Distal Radial Osteotomy

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Introduction

Fractures of the distal radius are very common. Displaced fractures of the distal radial metaphysis are one of the most frequent injuries which are treated on an out-patient basis in orthopedics. In spite of their commonplace occurrence, however, the results are less than satisfactory with malunion and continuing disability commonly occurring. Some authors have questioned this relationship.1,2 Conversely, a very strong case has been made between the correlation of loss of function and malunion by Sennwald.3

The authors have found a very high incidence of continuing wrist disability following distal radial fractures at their institution. Patients have most often been treated at other institutions where their outcome has been viewed as "satisfactory."

It is important to recognize that very discreet entities exist amongst radial fractures. In the young age group (ie, under 30 years), men predominate.3 In the older age group (ie, over 50 years), there is a tremendous predominance of women. In the 30 to 50-year-old age group, there tends to be a comparable incidence in the two sexes. It is only in the past 5 to 6 years that experience with corrective osteotomy has been documented.4-6 As of yet, a clear consensus regarding the indications for osteotomy has not emerged. This article examines technical considerations of corrective osteotomy, as well as their indications.

Indications

The authors have found four principle indications for corrective osteotomy: first, continuing pain and disability at least 1 year post fracture, in spite of adequate rehabilitative efforts: second, shortening of the radius by greater than 3 mm; third, articular step in excess of 3 mm; and finally, greater than 20° of retrotitilting of the distal radial articular surface. The fact that the loss of normal radial angle as seen on the PA projection is not regularly associated with symptoms, whereas all of the foregoing specific deformities are, is of interest.

Contraindications

There are patients in whom radial osteotomy is inappropriate. In the presence of distal radial malunion, two other alternatives exist: excision of the distal ulna and ulnar shortening. Excision of the distal ulna is the simplest method in the frail and elderly patient, but is inappropriate in the younger, more active individual. Ulnar shortening is an attractive option in the "young elderly" or in a case which radial shortening is the predominant feature.

The contraindications are either local or systemic. The local ones are:
- Poor bone quality, or
- Previous sepsis.

The systemic ones are:
- Excessive apprehension or anxiety,
- Advanced age,
- Poor compliance,
- Illness behaviors,
- Systemic ill health, or
- Motivated by secondary gain.

In short, a state of mutual trust existing between the surgeon and the patient is essential before undertaking reconstruction.
Fig. 1: A 50-year-old woman presented with a painful, malunited, extraarticular, distal radius fracture. The fracture had healed with excessive shortening and 40° of retrotilt. There was distal ulnar impingement on the carpus and secondary incongruity of the distal radioulnar joint (A). A secondary DISI deformity of the lunate is seen in the lateral projection (B). Corrective opening wedge dorsal extraarticular osteotomy through the metaphysis of the distal radius was performed to relieve pain and stiffness (C). Radial length was restored and the retrotilt seen in the lateral plane was corrected (D). An autogenous corticocancellous iliac bone graft was wedged into the defect and supplemented with additional cancellous graft. A dorsal “T” buttress plate plus a radial one-third tubular plate were used for stable fixation in a corrected position. A good result was achieved.

![Fig. 1A](image1a.jpg) ![Fig. 1B](image1b.jpg) ![Fig. 1C](image1c.jpg) ![Fig. 1D](image1d.jpg)

**Goals**

As with assessing fractures of the distal radius, the goals of osteotomy should use eight parameters. Unfortunately, in corrective osteotomies, only the first three may be considered and thus, achieve a less than ideal result. The factors are:

- Palmar tilt,
- Radial tilt,
- Ulnar radial variance,
- Dorsal ulnar translation,
- Radial ulnar translation,
- Rotation,
- Articular congruency of the radiocarpal joint, and
- Articular congruency of the radioulnar joint.

Unless all parameters are checked, they may be overlooked intraoperatively and a suboptimal result will be achieved. It is an important exercise in surgical judgment to determine which of the parameters are most significant in producing symptoms. It is simply not possible on all occasions to correct every aspect of a malunion. Of all the aspects of this corrective surgery, these considerations are most demanding.

Finally, it should be emphasized that sparing of the
Fig. 2: A 15-year-old boy was seen 3 years after a distal radial fracture resulting in a growth disturbance. He had shortening of the radius resulting in pain in the wrist and weakness of grip and pinch (A). A distal radial metaphyseal corticotomy was performed and the Ilizarov external fixator was applied without initial distraction (B). The radius is shown at 4, 5, and 6 weeks postoperatively (left to right, respectively) with increasing distraction and progressive bone formation (C). This same radius is shown at 12 weeks after surgery, demonstrating bone union with restoration of length (D). Radial growth arrest combined with continued ulnar growth is anticipated to result in an acceptable ulnar variance.
Fig 3: An 18-year-old man who had sustained an unrecognized displaced intraarticular distal radial fracture that later caused radiocarpal joint symptoms (A). The scaphoid facet was depressed and lateral films demonstrated a secondary DISI deformity with the lunate dorsiflexed 30° (B). An intraarticular osteotomy was performed (C). The fracture line was recreated, the scaphoid facet with the radial styloid immobilized and shifted distally to the correct anatomical position. The axial forces across the joint and the osteotomy were neutralized with the use of a small external fixator. Provisional, supplementary K-wire fixation was used while interoperative radiographs confirmed a satisfactory correction (D). Note that the carpal DISI deformity is also corrected. The K-wires are replaced with a buttress AO plate customized by cutting one bar of the “T” for definitive fixation (E-F). Bone grafting was not necessary because of the obliquity of the osteotomy with good surface contact. The external fixator was removed 4 weeks postoperatively and rehabilitation of the wrist and hand begun. These radiographs (shown on following page) show the maintenance of joint reduction and congruity, as well as restoration of carpal alignment 4 months postoperatively. The patient had regained a full painless range of wrist motion at this time (G-H).

distal ulna is imperative. The Darrach procedure should be undertaken sparingly owing to negative sequelae, particularly in the young, active individuals. The only indication for excision of the distal ulna is otherwise uncorrectably symptomatic arthritic change. The authors currently prefer a hemiresection-interposition distal radioulnar joint arthroplasty as an alternative to the Darrach procedure.  

Ulnar plus deformity can be corrected simultaneously, if necessary, by shortening osteotomy.

Technique

Until quite recently, corrective osteotomy almost always indicated the need to perform open surgery. With the advent of the Ilizarov concept\textsuperscript{10} and device, this assumption is no longer warranted, at least in the
case of extraarticular malunions. Accordingly, techniques should be considered as either open or closed.

For extraarticular malunions, the great majority are associated with dorsal displacement and volar angulation, therefore, a dorsal approach is appropriate. This should be done through a midline incision over the wrist extending from the third metacarpal proximally on the radius about 8 cm. The incision should be deepened between the third and fourth extensor compartments with the extensor pollicis longus being moved from its sheath beside Lister’s tubercle. Dissection should then be carried out undermining the fourth extensor compartment and the second extensor compartment at which point the whole of the distal radial metaphysis can be identified.

The appropriate osteotomy is then made at the level of the former fracture and guided by preoperative drawings (with comparisons from the opposite side) and the correction is undertaken. It is imperative that the correction be checked radiologically and fixed provisionally with either K-wires and a distractor such as a laminar distractor or preferably, an external fixator. Once correction is achieved, plating and bone grafting are accomplished, maintaining the radius in the corrected position (Fig. 1).

With the advent of the Ilizarov concept and technique, “closed” methods are now possible. These can only be utilized for extraarticular malunions. The concept entails performing a “corticotomy” instead of a formal osteotomy (Fig. 2). The key difference between the two procedures is that the corticotomy spares the periosteal and endosteal blood supply. The external fixator, whether it be an Ilizarov or other more standard device, is secondary in importance to sparing the foregoing blood supply. The corticotomy is left in situ for 1 week before corrective distraction.
and realignment is undertaken. If it is a single plane malunion, then a more standard external fixation device will suffice. If it is a multiplanar correction, there is an advantage to using the Ilizarov external fixator inasmuch as it allows three-dimensional correction. It is, however, much more demanding technically to monitor and use.

For intraarticular fractures, the approach is similar. Instead of just exposing the distal radial metaphysis, however, the exposure is continued into the dorsal wrist capsule and done through the midline, i.e., in line with the third metacarpal, and a T-shaped incision is made along the radius in order to expose the distal radial articular surface. It is important at this point to palpate with a dull instrument and distinguish between normal hyaline cartilage and fibrocartilage, which feels distinctively different by virtue of its softness. The fibrocartilage should be removed with care, otherwise the articular step will not be appreciated.

Osteotomy is then done through the old fracture site into the joint. Because this is demanding technically, it is recommended that a small (0.9 mm or 1.1 mm) K-wire first be passed along the plane of the fracture at 2 or 3 sites to ensure the correct plane is being utilized. Following radiographic confirmation
of accurate placement of the K-wires, osteotomy may be carried out. It may be necessary to go into both the radial carpal and radial ulnar joints. Reduction in that instance obviously must be monitored by direct observation as well as by radiograph (Fig. 3)

Summary

Malunions of distal radius fractures are commonplace. Patients are decreasingly willing to accept the disability that may be associated with them. While the first line of treatment is initial good fracture care, corrective osteotomies offer later opportunity for pain relief and improved function.

References


Editorial Discussion

ORTHOPEDICS: As we have each discovered, simple distal radial fractures are often anything but simple, and comminuted intraarticular distal radial fractures are perilous at best. Prevention of deformity is the best treatment for later complications but it is not always possible, despite our best efforts. Dr McMurtry and colleagues emphasize the importance of accurate and aggressive primary treatment, but they also provide us with the necessary parameters to evaluate the imperfectly united fracture. While corrective extraarticular osteotomy is nothing new, often only about 1 cm of length can be gained by this procedure. The application of Ilizarov’s technique of osteolysis and simultaneous correction and lengthening can give more length as is demonstrated. Intraarticular osteotomy provides a nice corrective touch and may be the best solution to a difficult problem. This article should increase our awareness of these useful treatment options.