Case report

Mechanical failure of the Coonrad-Morrey linked total elbow arthroplasty: A case report

T.T. Pham, N. Bonnevialle, M. Rongières, P. Bonnevialle, P. Mansat*

Institut de l'appareil locomoteur du CHU de Toulouse, Département d'Orthopédie et traumatologie, Hôpital Pierre-Paul-Riquet, place du Docteur-Baylac, 31059 Toulouse Cedex, France

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ABSTRACT

Semiconstrained (linked design) total elbow arthroplasty is indicated in a wide variety of cases. Long-term survival is better than with non-linked prostheses. However, mechanical failure of the hinge mechanism is a complication that may occur during follow-up. We report a case of failure of the axle assembly of a Coonrad-Morrey elbow prosthesis 8 years after implantation for nonunion of a supracondylar distal humerus fracture. Initial revision surgery included changing the axle and the polyethylene bushings. Revision surgery was necessary 1 year later when the axle failed again. A custom-designed locking axle had to be used to stabilize the hinge mechanism. After 3 years follow-up, the hinge was intact, there was no loosening of the components and function of the elbow was good.

1. Introduction

Total elbow arthroplasty (TEA) has been indicated for numerous degenerative inflammatory and traumatic elbow diseases [1–4]. Semiconstrained designs are usually used, allowing a certain degree of valgus/varus of the ulnar component in the hinge mechanism. One of the complications of these TEA at follow-up is wear of the polyethylene bushings in the hinge, and axle failure [5–10]. We report the case of repeated failure of the axle component due to excess valgus in a patient 8 years after initial TEA for nonunion of a supracondylar fracture of the distal humerus and propose treatment.

2. Case report

In 2001, a sedentary 61-year-old, right-handed patient presented with nonunion of a supracondylar fracture the right distal humerus (Fig. 1). CT scan confirmed nonunion and identified joint space disappearance. TEA was therefore indicated. A hinged prosthesis was chosen to obtain stability of the elbow following resection of the epiphysis of the distal humerus. A Coonrad-Morrey® TEA was used (Zimmer, USA).

Initial surgery was performed on December 11, 2001. A Bryan-Morrey approach was used and the ulnar nerve was isolated. The distal humerus was resected along with associated ligaments and muscles originating in the epicondyle. A 15 cm humeral component with an elongated anterior flange was cemented to the humeral diaphysis. A standard length ulnar component was also cemented and both components were stabilized by a self-locking axle with male and female parts. The collateral ligaments were not repaired. The intact radial head was preserved (Fig. 2).

Postoperative follow-up was uneventful and the patient recovered functional range of motion without pain. Elbow flexion/extension arc of motion included an extension deficit of 45°, to 130° flexion. Rotational range of motion was 160°, 80° pronation and 80° supination. The Mayo Elbow Performance Score was 95 points with a DASH score of 7 points.

The patient underwent a yearly follow-up consultation. In April 2009, severe wear of the polyethylene bushings of the hinge and axle failure was observed [8]. There was no sign of component loosening (Fig. 3). Surgical revision was performed on May 5, 2009. Metallosis was present due to metal-on-metal contact between the components at the hinge (Fig. 4). The male part of the axle had broken and the 4 flanges had fractured, explaining the separation of the male from the female parts. The polyethylene bushings were worn both in the humeral and ulnar components (Fig. 5). Revision included a synovectomy, changing the different polyethylene bushings and placing a new axle in the hinge mechanism.
The axle failed again at postoperative month 6. Repeat revision surgery was performed in November 2010, and the male part of the axle was broken in exactly the same manner as the first time with a fracture of the 4 flanges. The polyethylene bushings were only slightly worn. The components were perfectly cemented. A custom made axle was designed by Zimmer, including an axle with a locking system screwed to the outside of the hinge, providing stability of the axle and preventing any detachment (Fig. 6).

The patient was evaluated at a follow-up consultation in January 2014, or 3 years after the second revision surgery. The elbow was stable, there was no pain and there was functional range of motion. The Mayo Elbow Performance Score was 95 points with a DASH score of 25 points. Radiographic assessment showed an intact hinge mechanism and axle, a correctly centered ulnar component and no signs of component loosening 12 years after they were first implanted (Fig. 7).

### 3. Discussion

Linked design total elbow arthroplasties are indicated for many etiologies and studies reporting results with the Coonrad-Morrey prosthesis are the most frequent [4]. This design provides stability of the elbow joint despite bone loss or ligament defects. The semiconstrained design of TEA on the market today limits stress on the component-cement-bone interfaces, but increases stress on the hinge mechanism. Nevertheless, long-term survival of these implants is good and seems to be better than with non-linked designs [4,11–13].

However, wear of the polyethylene bushings has been shown to gradually develop during follow-up, resulting in progressive angulation of the ulnar component in the humeral component which may cause metal-on-metal contact when the polyethylene
bushings have disappeared. This excessive angulation increases stress on the axle of the hinge mechanism, which then fails [6,8–10]. Nevertheless, this is a rare complication. Only two (1.2%) of these cases occurred in our experience in a series of 164 Coonrad-Morrey TEA performed between 1997 and 2014. Lee et al. [8] reported a revision rate of 1.3% (12 cases/919) for polyethylene bushing wear. Polyethylene debris can also be released and cause a foreign body granuloma around components, which then loosen [6]. However, if wear is identified early, the bushings can be changed in a simple procedure before the components loosen, as in our clinical case report [8].

Several factors have been identified which may accelerate wear. Overuse of the elbow has been reported, in particular in young men treated for posttraumatic arthritis [13,14]. Wear is greater with severe preoperative deformities [8,14]. Indeed, the prosthesis compensates for these deformities while increasing stress on the hinge mechanism. Resection of the end of the distal humerus with detachment of associated ligaments and epicondylar tendons causes a loss of dynamic stability of the elbow and increases stress on the hinge [9]. Poor alignment or positioning of the components in relation to each other is also a source of wear [9]. Finally, excess valgus causes asymmetric stress on the hinge and wear of the polyethylene bushings and the hinge [8,10,14].

It is difficult to prevent this wear. Ligament and musculotendinous balance must be restored as effectively as possible to avoid excess stress on the hinge. Preservation of a non-pathological radial head can limit valgus stress. Reproduction of the elbow rotation axis and optimal alignment of components can also reduce stresses on the axle and the hinge. Finally, it is important to limit overload- ing the elbow by avoiding carrying heavy objects and repetitive movements of the upper limb. Annual follow-up is essential with static or stress views of the elbow, to identify severe wear of the polyethylene bushings and propose changing the hinge mechanism and bushings before axle breakage or loosening of the implants occurs.

4. Conclusion

Long-term survival of semiconstrained elbow arthroplasties is favorable. However, wear of the hinge mechanism is a risk during follow-up. Regular radiographic follow-up can identify axle failure. In case of failure, if the components have not loosened, the axle alone can be changed associated with new polyethylene bushings. In case of repeated failure of the axle, a custom-designed locking axle should be used.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


