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TECHNIQUE

Sauvé-Kapandji Procedure Using the Herbert Cannulated Bone Screw

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■ HISTORICAL PERSPECTIVE

In 1936, Mehmed Kapandji and Louis Sauvé described the fusion of the head of the ulna to the distal radius, and the creation of a pseudarthrosis proximal to that fusion by resecting part of the ulnar shaft to treat distal radioulnar joint (DRUJ) arthrosis (18).

Before this date, the Darrach procedure was the operation of choice for treating most disorders of the DRUJ (5,15). However, the potential complications associated with this technique led surgeons to search for alternative methods to eliminate diseased tissue (10,21). A greater understanding of the physiology of the DRUJ, particularly the role of the triangular fibrocartilague complex (TFC) and other DRUJ stabilizers, has led to modifications of the Darrach procedure, along with other new surgical techniques that better preserve rotational and axial stability. In this sense, Bowers' hemiresection arthroplasty (1), Feldon's "Wafer" procedure (6), Watson' matched distal ulnar resection (24), silicone capping of the remaining ulnar stump (4), and Milch's ulnar shortening osteotomy (8) have been described as alternatives to the Darrach procedure. However, in our opinion, each of these surgical techniques have very specific indications or have been abandoned for poor results (10).

The Sauvé-Kapandji procedure appears to be a reliable treatment option for treating most disorders of the DRUJ when preservation of stability on the ulnar side of the wrist is desired (10). Another benefit of this technique over other ablative procedures is the ability to perform the procedure without disturbing the attachment of extensor carpi ulnaris (ECU) tendon to the ulnar styloid, leaving a good cosmetic result. Finally, if the Herbert cannulated screw is correctly positioned, there is no need to remove the implant after bone union.

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■ INDICATIONS/ CONTRAINDICATIONS

Indications for surgical management for DRUJ dysfunction are based on a thorough history and evaluation of the patients with appropiate imaging studies (2,3,10,19,20).

Although it is important to select the type of surgical intervention based on the disease process and associated anatomic pathology, it is equally essential to consider the realistic functional demands of the patient (4,14). Additionaly, the track record of each procedure and the personal experience of the surgeons must be taken into account (10). However, we believe that the Sauvé-Kapandji procedure can be utilized for almost any type of disorder of the DRUJ (Table I), especially in the younger, more active patient. Fundamentally, this procedure is used in posttraumatic arthritis (17,20,21), rheumatoid arthritis (16,18,20–23), radioulnar discrepancy and shortening of the radius after fractures (11–13,17,20,21), ulnocarpal impigment (7), and in patients with chronic painful instability when ulnar shortening or ligamentous reconstruction does not correct the instability (17). Furthermore, the Sauvé-Kapandji technique can be used in conjunction with other reconstructive procedures (25), avoiding the necessity to perform a second operation. However, in patients with rheumatoid arthritis, the procedure does not prevent progression of preexisting ulnar or palmar traslation of the carpus (20,21,23). For this reason, the association of other surgical techniques - either radiolunate arthrodesis or total wrist arthrodesis - is recomended in some cases (21). It is also useful for those patients requiring a stable, fullwidth ra-

TABLE 1. *Injuries and disorders of the DRUJ (adapted from Chidgey LK: the distal radioulnar joint: problems and solutions. J Am Acad Orthop Surg 1995;3:95–109)*

Intra-articular fractures without instability
Sigmoid notch (intra-articular distal radial fractures)
Ulnar head (including chondral fractures)
Ulnar styloid
TFCC injuries without instability
Traumatic (some of Palmer's class I injuries will be associated with dislocation/instability)
Degenerative (ulnocarpal impaction syndrome/Palmer's class 2 Injuries/)
Idiopatic positive ulnar variance
Acquired positive ulnar variance
Dislocations and instability
Acute
Dorsal with or without fracture
Palmar with or without fracture
Multidirectional with or without fracture
Proximal-distal instability (Essex-Lopresti)
Chronic (with or without arthritis changes)
Dorsal with or without malunion or nonunion
Palmar with or without malunion or nonunion
Multidirectional with or without malunion or nonunion
Proximal/distal instability
Chronic instability after DRUJ resectional arthroplasty
Arthritis (e.g., osteo-, posttraumatic, or rheumatoid arthritis, Gout, pseudogout)
Others disorders
Congenital (madelung's deformity)
Unstable extensor carpi ulnaris tendon
Fixed forearm rotational contracture
Tumor (hereditary multiple exostosis involvement of DRUJ)

dioulnar surface for the support of a radiocarpal implant or arthroplasty (20–22). Another potential problem with the Sauvé-Kapandji technique can be patients with poor healing potential or poor bone stock (21).

■ TECHNIQUE

Under tourniquet control and with the forearm in pronation, a dorsal zigzag incission is made over the distal ulna. The dorsal branch of the ulnar nerve is identified and retracted in the skin flap (Fig. 1). The interval between the extensor digiti quinti (EDQ) and the ECU tendons is developed, and the superficial extensor retinaculum is divided longitudinally in the interval and preserved to allow for a plicature closure. The ECU retinaculum and subsheath are left undisturbed. The distal ulna is exposed through a longitudinal incision in the dorsal-ulnar periostium, and then a subperiosteal dissection of the distal 2 cm of the ulna is performed (Fig. 2). An osteotomy is then performed transversaly at the level of the radioulnar articulation just proximal to the sigmoid notch, and a 1 cm segment of ulna, with its periostium, is excised (Fig. 3). This leaves the interosseous membrane and pronator quadratus attachment undisturbed. A rongeur or osteotome is then used to deeorticate the articulated portion of the DRUJ. To facilitate this approach, the ulnar head is grasped with a towel clip for proper visualization of the articular radioulnar cartilage. This also preserves its orientation relative to the radius and the ECU tunnel (Fig. 4).

The amount of ulna to be excised depends upon preoperative ulnar variance. For patients who are ulnar positive, the amount of ulna resected should equal 1 cm plus the amount of positive variance present (Fig. 5). This allows the ulna to be pulled proximally to ulnar neutral variance accompanied by maintenance of the desired 1 cm gap. For patients who are ulnar neutral or negative, a 1 cm segment is simply resected. In this later situation, although the ulnar resection may be inferior to the desired gap, it is not critical for a good function of the forearm and wrist. The head of the ulna is then hinged away from the radius and is pinned to it using the Herbert cannulated guide pin drive from the lateral aspect of the ulnar head through the radius, until the tip is palpable under the skin on the radial aspect of the radius (Fig. 6A). After selecting the implant length and diameter (4.5 mm), the proximal drill bit is introduced over the guide pin and advanced until the built-in stop contacts the lateral cortex of the ulnar head (Fig. 6B). The distal drill bit is inserted over the guide pin and drilled to the desired depth, but without perforating the radial cortex of the radius (Fig. 6C). After threading the canal created by

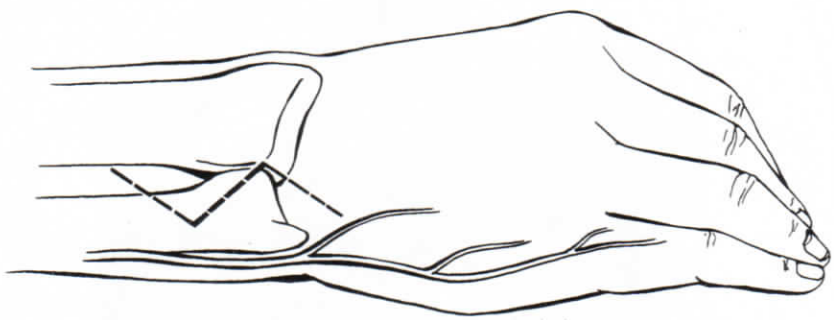

FIG. 1. A zig-zag incision (dotted line) on the dorsoulnar aspect of the wrist is used to expose the DRUJ. The dorsal branch of the ulnar nerve must be protected. *Illustration by Jennifer Smith.*

FIG. 2. The head of the ulna is exposed and its neck is subperiostically dissected to perform ulnar osteotomy.

both drill bits with the cannulated tap (Fig. 6D), the Herbert cannulated bone screw is introduced until the threaded proximal segment of the screw is completely embedded in the ulnar head (Fig. 7). The compression exerted by the Herbert screw across to the DRUJ is considerable, and in our opinion it is not necessary to place another screw proximal to the first screw to provide rotational control. Therefore, putting an additional bone graft into the sigmoid notch as an aid to radioulnar fusion is also unecessary. However, care should be taken to close the periosteal sleeve around the distal ulnar stump to avoid reformation of the excised shaft of the ulna. We believe it is unnecessary to have tissue interposition into the pseudarthrosis site (pronator quadratus, flap of DRUJ, "anchovy" of the palmaris longus, etc.) to prevent this complication. We also believe it is unnecessary to use stabilizing procedures in the proximal ulnar stump (9,21,24).

Finally, the DRUJ capsule and the extensor retinaculum are reapproximated and the skin is closed.

FIG. 3. A 1 cm portion of the distal ulna is excised by using an oscillating saw.

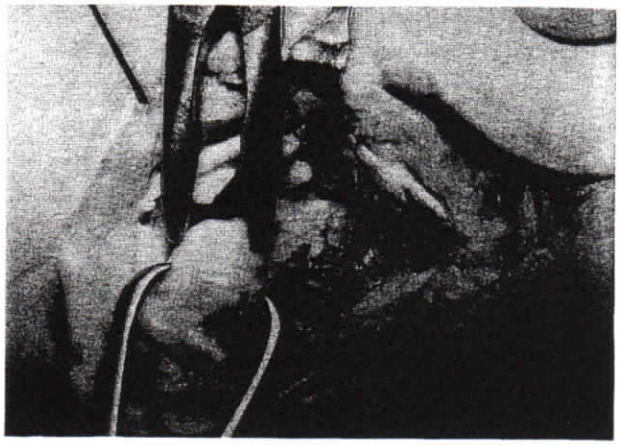

FIG. 4. Decortication of the DRUJ. To facilitate this approach the ulnar head is grasped with a towel clip to reflect it distally and medially.

■ COMPLICATIONS

The most common postoperative disadvantage to this technique, not unlike that with the Darrach procedure, is ulnar stump instability (4,10,21–23). To avoid this problem, Kapandji recommends a short distal ulnar fragment and small ulnar gap to create the pseudarthrosis as distally as possible, because the interosseous membrane and pronator quadratus are minimally disturbed, and in consequence, lacking residual instability. Furthemore, a more distal pseudarthrosis may increase grip strength, because the proximal ulna can receive the axial force from the radius more effectively when it is kept long.

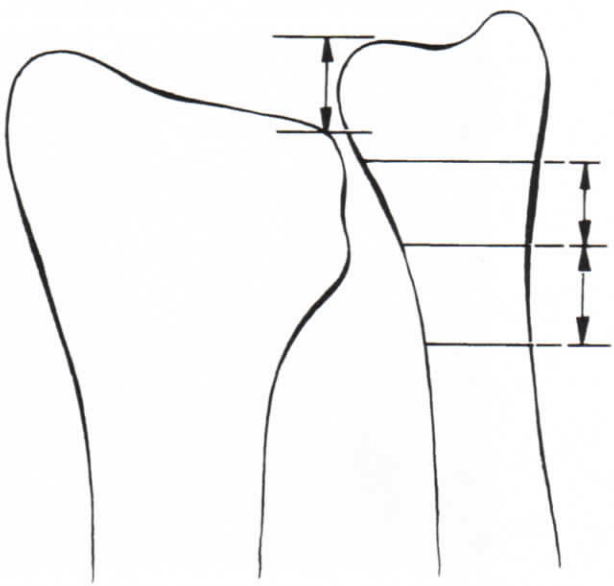

FIG. 5. Positive ulnar variance. The amount of ulna resected should equal 1 cm plus the amount of positive variance present **(A)**. *Illustration by Jennifer Smith.*

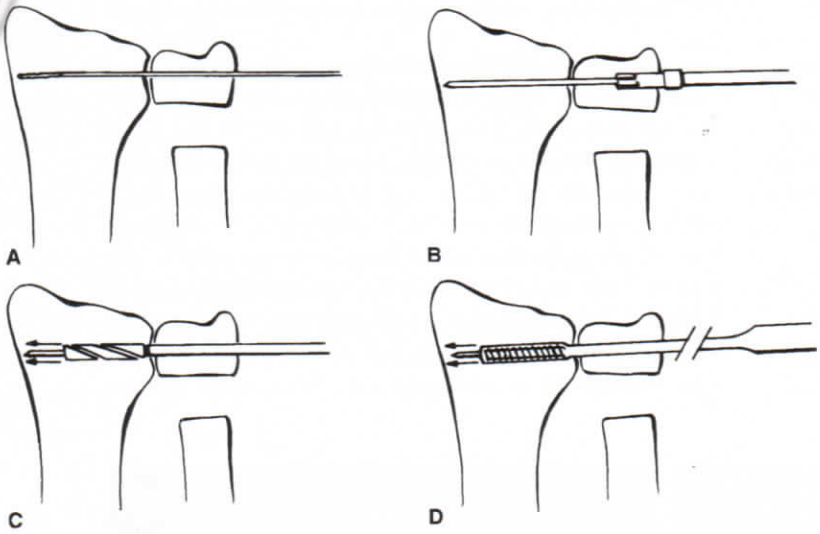

FIG. 6. Technique. **A:** The guide pin is drilled from the lateral aspect of the ulnar head through the radius, parallel to the distal radius surface. **B:** Insertion of the proximal drill bit over the guide pin to drill the lateral cortex of the ulnar head until the built-in stop contacts the cortex of the bone. **C:** Insertion of the distal drill bit over the guide pin to drill the radius until the end of the guide pin. **D:** Preparation of the canal with the cannulated tap for the leading screw threats of the implant. *Illustration by Jennifer Smith.*

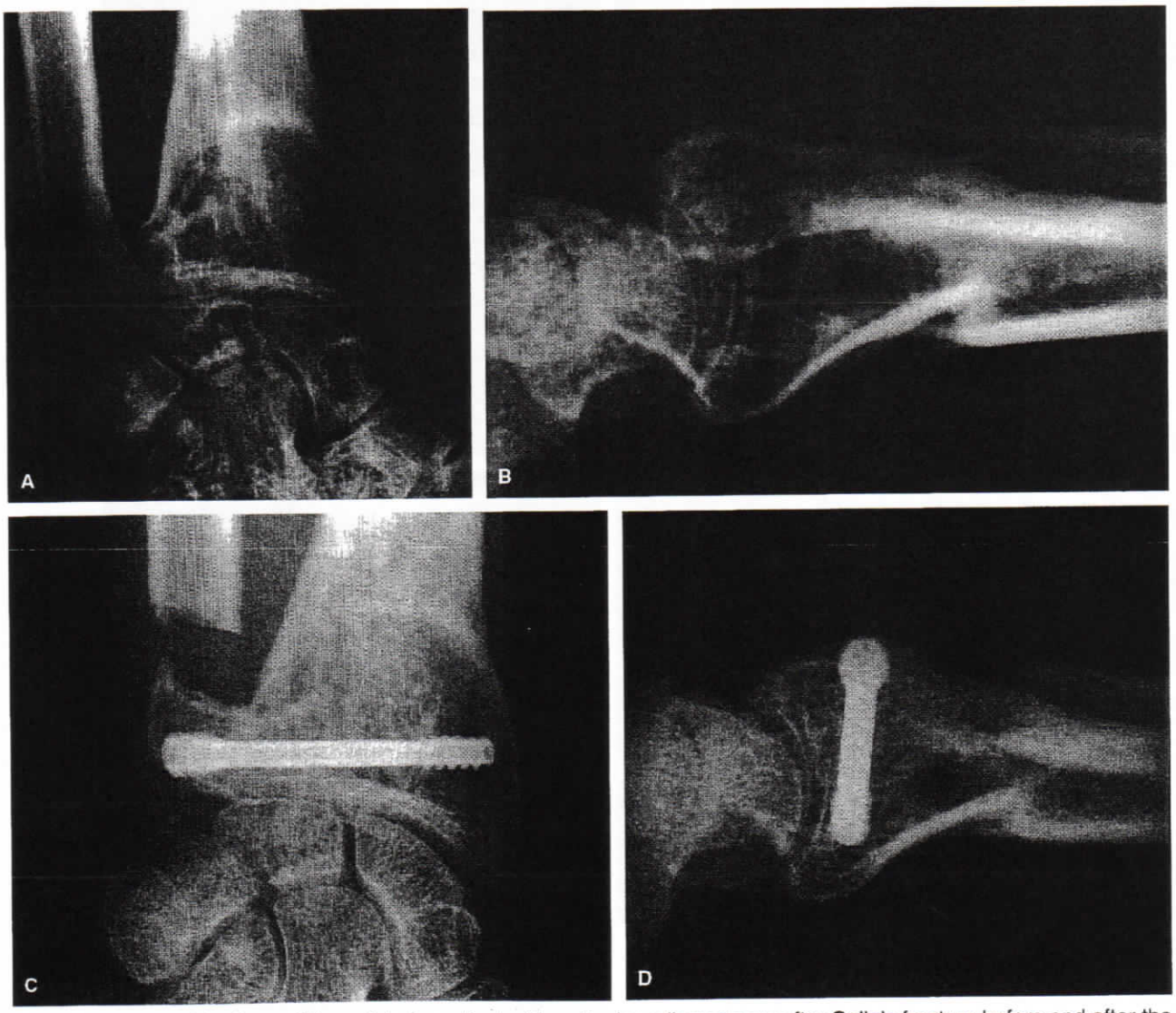

FIG. 7. Radiographic views of the wrist of a patient with radioulnar discrepancy after Colle's fracture before and after the Sauvé-Kapandji procedure. The preoperative posteroanterior **A:** and lateral **B:** and postoperative posteroanterior **C:** and lateral **D:** views are shown.

Less common complications include heterotopic ossification in the pseudarthrosis site and radio-ulnar nonunion (10,17,20). The heterotopic ossification in one or both portions of the pseudarthrosis sites causes no functional problems when it does not bridge the ulnar gap. However, if it develops a solid ossification across the gap, a blockage of pronation and supination occurs, requiring an additional operation to excise the osseous bridge. Radio-ulnar nonunion is not uniformly associated with failed results (16), but further studies are needed to confirm their results (10). However, in our opinion, the healing at the arthrodesis site is desirable. Other minor complications include broken AO screws and inflammatory changes surrounding the points of exit of the K-wires, depending on the internal fixation material utilized in the DRUJ fusion.

■ REHABILITATION

After the operation the wrist is immobilized with a short arm cast for ten days, and gentle active motion is allowed for the wrist and for forearm rotation. Motion is in-

FIG. 8. Radiographic views of the wrist of a patient with radiolunar discrepancy and dorsal radial deformity after Galeazzi fracture before and after the Sauvé-Kapandji procedure associated with a wedge osteotomy of the radius and synthetized by means of an external fixator. The preoperative posteroanterior **A:** and lateral **B:** and postoperative posteroanterior **C:** and lateral **D:** views are shown.

eased depending on the patient's pain level. If the DRUJ compression obtained with the Herbert screw is effective, the authors do not use an additional supporting splint, but in case of deficiency or inadequate compression across the arthrodesis site, our recommendation is to maintain the cast for three weeks. Once the fusion appears radiographically solid (in our series this occurs between the 6th and the 8th weeks), light strengthening can begin, moderated according to tolerance (19).

■ RESULTS

Ten patients, two women and eight men, were available for follow-up after about 2 years. The dominant wrist was involved in all patients. The youngest patient was 22 years old, and the oldest, 45 years (average 32 years). The needs for operation in these 10 patients included posttraumatic arthritis (five patients) or discrepancy (two patients) of the DRUJ after distal fracture of the radius (one of them with simultaneous dorsal deformity of the radius [Fig. 8]), distal radioulnar subluxation (two patients), and rheumatoid arthritis (one patient). All patients experienced pain along the ulnar side of the wrist, aggravated by forearm or wrist motions and by lifting or gripping. Severe limited forearm rotation was also present in all cases.

After the operation, all patients showed clinical and x-ray evidence of healing at the arthrodesis site within 6 to 8 weeks of surgery. All patients were entirely pain free, with the exception of one patient that developed a De Quervain disease due to protrusion of the Herbert cannulated screw in the radial aspect of the radius (Figure 9), which required removing the implant. Pronation and supination of the forearm were also full in all patients, and no loss of extension and flexion of the wrist were present.

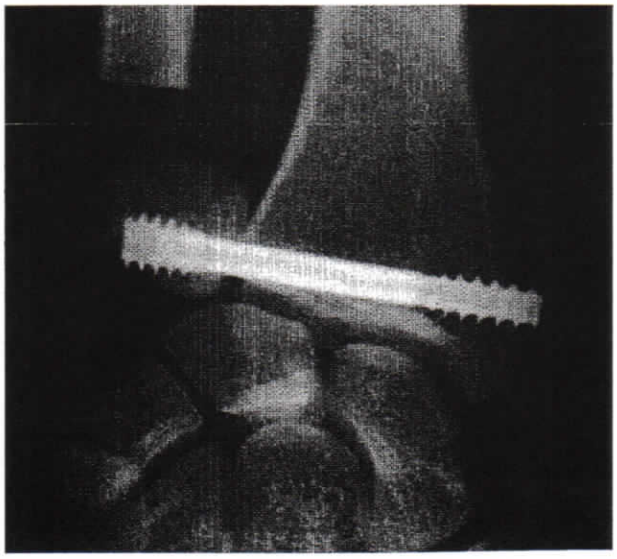

FIG. 9. Protrusion of the Herbert cannulated bone screw in the radial aspect of the radius. This protrusion produced in the patient a De Quervain disease.

There were no major complications. However, in one patient, heterotopic ossification occurred in the distal ulnar stump but without bridging the pseudarthrosis and caused no problems or functinal consequences.

Finally, all the patients returned to full activities and their previous occupations.

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