Humeral Shaft Fractures

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7.1 Introduction

Humeral shaft fractures account for approximately 7 % of all fractures in adults. They occur after direct trauma such as traffic accidents or after indirect, rotational trauma in sports accidents or falls at home. There are two peaks of incidence in the adult population: the young male and the older female. The first patient typically is the victim of high-energy trauma with multiple lesions, a more severe humeral fracture type and concomitant soft tissue damage. The latter patient suffers a solitary lesion and is the victim of a low-energy accident such as a fall from a standing or sitting position. The fracture type is then simple and there is no or minimal soft tissue damage. As pain is always severe and inability of use complete, there is an acute need of stabilization of the injured upper arm. Treatment modalities and principles have significantly changed during the last decades, as a response to the changing functional demands of the population and as a result of improvement of operative techniques and implants.

7.2 Diagnosis

Patients present with heavy and acute pain in the upper extremity. There is axial deviation and rotational deformity due to the fracture. The upper arm may be shortened. Local swelling and hematoma at the fracture site or of the whole upper arm are visible. Soft tissue trauma generally is minimal to moderate, the soft tissue mantle closed. In less than 10 % of cases, severe open or closed soft tissue damage is present.

Associated neurovascular damage is a common complication and should be looked for at admission of every patient. Radial nerve palsy is seen in more than 10 % of cases, especially in fractures of the middle and lower third. Isolated median and ulnar nerve palsy are rather seldom, more often they are part of a brachial plexus lesion. Brachial artery lesion or rupture is the exception; they are always the sign of a high-energy trauma (e.g., penetrating trauma, gunshot injury). As the brachial artery is the only vessel of the upper extremity, there must be a high index of suspicion for absence of pulse in the radial or ulnar artery or distal ischemia. Brachial artery repair is an emergency and must be considered together with the stabilization of the humeral shaft fracture.

Diagnosis is made by conventional X-rays in two planes perpendicular to each other, including the shoulder and elbow joint. X-rays must be read carefully in order to recognize or exclude secondary fractures or fissures extending into the adjacent joints. Further examinations are not necessary. CT examinations, three-dimensional views, and MRI are not helpful in the acute phase. They are useful in cases with delayed healing, pseudarthrosis, or deep infection.

Conventional X-rays cannot be the only tool; diagnosis is only complete when the study of the X-rays is combined with a thorough examination of the surrounding soft tissues and a neurovascular status is made, before any treatment is started.

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7.3 Classification

Fractures of the humeral shaft are classified as 1.2 lesions in the comprehensive classification of the Association for the Study of Internal Fixation (AO-ASIF). We distinguish three categories of fractures: types A, B, and C. From A to C, the fracture configuration becomes more complex and the number of fracture fragments and instability increases. Fractures of type A have the most simple configuration. After reduction, there is complete contact between the main fracture fragments. Type A1 is a spiral fracture, type A2 an oblique fracture (obliquity less than 45°), and type A3 is a transverse fracture. In the type B lesions, there always is a third fracture fragment. After reduction, the contact between the main fracture fragments is incomplete. Type B1 is a spiral fracture with an third spiroid fragment, type B2 an oblique or transverse fracture with an additional wedge fragment, and type B3 fracture an oblique or transverse fracture with several additional wedge fragments. Type C lesions are the most complex fracture types. After reduction, there is no contact between the main fracture fragments. Type C1 is a double spiral fracture, type C2 a segmental fracture, and type C3 a multifragmental or comminuted fracture.

Closed soft tissue damage is classified in accordance with the system of Tscherne; open soft tissue trauma in accordance with the classification of Gustilo.

7.4 Treatment Modalities

As fractures of the humeral shaft are unstable, painful, and hinder normal functioning of the whole upper extremity, there is an acute need for stabilization. This is usually achieved by putting the upper extremity at rest in an adduction bandage, attached to the thorax. Depending on the fracture configuration, personality of the patient, functional demands, and patient cooperation, different treatment modalities will be considered, each one with its specific advantages and drawbacks. There is a spectrum of options available for humeral shaft fractures, from conservative treatment, closed reduction and external fixation, and closed reduction and internal fixation, to open reduction and internal fixation. They will be discussed below.

7.4.1 Conservative Treatment

With the great advantages of operative fracture treatment in mind, Lorenz Böhler [1] stated that humeral shaft fractures should always be treated conservatively. They have a good healing tendency as the bone is circumferentially covered by muscles and receives excellent blood supply. As a non-weight-bearing extremity, perfect alignment is not needed. Axial and rotational deviations and also shortening up to 2 cm are well tolerated cosmetically and compensated functionally by the adjacent shoulder and elbow joint. The upper arm is adequately stabilized in different manners. In the acute phase, a circumferential bandage around the thorax, including the broken arm, or a Gilchrist bandage with the upper arm in adduction and endorotation is sufficient. The upper arm also can be aligned with a plaster of Paris splint, which is attached dorsally from the axilla to the wrist. If a fracture is situated between the rotator cuff and the pectoralis muscle, the humeral head will be abducted and internally rotated. If the fracture lies between the pectoralis muscle and the deltoid muscle, the proximal fragment will be adducted and the distal fragment laterally displaced. If the fracture line is situated distally from the deltoid muscle, the proximal fragment will be abducted. In case of a fracture proximal to the brachioradialis and the extensors, the distal fragment will be rotated laterally. After alignment and splinting, the whole arm is brought in adduction and endorotation and hanged in a collar and cuff. Sometimes, adduction of the upper arm is not possible as axial deformity in the fracture recurs. In this situation, stabilization in slight abduction is needed. The so-called hanging cast with a weight attached to the lower arm is not recommended as it gives distraction in the fracture site and hinders uneventful healing. It can only be considered as a temporary measure to achieve acceptable alignment of fracture fragments.

After 1 or 2 weeks, when swelling and pain subside, the plaster of Paris and adduction bandage is replaced by a functional brace until fracture healing [2]. Passive and active-assisted movements of the shoulder and elbow joint are followed by active motion to prevent stiffness. Rotator movements of the upper arm are allowed only when bridging callus is visible at the fracture site.

Literature data give high numbers of uneventful healing after conservative treatment, with nonunion

rates below 5 %. Average healing time is not longer than 3 months. Nevertheless, few data are available on shoulder and elbow function and of muscle force at the end of treatment [3].

Conservative treatment remains a valid method of treatment in acute humeral fractures, when the patient is informed and consents with common drawbacks such as long immobilization period, axis deviation and shortening, temporary muscle atrophy, and stiffness of the adjacent joints.

7.4.2 Operative Treatment

Conservative treatment is contraindicated in conditions where uneventful healing cannot be expected, in cases with a high suspicion of complications, or in patients who will not comply with the demands of successful conservative therapy. We distinguish absolute and relative indications for operative treatment. An absolute indication is a fracture associated with vascular damage, a severe open fracture, a humeral fracture in a polytraumatized patient, and unacceptable position of the fracture fragments after closed reduction [4]. A relative indication is a transverse, short oblique, or spiral fracture, bilateral lesions, a humeral fracture in a patient with an unstable thorax, fractures with extension into the shoulder or elbow joint, which need operative treatment, the combination of an upper with a lower arm fracture (floating elbow), a humeral fracture with a primary radial nerve palsy, extremely obese patients, and uncooperative patients (e.g., drug or alcohol addicts).

The reasons for operative treatment are obvious in all these categories. Fractures with damage to the artery need urgent operative revision for vascular repair. The fracture is stabilized in the same session. Open fractures need débridement and soft tissue cleaning to avoid wound infection. As wound healing is facilitated in a stable environment, fracture stabilization is needed. Polytraumatized patients profit from early stabilization of major instabilities such as fractures of the long bones. Stable extremities enable mobilization in and out of the bed as soon as the general condition allows it. Fractures at the proximal and distal end of the diaphysis especially tend to present unacceptable shortening or axis deviation. If axial deviation recurs after closed reduction, operative treatment should be performed. In cases of transverse or short oblique fractures, the area of bone contact may be too small and fracture instability too high for uneventful healing. In spiral fractures, direct bone contact may be prevented by intercalating muscle bellies. In bilateral lesions, conservative treatment makes use of both upper extremities for activities of daily life impossible. In patients with unstable thorax, normal breathing is additionally hindered by the adduction bandage. If a fracture of the humeral head or an intraarticular fracture of the distal humerus is combined with a humeral shaft fracture and needs operative treatment, both lesions will be stabilized in one operative session. The same is true for the floating elbow: the humeral fracture will be stabilized in one session together with fixation of the lower arm. In obese or uncooperative patients, conservative treatment will be connected with a series of problems. Stability of casts or splints is low due to a thick soft tissue mantle; other patients may dismantle their bandage or throw it away. These and other problems can be avoided by early fixation of the fracture.

The humeral shaft fracture combined with primary radial nerve palsy is a specific entity, which will be discussed separately. There is an ongoing discussion as to whether the nerve needs operative revision and release together with stabilization of the fracture. Literature data are not convincing for any of the presented solutions.

Different approaches and techniques of stabilization are available for the fixation of humeral shaft fractures [5]. They will be presented consecutively with their advantages and disadvantages or possible complications.

7.4.2.1 Plate Osteosynthesis

Open reduction and internal fixation with plates and screws has been the method of choice for decades, when operative stabilization of humeral shaft fractures was indicated [6–8]. Anatomic reduction of fracture fragments and rigid fixation is possible with this technique, enabling quick postoperative active motion. As the cross section of the humeral shaft is round and small, parallel drilling of multiple screws through the plate holes in one long row enhances the risk of a fissure or secondary fracture line running through the drill holes. This may create additional fractures with break-out of the screws and plate, especially during rotator movement of the upper arm. Therefore, the use of a broad dynamic compression plate with screw

holes in two rows instead of one or drilling of the screws in diverging directions is recommended. At least six to eight cortices should be taken by the screws at each side of the fracture. The plate can be used as a buttress; alternatively, compression is obtained in the fracture by eccentric positioning of some screws in the dynamic compression plate. In specific fracture configurations (spiral, long oblique, larger wedge fragment), lag screws are used separately or through the holes of the plate. In patients with osteoporosis, the use of an internal plate fixator with angle stable screws is recommended. The approach to the humeral shaft is dependent on the localization of the fracture. The course of nerves and vessels running near to the humeral shaft must be known precisely in order to avoid secondary, iatrogenic damage during surgery.

Fractures of the Proximal Third

The patient is placed in beach chair position or supine with the upper arm on a radiolucent side table. The larger fracture area must be visible under image intensification. The deltoidopectoral approach is chosen for these fractures. The skin incision starts below the coracoid process and runs S-shaped in the deltoidopectoral groove distally and laterally. The deltoid muscle is prepared laterally, the pectoralis, long biceps, and coracobrachial muscles medially. Damage to the cephalic vein is prevented by preparing it laterally together with the deltoid muscle. Other neurovascular structures are not at risk as they are at a distance from the approach. For better exposure of the fracture, the distal attachment of the deltoid muscle sometimes needs to be mobilized. The plate is carefully prebended and attached anterolaterally to the humerus (Fig. 7.1a–c). After plate fixation and rinsing, one Redon drain is placed, muscles are brought together with single stitches, and the subcutaneous tissue and skin are closed separately. A drain is removed the second day after surgery, and active motion is allowed as soon as possible.

Fractures of the Middle Third

The patient is placed supine with the broken arm on a radiolucent side table. The larger area of the fracture must be visible under image intensification. The deltoidopectoral approach as described for fractures of the proximal third is extended distally. The skin incision is curved in its upper part and is straight as it runs more distally. Proximally, the humeral shaft is exposed between the deltoid muscles laterally and the biceps, coracobrachial, and pectoral muscles medially. Distally, the anterolateral cortex of the humeral shaft is reached by longitudinal splitting of the brachial muscle. Special attention must be paid to the course of the cutaneous brachii and radial nerves. The first runs ventral to the brachial muscle, the last perforates the septum coming from the dorsal and going to the anterior and lateral muscle compartments. After plate fixation and rinsing, a single Redon drain is placed, muscle bellies are connected with single stitches, and the subcutaneous tissue and skin are closed separately. The drain is removed the second day after surgery, and active motion is allowed as soon as possible.

Fractures of the Distal Third

The patient is placed in a prone position with the broken arm in 90° shoulder abduction on a radiolucent side table and with the lower arm hanging down. The larger fracture area must be visible under image intensification. The skin incision runs strictly dorsally, in line with the humeral diaphysis, starting distally at the tip of the olecranon and going up as far as needed. Depending of the precise localization of the fracture, alternative deep approaches can be chosen. In fractures, located far above the olecranon fossa, the dorsal cortex of the humerus is exposed through longitudinal splitting of the triceps muscle. In more distal fractures, medial and/or lateral mobilization of the triceps muscle is recommended (Fig. 7.2a–c). In fractures with a very distal extension, olecranon osteotomy can be considered. Most challenging is the exposure and mobilization of the radial nerve, which crosses the dorsal cortex of the humeral shaft at the transition of its middle to distal third. Many times, placement of a plate between the radial nerve and the bone surface is needed. During fracture exposure, reduction maneuvers and plate placement, damage of the nerve by traction must be avoided. After plate insertion and rinsing, the triceps muscle is closed by single stitches. Two drains are placed, one in the triceps muscle, another in the subcutis. Subcutaneous tissue and skin are closed separately. The drains are removed the second day after surgery, and active motion is allowed as soon as possible.

Complications

Problems that are specific for plate osteosynthesis are seen after humeral plating as well. Other complications

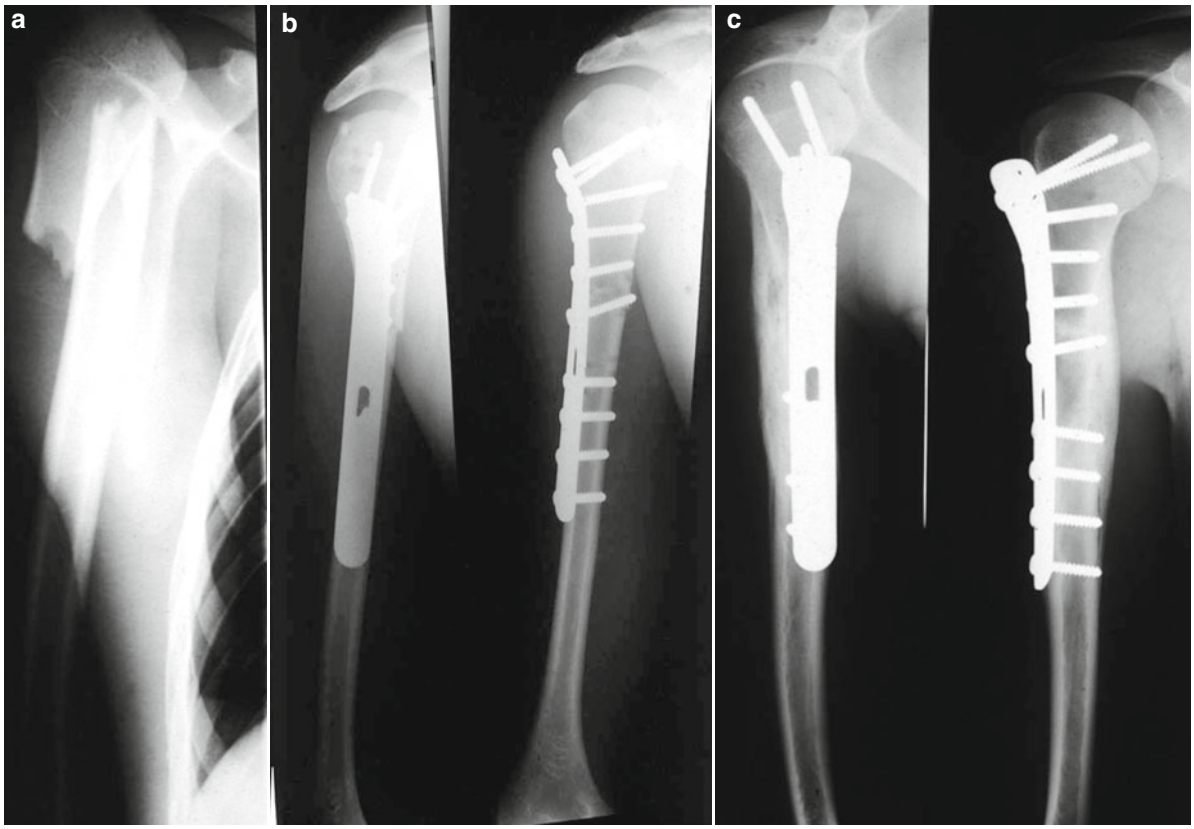

Fig.7.1 (**a**) Proximal transverse shaft fracture with important shortening in a 15-year-old boy after bicycle collision. (**b**) Anterolateral plating. Postoperative AP and lateral views. (**c**) Control X-rays after 6 months. Free shoulder and elbow function

are typical for the region in which the surgery is done. Delayed healing and pseudarthrosis is seen in between 5 and 10 % of cases. The main reason is deprivation of blood supply of fracture fragments resulting from careless manipulation. Other reasons are distraction of fracture fragments or bone defect in comminuted fracture types. Bone necrosis resulting from severe trauma is less frequent. Screw loosening or plate breakage leads to instability in the fracture site with axial deviation and pseudarthrosis. The origin can be found in severe osteoporosis or a weak bone-implant construct caused by a short plate and a small number of screws. Reosteosynthesis always will be needed, in most cases combined with cancellous bone grafting [9]. Deep infection is rare thanks to the excellent soft tissue coverage of the humeral shaft. It is the consequence of primary, severe traumatic soft tissue contamination or careless surgery. Secondary radial nerve palsy is a specific complication of plate osteosynthesis of fractures in the distal third of the shaft. The nerve must be exposed and mobilized to bring the plate on the dorsal cortex. Prognosis is good in cases of neuropraxia, but recovery of function can take several months [10]. Damage to the ulnar and median nerves or to the brachial artery is a rare complication. After surgery, a neurovascular examination of the operated extremity is compulsory to exclude or confirm any damage to these structures.

7.4.2.2 Intramedullary Nailing

This technique of stabilization has become the standard of treatment of femoral and tibial shaft fractures. Healing usually is uneventful, functional recovery quick, and the rate of complications low. Although used for more than 50 years, intramedullary nailing of humeral shaft fractures has only been widely accepted in the last decade. Older intramedullary implants bear the name of their inventors: Rush pins, Ender, Hackethal, Prévot nails. Their common

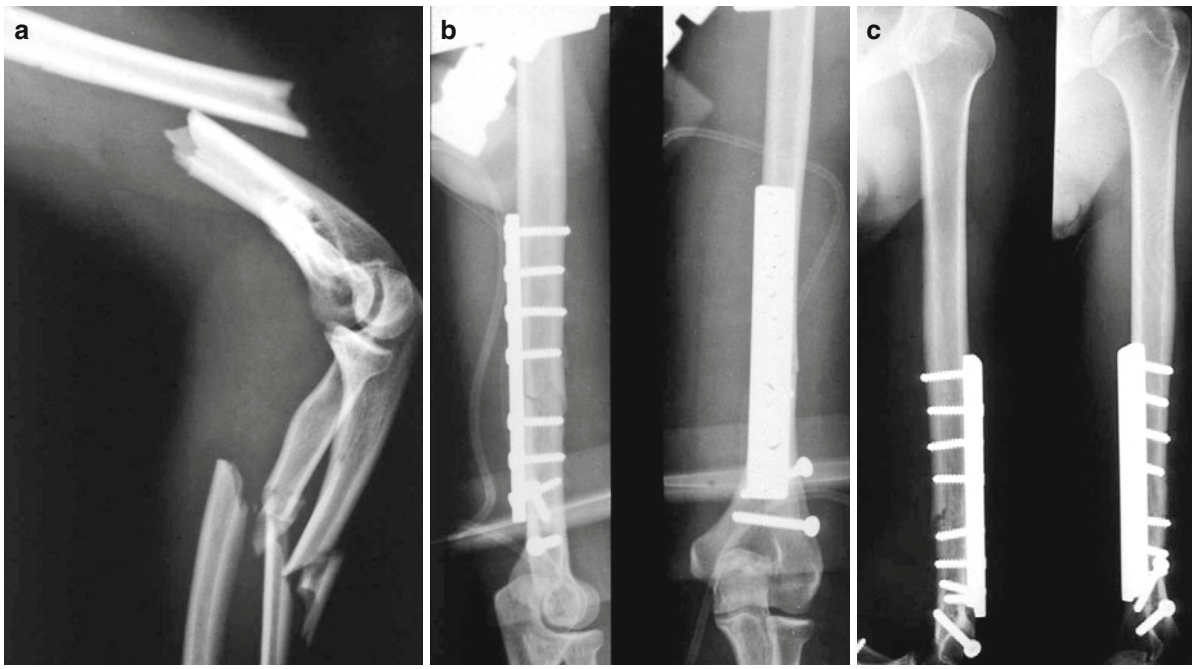

Fig. 7.2 (**a**) Floating elbow (distal humeral fracture and complete proximal lower arm fracture) of the *left side* in a 21-year-old male after car accident. Preoperative lateral view. (**b**) Dorsal plate osteosynthesis with broad DC plate. Additional lag screws for stabilization of intraarticular extension of the fracture. Postoperative AP and lateral views. (**c**) Control X-rays after 16 weeks. Free shoulder and elbow function

characteristic is that they are flexible, thanks to their small diameter, and noninterlocked implants. They are introduced in an antegrade or retrograde way through small entry portals in the metaphyseal region. When the whole medullary canal is filled up, the construction has an adequate stability. As the rods are not fixed to the bone, a common problem is their migration proximally or distally with perforation of the shoulder or elbow joint, instability due to loosening, and shortening caused by telescoping of the fracture fragments. Flexible nails are widely in use for stabilization of humeral shaft fractures in children and adolescents.

The different nails in use for adults are thicker, more rigid, and can be interlocked statically or dynamically. Sometimes interfragmentary compression can be obtained. Nails are available as solid, cannulated, or hollow implants. Thicker nails are inserted after reaming; thinner nails can be introduced without previous reaming. The nails can be introduced in an antegrade or retrograde way. The indications for both approaches are slightly different as well as their difficulties and drawbacks [11, 12].

Antegrade Nailing

Midshaft and more distal fractures are the best indication for this approach [13, 14]. In proximal fractures, adequate stability after antegrade nailing is only guaranteed by multiple interlocking of the humeral head fragment. The patient is placed in a beach chair position with the upper extremity on an arm support. The broken humeral shaft together with the shoulder joint must be visible on image intensification. The skin incision runs anteriorly starting from the lateral edge of the acromion and has a length of only 2 cm. The muscle fibers of the deltoid muscles are split, the subacromial bursa opened, and the supraspinatus tendon identified. The tendon is split carefully in line with its fibers and separated to expose the cartilage of the humeral head. The entry portal for the nail is situated medial to the attachment of the supraspinatus tendon in the lateral cartilage area of the humeral head. The nail is inserted with careful rotator movements until its point reaches the fracture line. Under image intensification, the fracture is reduced and the distal fragment picked up with the tip of the nail. The nail is further introduced until it reaches its final position. If the nail is cannulated, its

correct length can be read at the inserted guide wire; in case of solid nails, the length has to be measured preoperatively at the opposite extremity or at the reduced broken arm. At the insertion point, the nail must not protrude the articular surface of the humeral head. Double interlocking is recommended at each side of the fracture (Fig. 7.3a–e). Distraction must be avoided in the fracture site. Closure of the fracture gap or interfragmentary compression can be obtained by the use of a compression device in some nail types. Correct position of nail and screws is controlled under image intensification in two planes. The supraspinatus tendon is closed with separate stitches. A drain is placed between the supraspinatus tendon and the deltoid muscle. The deltoid muscle, subcutaneous tissue, and skin are closed consecutively. The operated extremity is placed in a collar and cuff bandage. The drain is removed on the second day and active motion of shoulder and elbow is allowed as soon as possible. As stiffness of the nail-bone construction is the lowest in the rotational plane, rotator movements of the arm are forbidden until bridging callus is visible on the follow-up X-ray controls.

Retrograde Nailing

This approach is more demanding than the antegrade, but it has the advantage of being totally extraarticular [11, 15–18]. The best indications are midshaft and proximal fractures. Distal fractures are better nailed in an antegrade manner. The patient is placed in the prone position with the broken arm on a radiolucent side

Fig. 7.3 (**a**) Closed multifragmental fracture of the right humerus after motorcycle accident in a 27-year-old male. AP and lateral views. (**b**) Antegrade nailing with double interlocking in the proximal and in the distal fragment. Postoperative AP and lateral views. (**c**) Control X-rays after 4 weeks. AP and lateral views. (**d**) Control X-rays after 16 weeks. AP and lateral views. (**e**) Control after 1 year, before metal removal. AP and lateral views. Free shoulder and elbow function

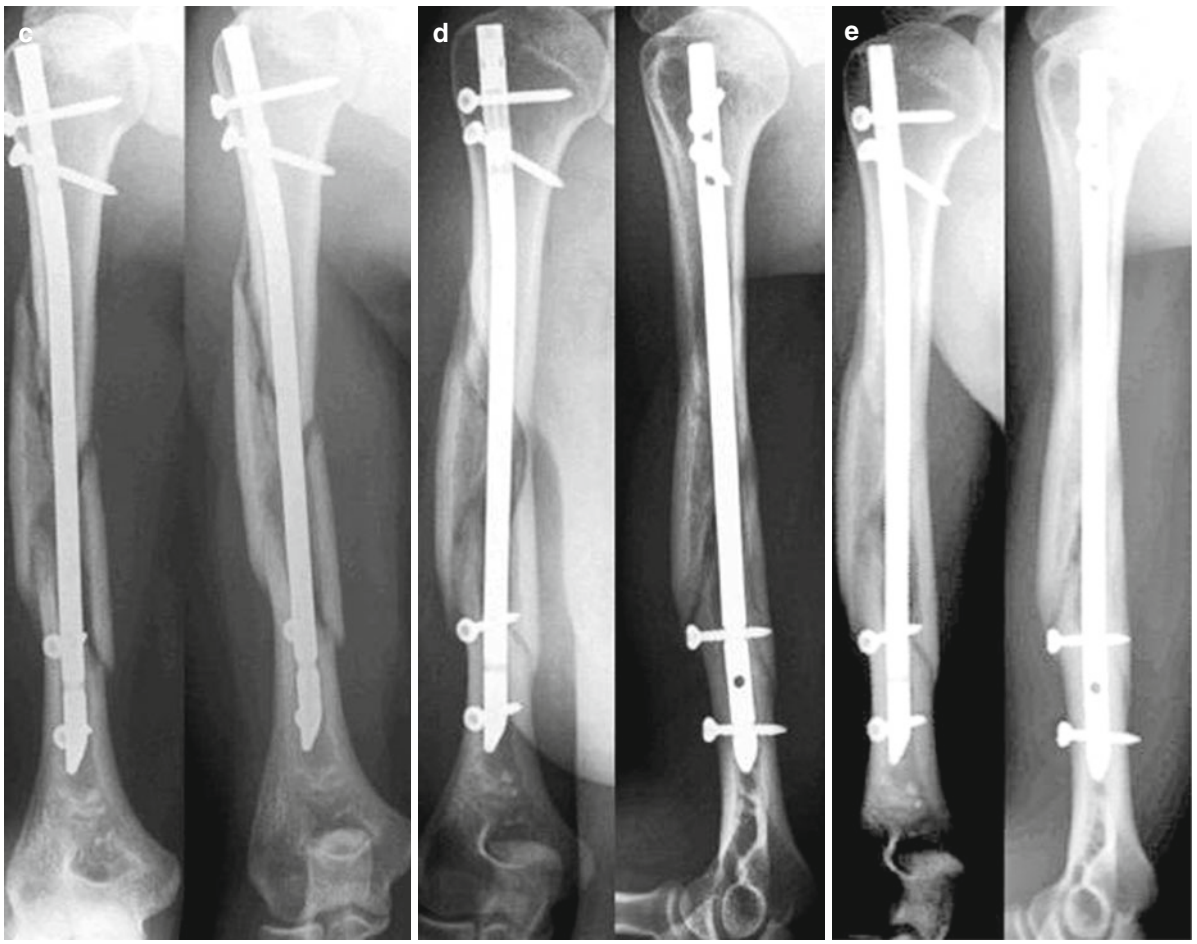

Fig. 7.3 (continued)

table and the lower arm hanging down. Before starting the procedure, one must make sure that the whole humeral shaft with the elbow and shoulder joint are visible in two planes with the image intensifier. A dorsal midline skin incision begins at the tip of the olecranon and runs 10 cm proximally. The triceps tendon is split longitudinally. The dorsal cortex above the olecranon fossa is exposed. An entry portal of 20 mm by 10 mm is made in the center of the triangle between the medial and lateral supracondylar ridge and the roof of the olecranon fossa. The distal humerus is prepared for nail insertion with hand reamers of increasing diameter. With careful rotator movements, the nail is inserted. Under image intensifier control, the proximal fragment is picked up with the tip of the nail. With hand force and further rotator movements, the nail is inserted until the tip reaches the proximal metaphyseal area. At least two interlocking bolts are placed at each side of the fracture (Fig. 7.4a–d). Wound irrigation and closure in different layers is performed. One Redon drain is placed at the entry portal. It is removed after 24–48 h. As in antegrade nailing, rotator movements are avoided until bridging callus is visible on follow-up X-rays. If the above-mentioned technique is strictly followed, the elbow and shoulder joint remain undisturbed. Ultimately, excellent shoulder and elbow function can be expected.

Complications

Damage to the rotator cuff and subacromial impingement are the most typical complications of antegrade nailing [19, 20]. They can be prevented by careful preparation of the entry portal and countersinking of the nail base below the level of the articular cartilage.

They result in chronic shoulder pain and loss of shoulder function. Damage to the axillary nerve is related to proximal interlocking. It can be avoided by meticulous dissection of the path between skin and bone for drilling and insertion of the bolt. Damage to the radial nerve may result from stretching of the nerve during manipulation of fracture fragments or false placement of the nail during nail insertion. If detected after surgery, the radial nerve should be revised as soon as possible to make sure its continuity is preserved and it is not intercalated between fracture fragments. A supracondylar fracture at the level of the entry portal in retrograde nailing is a major complication that leads to another osteosynthesis. Delayed union and nonunion are the consequence of suboptimal fracture alignment or low stability. In case of hypertrophic nonunion, stability must be enhanced. This can be obtained by exchange nailing with a thicker nail and interfragmentary compression; in hypotrophic pseudarthrosis stability is best obtained with compression plating [9, 21]. Cancellous bone grafting is also performed. Deep infection and vascular complications are rare after nailing.

7.4.2.3 External Fixation

Today, the spectrum of indications for external fixation is small. Accepted indications are severe open, contaminated fractures and infected fractures after previous treatment [22]. In selected patients with multiple lesions, primary and temporarily external fixation of a grossly unstable humeral fracture can be performed [23]. To avoid damage to the radial nerve, the pins of the external fixator are placed in the proximal and distal third of the humeral shaft. To avoid damage to the radial nerve, pins are never inserted in the middle third. In the proximal third, pins are placed from lateral to medial through the deltoid muscle. In the distal third, pins are placed from posterior to anterior through the

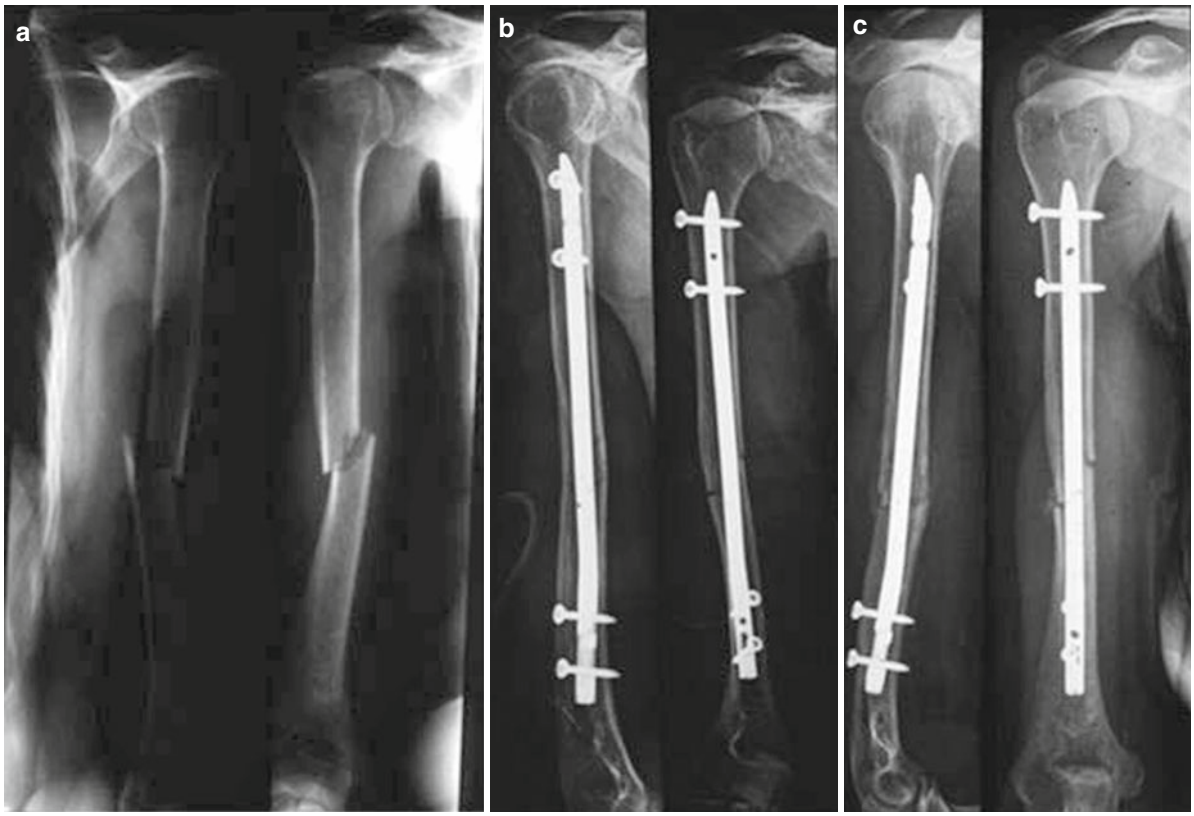

Fig. 7.4 (**a**) Closed oblique midshaft fracture of the left humerus in a 67-year-old woman after fall at home. AP and lateral views. (**b**) Retrograde nailing with double interlocking proximally and distally. No interfragmantary compression. Postoperative AP and lateral views. (**c**) Control X-rays after 4 weeks. AP and lateral views. (**d**) Control X-rays after 16 weeks. AP and lateral views. Free shoulder and elbow function

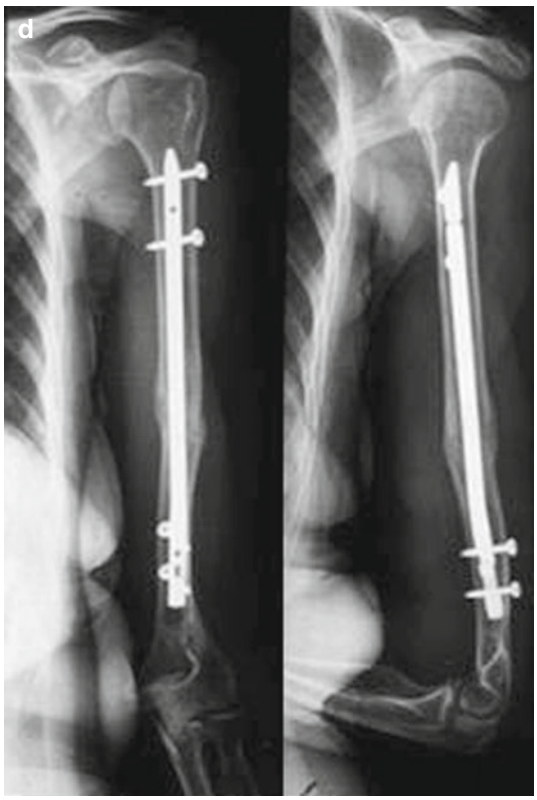

Fig. 7.4 (continued)

triceps muscle. Three pins are placed on each side of the fracture and connected with one or two bridging bars. Alignment is achieved by closed means. Wound management is done by regular debridements, wound irrigation, secondary wound closure, or split skin grafts with the external fixator in place. The fixator can be left in place until wound healing. The fixator can also be removed and stability achieved by plate osteosynthesis or nailing when no acute signs of infection are present. Because of the perforation of the deltoid and triceps muscle by the fixator pins, postoperative range of movement of the shoulder and elbow joint will be limited and mobilization painful.

Complications

As external fixator pins perforate skin and muscle bellies, they may be responsible for wound problems and pin track infections. In case of pin loosening, total stability of the construct diminishes. At the fracture area, this may lead to malalignment, delayed union, or nonunion. Fixator pins may perforate the brachial artery, the ulnar and median, and axillary nerve. Safe zones for pin placement must be considered. In very proximal or distal pin placement, the pins may perforate the shoulder or elbow joint with the danger of intraarticular infection.

7.4.3 Humeral Shaft Fracture with Radial Nerve Palsy

This special entity has been the subject of discussion for many years. Primary radial nerve palsy previously was not regarded as an indication for operative treatment as more than 90 % are caused by neuropraxia and recover after weeks or months with conservative measures. Some are in favor of early operative revision. The nerve is exposed at the level of the fracture site and directly sutured in case of axonotmesis. During the same procedure, the fracture is stabilized. The success ratio of this method of management is not significantly different from that of conservative treatment. If no clinical and electromyographic recovery of radial nerve function is observed after 3 months, operative nerve release with restoration of continuity is recommended.

In secondary radial nerve palsy, opinions do not differ. Secondary palsy can occur after closed fracture manipulation, or after plate osteosynthesis, nailing, or external fixation. Early revision of the nerve is recommended in all cases to ascertain nerve continuity and free trajectory.

Conclusion

Humeral fractures can be treated conservatively and operatively. There are absolute and recommended indications for operative treatment. There is a tendency toward more operative treatment for reasons of comfort, pain relief, and early functional recovery. Plate osteosynthesis remains a valid solution for most fracture types. Intramedullary nailing is gaining popularity as it is a less invasive and safe procedure in the antegrade and retrograde technique. External fixation only has exceptional indications. With careful soft tissue management and correct surgical technique, complications such as radial or axillary nerve palsy, subacromial impingement, or iatrogenic supracondylar fracture can be avoided. Uneventful healing can be expected in more than 90 % of patients when good fracture alignment and adequate stability is achieved by surgical or nonsurgical means.

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