Case report

Avulsion fracture of the supinator crest as an indication for a sustained posterolateral (sub)luxation of the elbow. A case report, anatomical evaluation and review of the literature


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A B S T R A C T

The treatment of elbow injuries can be challenging because of the complexity of both anatomy and pathology. We present a rare traumatic avulsion fracture of the supinator crest of the ulna in a 37-year-old patient. Conservative treatment in a long arm cast for four weeks led to satisfactory results. Reproduction of the fracture on a cadaveric elbow clarified that the avulsed fragment holds the insertion of the lateral ulnar collateral ligament (LUCL). The mechanism of trauma that causes this fracture is a posterolateral (sub) luxation of the elbow, which usually causes the LUCL to rupture, but in rare cases the insertion of this ligament can be avulsed. A posterolateral (sub) luxation of the elbow can lead to chronic posterolateral rotational instability and therefore the stability of the elbow should be taken into account in the treatment of patients with such a fracture. A review of the literature concluded that this fracture often is associated with other injuries to the elbow and that it is easily missed on conventional AP and lateral radiographs. CT or MRI imaging and a radial head-capitellum view radiograph can be beneficial. Both conservative and operative treatments have been described with good clinical results.

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1. Introduction

Treatment of elbow injuries can be challenging because of the complexity of both anatomy and pathology. We present an uncommon injury of the elbow – an avulsion fracture of the supinator crest. A reproduction of this fracture on a human cadaver gives clarity on which structures are involved and accordingly we describe a possible mechanism of injury.

1.1. Case report

A 37-year-old man was treated in our emergency department after he fell with his bicycle on his left arm. On physical examination, there was a hematoma and tenderness to palpation on the lateral side of his elbow and crepitus during pro- and supination. Besides five degrees of elbow extension deficit compared to the contralateral side, the range of motion was normal. Further clinical tests showed no varus or valgus instability and a negative pivot shift test. Conventional AP and lateral radiographs of the elbow were normal but the radial head-capitellum view revealed an osseous fragment on the ventral aspect of the proximal ulna (Fig. 1a). A CT-scan showed that the fragment measured 30 by 4 mm and originated from the supinator crest (SC) of the ulna. The fragment was slightly displaced radially (Fig. 1b). A long arm cast was applied with the elbow flexed in 90 degrees and the wrist in neutral position. MR imaging revealed the fracture was located at the ulnar insertion of the lateral collateral ligament complex (LCLC), and the ligamentous part of the lateral ulnar collateral ligament (LUCL) was intact. It also showed bone oedema of the radial head and the capitellum. One week later, the patient was re-examined and again the elbow was found to be stable. Cast immobilisation was continued for a total of 4 weeks after which physiotherapy was started. Three months after the injury there were no complaints, a full range of motion and a stable elbow. Radiographs showed union of the fracture. Fifteen months after injury, the patient complained about an unpleasant feeling during push-ups and pushing away weights with a supinated forearm. Physical examination revealed a full range of motion, no tenderness to palpation and a stable elbow. Because of the mild character of the complaints, the patient chose not to undergo any further evaluation.

1.2. Functional anatomy and pathophysiology

To obtain a better understanding of the aetiology and affected structures in our case, we studied a right arm of an embalmed cadaveric specimen. After removal of the anconeus muscle, the SC
was visible with its LUCL insertion and the supinator tendon origin (Fig. 2a). We produced an avulsion fracture by an osteotomy with the same dimensions as in our case (Fig. 2b). The reproduced fragment contained the complete LUCL insertion and part of the origin of the supinator muscle. We confirmed the similarity by comparing a fluoroscopic image of the cadaver elbow with the clinical radiographs (Fig. 3).

The LUCL usually consists of the lateral collateral ligament (LCL), the annular ligament (AL), the accessory lateral ligament (ALL) and the LUCL (Fig. 4) [1–3]. The LUCL originates at the lateral epicondyle of the humerus and runs towards the insertion on the SC of the ulna which on average is 44 mm long [4,5].

The elbow contains static and dynamic stabilizers. Primary static stabilizers are the unlnohumeral articulation, the medial collateral ligament (MCL) and the LCLC of which the LUCL is the most important stabiliser. Secondary static stabilizers are the radial head, the flexor, extensor and supinator ligamentous attachments and the elbow capsule. The muscles that run along the elbow joint act as dynamic stabilizers [6]. An insufficient lateral complex can result in an acute or chronic posterolateral rotational instability (PLRI). This type of elbow instability is well described in the literature [6–13].

The chronic phase of a mild PLRI causes pain at the lateral or medial side of the elbow or gives an unpleasant or unstable sensation when the lower arm is supinated or valgus stress and axial loading is applied.

2. Discussion

Our patient presented with an uncommon isolated and minimally displaced avulsion fracture of the SC. Conservative treatment with a long arm cast gave satisfactory results. No known studies described the effect of an isolated fracture of the SC on elbow
stability. However, numerous biomechanical cadaveric studies described the impact on elbow stability when different stabilizers fail [3,7–9]. Olsen et al. [8] reported significant PLRI after cutting the LUCL at the site of the SC. Unfortunately the role of secondary stabilizers was not accounted for in this study. Cohen et al. [3] studied the effect on failure of the primary and secondary stabilizers on 40 cadaveric elbows. They found that transecting the LUCL at the site of the SC results in only a mild instability because the extensor carpi ulnaris and supinator muscle act as secondary stabilizers. In absence of these secondary stabilizers the tests resulted in a significant PLRI. This implies that an isolated rupture of the distal part of the LUCL results in mild instability when the secondary stabilizers are intact.

What mechanism of injury causes a fracture of the SC is unclear. An avulsion fracture of the CS could be an expression of LUCL failure in which not the ligament itself but its osseous attachment fails. According to the Horii circle in the mechanism of a posterior elbow luxation, the LUCL will fail first [14]. O’Driscoll et al. [6] divide a simple traumatic posterior elbow luxation in three steps. The mildest type is characterised by a posterolateral rotational subluxation, which reduces spontaneously and causes the LUCL to rupture. In this case, the patient does not present with a dislocated elbow. The oedema in the ventral part of the radial head and the dorsal aspect of the capitelium seen on the MRI of our case suggest that a posterolateral translation in the elbow joint must have occurred. This mechanism could have resulted in an avulsion fracture of the LCLC insertion, instead of a ligamentous rupture. For this case report, a review of the literature was performed to identify studies that describe this typical fracture. In 2003, McKee et al. [13] describe this type of fracture for the first time. Unfortunately, no detailed information regarding the treatment or outcome of this case was described. In 2013, Shukla et al. [10] describe an avulsion fracture of the SC in two patients. The first patient also suffered from an impression fracture of the capitelium and a radial head fracture. In this patient, all three fractures were treated operatively, which resulted in a good clinical outcome. The second patient sustained an impression fracture of the capitelium and was initially treated conservatively, but after 18 months the LUCL was reconstructed with a graft because of persisting PLRI. Schmidt-Horlohé et al. [11] published a retrospective cohort of 17 patients with an avulsion fracture of the SC in 2013. They found a strong association with radial head fractures (41%), coronoid fractures (29%), distal humeral fractures (24%) or a combination. They concluded that the avulsion fracture could be the result of a posterolateral (sub) luxation of the elbow in which the increased tension on the LCLC and a dorsal translation of the radial head cause this fracture. In 2014, Athwal et al. [12] reported the results of a retrospective cohort of 14 patients and concluded that this fracture often is missed on conventional anteroposterior and lateral radiographs. They also found associated injuries to the radial head, capitelium or a terrible triad. In 66% of these cases, surgery was performed but the SC fracture never was the leading indication. In 63% of the operated patients also, the SC fracture was treated because of persisting instability. The avulsion was treated either with anchors or screws. Patients who were treated conservatively also had a radial neck or radial head fracture. After an average of 39 months, all operatively and conservatively treated patients had a good clinical outcome with no complaints of PLRI.

No evidence is available on the management of an isolated fracture of the SC. With the presumed injury mechanism in mind, the stability of the elbow could be the most important factor for determining whether a conservative or operative treatment should be chosen. However, it is unclear how the size and displacement of the fragment influence the stability in the acute and chronic phase. Conservative treatment in our case led to union of the fracture and a satisfying outcome. Nevertheless, it did not prevent the mild symptoms of a possible PLRI after 15 months. It is unclear if an operative treatment would have led to a better overall outcome.

3. Conclusion

In conclusion, we can state that a fracture of the supinator crest is a rare finding. This fracture is most likely caused by a mechanism that involves a posterolateral (sub) luxation of the elbow. The fracture is easily missed on conventional anteroposterior and lateral radiographs and therefore a radial head-capitellum view can be beneficial. A CT or MRI scan can be of added value because of the high incidence of associated elbow injuries. Both conservative and operative treatments have been described with good clinical results.

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Authors’ contributions

Dr. D. Broekhuis: writing of manuscript, cadaveric study, literature research and submitting manuscript.

Dr. J.J.M. Besems: involvement in treatment of patient in case report, brainstorming, cadaveric study, contributions to manuscript in particular to the anatomic evaluation, textural, grammar and spelling corrections.

Dr. J.W. Colaris: involvement in treatment of patient in case report, brainstorming, contributions to manuscript in particular to the mechanism of injury, textural, grammar and spelling corrections.

Disclosure of interest

The authors declare that they have no competing interest.

References