Fractures of the humeral shaft

Paul Cowling

Abstract

Fractures of the humeral shaft are relatively common and can occur in any a variety of age groups, and due to a variety of mechanisms of injury. The anatomy of the humeral shaft is vital to understand, to be able to plan management of these fractures: the intricate relationship of the radial nerve with the humeral shaft in particular, plays an important role in these fractures. Though non-operative measures are commonly employed for humeral shaft fractures routinely, there are some indications for operative management. There remain a variety of operative interventions available to a surgeon, all with pros and cons associated. This review aims to look in detail at the anatomy of the humeral shaft, the types and sites of fractures, the evidence and surgical methodology of the most common surgical interventions, including a discussion about the surgical complications, particularly a radial nerve palsy.

Keywords fracture; Holstein–Lewis fracture; humeral diaphysis; humeral shaft; radial nerve palsy

Introduction

Fractures of the humeral shaft are reasonably common, making up approximately 3% of all orthopaedic injuries.[1] A fracture of the humeral shaft can result in a significant burden to society due to lost productivity and wages.[2] Generally, most shaft fractures can be managed non-operatively, with certain exceptions based on fracture characteristics and patient factors. Operative interventions have traditionally been performed using plate fixation, intramedullary nails, or external fixation. One of the most common presenting complications of a humeral shaft fracture is a concomitant radial nerve palsy, and this could potentially change the management.[3] In this article we aim to discuss the anatomy of the humeral shaft, the fracture types associated with the humerus, management options along with risks and complications.

Anatomy of humeral shaft

The humeral shaft is defined as the bone positioned between the proximal exertion of pectoralis major tendon, and the metaphyseal flare of the distal humerus.[1] This area provides resistance to torsional and bending forces, as well as serving as the insertion point and origin of the major muscle groups of the upper limb, including pectoralis major, deltoid, latismus dorsi, teres major, coracobrachialis, brachialis, briachioradialis, and the medial and lateral heads of triceps. The anatomy of these muscular attachments to the humeral shaft is important when assessing the pattern of any humeral fracture and also in the surgical approach to the humerus.

Also of great importance to fracture pattern and surgical approach are the neurological structures of the upper limb that run in close proximity to the humeral shaft. The median nerve enters the upper arm from the axilla at the inferior margin of teres major, after receiving branches from the lateral and medial cords of the brachial plexus. The nerve then passes inferiorly lateral to the brachial artery between biceps brachii and brachialis. In the antecubital fossa, the median nerve passes medial to the brachial artery, and provides an articular branch to the elbow.[4]

The ulnar nerve originates from C8 and T1 nerve roots which form part of the medial cord of the brachial plexus and runs inferiorly down the arm medial to the brachial artery. At the insertion point of the coracobrachialis muscle it passes through the medial intermuscular septum to enter the posterior compartment of the arm, accompanied by the superior ulnar collateral vessels. It continues to pass inferiorly on the posteromedial humerus, posterior to the medial epicondyle of the humerus in the cubital tunnel. Like the medial nerve, it provides no innervation to muscles proximal to the elbow.[5]

The radial nerve, however, remains the nerve most considered in the presence of humeral shaft fracture, due to its intimate nature with the humerus. It originates from the posterior cord of the brachial plexus and runs behind the axillary artery into the arm. In the arm, it remains behind the brachial artery before entering the lower triangular space. Together with the profundal brachii artery, it travels in the radial groove on the posterior aspect of the humerus, between the lateral and medial heads of triceps. It pierces the lateral septum to enter the anterior compartment of the arm. This point is of such clinical and surgical significance, that several studies have tried to specify the exact anatomical whereabouts of this point: one anatomical study noted the radial nerve to enter the anterior compartment at a point within 5 mm of the junction of the middle and distal thirds of a line joining the lateral epicondyle to the most lateral point of the acromion process.[6] Quantifying things further, another study noted the nerve to leave the posterior humeral shaft on average 126 mm above the lateral epicondyle, and never less than 75 mm above the distal articular surface.[7] The radial nerve then further descends to cross the lateral epicondyle at the elbow, before dividing into the posterior interosseous nerve and the superficial radial nerve.[4,5]

Epidemiology of humeral shaft fractures

Humeral shaft fractures account for 3% of all fractures, and 14% of all fractures of the humerus.[1] There is a bimodal distribution peaking in the third and seventh decade, with fractures occurring in patients ages over 50 years accounting for 60% of all humeral shaft fractures.[8] The largest peak for men is the third decade, while for women it is the seventh decade.[8]

Up to 60 years of age, humeral shaft fractures occur equally in men and women: beyond 60, 80% of patients are women[9] and humeral shaft fractures become more frequent.[8,10]

The middle third of the shaft is the most common position of humeral shaft fractures (42–60%), with proximal and distal

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fractures occurring with similar frequency depending upon the literature.[8–10] The majority of fractures are simple fractures, generally either transverse or short oblique (56–63%),[16] with segmental fractures accounting for 1–4% of humeral shaft fractures.[8–10]

The commonest cause of a humeral shaft fracture is a fall, followed by a motor vehicle accident.[11] Causes other than these only account for 10% of humeral shaft fractures, and include sporting activities, work-related accidents, a fall from height, and bone pathology.[11] Pathological fractures of the humeral shaft account for 1.3–8% of the total, while open fractures account for 1.2–5%.[11]

The number of fractures of the humeral shaft has increased over recent years, and it has been predicted that by 2030, the number will almost double when compared to 2008.[12]

History of humeral shaft treatment

Fractures of the humeral shaft were recorded on the Edwin Smith Papyrus circa 1600 BC, where Egyptians described the treatment of three humeral shaft fractures with splints made from alum, cloth and honey.[14] The authors of the papyrus, which was decoded by James P. Allen of the Metropolitan Museum of Art in New York, proposed conservative treatment of humeral shaft fractures: 'Thou shouldst place him prostrate on his back, with something folded between his shoulder-blades; thou shouldst make for him two splints of linen, and thou shouldst apply one to the inside of the arm, and the other to the underside. Thou shouldst bind it with cloth, and treat afterward with honey every day until he recovers.'[13]

The Greeks, in 415 BC, then described using traction weights for closed reduction in *De Fracturis*.[14] They described closed reduction and splinting with bandages soaked in cerate, composed of lard mixed with wax.

Celsus, a Roman medic, described various humeral shaft fracture patterns in *De Medicina,* and wrote of the benefits of reducing humeral shaft fractures, recording the improvement in pain levels and restoration of humeral length.[14]

The common theme for all these century-old treatment methods described is that management with splintage was deemed successful. Often, though, the splints used extended past the elbow, so the time required for treatment often left the shoulder and elbow stiff, despite the relatively successful union results.[14]

Non-operative management

Landmark trial

When discussing the modern day non-operative management of humeral shaft fractures, it is difficult to start without mentioning Sarmiento's work, which has guided treatment methods still to this day. Sarmiento's original publication was a landmark study: humeral shaft fractures were treated non-operatively, initially using a hanging cast, sugar-tong splint or Velpeau bandage.[15] A functional brace was applied as soon as the initial pain and swelling subsided, which involved a prefabricated polypropylene sleeve allowing a complete range of motion at the shoulder and elbow, but also the ability to remove it for personal hygiene and repeated adjustment of the soft tissue compression required to maintain fracture alignment.[15]

Of the 51 humeral shaft fractures included in the study, all but one went on to union. Union was defined as the absence of pain and motion at the fracture site and radiological evidence of good callus formation. This included 13 open fractures, 11 gunshot wounds, and two pathological fractures due to metastatic breast carcinoma. Indeed, the one non-union recorded was in a patient receiving chemotherapy at the time of the injury, and required open reduction and internal fixation. The median time from injury to removal of the splint was 8.5 weeks. All but nine patients had full range of movement at the shoulder and elbow, while the average angulation at the fracture site was 4°, the most common deformity being varus. Six patients had an associated radial nerve palsy all of which recovered spontaneously, while three patients had an associated vascular injury treated with debridement, vascular repair, and skeletal traction.[15]

Despite the inability of more recent studies to produce such a successful union rate, these results provided the bedrock for our management of humeral shaft fractures since the paper's publication in 1977.

U-slab

In the UK, the initial emergency department management for most closed humeral shaft fractures is the application of a plaster of Paris splint (Figure 1). This is a temporary immobilization device to try to allow a patient to return home with a humeral shaft fracture splinted for pain relief. A U-slab can be utilised for such temporary splintage, especially if the fracture is located in the middle or distal third of the humerus[16] (Figure 2). The arm is covered with a stockinette, then a wool bandage. A strip of plaster of Paris is applied, stretching from the axilla down the medial side of the arm to the olecranon, then back up the lateral arm to the level of the acromion.[16] The plaster is then secured using a crepe or elastic bandage. The advantages of this splint is that it can be applied easily and fairly quickly. The disadvantage is that this type of splint can loosen and slip down the arm easily: it therefore can require adjustment or replacement.[16] It is therefore preferential for the U-slab to be replaced by a functional brace as soon as possible.

Hanging cast

The hanging cast is often used for shortened and displaced humeral shaft fractures: often these are simple mid-shaft fractures. This cast involves a full arm cast, with the plaster starting proximal to the humeral shaft fracture, and extending to the wrist with the elbow held at 90°, and the forearm in a neutral position.[16] Generally, if this technique is utilised, a patient would be in a hanging cast for 7–10 days in an attempt to reduce a humeral shaft fracture, before being replaced with a functional brace. If a hanging cast is neglected without regular monitoring, or left in situ for too long, it may result in distraction at the fracture site, leading to problems with fracture union.[16]

Functional bracing

As previously stated, Sarmiento's results using functional bracing has defined this as the gold standard treatment for non-operative management of humeral shaft fractures[15] (Figure 3). Sarmiento's brace consisted of a prefabricated polypropylene sleeve made available in two sizes. The sleeve extended medially from 2.5 cm below the axilla to 1.3 cm above the medial epicondyle of the

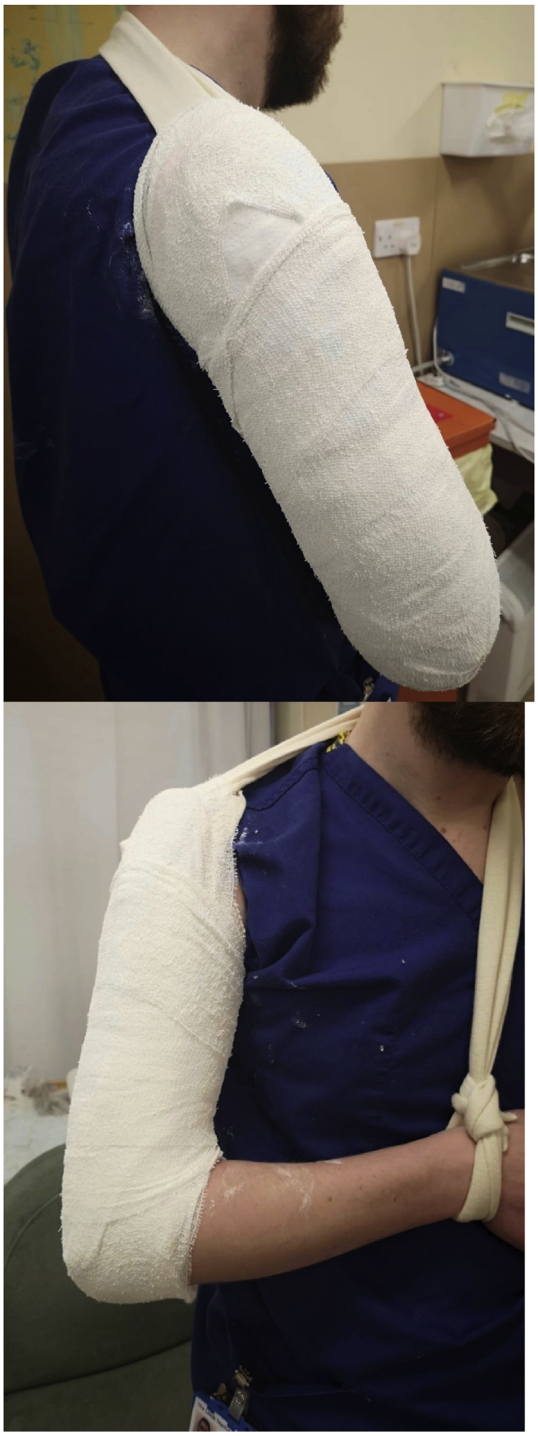

Figure 1 The application of a traditional U-slab – please note the 'sling' attachment to the superior part of the plaster laterally, to ensure it does not slip distally.

humerus and laterally from a point just below the acromion to slightly above the lateral epicondyle.[15]

As well as Sarmiento's original paper,[15] described above, he also published more recently the results of 620 of the 922 patients he had treated using his method between 1978-1990.[18] Mean healing time was 9.5 weeks for closed fractures, and 14 weeks for open fractures (which accounted for 25% of the cohort!). Closed fractures with a radial nerve palsy were also included (11%). Again, a very low non-union rate of 2.6% was quoted, (1.5% in closed fractures, 5.8% in open fractures). Authors found no significant difference between healing times for fracture location (proximal, middle or distal thirds), or fracture pattern (transverse, oblique, comminuted) (Figure 4). At the time of brace removal, 98% of patients had a limitation of shoulder flexion, abduction and rotation of 25° or less compared to the uninjured contralateral limb.[17] Authors also found that 87% of fractures healed in less than 16° of varus angulation, and 81% in less than 16% anterior angulation[18] (Figure 5). This is well within the acceptable healed deformity quoted in the literature, when generally up to 20° of anterior or posterior angulation, and 15° of varus can be tolerated well by the arm.[18,19]

There have since been a number of smaller series published confirming the success of functional bracing for humeral shaft fractures from across the globe.[18,19] The average union rate in these studies was 93% (77.4–100%), while time to union was reported from 6.5 to 22 weeks (mean 10.7 weeks).

A study worthy of highlighting to the British reader is that of Ali et al. from Cambridge, UK.[10] This is because the treatment described generally follows the standard care provided in most UK centres: the emergency department initially placed the patient in a U-slab. Then, at 7–10 days after the injury, the patient was reviewed in an orthopaedic fracture clinic where the U-slab could be converted to a functional humeral brace by an experienced plaster technician. The patient was educated in brace management, and offered a 'drop-in' appointment during the week if required, should they run into any issues. The authors followed 138 humeral shaft fractures, finding an overall union rate of 83%.

Operative management

Indications/contraindications

Although non-operative management still remains first choice of treatment for most humeral shaft fractures, there are some situations where operative fixation has been deemed more appropriate. Table 1 demonstrates some situations where operative intervention may be advisable, as documented in 'Rockwood and Green's Fractures in Adults'.[16]

Patients with multiple injuries may benefit from operative management, as otherwise their rehabilitation may be stunted, they could lie recumbent for a long period inhibiting nursing care, hygiene and comfort, and these patients are prone to malunion.[20]

Operative intervention can also be indicated in patients with bilateral humeral fractures, floating elbows, or other injuries of the same arm in order for the patient to start early physiotherapy and prevent stiffness, allowing a quicker recovery of independence and comfort.[21]

Risks of non-union

As discussed above, mean union rates for conservatively managed humeral shaft fractures using a humeral brace range from 77 to 100%.[10,18,19] Ali's study attempted to break down the union rate by position of the fracture, with proximal third fractures providing a union rate of 76%, compared to middle third at 88%, and distal third at 85%:[10] however the total numbers are

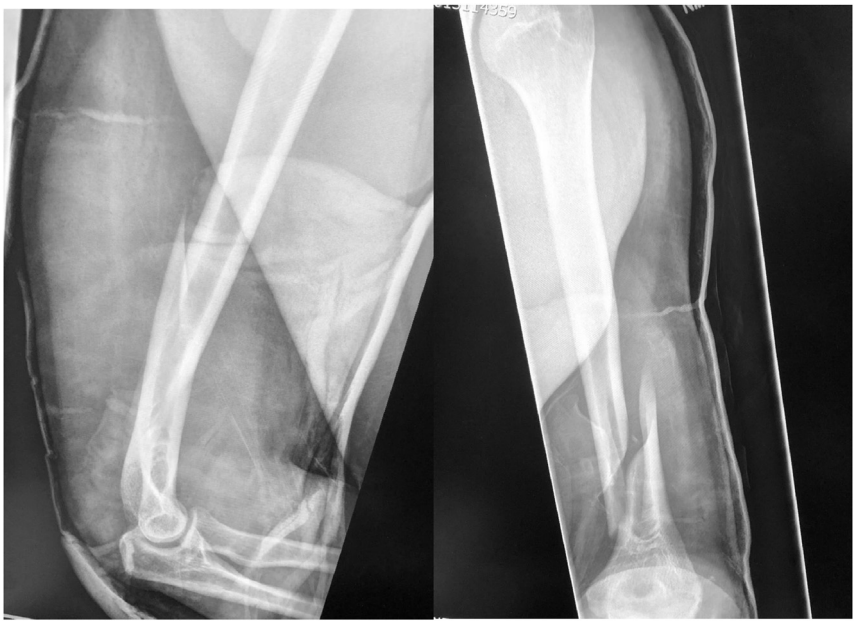

Figure 2 Distal third humeral shaft fracture controlled temporarily in a U-slab prior to application of a removable humeral brace.

Figure 3 Application of a modern humeral brace: as long a length of the humerus as possible should be covered by the brace, but without the medial brace impinging too high into the axilla. Please note the position of the chest strap to maintain the brace position and prevent it slipping distally.

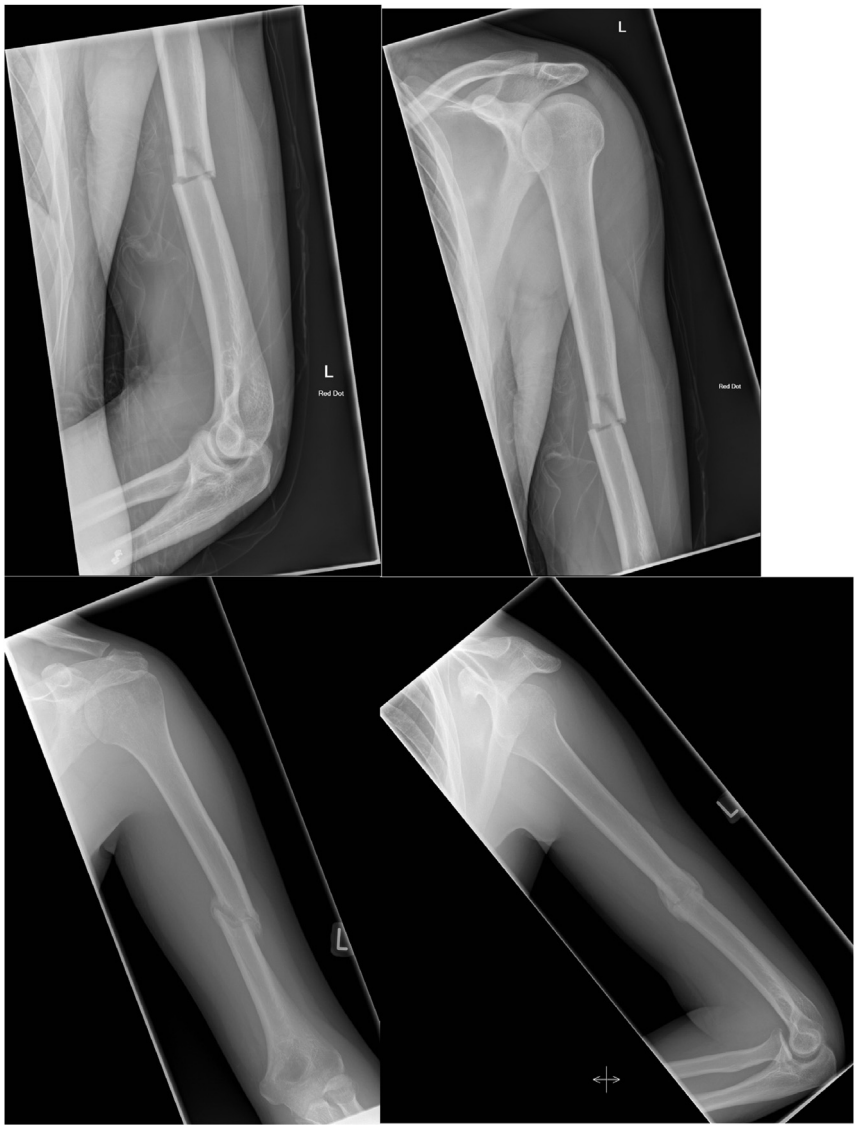

Figure 4 Successful non-operative management of a short oblique midshaft humeral shaft fracture in a humeral brace, healed clinically and radiologically at 9 weeks.

quite small, so the significance of this breakdown is uncertain. However, comminuted fractures had an 89% union rate regardless of position.[10] Conversely, it has been shown that operative intervention has a non-union rate of 5–30% depending upon the fixation technique.[1]

Open reduction and internal fixation with a plate

Open reduction and internal fixation (ORIF) is regarded as the surgical treatment of choice for humeral shaft fractures.[16] The union rate stands over 95% in most studies, with low rates of complications: radial nerve palsy (2–5%), usually found to be a neuropraxia; infection (1–2% for a closed fracture, 2–5% for an open fracture).[20,22]

Surgical approach for ORIF: in performing a humeral shaft ORIF, patient positioning is crucial, and will depend upon the approach being used. This is often determined by the fracture site: an anterolateral approach to the humerus is most frequently performed for proximal and middle third shaft fractures, whilst a posterior approach is used for middle and distal third. It is this author's preference to only use the posterior approach for distal third fractures.

For an anterolateral approach to the humerus, an extension of a deltopectoral approach can be used. Though some surgeons utilise an arm board to maintain an abducted shoulder of 45–60°, or a beach-chair position with the patient's head raised, this author prefers to provide only 20–30° of 'head up' on the operating table, and to keep to arm by the patient's side on a radiolucent table: the patient is often shifted laterally towards the contralateral side of the operating table, using a side extension to the table if necessary to support this contralateral side of the body. A tourniquet is not required, as it will get in the way of the surgical site. This author therefore often uses a single dose of tranexamic acid at induction, if not contraindicated (Figure 6).

The image intensifier can then be positioned from the head end of the operating table, and manoeuvred superiorly and

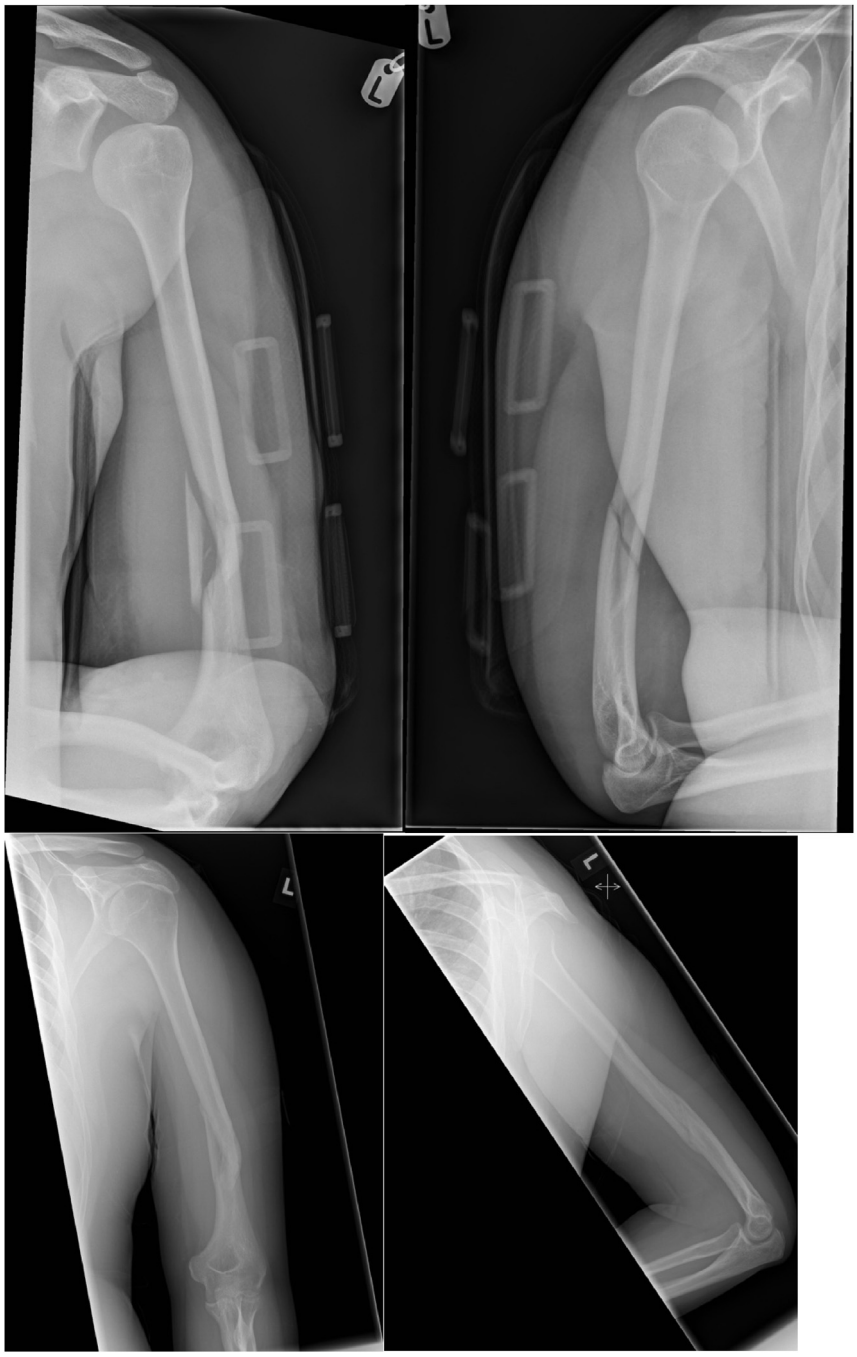

Figure 5 Successful union of a distal third humeral shaft fracture with a 'butterfly' fragment in a humeral brace, resulting in union at 10 weeks with varus angulation but no functional deficit.

inferiorly depending upon the fracture site. An alternative position is to place the image intensifier at the opposite side of the table, but this may depend of the width of the table used, and whether a side extension has been utilised.

The anatomical landmarks of the anterolateral approach are the coracoid process, and the lateral border of the biceps brachii.[8] The incision runs from the coracoid process, along the deltopectoral groove, and then distally following the lateral border of the biceps (Figure 7). The internervous plane proximally is between deltoid muscle (axillary nerve) and pectoralis muscle (medial and lateral pectoral nerves). More distally, the plane lies between the medial and lateral fibres of brachialis (musculocutaneous nerve medially, radial nerve laterally).[5]

Proximally, the deltopectoral interval is found, usually using the cephalic vein as a guide: the vein can be retracted either medially or laterally, and the plane developed laterally around the humeral shaft towards the deltoid insertion point. More distally, the biceps muscle belly can be retracted medially exposing brachialis, which cloaks the humeral shaft.[5]

Depending upon where the fracture is situated, further dissection may be warranted to expose the humeral shaft as required: proximally this is just lateral to the insertion of the

Absolute indications and relative indications for operative management of humeral shaft fractures[25]

Indications	Relative indications
• Inability to maintain satisfactory reduction by closed means • Multiple injuries • Bilateral fractures • Floating elbow • Intra-articular fracture extension • Progressive nerve palsy, or palsy after closed manipulation • Significant vascular injury • Neurological injury after penetrating injury • Non-union/infected non-union • Pathological fractures	• Segmental fractures • Non-compliant patients • Obesity • Periprosthetic fractures • Long oblique fractures of the proximal third (especially in varus angulation)

Table 1

Figure 6 Patient positioning for humeral shaft fixation using antero-lateral approach. Note the patient is placed over to the contralateral side of the radiolucent operating table to achieve access to the required limb with image intensifier access.

pectoralis tendon, where the circumflex humeral artery maybe found crossing medial to lateral: this must be ligated. To expose the humerus, a release of the pectoralis tendon may be performed. Further distally, the anterior part of the deltoid insertion may need to be released in a sub-periosteal fashion.

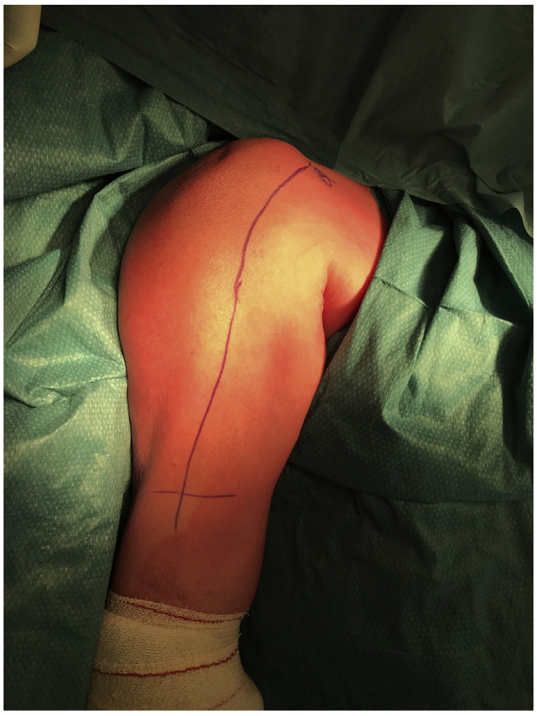

Figure 7 Patient positioning with drapes: note incision marked out pre-operatively, with coracoid marked proximally.

The fracture site will then determine the plate chosen, the mode the plate is to be used in: for comminuted fracture patterns, the plate may well be required to 'bridge' the fracture, providing the working length necessary to allow secondary bone healing by callus formation. The humerus is therefore restored to length, alignment and rotation. If a more simple fracture pattern is used, primary bone healing through compression at the fracture site may be achievable: this could be via lag screw compression, providing anatomical reduction where the plate is used as a neutralising force, primarily in the long bone against rotational/torsion forces[23] (Figure 8). A lag screw is particularly useful in short oblique or spinal fractures, where more than one lag screw may be required (Figure 9). For more transverse fractures, the place can be used in compression mode, again using AO Foundation principles.[23] Generally speaking, this author opts to attempt to place a plate with eight cortices of fixation above and below a fracture. This provides the strength and rigidity required in this long bone fixation.

The plate selected will also vary depending upon the site and fracture configuration. For proximal third humeral shaft fractures, a pre-contoured plate specific for the proximal humerus may be used, allowing for a number of fixation points to be placed within the humeral head: care must be taken to ensure these remain within the head and not exude into the gleno-humeral joint, so judicious use of the image intensifier is required.

For midshaft humeral fractures, a broad limited-contact dynamic compression plate (LC-DCP) large fragment (4.5 mm) plate is the plate of choice for this author: this provides the strength required in this upper limb long bone to combat the torsional forces through the upper arm, and being the 'broad' version, has 'offset' screw holes provide more rotational

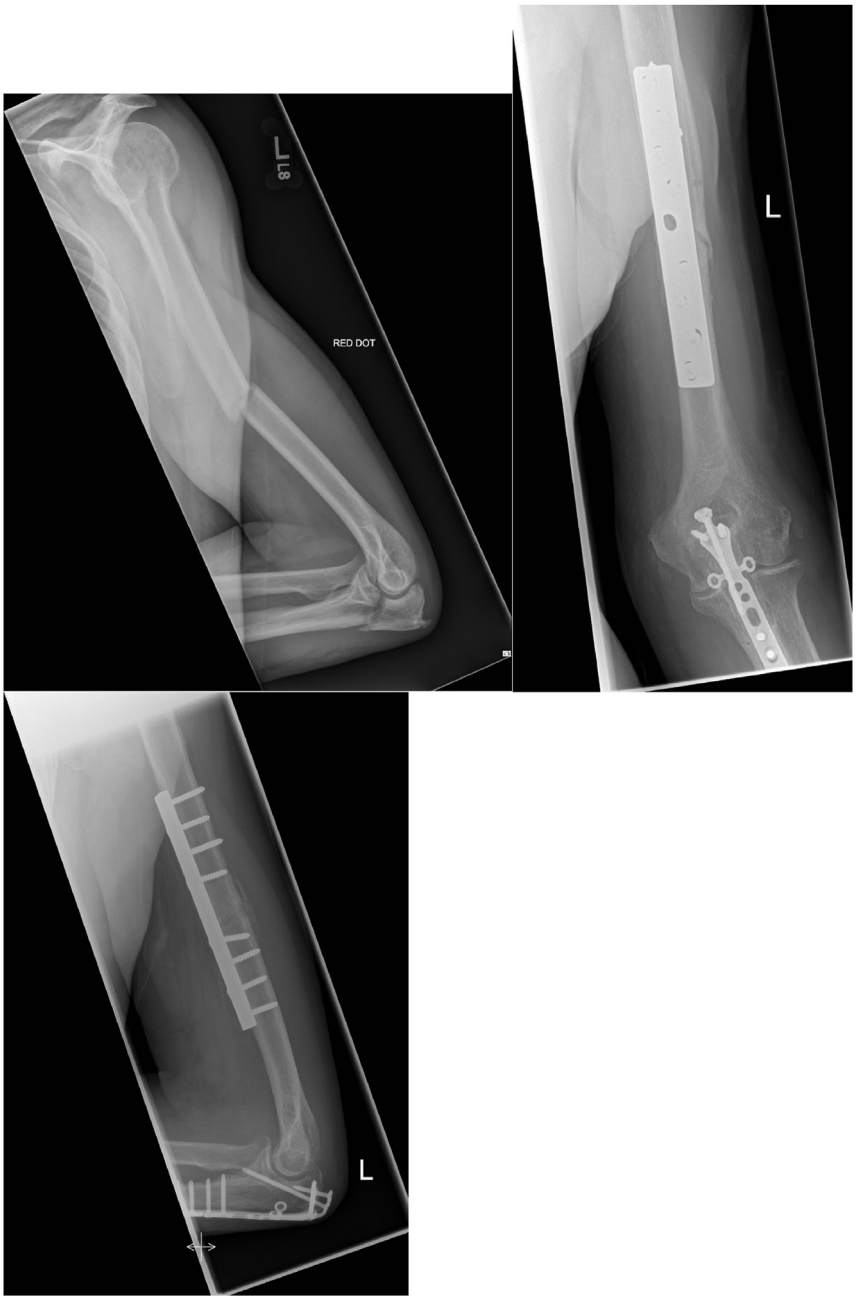

Figure 8 Transverse fracture of the humeral shaft treated with broad 4.5 mm dynamic compression plate, used in compression mode.

stability.[24] However, if the humeral shaft of a particular patient is deemed narrow, a standard 4.5 mm plate could be used, with the screws inserted divergently to achieve a similar effect.[16]

When such plates are being used through an antero-lateral approach, great care must be given to the structures at risk, in particular the radial nerve at the point of passing through the lateral intermuscular septum: it is recommended when providing plate fixation into the distal third of the humeral shaft through this approach to seek out the nerve using the landmarks and measurements documented in the anatomy paragraph above, and releasing it in the septum. It should then be documented on the operative note where the nerve was located, that it was intact (or otherwise) and protected, and reference for this could be made as to which screw hole of the plate it passes.

The posterior approach to the humerus is utilised for middle and distal third humeral shaft fractures. The patient is generally placed in a lateral position, using well-padded supports for the pelvis and contralateral upper limb. The arm can then be placed over a support, such as an L-shaped bar attached to the operating table. Again, unless the arm is of significant length or the fracture is very distal, it is often not possible to fit a tourniquet, so tranexamic acid could be considered at induction.

The palpable landmarks for this approach are the acromion proximally, and the olecranon fossa distally, and an incision is

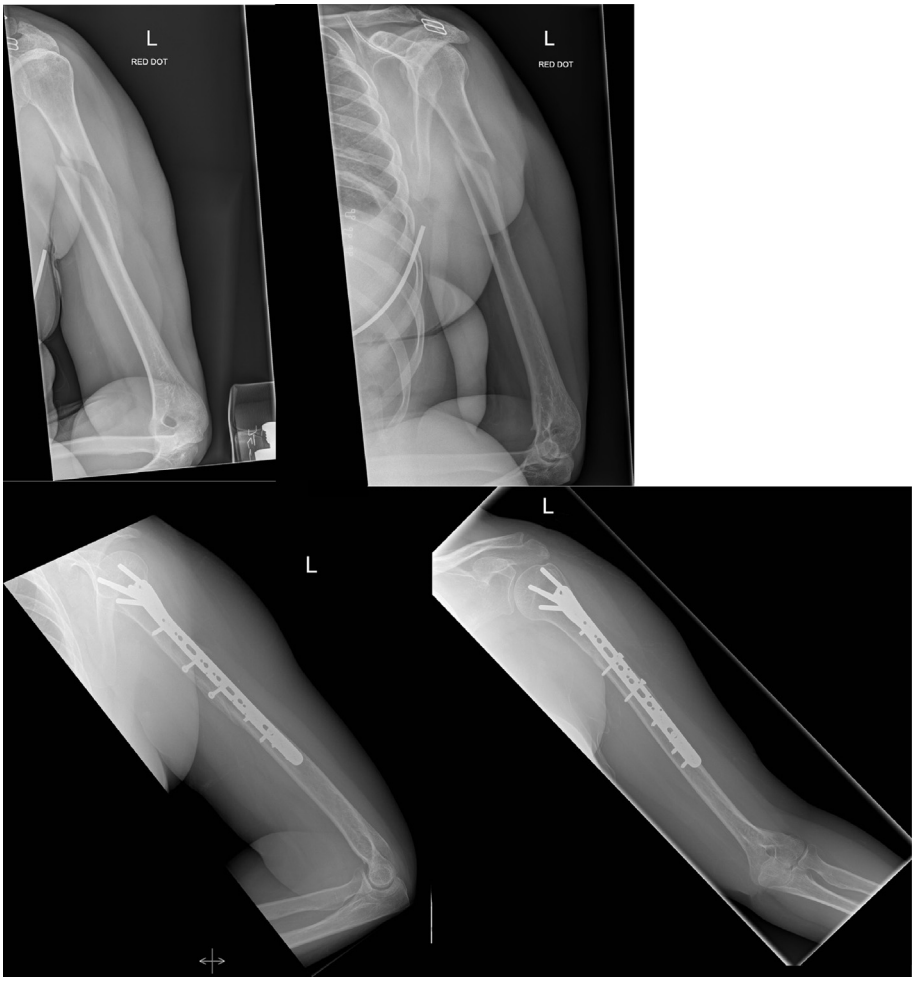

Figure 9 Lag screw fixation of a long spiral proximal humeral shaft fracture.

made in the midline of the posterior aspect of the arm.[5] For the posterior approach to the humeral shaft, there is no internervous plane, as dissection involves the heads of the triceps brachii muscle, all supplied by the radial nerve. The radial nerve lies in the spiral groove proximal to the medial (deep) head of triceps brachii, between the lateral and long heads of triceps.[5]

Indeed, the main structure at risk during this approach is the radial nerve as it passes distally down the arm in the spiral groove.[5] To that end, location of this nerve is paramount to its protection. A very eloquent method of location was published by Arora et al., who demonstrated that the apex of the triceps aponeurosis generally marks within 2.5 cm of where the radial nerve should be directly on the posterior aspect of the humeral shaft.[25] This paper concluded that following superficial dissection and defining the apex of the triceps aponeurosis, knowing the radial nerve would be passing within 2.5 cm deep to this point could shorten operative time and decrease blood loss. This has since been demonstrated to be a reliable anatomical landmark in cadaveric specimens.[26]

The plate then needs to be slipped deep to the radial nerve, which must be fully released so it does not sit taut overlying the plate. Again, adequate description of the appearance of the nerve, its position and the amount of dissection/release must be documented in the operation note.

For distal third humeral shaft fractures, close to the humeral metaphysis and olecranon fossa, selection of the plate to be used for fixation is important. A straight LC-DCP may not be the plate of choice, as it may not provide the distal fixation required: though there is evidence that a single 4.5 mm LCP with the purchase of two screws in the distal fragment can offer adequate stability,[27] pre-contoured posterolateral plates are now commonplace, extending down the lateral column to provide more distal fixation for these previously difficult fractures to manage.

Minimally invasive plate osteosynthesis (MIPO): percutaneous fixation of humeral shaft fractures using small incisions has been reported with reasonable results.[28] This is mainly performed using a minimal access approach to the humeral shaft.[8] The proximal window is within the deltopectoral groove, between the lateral border of the proximal biceps brachii, and the medial border of the deltoid. The distal window is along the lateral border of the biceps brachii muscle belly.[5] However, the surgeon

must remember that the musculocutaneous nerve could be at risk using a 'small' distal incision: it is therefore advised full supination of the forearm and a large open approach in this region to protect the nerve.[29]

Clinical results for a MIPO technique were historically mixed, but more recent studies have demonstrated union rates of over 95% at an average of 13 weeks.[30]

Intramedullary nailing

Antegrade intramedullary fixation of humeral shaft fractures has been a treatment option for a number of years, but its numbers are declining, with the main indication of use now being for pathological fractures or bone metastases to the humerus.[16] This may be because results for intramedullary nails have been mixed: the main complications include the requirement for an open reduction, propagating further humeral fracture during insertion, difficulty with distal interlocking, radial nerve palsy, poor shoulder function and lower union rates when compared to ORIF (ranging from 0 to 29%).[31,32] These studies point towards the cause of shoulder dysfuction often being subacromial impingement due to a prominent nail or scar tissue, and/or damage to the rotator cuff. A number of these studies site the requirement for modification of the nail's design and/or surgical technique to improve the outcomes.

Another option to intramedullary nailing of the humerus is a retrograde approach. This device is implanted through the posterior supracondylar humeral cortex, where the entry hole must be fashioned to accommodate the eccentric insertion of the nail into what is a small diameter canal in that region of the humerus.[16] This technique has fallen out of favour in recent years, mainly due to high complication rates and poor postoperative function: these included the requirement for open reduction; propagating further humeral fracture during insertion due to the narrow canal in the supracondylar region; the requirement of additional metalwork to facilitate stability; poor elbow function (mainly loss of extension); heterotopic ossification.[33]

ORIF versus intramedullary nail

A meta-analysis of studies comparing ORIF using plate fixation and intramedullary nailing has been performed.[34] Most found that plate fixation to be superior as ORIF may reduce the risk of reoperation (mainly to remove metalwork or correct fixation), and that intramedullary nailing led to worse shoulder function. However, there was no obvious difference in these analyses in the risk of non-union, infection, or radial nerve palsy when comparing plate to nail.

Humeral shaft fracture and radial nerve palsy

As discusses previously, the main neurological complication associated with a humeral shaft fracture, and/or its treatment is to the radial nerve.

The classic paper on this injury was published by Arthur Holstein and Gwilym Lewis in 1963,[35] which led to the eponymous title of a distal third humeral shaft spinal fracture with radial nerve palsy. A primary radial nerve injury (i.e. due to the initial injury) is relatively common compared to concomitant nerve injuries associated with other fractures, with a rate of 10–11.8%.[5] When analysing nerve injury according to fracture site, the prevalence of radial nerve palsy with proximal third fractures in one meta-analysis was 1.8%, middle third 15.2%, and distal third 23.6%.[5]

This meta-analysis found that 88.1% of all radial nerve palsies recovered, and there was no difference in the recovery rate between primary and secondary nerve injury.[5] It was found that in patients whose nerve palsy was left to recover spontaneously, the mean time to the onset of recovery was 7.3 weeks, while the time to full recovery was 6.1 months.[5] No significant difference was noted between groups of patients managed expectantly, and those with early exploration of a radial nerve palsy, suggesting the initial expectant treatment did not affect nerve recovery adversely.

These figures led to the authors producing an algorithm of treatment options, depending upon when the injury is noted and the type of fracture. They advocate considering an ultrasound scan to assess the nerve position at around 3 weeks to help with decision-making, as well as nerve conduction studies if no clinical recovery is noted: however, the authors are not drawn into making a recommendation as to how long a surgeon must wait for a nerve to show signs of recovery before exploration, but suggest this should be no longer than 6 months.[5]

Summary

Humeral shaft fractures are relatively common injuries that can often be successfully managed non-operatively. There are, however, specific indication for operative intervention, with a number of surgical options available. Open reduction and internal rotation with plate fixation remains the gold standard operation for humeral shaft fractures. The radial nerve must be examined at all stages of treatment to ensure documentation of its function, though palsy can often be managed expectantly. ◆

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