Carpal Wedge Osteotomy in the Arthrogrypotic Patient

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Introduction

Carpal wedge osteotomy in an arthrogrypotic patient repositions the wrist in neutral alignment while preserving available wrist motion.

Under tourniquet control, the procedure begins with release of any tight palmar structures through an incision in the distal part of the forearm on the palmar side. Tight fascia is released, followed by assessment of wrist, finger, and thumb flexors. If any of these are tight they can be lengthened at the intramuscular level or they can be z-lengthened.

A dorsal transverse incision is then made overlying the proximal part of the carpus with isolation and protection of the finger and thumb extensors. The radial wrist extensors are mobilized proximally with careful preservation of their distal insertion into the metacarpus. The extensor carpi ulnaris tendon is then transected at its insertion on the fifth metacarpal and delivered proximally through a second incision, for later rerouting. After the wrist capsule is opened, the biplanar osteotomy is performed. The osteotomy site is then stabilized with use of nonabsorbable suture and Kirschner wire after removal of the wedge of the carpus. (The suture is used as internal fixation, with the Kirschner wire used to hold the osteotomy site until healing has occurred.) The extensor carpi ulnaris tendon is then passed subcutaneously and sutured to the radial wrist extensors to complete the tendon transfer. The wound is closed and the extremity is placed in a long arm cast^{1,2}.

The procedure is performed with the following steps.

Step 1: Mark the Locations of the Incisions (Figs. 1-A and 1-B)

The location of the incisions allows excellent exposure of the wrist on both the volar and the dorsal surface.

Step 2: Release Tight Palmar Structures

After making the incision, carefully assess tight flexor structures and perform release and/or lengthening as appropriate.

- Under tourniquet control, make an incision over the distal palmar aspect of the forearm (Fig. 2).
- Release the palmar fascia in the distal aspect of the forearm.
- Lengthen or divide the wrist flexors if they are tight.
- Lengthen the finger and thumb flexors if they are tight. If you are in doubt about this, these flexors can be addressed at a later portion of the procedure.

Step 3: Dorsal Exposure

Make a dorsal transverse skin incision at the level of the carpus to allow identification and preservation of whichever thumb, finger, and wrist extensors are present.

- Make a transverse incision at the level of the proximal carpus.
- Make a dorsal incision over the mid-carpal area (Fig. 3-A).
- Isolate the thumb and finger extensors and retract them (Fig. 3-B).
- Mobilize the radial wrist extensor tendons, leaving their attachment distally. Identify and release the insertion of the extensor carpi ulnaris tendon from the base of the fifth metacarpal (Fig. 3-C).
- Mobilize the extensor carpi ulnaris tendon and then pass it into a separate incision made over its musculotendinous junction in the distal part of the forearm (Figs. 3-D, 3-E, and 3-F).

Step 4: Carpal Osteotomy

After careful exposure of the carpus, make the proximal and distal osteotomy cuts and then evaluate the resulting wrist position and stabilization.

- Expose the dorsal aspect of the wrist capsule and open it at the level of the lunate.
- Make a proximal osteotomy cut distal to the radiocarpal joint, perpendicular in two planes to the long axis of the forearm.
- Perform a distal osteotomy through the distal carpal row, perpendicular in two planes to the long axis of the metacarpus (Figs. 4-A through 4-F).
- In a young child the osteotomy can be performed with a number-15 scalpel (Fig. 4-G), whereas osteotomes and/or a saw may be needed in a more skeletally mature patient.
- Carefully remove a wedge of carpus. The subsequent defect from the osteotomy is larger on the dorsal and radial sides of the carpus (Fig 4-H).
- Place a figure-of-eight 2-0 nonabsorbable suture across the osteotomy site, but do not tie it until you have checked the position of the wrist. Ideally, the wrist is placed in a position of 0° to 10° of extension.
- Tie the suture after the osteotomy is reduced and held via a percutaneous Kirschner wire (Figs. 4-I and 4-J).

Step 5: Transfer the Extensor Carpi Ulnaris Tendon

Pass the extensor carpi ulnaris tendon to the radial wrist extensors and suture the tendon to the extensors.

- Pass the extensor carpi ulnaris tendon in a subcutaneous plane to the area of the radial wrist extensors.
- Suture the extensor carpi ulnaris tendon to the radial wrist extensors to help maintain wrist position.
- Assess the wrist and finger/thumb flexors and further lengthen them if they are still providing a deforming force on the wrist.
- Close all incisions and apply a long arm cast.

Step 6: Postoperative Care

Cast immobilization for six to eight weeks is followed by splinting for six months.

- Immobilize the extremity in a cast for six to eight weeks.
- The wrist is splinted for the next six months and then as needed after this point to provide stability.

Results (Video 1)

Our recently published study of patients with amyoplasia who underwent carpal wedge osteotomy showed that the corrected position was maintained and the individu-

als were satisfied with the results over the long term¹. We reported on seventy-five wrists in forty-six patients followed for an average of 5.7 years (range, two to 10.3 years). The average resting position of the wrist improved significantly ($p < 0.001$), with no significant change in the arc of wrist motion. Outcome measures including visual analog scales, the Manual Ability Classification System (MACS), and ABILHAND-Kids indicated that the mean overall satisfaction following surgery was 9.1 out of a possible 10 points.

What to Watch For

Indications

- Rigid flexion deformity of the wrist.

Contraindications

- Wrists that can be passively extended to neutral. Release of volar tight structures and tendon transfer may be adequate treatment for these patients.
- Very poor muscle strength and fixed radial deviated flexed wrists required for bimanual grasp

Pitfalls & Challenges

- Carefully dissect the extensor tendons as they can be very atretic and may be adherent to the wrist capsule.
- Exercise care when making the proximal carpal osteotomy to avoid violating the radiocarpal joint.
- Maintain good contact between the osteotomy edges, held with a Kirschner wire, before tying the suture.
- Ensure adequate release of volar structures.
- Carefully design the osteotomy to be wider on the dorsal-radial side, coming to apex on the palmar-ulnar side.

Clinical Comments

- Many of these patients require lower-extremity surgery as well, and carpal wedge osteotomy can be coordinated with these procedures to minimize the number of anesthetic sessions.
- It is imperative to leave enough of a proximal row following the proximal osteotomy cut to allow fixation of the osteotomy site and maintain radiocarpal motion.
- Every patient is different: at times the extensor carpi ulnaris is not well developed and therefore not available for transfer.
- Pin fixation of the osteotomy site with a Kirschner wire is crucial.

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Fig. 1-A

Fig. 1-B

Figs. 1-A and 1-B Preoperative position of the wrist and location of the incisions. Note the wrist flexion contracture.

Fig. 2

Incision on the volar side of the distal part of the forearm with assessment of tight structures.

Fig. 3-A
Location of the incision for the carpal wedge osteotomy.

Fig. 3-B
Isolation of the finger and thumb extensors.

Fig. 3-C
Isolation of the wrist extensors and extensor carpi ulnaris tendon.

Fig. 3-D
Figs. 3-D, 3-E, and 3-F The extensor carpi ulnaris tendon is mobilized and passed proximally through a subcutaneous tunnel.

Fig. 3-E

Fig. 3-F

A.

C.

B.

D.

Fig. 4-A

Figs. 4-A through 4-F Location and performance of the biplanar carpal osteotomy. MC = metacarpal.

Fig. 4-B

Fig. 4-C

Fig. 4-D

Fig. 4-E

Fig. 4-F

Fig. 4-G
The osteotomy being performed with a number-15 scalpel.

Fig. 4-H
The carpal wedge being removed.

Fig. 4-I

Fig. 4-J

Figs. 4-I and 4-J Percutaneous wire fixation of the osteotomy site and suture closure.