

# Sauvé-Kapandji Procedure with Limited Wrist Fusion for Disorders of the Distal Radioulnar Joint in Patients with Rheumatoid Arthritis

Khaled M. Abu-Elnasr

Department of Orthopaedic Surgery, Faculty of Medicine, Suez Canal University, Egypt

## Abstract

**Background:** The wrist is affected in as many as 95% of patients who have rheumatoid arthritis (RA). Involvement of the distal radioulnar joint leads to dorsal dislocation of the ulnar head that can cause pain, weakness, decreased forearm rotation, and rupture of the extensor tendons. When there is arthritis of the radiocarpal joint the problem become worthy. **Aim:** to assess the results of Sauvé-Kapandji procedure with limited wrist fusion in improving the wrist function in patients with RA. **Patients and Methods:** This operation was performed in seventeen wrists in seventeen consecutive patients with RA in whom Sauvé-Kapandji procedure was done in the inferior radioulnar joint with limited radiolunate fusion. **Results:** fifteen patients had no pain in the region of the distal radioulnar joint. Osseous union was achieved in all cases. The average time to osseous union was 8.7 weeks. The visual analog scores decreased from a mean of 7.2 before the operation to 2.0 after the operation ( $p < 0.01$ ). **Conclusion:** Sauvé-Kapandji procedure with limited wrist fusion significantly improves the wrist functions in patients with RA.

**Keywords:** Rheumatoid arthritis, Sauvé-Kapandji, limited wrist fusion

## Introduction

Rheumatoid arthritis (RA) is the most common systemic inflammatory disease with a worldwide prevalence of approximately 1% and an incidence rate of 0.03%<sup>(1)</sup>. The majority of patients develop RA between the ages of 30 and 60 years. RA is a chronic, systemic autoimmune disease that is characterized by an immunologically caused chronic inflammatory synovitis. The wrist, as one of the main targets in RA<sup>(2,3)</sup>, plays a key role in the chain of the articulations in the upper extremity. Three main factors play an important role in the pathologic process of wrist deformation: cartilage destruction, synovial expansion, and

ligamentous laxity. Synovial expansion causes stretching of the retaining extrinsic and intrinsic ligaments of the wrist, thus causing carpal supination and ulnar translation. With progressive ligamentous laxity, a dorsal subluxation of the ulna or, even more frequently, a palmar subluxation of the carpus occurs. The kinematics of the distal radioulnar joint change with a displacement of the center of rotation. Involvement of the distal radioulnar joint leads also to dorsal dislocation of the ulnar head that can cause pain, weakness, decreased forearm rotation, and rupture of the extensor tendons<sup>(4)</sup>. Resection of the distal part of the ulna has provided one surgical approach for the treatment of this

disorder. Reported operative problems associated with resection of the distal part of the ulna included distal ulnar instability, extensor tendon rupture, ulnar translation, weakness, and wrist pain. The Sauvé-Kapandji procedure is an alternative surgical solution<sup>(5,6)</sup>, with good reported results following the use of this procedure for the treatment of rheumatoid arthritis<sup>(7)</sup>. The expected natural course of the disease at the radiocarpal level has great implications for the decision of which surgical procedure should be performed. A review of the literature shows good clinical results and high patient satisfaction for limited wrist fusion in rheumatoid patients. The range of motion varies postoperatively, but, on average, is reported to be in functional range<sup>(8)</sup>. In this study, patients with RA of the wrist joint were treated by the Sauvé-Kapandji procedure combined with radiolunate fusion to give stability and reduce pain around the wrist joint.

## Patients and Methods

This operation was performed in seventeen wrists in seventeen consecutive patients between April 2008 and October 2011. The study group included ten men and seven women. Fourteen wrists were on the right side, and three were on the left. The average age at the time of the operation was 62 years. The average duration of rheumatoid disease was 10.2 years, and the average duration of follow-up was thirteen months. Patients were considered to be candidates for the procedure if they had pain that was localized to the distal radioulnar joint, decreased rotation of the forearm, and radiographic evidence of degenerative changes or instability, subluxation, or dislocation of the distal radioulnar joint and wrist joint. Pain in the radioulnar joint that was elicited by ballottement of the head of the ulna and pain in the radiocarpal or ulnocarpal

joint and when there was the destruction of the sigmoid notch and part of the lunate fossa of the radius. The pain was rated as mild if it occurred at the extremes of the active range of motion and did not bother the patient or interfere with the activities of work or daily living, moderate if it occurred during strenuous manual labor or caused some alteration in work activities, but did not interfere with the activities of daily living, and severe if it occurred during the activities of daily living or at rest. Preoperatively, all patients had a limited rotation of the forearm and had pain in the region of the distal radioulnar joint that was elicited by rotation of the forearm. The pain was rated as severe in fifteen patients and as moderate in two. In addition, patients also had pain at the radiocarpal level that was elicited by flexion and extension of the wrist; it was rated as severe in fourteen patients and as mild in three.

## Operative Technique

A longitudinal skin incision was made over the dorsal aspect of the wrist joint; the sixth dorsal compartment of the wrist was dissected subperiosteally and retracted toward the radius. The pretendinous retinaculum was exposed and incised, and the distal aspect of the ulna was exposed subperiosteally. A ten-millimeter segment of the distal end of the ulna was marked for resection, leaving room for the placement of screw distally. An oscillating saw was used to divide the ulna at the proximal end of the segment to be removed, and the distal fragment was levered out. The dorsal aspect of the capsule of the distal radioulnar joint was incised, and cartilage from the articular surfaces of the sigmoid notch and the ulnar head was denuded down to cancellous bone. The distal osteotomy then was completed, periosteum in the region of the gap was meticulously resected, and the region was thoroughly irri-

gated to remove bone debris. These measures were performed to prevent the formation of ectopic bone in the gap that was created after resection of the segment of the ulna. The ulnar head was temporarily fixed to the sigmoid notch of the distal part of the radius with a single Kirschner wire. Image intensification was used to ensure fixation in a position of neutral ulnar variance. Both cortices of the ulnar neck and the near cortex of the radius were predrilled, and a 3.5-millimeter cortical-bone screw was inserted. The lag-screw technique should not be used for this screw in order to avoid tilting the head of the ulna, which must remain parallel to the long axis of the ulnar shaft. The wrist joint is then opened with a longitudinal incision in the axis of the capitate, and two triangular flaps were raised from the radius, after the access to the radiolunate articulation, a complete synovectomy was performed. radiolunate fusion was done with the destruction of the radiolunate fossa with at least some preservation of the radioscaphoid fossa. In cases of complete destruction of the radiocarpal joint and preservation of the midcarpal joint, radio-scapholunate fusion was done and the patient was excluded from the study. The remaining cartilage was removed from the radiolunate joint to the subchondral cancellous bone, maintaining the curvature of both articulating elements to allow better matching of the lunate with the radius. The fluoroscopic radiographic examination was performed to confirm the correct position of the lunate in all planes. The internal fixation was performed with a 2-mm mini plate. The wrist capsule was closed in such a way that the implants were completely covered.

#### *Postoperative Management*

The patient was allowed to perform gentle forearm rotation exercises in a volar below-

the-elbow splint immediately after the operation. Two weeks postoperatively, the sutures were removed, the patient was fitted with a removable orthosis for the wrist, and physical therapy was begun with active forearm-rotation exercises. The wrist splint was removed when there was radiographic evidence of fusion.

#### *Evaluation*

For the assessment of the results at the time of the latest follow-up, the wrist-scoring system of the Mayo Clinic <sup>(9)</sup> was used, with residual pain, functional status, range of motion, and grip strength given a maximum of 25 points each (Table 1). A score of 90 to 100 points indicates an excellent result; 80 to 89 points, a better result; 65 to 79 points, a fairer result; and less than 65 points, a poor result. Radiographs made in the early postoperative period and at the time of the latest follow-up were evaluated for evidence of the union at the site of the arthrodesis, ulnar variance, ossification at the site of the resection, resorption of bone in the ulnar stump, and progressive degenerative changes in the radiocarpal joint.

#### *Statistical Methods*

The primary analysis outcome was the rate of successful union among the seventeen patients in the study. Paired t test was used for all statistical analyses, and the level of significance was set at  $p < 0.01$ .

## **Results**

At the recent follow-up examination, 15 patients had no pain in the distal radioulnar joint and 2 patients had mild pain with rotation of the forearm. Preoperatively, all patients with radiographic degenerative changes in the radiocarpal joint had pain with flexion and extension of the wrist. Postoperatively, 2 patients had mild pain secondary to progressive degenerative osteo-

arthrosis of the radio-carpal joint, osseous union was achieved in all cases.

**Table 1:** Modified Wrist-Scoring System of Mayo Clinic<sup>(9)</sup>

Category	Score points	Findings
Pain	25	- None
	20	- Mild, occasional
	15	- Moderate, tolerable
	0	- Severe or intolerable
Functional status	25	- Return to regular employment
	20	- Restricted employment
	15	- Able to work, but unemployed
	0	- Unable to work because of pain
Pronation-supination	25	- >170 degrees
	15	- 141-169 degrees
	10	- 101-140 degrees
	5	- 61-100 degrees
	0	- <60 degrees
Grip strength (% of that on normal side)	25	- 100 percent
	15	- 75-99 percent
	10	- 50-74 percent
	5	- 25-49 percent
	0	- 0-24 percent

The average time to osseous union was 8.7 weeks. The visual analog scores decreased from a mean of 7.2 before the operation to 2.0 after the operation ( $p < 0.01$ ). Fifteen patients had no subjective or objective findings of instability of the ulnar stump. Another one patient had unstable stump had moderate pain that appeared to be related to ossification in the resected area. One patient had multidirectional instability of the distal radioulnar joint before the operation had moderate pain and volar instability of the ulnar stump immediately after the operation. Three patients had mild tenderness at the tip of the stump, but they had good rotation of the forearm and no radiographic evidence of impingement between the ulnar stump and the radius. The mean supination had improved from 16 degrees preoperatively to 76 degrees at the time of follow-up. The mean pronation

had improved from 42 degrees preoperatively to 81 degrees at the time of follow-up. One patient had a neuroma of the dorsal sensory branch of the ulnar nerve, one patient had hypoesthesia without a neuroma, carpal tunnel syndrome reported in one patient. According to the wrist-scoring system of the Mayo Clinic fifteen patients had excellent results postoperatively and two patients had good results as there was still pain postoperatively due to advanced osteoarthritis of the wrist and inferior RA joint (Table 2).

**Table 2:** Postoperative results according to modified wrist- scoring system of the mayo clinic

	Excellent	Good	Fair	Total
Preoperative	0	1	16	17
Postoperative	15	2	0	17

## Discussion

Rheumatoid arthritis, characterized by hypertrophic synovitis that eventually destroys the cartilage of joints, erodes and rupture tendons, compresses adjacent nerves, and dislocates and erodes the joint itself, is one of the most painful chronic rheumatic diseases. It can cause such grotesque deformities of the wrist that the patient may be reluctant to be seen in public<sup>(10)</sup>. The synovial expansion may cause bony erosion, particularly at the sites of vascular penetration of bone, such as in the radial origin of the Testut ligament. These erosions cause sharp bony edges, which might lead to tendon rupture. In addition, synovial expansion causes stretching of the retaining extrinsic and intrinsic ligaments of the wrist, thus causing carpal supination and ulnar translation<sup>(11)</sup>. The stretching of the scapholunate ligament results in a scapholunate dissociation, whereas more global laxity and instability are responsible for the ulnar translation<sup>(12)</sup>.



**Figure 1:** Sixty-three years patient had RA affecting both inferior radioulnar and radiocarpal joint.



**Figure 2:** One and half year after Sauvé-Kapandji and limited wrist fusion.

Youm et al<sup>(13)</sup> in describing the carpal height ratio, measured rheumatoid wrists and summarized the aforementioned pathomechanical effects, which create a

reduction of the carpal height. Parallel to the processes at the radiocarpal and midcarpal joints, the distal radioulnar joint undergoes pathologic changes, which were first described by Backdahl<sup>(14)</sup>, and subsequently were called the *caput ulnae syndrome*. The ulnar side of the wrist is often the first place of significant synovitis in the rheumatoid wrist. Long-term prognosis, however, is determined by the progression of the disease at the radiocarpal level. Together with progressive ligamentous laxity, a dorsal subluxation of the ulna or, even more frequently, a palmar subluxation of the carpus occurs. An associated supination of the carpus causes a luxation of the extensor carpi ulnaris (ECU), a major stabilizer of the ulnar side of the wrist and the distal ulna.

A chronically unstable distal radioulnar joint can be treated with several different procedures depending on the abnormalities. These procedures include repair of a nonunion of the ulnar styloid process, repair of the triangular fibrocartilage complex, reconstruction of the radioulnar ligaments, tenodesis of the ulna to the carpus, and a variety of radioulnar sling procedures<sup>(15)</sup>. conventional Sauvé-Kapandji procedure to treat disorders of the distal radioulnar joint in patients with rheumatoid arthritis was previously described. Simmen and Huber<sup>(16)</sup>, in a study of patients with rheumatoid arthritis who had not had an operation on the wrist joint, reported that the amount of ulnar translation of the carpal bones over a period of ten years ranged from 3.8 mm in patients with stable forms of the disease to 9.5 mm in those with unstable forms of the disease. Van Gemert and Spauwen<sup>(17)</sup>, in a study of patients with rheumatoid arthritis who had unilateral resection of the distal part of the ulna, reported that the average amount of ulnar translation of the carpal bones was 5.3 mm in the treated wrist compared with 3.7 mm

in the untreated wrist after an average of 6.2 years. Several investigators have reported good results with the Sauvé-Kapandji procedure in patients who had a painful subluxated or dislocated distal radioulnar joint with a history of rheumatoid arthritis<sup>(18,19)</sup>. However, as Bowers<sup>(15)</sup> pointed out, the Sauvé-Kapandji procedure shares with the Darrach procedure the undesirable feature of a potentially unstable ulnar stump. Taleisnik<sup>(25)</sup> reviewed the results of the Sauvé-Kapandji procedure in twenty three patients who had derangement of the distal radioulnar joint. He noted that nine patients had some degree of pain related to the ulnar stump and two patients needed a repeat operation because of instability of the ulnar stump. Furthermore, patients who had preoperative instability, dorsal subluxation, or dislocation of the ulna were more likely to have postoperative problems with instability of the ulnar stump. In the present study, one patient had a painful ulnar stump postoperatively. This patient had marked instability in his RA joint preoperatively. The concept of partial fusion in rheumatoid wrists was first described by Chamay et al<sup>(20)</sup> and later by Linscheid and Dobyns<sup>(21)</sup>. Chamay et al<sup>(20)</sup> applied their observation of spontaneous radiolunate fusion with preserved functional range of motion and long-term stability to the treatment of rheumatoid deformities. The idea of limited fusion in the rheumatoid wrist includes the realignment of the subluxed carpus by reduction of the proximal carpal row combined with long-term stability. In cases of excessive radiocarpal damage, the concept of limited wrist fusion might be expanded to a radioscapulohunate fusion<sup>(22)</sup>. A review of the literature shows good clinical results and high patient satisfaction for limited wrist fusion in rheumatoid patients. The range of motion varies postoperatively, but, on average, is reported to be in func-

tional range<sup>(23,24,26)</sup>. In a study done by Chamy et al<sup>(20)</sup> on patients with advance RA of the wrist joint treated by limited radiolunate fusion he had good functional results in the improvement of the pain markedly post operatively. In this study limited radiolunate fusion was done in combination with Sauvé-Kapandji procedure to treat carpal instability associated with instability and painful distal radioulnar joint in patients with RA. Our results support the conclusion reached by other investigators that the Sauvé-Kapandji procedure is an excellent salvage operation for the treatment of derangement of the distal radioulnar joint in RA patients. If limited wrist fusion was also done to treat carpal instability a more stable, less painful wrist will be obtained in patients with RA. The present study of seventeen wrists demonstrated marked pain reduction, an improvement in forearm rotation, and prevention of ulnar translation of the carpal bones after a minimum duration of follow-up of three years.

## References

1. Alarcón GS. Epidemiology of rheumatoid arthritis. *Rheum Dis Clin North Am* 1995;21 (3): 589–604.
2. Wei N, Delauter SK, Beard S, Erlichman MS, Henry D. Office-based arthroscopic synovectomy of the wrist in rheumatoid arthritis. *Arthroscopy* 2001;17 (8): 884–887.
3. Hamalainen M, Kammonen M, Lehtimäki M. Epidemiology of wrist involvement in rheumatoid arthritis. *Rheumatology* 1992;17:1–7.
4. Lamey DM, Fernandez DL. Results of the modified Sauvé-Kapandji procedure in the treatment of chronic posttraumatic derangement of the distal radioulnar joint. *J Bone Joint Surg Am.* 1998;80 (12):1758–1769.
5. Chantelot C, Fontaine C, Flipo RM, Migaud H, Le Coustumer F, Duquenois A. Synovectomy combined with the Sauvé-

- Kapandji procedure for the rheumatoid wrist. *J Hand Surg Br.* 1999;24 (4):405-409.
6. Millroy P, Coleman S, Ivers R. The Sauvé-Kapandji operation. Technique and results. *J Hand Surg Br.* 1992;17 (4):411-414.
  7. Vincent KA, Szabo RM, Agee JM. The Sauvé-Kapandji procedure for reconstruction of the rheumatoid distal radioulnar joint. *J Hand Surg Am.* 1993;18 (6):978-983.
  8. Flury MP, Herren DB, Simmen BR. Rheumatoid arthritis of the wrist. Classification related to the natural course. *Clin Orthop Relat Res.* 1999;366:72-77.
  9. Bradway JK, Amadio PC, Cooney WP. Open reduction and internal fixation of displaced, comminuted intra-articular fractures of the distal end of the radius. *J. Bone and Joint Surg AM,* 1989;71 (6): 839-847.
  10. Cush JJ, Lipsky PE. Cellular basis for rheumatoid inflammation. *Clin Orthop Relat Res* 1991;265 :9-22.
  11. Shapiro JS. The wrist in rheumatoid arthritis. *Hand Clin* 1996;12 (3): 477-498.
  12. Ritt MJ, Stuart PR, Berglund LJ, Linscheid RL, Cooney WP 3rd, An KN. Rotational stability of the carpus relative to the forearm. *J Hand Surg Am* 1995;20 (2):305-311.
  13. Youm Y, McMurthy RY, Flatt AE, Gillespie TE. Kinematics of the wrist. I. An experimental study of radial-ulnar deviation and flexion-extension. *J Bone Joint Surg Am* 1978;60 (4):423-431.
  14. Backdahl M. The caput ulna syndrome in rheumatoid arthritis: a study of the morphology, abnormal anatomy and clinical picture. *Acta Rheumatol Scand suppl* 1963; 5:1-75.
  15. Bowers WH. The distal radioulnar joint. In: Green DP (ed) *Operative hand surgery*, 3rd ed. New York: Churchill. Livingstone, 1993:973-1019.
  16. Simmen BR, Huber H. The rheumatoid wrist: a new classification related to the type of the natural course and its consequences for surgical therapy. In: Simmen BR, Hagena F, editors. *The wrist in rheumatoid arthritis.* Basel, Karger; 1992. p 13-25.
  17. Van Gemert AM, Spauwen PH. Radiological evaluation of the long-term effects of resection of the distal ulna in rheumatoid arthritis. *J Hand Surg Br.* 1994;19 (3):330-333.
  18. Sanders RA, Frederick HA, Hontas RB. The Sauve-Kapandji procedure: a salvage operation for the distal radioulnar joint. *J. Hand Surg. Am.* 1991; 16 (6): 1125-1129.
  19. Rothwell AG, O'Neill L, Cragg K. Sauvé-Kapandji procedure for disorders of the distal radioulnar joint. A simplified technique. *J Hand Surg Am.* 1996;21 (5):771-777.
  20. Chamay A, Della Santa D, Vilaseca A. Radiolunate arthrodesis. Factor of stability for the rheumatoid wrist. *Ann Chir Main* 1983;2 (1):5-17.
  21. Linscheid RL, Dobyns JH. Radiolunate arthrodesis. *J Hand Surg Am* 1985;10 (6 pt 1):821-829.
  22. Nalebuff EA, Garrod KJ. Present approach to the severely involved rheumatoid wrist. *Orthop Clin North Am* 1984;15 (2):369-380.
  23. Minami A, Kato H, Iwasaki N, Minami M. Limited wrist fusions: comparison of results 22 and 89 months after surgery. *J Hand Surg Am* 1999;24 (1):133-137.
  24. Rittmeister M, Kandziora F, Rehart S, Kerschbaumer F. Radio-lunar Mannerfelt arthrodesis in rheumatoid arthritis. *Handchir Mikrochir Plast Chir* 1999;31 (4):266-273.
  25. Taleisnik J. *The wrist.* New York: Churchill Livingstone; 1985. p 329-334.
  26. Rehak DC, Kasper P, Baratz ME, Hagberg WC, McClain E, Imbriglia JE. A comparison of plate and pin fixation for arthrodesis of the rheumatoid wrist. *Orthopedics* 2000;23 (1):43-48.