STABILIZATION OF THE PROXIMAL ULNAR STUMP IN THE SAUVÉ-KAPANDJI PROCEDURE BY USING EXTENSOR CARPI ULNARIS TENDON

-LONG-TERM FOLLOW-UP STUDIES-

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Running title: Stabilization of the stump in S-K procedure

Keywords: extensor carpi ulnaris tendon, stabilization, proximal ulnar stump, Sauvé-Kapandji procedure

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ABSTRACT

Purpose: The Sauvé-Kapandji (S-K) procedure is considered a useful treatment option for distal radioulnar disorders. However, postoperative instability of the proximal ulnar stump and radioulnar convergence may be symptomatic. We modified the Sauvé-Kapandji procedure by stabilizing the proximal ulnar stump with a half-slip of the extensor carpi ulnaris tendon. We previously reported 13 patients with this procedure at an average follow-up of 35 months; the patients had satisfactory clinical results and improved stability of the proximal ulnar stump as shown by x-ray examination. In this paper, we address the question of whether those clinical and radiographic results noted at an average follow-up of 35 months postoperativery are maintained at later follow-up examinations.

Methods: We reexamined 12 of the 13 original patients and compared their intial follow-up results with their current results after an average follow-up of 95 months. Results: The results of this series after 95 months were similar to those at 35-months. These overall results suggest that the clinical and radiographic results at 35-month follow-up were maintained at the final follow-up visit.

Conclusions: Our results in this paper suggested that the clinical radiographic results at the 35-month follow-up were maintained in the long-term 95-month follow-up despite the finding that the hole in the proximal ulnar stump had broken in three wrists at follow-up.

INTRODUCTION

The Sauvé-Kapandji (S-K) procedure is considered a useful treatment option for distal radioulnar disorders.[1-3] Satisfactory clinical results have been obtained in most reports, however, instability of the proximal ulnar stump and radioulnar convergence have caused problems similar to those seen after Darrach's procedure at average follow-up periods ranging from 29 to 96 months in several papers. [3-6] Instability of the proximal ulna allows convergence of the ulna and radius. Narrowing of the interosseous space allows impingement of the proximal ulnar stump on the distal radial metaphysis. This may cause a painful snapping on rotation, limitation of motion, loss of strength and occasional bony erosion.

We developed a modification of the S-K procedure to use in the treatment of osteoarthritis (OA) of the distal radioulnar joint (DRUJ). We used a half-slip of the extensor carpi ulnaris (ECU) tendon to stabilize the proximal ulnar stump.[7] We reported our results with the first 13 patients at a mean average follow-up of 35 months. The clinical results were satisfactory and x-ray examination suggested the ECU tendon slip provided a stabilizing effect on the proximal ulnar stump in most of the patients. We concluded that in the treatment of DRUJ osteoarthritis stabilization of the proximal ulnar stump with a portion of the ECU tendon should be added to the S-K procedure. [7]

We address here the question of whether clinical and radiographic results noted 35 months after the procedure are maintained at later follow-up examinations. To answer this question, we compared the 35-month follow-up results with our current results obtained an average of 95 months after the procedure in the same patients.

PATIENTS AND METHODS

We previously reported the results of 13 wrists with OA of the DRUJ treated by a modified S-K procedure.[7] Twelve of the 13 wrists of that first group were available for recheck examination. One female patient was lost to follow-up. The average age of the patients was now 57 (range, 33-74) years. There were eight men and four women. The length of the follow-up period averaged 95 (range, 72-131) months. All the wrists were diagnosed as OA of the DRUJ (eight primary and four traumatic). Rheumatoid arthritis and other diseases of the DRUJ were excluded. X-rays were obtained from the last follow-up examination for each patient.

Preoperatively, all patients complained of pain in the wrist joint (particularly on forearm rotation), limitation of forearm pronosupination, limitation of wrist extension-flexion, weakness of grip strength, and wrist instability. Tears of the triangular fibrocartilage complex were identified intraoperatively in all wrists.[8]

We evaluated the clinical results on the following criteria; pain, range of motion (wrist flexion-extension and forearm pronation-supination), grip strength, and return to work status. Pain was graded as no pain, slight pain (cold weather exacerbation), mild (no effect on activity), moderate (affects activity), and severe (frequent pain with light activity).

To evaluate the radiographic findings, standard posteroanterior and lateral x-ray films were obtained before and after surgery. Ulnar variance was determined by measuring the distance between lines tangential to the articular surface of the lunate fossa of the radius and the distal articular surface of the ulnar head, which are perpendicular to the longitudinal axis of the forearm.[9]

Radioulnar convergence was determined by comparison of the changes in alignment and distance between the radius and ulna from their preoperative to their postoperative status. The interosseous distance between the radius and ulna at the level of the distal end of the proximal ulnar fragment was measured on the posteroanterior films as described by Nakamura et al.[4] Dorsolpalmer alignment on the lateral x-ray view was assessed as the perpendicular distance between the dorsal cortices of the radius and ulna at the point of ulnar resection on a true lateral view.[7] The measured point at the preoperative lateral x-ray film, which corresponded to the proximal ulnar stump after the S-K procedure , was estimated retrospectively. An accurate lateral view was defined as the overlapping of the tangents to the palmar cortex of the scaphoid tuberosity and palmar cortex of the capitate. The lateral views were deemed suitable for recording in all cases. If the ulnar stump lay dorsal to the radius a positive value was assigned.

Statistical analysis was calculated using a paired student's t-test.

Surgical Procedure

We performed the modified S-K procedure according to a method previously described.[3,7] A small segment of the ulnar shaft and its periosteum was resected proximal to the ulnar head. The corresponding articular surfaces of the distal radioulnar joint were decorticated. The resected fragment of the ulna was sculpted to fit into any remaining space between the ulnar head and sigmoid notch. These elements were then fixed by a Kirschner-wire and a 3-mm cacellous bone screw.

Then, the stabilization of the proximal ulnar stump was performed by the method described previously.[7] A 3.5-mm hole was drilled from the dorsoulnar aspect of the ulnar shaft into the intramedullary cavity. The ECU tendon was split in the central sulcus and the radial half was released at the ulnocarpal level. It was then reflected proximally, leaving it attached at the musculotendinous junction. This proximally based strip, approximately six to eight cm long, was then passed into the medullary canal through the drill hole, retrieved at the distal stump of the ulna, pulled distally under moderate tension, and then sutured back on itself in an interlacing fashion.

A long arm splint was applied for two weeks postoperatively, after which gentle active motion of the wrist and forearm was encouraged. Full motion of the wrist was allowed after bony fusion of the radioulnar joint was confirmed on x-ray films. The Kirschner-wire left in most cases, however, it was removed when skin irritation appeared at the tip of the wire. The Kirschner-wire was removed in two cases, one year and two years after the S-K procedure.

RESULTS

Clinical Results

Pain

All 12 patients complained of pain before surgery (nine severe and three moderate). The severity of the pain had impoved in all patients at the 35-month follow-up examination and pain had been rated as follows; moderate in one patient, slight in four, and absent in seven. At the final follow-up visit (at an average of 95 months after the modified S-K procedure), pain was rated as moderate in one patient, slight in three, and absent in eight.

Motion (Table)

The preoperative range of motion of the affected wrist averaged 47° ±19° (standard error) in extension and 42° ±15° in flexion. At the 35-month follow-up examination, extension averaged 56° ±15° and flexion 50° ±13° . These improvements were not statistically significant. After an average of 95 months, extension averaged 53° ±15° and flexion 48° ±13° .

The preoperative forearm motion averaged 68° ±25° in pronation and 63° ±22° in supination. At the 35-month follow-up examination, pronation averaged 81° ±10° and supination 77° ±15° . Both postoperative improvements were statistically significant ($p < 0.05$). After an average of 95-month follow-up, pronation averaged 78±10° and supination 78° ±14° .

There were no statistical significances with regard to range of motion (wrist extension flexion and forearm pronation-supination) between the 35-month and the 95-month follow-up examinations.

Grip strength (Table)

The preoperative grip strength of the affected wrist averaged 19±13kgf (61% of the contralateral side). After surgery, grip strength of the affected wrist at the 35-month follow-up visit averaged 29±15kgf (90%). All wrists had an increased grip strength over the preoperative value with a statistical value ($p < 0.005$). At an average of 95 months after the procedure, grip strength averaged 29±15kgf. This comparison suggests that the postoperative results at 35 months were maintained at 95 months.

Work status

Eleven patients returned to their previous occupations. One patient returned to light work, but had no difficulty with functions of daily living and his avocation at the time of 35-month follow-up examination. At an average of 95-month after the procedure, one patient retired from his occupation. However, ten patients continued the same occupation including that of house keepers.

X-ray Evaluations

Eleven of the 12 wrists had a positive ulnar variance with an average of 3.3mm (range, 2-8mm), preoperatively. Postoperative ulnar variance averaged +0.2mm (range,-1-+1mm).

Arthrodesis of the DRUJ was confirmed by x-ray examination in all wrists within 10 weeks postoperatively. The preoperative radioulnar distance averaged 13.9±3.1mm. The postoperative distance at 35-month follow-up examination measured 13.3±3.2mm. There was no statistical significance between them. At an average of 95-month after the procedure, the radioulnar distance was 12.1±4.0mm. The proximal ulnar stump did not impinge on the radius directly in any instance. At final follow-up, the proximal ulnar stump

had tapered proximally and hypertrophied distally in all cases. These results suggested that postoperative radioulnar convergence was diminished or prevented even after a long-term follow-up.

The preoperative measures of the dorsopalmar distance showed a +6.0±4.1mm while the postoperative measures at 35-month follow-up examination averaged +0.8±2.1mm. There was a statistical significance between them ($p < 0.01$). At the 95-month follow-up evaluation the postoperative measures showed +1.5±2.4mm. There was no statistical significance between values at 35 and 95-month follow-up examinations although there was slight tendency of dorsalward migration of the proximal ulnar stump at the final follow-up. These results suggested that stabilization procedure had a positive effect on reduction of the dorsal subluxation of the proximal ulnar stump after the S-K procedure.

Breakage of the drilled hole was found in three wrists at 95-month follow-up examination. However, the instability of the proximal ulnar stump was not marked in these three wrists.

These overall results suggest that the clinical and radiographic results at 35-month follow-up were maintained at the final follow-up visit.

CASE REPORT

A 37-year-old man had increasing pain in the patient's right wrist, associated with work without any trauma. The patient was seen in a clinic and diagnosed as an ulnar impingement syndrome. Although six-month conservative treatments including splintage and injections of corticosteroids were applied, pain was not improved. The wafer's procedure was performed by the open method. Operative findings revealed that there were chondromalacia of the ulnar head and the proximal articular surface of the lunate; and moderate degenerative changes on the DRUJ. However, there were no improvements. The patient was first seen in our clinic on September 1994. Preoperative x-ray film showed slight osteoarthritis of the DRUJ and neutral ulnar variance(Figure 1A). Pain was graded as severe. The patient had 30° extension and 40° flexion at the wrist, with 70° pronation and 30° supination of the forearm. Grip strength of the right wrist was 15 kgf (left, 45kgf). The modified S-K procedure with stabilizing the proximal ulnar stump with a half-slip of the extensor carpi ulnaris tendon was performed on October 1994 (Figure 1B). The postoperative course was uneventful. Bone union between the radius and ulna occurred eight weeks after the procedure. The patient had complete pain relief six months after the procedure. X-ray film three years and five months after the procedure showed well alignment of the proximal ulnar stump without any convergence toward the radius (Figure 1C). Eight years and six months after the procedure, the range of motion was 70° extension and 60° flexion of the wrist and 80° pronation and 90° supination of the forearm. Grip strength increased to 40kgf. X-ray examination demonstrated that the pseudathrosis gap of the ulna was well preserved and alignment of the proximal ulnar stump was acceptable (Figure 1D).

DISCUSSION

The S-K procedure has a reputation of being a reliable and effective method of dealing with distal radioulnar disorders.[1-7,10,11] Smet and Ransbeeck reported the outcome of the S-K procedure for posttraumatic wrist disorders. Eighty-four patients were treated, all with posttraumatic disorders of the DRUJ. There was significant pain decrease and high patient satisfaction (74%). The postoperative range of motion improved in the flexion / extension arc and pronation / supination arc with a statistical significance.[12] We also reported our clinical results of the S-K procedure performed in 13 patients with primary and secondary OA of the DRUJ.[3] Postoperative pain relief was good in all wrists. Postoperatively, the flexion / extension arc improved although there have been no statistical significance compared with the preoperative values. There was a postoperative statistical improvement of the pronation / supination arc.

On x-ray examination we saw some evidence of unstable proximal ulnar stumps and radioulnar convergence in all patients similar to that associated with the Darrach's procedure.[3,4] We reported that the postoperative x-ray evaluation showed an unstable proximal ulnar stump and radioulnar convergence in 12 out of 13 wrists.[3] Dorsal and radial instability of the proximal ulnar stump may be a major complication of the S-K procedure.

Several procedures have been proposed to improve the stability of the proximal ulnar stump following the S-K procedure.[7,13-16] We developed a stabilization procedure for the S-K procedure as a result of our early experience in the treatment of OA of the DRUJ. We use a half-slip of the ECU tendon as a dynamic tether to the proximal ulnar stump.[7]

Postoperative x-rays in our late series show improved alignment in both coronal and lateral planes.

Our method is very simple and doesn't require extension of the operative field. We have extended our surgical indications from OA of the DRUJ to other radioulnar disorders on the basis of our results to date, but these results will be followed further to see if the beneficial results persist.

We wondered whether the postive clinical and radiographic results seen in a short follow-up period would persist into long-term follow-ups. Our results treated in this paper suggested that the clinical and radiographic results at the 35-month follow-up were maintained in the long-term 95-month follow-up despite the finding that the hole in the proximal ulnar stump had broken in three wrists at follow-up.

This result suggest that this procedure is useful and reliable in preventing the development of an unstable proximal ulnar stump following the S-K procedure.

ACKNOWCEDGEMENT

The authors thank Ronald L. Linscheid, MD, Professor Emeritus, Surgery of the Hand, Department of Orthopaedics, Mayo Clinic, Rochester, MN, for his suggestions and during this investigation.

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FIGURE LEGENDS

Figure 1. (A) Preoperative x-ray film showed slight osteoarthrotis of the distal radioulnar joint and a neutral ulnar variance. Ulnar head had been removed partly by a wafer's procedure.

(B) Posteroanterior x-ray film two weeks after the modified Sauvé-Kapandji procedure with stabilizing the proximal ulnar stump with a half-slip of the extensor carpi ulnaris tendon.

(C) Posteroanterior x-ray film three years and five months after the procedure showed well alignment of the proximal ulnar stump without any convergence toward the radius.

(D) Posteroanterior x-ray film eight years and six months after the procedure showed that the pseudarthrosis gap of the ulna was well preserved and stability of the proximal ulnar stump was also preserved although the proximal ulnar stump was tapered.

Table: Comparison of Clinical Results at 35- and 95-month Follow-ups (n=12)

		Preoperative	At 35-month follow-up	At 95-month follow-up
Motion (degrees)				
Wrist	Extension	47±19*	56±15	53±15
	Flexion	42±15	50±13	48±13
Forearm	Pronation	68±25	81±10	78±10
	Supination	63±22	77±15	78±14
Grip strength(kgf)		19±13	29±15	29±15

*Average ± Standard Error