

Humeral Shaft Fractures: An Updated Overview

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Abstract

Background: Humeral shaft fracture make up approximately 3% of all fracture types. Whether or not surgical intervention is required for humeral shaft fractures remains controversial. With acceptable reduction, most humeral shaft fractures can be treated conservatively. Operative treatment is indicated in patients in whom there is failure to maintain stable alignment and reduction at the fracture site, as well as those with open fractures, segmental fractures, or fractures associated with neurovascular injury, multiple injury, and floating shoulder or elbow, surgical treatment is preferred to obtain a better clinical outcome.

Keywords: Humeral shaft fractures.

Humeral Shaft Fractures:

Most of the humeral shaft fractures are the result of a direct bending injury, car accidents, fall on outstretched hand and gunshot injuries. Occasionally, indirect injuries following forearm or arm twisting with extreme muscle contraction that produces the fracture. Elderly patients who suffer humeral shaft fracture as a result of a fall often have a less comminuted fracture pattern(1).

Types of fractures according to mechanism of injury:

A. Indirect torsional fracture:

Spiral oblique fracture with typical external rotation pattern occurs with vigorous movements. The fracture line runs from distal medial cortex upward to the proximal lateral cortex(2).

Internal rotational loading of the midshaft of the humerus result in spiral oblique fracture with a fracture line running from the distal lateral cortex to the medial cortex proximally(2).

B. Direct bending fracture:

Transverse fractures occur most commonly due to falling on the distal humerus with forceful abduction of the arm and locking of the proximal humerus in the glenoid(2).

C. Combination of torsional and bending fractures:

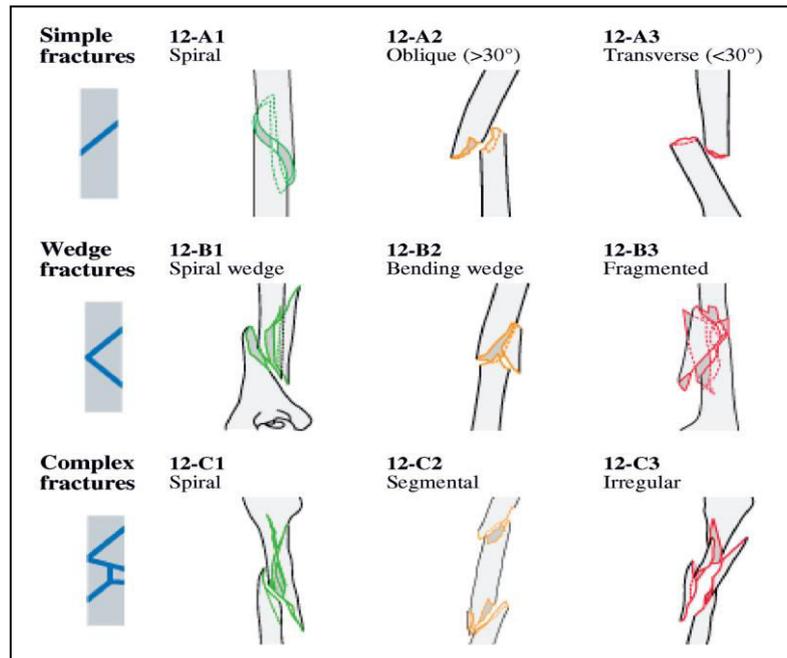
Oblique fractures with or without butterfly fragments are produced by combination of bending and torsion forces (2).

D. Comminuted fractures:

Those fractures are usually produced by a severe direct blow to the arm.(2)

E. Segmental fractures:

Those fractures are produced by a combination of two or more forces applied to the humerus at different levels.(1)

AO Classification:**Figure (1):** AO classification of humeral shaft fracture.(3)

Internationally, the most widely accepted classification is that of the Association for the Study of Internal Fixation (AO/ASIF) as published by Müller and Nazarian. Every anatomical region gets a number starting with the humerus as number 1, forearm number 2, femur number 3 and lower leg 4. Then it describes the bone segments into proximal 1, shaft 2, and distal 3. As consequence, humeral shaft gets the number 12. Then the fractures are classified in simple = a, wedge = b and complex = c(4).

Diagnosis**History:**

As with most fractures, a careful and detailed history and physical examination provide critical information that serves as a starting point for treatment. The predominant causes of humeral shaft fractures include simple falls or rotational injuries in the older population and higher-energy mechanisms in the younger patient including motor vehicle accidents, falls from a height, and throwing injuries. A history of minimal trauma causing fracture in the older patient may be the first point to alert the surgeon that the fracture may involve pathologic bone (maybe it is from metastatic disease or severe osteoporosis) and prompt a thorough history (e.g., for prior cancer) and possibly a metastatic work-up. In this situation, the treating surgeon has the potential to help the patient both in terms of the presenting fracture and the prevention of further fractures(5).

Examination:

Most patients upon presentation will have the traditional symptoms of fracture, such as pain, swelling, deformity, and crepitations. The arm may also be shortened and hypermobile at the site of the fracture. A thorough evaluation of the neurovascular status of the injured extremity is

crucial. Motor strength should be tested both proximally and distally to ensure that no injury to the radial, median, or ulnar nerve is missed(5).

Imaging:

Standard imaging for any humeral shaft fracture includes two radiographs at 90 degrees to each other that include the shoulder and elbow joints in each view. Further views can be ordered depending on the clinical examination and any abnormalities noticed on the initial films. For the typical humeral shaft fracture, it is rarely necessary to obtain further imaging. Exceptions to this would include shaft fractures with associated vascular injuries that should be investigated further with an angiogram or computed tomographic (CT) scans of associated intra- articular injuries proximally or distally(6).

Treatment of Humeral Shaft Fracture

There is considerable debate regarding the best method of treating humeral shaft fractures. There are many methods for treatment either conservative or operative. The goal of management is to establish union with an acceptable humeral alignment and to restore the patients to their pre traumatic level of function (7).

A. Non operative treatment:

The indications for conservative or operative treatment are applied according to the type of fracture either open or closed and its associated injuries as vascular insult (7).(Table 1)

There are various conservative methods of treatment each has advantages and disadvantages and they include:-(7).



Figure (2): Brace for treatment fracture of mid shaft humerus(8).

B. Operative treatment:

Indications for surgery:

- Unacceptable alignment after closed reduction.
- Open fractures.
- Segmental fracture.
- Floating elbow.
- Bilateral humeral fractures.

- Radial nerve palsy after manipulation.
- Pathological fractures.
- Associated vascular injury.
- Intra-articular extension.
- Neurological loss following penetrating injury.
- Non-union.
- Humeral fractures in polytraumatized patients(9).

Methods of surgical fixation:

1) Plate osteosynthesis:

Open reduction and internal fixation (ORIF) with direct fracture exposure often yield near-anatomic alignment. The rates of non-union and hardware failure necessitating revision range from 0% to 7%. The ROM of the elbow and shoulder predictably returns after plate fixation; when complete motion is not obtained, it is often the case that other associated skeletal or neurologic injuries exist.(10).

Evidence also suggests that immediate weight bearing on an upper extremity that has been treated with ORIF has little or no deleterious effect. The most common complications associated with plating procedures are iatrogenic nerve palsy (0-5%, with most cases being a transient problem that requires no further intervention) and infection (0-6%).(10).

The two approaches most commonly used for fracture exposure and plate application are the posterior approach and the anterolateral approach. Either is adequate for fractures in the midthird and distal third, but fractures in the proximal third often require the anterolateral approach. The medial approach has also been described, though less commonly used.(10). (Figure8, 9)

The posterior approach explores the interval between the lateral and long heads of the triceps (best found proximally). The medial head of the triceps is then incised down the midline to expose the posterior aspect of the humeral shaft.(11).

In the anterolateral approach, two different internervous planes are used. Proximally, the plane is between the deltoid and the pectoralis major. Distally, the plane lies between the medial fibers of the brachialis (i.e. the musculocutaneous nerve) and its lateral fibers (i.e. the radial nerve).(11).

Care should be taken to avoid excessive soft tissue stripping and devitalization of butterfly fragments. A 4.5-mm-broad dynamic compression plate (or a narrow plate in smaller individuals) is typically selected. Lag screws should be inserted when possible; and five to 10 cortices of fixation (proximal and distal to the fracture site) should be obtained. Fracture stability should then be assessed.(12). (Figure8)

The need for additional bone grafting is determined at the time of surgery. A low threshold for the addition of cancellous bone grafting should be maintained.(9).

2) Intramedullary nail:

Intramedullary fixation has gained popularity over the last several years. The initial reports revealed a higher non-union rate than that associated with conservative treatment or open reduction and internal fixation (ORIF) with plates and screws. However, several reports have demonstrated that newer implant and improved technique; locked intramedullary nailing can have a success rate as high as other methods.(1).

Conflict of Interest: No conflict of interest.

References

1. **Lovell NC, Grauer AL. (2019):** Analysis and interpretation of trauma in skeletal remains. *Biol Anthropol Hum Skelet*; 335–84.
2. **Whiting WC. (2018):** Dynamic Human Anatomy. Human Kinetics.
3. **Riener BL, Kellam JF, Butterfield SL, et al (1993):** The anterior acromial approach for antegrade intramedullary nailing of the humeral diaphysis. *Orthopedics*; 16(11):1219–23.
4. **Müller ME, Nazarian S, Koch P, et al (2012):** The comprehensive classification of fractures of long bones. Springer Science & Business Media.
5. **Makhni MC, Makhni EC, Swart EF, et al (2017):** Orthopedic Emergencies. Springer.
6. **Raby N, Berman L, Morley S, et al (2014):** Accident and Emergency Radiology: A Survival Guide E-Book. Elsevier Health Sciences.
7. **Cole PA, Horazdovsky R. (2016):** Shoulder girdle injuries. In: *Orthopaedic Trauma in the Austere Environment*. Springer; p. 431–52.
8. **Bauer AS. (2019):** Upper Extremity Nerve Injuries. In: *Upper Extremity Injuries in Young Athletes*. Springer; p. 189–208.
9. **Bucholz RW, Heckman JD, Court-Brown CM, et al (2009):** Humeral Shaft Fractures. In: *Rockwood and Green's*. 7th ed. Wolters Kluwer; p. 1719–51.
10. **Fan Y, Li YW, Zhang HB, et al (2015):** Management of humeral shaft fractures with intramedullary interlocking nail versus locking compression plate. *Orthopedics*; 38(9): e825–9.
11. **Hoppenfeld S, Boer P de, Buckley R. (2016):** The Humerus. In: *Surgical Exposure in Orthopaedic the Anatomic Approach*. 5th ed. Wolters Kluwer; p. 52–65.
12. **Canale ST, editor. (1998):** Shaft of humerus. In: *Campbell's Operative Orthopaedics*. 9th ed.

Mosby; p. 2296–309.