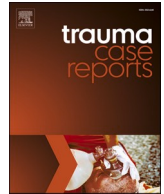




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Case Report

One incision-two windows approach for fixation of multifragmentary coronoid process fracture of the ulna: A case report

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ABSTRACT

Since the range of access of each surgical approach around the elbow has limitations, it is difficult to treat all types of fractures using only one approach. In the case reported herein, anterior and medial fragments of the comminuted ulnar coronoid process fracture were treated by preparing two access routes through one skin incision and effectively performing the buttress plating of each fragment.

The subject was a 27-year-old female who sustained a fracture of the coronoid process of the right ulna by falling during snowboarding. Computed tomography showed the concurrence of a type 2 subtype III and type 3 subtype I ulnar coronoid process fracture according to the O'Driscoll classification. The coronoid process was split into 3 parts: a fragment consisting of the anteromedial facet and upper half of the sublime tubercle (fragment 1), a central fragment including the tip (fragment 2), and a fragment extending from the radial side of the tip to the base of the coronoid process (fragment 3). A 12-cm-long skin incision was made on the anteromedial side of the elbow joint. The region of the anteromedial facet and sublime tubercle was reached by passage between the palmaris longus/flexor digitorum superficialis and humeral head of flexor carpi ulnaris using the over-the-top approach. Fragment 1 was fixed with a buttress plate. Using the anterior approach, the brachialis was then longitudinally split through by passage between the biceps and neurovascular bundle, fragments 2 and 3 were fixed together with a buttress plate.

The “one incision-two windows” approach, which provides two approaches (the over-the-top window and the anterior window) by a single skin incision, was implemented for a multifragmentary ulnar coronoid process fracture. This approach is considered to offer access from the front to each of the anterior and medial fragments and permits appropriate buttress plate fixation.

Introduction

The anterior approach [1–6], Taylor and Scham approach from posterior to anterior [7], Over-the-Top approach [8–10], and flexor carpi ulnaris (FCU)-Split approach are the primary surgical approaches used for fractures of the coronoid process of the ulna [8]. The approach selected is dependent on the size of the fragment of the coronoid process, the area of the fractured coronoid process, and

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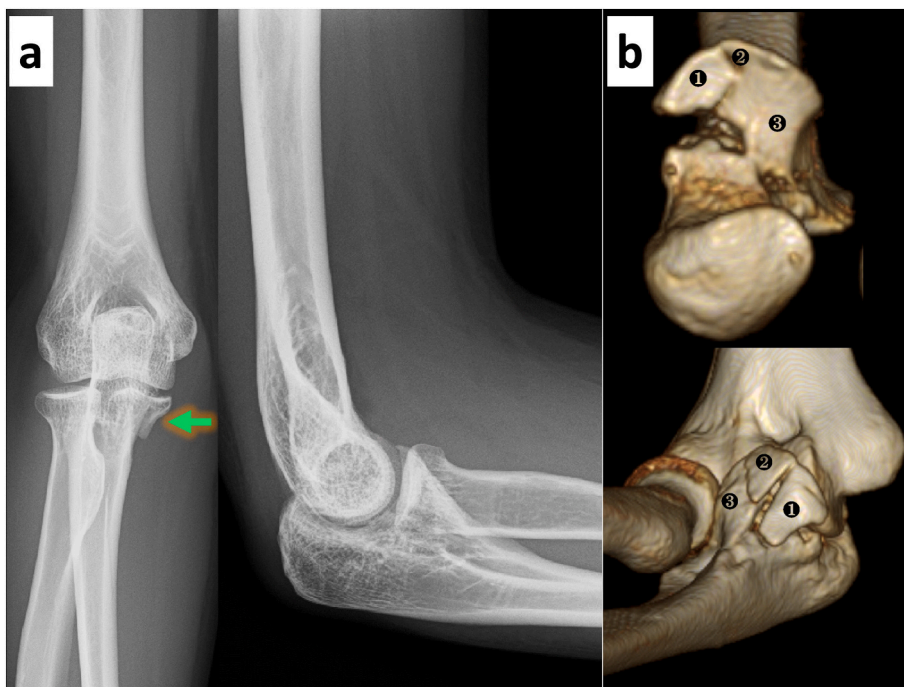


Fig. 1. a: Two plain X-ray views at the time of injury (the green arrow indicates the fracture site).

b: 3D-CT shows O'Driscoll type 3-1 ulnar coronoid process fracture comprising a fragment including the anteromedial facet and upper half of the sublime tubercle (●), a central fragment including the tip (●), and a fragment including the base radial to fragment 2 (●). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

injuries at other sites. Since the range of access of each surgical approach has limitations, it is difficult to treat all types of fractures using only one approach. In the case reported herein, anterior and medial fragments of the comminuted coronoid process were treated by preparing two access routes through one skin incision and effectively performing the buttress plating of each fragment.

Case report

The patient was a 27-year-old woman who sustained an injury by falling during snowboarding. She was examined at a local clinic, was diagnosed with a fracture of the coronoid process of the right ulna alone, received splinting, and was referred to our facility on the fifth day after injury (Fig. 1a). The physical finding on the visit was a restricted range of motion without any neurovascular injury. Computed tomography (CT) showed the concurrence of a type 2 subtype III and type 3 subtype I ulnar coronoid process fracture according to the O'Driscoll classification. The coronoid process was split into 3 parts: a fragment consisting of the anteromedial facet and upper half of the sublime tubercle (fragment 1), a central fragment including the tip (fragment 2), and a fragment extending from the radial side of the tip to the base of the coronoid process (fragment 3) (Fig. 1b). Stress radiography under brachial plexus block presented findings suggestive of varus posteromedial rotatory instability.

Surgery was performed on the tenth day after injury. To approach the sublime tubercle and the tip of the coronoid process from the front, an approximately 12-cm-long skin incision was made on the anteromedial side of the elbow joint extending distally from a point 4 cm proximal to the medial epicondyle level (Fig. 2a). To make the over-the-top and anterior approaches possible, subcutaneous tissue was sufficiently detached toward the medial and anterior directions (Fig. 2b, c). The region of the anteromedial facet and sublime tubercle was reached by passage between the palmaris longus/flexor digitorum superficialis and humeral head of FCU using the over-the-top approach. The fracture site was exposed without detaching the flexor-pronator origin from the medial epicondyle or denuding the median nerve, and fragment 1 was fixed with a buttress plate (Fig. 3a). Using the anterior approach, the brachialis was then longitudinally split through by passage between the biceps and neurovascular bundle, fragment 3 was lag-screwed using a 2.7 mm cortical screw, and fragments 2 and 3 were fixed together with a buttress plate (Fig. 3b, c). The plates used were all SYNTHES VA hand2.0. The time needed for surgery was 157 min, and the volume of hemorrhage was 40 mL.

Postoperative plain radiography showed the restoration of satisfactory alignment (Fig. 4a), and anatomical reduction of the

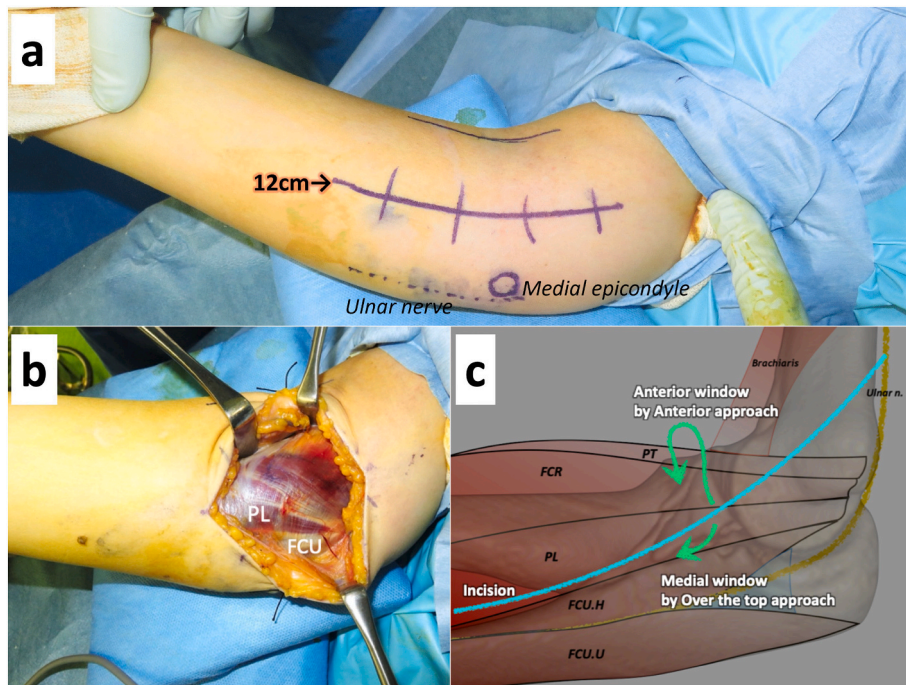


Fig. 2. a: A 12-cm-long skin incision was made on the anteromedial side of the elbow joint distally from a point 4 cm proximal to the medial epicondyle level (the dotted line indicates the ulnar nerve and the circle indicates the medial epicondyle).
 b: Detachment of subcutaneous tissue in the anterior and medial directions. (PL: palmaris longus, FCU: flexor carpi ulnaris).
 c: Anterior and medial windows (green arrows) were created by a single skin incision (blue line), through which both regions were approachable. (PT: pronator teres, FCR: flexor carpi radialis, FCU.H: humeral head of FCU, FCU.U.: ulnar head of FCU). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

fractured coronoid process was confirmed on postoperative CT (Fig. 4b). Two years after surgery, the active motion range of the elbow was 140° of flexion and 0° of extension, the angles of forearm pronation and supination were 90° each (Fig. 4c), the Disabilities of the Arm, Shoulder, and Hand score was 0, and the Mayo Elbow Performance score was 100. No osteoarthritic changes were noted in imaging studies.

Discussion

In the present case, effective buttress plate fixation was achieved for the fragment extending from the anteromedial facet to the sublime tubercle (fragment 1) using the medial intermuscular over-the-top approach and for the large fragments from the center to the radial side of the coronoid process of the ulna including the tip (fragments 2 and 3) using the anterior approach. Although a sufficiently long skin incision and subcutaneous detachment are needed to utilize these approaches through a single incision, it is less invasive to soft tissues than making separate skin incisions for each approach. To our knowledge, this is the first report of both approaches being performed using a single skin incision.

Internal fixation by the anterior approach is generally performed for relatively large fragments that include the tip to the base, such as O'Driscoll type 3 fractures [1–6]. However, due to the presence of the medial brachial neurovascular bundle in the view obtained by the anterior approach, dissection from the anteromedial to sublime tubercle is difficult [4,5], and there is a risk of damaging the neurovascular bundle during screw insertion. The over-the-top approach, which is often employed for O'Driscoll type 2 fractures, was originally intended for use to release contracture of the elbow [9]. Hotchkiss and Kasparyan et al., who originally devised this approach, reported that a wide area anterior to the elbow including the radial head may be reached by detaching the ulnar nerve, cutting the medial intermuscular septum, detaching the flexor-pronator origin from the medial epicondyle of the humerus, turning them distally, and retracting them radially with the brachialis muscle [9]. The over-the-top approach, which was adopted in the present case, is a contracted version without separation of the flexor-pronator origin. Since this made dissection of the coronoid process of the ulna toward the anterior region difficult, the anterior approach was simultaneously employed. If, in the present case, internal

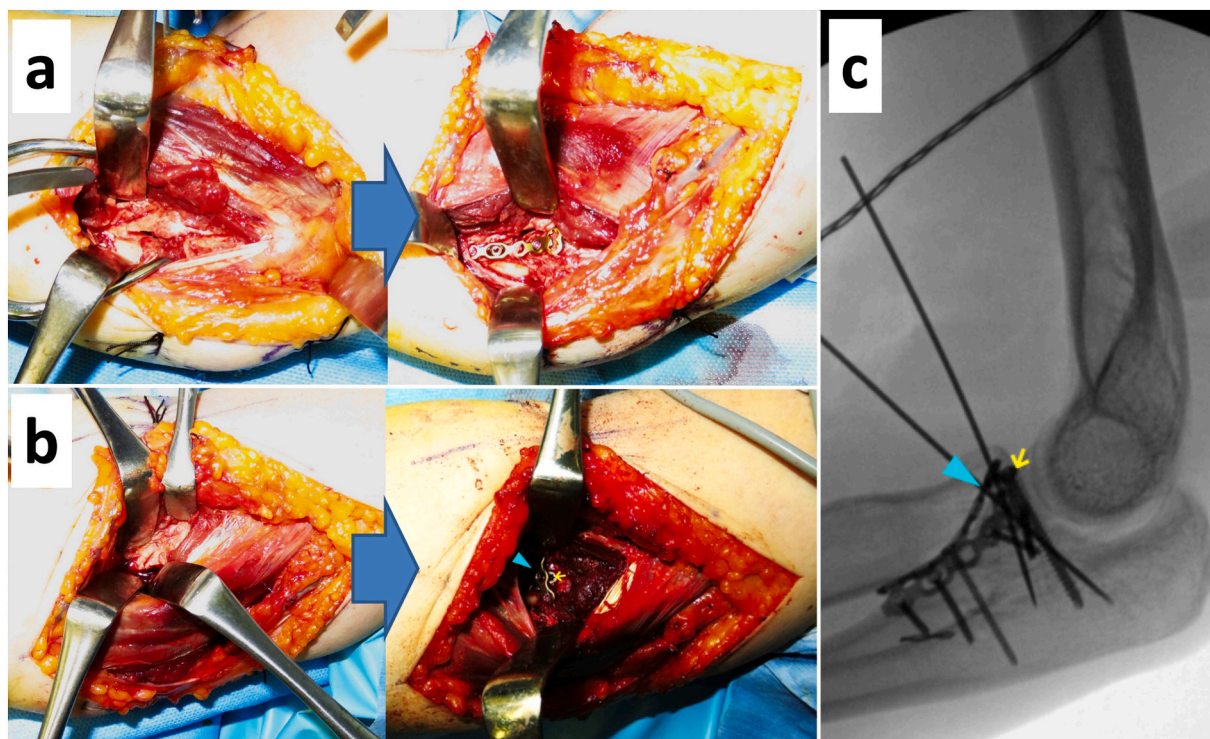


Fig. 3. a: Through the medial window, the anteromedial facet and sublime tubercle region was reached between PL/flexor digitorum superficialis and FCU.H, and the fracture site was exposed. Fragment ❶ was fixed with a buttress plate. b: Through the anterior window, the brachialis was split vertically through the gap between the biceps and neurovascular bundle, and the fracture site was exposed. Fragment ❸ was fixed with a lag screw (yellow arrow), and fragments ❷ and ❹ with a buttress plate (blue arrow). c: An intraoperative fluoroscopic lateral view showed two buttress plates for fragment ❶/❷ (blue arrow) and a lag screw for fragment ❸ (yellow arrow). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

fixation is only possible using the over-the-top approach alone, detachment of the ulnar head of the pronator teres muscle and insertion of the brachial muscle needs to be extended to the distal side of the ulna in addition to the above detachment of the ulnar nerve and separation of the flexor-pronator origin. Furthermore, it may be necessary to sufficiently release the neurovascular bundle in order to avoid applying excessive pressure on the median nerve and brachial artery and vein when laterally retracting the muscles *en bloc*. Therefore, in the present case, the medial side of the coronoid process was reached by the intermuscular route through the window of the over-the-top approach, and the anterior approach was additionally employed as another window to avoid invasion needed to reach the area anterior to the coronoid process medially. Osteosynthesis may be achieved less invasively by the one incision-two windows approach applied to the present case than by the over-the-top approach alone. Regarding preparation of the medial window, since the anteromedial facet occupied a larger area than the sublime tubercle in fragment 1 and the window for the anterior approach was added, the anterior and medial fragments of the coronoid process were reached more directly by the over-the-top approach than by the FCU-Split approach.

The “one incision-two windows” approach, which provides two approaches (the over-the-top window and the anterior window) by a single skin incision, was implemented for a patient with multifragmentary ulnar coronoid process fracture. This approach is considered to offer access from the front to each of the anterior and medial fragments of the coronoid process and permits appropriate buttress plate fixation. Further evaluations are needed to establish whether favorable outcomes may be achieved in similar cases using this approach.

Declaration of competing interest

None.

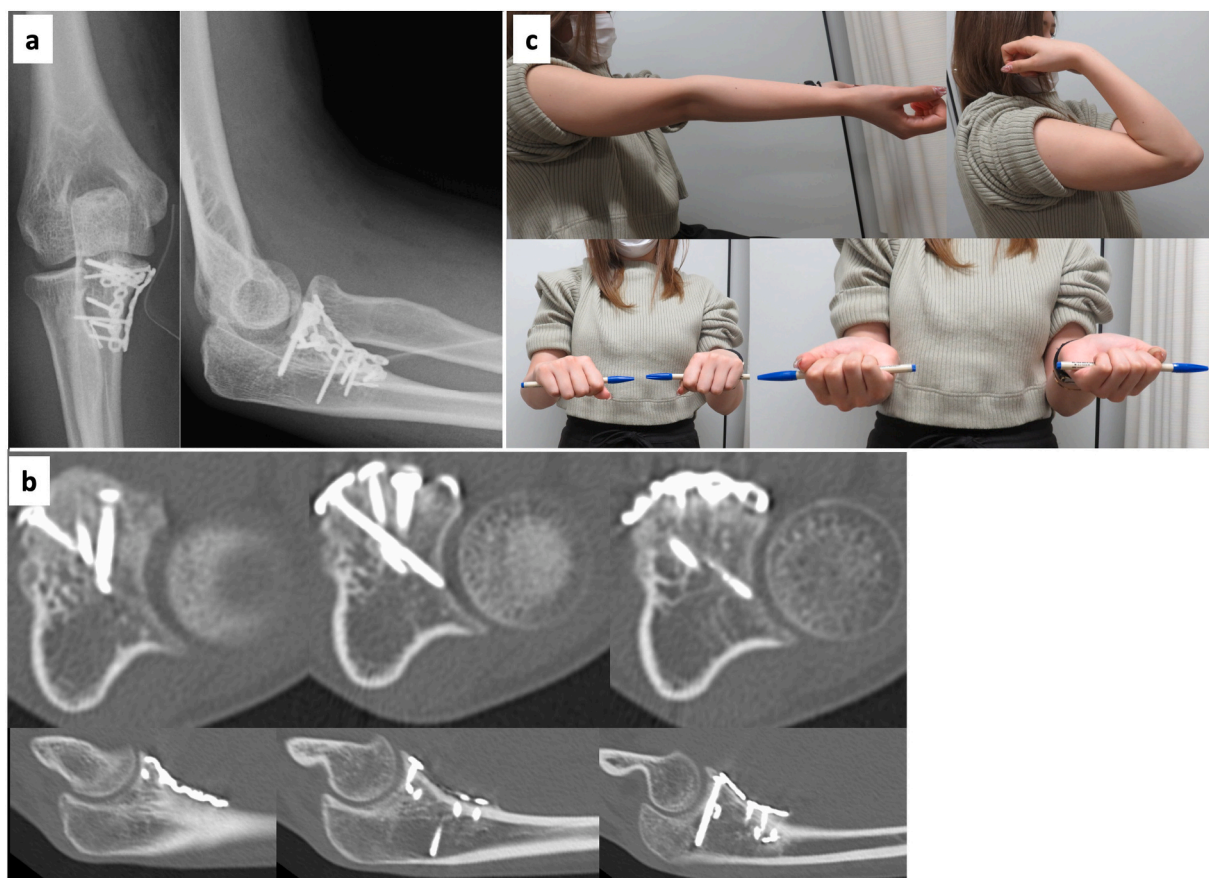


Fig. 4. a: Postoperative plain radiography showed the restoration of satisfactory alignment.

b: Postoperative CT scans also confirmed anatomical reduction of the fracture site.

c: Two years after surgery, the active range of motion of the elbow joint was 140° flexion, 0° extension, 90° forearm pronation, and 90° supination.

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