—Case Reports—

Irreducible Elbow Fracture and Dislocation due to Incarceration of the Medial Epicondyle of the Humerus in a Child

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Medial epicondyle fractures of the humerus account for 11%–20% of all elbow injuries in children. Although intra-articular incarceration of the medial epicondyle occurs in 5%–18% of medial epicondyle fractures associated with an elbow dislocation, the mechanism of intrusion of the fracture fragment is unknown. We report a case of an irreducible elbow fracture and dislocation due to incarceration of the medial epicondyle fragment of the humerus, classified as a Watson-Jones type 3 fracture of the medial epicondyle, and present the mechanism of the intra-articular incarceration of the medial epicondyle fragment. The patient was a 9-year-old boy who injured his right elbow in a fall, and was diagnosed with a Watson-Jones type 3 fracture of the medial epicondyle. As we could not achieve a good reduction under fluoroscopic imaging, surgery was immediately performed using a medial approach. We discovered that the incarcerated fracture fragment was attached to the flexor-pronator muscles, the medical collateral ligament (MCL), and the anterior articular capsule. The medial epicondyle was fixed with Kirschner-wires augmented with tension band wiring. After fixation, there was no remaining instability. After 4 months the patient's fracture had proceeded to union and the internal fixation was removed. After 30 months he was asymptomatic and able to perform all of his daily life activities without any limitation. Our case, a Watson-Jones type 3 medial epicondyle fracture, is suggestive of the mechanism of incarceration of the medial epicondyle fragment into the elbow joint. Our findings support the idea that the attachment of both the MCL and the articular capsule can result in the entrapment of a fracture fragment in the elbow joint. (J Nippon Med Sch 2018; 85: 60–65)

Key words: medial epicondyle fracture, incarceration, children, surgical treatment, case report

Introduction

Medial epicondyle fractures of the humerus account for 11%–20% of all elbow injuries in children[1,2]. In addition, 30%–55% of medial epicondyle fractures are associated with an elbow dislocation[1]. Although intra-articular incarceration of the medial epicondyle occurs in 5%–18% of medial epicondyle fractures associated with an elbow dislocation[1,3], the mechanism of the intrusion of the fracture fragment is unknown. We report a case of an irreducible elbow fracture and dislocation due to incarceration of a medial epicondyle fragment of the humerus, classified as a Watson-Jones type 3 fracture[4], and reveal the mechanism of the intra-articular incarceration of the medial epicondyle fragment.

Case Presentation

A 9-year-old right-handed boy injured his right elbow in a fall onto his outstretched hand and was transported to our hospital. Physical examination revealed marked swelling and tenderness over the medial aspect of the elbow. Although range of motion (ROM) of the elbow was restricted due to pain, there was no neurovascular deficit. Radiographs showed a medial epicondyle fracture of the humerus, with incarceration of the fragment (**Fig. 1**). According to the Watson-Jones classification[4], our case indicated an elbow fracture and dislocation associated with a medial epicondyle fracture of the humerus, Watson-Jones type 3. Under fluoroscopic control, a closed reduction of the elbow dislocation was attempted; however, a satisfac-

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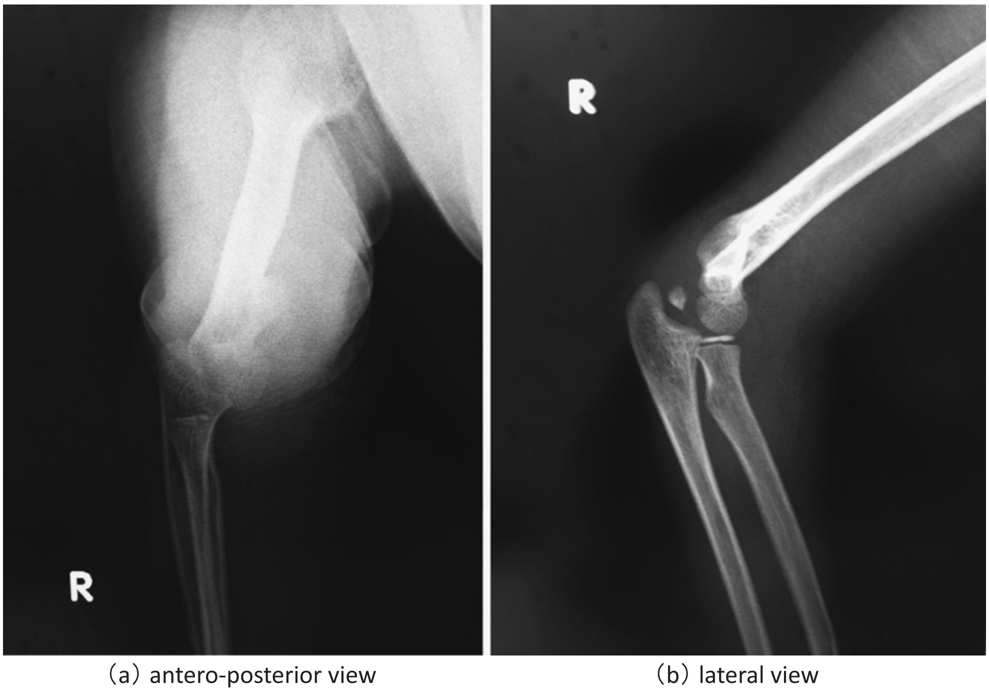

Fig. 1 Pre-operative plain radiographs
(a) Antero-posterior view. Pre-operative antero-posterior view shows intra-articular entrapment of the medial epicondyle without elbow dislocation.
(b) Lateral view. Lateral radiograph of the elbow shows entrapment of the medial epicondyle and an increase in the width of the medial joint space.

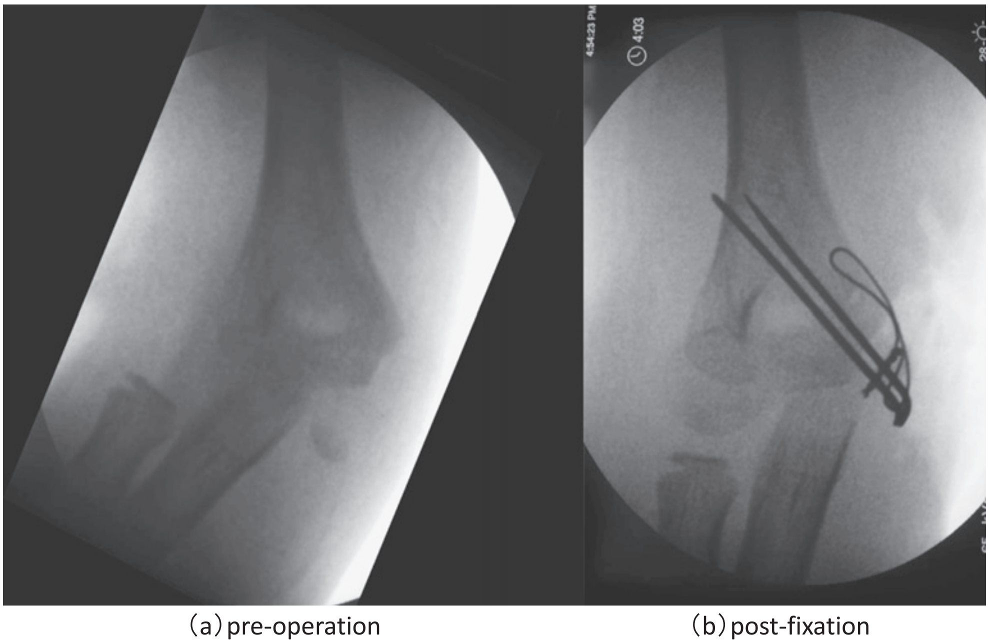

Fig. 2 Intra-operative fluoroscopic examination
(a) Pre-operation. (b) Post-fixation.
After fixation, there was no remaining valgus instability.

tory reduction of the elbow could not be achieved due to intrusion of the medial epicondyle fragment. A manual valgus stress test, under a general anesthesia, revealed remarkable valgus instability of the injured elbow (**Fig. 2**). An open reduction was immediately performed using a medial approach. Undermining the subcutaneous tissue, the antero-medial aspect of the elbow joint was exposed without incision of the joint capsule. Inspecting

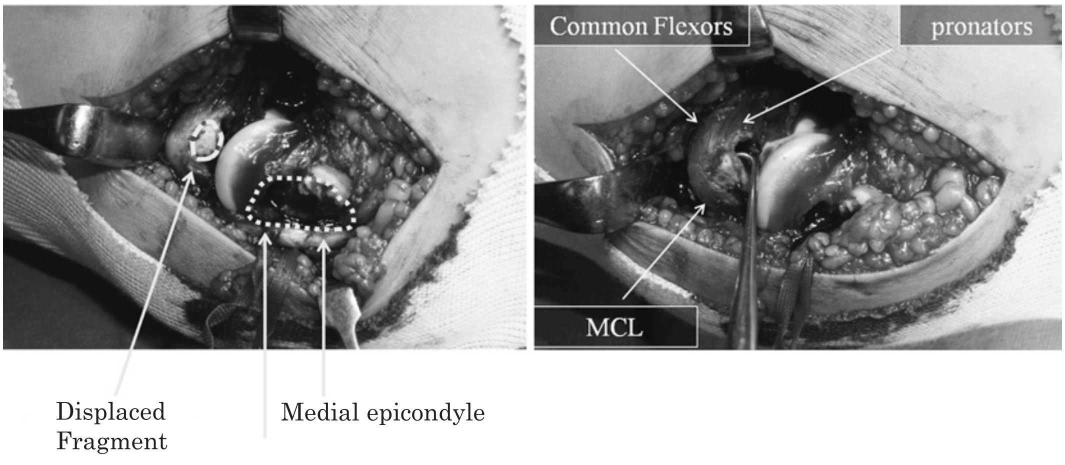

Fig. 3 Intra-operative photograph
Intra-operative photograph shows the fragment, which had been attached to the flexor-pronator muscle, the medial collateral ligament, and the antero-medial aspect of the articular capsule, was incarcerated in the elbow joint.

the elbow joint, the medial epicondyle fracture fragment, which was incarcerated in the elbow joint, was attached to the flexor-pronator muscles, medial collateral ligament (MCL), and the anterior articular capsule. The fragment consisted of the entire medial epicondyle and a partial fragment of the medial condyle, which were larger than expected from the radiographical assessment (**Fig. 3**). Identification and minimal release of the ulnar nerve revealed no obvious damage and no instability of the nerve. In order to prevent irritation of the ulnar nerve, complete release and anterior transposition of the ulnar nerve was not performed. The medial epicondyle fragment was reduced and fixed with Kirschner-wires augmented with tension band wiring. The preoperative valgus instability of the elbow joint disappeared after rigid fixation of the fragment (**Fig. 4**).

An above-elbow long arm cast was applied for four weeks, and active ROM exercises of the elbow followed removal of the cast. Four months after surgery, the internal fixation was removed under general anesthesia.

At the final follow-up (postoperatively 30 months), the final outcome was satisfactory. The range of flexion-extension measured 0° to 135°, and he had regained full ROM. Although the radiological evaluation showed sclerosis around the medial epicondyle, bone union had been achieved (**Fig. 5**). The patient had a stable, pain-free, elbow with a Mayo Elbow Performance Score of 100, and there was no remaining instability. The patient was able to perform all of his daily life activities, including sports, without any limitation.

Discussion

The entrapped medial epicondyle is often overlooked in medial epicondyle fractures of the humerus. There is general agreement that fractures of the medial epicondyle are usually caused by valgus stress, which produces traction on the flexor-pronator origin and subsequently on the medial epicondyle itself[5]. The valgus force may be produced by falling on an outstretched hand with the elbow extended, or a fall on the elbow. A larger valgus force may result in elbow dislocation or ligament injury. In addition, the fractured fragment of the medial epicondyle is usually displaced distally due to traction forces exerted by its soft tissue attachments[1]. Similarly, it is accepted that manipulation or operation is recommended to reduce a fracture entrapped in the joint[5–9]. Various theories for the mechanism of entrapment have been proposed. Some authors[6,7] have reported that entrapment was caused by the pull of the flexor-pronator muscles with a temporary opening of the elbow joint space medially; others[8] have reported that entrapment was caused by aspiration due to the vacuum phenomenon.

The flexor muscles of the forearm take their origin from anterior aspects of the medial epicondyle, which also gives attachment to a part of the MCL and the joint capsule[5]. In younger children, some of the capsule's origin extends up to the physeal line of the medial epicondyle; therefore a fracture line involving the medial epicondylar apophasis can enter the elbow joint. In most cases, the avulsed medial epicondyle fragment is small, and only flexor-pronator muscles might be attached to it. According to Chessare et al[9], the epicondyle is avulsed

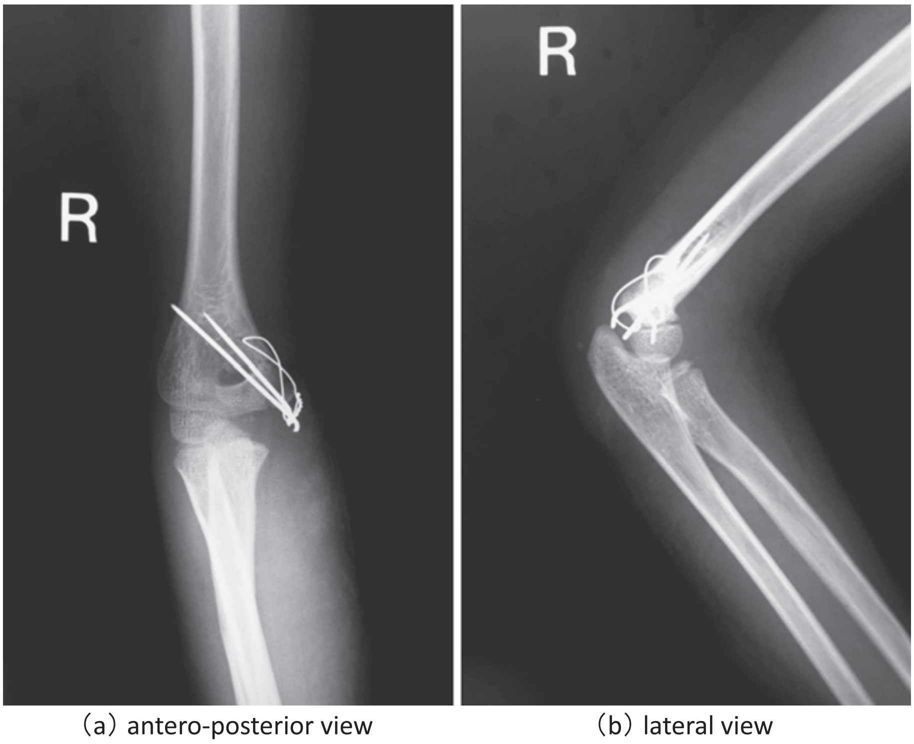

Fig. 4 Post-operative radiographs
(a) Antero-posterior view. (b) Lateral view.
The patient was treated with open reduction and internal fixation by two Kirschner -wires augmented with tension band wiring. Post-operative radiograph shows a good reduction.

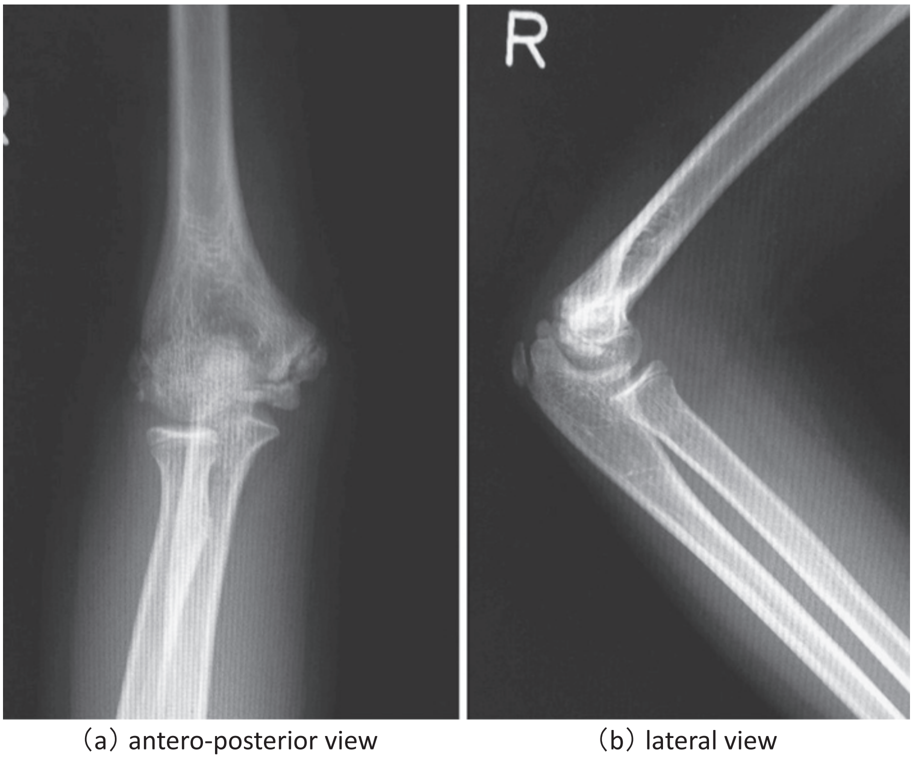

Fig. 5 Final follow-up radiographs
(a) Antero-posterior view. (b) Lateral view.
Radiographs show bone union and bone sclerosis.

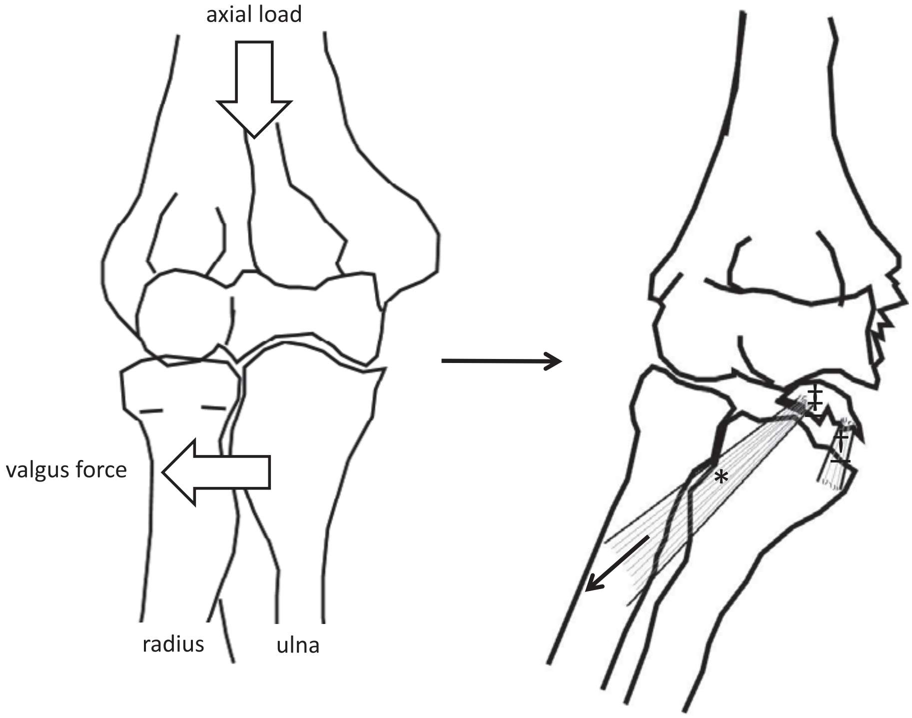

Fig. 6 Mechanism of intra-articular incarceration of the fragment
Schematic showing the mechanism of incarceration of the fragment. With valgus and axial force, medial epicondyle, tethered by the MCL and the capsule, is avulsed via tension. The medial joint space is momentarily opened and a vacuum is created within the elbow joint. As a result, the fragment, tethered by the MCL and the capsule, is left behind and incarcerated in the elbow joint. The symbols show: *flexor-pronator muscle, † MCL, and ‡ incarcerated fracture fragment.

and then drawn into the joint by the traction from the attached flexor-pronator muscle group and the MCL. Some authors[10,11] reported that the fracture fragment was usually found to be displaced anterior to its origin on the humeral condyle, because of the pull of the flexor-pronator muscles, and was located extra-articularly. Therefore, the fracture fragment was rarely incarcerated in the elbow joint, where it may be displaced by the traction of flexor-pronator muscles in a distal direction. Furthermore, Patric[8] stated that repeated closed manipulation with the elbow in valgus may damage the ulnar nerve. Thus, on failure to extract the fragment by manipulative techniques, open reduction should be performed for intra-articular incarceration of the fragment.

In our patient, the fragment of the medial epicondyle was accompanied by the flexor-pronator muscles, the MCL, and the joint capsule. The fragment, tethered by the MCL and the capsule, had been left behind and incarcerated into the elbow joint. As illustrated in **Figure 6**, a fall onto an outstretched hand, with the elbow in full extension, produces an axial load and valgus force, and then the medial epicondyle is avulsed via tension created by structures attached to it which includes flexor-pronator mass, MCL, and the capsule. With valgus stress, the medial joint space is momentarily opened and a vacuum is created within the elbow joint. As a result, the avulsed fragment becomes trapped into the joint (**Fig. 6**). Thus, our case suggested that excessive valgus and extension force may lead to fracture of the medial epicondyle, and the fragment, tethered by the MCL and the joint capsule, might become incarcerated in the elbow joint after closed reduction of the elbow dislocation.

In conclusion, our case, classified as a Watson-Jones type 3 medial epicondyle fracture, showed one of the possible mechanisms of the elbow joint incarceration in the medial epicondyle fracture of the humerus in a child. Our findings support the idea that the attachment of both the MCL and the articular capsule can result in the entrapment of a fracture fragment in the elbow joint.

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Conflict of Interest: The authors report that there are no conflicts of interest concerning the materials or methods used in this study or the findings specified in this paper.

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