12 Failed Fixation of Capitellum Fractures

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History of Previous Primary Failed Treatment

A fit and well 18-year-old male presented to the local hospital following a fall from his pushbike. He complained of right elbow pain with restricted range of movement with radiographs demonstrating a displaced fracture of the right capitellum (Fig. 12.1). A CT scan of the right elbow was performed to better detail the anatomy of the injury and confirmed a displaced, minimally comminuted right capitellum fracture, which had flexed through 90° and was no longer contained by the radial head (Fig. 12.2).

Following a discussion with the patient, an open reduction and internal fixation were performed at 10 days following injury. Fixation was performed via a Kaplan approach and the fracture fragment was reduced and fixed with two 2.4 mm headless compression screws (Fig. 12.3). Postoperatively he was advised to avoid loading of this arm for 6 weeks but was encouraged to perform a range of motion exercises from the first post-operative day, which were guided by the outpatient physiotherapy service.

He was seen in the clinic at a month following the operation at which time he had minimal pain and had near full elbow flexion and extension, and full pronosupination. Radiographs taken at this point demonstrated maintenance of the position of the capitellum, with no change to the position of the headless compression screws (Fig. 12.4). He was therefore discharged to the physiotherapy with the advice to continue avoiding weight-bearing activities for a further 2 weeks.

Unfortunately, a day following his outpatient clinic appointment, he vaulted a wall using his right arm for support and hyper-extended his elbow. He presented to the A&E department at this time complaining of increased pain in his right elbow, swelling and reduced range of movement. Repeated radiographs demonstrated pull out of the headless compression screws with vertical translation of the capitellum (Fig. 12.5).

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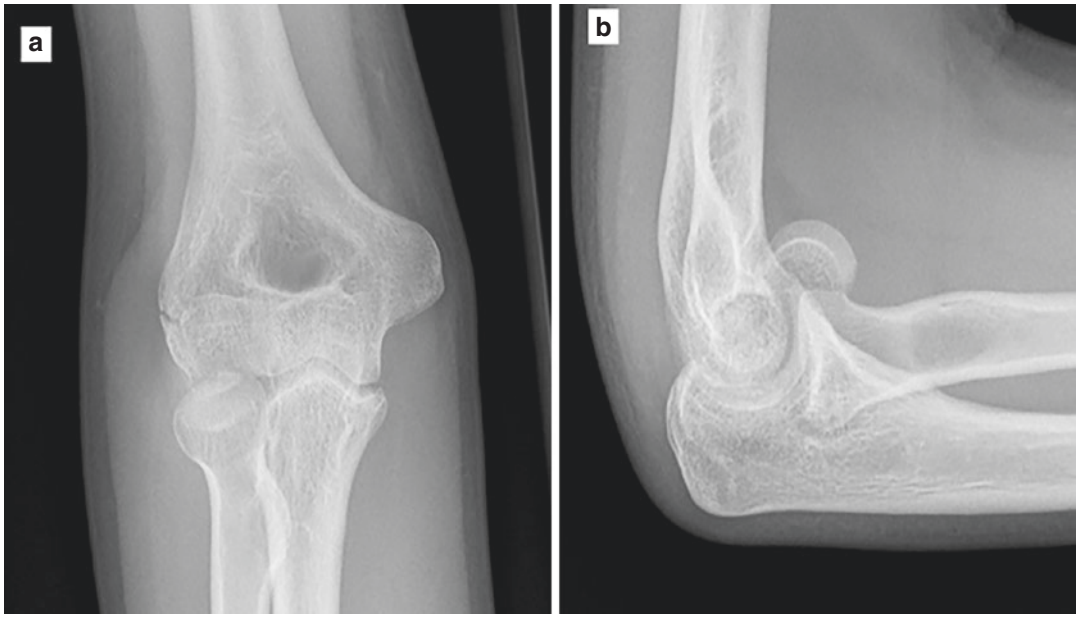

Fig. 12.1 (**a**) AP and (**b**) Lateral radiograph demonstrating a fracture of the right capitellum

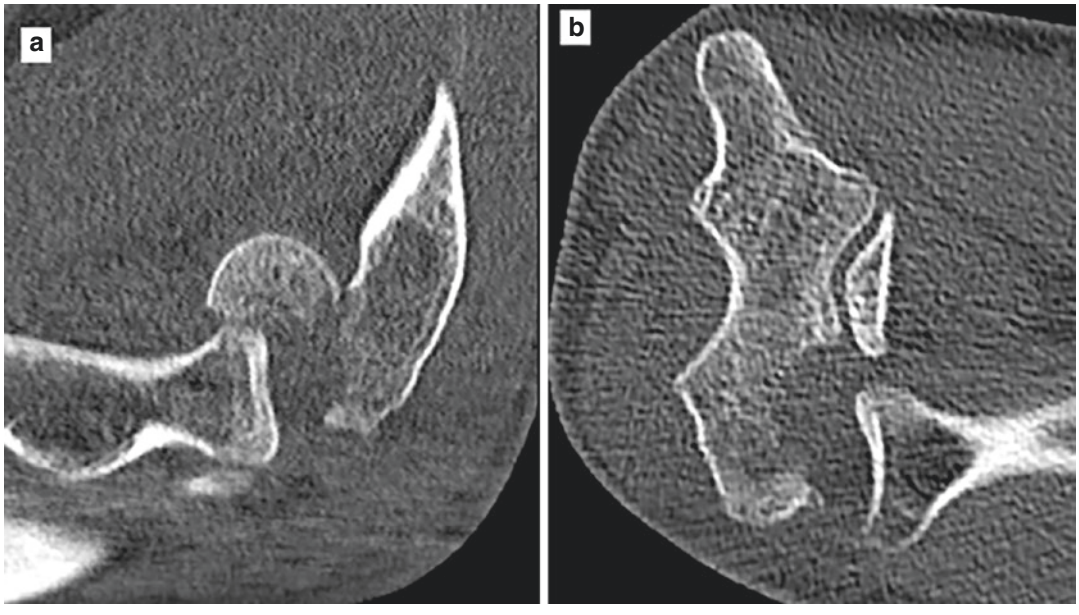

Fig. 12.2 (**a**) Sagittal and (**b**) coronal CT reformatted images demonstrating a minimally comminuted capitellum fracture that was rotated through 90° to sit anterior to the radial head

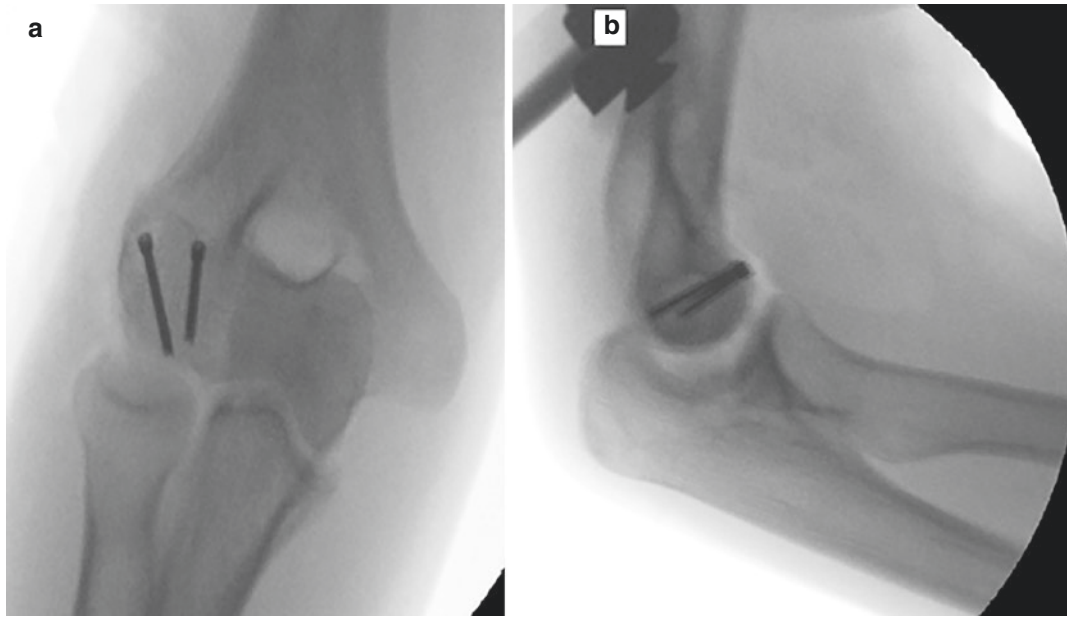

Fig. 12.3 (**a**) AP and (**b**) Lateral intraoperative images demonstrating reduction and fixation of the capitellum with two 2.4 mm headless compression screws

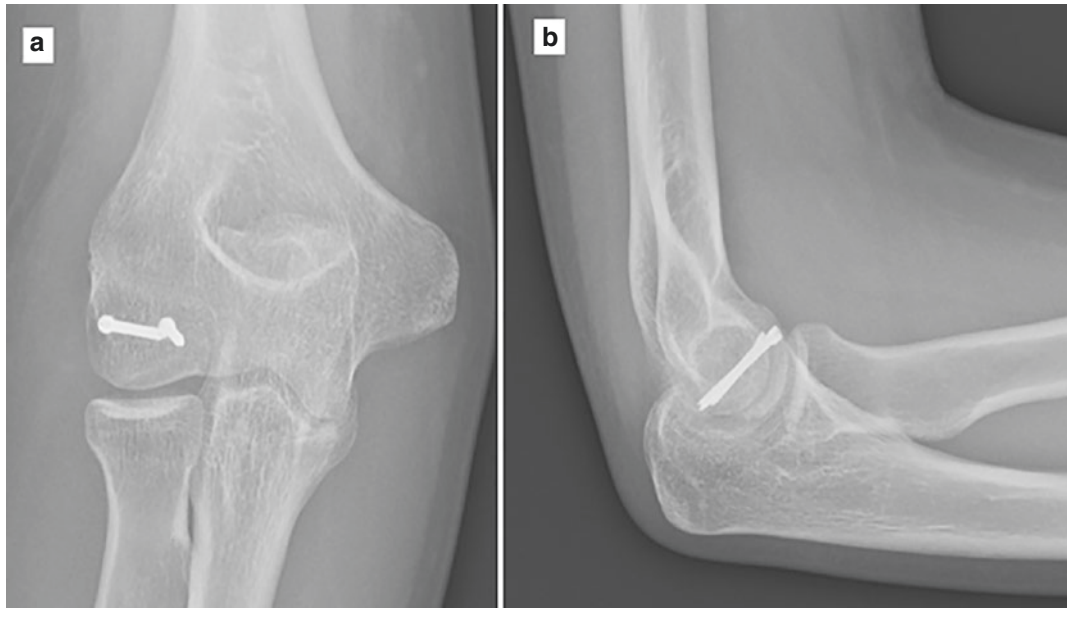

Fig. 12.4 (**a**) AP and (**b**) Lateral radiograph taken from clinic follow-up one month following surgery demonstrating maintenance of the position of the capitellum and no change to the position of the headless compression screws

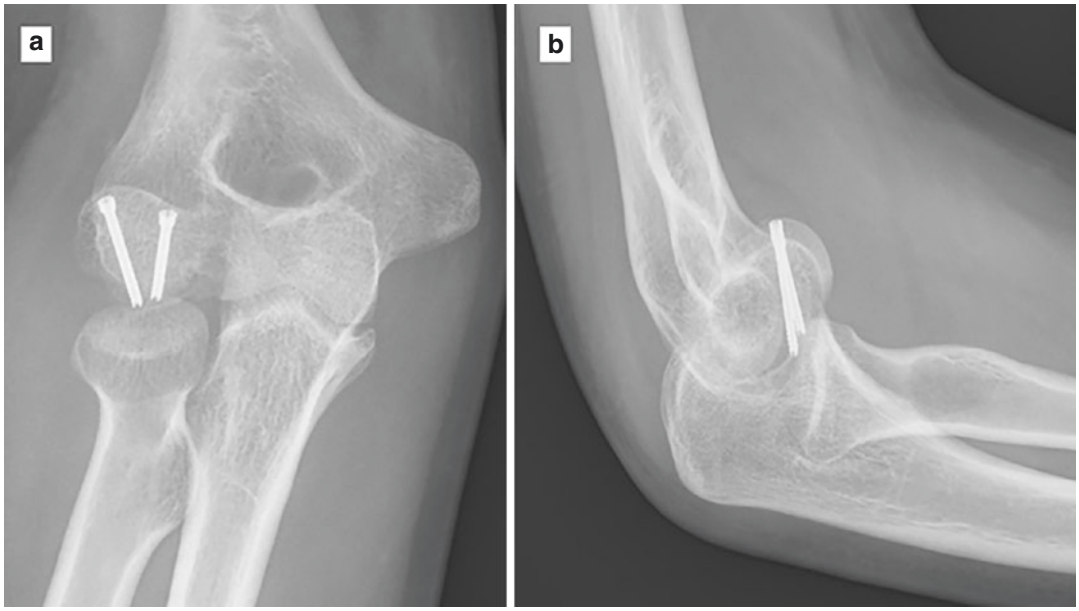

Fig. 12.5 (**a**) AP and (**b**) Lateral radiograph taken the day following final clinic appointment demonstrating pull out of the headless compression screws and vertical translation of the capitellum

Evaluation of the Aetiology of Failure of Fixation

The capitellum is particularly sensitive to shear due to its shape, which translates its centre of rotation anteriorly away from the majority of the humeral bone stock. As an intra-articular fracture, these injuries should be treated with anatomic reduction and compression; however, the fixation must also withstand the higher shear stresses experienced by the capitellum. This is of particular importance when loading the elbow whilst in extension. In this case, the original compression screws were placed oblique to the fracture plane, orientated inferiorly; as opposed to being applied perpendicular to the fracture plane. This made the fixation less resistant to shear forces which when combined with an early return to weight bearing in extension led to the early failure of this fixation.

Clinical Examination

On assessment, this patient was hesitant to move the elbow at all due to pain. His surgical scars were well healed and there was minimal swelling. He had good movements of both the shoulder above and the hand and wrist below. His distal neurovascular examination was normal.

Diagnostic-Biochemical and Radiological Investigations

Given the clear history of a repeated injury with no clinical evidence of injury, blood investigations were not required in this case. Consideration was given to the acquisition of a CT scan prior to embarking on revision surgery; however, it was felt that this would contribute little additional information to what would not otherwise be directly visible at the time of surgery.

Preoperative Planning

A discussion was undertaken with the patient as to the potential options moving forward. Non-operative treatment whilst possible would lead to an unsatisfactory outcome. Revision surgery would include the opening of the fracture site, removal of the 2.4 mm headless compression screws, reduction of the fracture and fixation with 3.5 mm screws perpendicular to the plane of the fracture. Revision fixation would mandate direct access to the fracture site and therefore percutaneous closed reduction with screw insertion from the posterior aspect would not be possible, nor would an arthroscopic approach. The patient was counselled that should there be excessive comminution or poor bone quality then excision of the fragments would be performed.

Revision Surgery

The patient was positioned supine on the table with an arm board. A high-arm tourniquet was applied and inflated for the duration of the revision procedure. Prophylactic antibiotics were given prior to the inflation of the tourniquet.

The previous incision was re-opened and extended distally by 1 cm to facilitate access. A plane posterior to the previous Kaplan approach was opened and developed to allow access to the fracture whilst also protecting the insertion of the lateral collateral ligament. The fracture site was found to have a small amount of callus within which was debrided to free up the capitellar fragment.

The original 2.4 mm screws were removed following which the capitellum was reduced and held with two K-wires perpendicular to the plane of the fracture (Figs. 12.6 and 12.7). The articular reduction was confirmed under direct vision and with the image intensified following which two 3.5 headless compression screws with a continuously varying pitch achieved maximal compression (Figs. 12.8 and 12.9).

Under examination, the elbow was stable and therefore closed in layers. Post-operatively the patient was instructed to wear a sling for 2 weeks but was able to flex from 90 to maximal

Fig. 12.6 The capitellum fragment was approached through the original incision, and mobilised to facilitate reduction

Fig. 12.7 Once mobilised the capitellum fragment was reduced and held with a pointed reduction clamp, at which point two K-wires were passed orthogonal to the plane of the fracture

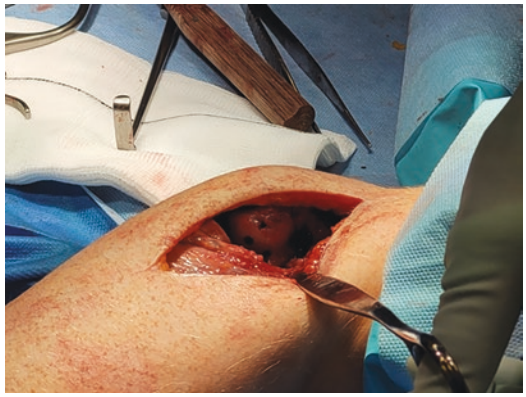

Fig. 12.8 Once an acceptable reduction was attained on image intensifier, two headless compression screws were passed achieving good compression

flexion with no restrictions on pronosupination. At 2 weeks, he began to work on passive extension achieving a flexion-extension arc from 45° to 120° by the 4-week mark. By eight weeks, he achieved a flexion-extension arc of 30–130° and had full pronosupination. His radiographs at 12 weeks demonstrated a small amount of heterotopic ossification adjacent to the radial head; however, no complication regarding his revision fixation (Fig. 12.10). At this point, weight-bearing activities were resumed through this limb, guided by the physiotherapists.

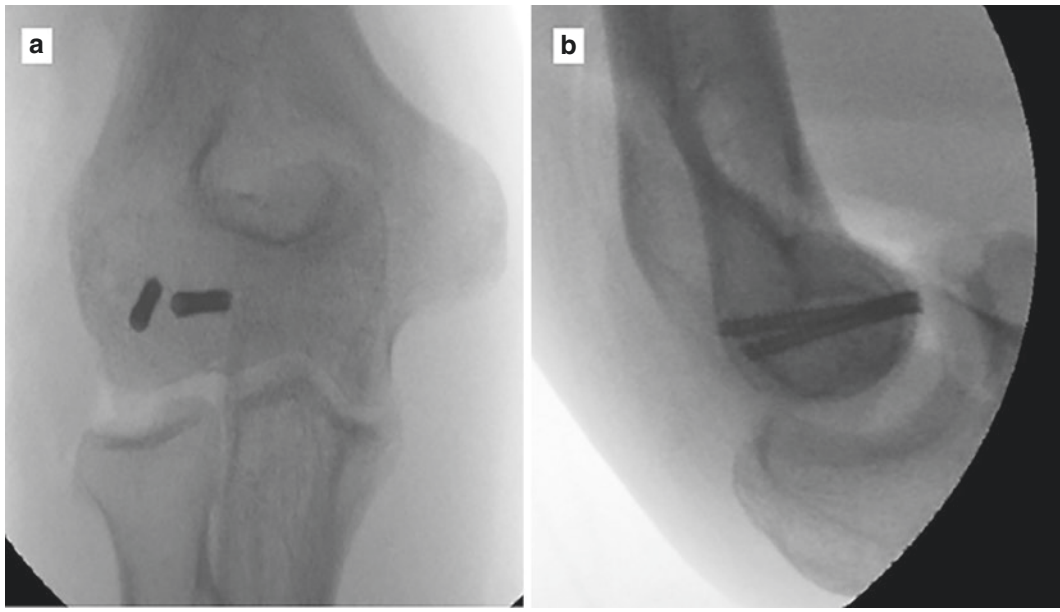

Fig. 12.9 (**a**) Intraoperative AP and (**b**) Lateral image intensifier images demonstrating revision fixation with 3.5 mm headless compression screws with continuously variable pitch

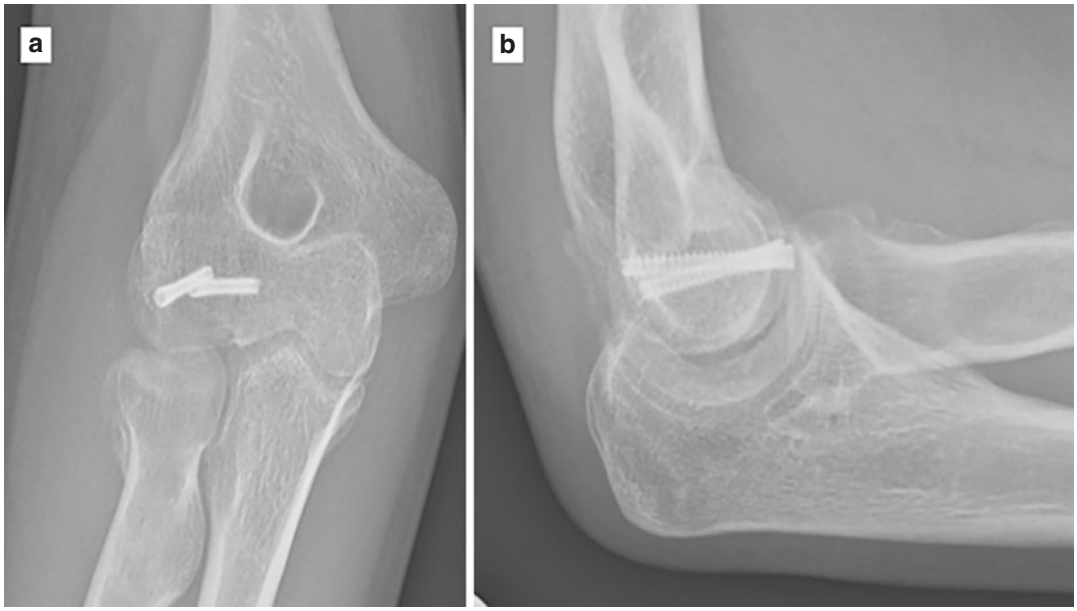

Fig. 12.10 (**a**) AP and (**b**) Lateral radiograph taken 12 weeks following revision fixation demonstrating maintenance of the reduced position with no peri-implant complication. A small amount of heterotopic bone is visible adjacent to the radial neck

Summary: Lessons Learned

This case summarises a young patient who presented with an early failure of headless compression screw fixation of the capitellum, which was utilised to treat a shear-type injury. It is important to consider the need to compress these injuries not only to achieve primary bone healing due to the intra-articular element of this fracture, but also to resist the shear forces to which the capitellum is subjected. Care should also be taken to clearly instruct the patients as to the post-operative weight-bearing protocol and the rationale for this in order to reduce the risk of overuse early in rehabilitation. This case was successfully revised utilising larger screws orientated perpendicular to the fracture plane with a continuously variable pitch allowing maximal compression and maximal resistance to shear.

Further Reading

Bayam L, Arshad M, Kumar P, Wykes P, Warner J, Hodgson S. A review of outcomes following surgical fixation of adult capitellum fractures: a six-year case series. Acta Orthop Belg. 2020;86(3):8–16.

Bellato E, Giai Via R, Bachman D, Zorzolo I, Marmotti A, Castoldi F. Coronal shear fractures of the distal humerus. J Funct Morphol Kinesiol. 2022;7(1):7. https://doi.org/10.3390/jfmk7010007.

Elkowitz SJ, Kubiak EN, Polatsch D, Cooper J, Kummer FJ, Koval KJ. Comparison of two headless screw designs for fixation of capitellum fractures. Bull Hosp Jt Dis. 2003;61(3-4):123–6.

Ruchelsman DE, Tejwani NC, Kwon YW, Egol KA. Open reduction and internal fixation of capitellar fractures with headless screws. Surgical technique. J Bone Joint Surg Am. 2009;91(Suppl 2 Pt 1):38–49. https://doi.org/10.2106/JBJS.H.01195.