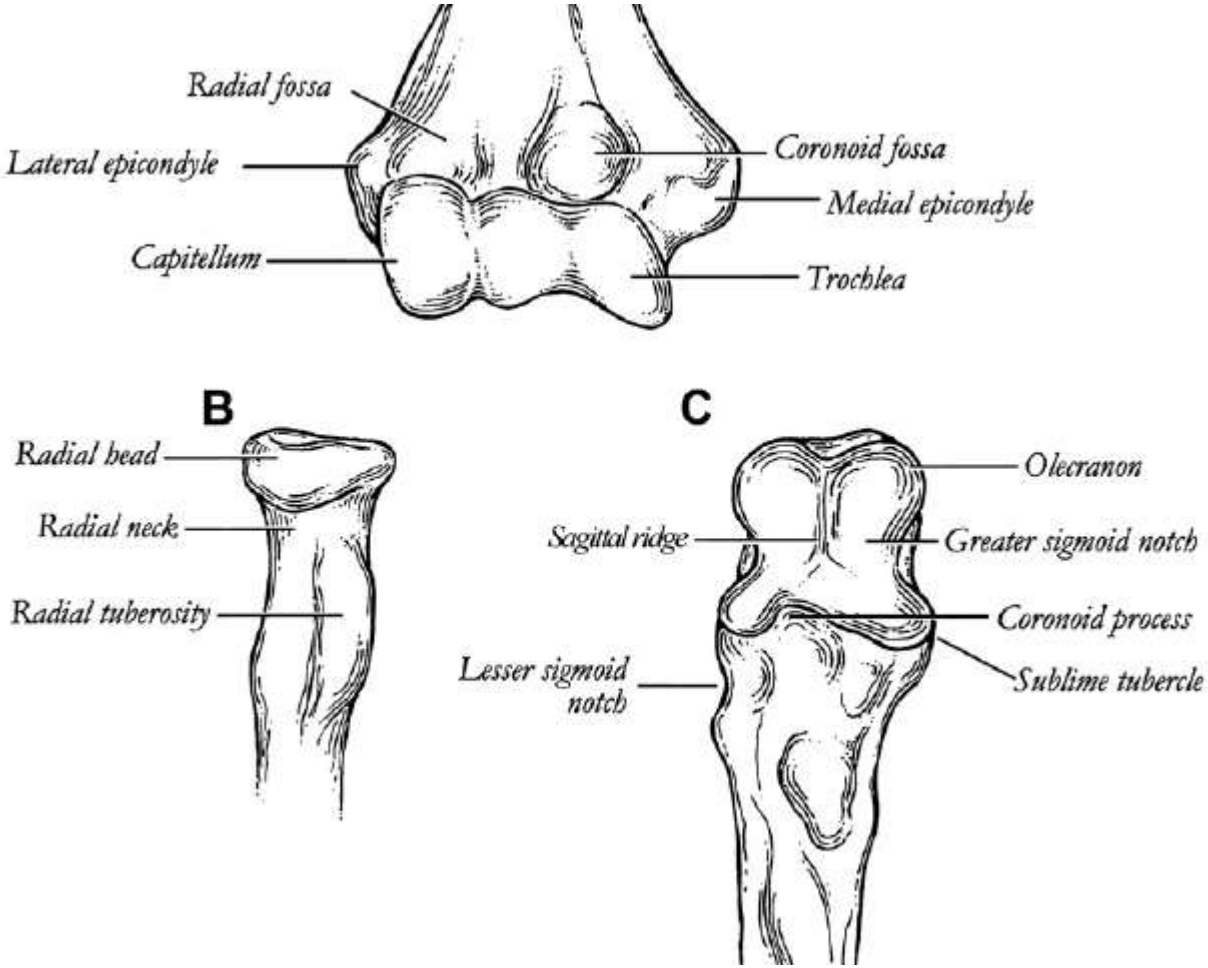


Overview

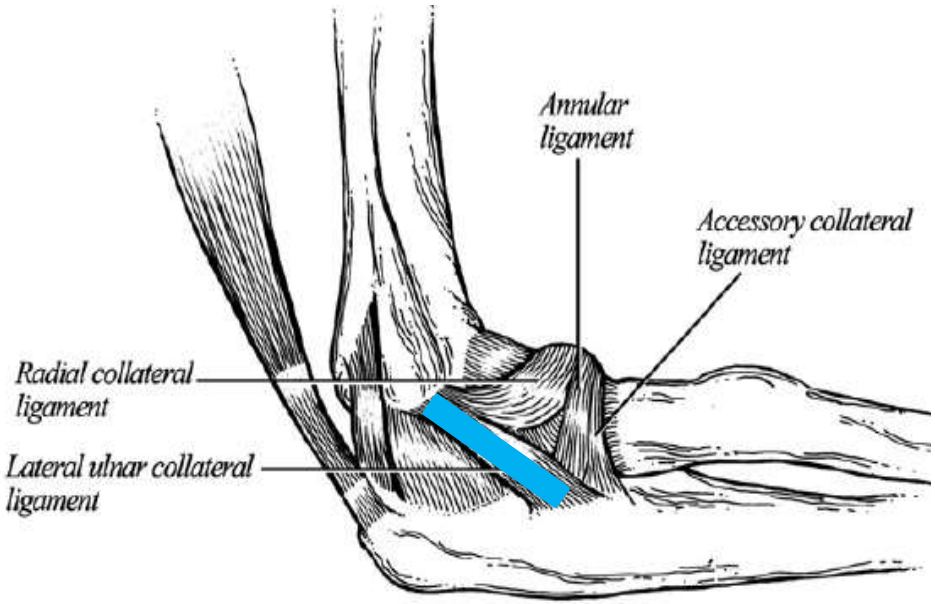
Historically, the radial head was believed to be expendable.

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

Anatomy

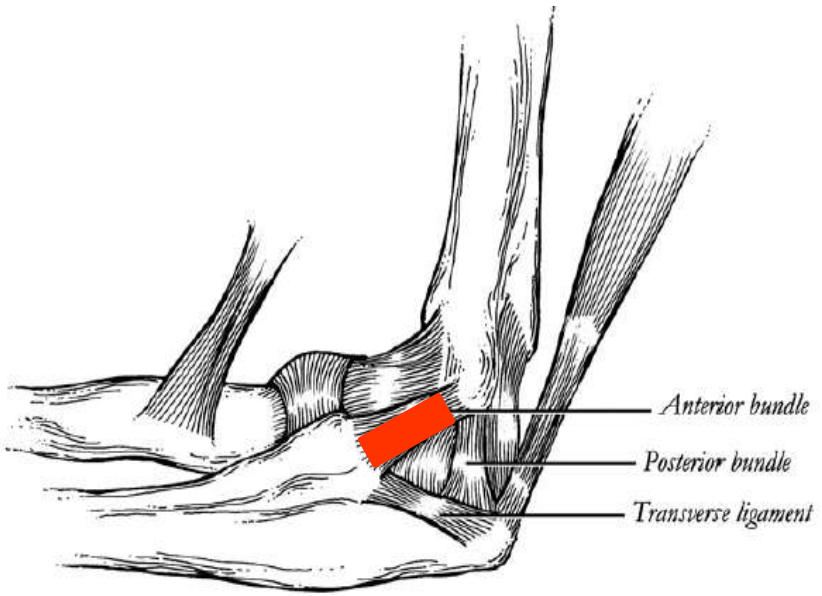

Radial fossa
Lateral epicondyle
Capitellum
Coronoid fossa
Medial epicondyle
Trochlea
B
Radial head
Radial neck
Radial tuberosity
C
Olecranon
Sagittal ridge
Greater sigmoid notch
Coronoid process
Lesser sigmoid notch
Sublime tubercle

Anatomy

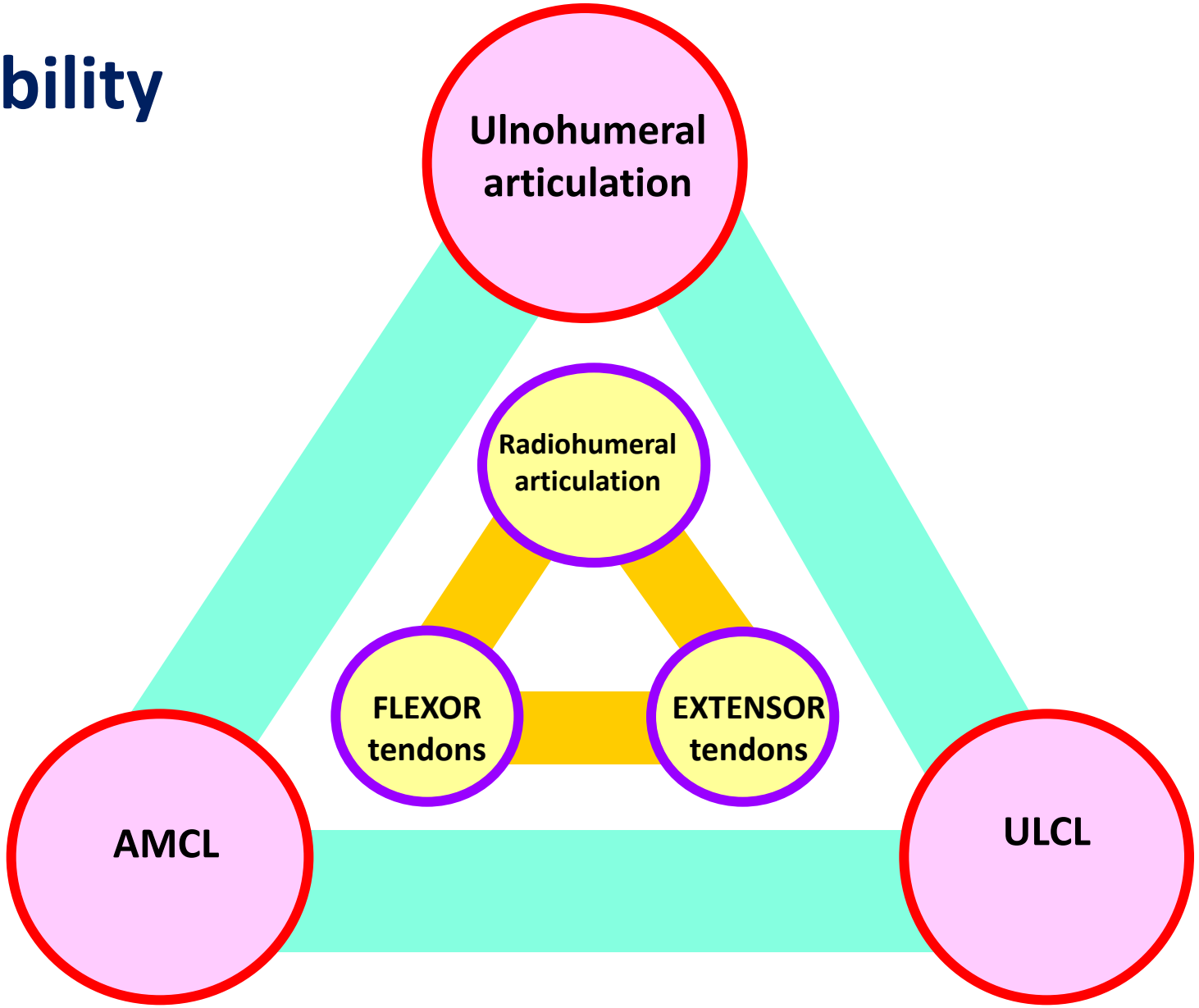


Lateral

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

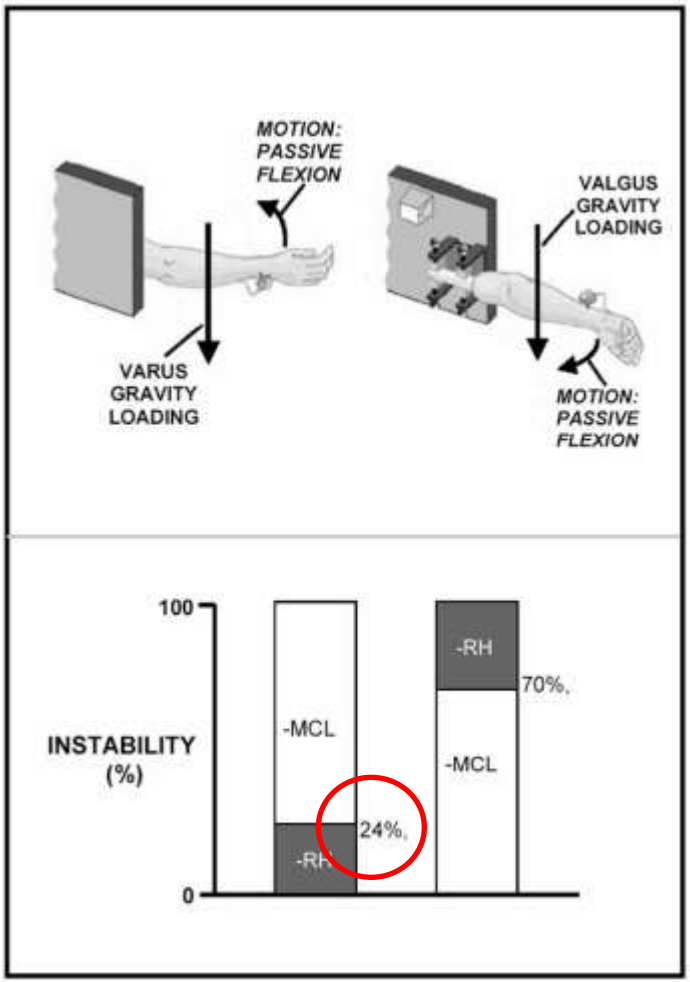
- if interosseous membrane is disrupted the radius is proximally migrate

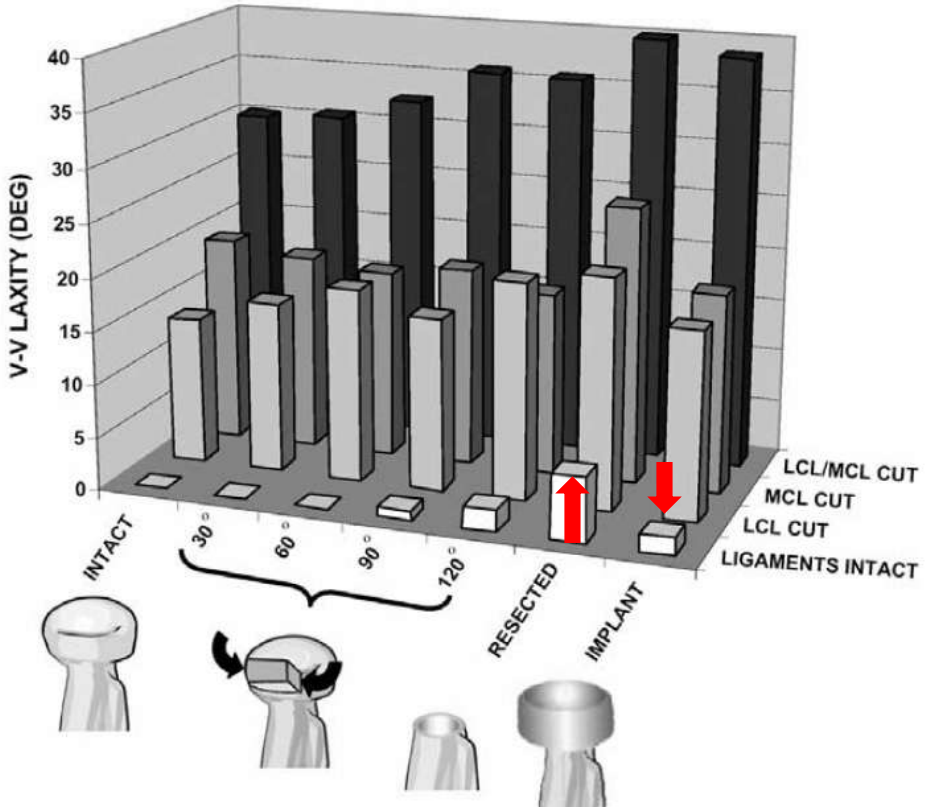
- for each mm of radial shortening, the distal ulnar load increases by approximately 10%.

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.)





Clin Orthop Relat Res
DOI 10.1007/s11999-013-3331-x

Clinical Orthopaedics and Related Research®
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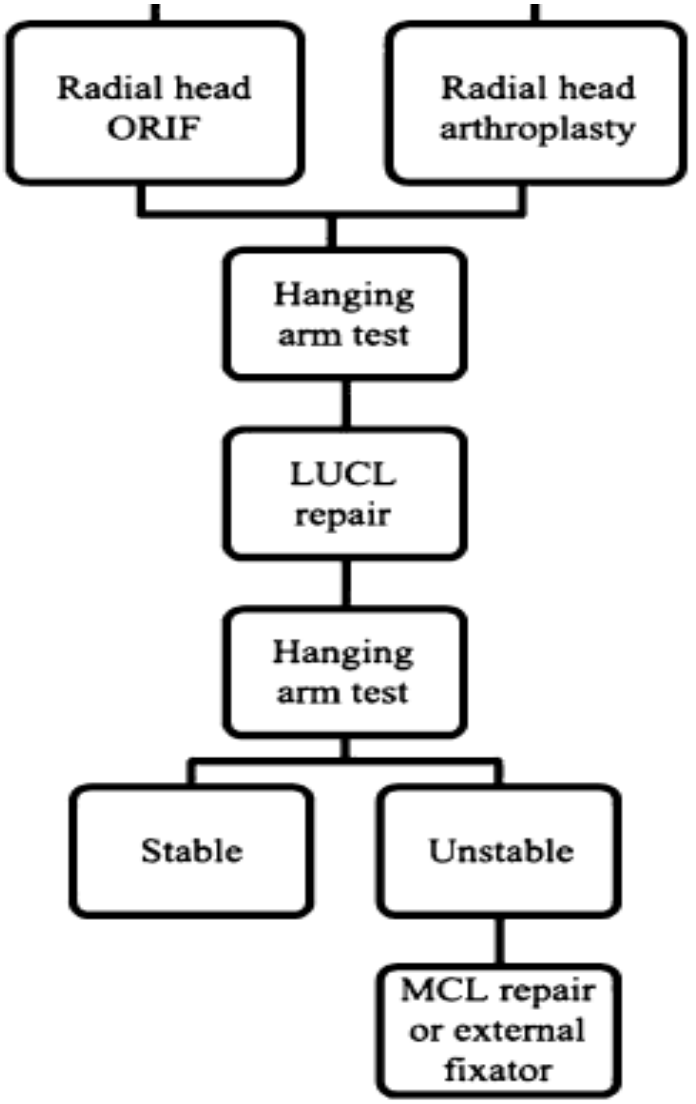
SYMPOSIUM: TRAUMATIC ELBOW INSTABILITY AND ITS SEQUELAE

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

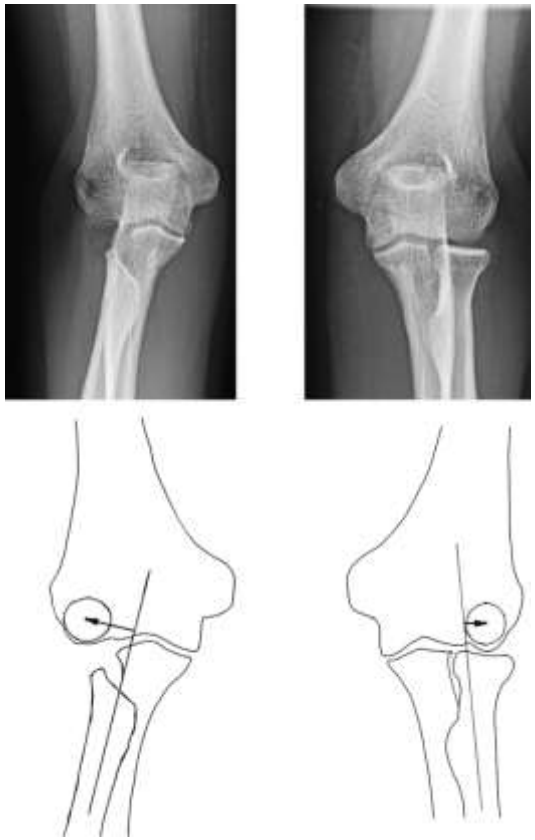
HANGING ARM TEST



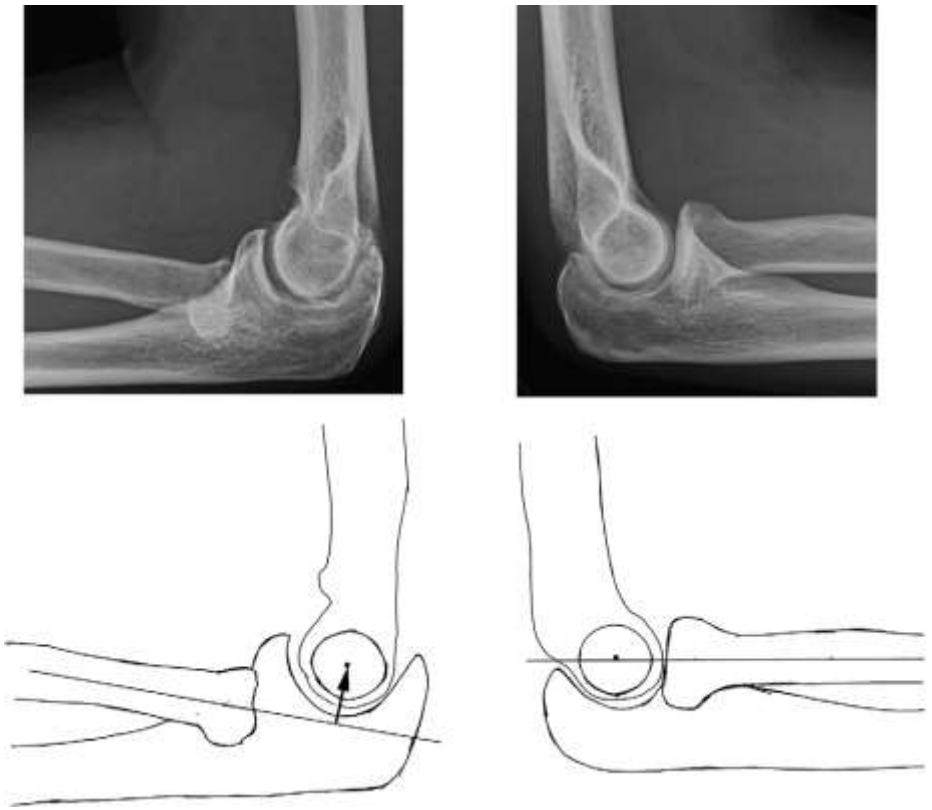
Proximal radial drift following radial head resection

Alison Schiffern, MD[a], Stephen P. Bettwieser, BA[a],
Christina A. Porucznik, MSPH, PhD[b,c], Julia R. Crim, MD[a], Robert Z. Tashjian, MD[a,c,*]

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



Medial drift



Posterior drift

Proximal radial drift following radial head resection

Alison Schiffern, MD[a], Stephen P. Bettwieser, BA[a],
Christina A. Porucznik, MSPH, PhD[b,c], Julia R. Crim, MD[a], Robert Z. Tashjian, MD[a,c,*]

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

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

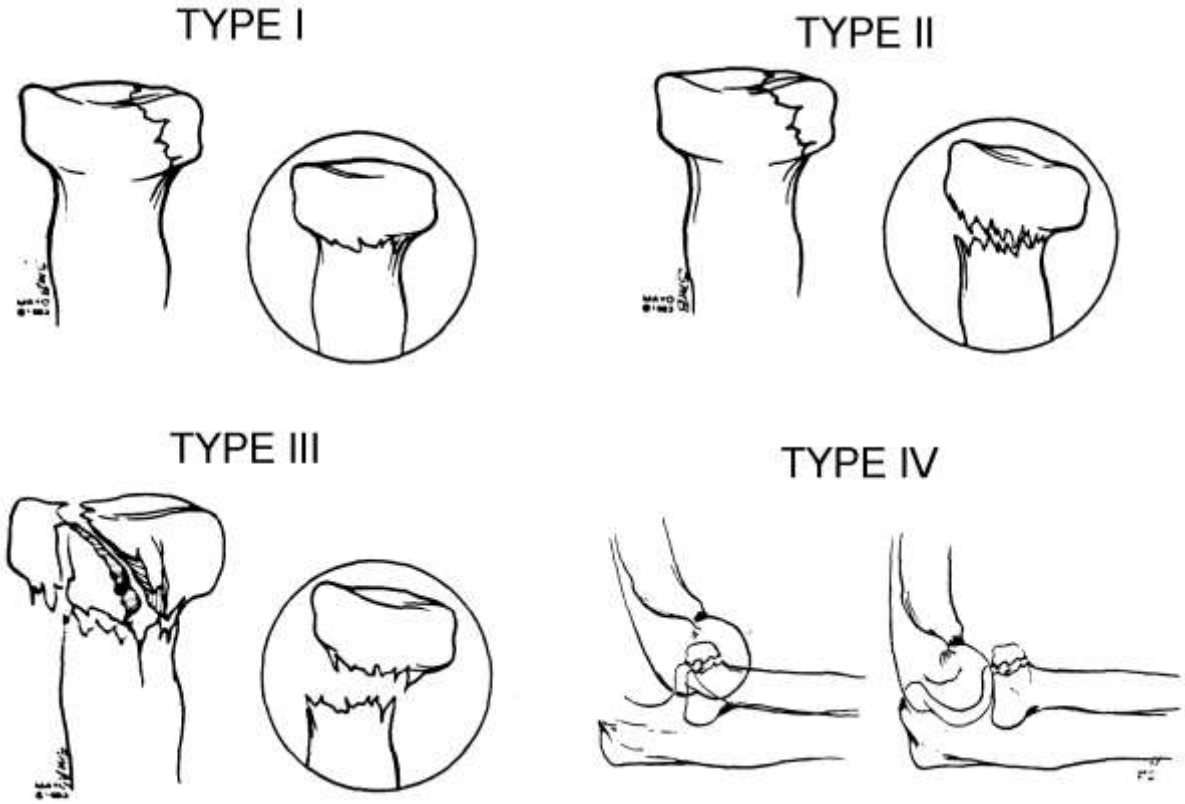
Only with **dislocation** there were worse functional outcomes

Classification

- Another fracture
- Ligamentous injury

Classification

Mason








Radial head fractures — update on classification and management

ORTHOPAEDICS AND TRAUMA 26:2

Vinod Kumar
William Angus Wallace

Hotchkiss

The modified Mason classification of radial head fractures[a]

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,*],
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

Undisplaced

Displaced

Clin Orthop Relat Res (2008) 466:130–134
DOI 10.1007/s11999-007-0064-8

ORIGINAL ARTICLE

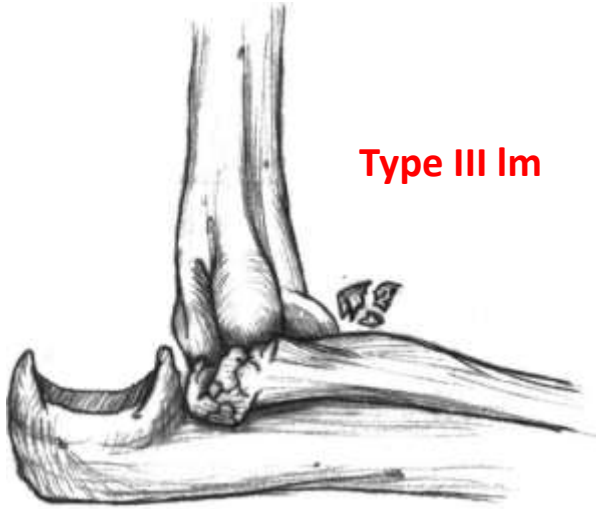
Documentation of Associated Injuries Occurring With Radial Head Fracture

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

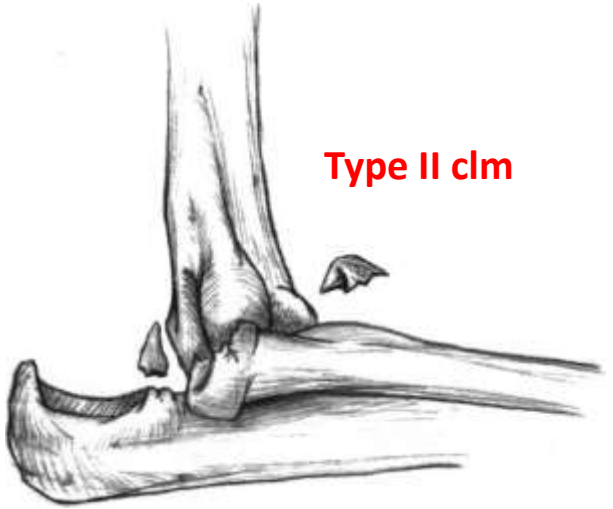
Mayo

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

Radial head fracture (Mason) type	Associated injury suffixes	
I–III	Articular injuries	c = coronoid fracture
		o = olecranon fracture
	Ligamentous injuries	m = medial collateral ligament
		l = lateral collateral ligament
		d = distal radioulnar disruption



Type III lm

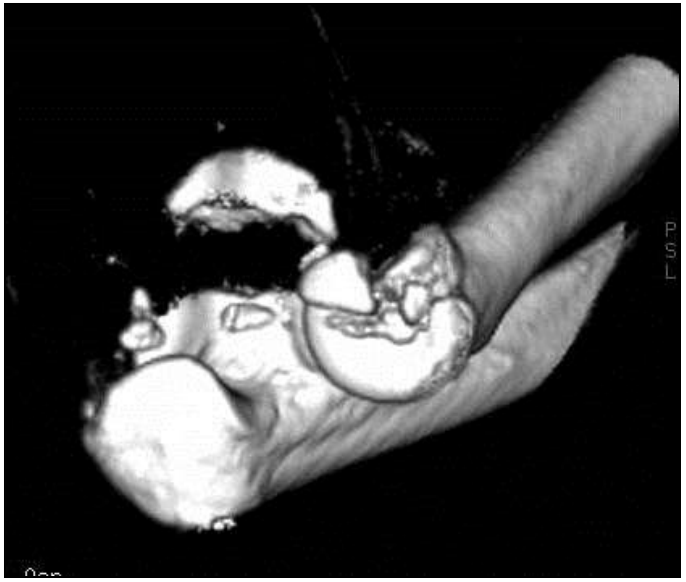


Type II clm

Imaging

Greenspan-Norman radiocapitellar view

CT scan

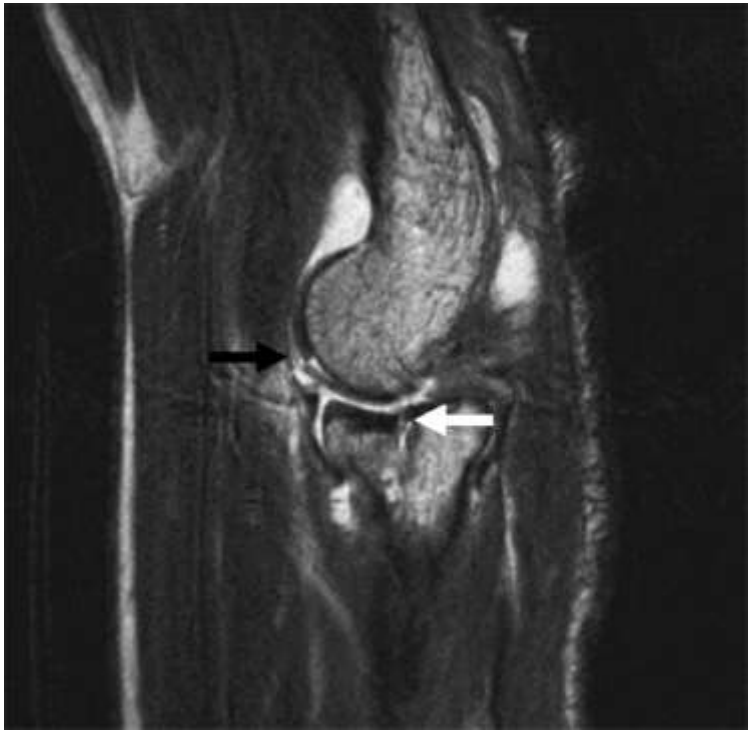


Acta Orthopaedica 2010; 81 (3): 373–376

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

Laurens Kaas[1,2], Jeroen L Turkenburg[3], Roger P van Riet[4], Jos P A M Vroemen[5], and Denise Eygendaal[1]

Associated injury	Mason type I (n = 17)	II (n = 23)	III (n = 6)
LCL	8	15	6
MCL	–	–	1
Capitellar injury	8	8	2
Loose osteochondral fragment	–	2	–
Bone bruise lateral epicondyle	–	1	–
Coronoid fracture	–	1	
Any type of associated injury	12	17	6



Patterns of Traumatic Elbow Instability With Fracture

Dislocation+ radial head fracture

Terrible Triad

Dislocation

Dislocation Injuries

Anterior

Posterior

Olecranon fracture-Dislocation

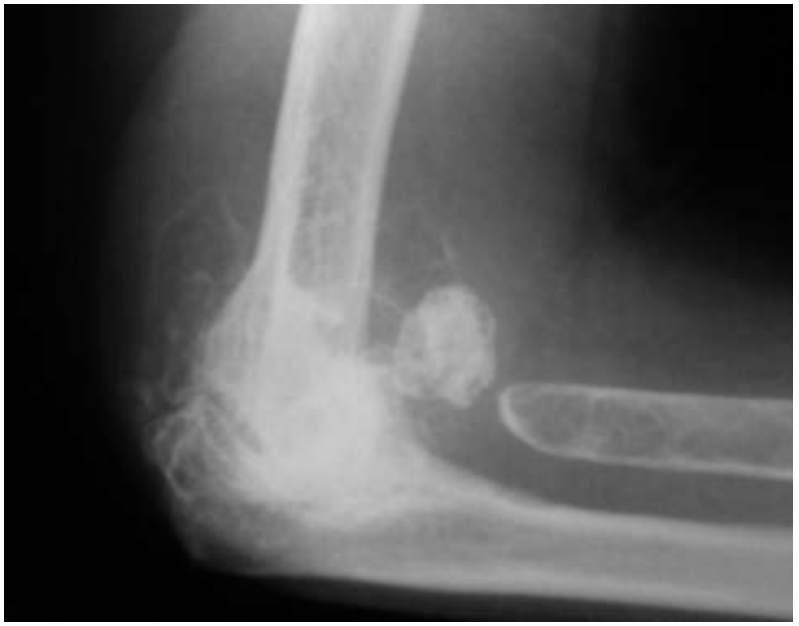
Varus posteromedial rotational instability

Disruption Injuries

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

Eur J Orthop Surg Traumatol
DOI 10.1007/s00590-013-1386-8

Received: 3 October 2013 / Accepted: 28 November 2013

ORIGINAL ARTICLE

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

Caputo AE, Burton KJ, Cohen MS, et al: Articulator cartilage injuries of the capitellum interposed in radial head fractures: A report of ten cases. J Shoulder Elbow Surg 15:716-720, 2006

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,

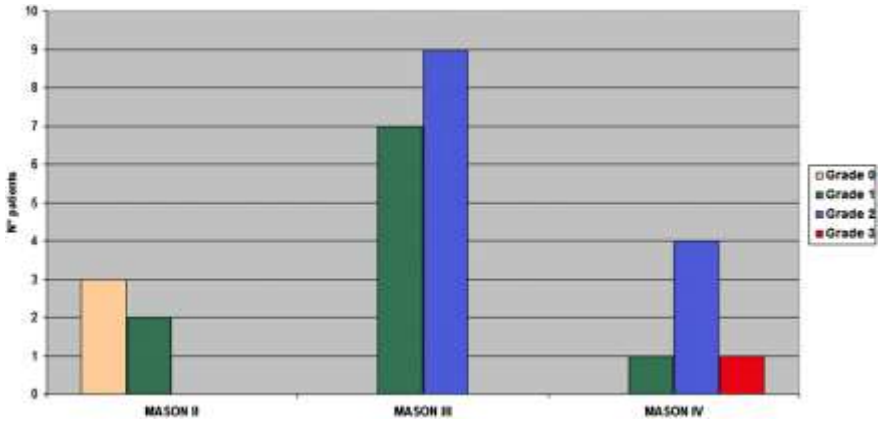
Resection arthroplasty for radial head fractures: Long-term follow-up

J Shoulder Elbow Surg (2011) 20, 45-50

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

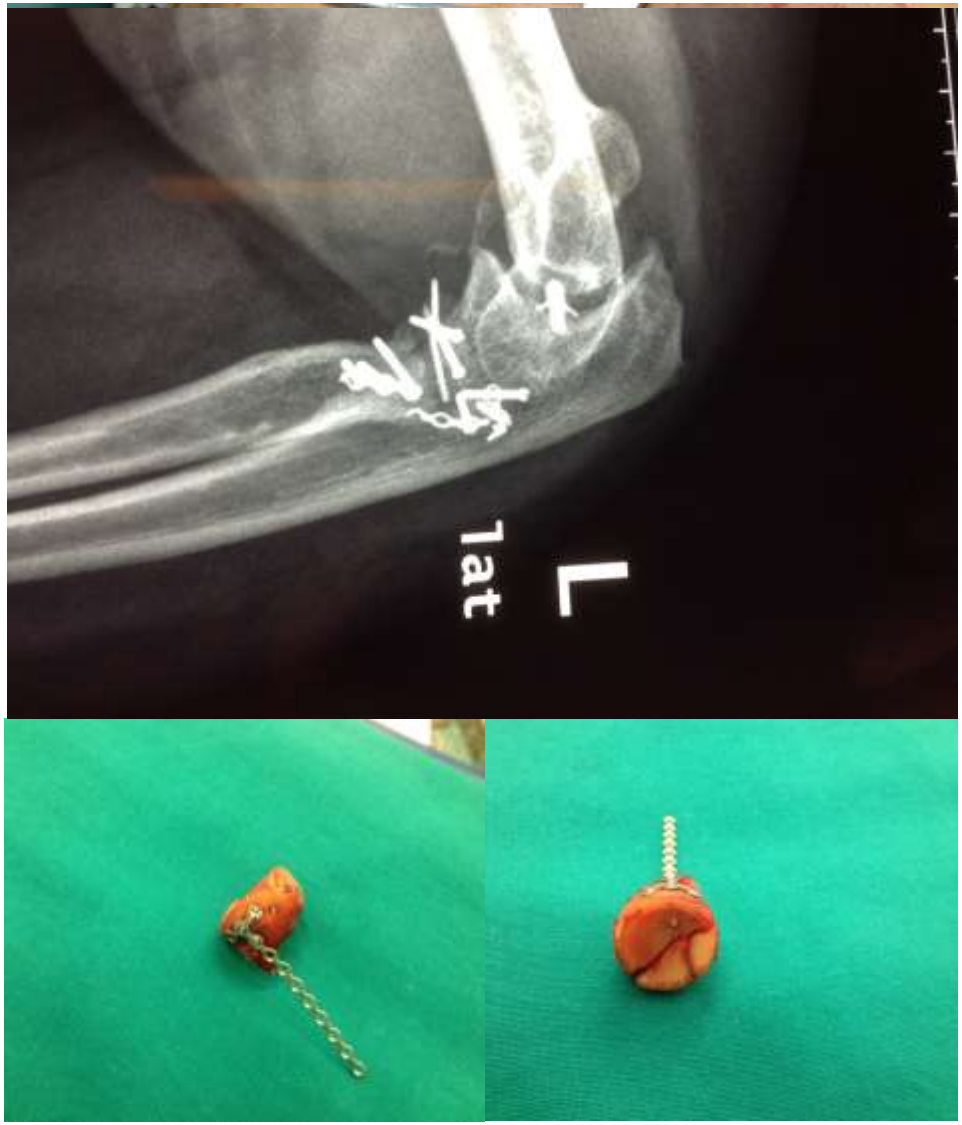
No more than 3 fragments

Small screws, Hebert screws

Low profile special plates

“Safe” zone

Ligament repair, associated injuries



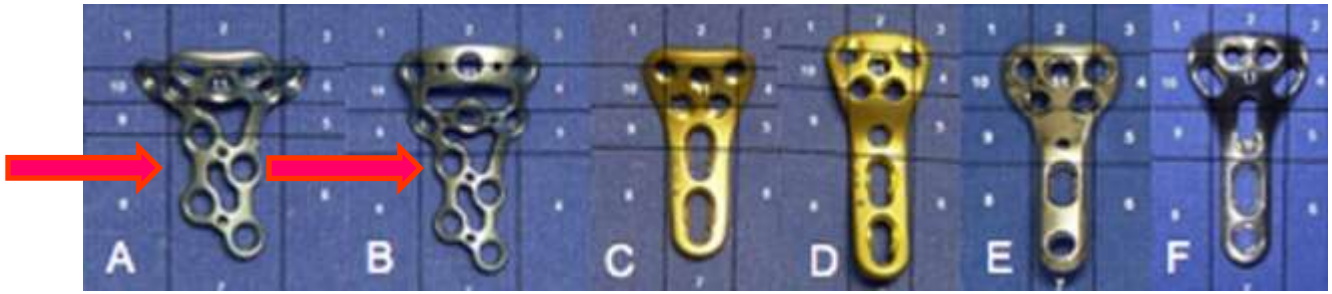
Implant selection

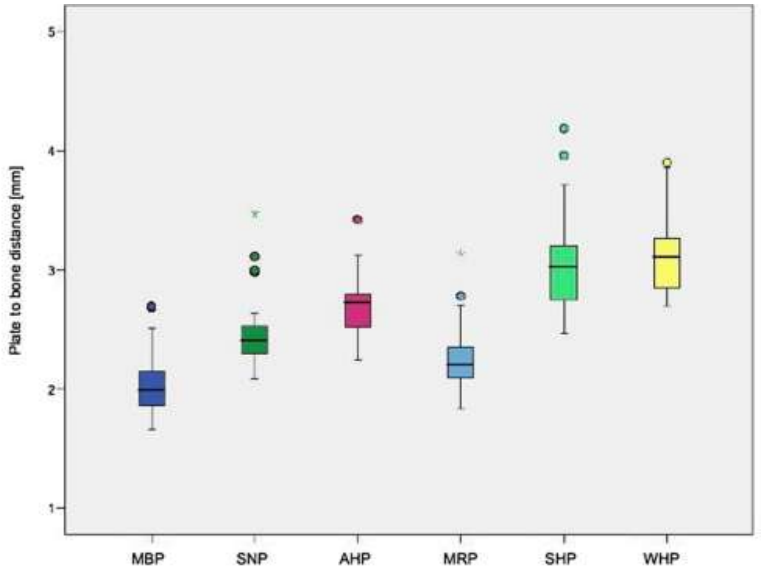
SCIENTIFIC ARTICLE

Anatomic Fit of Six Different Radial Head Plates: Comparison of Precontoured Low-Profile Radial Head Plates

JHS • Vol 36A, April 2011

Klaus Josef Burkhart, MD, Tobias E. Nowak, MD, Yoon-Joo Kim, MD, Pol M. Rommens, PhD, Lars P. Müller, PhD

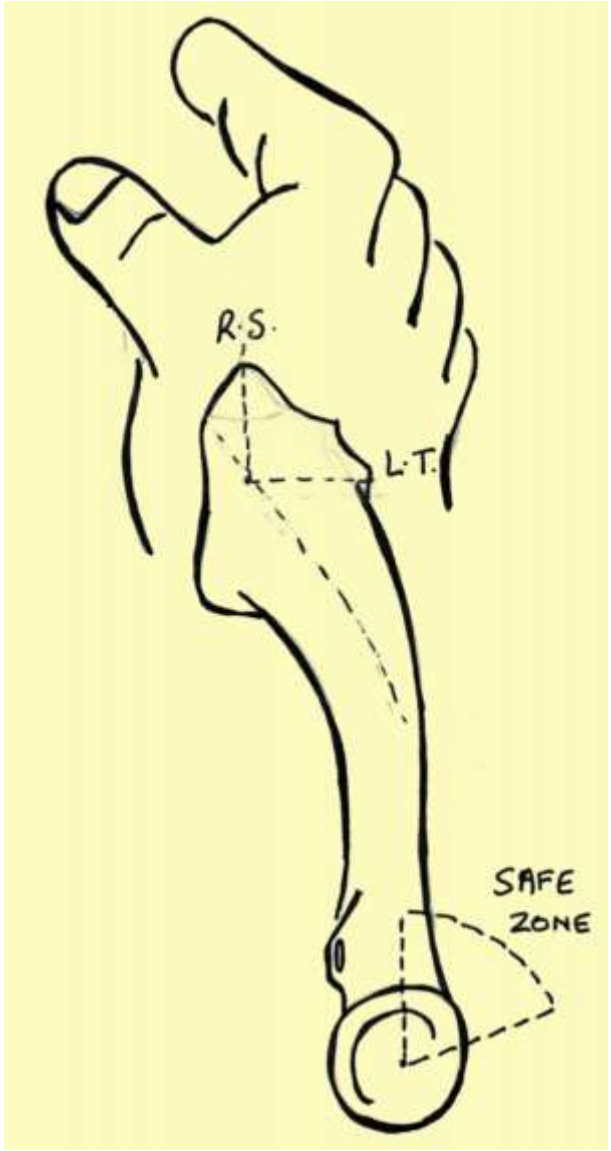




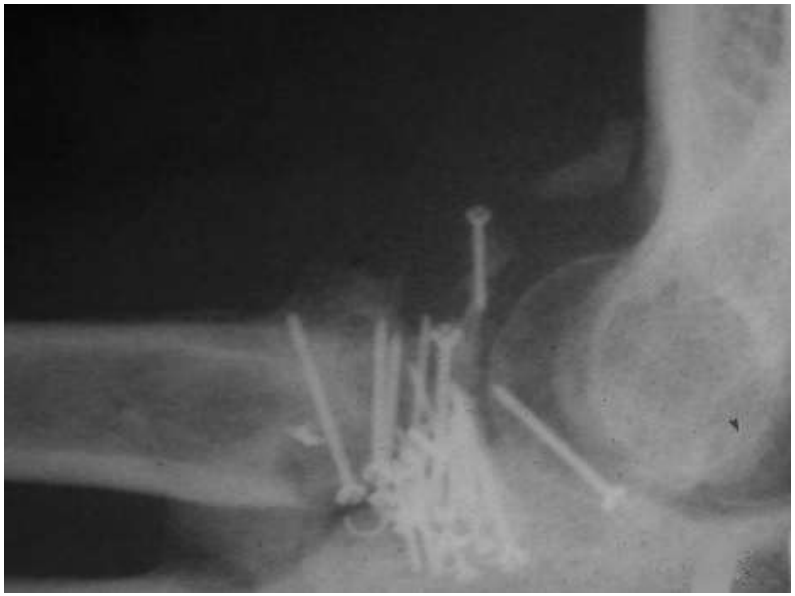
Safe zone for fixation

110^{o} 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

(*J Trauma.* 2009;67: 143–146)

The Long-Term Outcome of Open Reduction and Internal Fixation of Stable Displaced Isolated Partial Articular Fractures of the Radial Head

Anneluuk L. C. Lindenhovius, MSc, Quinten Felsch, BA, David Ring, MD, PhD, and Peter Kloen, MD, PhD

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

Open reduction and internal fixation of comminuted fractures of the radial head using low-profile mini-plates

M. Ikeda, Y. Yamashina, M. Kamimoto, Y. Oka
From Tokai University Oiso Hospital, Kanagawa, Japan

J Bone Joint Surg [Br] 2003;85-B:1040-4.
Received 2 September 2002; Accepted after revision 28 April 2003

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

Fig. 2a

Fig. 2b

Injury, Int. J. Care Injured 41 (2010) 583–588

Contents lists available at ScienceDirect

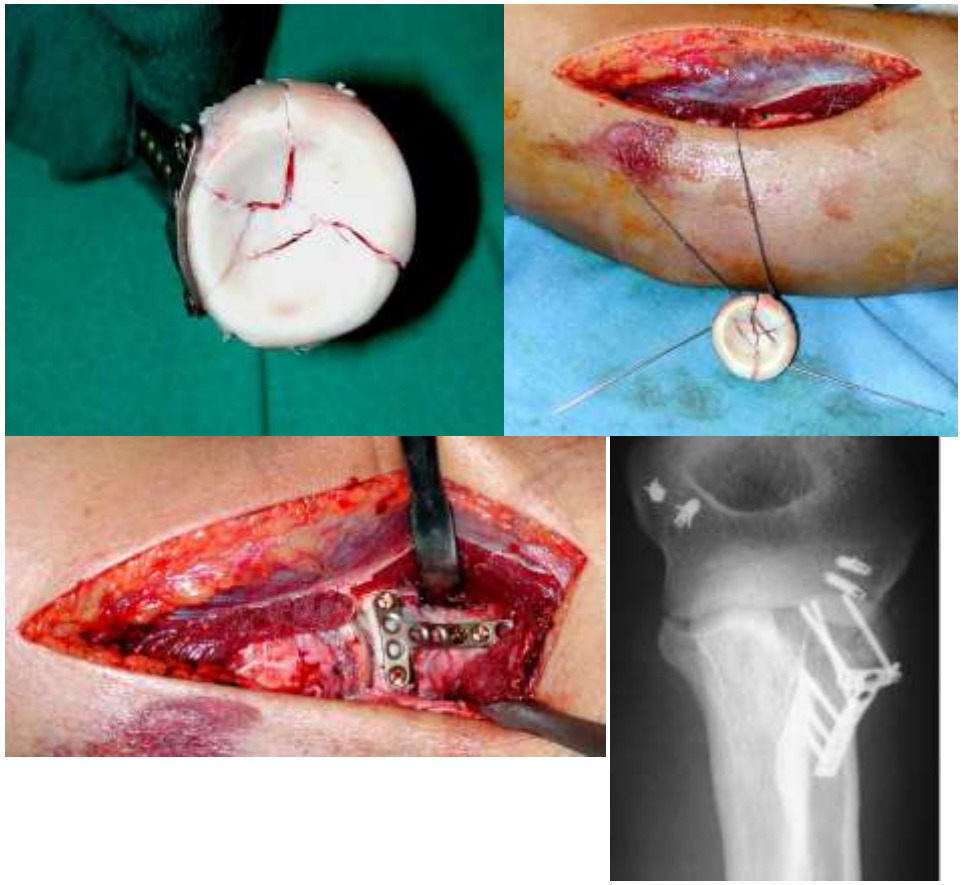
Injury

journal homepage: www.elsevier.com/locate/injury

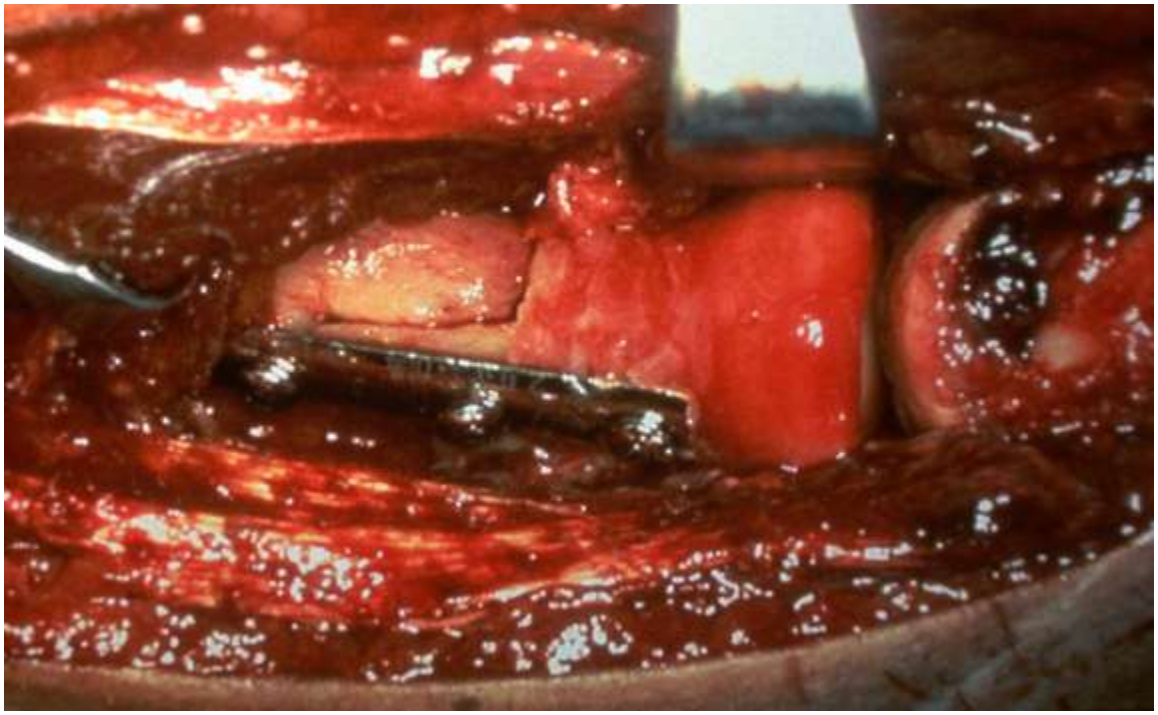
On-table reconstruction of comminuted fractures of the radial head

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,.



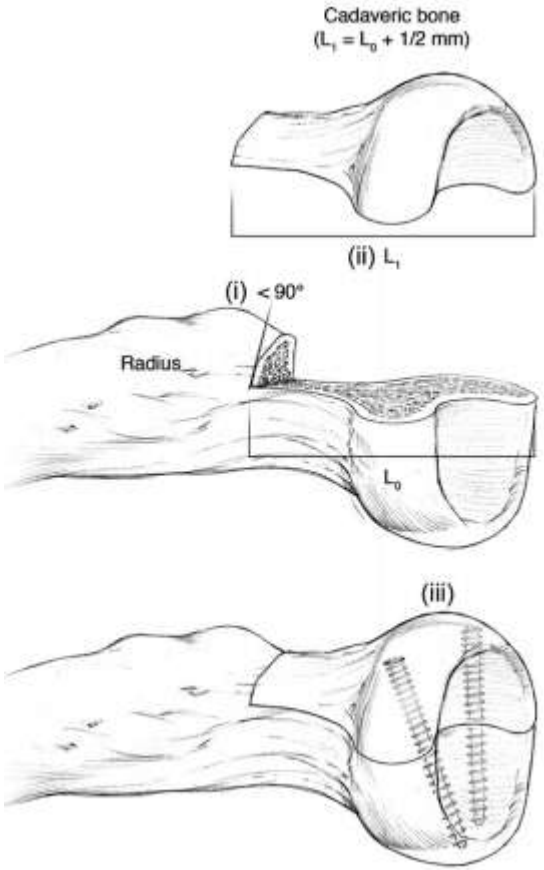
Allograft reconstruction



Partial allograft replacement of the radial head in the management of complex fracture-dislocations of the elbow

J Shoulder Elbow Surg (2012) 21, 396-404

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

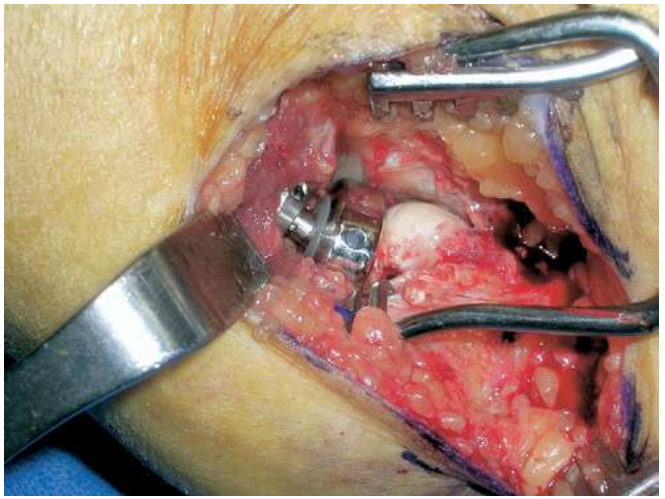
Silicone rubber prostheses are no longer used

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

RH should be in line with the proximal edge of the **lesser sigmoid notch** to avoid overstuffing

Radius pull test

change in Ulnar variance > 3 mm: rupture of the IM

> than 6 mm, both TFCC and IM are disrupted

International Orthopaedics (SICOT) (2009) 33:249–253
DOI 10.1007/s00264-007-0453-3

ORIGINAL PAPER

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

Eur J Orthop Surg Traumatol
DOI 10.1007/s00590-013-1367-y

ORIGINAL ARTICLE

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

Injury, Int. J. Care Injured 44 (2013) 1540–1550

J. Zwingmann*, M. Welzel, D. Dovi-Akue, H. Schmal, N.P. Südkamp, P.C. Strohm

Department of Orthopaedic and Trauma Surgery, University of Freiburg Medical Center, Hugstetter Straße 55, 79106 Freiburg, Germany

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

ELSEVIER

Operative Techniques in Orthopaedics

Radial Head—Resect, Fix, or Replace

Corinne VanBeek, MD, and William N. Levine, MD