



ELSEVIER

## CASE REPORT

# An important lesson in assessing neurovascular involvement in proximal humeral fractures: the presence of neuropathic pain in a dysvascular limb



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Proximal humerus fracture is a common upper limb fracture with an incidence of around 5%.<sup>12,13,20</sup> It is often a result of a high-energy injury in the younger population; in the elderly, it is often due to a trivial fall.<sup>6,10</sup> The proximity of the infraclavicular plexus and the brachial artery (the brachial bundle) to the fracture site can result in a variety of possible neurovascular presentations, making the injury uniquely challenging.<sup>22</sup> Hence, clinicians should maintain a high index of suspicion for neurovascular compromise complicating even a simple proximal humerus fracture. This approach will allow early investigation and diagnosis and thus appropriate management. Failure to recognize complications of the fracture can have catastrophic consequences, including limb amputation in about 11% of neurovascular complicated cases.<sup>24</sup>

We present this case report, in which a high index of suspicion for neurovascular entrapment from correctly assessing the clinical presentation led to magnetic resonance imaging that highlighted the diagnosis (of brachial bundle entrapment in the fracture) and allowed prompt surgical treatment. We present an optimal outcome at 1-year follow-up and highlight the severe presentation that may have ensued with nonoperative management. We emphasize the excellent neurologic outcome made possible through prompt recognition and treatment.

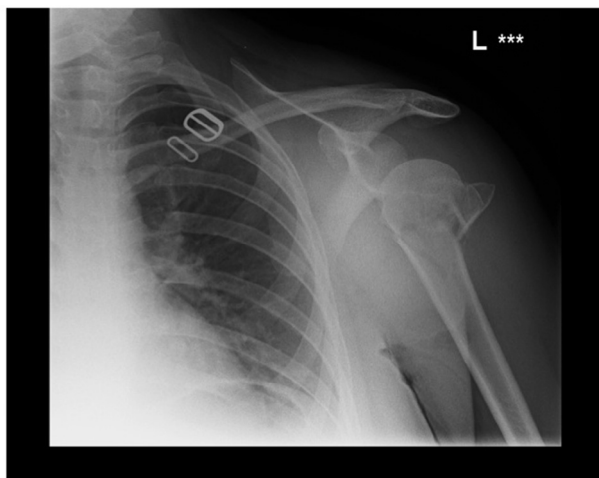
We recommend that such complex cases with neurovascular involvement be managed through expedited discussion with and support from a tertiary referral unit specializing in nerve injury and a multidisciplinary approach to rehabilitation to achieve the best outcome.

## Case report

### Case history

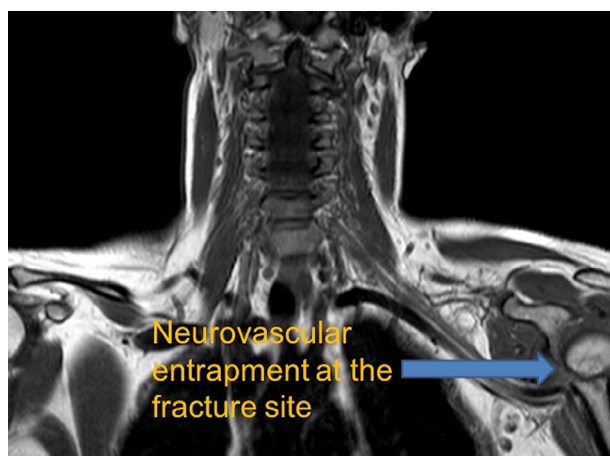
A 32-year-old female was involved in a road traffic collision, when a car collided with her riding a pushbike. This resulted in a closed injury to her left shoulder. Initial emergency assessment showed a flail arm, globally Medical Research Council 0/5 power from all branches of the infraclavicular plexus, and shoulder movements reduced by the direct effect of the fracture. Sensory examination showed that there was 0/10 sensation in radial and ulnar nerve distribution and greatly reduced sensation in the median (4/10) and axillary nerve areas (2/10). There was a Tinel sign on percussion of the skin overlying the axilla that radiated to the dorsum of the wrist. There was reduced sympathetic function in the hand. Pain was rated 5/10 on a visual analog scale and felt mainly in a distribution over the medial arm and dorsum of the hand. Radial arterial pulsation was weak but palpable, whereas no brachial pulse was felt. Radiographs demonstrated a 4-part proximal humerus fracture (Fig. 1).

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**Figure 1** Radiograph demonstrating a 4-part proximal humerus fracture.

The local vascular team advised no intervention as the hand was well perfused. The injury was then referred to our unit for advice regarding the neurologic findings. The high index of suspicion of the referring team and prompt referral allowed the injury to be approached within 48 hours. Clinical examination at that stage showed an intact supraclavicular plexus with good serratus anterior and rhomboid function. There was palpable supraspinatus contraction although clearly limited by pain and defunctioned by the fracture. There was no Horner sign, a full range of neck movements, and no supraclavicular Tinel sign or vascular bruit. Otherwise, the findings were unchanged from the status at referral. Further imaging in the form of magnetic resonance angiography excluded a supraclavicular injury but demonstrated a tethering of the infraclavicular brachial bundle to the medial edge of the humeral fracture (Fig. 2). The presence of alteration to the sympathetic function and a Tinel sign showed that

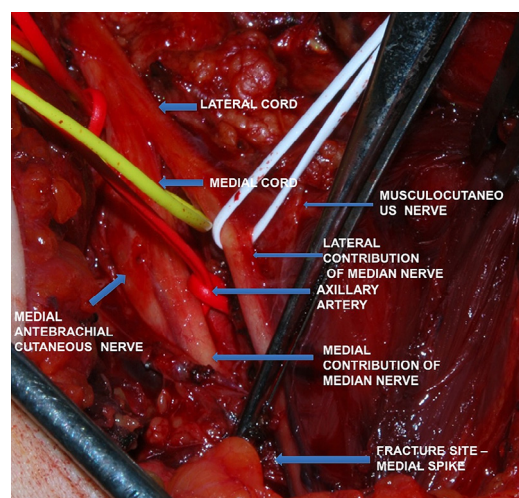


**Figure 2** Magnetic resonance imaging shows tethering of the infraclavicular brachial bundle to the medial edge of the humeral fracture.

some of this injury was degenerative. The findings from the neurologic examination, the Tinel sign, and the nature of the neuropathic pain strongly suggested that there was an ongoing injury to the nerve through traction or compression. Thus, the aims, implications, and potential complications were discussed with the patient, explaining that the operation would be to confirm or to refute the diagnosis of entrapment of the nerves of the arm and would allow extraction of the nerves and further assessment and treatment of the injury (in the form of nerve grafting if necessary), and consent was received to explore the injury. It was explained that if the diagnosis were confirmed, it was likely that a delay in treatment would lead to worsening of the degree of injury through the nerves becoming embedded in callus or further abraded by a mobile nonunion and thus deleteriously affect the final outcome.

Under general anesthetic (without use of muscle relaxant to allow intraoperative distal neuromuscular assessment) and with full intraoperative neurophysiologic support, the fracture was approached through a deltopectoral incision. After careful dissection, following the infraclavicular plexus and axillary artery from proximal and distal to the fracture, it was found that the whole brachial bundle was pinched into the fracture site (Fig. 3).

Musculocutaneous (high riding) and lateral contributions to the median nerve were tightly compressed because of fascia and the crossing vessels. The medial contribution to the median nerve and the ulnar, radial, and medial cutaneous nerves of the arm were observed in the fracture, entrapped over the medial spike of the distal fragment. A conduction block was confirmed for musculocutaneous, ulnar, and median nerves through intraoperative neurophysiologic testing, which showed conduction over the segments of nerve distal to the site of injury. The radial nerve demonstrated multiple petechiae but no neuroma or tactile evidence of significant intraneural scar. There was, however, no conduction evident



**Figure 3** Infraclavicular brachial bundle pinched into the fracture site.

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