Salvage of the Unstable Sauvé-Kapandji Procedure: A New Technique

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ABSTRACT

The Sauvé-Kapandji procedure has been commonly performed in the setting of posttraumatic osteoarthritis of the distal radioulnar joint. A recognized complication is instability of the proximal ulnar stump, which may occur in up to 33% of cases. Salvage of the failed Sauvé-Kapandji procedure in this setting is difficult and can sometimes involve sacrifice of forearm rotation. We report the results of 3 cases of a new salvage procedure in this setting. The radioulnar pseudarthrosis was taken down; ulnar continuity was restored with an intercalary graft; and forearm rotation was restored with matched hemiresection and interposition arthroplasty at the site of previous radioulnar fusion. Postoperatively, all patients achieved good forearm rotation (mean supination, 60 degrees; mean pronation, 65 degrees), had no symptoms of instability, and were satisfied with the results of the procedure. Disabilities of the Arm, Shoulder and Hand scores improved from preoperative mean of 55 to postoperative mean of 18.

Keywords: Sauvé-Kapandji procedure, distal radioulnar joint, DRUJ

HISTORICAL PERSPECTIVE

Distal radioulnar joint dysfunction is a common consequence of distal radial fracture, with a reported incidence of ulnar-sided wrist pain requiring operative intervention of 3.5%. The consequence of incongruity of the distal radioulnar joint may be the development of posttraumatic osteoarthritis. A variety of techniques are available to address posttraumatic arthritis of the distal radioulnar joint, including resection of the distal ulna as described by Darrach, hemiresection of the ulnar articular surface with interposition arthroplasty as described by Bowers, matched hemiresection of the distal ulna as described by Watson et al, and the Sauvé-Kapandji procedure.

The Sauvé-Kapandji procedure of arthrodesis of the distal radioulnar joint and creation of a proximal ulnar pseudarthrosis to restore rotation is documented as a reliable method of addressing distal radioulnar joint dysfunction in the setting of rheumatoid arthritis and after distal radial fracture. At our center, a series of 81 Sauvé-Kapandji procedures has previously been described with excellent patient satisfaction. The results in this series were good or excellent in most patients; however, the most common complication noted in that article was clicking of the proximal ulnar stump. In 6 of
Since then, several other procedures have been described. These include the use of a strip of the extensor carpi ulnaris (ECU) to tenodese the proximal ulna, which has been shown to be effective in preventing radioulnar convergence as well as anterior-posterior translation of the proximal ulna.\(^6\)\(^8\) The flexor carpi ulnaris has also been used successfully to tenodese the proximal ulna and reduce the incidence of this problem.\(^9\) It has been suggested, however, that these reconstructions have a tendency to deteriorate over time.\(^10\) Despite these techniques to reduce its incidence, ulnar stump instability remains a commonly encountered problem with the Sauvé-Kapandji procedure. Nonoperative treatment with forearm bracing has been used in this setting, with improvement in patients’ symptoms; however, its mechanism of action is unclear because radiographic parameters of radioulnar convergence are not improved.\(^11\)

A variety of salvage options are available in this setting, including capsulodesis\(^12\) or tenodesis\(^6\) as discussed earlier, conversion to a 1-bone forearm,\(^13\) more proximal resection of the ulna,\(^14\) or insertion of an ulnar head prosthesis.\(^15\)\(^16\) Conversion to a 1-bone forearm via radioulnar arthrodesis carries a risk of up to 32% nonunion, and results are documented as poorer in younger patients with posttraumatic primary etiology.\(^17\) More proximal resection of the ulna without soft tissue stabilization has been reported to produce acceptable patient satisfaction rates but still retains a significant failure rate requiring subsequent conversion to a 1-bone forearm.\(^11\) Insertion of an ulnar head prostheses while either preserving the distal radioulnar fusion mass and allowing the implant to articulate with its proximal undersurface\(^18\) or with resection of the distal radioulnar arthrodesis and ulnar head and articulation of the prosthesis with a recreated sigmoid notch\(^13\) have reported good short-term results but carry the risk of implant instability, loosening, or erosion into the recreated sigmoid notch of the radius over time.\(^19\)

These salvage procedures all have disadvantages as outlined above, particularly in the younger active patient. In this article, we report a new salvage procedure for intractable instability of the proximal ulna remnant involving restoration of ulnar length with grafting of the previously created pseudarthrosis to restore ulnar continuity, taking down of the distal radioulnar joint arthrodesis, and restoration of rotation with a matched hemiresection and interposition arthroplasty.

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**TABLE 1. Clinical Outcome Measures**

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Postoperative</th>
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</thead>
<tbody>
<tr>
<td>Pronation (degrees)</td>
<td>40 (5–65)</td>
<td>65 (60–70)</td>
</tr>
<tr>
<td>Supination (degrees)</td>
<td>45 (20–70)</td>
<td>60 (50–70)</td>
</tr>
<tr>
<td>Flexion (degrees)</td>
<td>45 (30–60)</td>
<td>50 (45–60)</td>
</tr>
<tr>
<td>Extension (degrees)</td>
<td>50 (40–60)</td>
<td>60 (50–65)</td>
</tr>
<tr>
<td>Grip strength (kg)</td>
<td>15 (3–25)</td>
<td>36 (22–42)</td>
</tr>
<tr>
<td>DASH score</td>
<td>55</td>
<td>18</td>
</tr>
</tbody>
</table>

Values are given as mean (range). DASH score indicates Disabilities of the Arm, Shoulder and Hand score.

the 71 patients, this clicking was a cause of ongoing postoperative discomfort and some concern (Table 1).

Since then, our observation of ongoing development of an unstable proximal ulna stump in a small number of patients has actually led us to stop performing the Sauvé-Kapandji procedure in our unit. The reason for discontinuing the procedure is that although most patients attain an excellent result, the problem of an unstable stump, if it is functionally impairing, is extremely difficult to deal with. Some studies report no statistically different complication rate when comparing the Darrach and Sauvé-Kapandji procedures\(^5\); however, both procedures have been associated with the postoperative problem of instability or clicking of the proximal ulna, with a reported incidence of up to 33% after the Sauvé-Kapandji procedure.\(^5\)\(^7\)

Although the Sauvé-Kapandji procedure was very well received and gave generally good results as we reported in 1992,\(^2\) since then, several other procedures such as a Bower hemiresection\(^2\) or a Watson\(^3\) matched ulna resection have become more popular. These have become preferable to the Sauvé-Kapandji as they maintain the length of the ulna. Maintaining maximal length of the ulna improves stability.

The other advantage of maintaining length is that future salvage procedures may be simpler, and better stability of a prosthesis or other lengthening procedure can be expected.

In our previous article, we emphasized the importance of keeping the remnant ulna head short (1–1.5 cm proximal to the ulnar styloid), inserting one screw only, and making a final gap of a maximum of 1 cm at the end of the ulna.\(^4\) By doing this, the distal stump of the ulna is a maximum of 2 cm from the ulnar styloid.

It should be noted that shortening of the proximal ulna stump can be a problem if the surgery is not performed in a technically satisfactory fashion, with the osteotomy being performed more proximal at the time of the index surgery. Unfortunately, however, we have also observed that over a period, in some cases, despite a suitably distal osteotomy, there is resorption of the proximal ulna stump, with loss of length aggravating the instability. Unfortunately, this seems to be more common in patients performing manual work, who are exactly the group of patients more likely to complain of a significant functional impairment as a consequence of proximal ulna stump instability.

In an attempt to prevent postoperative instability of the proximal ulna, modified techniques incorporating soft tissue procedures to stabilize the proximal ulna have been described. These include the use of a strip of the extensor carpi ulnaris (ECU) to tenodese the proximal ulna, which has been shown to be effective in preventing radioulnar convergence as well as anteroposterior translation of the proximal ulna.\(^6\)\(^8\) The flexor carpi ulnaris has also been used successfully to tenodese the proximal ulna and reduce the incidence of this problem.\(^9\) It has been suggested, however, that these reconstructions have a tendency to deteriorate over time.\(^10\) Despite these techniques to reduce its incidence, ulnar stump instability remains a commonly encountered problem with the Sauvé-Kapandji procedure. Nonoperative treatment with forearm bracing has been used in this setting, with improvement in patients’ symptoms; however, its mechanism of action is unclear because radiographic parameters of radioulnar convergence are not improved.\(^11\)

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In this article, we report a new salvage procedure for intractable instability of the proximal ulna remnant involving restoration of ulnar length with grafting of the previously created pseudarthrosis to restore ulnar continuity, taking down of the distal radioulnar joint arthrodesis, and restoration of rotation with a matched hemiresection and interposition arthroplasty.
**TECHNIQUE**

The means of restoring stability of the ulna in this technique is based on the premise that the primary cause of proximal ulna stump instability is a combination of a stump that is too short (ie, the osteotomy has been performed too proximally or there has been subsequent resorption of the stump) and obvious loss of continuity between the proximal ulna and the triangular fibrocartilage and the radioulnar ligament complex that remains attached to the distal section of the ulna distal to the pseudarthrosis.

We have, therefore, developed a strategy that would both lengthen the ulna and restore continuity between the proximal ulna and the stabilizing ligamentous structures while still maintaining forearm rotation.

The procedure involves inserting an intercalary tricortical bone graft harvested from the iliac crest into the site of the previous osteotomy in an attempt to restore bony continuity between the proximal and the distal ulna. The previous fusion of the distal radioulnar joint is resected in a fashion similar to that which would be performed in a distal radioulnar joint matched hemiresection procedure.3

The hemiresection arthroplasty is augmented with soft tissue interposition, and this uses whatever soft tissue is available locally.

**Exposure**

The surgical approach uses a standard dorsoulnar approach over the distal radioulnar joint through the floor of the fifth extensor compartment, which is then extended proximally to achieve access to the proximal ulna stump at either side of the ECU tendon, and the screw previously inserted for the Sauvé-Kapandji procedure is removed. Care is taken to preserve any residual tissue distally between the radius and the distal ulnar head, including the triangular fibrocartilage and the dorsal radioulnar ligaments.

**Osseous Reconstruction**

The existing gap between the distal ulnar head and the proximal ulnar stump is measured with the forearm in pronation before the fusion is taken down. If the preoperative radiographs do not show positive ulnar variance, then the bone graft should equal this measurement to avoid a long ulna postoperatively. If, however, the ulnar head has been fused in a position of...
positive ulnar variance on preoperative radiographs, then the graft should be shortened proportionately. It should be remembered, however, in these calculations that there is likely to be some further loss of bony length (2 mm) in the course of preparing the surfaces of the ulnar to join to the intercalary graft, so it is better to prepare the surfaces before taking down the fusion or measuring the gap.

The previous distal radioulnar fusion is taken down using a microsagittal saw with a fine blade (4–6 mm). This initial cut is made in a direct posterior to anterior direction. Although a small part of the most distal and radial aspect of the ulnar head may be left attached to the radius, care should be taken to leave adequate bone on the ulnar side of this cut to facilitate sound distal fixation, and intraoperative fluoroscopy should be used if there is any uncertainty regarding the location of this initial bony cut.

Depending on the nature of the primary pathology, there may be other bony fragment distal to the ulnar head, such as nonunited ulnar styloid fragments. These should be left undisturbed.

After the ulnar head and the radius have been separated, the opposing aspects of the radius (sigmoid notch) and ulna head are fashioned into concavoconvex surfaces with a rongeur or burr.

A tricortical graft is harvested from the iliac crest, with the superior cortex of the crest corresponding to the length of the intercalary graft as determined by the measurements described above so that 3 cortices are placed parallel to the long axis of the ulnar shaft. The mean graft length in our series was 18 mm.

Our primary concern in performing this procedure was whether we would achieve union at both the proximal and distal interfaces of the intercalary graft. We used a 2.3-mm minicondylar blade plate from the AO modular handset (Synthes) augmented by a second plate positioned at almost 90 degrees, so as not to impinge on the radius during forearm rotation; most plates were 8 holes. We felt that double-plating would be appropriate because of the need to pursue early postoperative mobilization to achieve restoration of forearm rotation through the new hemiresection and avoid formation of recurrent synostosis. The procedure may potentially be simplified by single-plate fixation;
however, this may be at the expense of a higher risk of nonunion at one of the interfaces of the graft. Newly available small locking plates may play a role in this technique in the future.

**Closure**

Interposition of soft tissue is performed using local soft tissue. This may include the ECU, pronator teres, or floor of fifth extensor compartment, whichever is available, depending on previous surgical procedures. Careful repair of the dorsal soft tissues is performed, and we have found it useful to use part of the extensor retinaculum overlying the fifth compartment, rerouted deep to the extensor digiti minimi and sutured to the interposition tissue.

**REHABILITATION**

Postoperatively, the patient is immobilized in a short-arm thermoplastic splint for 6 weeks, with forearm rotation exercises supervised by a hand therapist. Active and passive supination and pronation exercises are performed with range of motion set according to intraoperative observation of available movement. Radiographs are taken at 6 weeks to confirm union before cessation of splint.

**INDICATIONS AND CONTRAINDICATIONS**

This procedure is indicated in patients with significant symptomatic instability of the proximal ulnar stump after the Sauvé-Kapandji procedure where other salvage procedures may be inappropriate because of relatively young age, high functional demand, or have already failed (Fig. 1).

We remain undecided as to the place of attempting a soft tissue stabilization procedure before this osseous reconstruction but feel that, in our hands, it would difficult to justify such a procedure given our limited success in this setting when compared with the outcome of the osseous reconstruction described here.

This procedure is contraindicated where there is insufficient distal ulnar bone to achieve satisfactory fixation.

We have performed this procedure on 3 patients with severe functional limitation due to ulnar stump instability after Sauvé-Kapandji procedures. The mean age was 46 years (range, 33–48 years), and all procedures were on dominant right arms. The mean interval between the index Sauvé-Kapandji procedure and the definitive procedure was 2.5 years (range, 15 months–4 years). All patients had an intervening attempted soft tissue stabilization procedure (ECU tenodesis)\(^6\,^8\) (Fig. 2) All 3 patients were unable to work because of the painful instability.

In the setting of a failed Sauvé-Kapandji procedure that is due to proximal ulnar remnant instability, this procedure provides a useful alternative to other salvage procedures such as creation of a 1-bone forearm, more proximal ulnar resection, or ulnar head arthroplasty. It allows maintenance of distal ulnar ligamentous support of the carpus and restoration of forearm rotation without the concerns of long-term implant survival in young patients.

**RESULTS**

All 3 cases experienced resolution of their instability symptoms and marked functional improvement (Fig. 3).

All patients were extremely satisfied with the outcome of the procedure and stated they would definitely have it again.

All 3 cases achieved union at both sides of the intercalary bone graft. There was evidence of bridging callus at 6 weeks in 2 cases and at 9 weeks in the third. Two of the 3 cases have had the metal work removed after union (Fig. 4).

The patients all returned to their previous occupations (Figs. 5 and 6) (Table 1).

**REFERENCES**


