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ORIGINAL ARTICLE

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Radiographic comparative evaluation of the Sauve-Kapandji procedure and the Darrach procedure for rheumatoid wrist reconstruction

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Abstract For surgical treatment of rheumatoid wrists, we have routinely selected the Sauve-Kapandji (S-K) procedure or the Darrach procedure based on predetermined indications. In this study, we conducted a retrospective radiographic comparative evaluation of the changes in the carpus after the two procedures. The S-K group and the Darrach group each consisted of 13 wrists of 10 patients (all women). The indications for the Darrach procedure were the presence of radiolunate fusion, radial shelf formation, and old age. The carpal height ratio (CHR) and the ulnocarpal distance ratio (UCDR) were determined on wrist radiograms obtained before operation and at the final follow-up. The mean follow-up period was 4 years. Fisher's test was used to analyze the differences between the two groups. Both groups showed a decrease in mean CHR and an increase in mean UCDR at the final follow-up compared to the values before the operation, and there were no statistically significant differences. Furthermore, in the Darrach group, no significant differences in changes of the carpus were observed between patients with or without a radial shelf. We concluded that the present results do not support the superiority of the S-K method over the Darrach procedure for rheumatoid wrist reconstruction based on a radiographic evaluation.

Key words Darrach procedure · Rheumatoid arthritis (RA) · Sauve-Kapandji (S-K) procedure · Wrist joint

Introduction

Rheumatoid arthritis (RA) progressively disrupts joints despite various drug therapies, resulting in instability. In patients with RA, the wrist is destroyed at a high frequency, leading to instability of the distal radioulnar joint (DRUJ). For RA wrists with an impaired DRUJ, combined procedures of synovectomy and arthroplasty of the DRUJ are often performed.

Rahimtoola et al.[1] indicated that most investigators report satisfactory outcomes of the Darrach procedure for resection of the distal ulna in RA wrists. However, this procedure has the shortcomings of allowing progressive ulnar translocation of the carpus[2] and enhanced joint destruction. To compensate for the demerits of the Darrach procedure, the Sauve-Kapandji (S-K) procedure is increasingly being used. As a result, many reports have recommended the S-K procedure for rheumatoid wrist reconstruction.[3–6]

For surgical reconstruction of rheumatoid wrists, we have selected either the S-K or the Darrach procedure based on predetermined indications. The purpose of this study was to compare the intermediate-term results of the S-K and Darrach procedures for rheumatoid wrist reconstruction by conducting a retrospective radiographic evaluation of changes in the carpal bones after a mean follow-up of 4 years.

Patients and methods

Patients

The S-K group consisted of 13 wrists of 10 patients (all women) who underwent a combined S-K procedure and synovectomy between May 1989 and April 2002 and who were followed for at least 1 year. The mean age at the time of surgery was 53 years (range 37–70 years), and the mean duration of RA was 8 years (range 3–16 years). Surgery was performed on eight right wrists and five left wrists. Two wrists were also complicated with extensor tendon rupture. Three wrists were classified as Larsen grade II, six wrists as grade III, and four wrists as grade IV. The mean postoperative follow-up period was 54 months (range 12–180 months).

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The Darrach group consisted of 13 wrists of 10 patients (all women) who underwent a combined Darrach procedure and synovectomy between February 1997 and July 2003 and were followed for at least 1 year. The mean age at the time of surgery was 63 years (range 53–71 years), and the mean duration of RA was 10 years (range 2–36 years). Surgery was performed on nine right wrists and four left wrists. Five wrists were also complicated with extensor tendon rupture. The degree of wrist joint destruction as classified by Larsen was grade II in three wrists, grade III in one wrist, and grade IV in nine wrists; a radial shelf was observed in five wrists. The mean postoperative follow-up period was 42 months (range 12–89 months).

Indications for surgery

The indications for surgery were pain and swelling caused by destruction of the radiocarpal joint, the DRUJ, or both and rupture of the extensor tendon. The Darrach procedure was selected when radiolunate fusion was observed on a posteroanterior radiogram of the wrist joint or there was formation of a radial shelf, and in low-demand elderly patients. On the other hand, the S-K procedure was selected for high-demand young patients and those with a risk of ulnar translocation of the carpal bone if reconstructed by the Darrach procedure.

Surgical techniques

The S-K procedure involved a gently curved incision on the dorsum of the wrist through which the DRUJ passes. The fourth compartment was incised to expose the distal ulna. An electric bone saw was then used to perform a transverse osteotomy approximately 1.5 cm proximal to the ulnar tip; a segment of the ulna approximately 1 cm in length was resected, and a pseudoarthrosis was created. The osteotomy increased the mobility of the ulnar head, so synovectomy of the wrist joint was then conducted with greater ease and completeness. After removing the cartilage on the joint surface of the ulna and radius, two titan cannulated cancellous screws were used to fix the ulnar head to the radius to obtain fusion of the DRUJ. Screws were used in 12 of 13 wrists, and several Kirschner nails were used in the remaining wrist. In cases complicated by tendon rupture, tendon reconstruction was also done. Finally, holes were drilled in the proximal ulna, and the extensor carpi ulnaris was used to perform tenodesis to obtain proximal ulnar stability.

The Darrach procedure was the same as the S-K procedure except that the ulnar head was not fixed to the radius by screws.

Radiographic evaluation

Using the posteroanterior radiograms of the wrist joint obtained before surgery and at the final follow-up, the following parameters were determined. The carpal height ratio (CHR) was calculated according to the definition of Youm et al.[7] as follows. The distance from the base of the third finger metacarpus to the subchondral plate of the radius was divided by the length of the third finger metacarpus. The CHR is an indicator of the degree of collapse of the carpus.

The degree of ulnar translocation of the carpus was calculated according to the method of Thirupathi et al.[8] The outline of the pisiform is maintained even in advanced-RA wrists. The ulnocarpal distance (UCD) was measured as the distance between the center of the ulnar border of the pisiform and the radial styloid. The ulnocarpal distance ratio (UCDR) was calculated by dividing the UCD by the length of the third finger metacarpus.

Statistical analysis

Statistical analyses were performed on the mean CHR and UCDR before surgery and at the final follow-up. The change with respect to the preoperative value was analyzed by Fisher's test to determine the P values and was compared between the two groups. $P < 0.05$ was considered significant. Furthermore, subgroup analysis of the presence or absence of a radial shelf was conducted in the Darrach group.

Results

S-K group

Fusion of the DURJ was complete in all cases. The CHR was lowered by ≥ 0.1 in two wrists, was lowered by <0.1 in ten wrists, and remained unchanged in one wrist. The mean CHR was 0.44 ± 0.03 (range 0.40–0.49) before operation and decreased to 0.41 ± 0.06 (range 0.25–0.49) at the final follow-up.

For the UCDR, three wrists showed increases of ≥ 0.1, two of which had a follow-up of 114 months or longer; three wrists showed increases of ≤ 0.1, and seven wrists remained unchanged. The mean UCDR was 0.75 ± 0.06 (range 0.63–0.86) before operation and increased to 0.77 ± 0.09 (range 0.63–1.00) at the final follow-up (Fig. 1). Statistical analysis showed no significant changes in the mean CHR or UCDR during the postoperative follow-up compared to the values before operation (Table 1). Two wrists classified as Larsen grade II and III, respectively, showed progression of one grade. However, there was no correlation between the increase in UCDR and progression of Larsen's grade.

Darrach group

The CHR was lowered by <0.1 in nine wrists and was unchanged in four wrists. The mean CHR was 0.43 (range 0.32–0.53) before operation and changed to 0.41 (range 0.30–0.51) at the final follow-up.

Table 1. Comparison of carpal height ratio and ulnocarpal distance ratio between the S-K and Darrach procedures

Procedure	Preoperative	Final follow-up	Difference
Carpal height ratio			
S-K	0.44 ± 0.03	0.41 ± 0.06	−0.03
Darrach	0.43 ± 0.07	0.41 ± 0.07	−0.02
Ulnocarpal distance ratio			
S-K	0.75 ± 0.06	0.77 ± 0.09	+0.02
Darrach	0.75 ± 0.05	0.78 ± 0.06	+0.03

Table 2. Comparison of carpal height ratio and ulnocarpal distance ratio between the presence and absence of a radial shelf in patients who underwent the Darrach procedure

Measurement	Preoperative	Final follow-up	Difference
Carpal height ratio			
Radial shelf (+)	0.44 ± 0.05	0.43 ± 0.06	−0.01
Radial shelf (−)	0.43 ± 0.09	0.40 ± 0.08	−0.03
Ulnocarpal distance ratio			
Radial shelf (+)	0.76 ± 0.05	0.79 ± 0.07	+0.03
Radial shelf (−)	0.75 ± 0.06	0.77 ± 0.05	+0.02

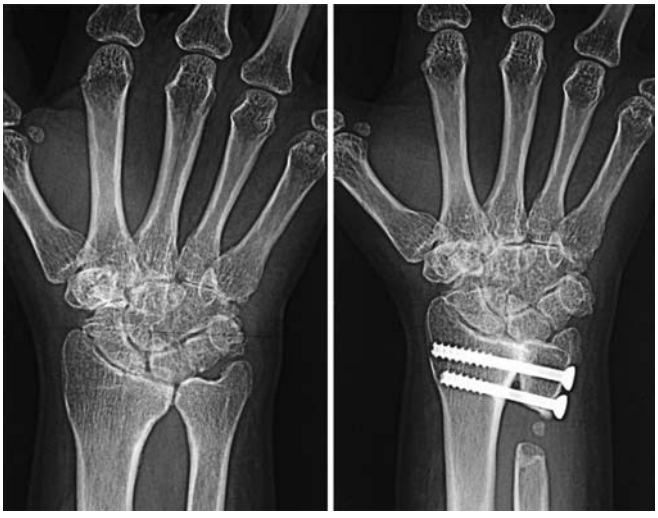

Fig. 1. Posteroanterior radiograms before operation and at the final follow-up of a 43-year-old patient who underwent the Sauve-Kapandji (S-K) procedure. At 2 years after operation, the carpal height ratio (CHR) had decreased by 0.02, and the ulnocarpal distance ratio (UCDR) had increased by 0.04

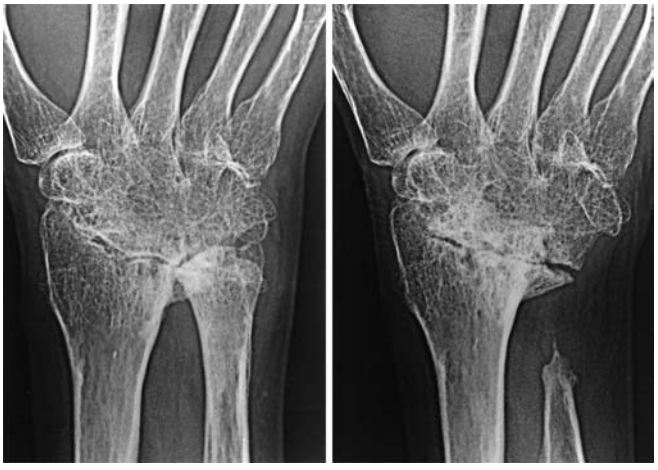

Fig. 2. Posteroanterior radiograms before operation and at the final follow-up of a 62-year-old patient who underwent the Darrach procedure. Presurgical radiogram shows a radial shelf. At 4 years after operation, the CHR had decreased by 0.02, and the UCDR had increased by 0.01

The UCDR was increased by ≥0.1 in two wrists showing a radial shelf with follow-up periods of 12 and 44 months, respectively; it was increased by ≥0.1 in five wrists, and remained unchanged in six wrists. The mean UCDR was 0.75 (range 0.69–0.83) before operation and changed to 0.78 (range 0.71–0.89) at the final follow-up (Table 1). Statistical evaluation showed no significant changes in the mean CHR or the UCDR. When the cases were stratified into the presence or absence of a radial shelf, the subgroup with a radial shelf had a mean CHR of 0.44 before operation and 0.43 at the final follow-up and a mean UCDR of 0.76 before operation and 0.79 at the final follow-up (Fig. 2). In the subgroup without a radial shelf, the mean CHRs were 0.43 and 0.40, and the mean UCDRs were 0.75 and 0.77, respectively (Table 2). Again, there were no significant differences. One wrist classified as Larsen grade II progressed to grade III. Like the S-K group, there was no correlation between the change in UCDR and progression of Larsen's grade.

Intergroup comparisons

No significant differences in mean CHR or UCDR were observed between the S-K group and the Darrach group.

Discussion

The short-comings of the Darrach procedure include an unstable radiocarpal joint, lowered grip strength due to ul-

nar translocation of the carpus, and cosmetic complaints due to the concavity formed by resecting the distal ulna. The demerits of the S-K procedure are that it is a more complicated surgical technique than the Darrach procedure, and there is a possibility of incomplete fusion of the DRUJ. The advantage of the S-K procedure is that it preserves the wrist joint similar to the physiological condition, and some radiographic studies have reported that ulnar translocation of the carpus may be prevented.[4–6] For this reason, a relatively larger number of reports have recommended the S-K procedure.[2,3]

Gainor and Schaberg[9] reported that after the conventional Darrach procedure late development of radiolunate fusion of a radial shelf after surgery occurred in 12% of the cases, and these structures facilitated a long-term favorable result. These authors also suggested that the Darrach procedure is preferred when a bony stabilizer is already present before operation. Another report observed no significant differences in radiographic evaluation of patients who underwent the Darrach or S-K procedure selected based on the indications.[10]

Rahimtoola et al.[1] reported a radiographic analysis of the long-term changes between a group treated by the Darrach procedure and a nonoperated group. They observed increases in ulnar translocation and decreased CHR in both groups but found no significant differences between the two groups. They concluded that resection of the distal ulna has no effect on the inevitable progression of RA.

We select the Darrach procedure or S-K procedure according to the posteroanterior radiogram of the wrist joint. We believe that patients who have developed radiolunate fusion, those showing a radial shelf, those with severe ulnar head destruction, and low-demand elderly patients are candidates for the Darrach procedure. On the other hand, middle-aged patients with a risk of ulnar translocation of the carpus if it is reconstructed by the Darrach procedure are candidates for the S-K procedure.

In the present radiographic study, the CHR decreased in both the S-K and Darrach groups, and neither procedure could prevent collapse of the carpus. Furthermore, there were no significant differences between the patients with or without a radial shelf in the Darrach group. As for ulnar translation of the carpus, the UCDR increased a mean of 4 years after surgery using the S-K method.

In the S-K group, two of the three wrists that showed increases in the UCDR of ≥ 0.1 had been followed for a long period after surgery, suggesting that progression of ulnar translation of the carpus may depend on the duration of the interval after surgery. In the Darrach group, on the other hand, two of the five wrists with a radial shelf showed increases in the UCDR. This finding indicates that radial shelf formation does not completely prevent ulnar translation of the carpus. Thus, our results do not support the superiority of the S-K method over the Darrach procedure. However, the fact that there were no significant differences in the CHR or the UCDR between the S-K and Darrach groups highlights an important point: that selection of the surgical method has been done appropriately using valid indications.

When fixing the distal end of the ulna to the radius, Nakamura et al.[11] observed bone absorption around the screw in a few cases using metal screws, and they recommended the use of poly-L-lactic-acid-absorbable screws. In recent years, we have used titan cannulated cancellous screws to fix the DURJ and have obtained complete fusion. In the patients in whom we have used titan screws, there has been no screw-induced damage, such as bone absorption around the screw. We thus believe that titan cannulated cancellous screws are useful for the S-K procedure.

Conclusions

No significant differences were observed between the S-K procedure and the Darrach procedure for RA wrist reconstruction with respect to carpal changes after an intermediate-term follow-up (4 years on average). However, decreased CHR and increased UCDR were observed for both procedures. There was no evidence that the Darrach procedure is inferior to the S-K procedure. Our results demonstrated the natural course of RA progression and highlighted the importance of establishing valid indications for choosing between the two treatment methods.

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