

“Quadrangular-construct” modification of Sauve-Kapandji procedure

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ABSTRACT

Background: Subluxation of ulna in distal radioulnar joint disorders causes pain on motion, loss of grip strength, and a restriction of forearm rotation. Several procedures have been described to salvage DRUJ disorders including the Darrach procedure, the matched distal ulnar resection, the hemiresection interposition arthroplasty (Bowers procedure) and the Sauve-Kapandji (S-K) procedure. All these procedures are associated with either loss of grip, pain over proximal ulnar stump or instability. We describe our modification of S-K procedure with good functional outcome.

Materials and Methods: Twenty patients, 12 male and 8 female, underwent S-K procedure, with our modification, were included in this study. Patients were evaluated preoperatively, postoperatively, and on followup visits using Modified Mayo Wrist Score and wrist radiographs. Average followup period was 34.55 months (range 24-64 months).

Results: Excellent results were found in one patient, good in 15 patients, and fair in four patients. Mean Modified Mayo Wrist Score improved from 32 to 79.75, which was statistically significant.

Conclusions: Our modification of S-K procedure provides good functional outcome with stable ulnar stump and without significant procedure-related complications.

Key words: Distal radioulnar joint, arthritis, wrist, Sauve-Kapandji, modification of Sauve-Kapandji

MeSH terms: Wrist joint, wrist injuries, radius fractures, arthritis, arthroplasty

INTRODUCTION

Distal radioulnar joint (DRUJ) disorders arise from various causes such as osteoarthritis, trauma, ulnocarpal abutment syndrome, congenital malformation, and rheumatoid arthritis. Subluxation of the ulna in these disorders causes pain on motion, loss of grip strength, and a restriction of forearm rotation.

Several procedures have been described to salvage DRUJ disorders including the Darrach procedure,¹⁻³ the matched distal ulnar resection,⁴ the hemiresection interposition arthroplasty (Bowers procedure),⁵ and the Sauve-Kapandji (S-K) procedure.

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The earliest reference of distal ulnar resection was found to be given by Bernard and Huetter⁶ in “Illustrated manual of operative surgery and surgical anatomy.” This was first published in French in 1851 and was translated to German in 1855 and English in 1857. Another reference to this procedure was made by Malgaigne⁷ in 1855. Later on it was described by Darrach^{8,9} in 1912 and 1913. However, Darrach’s name became the preferred eponym for the excision of ulnar head following report by Dingman¹⁰ in 1952. It is an easy procedure restoring successfully the forearm rotations but not devoid of complications such as loss of grip strength and pain over proximal ulnar stump. In 1936, Sauvé and Kapandji described a similar technique in which DRUJ arthrodesis was performed along with pseudarthrosis of ulna.¹¹ However, Berry¹² had already published a similar technique in 1931 using a bone peg

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instead of a screw or a Kirschner wire to stabilize the DRUJ arthrodesis.

The S-K procedure has advantages over the Darrach procedure in preventing ulnar translation of the carpal bones, which gives better cosmetic results. Although satisfactory results are obtained in most cases, the instability of the proximal ulnar stump in both coronal, as well as sagittal planes remains the major complication causing pain and discomfort while doing daily activities, especially in pronation.¹³⁻¹⁷

In our modification of S-K procedure, we used resected piece of ulna to form a stable “Quadrangular-construct” at wrist joint along with stabilization of proximal ulna using pronator quadrates muscle.

MATERIALS AND METHODS

Twenty consecutive patients having DRUJ instability with posttraumatic arthritis presented between 2006 and 2009, were included in this prospective study. There were 12 males and 8 females. Average age was 44.1 years (range 35–54 years). Dominant wrist was involved in 13 cases. All patients were operated upon using this modified technique for S-K procedure. Patients were evaluated preoperatively, postoperatively, and on followup visits using Modified Mayo Wrist Score. Wrist radiographs were taken preoperatively, postoperatively, and on followup visits.

Paired *t*-test was used to compare the preoperative and final followup Modified Mayo Wrist Score and to calculate the *P* value.

Operative procedure

Incision was made between the 5th and 6th extensor compartments. Dorsal branch of ulnar nerve was preserved. DRUJ was opened. About 1.5 cm ulna was resected 1 inch from the tip of ulnar styloid process. This resected fragment was used as graft interposed between distal radius and ulna and fixed with screw [Figure 1a]. Radio ulnar joint was fixed with screw to do arthrodesis. Pronator quadrates muscle was dissected subperiosteally, was cut into two halves along its length and tied to proximal and distal ulnar stumps after drilling holes in the bone with non absorbable suture [Figure 1b]. Wound was closed in layers. Suture removal was done at 2 weeks.

Removable POP slab was given for 3 weeks. ROM exercises were started at 3 weeks. Strengthening exercises were started 3 months onward. Patients returned to full activity after complete bony fusion seen on X-rays.

RESULTS

Average followup period was 34.55 months (range 24-64 months). On final followup, excellent results were found in one patient, good in 15 patients, and fair in four patients. Mean Modified Mayo Wrist Score improved from 32 to 79.75 [Table 1]. This improvement in score was statistically significant (compared by using “Paired *t*-test;” *P* < 0.0001). There was no incidence of infection noted in the study. No graft resorption was seen in any of the cases. No bone formation was seen between proximal and distal ulnar fragments. No patient had problem related to proximal ulnar stump. Osseous fusion was seen in all the cases (mean fusion time 12.6 weeks). Two patients experienced transient numbness in the distribution of the dorsal branch of the ulnar nerve, which recovered spontaneously over time.

DISCUSSION

For symptomatic DRUJ dysfunction, Darrach procedure was a popular treatment option in past. However, this procedure is now mostly limited to low demanding elderly patients because of poor functional results, especially loss of grip strength, which Minami *et al.*¹⁸ reported to be decreased by 25% postoperatively. The S-K procedure has advantages over the Darrach procedure in preserving the ulnocarpal joint. Distal end of the ulna is an important structure for wrist stability as it provides the attachment site for ulnocarpal ligaments and triangular fibrocartilage complex which are stabilizers of the ulnocarpal joint and DRUJ.¹⁹ Shaaban *et al.*²⁰ reported in a cadaveric study that distal end of ulna

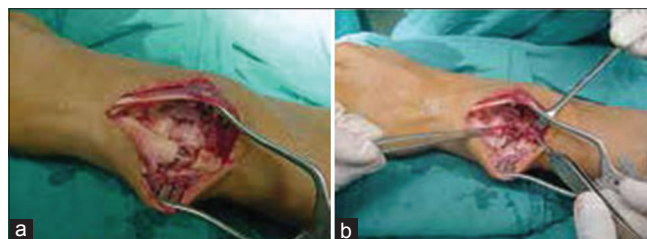


Figure 1: Perioperative photographs of procedure showing (a) Resected piece of ulna fixed with a screw between distal radius and distal ulnar stump. (b) Pronator quadratus muscle cut and drill holes were made in proximal and distal ulnar stumps to suture the muscle

Table 1: Mean preoperative and final follow-up values of Modified mayo wrist score

Sections of Modified Mayo Wrist Score	Preoperative (± SD)	Final follow-up (± SD)	<i>P</i>
Pain	8.75±7.41	22±2.51	<0.0001
Function	10.25±9.79	21.75±2.93	<0.0001
Pronation supination (°)	6.75±2.44	17.25±3.79	<0.0001
Grip strength (percentage of normal)	6.25±5.34	18.75±4.83	<0.0001
Total Modified Mayo Wrist Score	32±15.33	79.75±7.15	<0.0001

transmitted up to 34% of the axial load. Furthermore, the ulnar head acts as a pulley for extensor carpi ulnaris (ECU) tendon, which is the most important dynamic stabilizer of the wrist²¹ and release of ECU subsheath from its attachment on the distal ulna increases the excursion of the ECU tendon and leads to decreased grip strength.²² For these reasons, S-K procedure, which preserves distal end of ulna, provides better grip strength as compared to Darrach procedure. However, S-K procedure is not devoid of complications and problem of painful unstable ulnar stump has been described by authors after this procedure.^{13,23,24}

Several procedures for stabilizing ulna after Darrach procedure have been reported using ECU and flexor carpi ulnaris tendons.²⁵⁻²⁹ Gupta *et al.*³⁰ used double breasted slip of extensor retinaculum to stabilize the DRUJ. Use of pronator quadrates muscle as a stabilizer of proximal ulnar stump after Darrach procedure has also been described.^{31,32} Combination of the pronator quadrates muscle and the distally based extensor carpi tendon strip has also been described for the salvage of the failed Darrach procedure.³³ There is no evidence that one method is better than other. In our technique, we stabilized the proximal ulnar stump by using pronator quadrates muscle. Along with stabilization of the proximal ulnar stump, we also used the resected piece of ulna as a bony bridge between distal radius and ulna in addition to arthrodesis the DRUJ.

Fujita *et al.*¹⁶ in 2006 described a modification of S-K procedure where distal part of the ulna, including the ulnar head, was resected, rotated 90° and then mounted on the ulnar notch of the radius forming an artificial radial shelf. The authors reported that VAS (visual analog scale) score to assess wrist pain was resolved or significantly decreased after surgery. The mean total range of forearm rotation increased from 144° preoperatively to 167° on latest followup and the mean carpal translation index, measured radiologically, remained maintained. Ota *et al.*¹⁷ in 2013 reported satisfactory results with their own 1 modification of S-K procedure in which resected piece of ulna was used as a graft between ulnar head and ulnar notch of radius. The authors found that radioulnar width of the wrist, pseudarthrosis gap, and radioulnar distance were well maintained throughout the period. However no functional assessment was done. In our study we evaluated the results using Modified Mayo Wrist Score which improved significantly after surgery. In addition to this, the authors preserved the (ECU) tendon sheath attachment into the ulnar head and shaft, providing a dynamic stabilizing effect on the proximal stump. None of the authors used pronator quadrates muscle to stabilize the proximal ulnar stump.

Unlike the previously described techniques, we used the resected piece of ulna as interposition graft to form bony

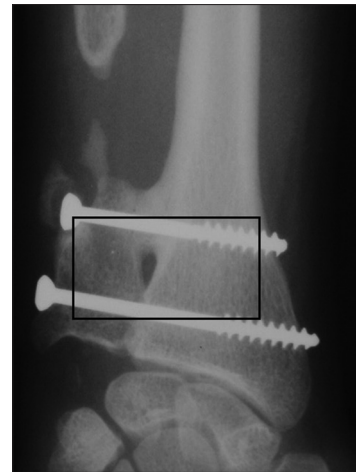


Figure 2: X-ray of wrist anteroposterior view showing “quadrangular-construct” formed by distal stump of ulna and radius fixed at two levels

bridge at a site proximal to DRUJ arthrodesis. The distal ulnar stump is fixed to radius at two points as compared to previous S-K procedures where it is fixed at single site. The “Quadrangular-construct” thus made provides bulky and stable ulnar stump [Figure 2]. We also used pronator quadrates muscle to stabilize the proximal ulnar stump.

Despite many modifications described in literature for S-K procedure, there is no data supporting one technique over other. We, in our new modification of S-K procedure, describe for the first time the combination of use of resected ulna as interposition graft to form a stable “Quadrangular-construct” at wrist joint along with the stabilization of proximal ulnar stump with pronator quadrates muscle.

CONCLUSION

In conclusion, modification of S-K procedure provides good functional results with stable proximal ulnar stump though further study is required to compare the results with other methods.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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