CASE REPORT

Natural History of a Traumatic Olecranon Loss Resulting in a "Reversed Elbow": A Case Report

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Abstract

Case description: A 58-year-old woman suffered an open displaced olecranon fracture with extensive soft tissue damage when she was involved in a car accident in Africa. Local doctors performed a debridement of the elbow. Later, she presented in our centre for further treatment. There was a possibility of active infection, for which antibiotics were given and a debridement was performed. We then applied dynamic external fixation to minimize infection risk. Physiotherapy started soon after. External fixation was removed after 2 months. On follow-up, the patient reported no pain and no signs of major instability were present. Therefore, we agreed not to perform additional surgery. Annual follow-up radiographs showed progressive remodelling of the joint. Eleven years after the initial trauma, a reversed elbow has formed. It is a fully functional neo-articulation that is shaped by osteophyte formation and erosion of ulna, radius and humerus. The patient is free of pain and shows intact flexion and supination, while extension and pronation are limited. She has regained good elbow function and can perform most of her daily activities.

Conclusion: Invasive reconstructive surgery with implantation of foreign material should be avoided or postponed in heavily contaminated fractures to avoid infection. It could be valuable to consider a watchful waiting strategy, which sometimes results in a good functional end result. Nature can be kind, which has been proven in our case.

Keywords: Bone remodelling, Elbow joint, Natural history, Neo-articulation, Olecranon fracture, Traumatic olecranon loss.

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Introduction

The olecranon is a common site of fracture, accounting for almost 10% of all upper limb fractures. This can be disruptive to the joint's anatomy and necessitates proper treatment to ensure restoration of the articular alignment. When untreated, complications like limited range of motion (ROM), joint stiffness, degeneration and instability can ensue. Olecranon fractures are often treated with open reduction and internal fixation (ORIF). Standardised treatment guidelines for near complete loss of the olecranon with concurrent injury of the additional stabilisers of the elbow are lacking.

Up to now, research has focused on intensive treatment of such injuries, instead of allowing the body to heal itself.

As our review of the literature did not yield similar cases, we present this clinically relevant case of a traumatic olecranon fracture with major substance loss. Without reconstruction, a natural "reversed elbow" has evolved over time, with higher activities of daily living (ADL) capabilities than expected.

Case Description

A 48-year-old female school principal suffered an injury to the right elbow. The patient was involved in a car accident while traveling through Africa. The car landed on the side, her arm hanging out the window and scraping the tarmac. Resulting from this trauma, she had an open displaced olecranon fracture, with the proximal end of the olecranon completely missing up to the level of the coronoid. The distal humerus was also fractured and soft tissues were extensively damaged. She was admitted to a local hospital, where doctors performed a debridement of the elbow. Later, she presented in our centre (UZA, Antwerp University Hospital, Belgium) for assessment (Fig. 1A) and further treatment. There was some remaining debris in the elbow, with a possibility of active infection. Antibiotics were given. We performed a debridement with anterior capsule release, by which a nearly full arc of motion was made possible. A dynamic joint distractor (DJD) external fixation system was applied (Fig. 1B) to minimize infection risk, with the option of doing reconstructive surgery later. The DJD preserved the axis of rotation, while allowing early mobilisation of the joint, although non-weight-bearing and with a restricted ROM. The patient soon started with physiotherapy and basic revalidation. After 2 months, external fixation was removed and physiotherapy intensity increased. During follow-up, she reported no pain and clinically no signs of major instability were present. Therefore, we agreed not to perform additional surgery. We went for a watchful waiting strategy instead.

The patient reported alteration of sensitivity due to ulnar nerve damage caused by the initial trauma. Electromyography (EMG) confirmed a denervation of the ulnar nerve along with some motor impairment. In the years following, the patient experienced persistent loss of dexterity in the right hand. She reported

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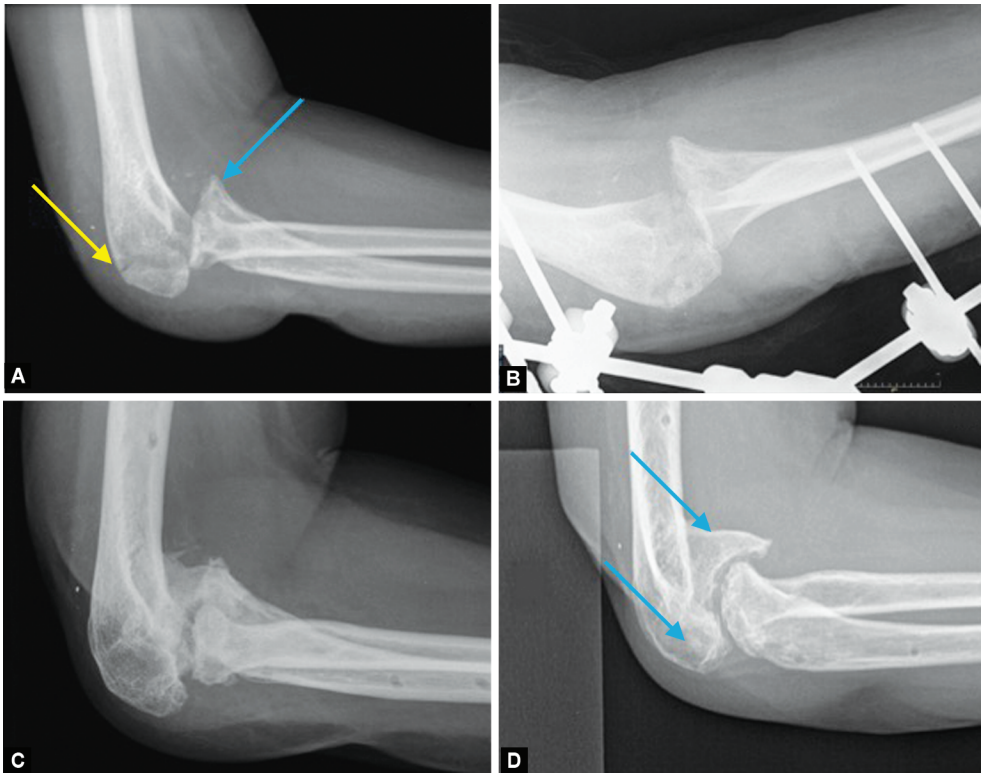


Figs 1A to D: Lateral view radiographs of the right elbow in (A) November 2006, on initial presentation at our centre, showing the ulna without olecranon (blue arrow) and the humeral fracture line (yellow arrow); (B) One week after debridement and application of dynamic external fixation system; (C) In November 2007, progression of bone remodelling is noted; (D) January 2011 further progression with formation of humeral "cup" (arrows)

intermittent cracking of the elbow during active motion and avoided putting pressure on the arm, because of a feeling of instability. However, she did not seek medical advice.

Annual follow-up radiographs (Figs 1C and D) showed progressive degeneration and remodelling of the elbow joint. At the time of this report, at age 59, 11 years after the initial trauma, we observe the surprising result of this joint remodelling (Fig. 2): A functional elbow joint; a *reversed elbow*, similar to the reversed shoulder prosthesis. The humeral bone functions as the joint socket, shaped by osteophytes. The eroded ulna and radius together function as a joint ball component. With the patient's full consent, we further examined the elbow's anatomy using computed tomography (CT) and magnetic resonance imaging (MRI). Its clinics and kinetics were tested by performing a thorough clinical examination.

The section below is a description of the functional outcome.

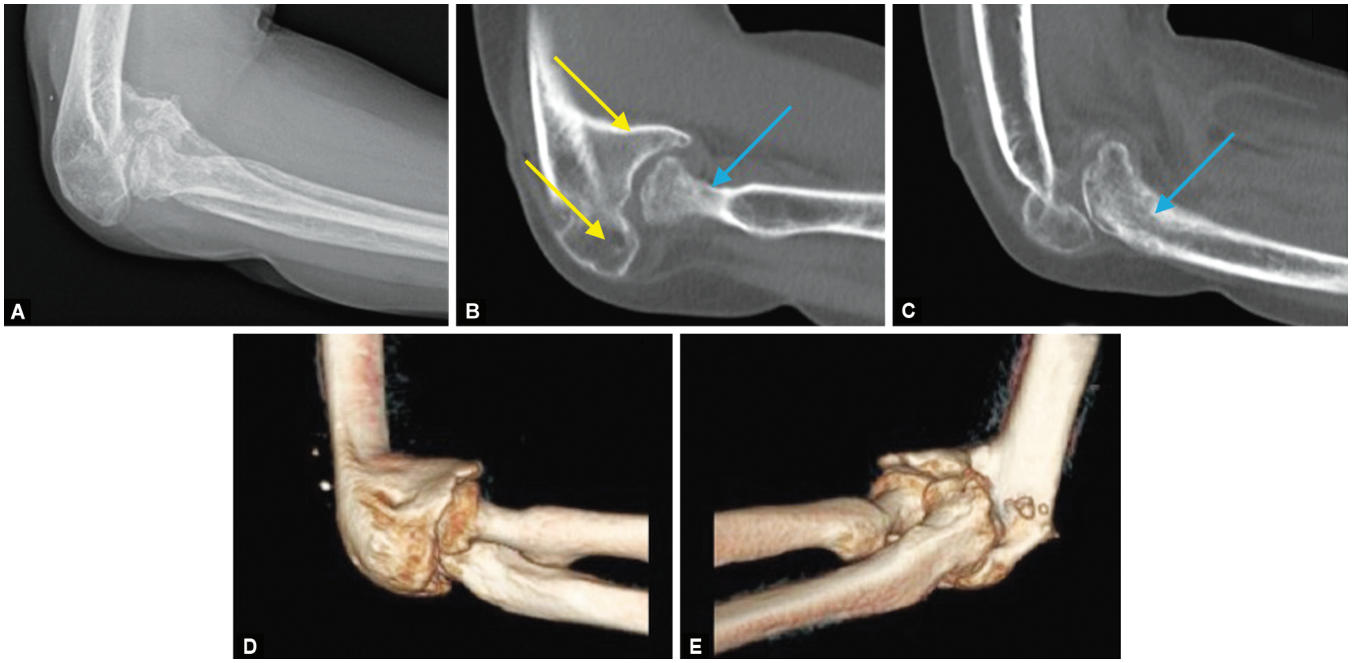
Discussion

Morrey et al. observed that most ADL can be accomplished with a ROM of 100° of flexion (30°–130°) and 100° of forearm rotation (50° pronation, 50° supination).[1] Other studies measure a range of 121° of flexion, with a minimum of >81° of flexion and a –13°–53° arc of forearm rotation.[2] Adjacent joints can compensate for the loss of motion so that even a flexion arc of 75°–120° does not lead to impairment.[3]

Our patient measures an arc of 75° (60°–135°) of flexion (Table 1, Fig. 3). Extension is limited, but flexion is mainly kept. This is well tolerated, as flexion is needed for feeding, personal hygiene and cell phone use.[4] These finding are confirmed by our patient, who is still able to perform such tasks. Supination is kept (90°), pronation is limited (10°) (Table 1, Fig. 4). As a consequence, she experiences difficulties while using a keyboard, a mouse or a knife. These tasks rely on intact pronation function.[4] Triceps muscle atrophy is clinically visible. Its function is maintained by some residual triceps tendon that is still connected to the ulna. Extension force is graded M4.

There is a significant influence of pain on elbow rating scores like the Morrey Elbow Performance Score (MEPS) and the Disabilities of the Arm, Shoulder and Hand score (DASH). They also measure functional outcome and a set of ADL. Our patient does not experience any pain in the elbow. As a school principal, she is not a high demand patient. For ADL, she developed accurate coping mechanisms. These factors contribute to an overall high end score (Table 2). Psychological factors contribute only little to the MEPS and DASH, though in this case they are of great importance to our patient.

Elbow stability is a major outcome parameter after trauma or surgery. It is provided by a combination of bony articular and soft tissue structures. Biomechanical studies report that, with additional stabilisers intact, up to 50%,[5] 75%[6] and even 80%[7] of the olecranon can be safely removed without causing major instability, but nevertheless demonstrating a reduction in stability that is proportional with further bone loss. This makes subluxation and dislocation much more likely. A 100% olecranon resection is devastating to the joint's stability, even when additional stabilisers are intact.[6] Considering our case, with a nearly complete olecranon loss and extensive soft tissue damage, a severely disabling end result was expected.



Figs 2A to E: Recent (2017) state of the right arm: (A) Lateral radiograph. CT imaging [sagittal multiplanar reformat (MPR)] of elbow joint with (B) radius (blue arrow) and humeral socket (yellow arrows) and (C) degenerated ulna (arrow); (D) Lateral and (E) medial view on CT imaging [volume rendering (VR) technique], showing a clear view on the reversed elbow joint

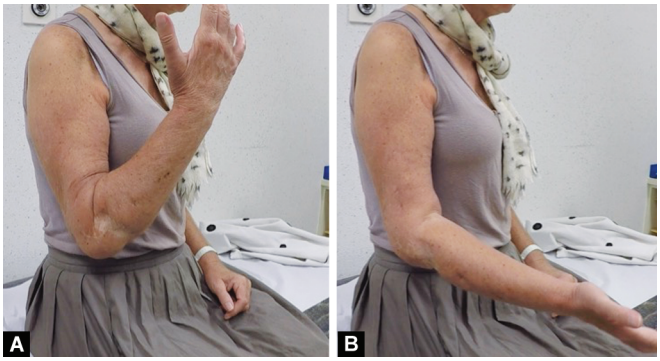
Table 1: Outcome data

Item	*Right (injured)*	*Left*
Measurement (cm)		
Upper arm circumference	23	26
Lower arm circumference	22	25
ROM (°)		
Extension	60	0
Flexion	135	142
Flexion-extension arc	75	142
Pronation	10	65
Supination	85	90
Pronation-supination arc	95	155
Power (M1–5)		
Extension force	4	5
Flexion force	5	5

There is a wide variety of fractures of the olecranon. This case can be classified as a Schatzker group D (comminuted)/group F (fracture dislocation) or a Mayo type 3B (unstable comminuted) fracture, which have a precarious prognosis.[8]

The main goal of treatment is to restore joint function and articular alignment. The vast majority of cases require surgical intervention. Open reduction and internal fixation is often preferred, because it allows early mobilisation. Treatment options include tension band wiring (TBW), intramedullary nailing and plating. In our patient, the olecranon was completely lost up to the level of the coronoid, so none of these fixation techniques were suitable for our case. Other techniques are fragment excision with triceps advancement, joint reconstruction and arthroplasty.

An immediate reconstruction or arthroplasty was contraindicated, as infection risk was very high.[9] It could have led to a disastrous result in our patient with a heavily soiled open and outside-in fracture. Instead, we chose for dynamic external fixation to minimize infection risk[10] and for soft tissue healing. There were no signs of infection along the way.

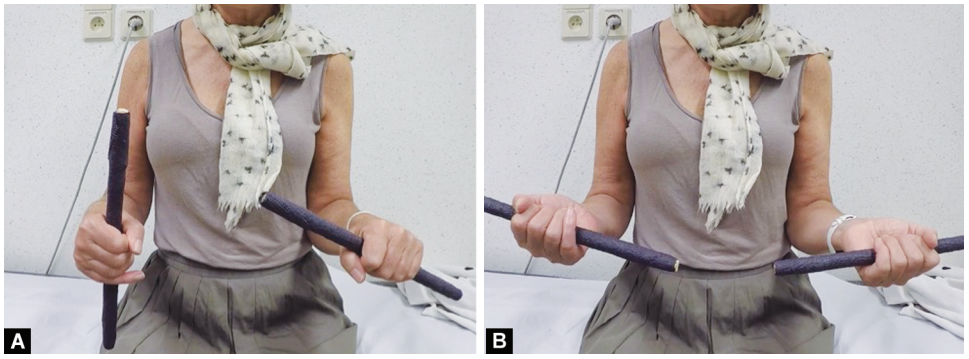


Figs 3A and B: Flexion (135°)/extension (60°)

This case suggests that a non-reconstructive approach could be an option for a select group of patients. The natural history of injuries tends to promote self-healing. Compensatory measures provide functionality, which is well demonstrated in this case of joint remodelling. It could be useful for surgeons to consider this option prior to immediate intervention. In particular, we urge consideration of this approach in patients with contaminated fractures, who have an unfavourable perspective with immediate reconstructive surgery. When chosen not to intervene, it is essential to watch closely over the process and step in whenever necessary.

The question rises whether it could be possible to deliberately initiate this natural remodelling process, and how to control it. How will it evolve? Is a surgical intervention necessary to stop the degenerative process?

If bone degeneration and osteophyte formation progresses, our patient will eventually present with increasing symptoms



Figs 4A and B: Pronation (10°)/supination (85°)

Table 2: Functional outcome scoring

Scoring system (0–100)	*Result*
MEPS[a]	90 (excellent)
DASH[b]	24 (mild disability)

[a]MEPS = Mayo elbow performance score, 100 = excellent result
[b]DASH = Disabilities of the arm, shoulder and hand, 100 = total disability

and/or functional deficit. Surgical intervention will impose itself, but of what sort? TEA,[11] allo-/autograft bone reconstruction[12] or interposition of Achilles tendon could be potential treatment options.

Conclusion

The natural history of traumatic olecranon loss with significant soft tissue damage has resulted in a functional elbow. Over time, a reversed elbow, a neo-articulation is formed by erosion of the ulna and osteophyte formation on the distal humerus (Fig. 2). Our patient is pain free and can perform most of her ADL. She has regained good elbow function, better than could ever be expected. This result is a fortunate consequence that may or may not have anything to do with the treatment that was provided. A pain-free course cannot be guaranteed and may be more patient related. Invasive surgery with implantation of foreign material should be avoided or postponed in heavily contaminated fractures to avoid infection. It could be valuable to consider a watchful waiting strategy instead, which sometimes results in a good functional end result. Nature can be kind, which has been proven in our case, and can accommodate for a lot of damage of the human body.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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