

### What Have I Changed (Learned) in Treating the Terrible Triad



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Mayo Clinic, Rochester, MN



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### Disclosures

- None Relevant



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Shawn O'Driscoll

Joaquin Sanchez-Sotelo



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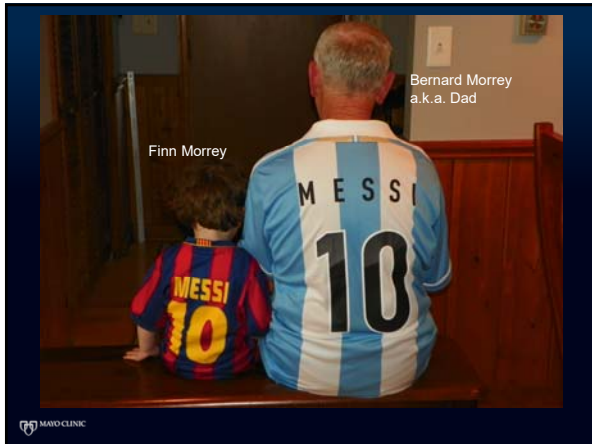
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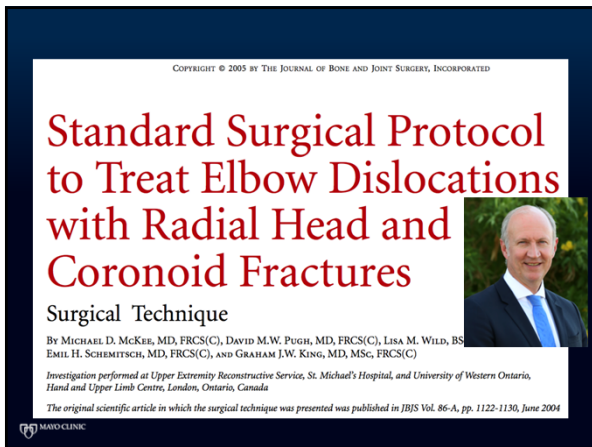
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 **Injury**  
Volume 46, Supplement 8, December 2015, Pages S68-S76

**Terrible triad of the elbow: is it still a troublesome injury?**  
Giuseppe Giannicola <sup>a, R, B</sup>, Piergiorgio Calella <sup>a</sup>, Andrea Piccoli <sup>a</sup>, Marco Scacchi <sup>a</sup>, Stefano Gumina <sup>a</sup>

- **Results**
  - ~3 years Mean follow-up was 31 months.
  - ROM= F137° , E10° , S77° and P79°
  - MEPS =96 , m-ASES = 91 and Q-DASH = 8



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# A Few Basic Concepts



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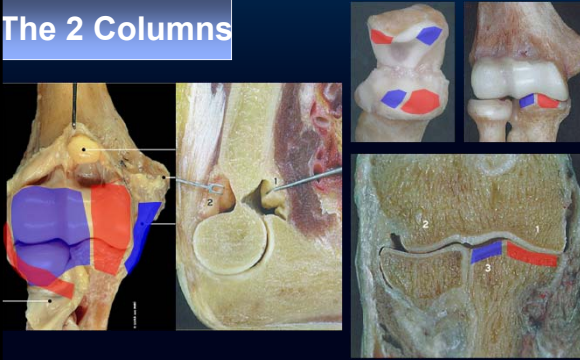
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## Anatomy of Elbow Stability

### The 2 Columns





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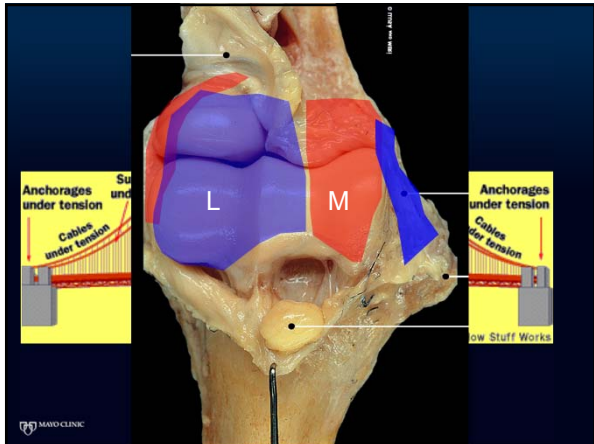
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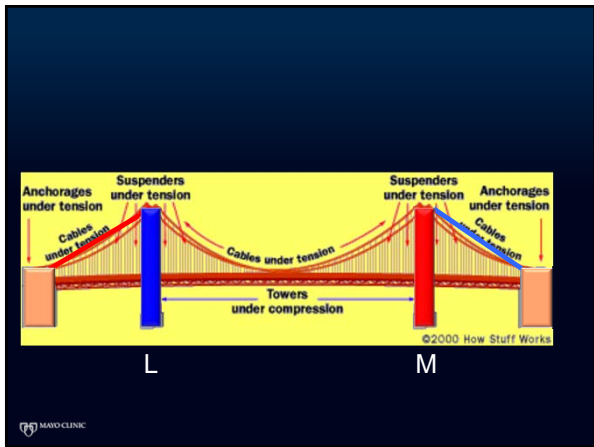
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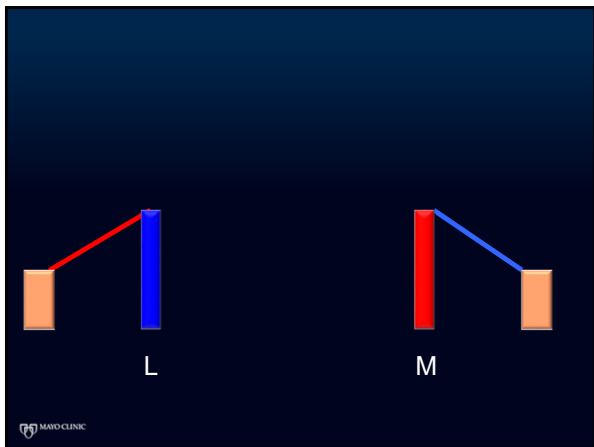
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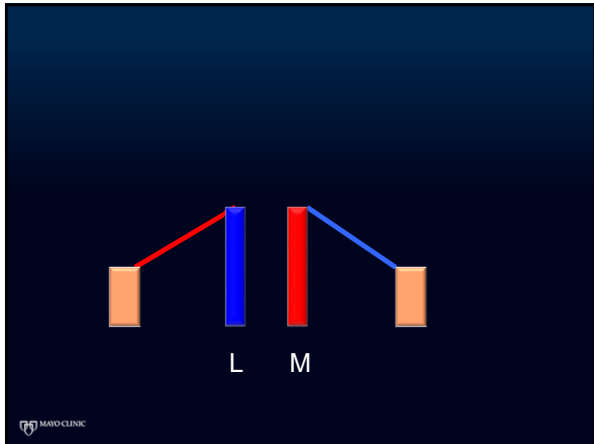
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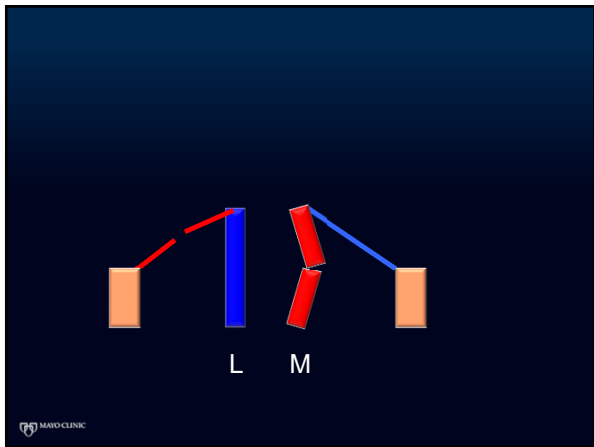
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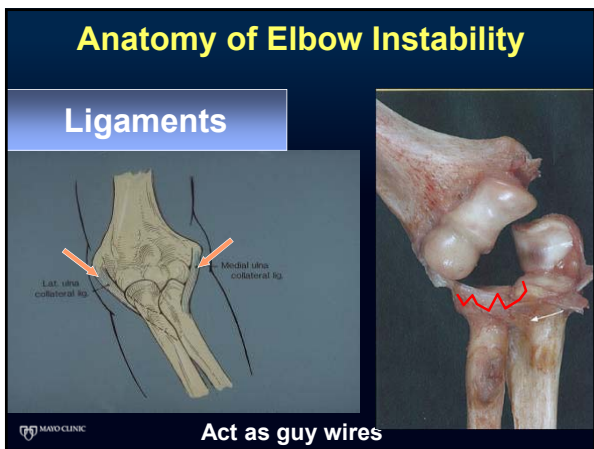
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### Principles of Treatment

- (1) Restore lateral column
  - RH fixation or replacement??
- (2) Fixation of the coronoid fragment
  - When?
- (3) Repair LUCL
  - How?
- (4) Repair or neutralize the MCL
  - How and who?



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### To Be or Not to Be...



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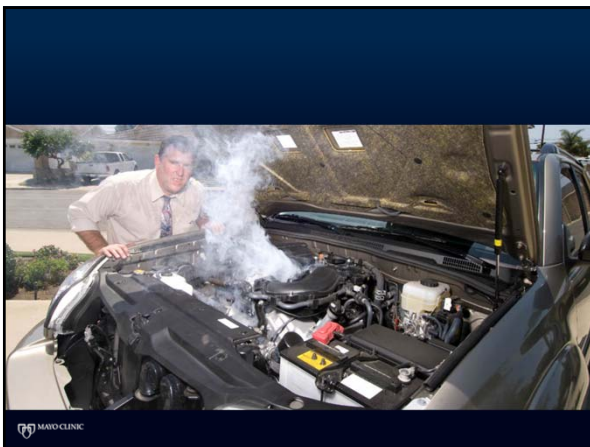
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### Why do we need it?

**Radial head/MCL**

Radial head not necessary for stability but desirable to preserve

RH takes 60% of the load with axial and valgus loading as in a pushup.

Radial H Stabilize

Stability

RH MCL

MCL RH

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Court. Klaus Burkhart

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Court. Klaus Burkhart

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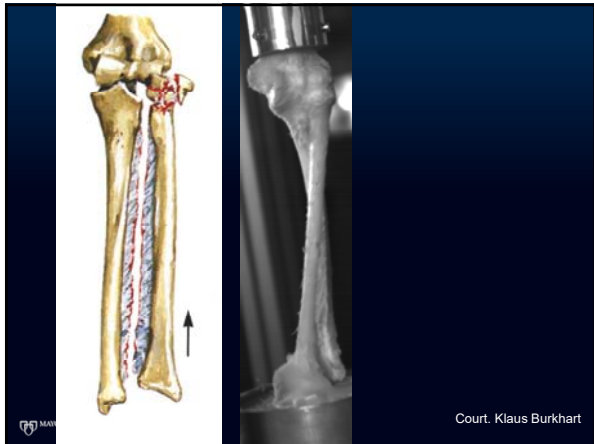
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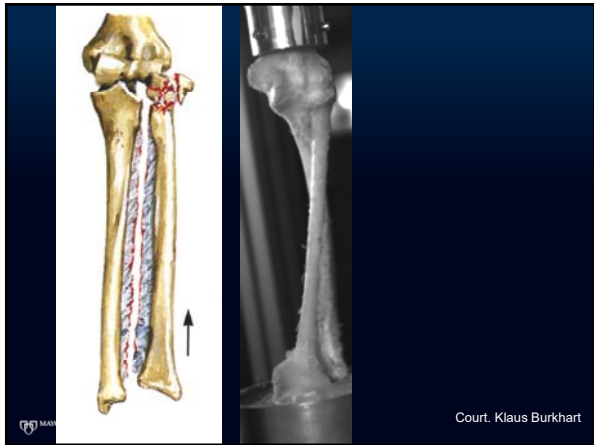
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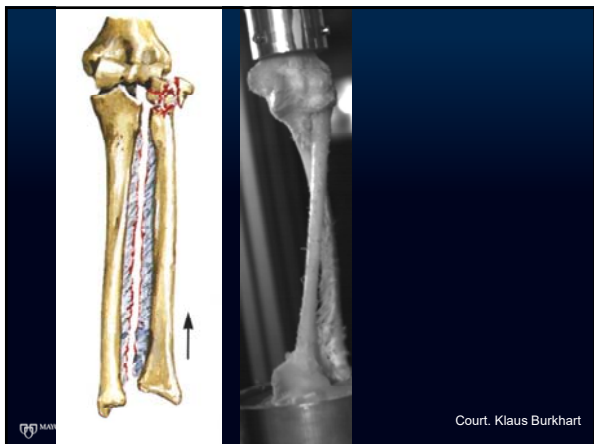
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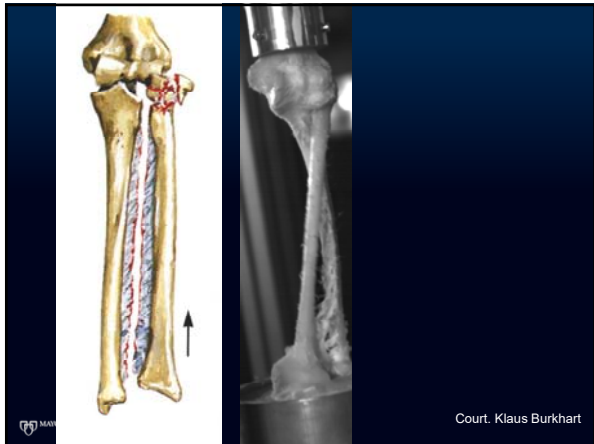
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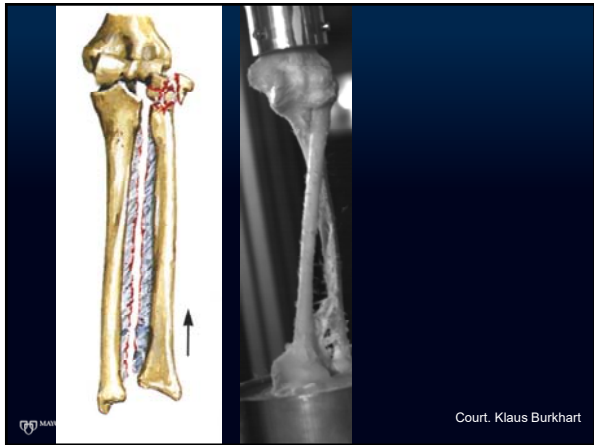
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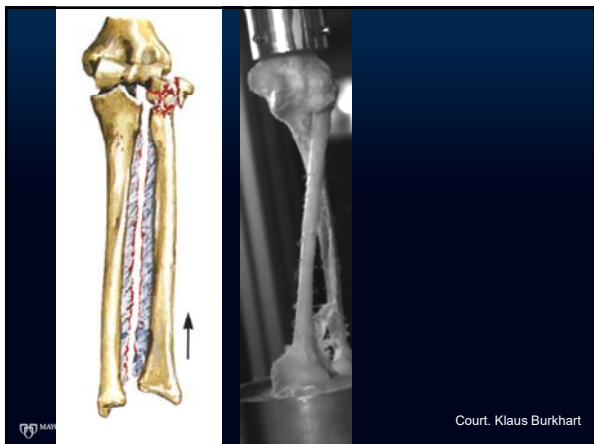
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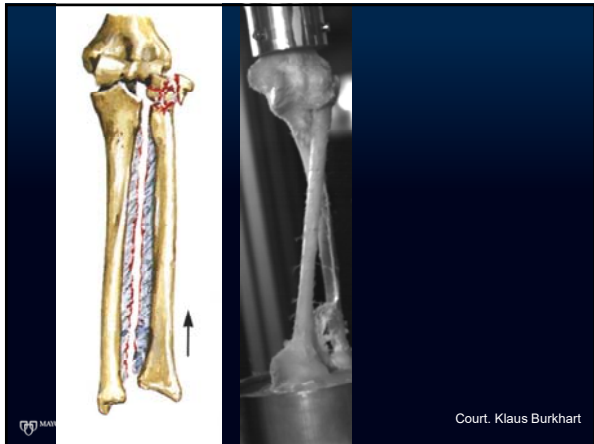
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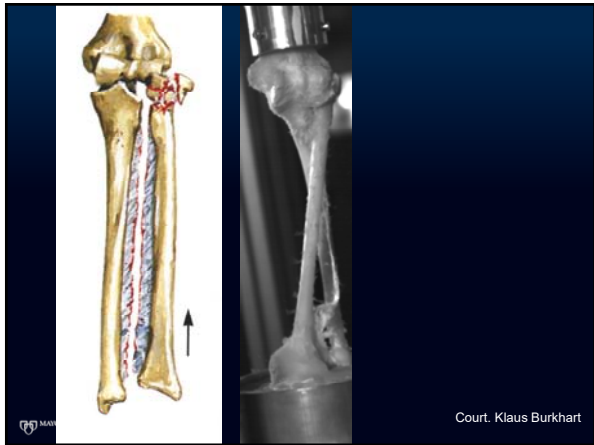
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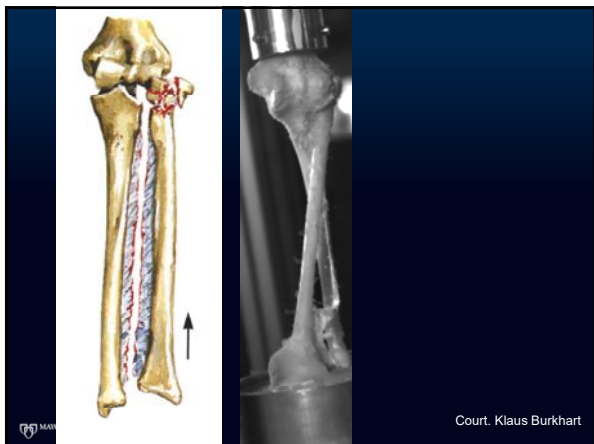
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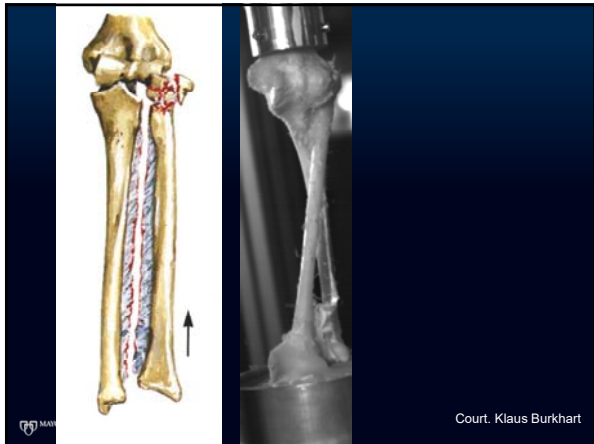
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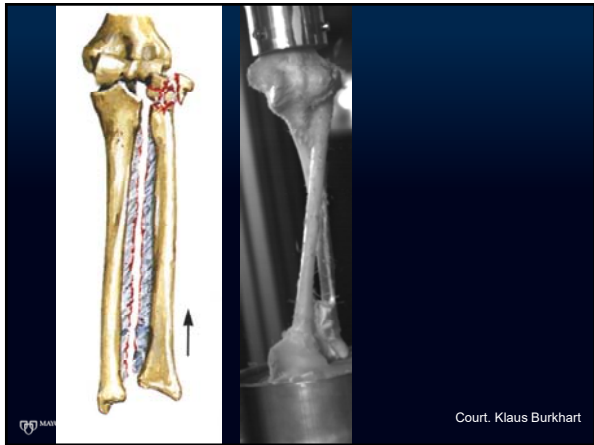
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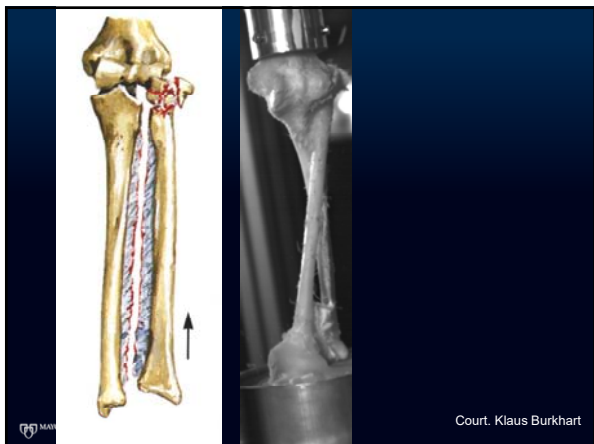
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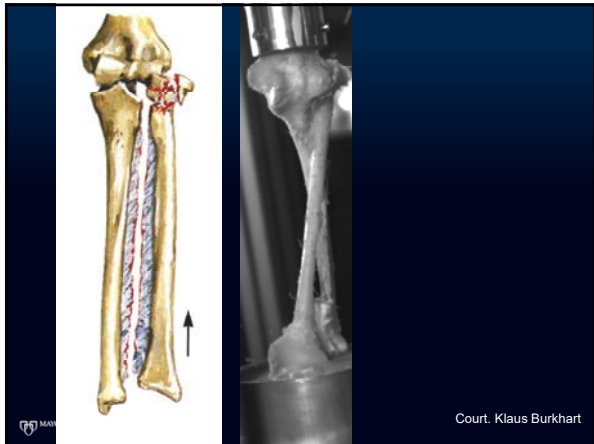
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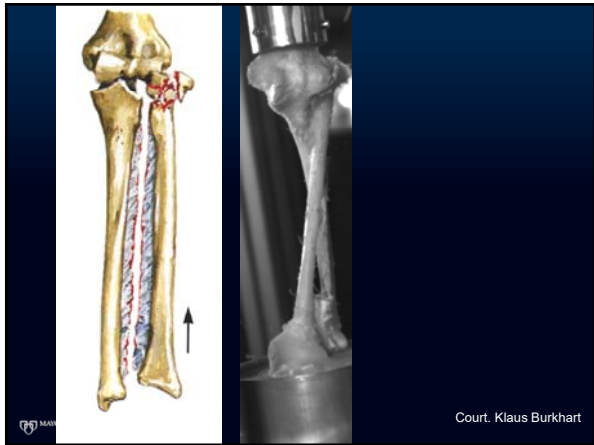
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**Treatment Options Terrible Triad:  
Radial Head**

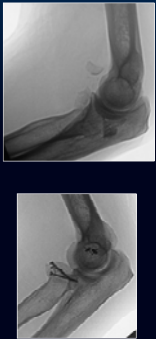
**Internal fixation**

- 2-3 fragments
- Young patient
- **More likely** to use ex-fix fixator

**Replacement**

- All others
- If replaced **less likely** to use ex-fix

**Resection.....NO!...PLEASE NO!!**



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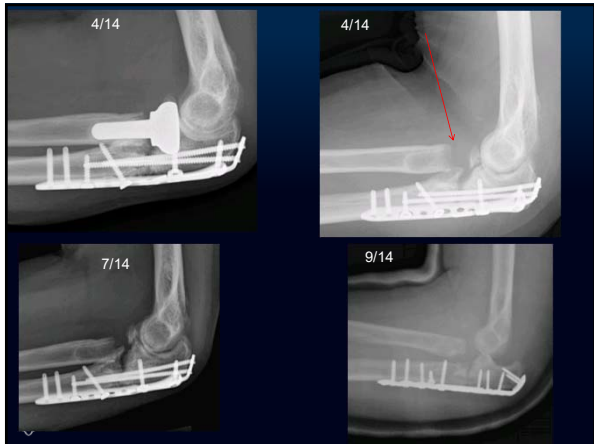
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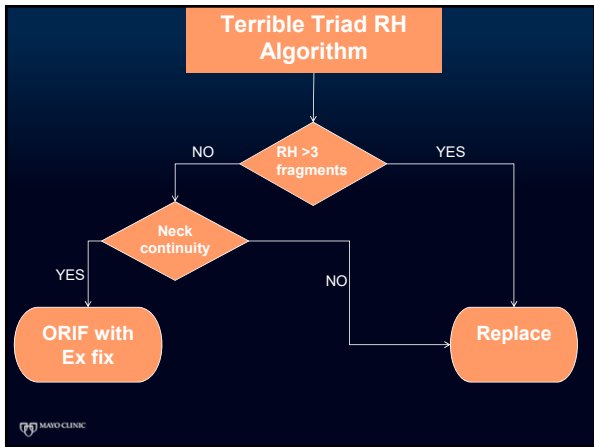
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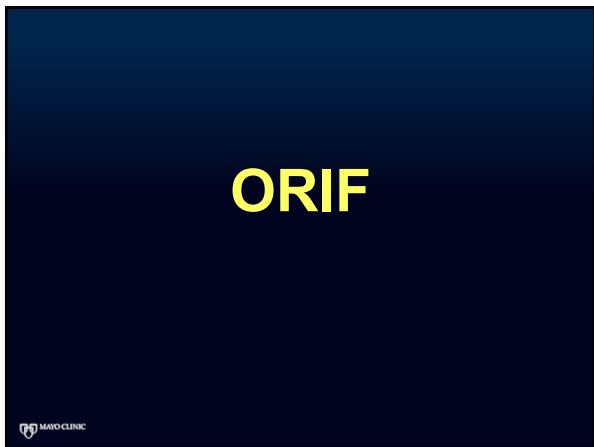
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## ORIF

**Pearls**

- Most through soft tissue interval
- Have options available
  - Threaded K-wires
  - Absorbable pins
  - Headless screws
- Know your screw lengths
- Avoid plates if possible (poor forearm rotation)
- Use fluoroscopy and exam under anesthesia
- Ex-Fix



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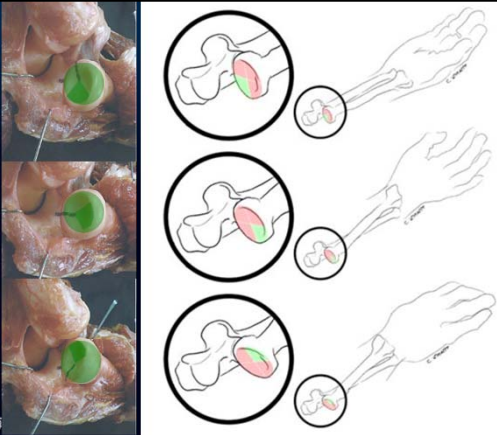
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Enderpin FN: Displaced fractures of the radial head - external fixation or excision? J Am Acad Orthop Surg 1997;5(1):1-10.



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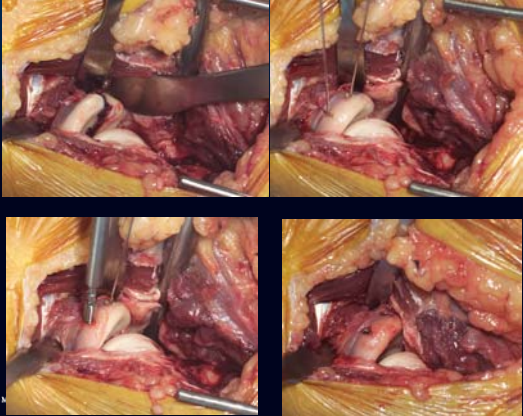
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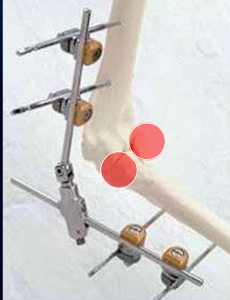
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### Points of Learning

- LUCL repair
- Use of a Fixator
  - Off-load repair
  - Off-load MCL
  - Motion
  - Free EUA



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# Arthroplasty

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### Arthroplasty

**Pearls**

- Sizing and alignment
- Diameter → articular dish
- Reduce the Ulnohumeral joint → RH length
- Tracking



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**Arthroplasty Technique**  
Courtesy JSS



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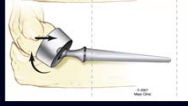

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Overlengthening      Loosening      Polyethylene Wear



Capitellar Damage      Component Dissociation



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**Arthroplasty**

**Controversies and unknowns**

- Head design: round vs anatomic
- Monopolar vs bipolar
- Stem fixation
- Long-term effects capitellum
- Mechanical failure rate



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## Arthroplasty

### Controversies and unknowns

- Head design: round vs anatomic
- Monopolar vs bipolar
- Stem fixation
- Long-term effects capitellum
- Mechanical failure rate



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### Results 2000-2015 RH Arthroplasty in Acute Trauma

- 135 patients, elbows, implants
- 3 Major implants (No bipolar)
  - Acumed- Anatomic
  - Avanta/Sbi- Round
  - Wright- Round
- 8 cemented vs 127 uncemented



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### Results 2000-2015 RH Arthroplasty in Acute Trauma

- 30% reoperation!!
  - Limited motion/HO/contracture (~15%)
  - Loosening (7%)
    - No difference b/w fixation type
    - Sbi (4%) >Wright (3%)>Acumed (0%)
  - Ligament (~5%)
- Removal of implant
  - Sbi 3.5%
  - Wright 3.5%
  - Acumed 0%



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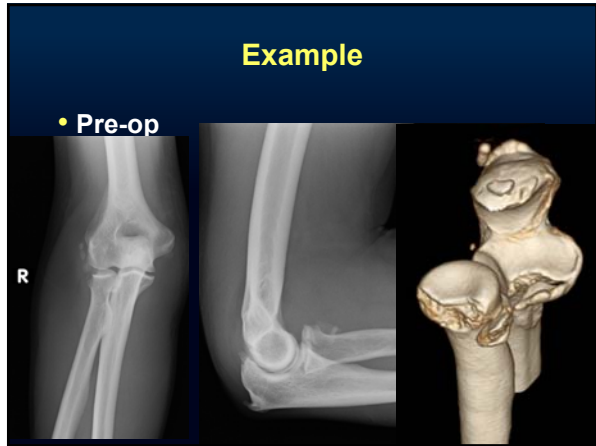
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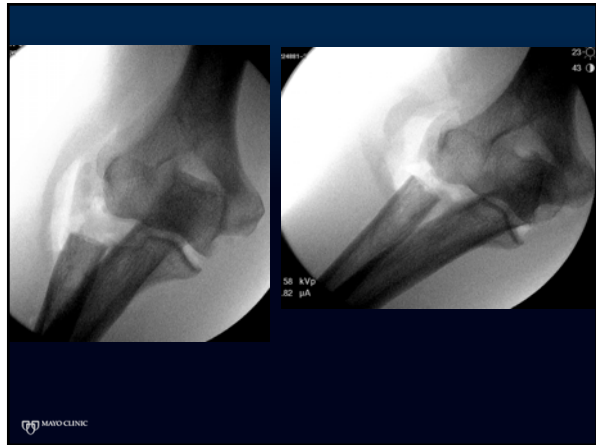
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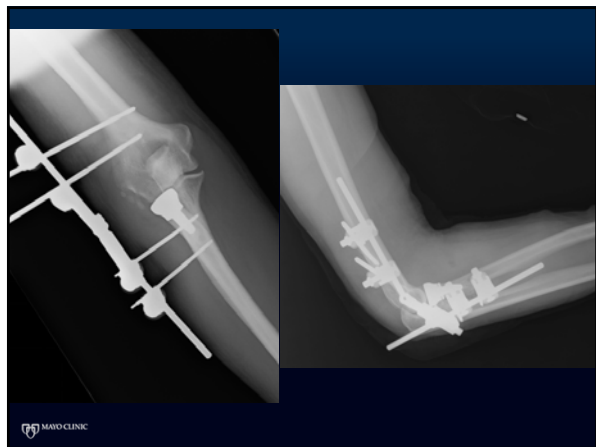
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# Outcomes

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## Outcomes RH Arthroplasty

**TABLE 24-1 Summary of 15 Years of Literature Involving Prosthetic Radial Head Replacement**

Author	Year	Type	PROSTHETIC INTERVENTION		Total (%)	Follow-up (yr)
			Acute	Delayed		
Knigh <sup>6</sup>	1993	Mono	31 (94)	—	31 (94)	4.5
Judet <sup>6</sup>	1996	Bipolar	7 (100)	7 (72)	14 (86)	4
Wick <sup>11</sup>	1998	Mono	—	—	50 (73)	—
<b>Total (% satisfied)</b>			<b>127 (92)</b>	<b>25 (48)</b>	<b>202 (82)</b>	<b>3-4</b>
Alme <sup>1</sup>	2003	Bipolar	18 (100)	4 (0)	22 (82)	1.5
Bain <sup>1</sup>	2005	Mono	10 (100)	6 (50)	16 (81)	2.8
Doornberg <sup>2</sup>	2007	Mono	27 (82)	None	27 (82)	3.5
<b>Total (% satisfied)</b>			<b>127 (92)</b>	<b>25 (48)</b>	<b>202 (82)</b>	<b>3-4</b>

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# When Should I fix The Coronoid?

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## Articular Stability of the Elbow

Clinical Experience

Not all coronoid fractures have to be fixed!!



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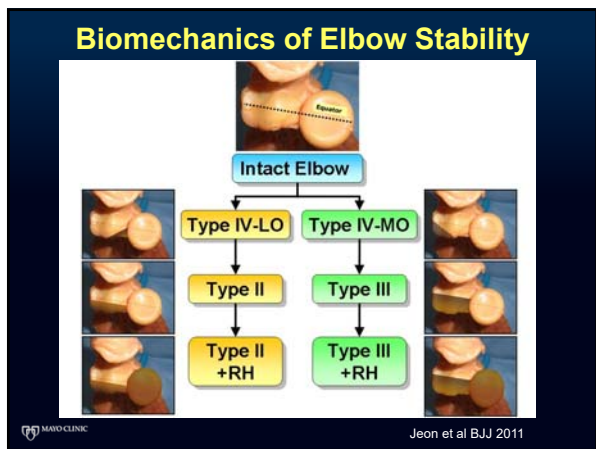
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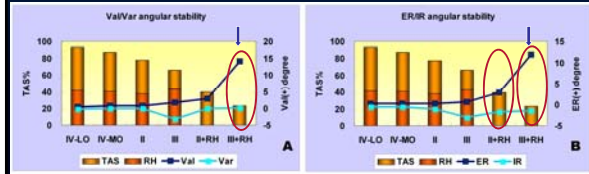
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# Articular Stability of the Elbow

## Results - Angular



- Oblique fractures are stable : V/V; I/E rotation
- Type II coronoid with r head; stable in V/V; I/E rot
- Type II coronoid without r head; unstable in V/V; I/E
- Type III coronoid with r head; unstable in V/V;I/E
- Type III coronoid without r head – grossly unstable!

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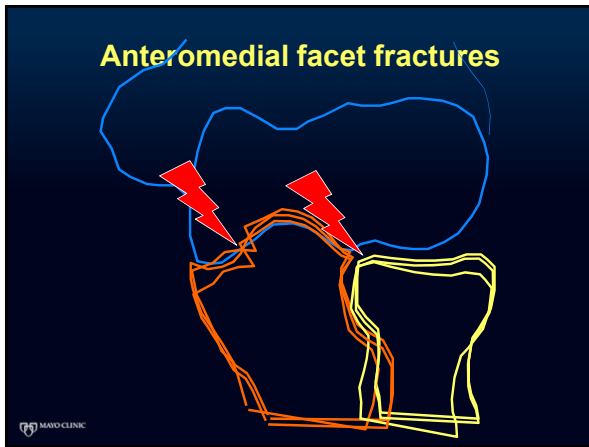
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## Biomechanical Studies

Authors	Fracture Type	Pattern	Recommendation
Beingsnessner et al.	Transverse	tip	Do not need fixation
Hartzler et al.	Transverse	50%	50% coronoid; intact RH. Stability tested after LUCL repair to determine need for ORIF.
Hartzler et al.	Transverse (Triad model)	50%	50% coronoid height fractures c/ RH fx = ORIF
Closkey et al.	Transverse	RM I, II, III	ORIF 2,3
Schneeberger et al.	Transverse	30%, 50%	<30% no ORIF. 50% = ORIF
Jeon et al.	Transverse	RM II, III	Type II fractures (40% coronoid & intact ligaments) +/- fixation. Type III fractures (60%) = ORIF.
Jeon et al.	Oblique	AM, AL	Oblique fractures <20% of the articular surface area no ORIF.
Pollock et al.	Oblique	AM subtype I, II, III	AM subtype I fractures require only LCL repair; large AM subtype II and all subtype III fractures should be fixed.

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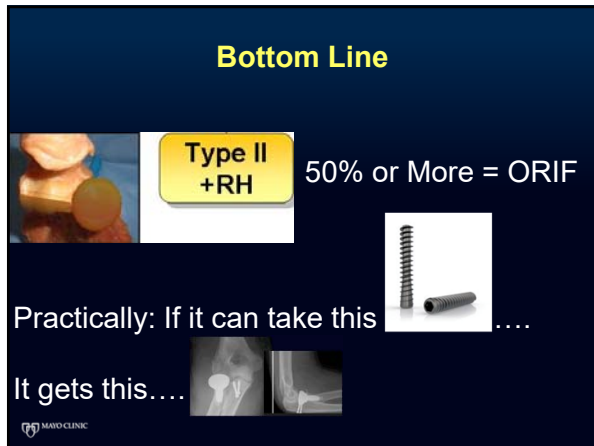
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### Bottom Line

Type II +RH 50% or More = ORIF

Practically: If it can take this ....

It gets this....



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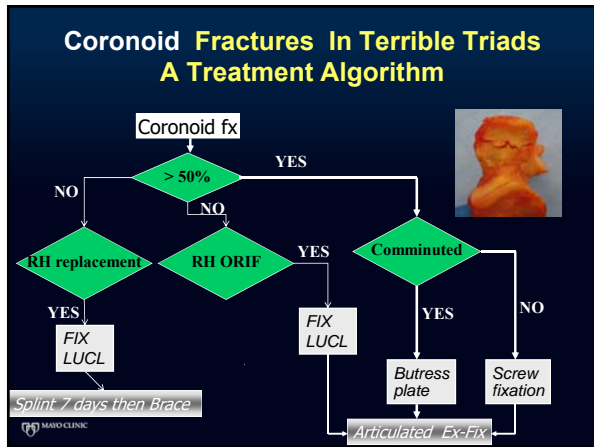
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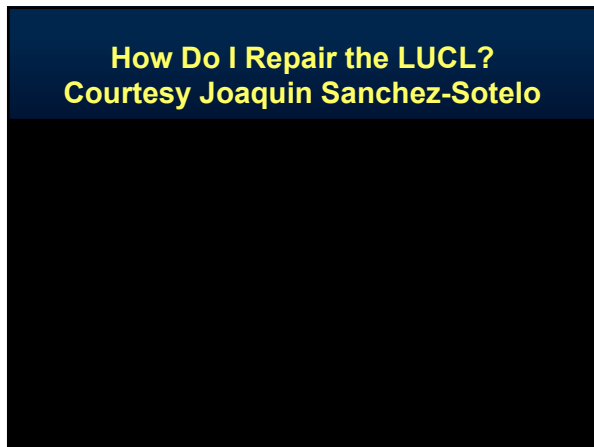
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### How Do I Repair the LUCL? Courtesy Joaquin Sanchez-Sotelo



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### How Do I Neutralize the MCL

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#### Effectiveness of the Lateral Dynamic External Fixation After Elbow Ligament

By Srinath Kamineni, MD, Hirotsune Hirahara, MD, Patricia Neale, MSc, Kai-Nan An, MD, PhD, and Bernard F. Morrey  
Investigation performed at the Department of Orthopedic Biomechanics, Mayo Clinic

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## Summary

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### Principles of Treatment

- (1) Restore lateral column
  - RH fixation  $\leq$  3 fragments
  - Replace others
- (2) Fixation of the coronoid fragment
  - $\geq$ 50% ~Can it take a screw?
- (3) Repair LUCL
  - Deep to crista  $\rightarrow$  Superficial to LE
- (4) Repair or neutralize the MCL
  - If ORIF of RH or unstable MCL

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