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Case reports

Simultaneous Distal Radius Fracture with Acute Radial Artery Injury: Is it a Unique Complex Injury or a Misdiagnosis Lesion?

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Abstract

In spite of the fact that distal radius fractures are one of the most common injuries in emergency department, when these injuries accompanied with radial artery laceration, consist a very unique problem concerning the diagnosis as much as the treatment management. While many reports exist in literature which present the vascular complication of radial artery after surgical management of distal radius fracture, only three studies analyzed this complex injury. The qualified treatment of isolated DRF has been clarified but when the fracture is associated with radial artery lesion the protocol of treatment remains unclear. The aim of this study is to analyze three cases with simultaneous injuries of DRF and radial artery and to analyze our results compared to those presented in literature referring to the incidence of rate and treatment management.

Keywords: ***Distal radius fracture, radial artery, vascular complication, incidence rate.***

Introduction

Distal radius fractures (DRF) are one of the most common types of fractures seen frequently in emergency department, accounting to 25% of fractures in the pediatric population and up to 18% of all fractures in age over 65 years old [1]. Literature advocates that the majority of cases associated to vascular injuries (radial or ulnar artery) with distal radius fracture was iatrogenic caused during surgical management of the fracture with internal or external fixation implant as a type of pseudoaneurysms [2,3,4]. Laceration of radial or ulnar artery as a result of distal radius or ulnar fractures were infrequent injuries, and only a few reports have been presented in literature [5,6,7].

While the treatment management of isolated arterial injuries of radial or ulnar artery with the indication of treatment (conservative or surgical) of isolated DRF is clarified, it is unknown which is the best treatment option when a distal radius fracture is associated with laceration of radial artery. Reconstruction of the artery or ligation, are the two modalities of vascular treatment and in long-term results there is no difference between these two surgical procedures concerning "cold" sensitivity symptoms, when the hand presents normal function preoperatively.

The aim of this study is to present three cases with concomitant radial artery laceration and distal radius fracture and to analyze the incidence of these lesions and the treatment protocol of these concomitant injuries with referring literature.

Case reports

Case 1

A 72 year-old female proceed in emergency department after a fall from a standing height with right wrist deformity and swelling. She had an ecchymosis on distal radio-volar surface of the forearm.(Fig 1(a)) There was no motor or sensory nerve deficit function of the median or ulnar nerves. The x-rays and ct/scan revealed a comminuted fracture of right distal radius (AO/OTA 23C3.3) with styloid process of ulna and a lunate fracture.(Fig 1(b),1(c),1(d),1(e)). The patient underwent to the operative theatre in which an open reduction and internal fixation of the fractures under regional anesthesia and tourniquet application was performed. An extended flexor carpi radialis approach applied initially for stabilization of DRF. The radial artery was lacerated and entrapped between the bone fragments of radius. The distal radius fracture was fixated with a volar locked plate while the lunate fracture with a Herbert screw.(Fig 1(f),1(g),1(h)) After release the tourniquet the hand was well perfused by ulnar artery. Because of the medical history of the patient (Diabetes mellitus type I, rheumatoid arthritis) the ligation of the radial artery was decided. Patient started a standard protocol of rehabilitation

initially, after the second postoperative day, with passive and self-assistive motion of the fingers and active motion of the wrist at six weeks postoperatively. At eight months follow-up the hand was pink with normal capillary refill and without any neurological deficit. The range of motion was 72° of wrist extension and 51° of flexion with full forearm rotation and full digit motion.

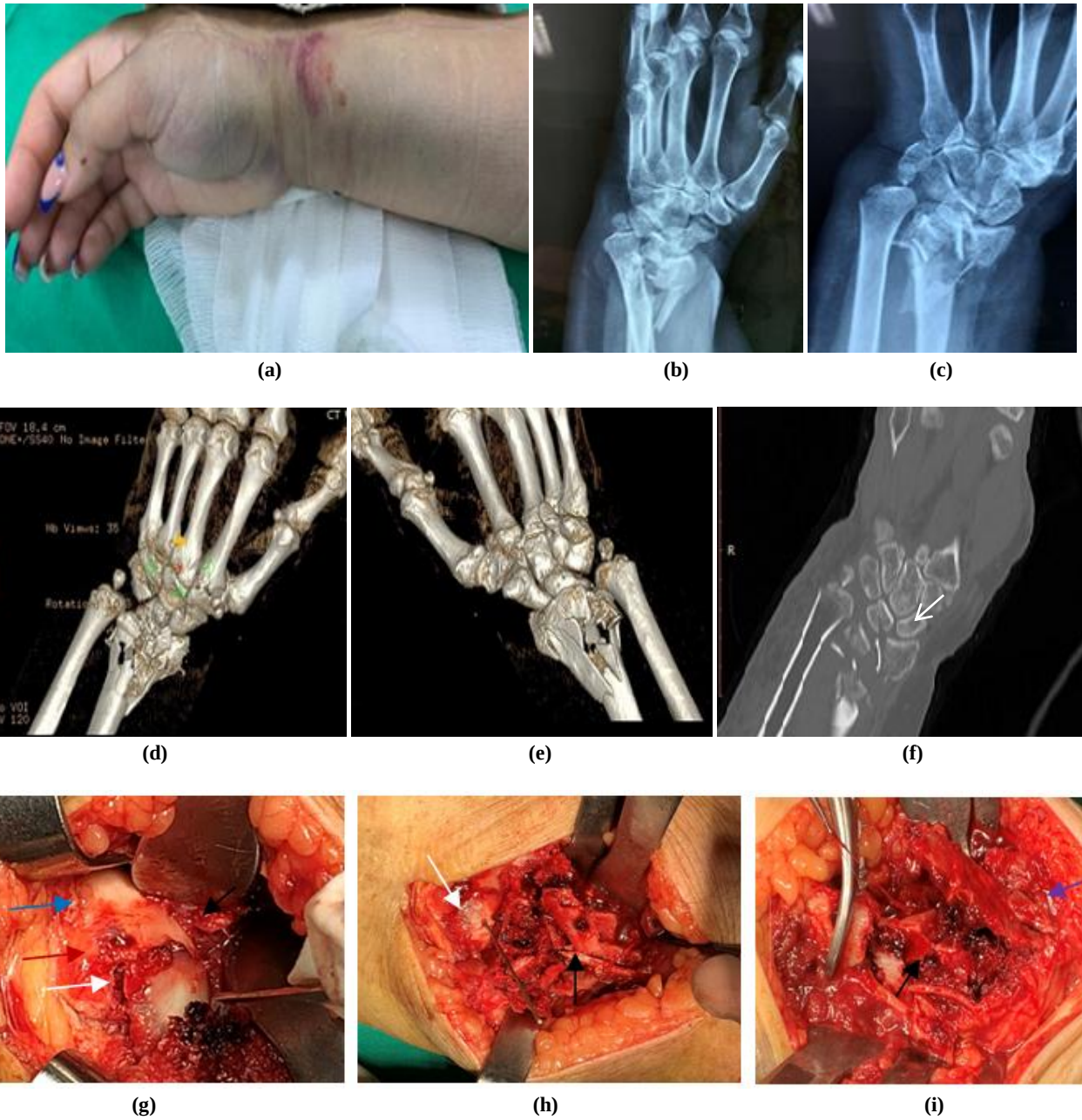

Figure 1: Ecchymosis of the radial – volar surface of distal area of right forearm (a). X-rays of patient F(b) - Pr(c) and ct/scan (d,e) which reveals a comminuted fracture of DRF(AO/OTA 23C3),styloid process of ulna and fracture of lunate (f (white arrow)). Intraoperative (g) fracture of lunate (white arrow, SLL (red arrow), of scaphoid(blue arrow)). Dorsal aspect(h) of the DRF(black arrow, lunate bone osteosynthesis(white arrow). Volar aspect(i) of DRF (black arrow) with radial artery lacerated (distal part blue arrow) and flexor carpi radialis tendon (grey arrow).

Case 2

A 24 year-old female was admitted in emergency department after a road traffic accident with an open volar fracture dislocation of distal ulna at right wrist.(Fig 2(a)). After ATLS damage control, patient reported numbness along the distribution of the ulnar nerve and the clinical examination of the hand revealed a satisfactory hand circulation. In provintional reduction of distal radio-ulnar joint (DRUJ) dislocation in emergency department, in order to immobilise the fracture, patient reported amelioration of the numbness. Radiography examination showed a comminuted fracture of distal radius (type I) with a volar dislocation of DRUJ (AO/OTA 23C2). (Fig 2(b), 2(c)) Patient admitted to the operative theatre in which under general anesthesia and tourniquet initially, a meticulous irrigation of the volar trauma of ulnar side of the wrist and exploration performed. The ulnar artery and nerve were intact. During the extended flexor carpi radialis approach for osteosynthesis of distal radius fracture, we discovered a total laceration of radial artery. The ends of artery were between the radius fragments.Fig2 (d)). DRF was reduced and stabilized with a volar locking plate and the radial artery was repaired with 6-0 prolene sutures. The distal radioulnar joint was reducible and stabilized with a Kirschner wire. (Fig 2(e),2(f) After tourniquet release the artery was functional without bleeding and the hand was warm with normal capillary refill. In six weeks the Kirschner wire was removed and a standard protocol of rehabilitation started as

mentioned previously. At the last examination at one year time, the patient had good vascular status without neurological deficit and the range of motion was 70° of wrist extension and 55° of flexion with full forearm rotation and digit motion.

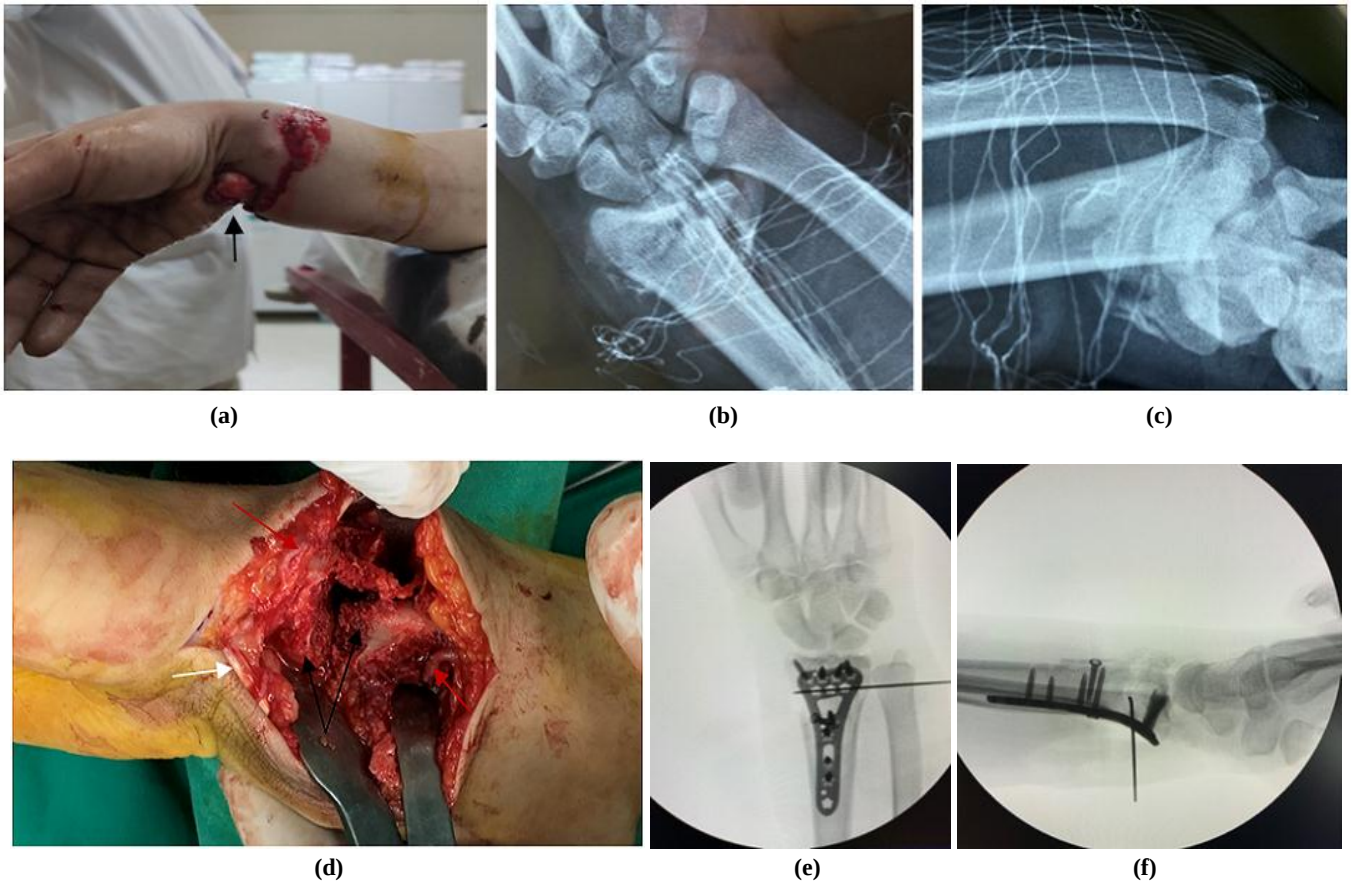

Figure 2: Open(a) volar dislocation of distal ulna in right hand(black arrow). Preoperative x-Rays F(b) and Pr(c) show a comminuted DRF(AO/OTA 23C2)with DRUJ disorganization.
Laceration of radial (d) artery(red arrows) with radial bone fragments(black arrows), flexor carpi radialis tendon (white arrow). Post surgery x-rays of the lesion with palmar plate and DRUJ stabilization with Kirschner wire(e,f)

Case 3

A 54 year-old man manual worker was admitted in emergency department after a fall from high with left wrist deformity and swelling. The nerve examination was without sensitivity or motor nerve deficit and the hand had normal capillary refill. In past medical history the patient reported an old fracture of styloid process in the same wrist and DRF in the right wrist two years before. Initial x- Rays (Fig 3(a)-3(b)) and ct/scan (Fig 3(c), 3(d),3(e)) of the left wrist showed an intra-articular distal radius fracture clasiffied as AO/OTA 23B3. Patient underwent to operative theatre for open reduction and internal fixation of DRF. An extended flexor carpi radialis approach performed for a palmar locking plate. The radial artery was completely lacerate as a result from the contact to the sharp edge of radial bone fragment.(Fig 3(f),3(g)) Radial artery was repaired with 6-0 prolene sutures. After tourniquet release, the artery was functional without bleeding and the hand was warm with normal capillary refill. In four weeks time the patient started full rehabilitation program and at final examination at one year the hand presented without neurological deficit. The patient had full digit motion and forearm rotation while the wrist extension was 52° and wrist flexion73°.

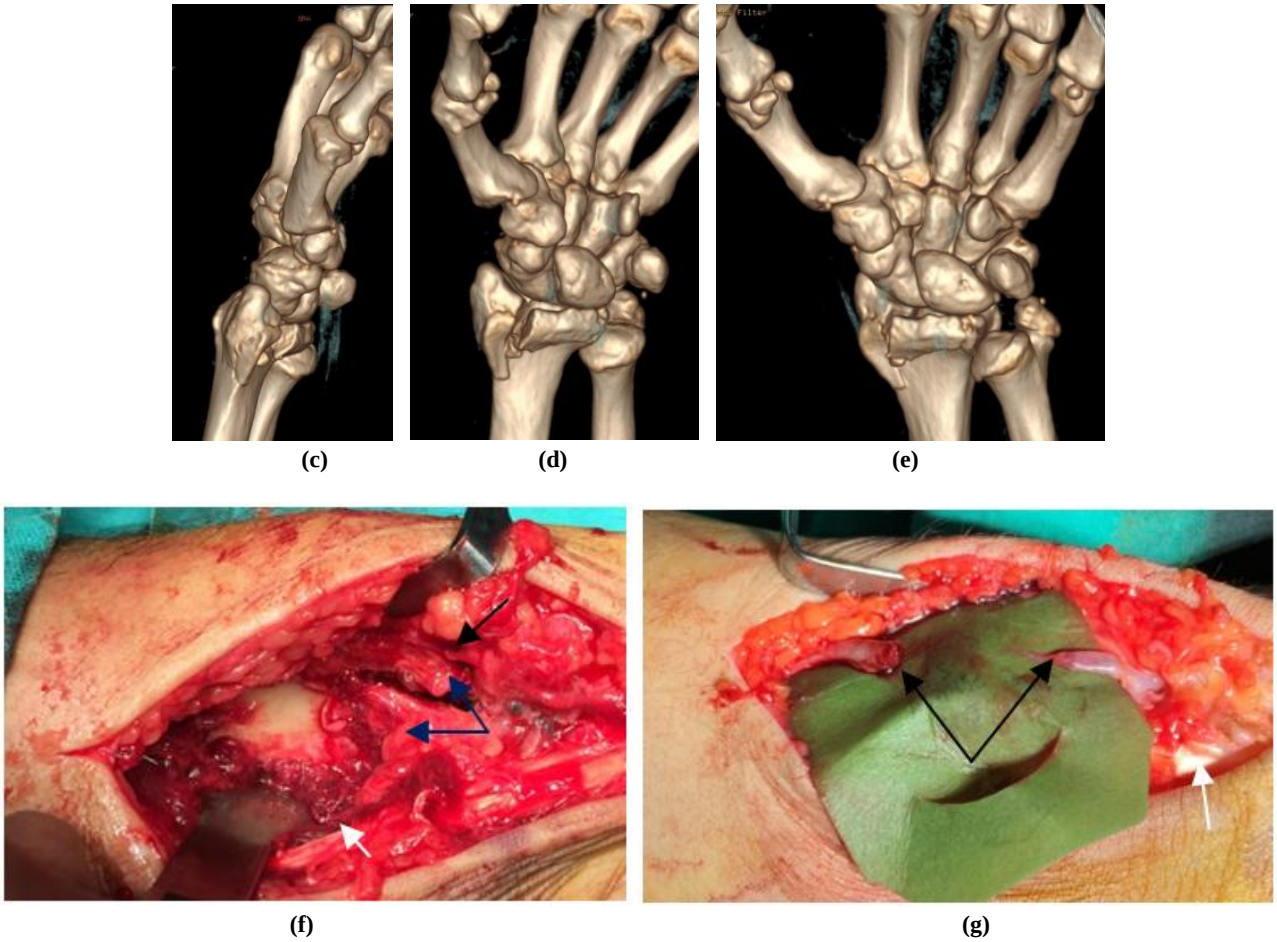

Figure 3: Preoperative x-Rays F(a) and Pr(b) and ct/csan (c,d,e)show a intra-articular distal radius fracture (AO/OTA 23B2). Radial artery with complete laceration(f (black arrow)) as a result of sharp edge of the radial bone fragment which was in contact (blue arrows - flexor carpi radialis tendon (white arrow)). Ends of lacerated radial artery (g (black arrows - flexor carpi radialis tendon (white arrow)).

Discussion

Isolated distal radial fractures are the most common injuries and occur in all age groups of the population. The rate of DRF in emergency department is one-sixth of the fractures [8]. Davis et al(2010) support that DRF is not only a bone problem but is associated with a potential soft tissue complication which can affect the final functional outcomes [11]. In literature many authors have described complications which appeared after a distal radius fracture and could be distinguished in two categories: the one that complications are associated with the fracture at the time of injury (laceration of median or ulnar nerve injury) and the other that complications are resulting from surgical or conservative treatment [9,10,12,13]. Vascular complication after DRF reported in literature, refers in ulnar artery either preventing the fracture reduction or that has been displaced dorsally around the ulnar styloid [14]. Isolated radial artery injury is reported as pseudoaneurysm after osteosynthesis of a distal radius fracture with a volar locking plate [3].

Radial artery lesion as a sequel of the distal radius fracture is very rare and only 3 reports have been presented in literature. Deepak et al(2005) first described a case with radial artery laceration and displaced distal radius and ulna fracture, when the patient presented cool fingers and poor range of motion. The artery was ligated and the patient was not appeared with vascular deficit [5]. Bas de Witte et al(2008) presented 6 cases with arterial lesions(four radial and two cases of ulna artery) as a result of fracture of distal radius and supported that these vascular complications were discovered when volar approach performed for osteosynthesis of the fracture [7]. O'Toole et al (2013) presented the results of a survey with the scope to describe the rate of frequency of these complex lesions [6]. He estimated that the incidence rate of these combined injuries is 2% of patients who are treated operatively with an anterior approach, and he suggested that open radial fracture is a risk factor for arterial injury [6]. In our cases all the fractures were operated by one surgeon and with extended flexor radialis approach, which routinely explores radials artery. One patient from our series had an open fracture type I (case 2), one case appeared with a hematoma in distribution of radial artery in distal forearm (case 1) and all three patients appeared with the comminuted facture of distal radius. Supporting the standpoint of O'Toole we postulate that in all open DRF and even those which appeared with hematoma of volar radial surface of distal forearm, assiduous vascular examination should be performed prior to preoperative treatment planning.

Reconstruction of injured arteries in forearm and wrist has three major objectives: preservation of hand viability, restoration of functional ability of hand, and maintaining vascular function in order to avoid complication because the limb is more prone in future injuries [6]. On the contrary, there are reports of limb viability when an isolated vascular injury (radial or ulnar artery) in forearm is not repaired. DeBakey et al reported that 5/99 radial and 1/69 ulnar artery lacerations lead to amputation of the limb, while Perry et al, in 58 radial and 39 ulnar arteries injury reported that no amputation performed [15,16]. Johnson et al (1993) suggested that ligation of the injured isolated artery(radial or ulnar) is a safe method of treatment in cases in which there is no acute hand

ischemia and when there is no important palmar arch arterial trauma [17]. Recent studies of the use radial artery for coronal bypass or radial forearm flaps present a few complications and support the above option [18,19].

When isolated arterial injury is at the level of the wrist, Coleman et al(1961) suggest that vascular complication is small because the other artery is remaining intact to supply the hand [20]. Hunt et al(2000) supported the above option and strongly suggest that the most critical point is that revascularization time should not exceed 12 hours from the injury to optimize the outcomes [21]. Kleinert et al(1989) reported that the radial artery was dominant for three or more fingers in 57% while ulnar artery in three or more finger in 21,5% and that the arterial system in the finger can terminate with variation and to appear without arch [22]. This is a critical reason necessitating reconstruction to arterial lesion to maintain vialability of the hand [6].

Until today several studies tried to compare the functional outcomes after reconstruction or ligated injured radial artery, but failed to demonstrate a connection between patients' symptoms of claudication or cold intolerance and radial artery lesion [17,23]. Gelberman et al(1982) supported that the symptoms of cold intolerance seem to be more linked when neurological injury exists rather than arterial deficit [24]. De Witte suggests that "it is critical to confirm sufficient arterial supply to hand from the remaining intact artery, before proceeding to forward ligation, because there may be arterial insufficiency prior to injury or anatomic variation"[7]. In our series vascular examination was performed prior to surgery which revealed sufficient arterial supply of the affected hands. In one case, in which ligation of the radial artery performed, the procedure was undergone after the release of tourniquet and was found sufficient perfusion of the hand. All the patients at final follow-up presented no symptoms related to prior arterial injury.

Conclusion

While any complications after distal radius fractures may be appeared for many reasons, the incidence rate of simultaneous vascular complication associated with DRF is very rare. The only explanation one could give is that isolated artery injury in wrist doesn't lead to ischemia of the region. Recognition of this complex injury should be done in emergency department and must always be a suspicion of lesion when risk factors are present (open or comminution of the fracture) and not during surgical management of the fracture. Reconstruction of the artery offers better functional outcomes.

Conflict of Interest

The authors declare that there is no conflict of interest. We certify that no funding has been received for the conduct of this study and/or preparation of this text.

Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

Consent form

Verbal informed consent was obtained from the patient for their anonymized information to be published in this article

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