Title: Revision total elbow arthroplasty (rTEA) for humeral loosening (HL): what is the optimal prosthesis to reduce re-revisions for humeral loosening?

Authors: K. Achors, MD; D. Teytelbaum, BS; J. Patel, MS; K. Saloman, BS; G. Haidamous, MD; L. Mesa, MD; P. Simon, Ph.D; K. Cronin, MD; M. Frankle, MD

Background: Revision total elbow arthroplasty (TEA) in the setting of humeral loosening (HL) is a challenging problem. Design modifications such as increasing humeral stem and/or flange length has been proposed to enhance humeral fixation. The purpose of this study was to compare the effectiveness of the 5 different designs to treat humeral loosening: 1) medium stem with short flange (MS-SF), 2) medium stem with long flange (MS-LF), 3) long stem with short flange (LS-SF), 4) long stem with long flange (LS-LF), and 5) long stem with very long flange (LS-vLF). The primary objective was to determine the revision rate for humeral loosening based on implant design. The secondary objective was to describe the functional outcomes, complications, and signs of radiographic loosening at final follow up.

Methods: We retrospectively reviewed 181 TEAs performed between 2000 and 2021. Patients who underwent revision for humeral loosening with a minimum of 2-year clinical and radiographic follow up were included. One-hundred twenty-five cases were excluded for: 1) ulnar loosening (n= 35), 2) infection with no HL (n= 28), 3) failed bushing (n= 19), 4) primary TEA (n= 18), 5) hardware failure without HL (n= 16), 6) insufficient follow up data (n= 6), 7) trauma (n= 2), 8) excisional arthroplasty as first procedure for HL (n= 1). Fifty-six revision TEAs performed on 46 elbows (45 patients) met the inclusion criteria. Indication for primary TEA were rheumatoid arthritis (17), acute fracture (7), post traumatic arthritis (8), failed internal fixation or malunion (6), osteoarthritis (2), silicone synovitis (2), and unknown (4). Patients were then categorized into 5 different groups based on stem and flange lengths: 1) MS-SF (n= 9), 2) MS-LF (n=4), 3) LS-SF (n=7), 4) LS-LF (n=21), and 5) LS-vLF (n=12). Failure rates among each group were compared. Additionally, the results of LS-LF and LS-vLF were combined and compared against the other three groups. Mean clinical and radiographic follow up was 54 months (SD, 51 months) and 57 months (SD, 57 months), respectively.

Results: The overall re-revision rate for humeral loosening was 18%. The highest rate was observed with MS-LF prostheses (50%, n= 2), followed by the MS-SF prosthesis (22%, n= 2), the LS-SF prostheses (43%, n=3), and LS-LF prostheses (14%, n=3). There was no humeral loosening with the LS-vLF prostheses. We observed a lower combined revision rate (9%) in the combined LS-LF and LS-vLF group compared to the shorter stem or flange groups (1,2, and 3) (35%). Mean range of motion was 21° (range: 0°-90°; SD: 21°) to 123° (range: 0°-160°; SD: 37°) at final follow-up. Complications included ulnar neuropathy (n= 17; 37%), radial neuropathy (n= 8; 17%), infection (n=7; 15%), ulnar loosening (n= 6; 13%), and fracture (n= 6; 13%). None of the elbows were considered radiographically loose at most recent follow up.

Conclusion: The use of longer stems with longer flanges reduces the rate of humeral loosening after revision TEA compared to other stem designs. Nevertheless, revision TEA for humeral loosening has a high complication rate, the most common being neurologic.