

Total Elbow Arthroplasty: an Update

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ELSEVIER

REVIEW ARTICLES

Prevalence and projections of total shoulder and elbow arthroplasty in the United States to 2015

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Hypothesis: This study examined national trends and projections of procedure volumes and prevalence rates for shoulder and elbow arthroplasty in the United States (U.S.). This study hypothesized that the growth in demand for upper extremity arthroplasty will be greater than the growth in demand for hip and knee arthroplasty and that demand for these procedures will continue to grow in the immediate future.

Materials and methods: The Nationwide Inpatient Sample (1993-2007) was used with U.S. Census data to quantify primary arthroplasty rates as a function of age, race, census region, and gender. Poisson regres-

Procedure volumes and rates increased at annual rates of 6% to 13% from 1993 to 2007.

Compared with 2007 levels, projected procedures were predicted to further increase by between 192% and 322% by 2015.

The revision burden increased from approximately 4.5% to 7%.

The growth rates of upper extremity arthroplasty \geq THA, TKA.

Of particular concern was the increased revision burden.

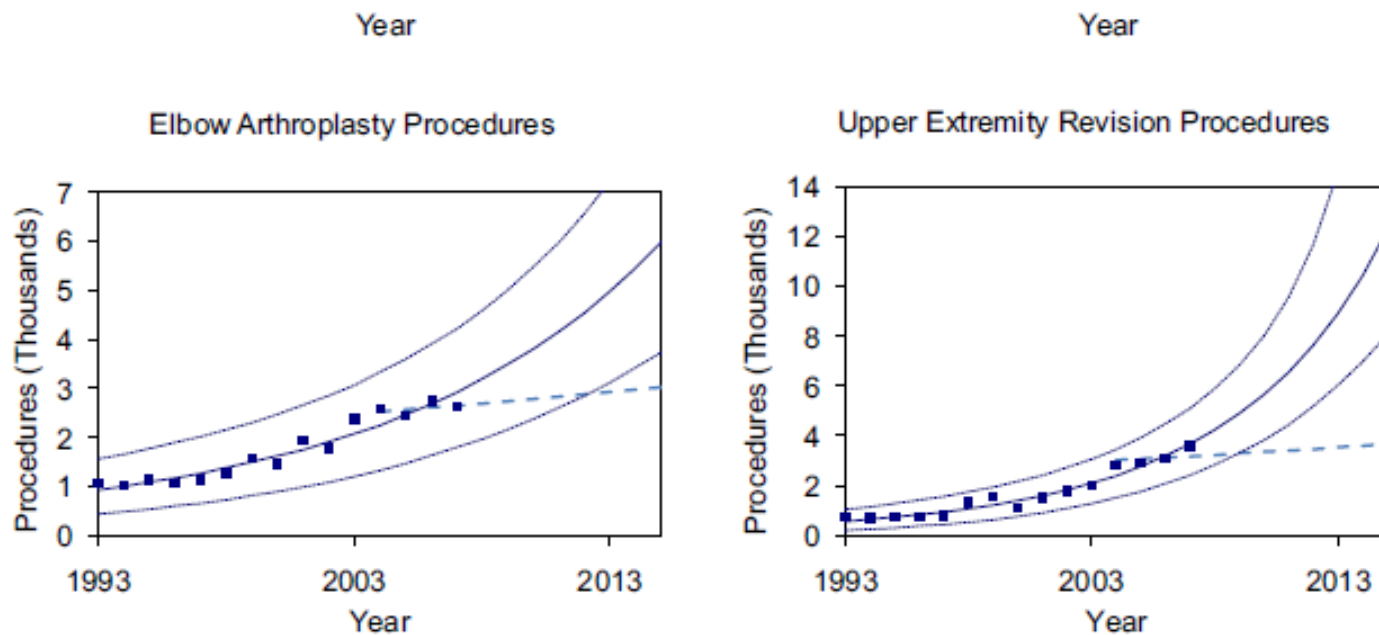


Figure 1 Total annual procedure counts were plotted for each procedure (*squares*). The resulting model fits and projections from the variable rate Poisson regression were plotted (*solid line*) together with the 95% confidence intervals (*dotted lines*). Results from a fixed-rate model based on data from 2003 to 2006 were also included for reference (*dashed line*). The number of total procedures increased steadily over the period studied.

Indications for Total Elbow Arthroplasty are expanding

- Rheumatoid/inflammatory Arthritis
- Posttraumatic Arthritis
- Acute Distal Humerus Fractures
- Nonunion of Distal Humerus Fractures
- Tumors
- Revision



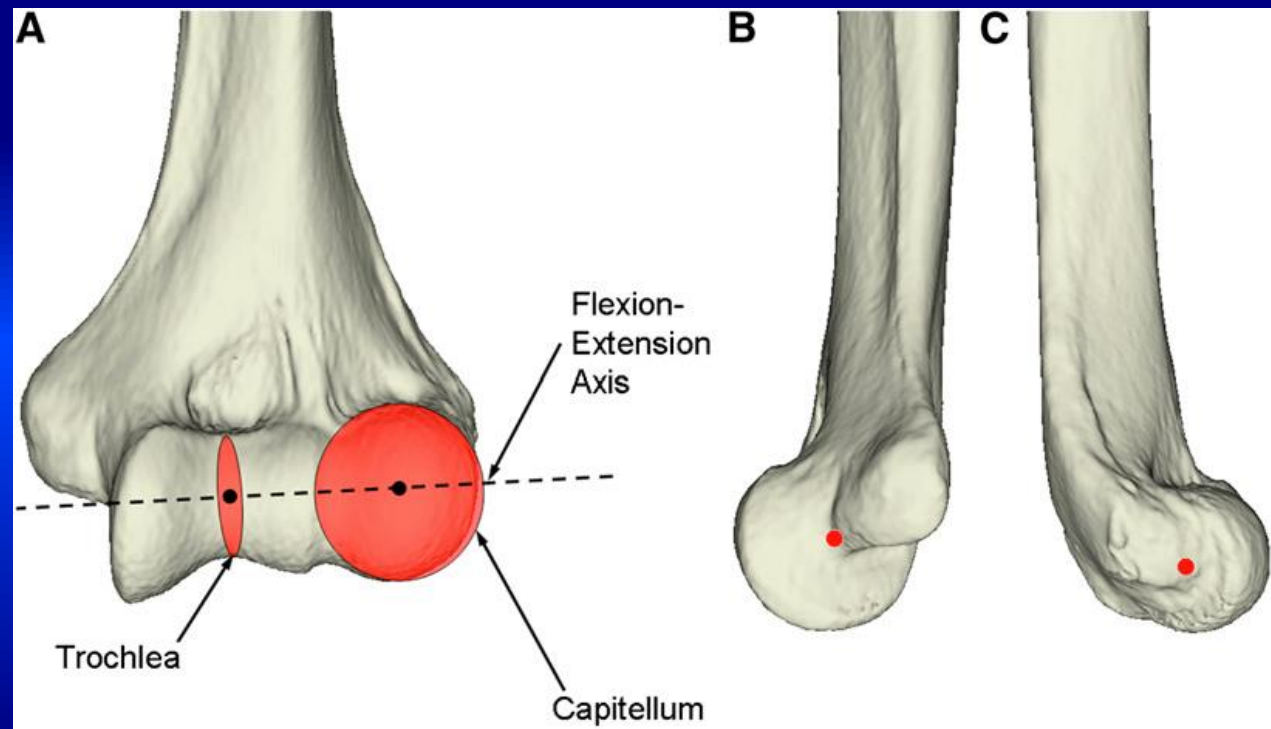
Elbow Joint Forces

- Ulnohumeral joint – 1-3 x body weight
- Cyclic loading
 - Extension – forces are directed anteriorly
 - Flexion – Posterior directed forces
- Weight bearing joint?



Design Considerations – Linked implants

- The elbow is not a rigid hinge
- FE axis technically challenging to identify and recreate with a prosthesis



History of Total Elbow Arthroplasty

- First used in RA
- Initial Linked devices were “fully constrained” and performed poorly due to high rates of mechanical loosening



Design Considerations – Linked implants

- 5-10 degrees of built in laxity allow out of plane forces to be transferred to the soft tissues = “semi-constrained”
- Theoretically decreases stresses at the bone-cement and cement-implant interfaces
- Decreased aseptic loosening rates



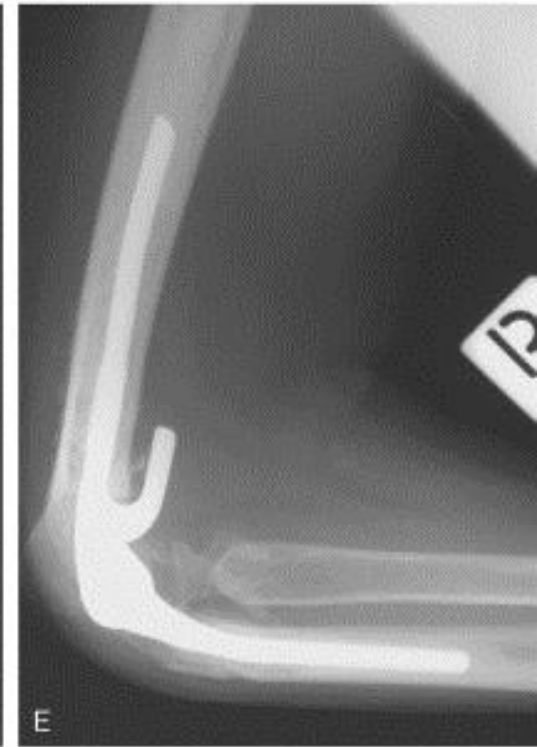
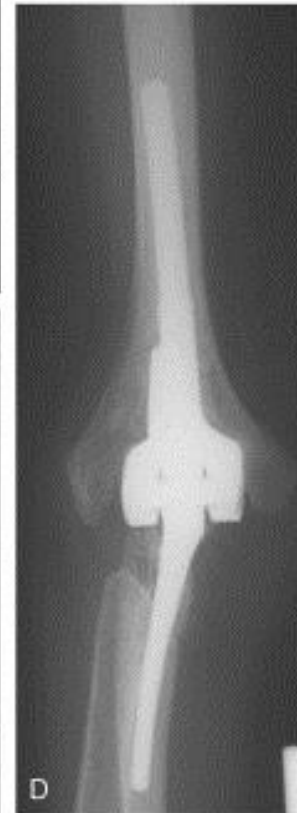
History of Total Elbow Arthroplasty

- Un-Linked resurfacing implants also fared poorly due to issues of mechanical loosening and instability



History of Total Elbow Arthroplasty

- Coonrad-Morrey - Linked Semiconstrained Device
 - Currently third generation
- Indications and use increasing

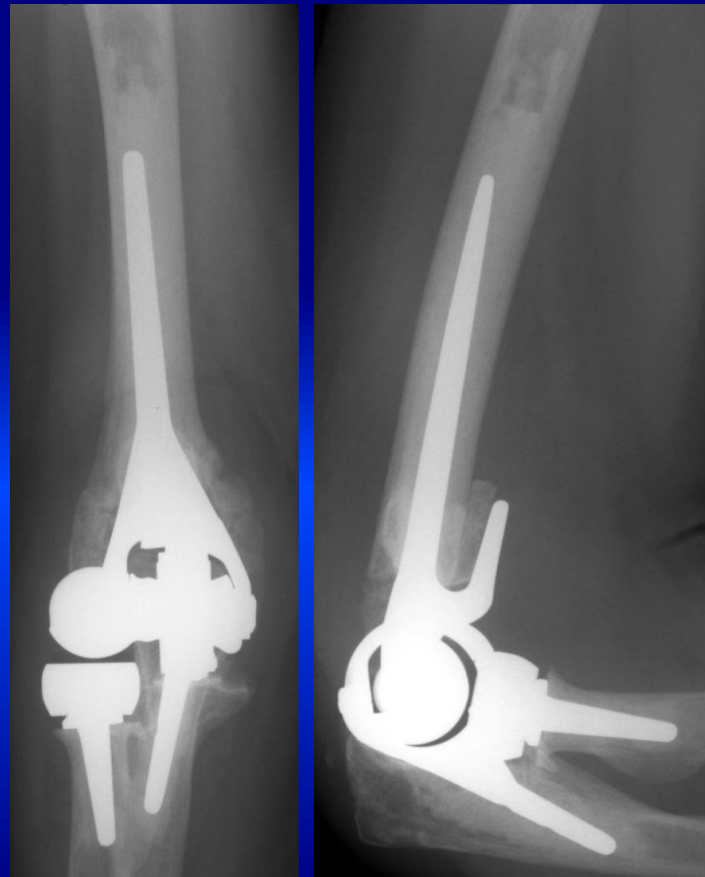


EVOLUTION OF THE TEA

NEW DESIGNS

- Sorbie
- Solar
- Discovery
- Acclaim
- Latitude

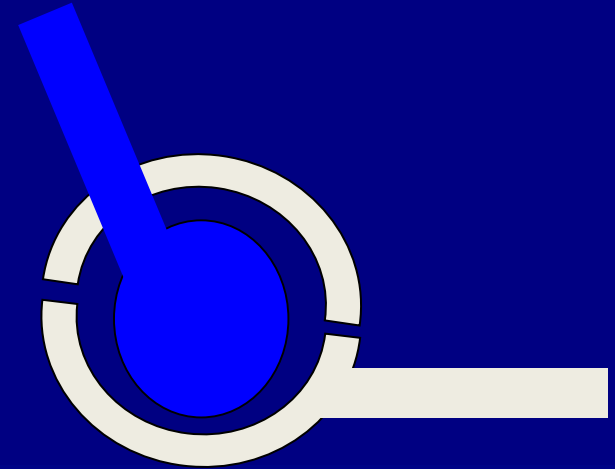
Radial head - variable



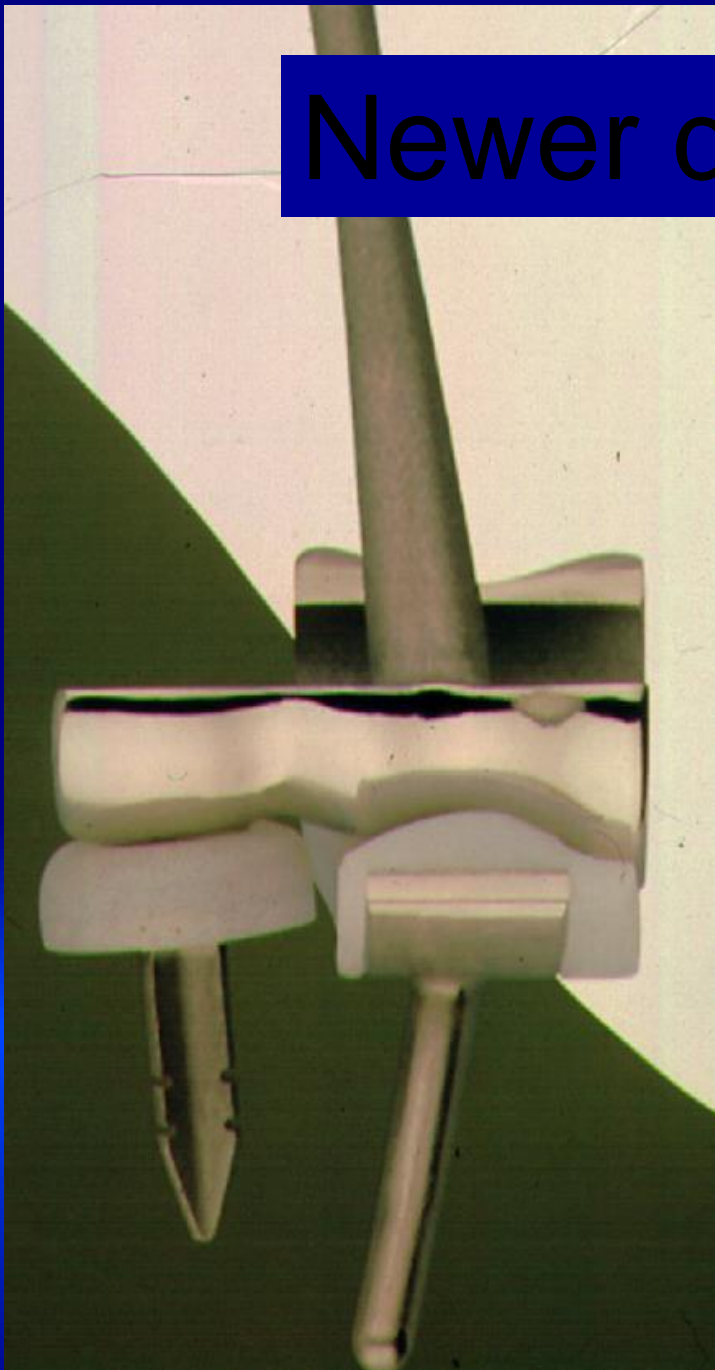
EVOLUTION OF THE TEA

NEW DESIGNS

- Sorbie
- Solar
- Discovery - linked/unlinked
- Acclaim - linked/unlinked
- Latitude - linked/unlinked



Newer designs - no data



Coonrad-Morrey TEA

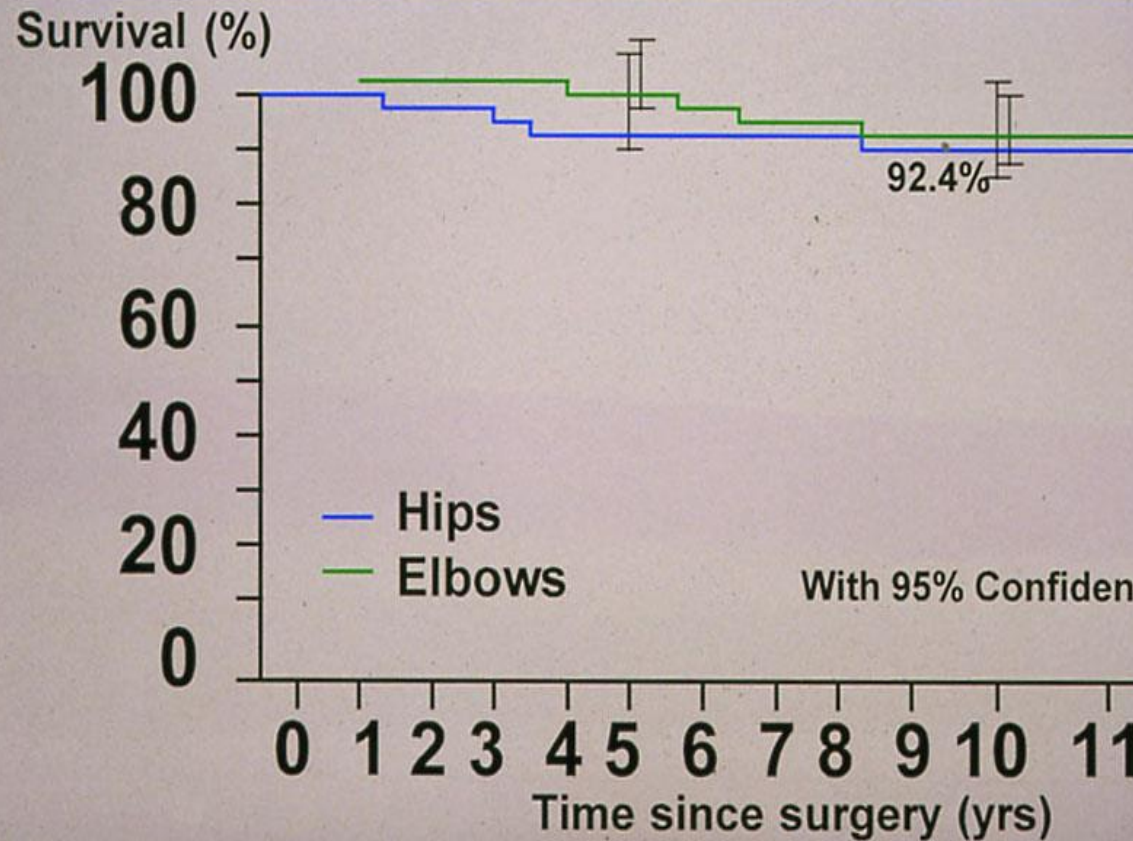
MAYO 20 YR
EXPERIENCE

- PROCEDURES - 977 (1982 -)
 - RA → 345 (34%)
 - PT 280 (29%)
 - Revision 256 (26%)





Survival for RA: Charnley THA / Coonrad-Morrey TE



OUTCOME APPROACHES THAT OF THA
In RA



Coonrad-Morrey TEA

MAYO 20 YR
EXPERIENCE

- PROCEDURES - 977 (1982 -)
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 - PT → 280 (29%)
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Failure Patterns After Linked Semiconstrained Total Elbow Arthroplasty for Posttraumatic Arthritis

By Thomas Throckmorton, MD, Peter Zarkadas, MD, Joaquin Sanchez-Sotelo, MD, PhD, and Bernard Morrey, MD

Investigation performed at the Department of Orthopedics, Mayo Clinic, Rochester, Minnesota

Background: Total elbow arthroplasty for the treatment of posttraumatic arthritis is associated with a relatively high failure rate. An understanding of these failures can lead to improved implant design and surgical technique.

- 69 elbows
- 9 y followup
- Most common cause of early failure (<5 y) = infection
- Intermediate-term failure (5-10 y) = bushing wear
- Late failure (> 10 y) = loosening

were subjectively satisfied. Kaplan-Meier analysis demonstrated a thirteen-year survival rate of 70% with revision or resection for any reason as the end point.

Conclusions: Semiconstrained total elbow arthroplasty in patients with posttraumatic arthritis places high demands on the implant and is associated with a relatively high failure rate. Seventy-five percent of failures occur in patients less than

TABLE III Complications and Reoperations Following Total Elbow Arthroplasty*†

Complications (68)		Reoperations (122)	
Implant-Related (29)	Non-Implant-Related (39)	Implant-Related (47)	Non-Implant-Related (75)
Bushing wear (17)	Triceps insufficiency (9)	Bushing exchange (20)	Irrigation and debridement (37)
Ulnar component loosening (4)	Deep infection (7)	Implant resection (6)	Triceps repair/reconstruction (10)
Humeral component loosening (3)	Wound-healing problems (4)	Humeral component revision (5)	Wound revision/coverage (4)
Ulnar component fracture (3)	Periprosthetic fracture (4)	Ulnar component revision (5)	Manipulation under anesthesia (4)
Humeral component fracture (2)	Arthrofibrosis (4)	Irrigation and debridement with polyethylene exchange (4)	Radial head excision (2)
	Ulnar neuropathy (3)	Bone-grafting (4)	Open reduction and internal fixation of periprosthetic fracture (2)
	Radial head impingement (2)	Total elbow arthroplasty reimplantation (3)	Heterotopic ossification resection (2)
	Heterotopic ossification (2)		Olecranon bursectomy (2)
	Reflex sympathetic dystrophy (1)		Interposition arthroplasty (2)
	Deep hematoma (1)		Hardware removal (2)
	Ulnar nerve rupture (1)		Ulnar nerve repair (1)
	Proximal biceps (1)		Revision arthroplasty (1)

34% complication rate.

28% required at least one additional operation.

Majority of complications and reoperations were not implant related

Bushing wear



Fig. 3-A



Fig. 3-B

Fig. 3-A Despite evidence of worn bushings as seen on this anteroposterior radiograph, osteolysis and radiographic evidence of loosening were not commonly seen. **Fig. 3-B** Lateral radiograph demonstrating radiolucent lines in the humerus, which were present initially after surgery and remained unchanged.



High revision rate after total elbow arthroplasty with a linked semiconstrained device. Orthopedics. 2009 May;32(5):321.

[Patil N](#), [Cheung EV](#), [Mow CS](#).

- Solar TEA device (Stryker)
- 13 elbows, retrospective 8.4 yrs followup
- PTA in 6, inflammatory arthritis in 7
- Avg age 63 yrs
- 7/13 elbows required at least 1 revision
- 2 humeral loosening, 2 ulnar loosening, 2 bushing failure, 1 deep infection
- 3 of the 4 loose components were associated with periprosthetic fx



Modes of Wear After Semiconstrained Total Elbow Arthroplasty

By Steven H. Goldberg, MD, Robert M. Urban, Joshua J. Jacobs, MD, Graham J.W. King, MD, MSc, FRCSC, Shawn W. O'Driscoll, PhD, MD, FRCSC, and Mark S. Cohen, MD

16 retrieved components (15 revision, 1 post-mortem). Mean 5 y after implantation

All humeral and ulnar bushings were damaged

Metal-on-metal wear was common

Histopathology of tissues similar to that in osteolysis in TKA, THA: titanium alloy, poly debris, barium sulfate particles → particulate burden which is pathogenic

Conclusion: multimodal wear in TEA can lead to osteolysis, aseptic loosening, and prosthetic and periprosthetic fx



Titanium alloy and PE with histiocytes in periprosthetic tissues

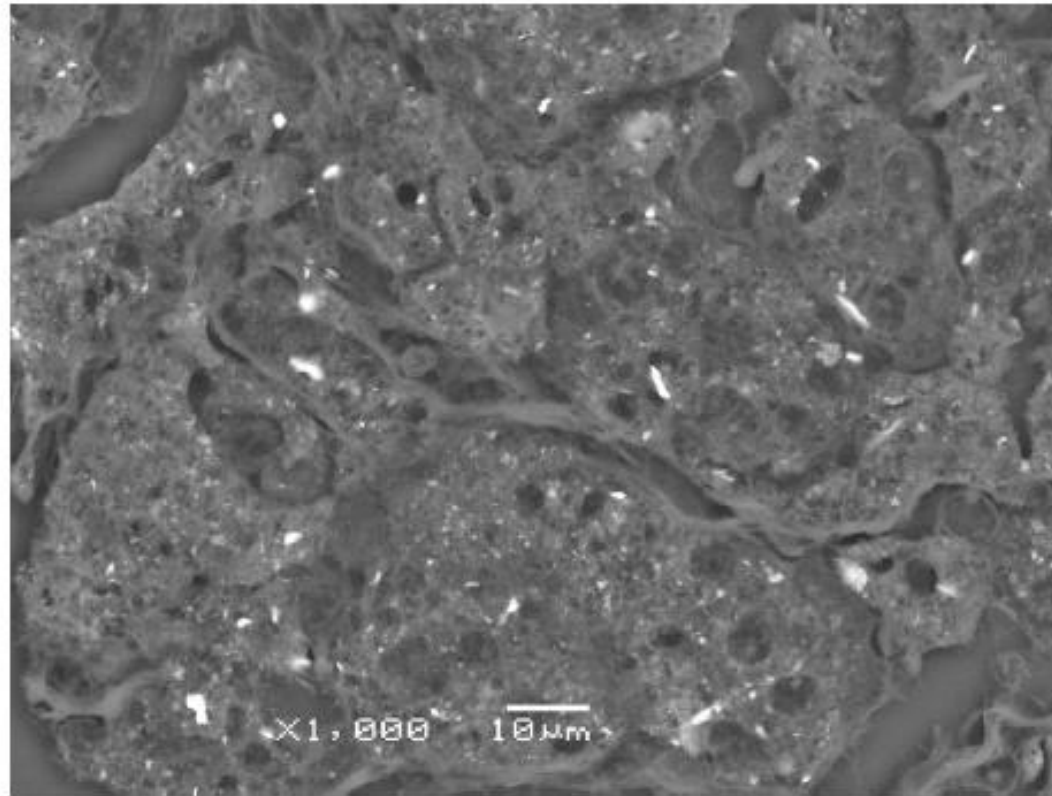


Fig. 6

An implant (Case 1) was revised for osteolysis with aseptic loosening and fracture of the ulnar component after sixty-eight months. As in the majority of the implants, titanium alloy granules and shards were the most abundant particulate within histiocytes in the periprosthetic tissues. This backscattered scanning electron micrograph reveals that most of the titanium alloy particles, which appear as bright inclusions due to their relatively high atomic number, were typically submicrometer in size ($\times 1000$).



Bushing wear, metal on metal wear

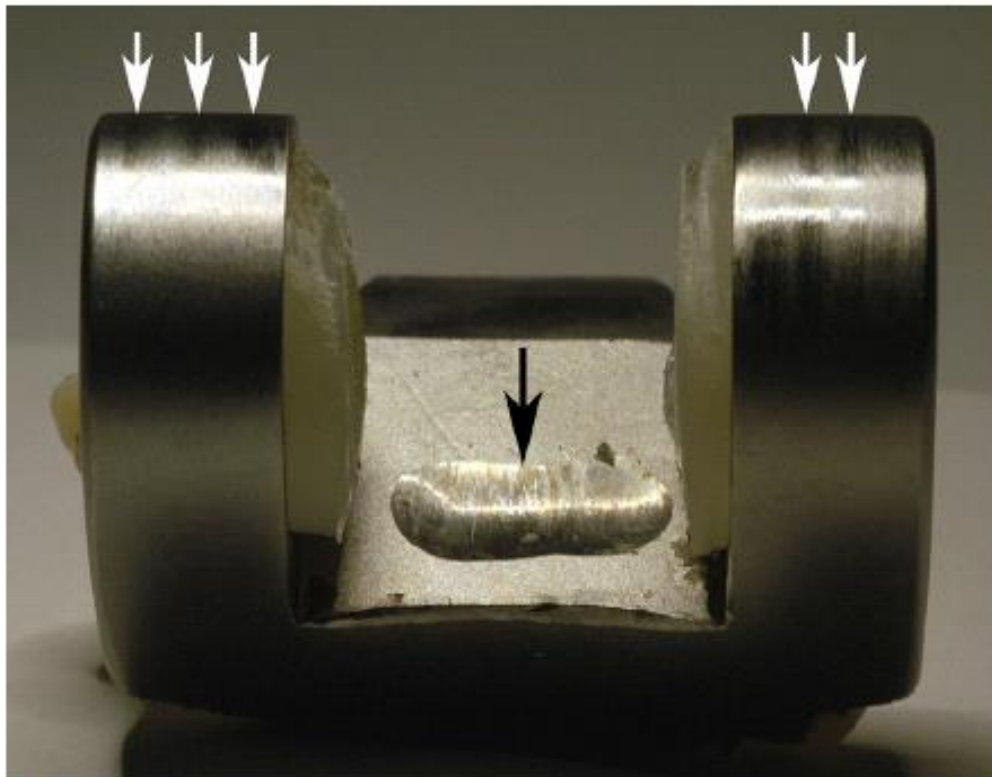


Fig. 5
An implant (Case 5) that was revised after forty-eight months for fracture of the humeral component and aseptic loosening of the ulnar component. Wear and deformation of the ulnar polyethylene bushings resulted in unintended contact and metal-on-metal wear between the ulnar and humeral devices (black arrow) and between the humeral condyles (white arrows) and cement and bone of the ulna.

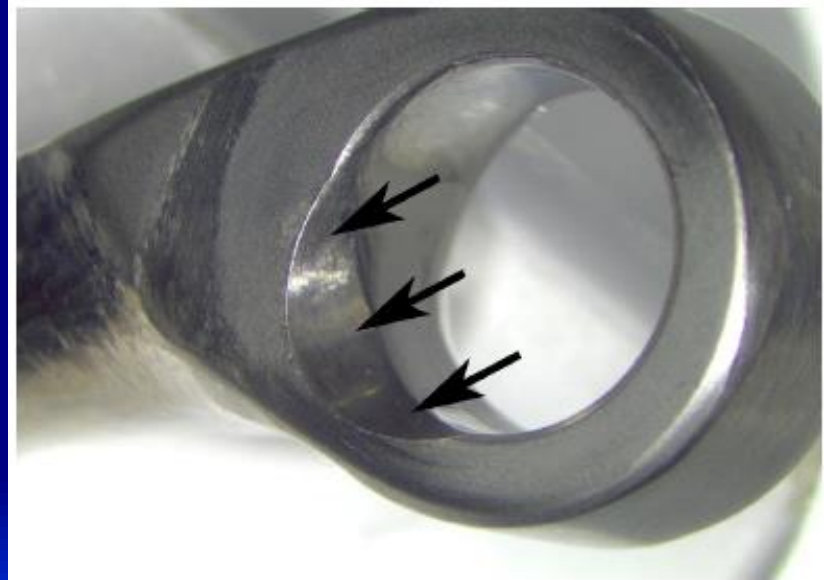


Fig. 4-A



Indications expanding



McKee et al. JSES 2009, 18:3-12

Multicenter PRCT: ORIF vs TEA for displaced intra-articular distal humeral fractures in elderly patients

TEA: Decreased re-operation rate than ORIF

TEA: Slightly better motion

TEA: quicker recovery

TEA: superior functional scores in early follow-up, but not significant at 1 year follow-up.

TEA is preferable in elderly pts with complex dist hum fxs that are not amenable to internal fixation



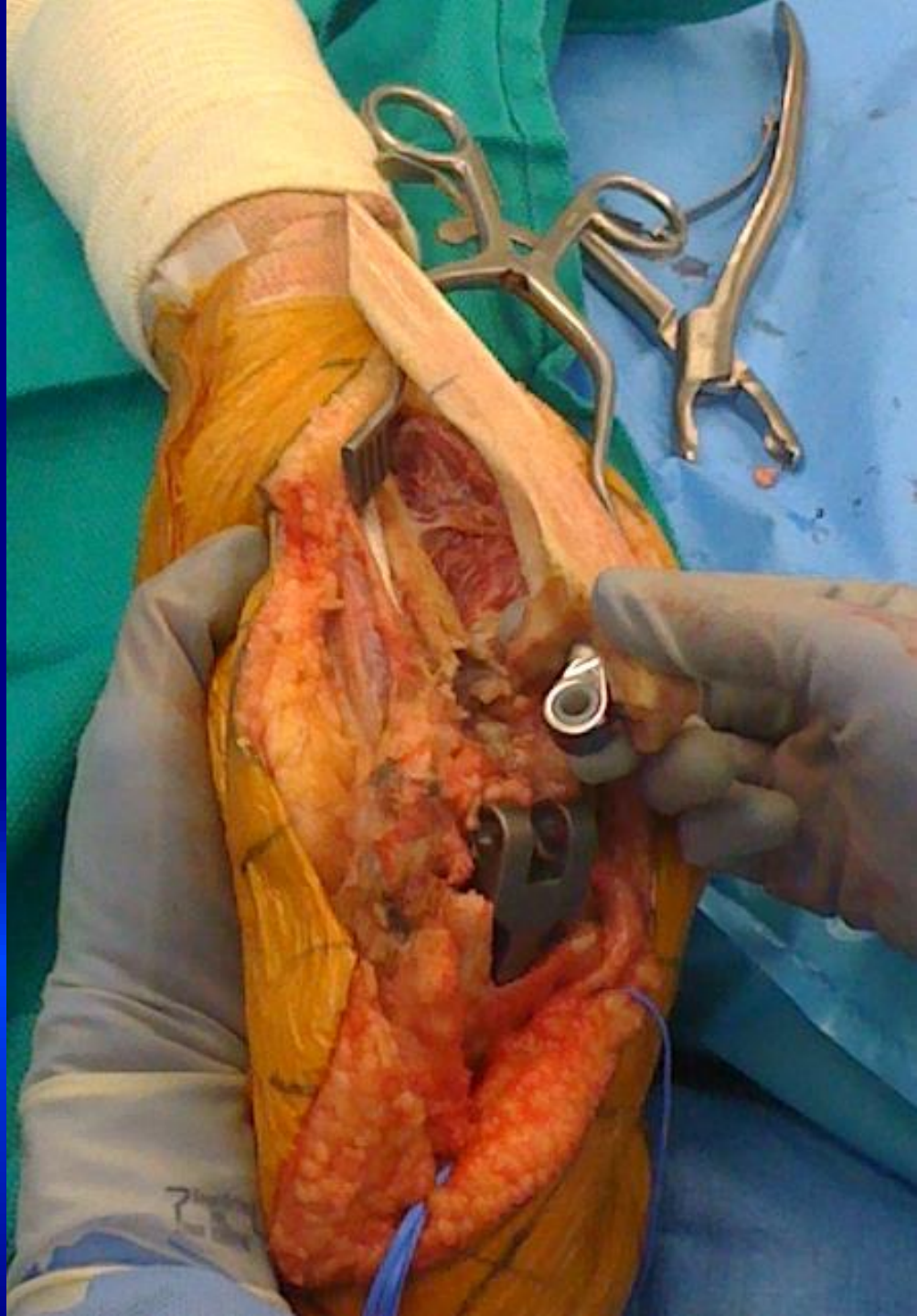
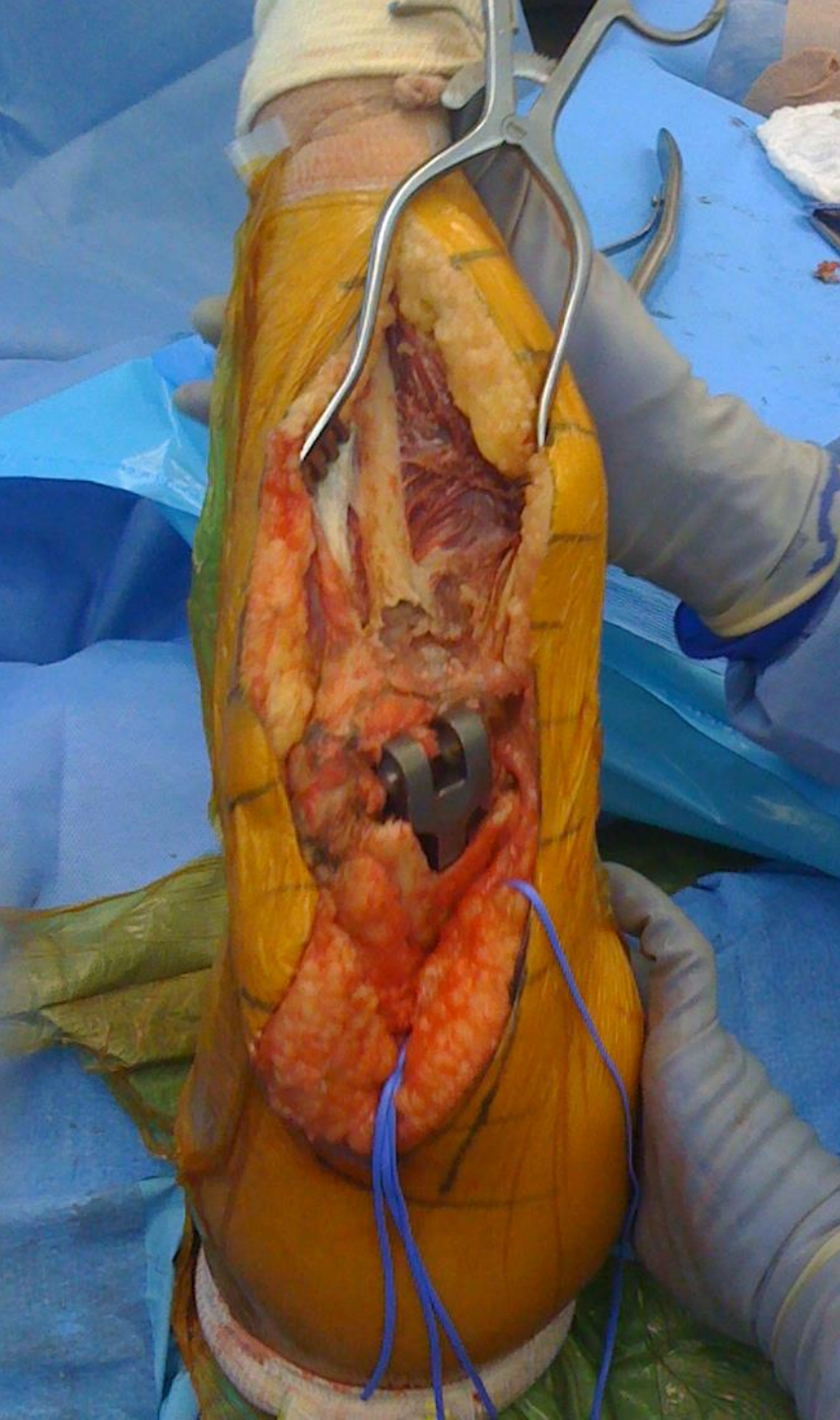
Question: What will happen with long-term follow-up of these patients?



Case







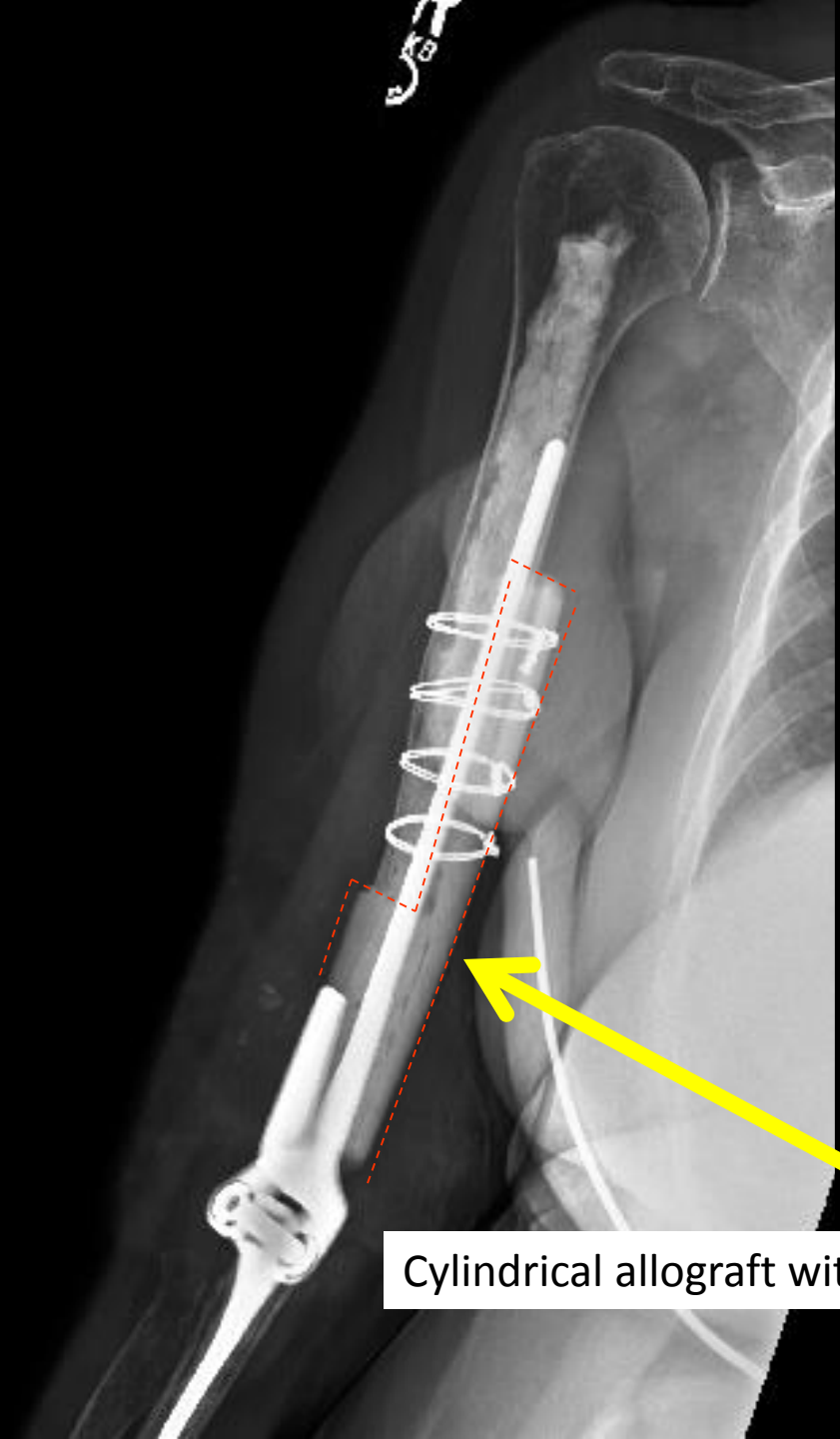




Case







Cylindrical allograft with long, plank step-cut

Follow-up



What's new?



Posterior Wound Complications at the elbow



Immobilize the elbow in extension and elevation



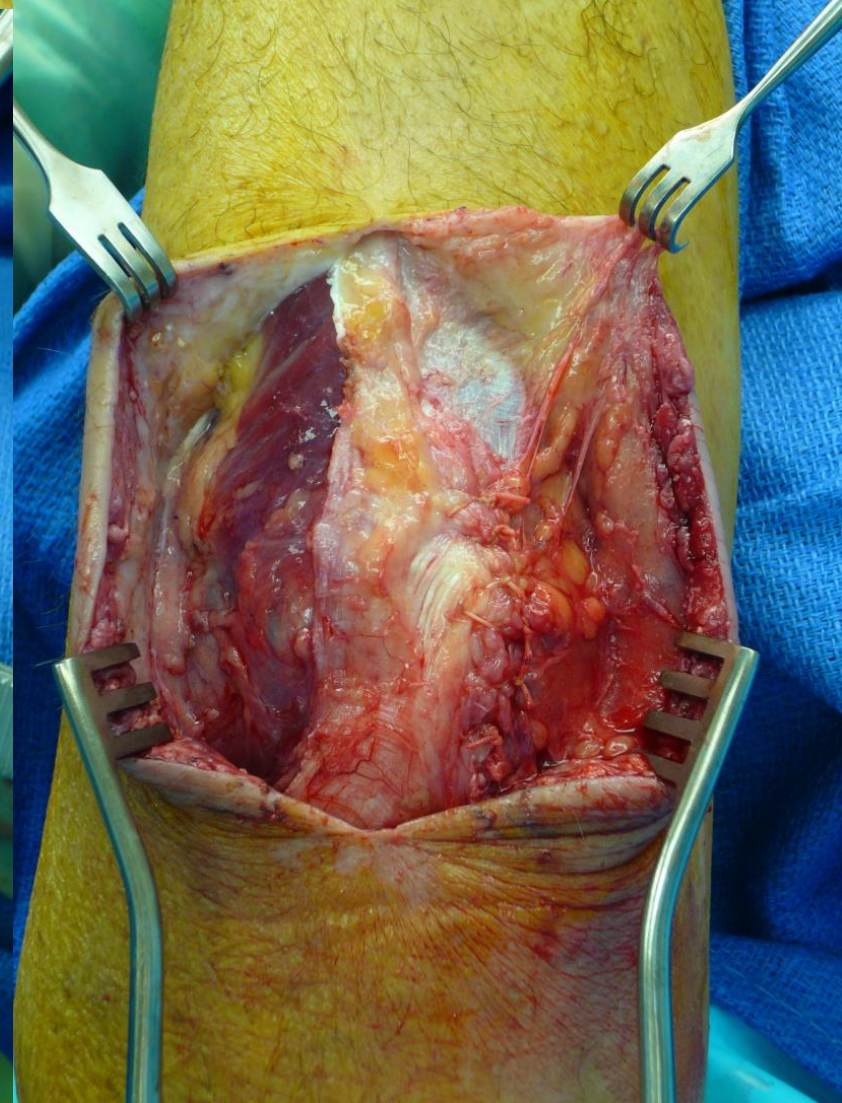
The "anconeus slide": rotation flap for management of posterior wound complications about the elbow

JSES 2011

Kristen E. Fleager, MD, Emilie V. Cheung, MD*

Department

Background
with surgical
described in



Incisional wound vac



Summary

- Best surgical results are achieved in patients with Rheumatoid Arthritis.
- Improvements in component design have lowered complication rates, but they are still high
- Avoid in posttraumatic arthritis
- Results of newer designs remain to be seen
- Revision TEA Rates will increase



Thank you

