

Case Report

Bilateral post-traumatic forearm and hand compartment syndrome: a case report and review of literature

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ABSTRACT

Acute compartment syndrome is a condition in which interstitial tissue pressure within a closed osteo-fascial compartment is elevated to a nonphysiologic level causing decrease in tissue perfusion, which if left elevated for sufficient time, can lead to tissue necrosis and devastating loss of function. It poses a diagnostic and therapeutic challenge for treating surgeons. We present a case of acute post-traumatic bilateral forearm and hand compartment syndrome in a 12 year old boy associated with fracture of distal ulna and metacarpals. Patient regained excellent function with emergent fasciotomy of volar forearm and hand followed by wound management with vacuum-assisted wound closure system (VAC), delayed primary closure and split-thickness skin graft (SSG). Early diagnosis and emergent fasciotomy are crucial to avoid debilitating complications.

Keywords: Bilateral, Compartment syndrome, Fasciotomy, Forearm, Hand, Split-thickness skin graft

INTRODUCTION

Compartment syndrome is a condition in which increase in interstitial tissue pressure within a closed osteo-fascial compartment leads to microvascular compromise.¹

Delay in diagnosis can result in irreversible damage of tissues within the affected compartment, which can lead to limb and life threatening complications. It is one of the most challenging diagnostic and decision making problems faced by the treating surgeons.

High index of suspicion is required to diagnose the condition, and it is critical for treating surgeon to proceed with emergent surgical decompression to avoid potential complications.

We report a case of post-traumatic bilateral forearm and hand compartment syndrome associated with multiple fractures. To our best knowledge, no such case has been reported in literature so far.

CASE REPORT

A 12 year old boy presented to emergency department 3 hours after a fall from height (nearly 12 feet) on outstretched hands. He sustained injury to both forearm and hand. Examination revealed tender and tense swelling of bilateral forearm and hand. He was also complaining of numbness of fingers. Pain was elicited on passive movement of wrists and fingers. Radial pulses were palpable on both sides. Radiography revealed fracture shaft of ulna on both side, fracture of 3rd, 4th and 5th metacarpals on left side and fracture of 5th metacarpal on right side. Vitals were stable and significant injury to head, chest and abdomen were ruled out by appropriate examination and imaging. Despite adequate analgesia, patient complained of severe pain.

Provisional clinical diagnosis of bilateral compartment syndrome of volar compartment of forearm and hand was made. Volar forearms were decompressed with a volar curvilinear incision starting from 2 cm above antecubital

fossa extending to palm to include the carpal tunnel. Lacertus fibrosus and transverse carpal ligaments were released. Superficial volar and deep volar compartment were decompressed. Interossei compartments of hands were decompressed by two longitudinal incisions over 2nd and 4th metacarpals, and by dissecting along shaft of metacarpals. Fractured ulna and metacarpals were stabilised with K wires (Figure 1). No muscle necrosis was encountered during surgery and the muscles were contractile. After fasciotomy, wounds were left open and bulky saline-wet-to-dry dressings were applied and both extremities were loosely splinted and kept in functional position.



Figure 1: Post OP radiographs; (A) right side; (B) left side.

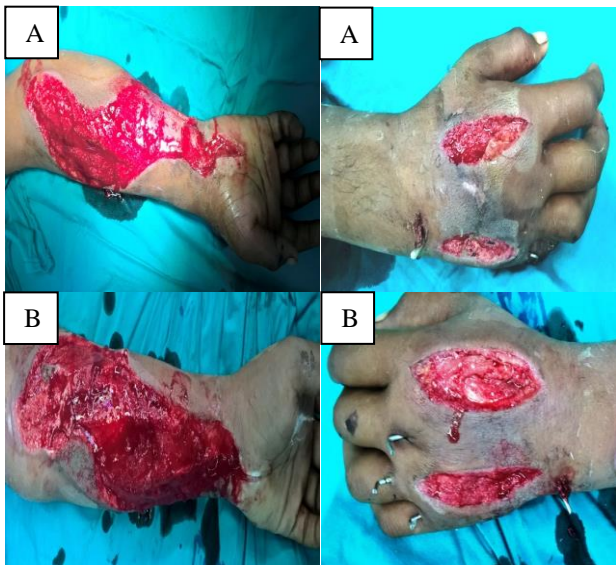


Figure 2: Fasciotomy wounds 3 days after VAC application showing healthy granulation tissue; (A) right side; (B) left side.

After 24 hours, patient was taken to operating room for re-exploration. Muscles were found to be healthy and after a thorough wound wash Vacuum-assisted wound closure system (VAC therapy system; KCI, San Antonio, TX) was applied over fasciotomy wounds of forearm and hands. Intra-operative wound cultures were also sent, which were reported to be sterile later on. VAC change

was done 3 days later, and the wounds were found to be healthy and granulating well and decreased in size from pre-VAC dimensions (Figure 2). After another 3 days, patient was again taken to operating room for wound management. Delayed primary closure of hand fasciotomy wound was done on both sides. Bilateral forearm wounds were partly sutured and partly reconstructed with split-thickness skin grafts (SSG) (Figure 3). Post-op dressing was done at 5th day. Upper extremity active and passive ranges of motion exercises were commenced. At the time of discharge, wounds were healthy with good uptake of SSG. At 3 weeks follow-up visit, K-wires from ulna and metacarpals were removed under local anaesthesia under aseptic conditions.



Figure 3: Intraoperative photograph after wound closure and split-thickness skin grafting.

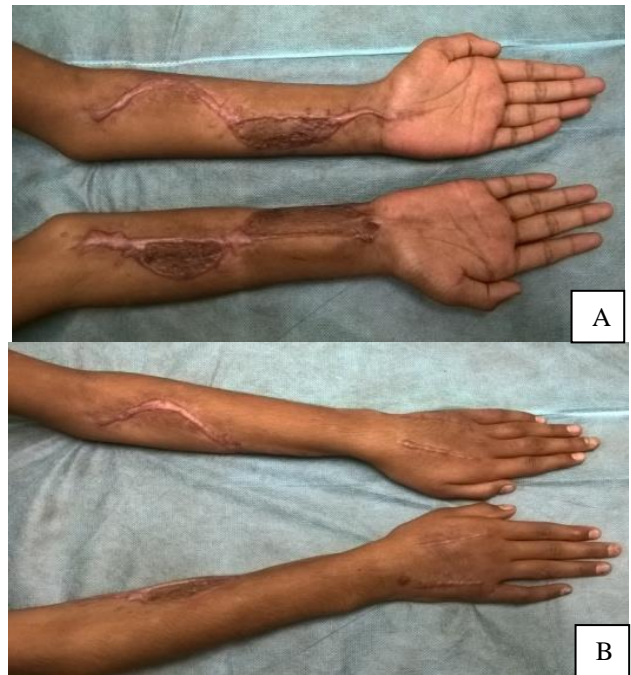


Figure 4: Clinical photographs at 6 weeks follow-up showing complete healing of fasciotomy wounds and satisfactory uptake of split-thickness skin grafts on both sides.

At 6 weeks follow-up visit, the patient was found to have completely healed wound on both sides (Figure 4). Fractures of ulna and metacarpals were found to be united radiologically (Figure 5).

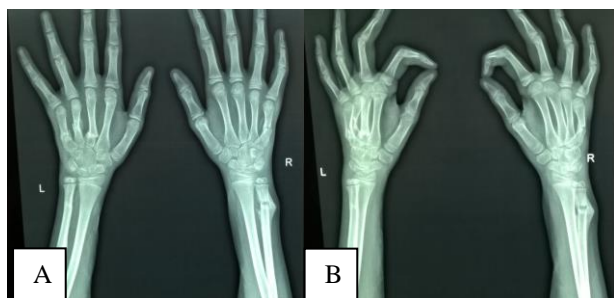


Figure 5: At 6 weeks follow-up, radiographs demonstrating union of fractures (fracture shaft of ulna on both sides, fracture of 3rd, 4th and 5th metacarpals on left side, and fracture of 5th metacarpal on right side).

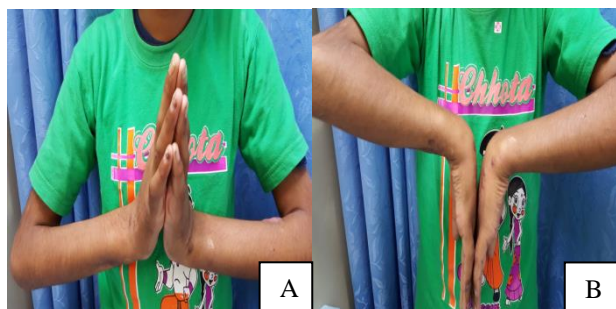


Figure 6: At final follow-up, patient having good range of motion of wrists and fingers, except for mild restriction of wrist dorsiflexion on right side.

Range of motion was full on both elbows. However, there was mild restriction of wrist dorsiflexion on right side (0-80 degrees) compared to left (0-90 degrees). Examination revealed no neurological deficit with good grip and pinch strength on both sides (Figure 6).

DISCUSSION

In 1881, Richard von Volkmann first extensively studied the etiology, pathophysiology, management and associated complications of compartment syndrome.² Increase in intra-compartmental pressure in closed osteofascial space above a critical level for sufficient time can lead to devastating complications including loss of function, permanent neurologic deficit, Volkmann ischaemic contracture, infection and even amputation. High index of suspicion is required to diagnose the condition, and it is critical for treating surgeon to proceed with emergent surgical decompression to avoid potential complications.

Acute compartment syndrome in upper extremity can be caused by a wide range of factors, including fractures, crush injury, constrictive dressings, tight casts, burns, infection, bleeding disorders, spider bite, snake bite, arterial injury, reperfusion injury, extravasations of infusion, injection of illicit drugs, regional anaesthesia, prolonged compression etc.³⁻⁶ The question of whether to

proceed to fasciotomy based on clinical findings alone or on the basis of compartment pressure monitoring, still remains to be definitively answered and there are proponents of both. However, treatment is often guided by physical examination alone.^{1,7} In a review of 201 fasciotomies (37 in upper extremity) in a Level I trauma centre, Dente et al reported that the decision to perform a fasciotomy was a clinical one in 75 % of patients.⁷

We do not routinely employ intra-compartmental pressure monitoring, and base our managements principally on clinical findings, albeit intra-compartmental pressure measurement is strongly considered in equivocal cases. When using clinical criteria alone, it must be emphasized that regular examinations by an astute surgeon and a high index of suspicion are a must in order not to delay the fasciotomy and risk permanent damage.

The forearm with compartment syndrome presents with tender, tense, swollen extremity, with fingers partially flexed. Clinically hand compartment syndrome presents with tense, swollen hand in intrinsic minus position (i.e. Extension of metacarpophalangeal joints and flexion of the interphalangeal joints).³ Pain out of proportion to injury and pain with passive stretching of muscles of the involved compartment are the earliest indicators of compartment syndrome, and can be enough to proceed with expedient surgical decompression.⁶ Caution must be exercised in case of children, patients who are obtunded, and those who have undergone regional anaesthesia, who have inconsistent perception of pain and cannot communicate properly.³⁻⁵ There is a definite role of compartment pressure monitoring in such patients.

The mainstay for treatment of acute compartment syndrome is emergent fasciotomy with decompression of all affected compartments. Outcome following compartment syndrome is attributed to the severity of injury, duration of ischaemia, preinjury status and co morbidities. The most important determinant of outcome is time from diagnosis to fasciotomy.^{3,5}

In present patient, we proceeded with immediate fasciotomy after clinical diagnosis was made in emergency department. Additionally, wound was managed with vacuum-assisted wound closure system (VAC) followed by delayed primary closure and split-thickness skin graft. VAC has been shown to decrease hospital stays, promote wound healing, reduce risk of infection, and in addition reduce time to primary closure of wound or time to skin grafting.⁸ We have achieved excellent function with no neurologic deficit, except for 10 degree loss of dorsiflexion in right wrist. Early initiation of upper extremity range of motion is of paramount importance for optimal outcome.

Quellette and Kelly noted good outcome in 13 of 17 patients treated with fasciotomy for compartment syndrome of the hand.³ Four patients had poor outcome,

and all four patients were obtunded at presentation. Bostrom et al reported on 16 patients with compartment syndrome of the forearm after fractures, who were treated with fasciotomy and fracture stabilisation with a follow-up of 2-to-5 years. Median nerve function recovered in 15 patients. 8 patients had good outcome, and could resume their occupation within one year.⁹

Bilateral forearm or hand compartment syndrome is not uncommon, and various etiologies have been described in literature.^{10,11} However, traumatic factor leading to simultaneous involvement of bilateral forearm and hand has not been reported so far. It poses an immense diagnostic dilemma and therapeutic challenge, meticulous attention to be paid and a high index of suspicion must be maintained to avoid disastrous consequences. Prompt diagnosis and emergent fasciotomy are the cornerstones to achieve good clinical outcome.

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