Given that most epidemiologic studies [1–5] on fractures of the distal radius have combined several different fracture patterns, it is still difficult to assess the real incidence of extra-articular and intra-articular injuries, and it is even more complex to appreciate the occurrence of stable and unstable fracture types. For this reason it is impossible to produce an accurate estimate on the overall percentage of distal radius fractures that can reliably be treated conservatively. In an exhaustive review of 2,141 fractures McQueen [5] using the AO classification identified 1,029 extra-articular (type A) fractures accounting for 48% of the population, 219 (10%) partial articular fractures (type B), and 893 (42%) complete articular fractures (type C). Of the extra-articular group (48%) 15% were minimally displaced (A2.1 types), and therefore theoretically amenable to cast immobilization, whereas the most common fracture pattern was the dorsally displaced with dorsal metaphyseal comminution (A3.2 types, 26%). This group most probably included the more unstable fracture patterns, for which cast treatment is usually contraindicated.

In view of the current overwhelming sophistication of surgical management of distal radius fractures with predictable outcomes, it has become difficult for the younger generation to recognize which fracture types may be treated with a classic closed reduction and plaster immobilization and still guarantee a good functional result. It is important to keep in mind that to achieve anatomic results with conservative treatment, the surgeon must possess the same or even better technical abilities when applying a plaster cast than those needed to perform external or internal fixation of a wrist fracture. Conservative fracture treatment is more cumbersome, because frequent radiographic and clinical controls and possible cast changes are necessary to assess the quality of reduction and to prevent secondary displacement or detect misdiagnosed unstable fracture patterns that may require early secondary external or internal stabilization. To a certain extent this may explain why many fractures that perhaps would heal in a cast in an acceptable position are primarily over-treated with external or internal fixation just to eliminate the risk for secondary displacement in a cast. Furthermore, in patients who demand early use of the hand, some distal radius fractures that may fall into the category of displaced but stable are fixed internally but would otherwise be amenable to cast treatment.

The basic decision that has to be taken when dealing with a distal radius fracture is whether or not it can be treated conservatively (closed manipulation and cast immobilization) or surgically. Several factors, such as age, bone quality, occupation, and general condition of the patient, together with characteristics of the fracture, associated lesions, and the surgeon’s experience with different treatment modalities, must all be taken into consideration to select the best treatment. Although occasionally a fracture that, because its characteristics represent an absolute surgical indication, has to be treated in a cast because of the bad general condition of the patient, the basic parameters to decide for a conservative management are whether or not the fracture is reducible with closed manipulation and if it remains stable after reduction; in other words, those fractures in which the tendency to re-displace in plaster is minimal.

E-mail address: diegof@bluewin.ch
The aims of conservative treatment are to obtain and maintain anatomic realignment of the fracture for a period of 4 weeks, the time at which bony union is well advanced, so that the risk for secondary displacement at that stage is practically nonexistent. It must be kept in mind, however, that contrary to skeletal fixation by a bridging implant that controls interfragmentary motion, the position of the distal fragment is maintained indirectly by external cast contact, tension on soft tissue structures, and by the hydraulic pressure of the soft tissue envelope. The greater the initial displacement, cortical comminution, and cancellous bone impaction, the greater the amount of settling of the fracture in the cast is therefore to be expected, despite the use of a meticulous casting technique.

**Indications for conservative treatment**

Conservative treatment of distal radius fractures in adults is recommended and reliable for nondisplaced extra-articular and intra-articular fractures, for displaced fractures that remain stable following closed reduction, and certain unstable fractures in elderly patients, in which the surgeon accepts the possibility of a tolerable amount of secondary displacement, which falls in the category of an asymptomatic, well functioning malunion.

The decision making for nonoperative management is based on a large body of clinical and experimental evidence [6–15] that has demonstrated a strict correlation between the quality of reduction, the radiographic result, and the functional outcome and also on the analysis of the radiographic criteria of instability [16,17]. Fractures that show on initial radiographs more than 20° of dorsal (or palmar) angulation, a displacement of more than two thirds the width of the shaft in any direction, metaphyseal comminution, more than 5 mm of shortening, intra-articular component, an associated ulnar fracture, or advanced osteoporosis are considered unstable, with a high risk for secondary displacement in a cast, despite acceptable initial reduction and correct plaster techniques (Fig. 1). On the other hand, stable fractures are those that do not displace at the time of presentation or following manipulative reduction [18–21]. Abbaszadegan et al [22] defined stable extra-articular fractures as those presenting with minimal displacement having dorsal angulation less than 5° and shortening less than 2 mm (Fig. 2).

**Conservative management**

**Nondisplaced fractures**

Bending fractures of the distal radius that present with little or no displacement result in
the great majority of cases with an excellent functional outcome and have a long-term favorable prognosis [23–26]. Fractures with minimal displacement (5° of dorsal tilt and shortening less than 2 mm) or impacted fractures are stable even when supported with elastic bandages rather than plaster casts (Fig. 2). The author, however, prefers to immobilize them for a period of 3–4 weeks in a dorsal splint or a well molded below-elbow cast followed by a removable wrist brace until the patient feels comfortable, usually 5–6 weeks following injury. One complication that seems to be uniquely associated with nondisplaced distal radius fracture is the spontaneous rupture of the extensor pollicis longus tendon [27–29]. Most of these ruptures occur within the first 2 months after the fracture, their etiology attributed to attrition and hypovascularity of the tendon at the level of Lister's tubercle.

Displaced fractures

Closed reduction is indicated for displaced fractures in which there is radiographic evidence that a stable realignment of the fracture fragments can be achieved and that the minimal residual interfragmentary motion can be controlled with meticulous casting technique.

Adequate anesthesia, depending on the local soft tissue conditions, is imperative. Fracture hematoma block, intravenous regional, brachial plexus block, and general anesthesia have specific indications. The first two usually are selected for low energy displaced fractures without significant swelling.

With dorsally displaced fractures, the author prefers to infiltrate the fracture site following aspiration of the hematoma with 5–10 cm of 1% or 2% Lidocaine without epinephrine, with the point of entrance of the needle on the volar side, because the dorsally impacted cortex may not always permit the needle to enter the fracture site easily. A second injection is recommended in the area of the distal radioulnar joint and ulnar styloid. The two most common disadvantages of the fracture hematoma block are insufficient analgesia and muscle relaxation. For these reasons fracture hematoma block should be reserved for simple, readily reducible fracture patterns. Axillary blocks are indicated especially if a difficult reduction is anticipated, as in fractures seen late, in re-manipulations, and in instances in which local skin and soft tissue contusions or open wounds are present.

Fig. 2. (A) Minimally displaced dorsally impacted distal radius fracture. (B) No reduction necessary, dorsal plaster splint support. (C) Radiographs at 5 weeks showing fracture healed in the initial position.
wounds and significant edema contraindicate the use of local anesthesia. General anesthesia is reserved for pediatric fractures or for patients allergic to local anesthetics.

**Methods of closed reduction**

Reduction of displaced fractures of the distal radius has been based on two approaches: (1) direct manipulation of the fracture fragments, and (2) indirect fracture reduction with longitudinal traction.

**Manual reduction**

The technique of direct manipulation of the fracture with disimpaction of the distal fragment before reduction has been attributed to Sir Robert Jones [30]. It requires an assistant to provide countertraction on the arm above the elbow (Fig. 3). The first step is to disimpact the fracture by increasing the initial deformity. Reduction then is obtained with the opposite force to the one responsible for the fragment displacement (mechanism of injury). For Colles fractures, therefore, while traction is maintained the surgeon manipulates the distal fragment into a volar and ulnar direction with the opposite hand applying counterpressure on the shaft fragment. The final maneuver is to lock the fracture by placing the patient’s hand and distal fragment into pronation. The hand thereafter is allowed to rest without support to assess the stability of the reduced fracture clinically. Smith fractures, which present with increased volar tilt, shortening, and pronation of the distal fragment, are reduced with longitudinal traction, extension, and supination maneuvers.

**Longitudinal traction**

This technique, initially popularized by Böhler [31,32] during the 1920s, is based on strong longitudinal traction applied to the patient’s thumb and digits against a fixed and flexed elbow, while the fracture is manipulated directly by the surgeon. This method, which requires at least one assistant but often two, was simplified by the introduction of metallic finger traps by Caldwell in 1931 [33]. The hand now could be suspended with a counterweight over the upper arm, providing continuous longitudinal traction without the need of assistants (Fig. 4). Although length, distal radioulnar congruency, and ulnar inclination are invariably achieved, restoration of volar tilt requires an additional palmarly directed force by translating the hand volarly, as advocated by Agee [34]. This displaces the capitate palmarly, which in turn volarly rotates the scaphoid and lunate, effectively forcing the distal fragment into flexion (Fig. 5). A similar observation was reported by Gupta in 1991 [35], in which, with careful modeling of the cast with the wrist in neutral or slight extended position, the same effect was obtained with a low incidence of fracture redisplacement. Agee [36] further advocated radioulnar translation to realign the distal fragment with the radial shaft in the frontal plane. This is controlled by tension on the soft tissue hinge of the first and second dorsal compartment. For adequate reduction in the frontal plane it is important to restore the anatomic relationship of the sigmoid notch and the ulnar head. The application of a dorsopalmar reduction force to restore volar tilt should be kept in mind, because it offers better anatomic restoration with immobilization of the hand in a more physiologic and functional position.

**Cast immobilization**

Despite the widespread acceptance of cast immobilization, questions remain regarding the optimal position, the duration of immobilization, and the need to extend the cast above the elbow. Having reduced the fracture, the author prefers to immobilize initially all distal radius fractures in a sugar tong splint that is maintained for the first 2–3 weeks (Fig. 6). Its advantages are that the splint is applied easily while the upper extremity is
still suspended with the finger trap traction, and as the cast sets, the hand can be translated palmarly and placed in the definitive position of immobilization. Because the U part of the splint comes around the elbow, the sugar tong controls forearm rotation and therefore efficiently maintains the desired position of pronation or supination according to the fracture type. Furthermore, the sugar tong splint immobilizes the distal radioulnar joint, and patients have less pain as compared with those immobilized in a short arm cast.

Colles fractures are immobilized initially in 15° of palmar flexion, 10°–15° of ulnar deviation, and slight pronation (25°) for the first 2 weeks. To maintain a stable reduction it is imperative to follow the details of the three-point contact casting technique described by Charnley [37] (Fig. 7). This implies the application of two points of contact proximally and distally to the fracture on the side of the concavity of the initial angulation, and a counterpoint of contact at the fracture level on the convexity of the initial angulation. A slight bend to the splint or cast (10°–15° and slight ulnar deviation) places the soft-tissue hinge (periosteum and overlying tendons) under tension, provided that the opposite cortex has good contact (tension-band principle). For a Colles type fracture, the counterpoint or fulcrum (definition: point on which a lever turns) is the volar cortex (Fig. 8). If reduction of the volar cortex is anatomic without overlapping of the fracture edges and the dorsoradial soft tissue hinge is maintained under tension, the chances of secondary displacement are minimal. With increasing osteoporosis, however, a greater amount of settling and shortening is to be expected.

For the first 2 weeks the sugar tong splint is maintained and follow-up radiographs are performed 3, 7, and 12 days following reduction; this enables detection of early loss of reduction and whether or not settling and residual deformity is acceptable. During the first 2 weeks the initial splint should be adapted and remolded as soon as soft tissue swelling decreases. This is achieved with tighter wrapping of the splint with elastic bandages at the time of the radiographic controls. In this way a continuous and sufficient pressure is maintained throughout the early postreduction period, reducing the possibility of secondary displacement.

Fig. 4. (A) Finger trap-traction with the hand suspended and counterweight around the upper arm. Notice C-arm for fluoroscopic control. (B) Following disimpaction through continuous traction the distal fragment can be manipulated easily into the desired final position.
displacement. At 2 weeks the splint is changed to a short forearm cast for another 3–4 weeks, taking care to maintain the three-point contact principle, avoiding bulky padding of the cast.

Smith (or reversed Colles fractures) require 20° of dorsiflexion and 40° of supination to maintain a stable reduction. Because the pronatory deformity of the distal fragment is always present, above-elbow fixation to control forearm rotation is mandatory for the first 4 weeks (Fig. 9).

**Duration of immobilization**

Most well reduced extra-articular fractures heal by 4–5 weeks after injury [38]. Wahlström, using 99Tc bone scans, observed well advanced new bone formation by 28 days after injury. He suggested that little additional immobilization is required beyond this point [39]. In contrast, Kristiansen et al observed early trabecular healing 39 ± 2 days after fracture, with initial cortical bridging at 50 ± 3 days [40].

In the author’s experience, impacted and minimally displaced fractures should be immobilized for 3–4 weeks, and displaced fractures with increasing comminution for 6 weeks (2–3 weeks in a sugar tong and 3–4 weeks in a short arm cast) (Fig. 10). Thereafter a protective removable wrist orthosis is worn by the patient for an additional month while active range of motion exercises are begun. During that month the patient is weaned progressively from the brace.

During the period of immobilization and also during the period of weaning from the splint, all patients are instructed to keep their fingers mobile by performing the six-pack exercises as

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**Fig. 5.** (A) Longitudinal traction with finger traps can restore skeletal length. (B,C) Restoration of the normal volar tilt of the distal radius articular surface, however, may require palmar translation force of the mid-carpus. (Courtesy of Hand Biomechanics Lab, Sacramento, California; with permission)

**Fig. 6.** Technique of application of the sugar tong splint. Notice minimal padding using thin layer of felt. The splint is wrapped with elastic bandages while the cast begins to set.

**Fig. 7.** Schematic representation of the three-point contact cast. If the volar cortex is reduced perfectly (compression side), the dorsoradial soft tissue hinge is maintained under tension with slight flexion and ulnar deviation of the hand.
popularized by Dobyns [41] and by active elbow and shoulder mobilization at least three times a day. Physiotherapy measures are indicated solely for those patients who have trouble restoring joint motion and forearm rotation following cast removal.

**Summary**

Closed reduction and cast treatment of distal radius fractures renders satisfactory results in fractures that are reducible and stable and do not re-displace in plaster in the first 2 weeks
following reduction [10,12]. Intra-articular and unstable fractures have a high risk for re-displacement in plaster [11] and therefore represent a contraindication for cast treatment. A fracture that re-displaces in plaster despite perfect casting technique is most probably an unstable type that requires skeletal fixation. A fracture that re-displaces in a non-molded, loose, or over-padded cast because of insufficient technique is, however, in the author’s view, the only clinical situation in which re-manipulation is worth the effort [8].

The tolerable amount of residual deformity has been radiographically defined by Fourrier et al in an analysis of 64 malunions of the distal radius and correlated the functional impairment with the residual deformity of the distal radius. They concluded that the lower limits of deformity, at which symptoms are likely to be present, are

Fig. 9. (A) Smith fracture with metaphyseal comminution and rotational malalignment. (B) Roentgenograms following anatomic reduction that was maintained for 6 weeks in an above-elbow cast with the hand in dorsiflexion and mid-supination (bottom). (C) Radiographs at 3 months show an excellent radiographic result.
a radial deviation of 20°–30°, a sagittal tilt of 10°–20°, and a radial shortening of 0–2 mm [42]. In addition, experimental evidence suggests that a sagittal tilt of 20°–30° should be viewed as a pre-arthrotic condition [13,14,43]. Although these figures are useful for decision making, acceptance of deformity when treating fractures conservatively varies individually according to the age, osteoporosis, and functional demands of the patient. Anatomic restoration, however, should remain the primary goal of conservative management.

References


