Case Report

A rare cause of elbow stiffness after internal fixation of proximal ulna fracture: a case report of heterotopic ossification

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Abstract: Heterotopic ossification (HO), as a complication of internal fixation of proximal ulna, has seldom reported. In this case we experienced the HO in the triceps after operating the woman on the proximal ulna fracture. After locking plating on the proximal ulna the patient didn't recover her functional range of motion (ROM) in time, although anatomical reduction of the articular surface was correct and early mobilization was done. Elbow stiffness, especially extension loss was notable. Six months later, HO was found in the triceps over the olecranon, which significantly resisted the extension of elbow. Thus, excision of ossified tissue was performed simultaneously with the implant removal, and then rehabilitation therapy and pharmacologic therapy was performed. Final outcomes of excision of HO was good, showing the satisfactory recovery of functional ROM. Through this experience we suggest that after open reduction and plate fixation of comminuted fracture of proximal ulna, HO can be developed around the elbow, disturbing the recovery of elbow function. In order to prevent postoperative HO, intraoperatively, surgical dissection should be performed as carefully as possible, and postoperative, management should involve all effective measures.

Keywords: Heterotopic ossification (HO); ectopic calcification; elbow stiffness; proximal ulna; internal fixation; case report

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Introduction

Olecranon fractures comprise approximately 10% of all fractures around the elbow (1). They vary in their complexity from relatively straightforward transverse fractures to comminuted and unstable configurations. As in other articular fractures, the aims of treatment, as defined by the AO group, are to restore the articular surface, achieve absolute stability of the fracture, and commence early active motion, and, finally, the restoration of function without pain (2,3).

This is only possible with ORIF (open reduction and internal fixation) such as TBW (tension band wiring), plate and intramedullary fixation techniques as well as fragment excision with triceps advancement (4-8). The TBW described by Weber and Vasey (3) has been widely used in the ORIF of olecranon, however, plate fixation has been used principally for the management of comminuted olecranon fractures in which TBW is not appropriate (4). Plates are generally applied to the dorsal surface of the ulna because this is the tension side of the olecranon which makes the construct most biomechanically sound, and because screws can be passed into the coronoid (9,10).

Anatomically contoured locking plates are one of the newest developments in olecranon plate technology and are being marketed as offering superior fixation as a result of the fixed angle construct (5).

Whilst good results have been shown with the use of these plates, there is currently insufficient evidence to suggest they are superior to other forms of plate fixation (5,11).

This report describes heterotopic ossification (HO) as a complication related to the internal fixation of a proximal ulna comminuted fracture.

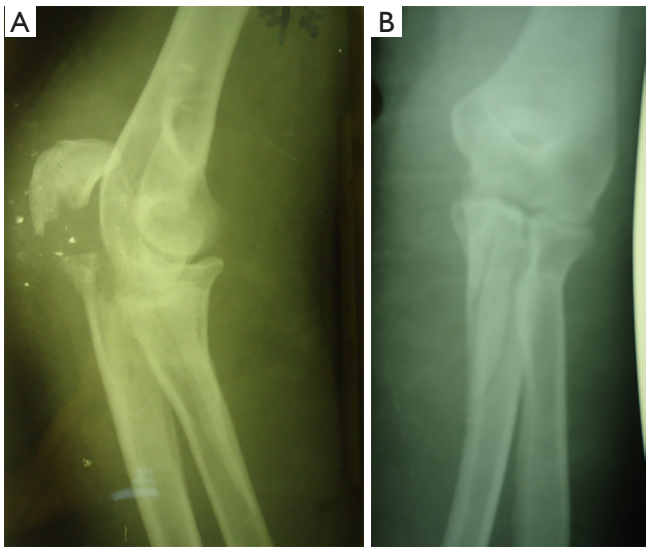

Figure 1 Preoperative X-ray view of the patient sustaining an intra-articular, comminuted, fracture of the left proximal ulna. Olecranon, coronoid process and the shaft of ulna are separated. (A) Lateral view. (B) Anterioposterior view.

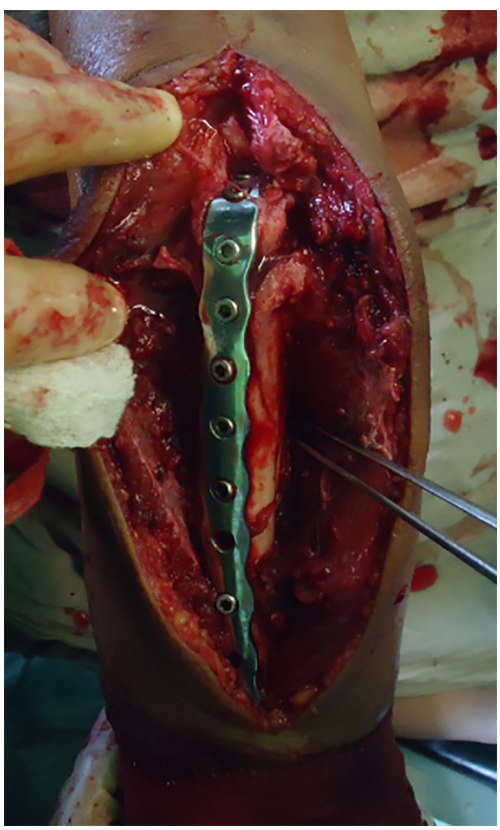

Figure 2 Intraoperative view (competition of internal fixation).

Case presentation

A 35-year-old, right-hand–dominant woman fell from a height sustaining an intra-articular, comminuted, fracture of the left proximal ulna (*Figure 1*). As shown in *Figure 1*, direct forces generated comminution (fragmentation) of the central portion of the proximal part of ulna including olecranon articular surface and, also avulsions of the coronoid process including the extension of the ulna shaft. The triceps brachii inserted into the posterior third of the olecranon and the proximal ulna separated the olecranon, the brachialis inserted into the coronoid process of the ulna produces tensile forces across the elbow joint during contraction, so as to separate the coronoid, thus resulting in complex fracture of proximal ulna and severe dysfunction of the elbow.

There was no abnormal findings in her medical, family and psycho-social history including relevant genetic information.

According to the AO principle of articular fracture management, ORIF using anatomical locking plate was performed, one day after the injury, without any complication.

Surgical technique

A direct reduction was performed using hooks, pointed reduction forceps, and K-wires. With exposure of the major fragments under direct vision, reduction was achieved and maintained with temporary pin fixation. The fracture reduction was visualized on each of the sigmoid notch and dorsally. Visualization of the coronoid could be made through the fracture site of the separated olecranon fragments before reduction.

After reduction and temporary fixation, a posterior locking plate 3.5 which was contoured to the anatomical shape of proximal ulna was applied for this comminuted fractures.

Coronoid process was fixed with 3 screws and subsequent bicortical screws were placed in a locking plate (*Figure 2*).

Postoperative management

No external device like a dorsal splint was applied. The patient was started on an early rehabilitation program. The patient was allowed to use her elbow as tolerated. Active assisted exercises are started the day after, including gravity assisted elbow flexion with the patient lying supine.

Figure 3 Occurence of heterotopic ossification in the triceps muscle.

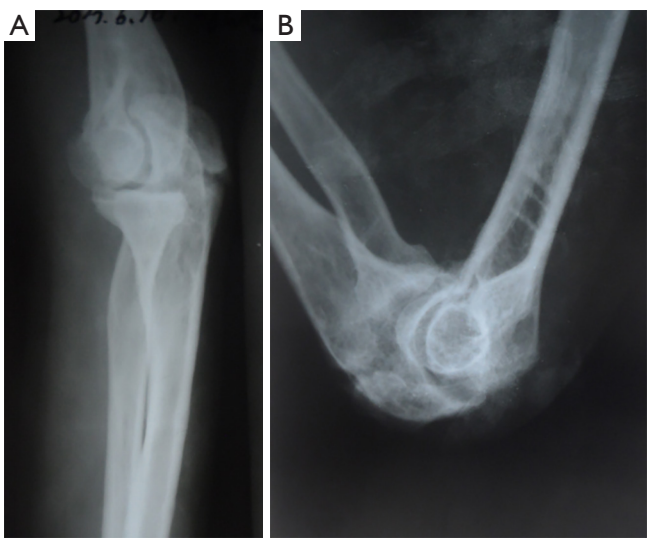

Figure 4 X-ray view of the elbow after removal of HO and implants. (A) Lateral radiograph view of the extended elbow. (B) Lateral radiograph view of the flexed elbow.

At approximately 8 weeks the evidence of union was revealed on plain radiograph, but she didn`t recover her functional range of elbow motion, although professional physical therapy was applied.

She subsequently developed progressive elbow stiffness that was resistant to formal therapy.

At 16 weeks after surgery, his elbow flexion arc was not returned to functional range yet, ROM was 45° to 100°. Physical examination showed a loss of about 45° of extension, and about 50° of flexion compared with the uninjured side. Forearm rotation was maintained.

Radiographs taken at 6 months showed a union of proximal ulna and also profound heterotopic ossification posteriorly within the triceps muscle just over the olecranon and posterior to olecranon fossa within the triceps muscle (*Figure 3*).

Revision surgery & final results

Six months after the initial procedure we performed the second surgery, which included removal of plate and screws and excision of heterotopic ossification at the same time.

Intraoperatively we could find the 2 cm long bony mass surrounding the first and second screw hole of plate on the olecranon. Intraoperatively, we confirmed a full passive range of movement under anaesthesia (*Figure 4*).

Postoperative radiographs confirmed that the entire mass has been excised. 75 mg indomethacin was prescribed daily for 6 weeks after the second surgery. The patient started a regimen of active assisted elbow movements from the second postoperative day.

She was pain-free and obtained functional range of motion 3 weeks after the second procedure.

Two months after revision surgery, the patient was asymptomatic and had regained a range of elbow motion from 20° to 130°. The functional assessment revealed possibilities for global nutrition (hand-mouth), hygiene (hand-face) and grooming (hand-neck). On the basis of plain radiographic findings, we didn't find any sign of recurrent ossification after an 18-month follow-up period. The evaluation of 24-month follow-up period showed relief of pain and maintenance of functional range of motion (*Figure 5*).

At the final follow-up, there was no adverse and unanticipated events.

- ❖ Injury on the 15th Dec. 2015.
- ❖ ORIF and then early rehabilitation program.
- ❖ Postop.8th week—union, but not enough elbow ROM.
- ❖ Postop.8th week—ROM 45° to 100°.
- ❖ Postop.6th month—union of proximal ulna and also profound heterotopic ossification posteriorly within the triceps muscle just over the olecranon.

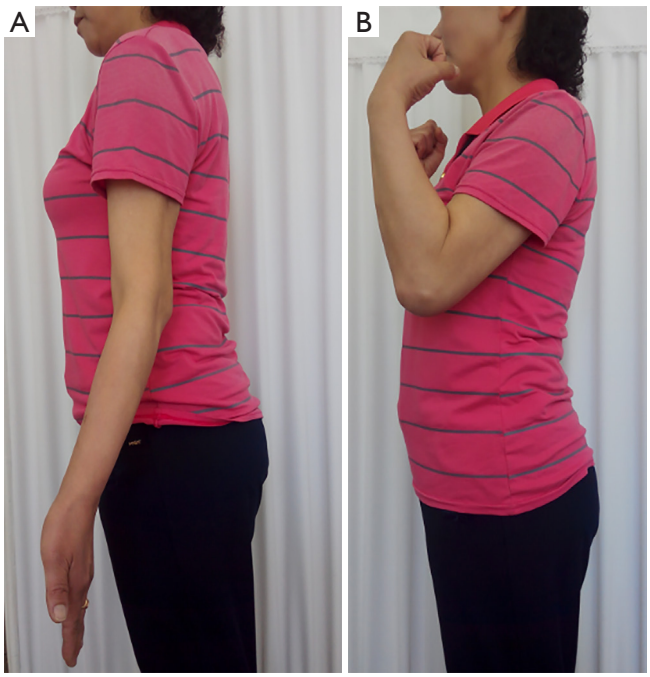

Figure 5 Recovered functional arc of the elbow. (A) Extension loss is approximately 20 degree. (B) Flexion is approximately 130 degree.

- Second procedure which included removal of implants and excision of heterotopic ossification.
- Indomethacin administration.

❖ Postop.8th month (2 months after revision surgery)—elbow ROM 20° to 130°.

❖ Postop.18th month—not any sign of recurrent ossification.

❖ Postop.24th month—relief of pain and maintenance of functional ROM, no adverse and unanticipated events.

Discussion

The functional outcome following olecranon fracture fixation is generally good or excellent whatever method of fixation is used. The main complication following internal fixation of olecranon fractures is related to irritation caused by hardware.

Loss of motion is commonly encountered with patients typically losing 10°–15° of extension. The loss of elbow motion is worse in cases associated with fractures of the radial head, capitellum, coronoid or Monteggia fracture-dislocations (12,13).

The majority of patients recover a functional range of motion, frequently with small losses of extension, usually with no associated disability.

Previous studies of proximal ulna comminuted fracture, however, to our knowledge, have reported no cases of HO as a complication, despite the potential development of ectopic bone in the elbow.

Heterotopic ossification (HO), which is first described by Patin in 1962, is the formation of mature lamellar bone in nonosseous tissue. It is also termed heterotopic bone or ectopic osteogenesis (ossification and calcification). The most common cause of HO is trauma such as musculoskeletal injury, surgical trauma, or warfare injuries. When it forms outside the joint capsule and periosteum, it causes pain, swelling and is usually associated with limited range of motion. that is why, this is an important problem throughout orthopaedic surgery (14-24).

Heterotopic ossification may follow intracranial damage and is made more likely by delayed fixation and by passive stretching of the elbow (25).

It was reported that HO developed in approximately 3% of patients with a local injury of the elbow (26-29), and Elbow HO occurs in 20% of patients with Traumatic Brain Injury and forearm fractures (27,30-32).

Otherwise, Robert W. Wysocki (33) reported a case of triceps muscle ectopic ossification and resultant elbow stiffness after application of recombinant human bone morphogenetic protein to a distal humerus nonunion site. This case was directly related to the use of OP-1.

Most investigators agreed that the most frequent cause of heterotopic bone about the elbow is direct trauma, however, HO after ORIF of proximal ulna has not been reported yet, to our knowledge.

So now we are reporting a case of HO affecting the elbow motion after ORIF of proximal ulna comminuted fracture.

According to Hastings and Graham (27), this case seems class IIA.

In the present case we have experienced a complication of massive HO within the triceps directly over the olecranon where anatomical locking plate was lied, leading to marked loss of elbow motion. We believe that anatomical locking plate fixation is much superior over other techniques, but this unpredicted complication which was directly related to the operation developed.

The internal fixation in the present case has been rigid enough to ensure stability of fracture site, but we guess that the microtrauma caused by friction between the plate and

triceps may have been the main factor. After operation we allowed the patient to use her elbow as tolerated, and then formal physical therapy which was thought to aggravate the injury caused by incision and muscular dissection.

This is supported by the pattern and extent of the ectopic bone that formed in this case.

Furthermore, we've not taken any measure to prevent the HO, which could be also a cause of this unique case, to our knowledge.

Careful handling of tissue during any surgical procedure, especially around the hip and elbow, is also of importance to minimize any trauma and subsequent inflammation. But the role of proper surgical technique in the formation of heterotopic bone is difficult to quantitate, so various preventive modalities of HO have been discussed in the literature (34).

Different modalities used include diphosphonates, etidronate, and NSAID's such as indomethacin and naproxen. radiotherapy, Noggin, a BMP inhibitor, pulsed electromagnetic fields (PEMF), and free radical scavengers and N-acetylcysteine (35-39).

But we've not taken any the abovementioned measures because this complication has been very rarely reported. We thought postoperative therapy was not proper in this case, either. The principal of the HO treatment is appropriate immobilization for immature bone and physical therapy for a mature mass (38).

Just only focusing on the early motion of the injured elbow was more likely to promote the development of HO.

In the present case, we wonder if immobilization for 3–4 weeks rather than early motion would be beneficial. Although early motion and manipulation has been essential to prevent stiffness and has been reported to improve range of elbow motion, in this case they may have predisposed to hematoma formation, scarring, and heterotopic ossification.

From this experience, we do not recommend isolated physical therapy in patients with elbow injury, rather we recommend combined physical therapy with other preventive measures. Many authors agree that if ectopic bone around the elbow is causing or contributing to a loss of functional elbow motion, an operative procedure is warranted to remove the offending bone and release the joint capsule whether the motion limitation is partial or complete (ankylosis) (16,27).

Results of surgical excision of heterotopic ossification about the elbow have shown significant improvement in range of motion, independence, and quality of life in most cases (40-44).

They suggest that patients usually regain a full active range of motion within a few days of excision of the bony mass (21,24). In this case, the result of surgical excision was similar to the previous data.

The patient was pain-free and obtained functional range of motion 3 weeks after the second procedure.

Although this is a very rare case, we recommend that postoperative therapy should be performed with caution in the elbow where formation of excess bone restrict motion. Unless the recovery of functional ROM is achieved as predicted, HO should be doubted, refraining from passively stretching the injured elbow.

In order to prevent postoperative HO, intraoperatively, surgical dissection should be performed as carefully as possible, and postoperative, management should involve all effective measures such as abovementioned ones.

The patient felt satisfactory about her final outcome of the treatment and consent to this case report.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/dmr.2020.01.01). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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