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Hemiresection of the Distal Ulna by Means of Pronator Quadratus Interposition and Volar Stabilization

Gregory I. Bain, MBBS, FRACS, Ronald J. Heptinstall, RNFA,
Justin M. Webb, MBBS, and Poul V. Madsen, MD
Royal Adelaide Hospital
Modbury Public Hospital
University of Adelaide, Australia

ABSTRACT

Surgery for ulnar-sided wrist problems have proved a major challenge. A variety of bony procedures, which may or may not be supplemented with soft tissue interposition, tenodesis, and fusion of the distal radioulnar joint, have been designed in an attempt to address this challenge. The problems encountered in the use of these procedures have included weakness, snapping and instability of the distal ulna, pain and impaction, nonunion, and regrowth of bone.

To address the instability of the distal ulna and the radioulnar impaction, we have designed an operative technique involving the hemiresection of the distal ulna and the interposition of pronator quadratus (volar stabilization of the distal ulna).

This procedure is a safe method for dealing with pain and loss of function due to disorders of the distal radioulnar joint. It provides good pain relief, strength, and motion.

Keywords: hemiresection, interposition, pronator quadratus, volar stabilization

HISTORICAL PERSPECTIVE

Problems with the distal radioulnar joint (DRUJ), resulting in ulnar-sided wrist pain and reduced grip strength, is a common problem in patients with rheumatoid arthritis; it is also common after wrist injuries. The treatment of this problem has proved a major challenge for orthopedic surgeons.

Darrach[1] first described a procedure for the resection of the distal ulna in 1913. The early reports of this procedure were favorable, and it was used extensively. Later reports, however, have shown a number of complications. The resultant instability in the ulna stump after the Darrach procedure can result in decreased grip strength and pain.[2,3] This has prompted the development of a number of other surgical options.

To combat ulnoradial impaction, a number of authors have described a hemiresection interposition arthroplasty. Bowers[3] described a hemiresection interposition arthroplasty using either a tendinous anchovy or a dorsal DRUJ capsule. The extensor retinaculum was also used by Bain et al[4]; however, they advised against separating the dorsal capsule from the retinaculum. Pronator quadratus has previously been used as an interposition graft. Kleinmann and Greenberg[5] used pronator quadratus for patients who underwent a failed Darrach procedure. A longitudinal intramedullary extensor carpi ulnaris tenodesis. Reinforced 2 divergent Kirschner wires and a pronator quadratus interposition, Ruby et al[6] used pronator quadratus as an interposition material alone. Watson and Gabuzda[7] then described the importance of penciling the distal ulna to correspond to the sigmoid notch and the distal radius.

To prevent the dorsal translation of the distal ulna, Blatt and Ashworth[8] described a technique of suturing a flap of volar capsule to the dorsal ulna to tie it down. The pronator quadratus advancement technique described by Johnson[9] was used to treat dorsal instability of the distal ulna.

The pronator quadratus is a strong muscle that makes the radius and the ulna converge, particularly in power grip. After a Darrach or Sauve-Kapandji procedure, there is instability of the distal ulnar stump. During power situations, the pronator quadratus can accentuate the instability and produce a painful snap with forearm rotation.

The technique described in this article combines the hemiresection of the distal ulna with the use of pronator quadratus as an interposition graft and the stabilization of the distal ulnar with the triangular fibrocartilage

Address correspondence and reprint requests to Gregory I. Bain, MBBS, FRACS, 196 Melbourne Street, North Adelaide 5006, Australia. E-mail: greg@gregbain.com.au.

(TFC). It has been used in a series of 37 patients (39 wrists), of whom 28 (30 wrists) were available for follow-up. Of these patients, 27 stated that they were satisfied with the outcome. Most patients achieved a significant reduction in pain and improvement in function.

■ INDICATIONS/CONTRAINDICATIONS

This procedure is indicated in patients with an unstable or degenerate DRUJ resulting in pain and loss of function. It is suitable for use in patients with rheumatoid arthritis, osteoarthritis, and posttraumatic DRUJ. It can also be considered in patients with extensor tendon attrition rupture. Patients with positive ulnar variance are not contraindicated for this procedure because the ulna shortening minimizes the risk of stylocarpal impaction.

There are no absolute contraindications for this procedure. However, we have not used this procedure on individuals with high demand, such as laborers or athletes.

The patients are assessed clinically for signs of DRUJ instability; then, standard radiographs are obtained. These radiograph results are assessed for DRUJ arthritis and subluxation of the ulna. They should also be assessed for ulnar variance and signs of ulnocarpal impaction.

These patients should be considered for this procedure once nonoperative therapy has failed.

■ TECHNIQUE

Setup/Exposure

The arm is exsanguinated and placed on an arm board.

Exposure

A curved dorsoulnar incision is made over the wrist, with the dorsal branch of the ulnar nerve protected throughout the procedure. The deep fascia is divided in 2 locations: (1) on the volar aspect between the FCU and the subcutaneous border of the ulna, and (2) dorsally along the line of the EDM tendon. Elevating the ulnar neurovascular bundle and flexor tendons identifies the space immediately adjacent to the ulnar border of the pronator quadratus. It should then be possible to advance the surgeon's finger to the radial side of the wrist.

The periosteum of the ulnar aspect of the ulna is then incised, elevating both the periosteum and the pronator quadratus insertion. It is important to include the thickened periosteum because it assists in suturing to the distal ulna. This is performed methodically by means of a sharp and blunt dissection until it is completely separate from the ulna (Fig. 1A). The interosseous membrane is released to allow the pronator quadratus to be used as an interposition.

Hemiresection of the Ulna

The distal ulna is released in the subperiosteal plane from the TFC attachment. The distal ulna is then positioned such that its distalmost extent is level with the distal aspects of the sigmoid notch of the radius. The ulna must then be penciled to be parallel to the sigmoid notch throughout the forearm range of motion. A rasp is then used to scarify the surface to promote soft tissue healing of the ulna.

Drill holes are made in the distal ulna to accommodate 2 No. 1 polyester sutures, which are placed in the

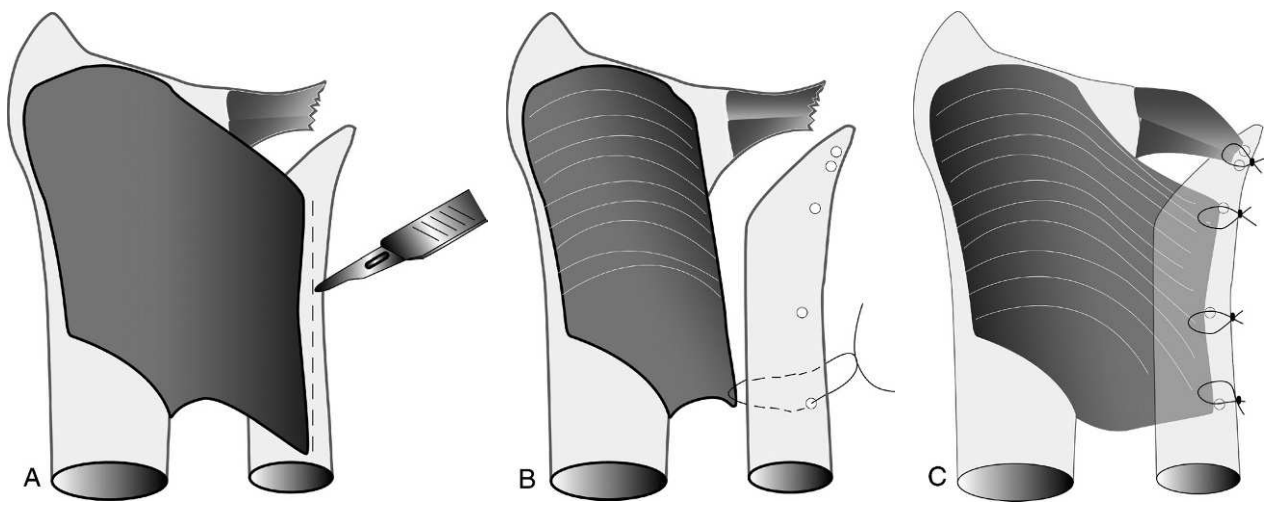

FIGURE 1. A, Diagram demonstrating that the ulna has been shortened to the level of the distal aspect of the sigmoid notch. The pronator quadratus is released from the ulna. B, The pronator quadratus is passed through the interosseous membrane, and sutures are preplaced to stabilize the pronator quadratus to the dorsal distal ulna. C, The distal ulna has been sutured to the volar radial ulnar ligament; then, the pronator quadratus has been used as an interposition graft and sutured to the dorsal aspect of the ulna.

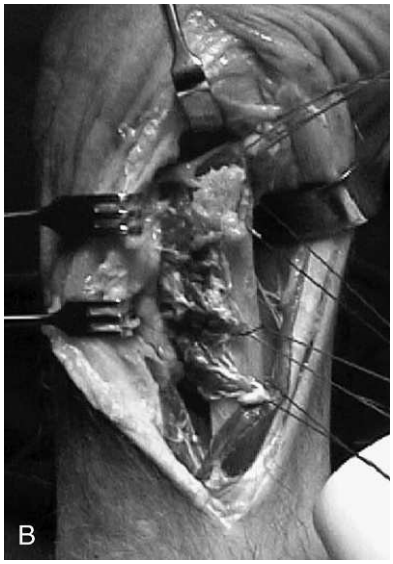

FIGURE 2. The released pronator quadratus with the attached periosteum is elevated as a flag in preparation to be used as an interposition graft.

volar aspect of the TFC (volar radioulnar ligament). The stabilization of the distal ulna to the volar aspect of the TFC is important to minimize dorsal translation and radioulnar convergence.

The point of suture into the volar radioulnar ligament is approximately 1 cm ulnar to the sigmoid notch. The authors think that maintaining this distance is important to keep the radioulnar divergence to overload the pronator quadratus being pinched as the forearm rotates.

Pronator Quadratus Interposition

The pronator quadratus is elevated and mobilized like a ''flag'' through the interosseous membrane to the dorsal aspect of the ulna (Fig. 2). Three holes are drilled into the ulna to accommodate No. 2 Vicryl sutures, which are preplaced in the periosteal attachment of pronator quadratus (Fig. 1B). The pronator quadratus acts as an interposition and dynamic stabilizer of the distal ulna. As it is released, it will decrease the natural convergence effect of the pronator quadratus dorsal translation of the ulna.

Stabilization of the Ulna

The preplaced pronator quadratus sutures are then ligated to stabilize the distal ulna and secure the pronator quadratus (Fig. 1C). The stability of the wrist is then assessed and tested through a range of motion. There should be no impingement nor instability of the ulna throughout the range of motion. Satisfactory position is then confirmed by means of radiology (Fig. 3).

RESULTS

The average pain score (VAS0–10) improved from 5.6 preoperatively to 1.3 postoperatively. The median pain score was 0.

The patient satisfaction level (VAS0–10) was 8.0.

The mean range of supination improved from 67 degree preoperatively to 76 degree postoperatively. The mean range of pronation improved from 63 degree to 79 degree. The grip strength improved from 7 to 12 kg.

COMPLICATIONS

One patient developed a postoperative hematoma requiring drainage. We have seen 2 patients with reabsorption of part of the distal ulna but have not required further operative treatment. Ulnocarpal compaction is a potential

FIGURE 3. Radiograph demonstrating the hemiresection of the distal ulna. Marks were placed on the width of the interval between the ulna and the radius due to the pronator quadratus interposition and the position in which the distal ulna was stabilized to the volar radial ulnar ligament.

complication but is avoided by means of the resection of the distal ulna at the level of the distal sigmoid notch.

Instability and impingement of the ulna stump are potential problems of this procedure, as observed in the Darrach and the Suave-Kapandji procedures. The authors consider that the volar stabilization has 2 important jobs: it prevents the dorsal instability of the ulna stump, but also acts as a pivot point around which the forearm rotates. Placing it 1 cm from the sigmoid notch minimizes the convergence of the radius and the ulna, which is important to prevent the impaction between the radius and the ulna.

REHABILITATION

The above-elbow cast is removed at 1 week and replaced with a below-elbow cast to be worn for 5 more weeks. The patient is advised not to do any heavy lifting for 3 months.

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