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Proximal Humeral Fracture Complicated by Axillary Artery Occlusion and Axillary Nerve Palsy Following a Low-Energy Fall: A Case Report

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Abstract

Proximal humeral fractures complicated by a vascular injury are rare but potentially limb-threatening, requiring prompt recognition and coordinated multidisciplinary management. We report the case of a 67-year-old right-hand-dominant male who sustained a displaced proximal humeral fracture following a low-energy mechanical fall and subsequently developed acute upper limb ischaemia secondary to axillary artery occlusion caused by an intimal tear, accompanied by axillary nerve dysfunction. Crucially, the limb remained pink and free of ecchymosis throughout the initial assessment period, illustrating how robust shoulder girdle collateral circulation can maintain distal perfusion despite significant proximal arterial compromise. Early CT angiography (CTA) identified the arterial injury and facilitated an expedited transfer to a tertiary centre. The patient underwent emergency axillary artery repair (thrombectomy, limited endarterectomy and bovine pericardial patch angioplasty), along with prophylactic upper limb fasciotomies, followed by staged reverse total shoulder arthroplasty (RTSA). This report highlights the critical importance of serial neurovascular assessment in proximal humeral fractures and underscores that preserved limb coloration, the absence of ecchymosis, and a faint distal pulse must not be considered reassuring findings that exclude significant vascular injury in the presence of other clinical warning signs.

Categories: Trauma, Orthopedics, Cardiac/Thoracic/Vascular Surgery
Keywords: axillary nerve, fasciotomy, orthopaedic emergency, proximal humerus fracture, reverse total shoulder arthroplasty

Introduction

Proximal humeral fractures account for about 4-6% of all adult fractures and are among the most common fragility fractures in older adults [1,2]. They predominantly occur after low-energy falls in elderly patients with osteoporotic bone, and their incidence is expected to rise as the global population ages [3].

Neurovascular injury complicating proximal humeral fractures, while uncommon, carries significant morbidity. Axillary artery injury is a particularly rare but serious complication that may result in limb-threatening ischaemia if unrecognised or inadequately treated. The reported incidence of axillary artery injury in this setting is approximately 0.09%, while concomitant axillary nerve injury is far more common, reported in up to 53% of cases depending on the method of neurological assessment [4,5]. Critically, the rich collateral circulation around the shoulder girdle (including the subscapular, circumflex humeral and suprascapular anastomoses) can maintain distal limb perfusion despite complete proximal arterial occlusion, thus creating a deceptively benign clinical picture and delaying diagnosis [6,7].

Intimal injury with secondary thrombosis has been identified as the most common vascular mechanism in this injury pattern, occurring in approximately 63% of reported cases and may evolve insidiously without overt ischaemic features [8]. We present a case of a displaced surgical neck fracture of the proximal humerus in a 67-year-old male complicated by axillary nerve palsy and axillary artery occlusion, demonstrating the diagnostic pitfalls, the indispensable role of CT angiography (CTA), and the outcome following combined vascular and orthopaedic intervention.

Case Presentation

History and presentation

A retired 67-year-old right-hand-dominant male presented to the emergency department following a mechanical fall at home. He reported consuming approximately four units of alcohol between 18:00 and 22:00 hours before tripping over his dog and landing directly on his right upper limb. He denied any preceding chest pain, shortness of breath, dizziness, loss of consciousness, urinary symptoms, or systemic signs of infection. His medical history included ischaemic heart disease, hypertension, hyperlipidaemia, pulmonary emphysema, and hearing impairment. Prior to the injury, he had been fully independent in all

activities of daily living, lived at home with his partner, and was able to walk approximately three miles without limitation. He was a non-smoker, with no regular anticoagulant therapy documented.

Physical examination

Examination of the right shoulder revealed marked tenderness over the proximal humerus. Importantly, no ecchymosis was present around the shoulder or axillary region at the time of presentation. This finding is consistent with the early temporal window following injury, as bruising may take 24-48 hours to become clinically apparent even after significant fracture displacement, a point of considerable diagnostic importance that should not be misinterpreted as evidence against serious injury [9].

Neurovascular assessment demonstrated a markedly diminished radial pulse compared with the contralateral limb, with the right upper extremity notably cold to touch. Despite this, the limb retained normal coloration with no overt signs of distal ischaemia, reflecting preserved collateral perfusion, which is a well-recognised phenomenon in axillary artery occlusion [6,7]. Sensory examination revealed axillary nerve dysfunction, and systematic distal neurological examination confirmed intact radial, median, and ulnar nerve function. Distal sensation was globally reduced across all territories. Serial clinical reassessment over the initial observation period demonstrated progressive distal numbness, further raising concerns for evolving arterial compromise despite the preserved limb coloration.

Investigations and imaging

The patient was commenced on analgesia, placed nil by mouth and immobilised in a collar-and-cuff sling, with urgent orthopaedics and vascular consultation requested. Plain radiographs of the right shoulder, as seen in Figure *1*, demonstrated a significantly displaced fracture of the surgical neck of the proximal humerus with a separate fracture of the greater tuberosity. The humeral shaft was significantly displaced in a superomedial direction, while glenohumeral articulation remained preserved. Generalised osteopenia was evident. Medial displacement of the humeral shaft is a recognised plain radiographic predictor of axillary artery injury risk [10].

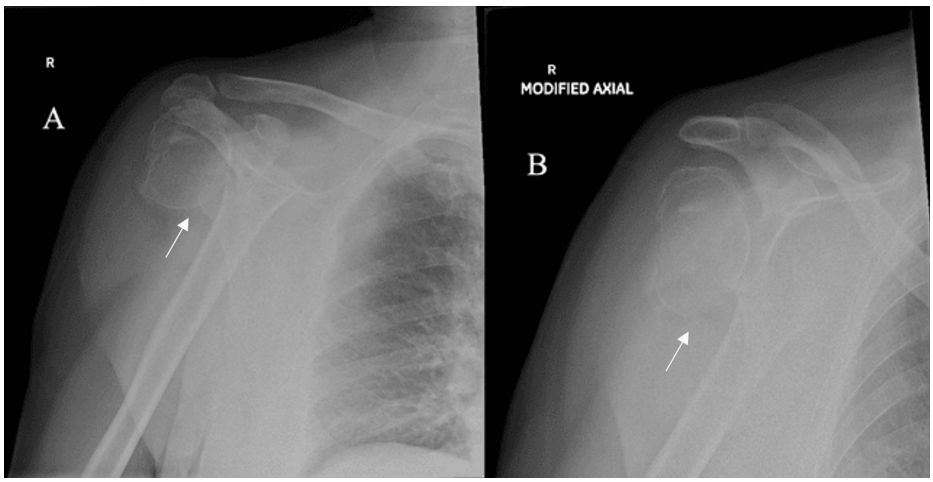


FIGURE 1: Plain radiographs of the right shoulder at presentation from (A) anteroposterior and (B) axial projections

The white arrows highlight the fracture of the proximal humerus: a displaced fracture of the surgical neck of the proximal humerus with a separate greater tuberosity fracture

Figure *1* demonstrates a displaced fracture of the surgical neck of the proximal humerus with a separate greater tuberosity fracture. Significant superomedial displacement of the humeral shaft with preservation of the glenohumeral joint is demonstrated. Generalised osteopenia is evident. Medial shaft displacement relative to the coracoid is a recognised radiological risk sign for axillary artery injury.

CTA of the right upper limb vasculature was performed urgently (Figure *2*). CTA has been established as the imaging modality of choice for suspected arterial trauma, offering high sensitivity and specificity for occlusion, intimal flaps, pseudoaneurysm and distal reconstitution through collateral pathways [11,12]. Initial reporting described apparent traumatic transection of the distal axillary artery. Subsequent consultant radiologist review revised this interpretation, with the CTA demonstrating abrupt cessation of contrast opacification at the level of the axillary artery near the origin of the posterior circumflex humeral artery, with distal reconstitution through collateral vessels and no surrounding haematoma or active extravasation. These findings were more consistent with compression-induced intimal injury and secondary

thrombosis, which is the most common mechanism in this injury pattern [8], rather than complete arterial transection (Figure *2*).

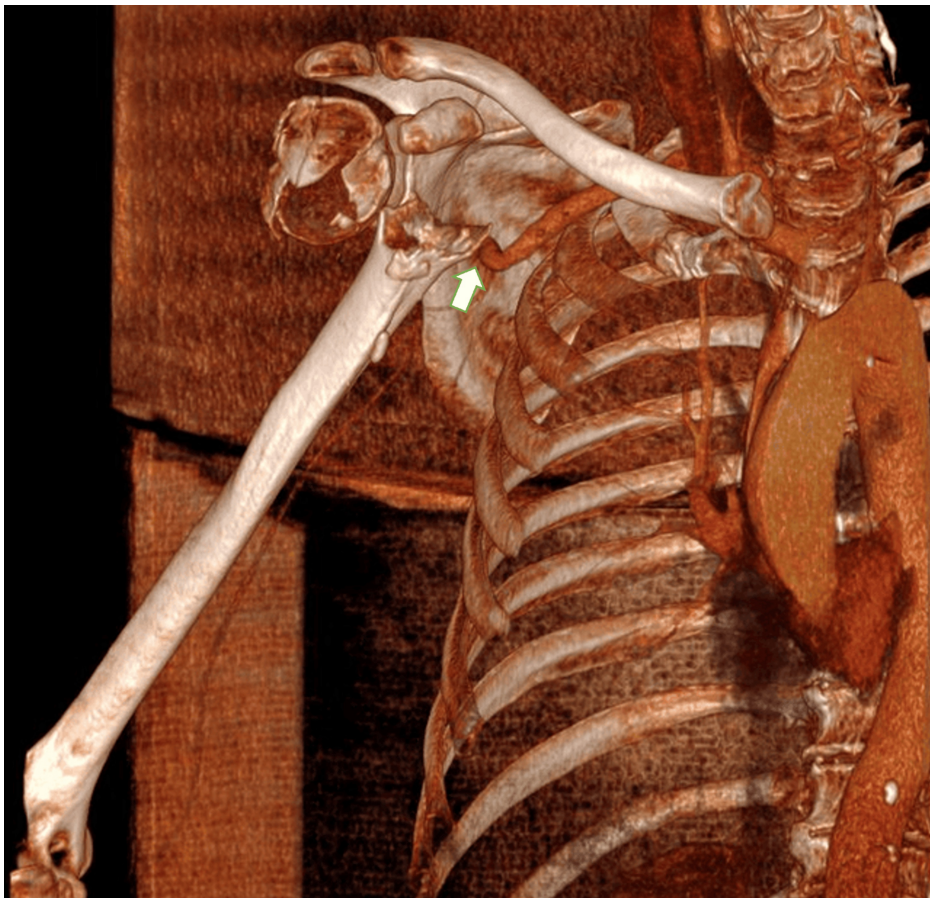


FIGURE 2: CTA demonstrating axillary artery occlusion

The white arrow highlights the area at which the fractured and displaced proximal humerus leads to an abrupt cessation of contrast opacification

CTA: computed tomography angiography

Figure *2* demonstrates an abrupt cessation of contrast opacification at the level of the axillary artery near the posterior circumflex humeral artery origin. Distal reconstitution via collateral circulation is demonstrated. No surrounding haematoma or active contrast extravasation is identified, consistent with compression-induced intimal injury rather than arterial transection.

Management

Following multidisciplinary discussion involving emergency medicine, orthopaedic surgery, vascular surgery, and radiology, the patient was transferred urgently to a tertiary vascular centre for definitive management. On arrival, the patient was taken directly to the operating theatre for a combined procedure performed jointly by the vascular and orthopaedic surgical teams. Exploration of the right upper limb confirmed a contused segment of the distal axillary artery at its junction with the proximal brachial artery, with preserved proximal inflow but absent distal flow, consistent with the occlusion identified on CTA. A longitudinal arteriotomy was performed, revealing disrupted intima with localised intraluminal thrombus. A limited endarterectomy of the disrupted intimal segment was performed, and a 3 French Fogarty embolectomy catheter was passed distally, retrieving a small volume of residual clot. This successfully restored satisfactory distal flow, and the arteriotomy was repaired using bovine pericardial patch angioplasty.

Given the risk of reperfusion injury following approximately 12 hours of distal ischaemia, prophylactic fasciotomies of the right upper limb were undertaken during the same procedure. The forearm was decompressed through a volar (Henry) approach, which utilises the plane between the muscles supplied by the median and radial nerves [13]. The release was extended to encompass the deltoid, the anterior and posterior compartments of the arm, the forearm compartments, and all compartments of the hand. Upper

limb fasciotomy is a recognised adjunct in this setting, with published series reporting its use in approximately half of patients with axillary artery injuries complicating proximal humeral fractures [14].

Definitive orthopaedic reconstruction was deliberately staged. At the index operation, following completion of the vascular repair, an antibiotic-loaded cement spacer was placed within the proximal humerus as a temporising measure, with a planned second-stage reconstruction. This staged approach allowed confirmation of a stable vascular repair and limb perfusion before committing to definitive arthroplasty. Two days later, the patient returned to theatre and underwent a successful reverse total shoulder arthroplasty (RTSA) for the proximal humeral fracture. He was managed in the ICU for two days postoperatively before being stepped down to the ward. Figure *3* illustrates the postoperative radiographic appearance.

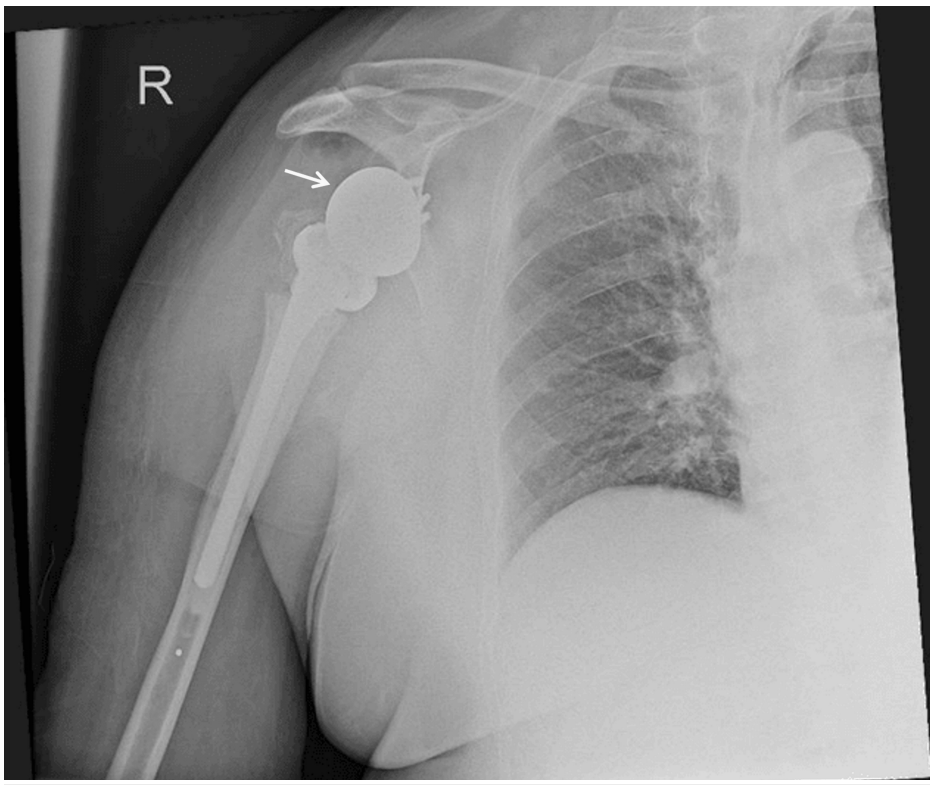


FIGURE 3: Postoperative radiograph of the right shoulder following RTSA

The white arrow highlights the right shoulder following RTSA

RTSA: reverse total shoulder arthroplasty

Postoperative recovery was uneventful. Neurovascular status improved with restoration of a palpable radial pulse and gradual improvement in distal sensation. The patient was commenced on structured physiotherapy-guided shoulder rehabilitation and discharged with follow-up arranged with his local orthopaedic and vascular teams.

Discussion

Axillary artery injury complicating proximal humeral fractures is rare, with a reported incidence of approximately 0.09%, yet its consequences are potentially catastrophic [4]. The injury predominantly affects elderly patients with displaced fractures and pre-existing vascular disease, in whom atherosclerotic vessel wall changes increase susceptibility to intimal disruption even with low-energy fracture displacement [5,8]. Several injury mechanisms have been described: direct laceration by fracture fragments, traction injury from humeral displacement, external compression by displaced bone, and intimal disruption with secondary thrombosis [6,8,9]. Intimal injury with secondary thrombosis is the single most common mechanism, accounting for approximately 63% of published cases, and carries particular diagnostic significance because arterial occlusion may evolve insidiously without the classical hard signs of acute limb ischaemia [8].

A central diagnostic challenge illustrated by this case is the capacity of collateral shoulder girdle circulation to maintain distal limb perfusion despite complete proximal arterial occlusion. The subscapular, anterior

and posterior circumflex humeral, and suprascapular anastomoses can effectively bypass a short axillary artery segment, preserving limb coloration and even a palpable, albeit diminished, distal pulse [6,7]. Peters et al. reported that axillary artery injury went unrecognised at initial presentation in several of their six cases owing to palpable peripheral pulses and the absence of overt ischaemic features [5]. Rajeev and Timmons similarly reported a case of axillary artery injury following shoulder fracture-dislocation with an intact radial pulse, where the diagnosis was established only after CTA was performed in response to an expanding haematoma [9]. These reports reinforce that palpable distal pulses and preserved skin coloration are unreliable indicators for excluding significant proximal arterial injury.

The absence of ecchymosis at initial presentation in our patient deserves specific discussion. Ecchymosis following proximal humeral fracture is a delayed phenomenon, typically requiring 24-48 hours to manifest clinically as blood dissects along fascial planes. Its absence in the acute setting therefore provides no meaningful reassurance against the presence of significant fracture displacement or vascular injury. This point is particularly relevant in the emergency department setting, where clinicians may mistakenly interpret the absence of bruising as an indicator of a less severe injury.

Axillary nerve injury is the most common neurological complication of proximal humeral fractures, with a reported incidence ranging from 6.2-45%, depending on the assessment method, with higher figures obtained via electromyography [4,5]. In the presence of concurrent vascular findings, such as diminished pulse volume, limb cooling, and progressive sensory loss, axillary nerve dysfunction should heighten clinical suspicion for associated neurovascular injury rather than being attributed solely to the fracture pattern. The combination of axillary nerve palsy with any vascular finding in this setting should be considered a mandatory indication for vascular imaging [4,15].

CTA has become the first-line investigation for suspected upper-extremity vascular trauma, demonstrating high sensitivity and specificity in characterising arterial occlusion, intimal flap, active extravasation, pseudoaneurysm, and distal collateral reconstitution [11,12]. In the present case, CTA not only confirmed arterial occlusion but also facilitated revision of the initial radiological interpretation from complete transection to intimal injury, directly informing the operative approach. This diagnostic distinction is clinically important, as intimal injury with thrombosis may be amenable to arteriotomy, thrombectomy, and patch repair, representing a less complex reconstructive procedure than the interposition grafting required in cases of complete transection [8,9].

Plain radiographic assessment also merits attention. Park et al., in a recent UK cohort study published in 2026, identified medial translation of the humeral shaft beneath the level of the coracoid on plain radiographs as a potential warning sign for axillary artery injury [10]. This radiographic feature was clearly evident in the present case and may serve as a useful early indicator to prompt heightened vascular vigilance.

The management of concurrent proximal humeral fracture and axillary artery injury demands a coordinated multidisciplinary approach and remains an area without formal clinical guidelines. The optimal sequence of vascular versus orthopaedic intervention must be individualised. When fracture fixation is planned, skeletal stabilisation before vascular repair is generally favoured to prevent disruption of the arterial reconstruction during fracture manipulation [5,6]. In the present case, axillary artery repair and prophylactic fasciotomies were completed first. Orthopaedic reconstruction was subsequently undertaken in two stages, with placement of an interim cement spacer during the initial operation, followed by definitive reverse total shoulder arthroplasty (RTSA) two days later. This damage-control strategy prioritised restoration and protection of limb perfusion, allowing the vascular repair to be confirmed as stable before proceeding with complex arthroplasty surgery. This approach also reduced the physiological burden of any single operative episode in an elderly patient with significant cardiovascular comorbidity. A comparable rationale for delaying definitive arthroplasty after vascular reconstruction has been described elsewhere, in which shoulder replacement was postponed until safe exposure could be achieved without jeopardising the repair [6].

RTSA is now regarded as the preferred definitive surgical strategy for displaced complex proximal humeral fractures in elderly patients, particularly those with comminuted patterns, osteoporotic bone, or associated glenohumeral pathology. Lanzetti et al. demonstrated superior functional outcomes and lower reoperation rates with RTSA compared with open reduction and internal fixation (ORIF) in patients older than 70 years with three- or four-part fractures [16]. A systematic review by Heo et al. similarly reported significantly better Constant shoulder scores and lower complication rates with RTSA compared with ORIF in the older population [17]. These findings support the use of RTSA as the definitive orthopaedic intervention for complex proximal humeral fractures, as undertaken in the present case.

Conclusions

This report demonstrates that displaced proximal humeral fractures may be complicated by clinically significant axillary artery injury despite an initially deceptively benign presentation. Preserved limb coloration, the absence of ecchymosis, and a detectable distal pulse do not exclude significant arterial compromise when collateral shoulder girdle circulation remains functional. Ecchymosis is a delayed clinical

sign; therefore, its absence during the acute presentation provides no meaningful reassurance. Serial neurovascular examinations are essential, as vascular compromise may develop progressively following the initial presentation. CTA should be performed without delay when vascular injury is suspected on clinical or radiological grounds, including when medial displacement of the humeral shaft is identified on plain radiographs. Prompt multidisciplinary coordination involving emergency medicine, orthopaedic surgery, vascular surgery, and radiology is critical to achieving timely revascularisation and optimal patient outcomes. A combined approach involving vascular repair and RTSA, undertaken at an appropriately equipped tertiary centre, can facilitate satisfactory functional recovery in this rare and challenging clinical scenario.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Mohamed Ziad Farran, Mohammed As-Sultany, Hon Leun Cheong

Acquisition, analysis, or interpretation of data: Mohamed Ziad Farran, James J. Rushton

Drafting of the manuscript: Mohamed Ziad Farran, James J. Rushton

Critical review of the manuscript for important intellectual content: Mohamed Ziad Farran, Mohammed As-Sultany, Hon Leun Cheong

Supervision: Mohammed As-Sultany

Disclosures

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