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ORIGINAL ARTICLE

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Clinical and radiological manifestations of the rheumatoid wrist after the Sauvé–Kapandji procedure

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Abstract A retrospective study was performed to investigate the clinical and radiological results of the Sauvé–Kapandji (S–K) procedure for the rheumatoid wrist. One hundred and eight rheumatoid wrists in 98 patients were operated on in our institute from 1992 to 2000, and in 82 wrists we used the S–K procedure. In other cases, synovectomy alone was performed on 16 wrists, and partial and total arthrodeses were performed concurrently on 5 wrists each. Carpal bones and/or radiocarpal joints in which the union could not be assessed radiologically were found in 49 wrists (59.8%) after the S–K procedure, and among them there was definite nonfusion of the carpal bone and radiocarpal joints in 29 wrists (35.4%). However, definite fusion of carpal bones and/or radiocarpal joints was found in 33 wrists (40.2%). The formation of carpal bones and partial radiocarpal fusion with some mobility was detected in some cases. Therefore, the S–K procedure may stabilize the carpus in the rheumatoid wrist to some extent while maintaining a functionally important range of motion and relieving pain. However, it does not stop the disease process and cannot reestablish or maintain carpal height. We concluded that the S–K procedure is the treatment of choice for the rheumatoid wrist, and if the wrist is unstable, as seen with arthritis mutilans, we then perform either radiolunate partial arthrodesis or total wrist arthrodesis.

Key words Arthrodesis · Rheumatoid wrist · Sauvé–Kapandji (S–K) procedure · Synovectomy

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Introduction

The rate of deformities in the wrist joint is highest in cases of rheumatoid arthritis (RA) from an early stage. The treatment of a hand with RA has not changed significantly in the past few years. Early synovectomy has been reintroduced as a valuable technique, and the need for an approach to disease management has been emphasized. Several authors have stressed the importance of rigid surgical fixation of the wrists to improve clinical symptoms.

Patients with a derangement of the distal radioulnar joint can also benefit from the Sauvé–Kapandji (S–K) procedure. The aim of synovectomy combined with the S–K procedure is to obtain a stable painless wrist, while retaining enough mobility for function.[1] At our institute, we mainly use the S–K procedure to maintain the range of motion in patients with rheumatoid wrists, as well as to prevent ulnar deviation and promote stability of the radiocarpal joint.[2] However, we have some patients who have slight ulnar deviation of the proximal carpal row after the S–K procedure. Moreover, we have experienced spontaneous arthrodesis of the wrist in other patients even after the same procedure. To confirm these clinical results, we examined the clinical and radiological manifestations of these patients after the S–K procedure.

Patients and methods

We examined 108 wrists in 98 patients with RA whose postoperative clinical progress was monitored for 24 months or longer from 1992 to 2000. An interview and a clinical examination were performed, and all patients were examined clinically and radiologically at follow-up. There were 15 wrists in 12 males and 93 wrists in 86 females. The mean age was 53.7 years (range 23–79 years) at surgery. The mean morbidity period for RA was 9.3 years (range 3–25 years). The mean postoperative monitoring period was 34.9 months (range 24–61 months). There were 69 right wrists

and 39 left wrists, including 65 wrists with reconstruction of the extensor tendon at the same time.

Pre- and postoperative X-rays were measured to calculate the ulnar translation index and the carpal height index, and the X-rays were evaluated for osseous union in the wrists. A study was conducted of the changes in clinical findings, roentgenographic carpal height ratio (CHR), and carpal radial distance ratio (CRDR) between the preoperative observation visit and the final observation visit during the follow-up period in both the S–K group and the partial arthrodesis group.[3] The CRDR in this study was defined as the value calculated by dividing the distance between the extension of the radial central axis and the rotation center of the capitate bone by the length of the third metacarpal bone.[4]

Surgical treatment is indicated in cases of severe pain in the wrist joint and/or in cases of a concurrent operation with reconstructive surgery for rupture of extensor tendons. However, we selected the S–K procedure for patients with rheumatoid wrists, and we then performed either radiolunate partial arthrodesis or wrist total arthrodesis on unstable wrists, such as those with arthiritis mutilans, during surgery. We used the Larsen classification for radiological evaluation of destructive arthritic changes.[5]

Synovectomy alone is indicated for grade I cases, but the S–K procedure is indicated for all cases of grade II or over. Radiolunate partial arthrodesis is also indicated in cases in which scapholunate dissociation is seen, and total arthrodesis is also indicated in cases in which collapse–dislocation of the radiocarpal joint is seen. Plane radiographs in posterior–anterior and lateral views are necessary for evaluation.

The S–K surgical procedure is as follows. The oblique approach is taken from the dorsal surface through the distal radius to the proximal ulna. The extensor retinaculum is everted from the ulnar side to the radial side. We routinely perform a synovectomy of the extensor tendons and the radiocarpal, midcarpal, and radioulnar joints. The posterior interosseus nerve is resected at the level of the fourth extensor compartment. After the performance of tendinous and intraarticular synovectomy during the S–K procedure, the forearm is kept at maximum supination by flexing the elbow joint. Then the ulna is kept on the volar side and the extensor carpi ulnaris tendon is kept running as much as possible toward the dorsal side. The ulnar head is pushed to the volar side and the distal radioulnar joint is fixed temporarily using Kirschner wire. Ulnar osteotomy is performed at about 15 mm from the distal end so that there is a gap of about 5 mm. The distal end of the ulna is everted to avoid injury to the ulnar supporting system, and a synovectomy is performed around the distal end of the ulna. Screw fixation

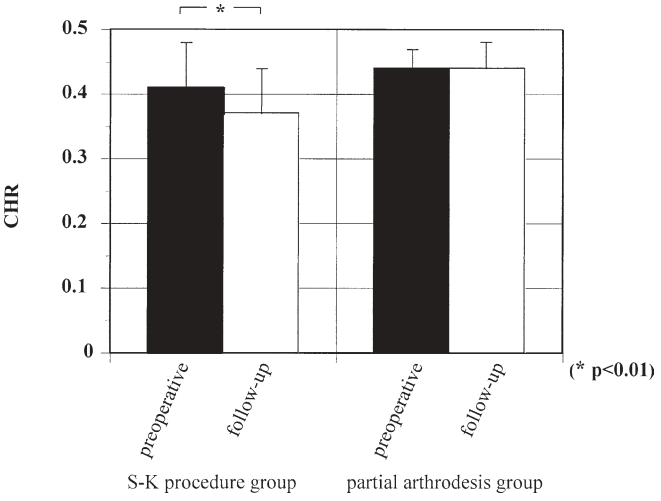

Fig. 1. Carpal height ratio (*CHR*) between the preoperative period and the end of follow-up in the Sauvé–Kapandji (*S–K*) procedure group and the partial arthrodesis group

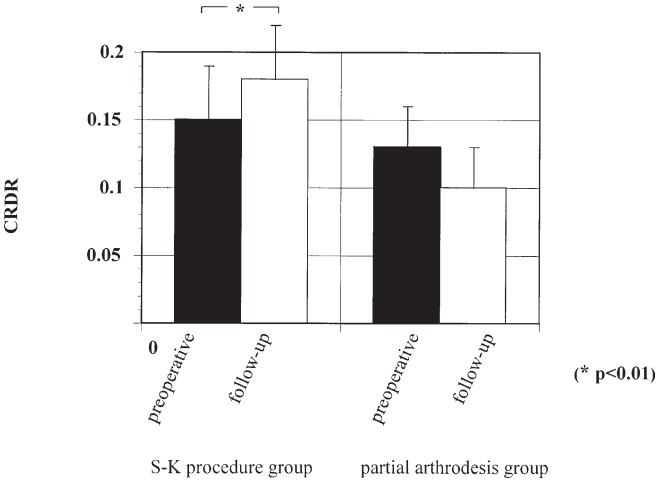

Fig. 2. Carpal radial distance ratio (*CRDR*) between the preoperative period and the end of follow-up in the Sauvé–Kapandji (*S–K*) procedure group and the partial arthrodesis group

is performed with the Kirschner wire as a landmark, and then the Kirschner wire is removed.

The radiolunate partial arthrodesis procedure is as follows. Radiolunate interosseal chondrectomy is performed, the carpal bone is reduced in as correct a position as possible, and fixation is performed with two strings of Kirschner wire and/or staples.

The total arthrodesis procedure is as follows. Intramedullary nailing is performed from the third metacarpal bone

Fig. 3. **A** Pre- and postoperative anteroposterior radiographs of a 57-year-old woman who underwent the S–K procedure. She had the operation at 52 years of age, and the pain and swelling around her wrist joint disappeared. The radiocarpal and carpal bones had spontaneous osseous fusion 5 years after surgery. **B** Pre- and postoperative anteroposterior radiographs of a 43-year-old woman who underwent the S–K procedure and reconstruction of the ring and little finger extensor tendons. She had the operation at 41 years of age, and the radius, lunate, triquetrum, and pisiform had spontaneous osseous fusion 2 years after surgery. **C** Pre- and postoperative anteroposterior radiographs of a 61-year-old woman who underwent the S–K procedure. She had the operation at 57 years of age, and the radiocarpal bone had spontaneous osseous fusion 1 year after surgery

Before operation | 1 week after operation | 6 months after operation | 5 years after operation

Before operation | 4 week after operation | 3 years after operation

Before operation | 1 day after operation | 3 years after operation

to the radius, along with supplemental fixation using one or two strings of Kirschner wire.

After surgery, active exercise is initiated 1 week after surgery with the S–K procedure with no concurrent tendon treatment. Exercise is initiated 2 weeks after fixation using a plaster slab in cases where concurrent tendon transfer or tendon graft is performed. During arthrodesis, the joint is fixed using a plaster slab for 4 weeks.

Statistical analysis

Statistical analyses were done using Stat View 5.0 software (SAS Institute, Cary, NC, USA). All results are expressed as the mean ± standard error. Student's paired *t*-test was used to compare the results. A P value less than 0.05 was considered to be significant.

Results

Based on our criteria for indications for surgical methods, synovectomy was performed in 16 wrists, the S–K procedure in 82 wrists, and partial and total arthrodeses were performed concurrently with the S–K procedure in 5 wrists each.

In this study, we mainly investigated the clinical results of the S–K procedure. Seventy-one of the 82 wrists which had the S–K procedure were almost pain-free at follow-up. Pain under a heavy load was reported in six patients, and three patients complained of wrist stiffness. Only two wrists were painful at rest. No patient had a postoperative relapse of synovitis in the operated wrist joint.

In a comparison of changes in CHR between the S–K and the partial arthrodesis groups, CHR decreased from 0.41 ± 0.07 before surgery to 0.37 ± 0.06 at the final follow-up ($P < 0.01$) in the S–K group, but CHR did not change (0.44 ± 0.03 before surgery, 0.44 ± 0.04 at the final follow-up) in the partial arthrodesis group. Based on these results, the partial arthrodesis group is thought to be less likely to have postoperative crushing of the carpal bone than the S–K group (Fig. 1). In a comparison of changes in CRDR between the groups, CRDR increased from 0.15 ± 0.04 before surgery to 0.18 ± 0.06 at the final follow-up observation visit ($P < 0.01$) in the S–K group, while CRDR decreased from 0.13 ± 0.03 before surgery to 0.10 ± 0.02 in the partial arthrodesis group at the final follow-up visit. Based on these results, the partial arthrodesis group is thought to be less likely to have ulnar deviation of the carpal bone than the S–K group (Fig. 2).

In the S-K group, the mean range of motion in extension and flexion increased mainly in the extension direction from 50.1° (extension 19.1 ± 17.2; flexion 31.0 ± 22.5) before surgery to 60.3° (extension 37.3 ± 32.5; flexion 23.0 ± 24.5) at the final follow-up observation visit, but in the partial arthrodesis group, it decreased from 55.3° (extension 25.3 ± 21.3; flexion 30.0 ± 25.6) before surgery to 45.0° (extension 20.0 ± 17.9; flexion 25.0 ± 24.3) at the final follow-up observation visit. In the total arthrodesis group, the range of motion of the wrist joint was 0° after surgery. In the SK group, the mean range of motion in pronation and supination increased from 127.3° (pronation 70.0 ± 17.6; supination 57.3 ± 15.9) before surgery to 147.4° (pronation 70.4 ± 21.7; supination 77.0 ± 23.4 degrees) at the final follow-up, while in the partial arthrodesis group, it decreased mainly in the pronation direction from 140.4° (pronation 70.1 ± 19.1; supination 70.3 ± 26.6) before surgery to 125.6° (pronation 45.4 ± 22.8; supination 80.2 ± 29.6 degrees) at the final follow-up.

We also investigated the ratio of osseous union after the S–K procedure from the radiographic findings at follow-up.

Carpal bones and/or radiocarpal joints of which union could not be assessed radiologically were found in 49 wrists (59.8%) after the S–K procedure, and among them there was definitely nonfusion of the carpal bone and radiocarpal joints in 29 wrists (35.4%). However, definite fusion of carpal bones and/or radiocarpal joints was found in 33 wrists (40.2%). Formation of carpal bones and partial radiocarpal fusion with some mobility were detected in some cases (Fig. 3).

Discussion

RA commonly affects the wrist, leading to pain, deformity, and reduced quality of life for the patient. A complete assessment of the whole patient, along with a clear understanding of the progression of rheumatoid deformities, is the key to success when contemplating surgical intervention for RA of the hand. The decision to perform surgery must be made following a careful evaluation of the patient's signs and symptoms weighed against the potential benefits of surgery. The surgical plan varies from patient to patient and it should be tailored accordingly.

Synovectomy of the wrist is thought to be effective in eliminating pain in cases in which no osseous deformity is seen, but concurrent reconstruction is required in cases in which osseous deformity is present.

Chamay and Della Santa[6] observed that patients who spontaneously undergo radiolunate ankylosis retain a highly functional range of wrist flexion and extension and do not manifest subsequent radiocarpal instability or subluxation. Therefore, Chamay and Della Santa,[6] Stanley and Boot,[7] and Linscheid and Dobyns[8] recommend radiolunate partial arthrodesis. They suggest that this procedure had advantages such as the elimination of pain, the preservation of a range of motion in pronation and supination, stability of the radiocarpal joint, and prevention of ulnar/volar dislocation and crushing of the carpal bone.

On the other hand, Taleisnik[9] and Vincent et al.[10] have also performed surgery with the S–K procedure on rheumatoid wrists. They suggest that this procedure had advantages, including the elimination of pain, the preservation of a range of motion in pronation and supination, stability of the radiocarpal joint, and prevention of ulnar deviation of the proximal carpal row, and that it was effective for the

treatment of a rheumatoid wrist. However, they reported that partial or total arthrodesis is indicated for concurrent dislocation.

Until now, it has not been clearly demonstrated that progressive radiocarpal subluxation can be prevented by the S–K procedure. The results of this study suggest that crushing of the carpal bone and ulnar deviation of the proximal carpal row cannot be completely controlled by the S–K procedure. However, patient satisfaction was very high in the S–K group, which was probably attributable to the effect of synovectomy and division of the posterior interosseous nerve. Moreover, an osseous union around the carpal lesion was sometimes detected, and was thought to be related to those clinical results. We believe that osseous union leads to stability of the wrist joints to some extent. As part of the S–K procedure, we performed a synovectomy around the radiocarpal joint, and osseous union tended to occur after surgery. Partial arthrodesis can result in a decrease in the range of motion, although control of ulnar deviation of the proximal carpal row and the preservation of a certain degree of range of motion are attainable. Although total arthrodesis does eliminate looseness of the wrist joint, at the same time, it can lead to a decrease in the range of motion and eventually cause restriction of the activities of daily living, including difficulty doing push-ups, as a result of the restriction of the extension of the wrist joint. Therefore, we think that the S–K procedure should be selected as the first choice.

The Simmen classification[11] was developed to classify wrist damage into three categories: type I ankylosis, type II osteoarthritis, and type III disintegration. In type III, there is carpal collapse and ulnar translation of the carpus with a faster rate of progression than in types I and II wrists. Thus, there is a clear need for clinical judgment in the selection of patients for surgery. Further work needs to be done to develop predictive criteria that will help to identify rheumatoid wrists requiring early stabilization, and the existing indices for the measurement of carpal position need to be improved.[12]

In summary, the S–K procedure may stabilize the carpus of the rheumatoid wrist while maintaining a functionally important range of motion and relieving pain. However, it does not stop the disease process and cannot reestablish or maintain carpal height. We select the S–K procedure for rheumatoid wrists, and if we recognize an unstable wrist, like the mutilans type, we then perform either radiolunate partial arthrodesis or wrist total arthrodesis. For these purposes, we should establish predictive criteria that will help to classify the types of rheumatoid wrists.

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