Total Elbow Arthroplasty: an Update

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REVIEW ARTICLES

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

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\textbf{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.

\textbf{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 >= 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%)
OUTCOME APPROACHES THAT OF THA In RA
Coonrad-Morrey TEA

MAYO 20 YR EXPERIENCE

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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
34% complication rate.
28% required at least one additional operation.
Majority of complications and reoperations were not implant related.
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.

- 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
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 (×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.
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
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 “aneconeus slide”: rotation flap for management of posterior wound complications about the elbow

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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