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ORIGINAL ARTICLE

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Usefulness of absorbable screws in the Sauvé–Kapandji procedure for rheumatoid wrist reconstruction

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Abstract In the Sauvé–Kapandji (S–K) procedure for rheumatoid wrist reconstruction, the distal end of the ulna is fixed to the radius with screws. Recently, absorbable screws have increasingly been used instead of metal ones. However, the clinical usefulness of absorbable screws in S–K procedures for rheumatoid patients is still unknown. The purpose of this article is to evaluate the effect of absorbable screws in this procedure by comparing their clinical results with those of metal screws. Poly-L-lactic acid (PLLA) absorbable screws were used in 23 wrists, and metal screws were used in 20 wrists. We evaluated the presence of general or local reactions to PLLA, the stability of the ulnar head, the time to bone union, changes in the shape of the distal ulna, and the presence of bone resorption around the screws. There were no complications with the use of PLLA screws, and their fixation stability was adequate to form sufficient bone union. In five cases in the metal screw group, bone resorption around the screws occurred between 1 and 2 years after surgery. Bone resorption around the PLLA screws was not observed. We conclude that absorbable screws may be more useful than metal screws in the S–K procedure for rheumatoid wrist reconstruction.

Key words Absorbable screw · Poly-L-lactic acid (PLLA) · Rheumatoid arthritis · Sauvé–Kapandji (S–K) procedure · Wrist reconstruction

Introduction

Some rheumatoid patients have a dislocation or a subluxation of the ulnar head which results in a limitation of forearm supination, and pain during this motion. For a long time, resection of the distal end of the ulna (Darrach procedure[1,2]) was commonnly used for reconstruction in such cases. However, this procedure unfortunately resulted in an instability of the carpus, which had a tendency to slide and deviate ulnarly whilst the grip strength became weaker.[3,4]

To avoid the disadvantages of the Darrach procedure, a procedure described by Sauvé and Kapandji (the S–K procedure) in 1936,[5–7] which includes an arthrodesis across the distal radioulnar joint and creates a pseudoarthrosis of the ulna, proximal to the fusion, to restore forearm pronation and supination, has been used since the mid-1970s. Many authors have reported good results with this procedure for rheumatoid disorders of the distal radioulnar joint.[3,4,8–11]

In the S–K procedure, metal screws are usually used to fix the distal end of the ulna to the radius to form a ledge. We also used metal screws, but in several patients this seemed to cause bone resorption around the screws. Recently, absorbable screws made of poly-L-lactic acid (PLLA) have increasingly been used instead of metal screws because they have the advantage of not requiring removal. We have been using absorbable screws in this procedure since 1996. However, the effects of using these screws in the S–K procedure for rheumatoid patients have not yet been properly or completely researched or documented.

To evaluate the clinical usefulness of absorbable screws in this procedure for rheumatoid wrist reconstruction, we compared their clinical results with those of metal screws retrospectively.

Materials and methods

Patients

From March 1989 to December 1995, metal screws were used in 20 wrists of 19 rheumatoid patients who had a disorder of the distal radioulnar joint. From January 1996 to

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September 1999, PLLA screws were used in 23 wrists of 21 rheumatoid patients.

The mean average age of the patients in the PLLA screw group was 59 years, and that of patients in the metal screw group was 54 years.

The follow-up periods were from 1.5 to 5 years (mean 3 years and 2 months) in the PLLA screw group, and from 5 to 11 years (mean 6 years and 7 months) in the metal screw group.

Materials

We used high-pressed PLLA screws (NEOFIX, Gunze) in all the wrists of patients in the PLLA screw group. These screws were the same shape as AO (Arbeitsgemeinschaft für Osteosynthesefragen) small cancellous screws.

AO small cancellous screws were used in 18 wrists of patients in the metal screw group, but cannulated cancellous screws made of titanium (Best Medical) were used in the other two wrists.

Clinical evaluation

We clinically evaluated any local reactions to the screws, the stability of the ulnar head, and the range of motion of the wrist joint. The grip strength was measured using a modified sphygmomanometer. Complete blood counts, blood chemistry, and urine analysis were performed on the first postoperative day, 1 week, 2 weeks, 1 month, and 3 months after surgery. The disease severity of the patients was evaluated on the basis of the classification proposed by Ochi et al.[12]

X-ray evaluation

X-ray films were taken 2 weeks after surgery, and then every month until the bone union between the radius and the ulnar head was complete. After the bone union had occurred, follow-up X-ray films were taken every 6 months.

From these X-ray films, we evaluated the displacement of the ulnar head, the time of bone union, the shape of the ulnar head, the carpal height ratio, ulnar shift, and the presence of bone resorption around the screws.

To evaluate the shape of the ulnar head, the length, distal width, and proximal width were measured (Fig. 1). The carpal height ratio was represented by the value of the carpal height/the length of the third metacarpal bone. Ulnar shift was determined by the value of the distance between the medial border of the radius and the center of the carpal bones.[10] If there was a radiolucent area around the screws and the cortical bone had thinned, we decided that there was bone resorption around the screws.

Statistical analysis

Statistical differences between the preoperative and postoperative data in range of motion, grip strength, complete blood count, blood chemistry, carpal height ratio, and ulnar shift were analyzed using Student's *t*-test. *P* values less than 0.05 were considered to be significant. The distribution of patients based on disease severity was analyzed by the χ^2 test.

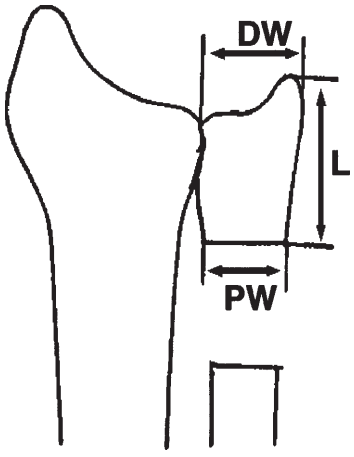

Fig. 1. X-ray evaluation of the shape of the ulnar head. *L*, length; *DW*, distal width; *PW*, proximal width

Results

We found no detectable local adverse reaction to the screws, no instability of the distal ulnar head, and no abnormal change in the complete blood count, blood chemistry, or urine analysis data. In each group, the mean grip strength postoperatively was greater than that preoperatively, but there were no significant differences. However, the ranges, or degree of supination, increased significantly after surgery in both groups.

X-ray films showed no displacement of the ulnar head in either group. The mean period of bone union was 3.1 months in the PLLA screw group and 3.5 months in the metal screw group. There was no statistical difference between the two groups.

There was no statistical difference between the preoperative and postoperative values of the carpal height ratio in either group, and no increase in ulnar shift was observed in either group.

The length of the ulnar head had decreased in two wrists in the PLLA screw group and in nine wrists in the metal screw group. The distal width had decreased in four wrists in the metal group, but had not decreased in any of the PLLA group, while the proximal width had decreased in four wrists in the PLLA group and six wrists in the metal group (Table 1).

Bone resorption around the screws was seen in five wrists in the metal screw group (Table 1, Fig. 2); this phenomenon occurred from 1 to 2 years after surgery (mean 1 year and 6 months). In four cases the screws had to be removed because bone resorption developed gradually. No

bone resorption was observed around the PLLA screws (Table 1, Fig. 3).

The distribution of patients based on the disease severity was not statistically different between the two groups. Bone resorption around the metal screws occurred regardless of disease severity (Table 2).

Table 1. Changes to the shape of the ulnar head and bone resorption around screws

	PLLA 23 wrists	Metal 20 wrists
Shape of the ulnar head		
Decrease of L	2	9
DW	0	4
PW	4	6
Bone resorption around the screws	0	5

PLLA, poly-L-lactic acid; L, length; DW, distal width; PW, proximal width

Discussion

Until recently, the Darrach procedure was used for rheumatoid patients with dislocation or subluxation of the ulnar head causing wrist pain and a limitation of forearm supination. However, this procedure could give rise to abnormal postoperative carpal subluxation, ulnar deviation, or ulnar

Table 2. Disease severity and bone resorption around screws

	PLLA 21 patients	Metal 19 patients
Least erosive subset	13	11 (1)
More erosive subset	6	5 (2)
Mutilating disease	2	3 (2)

Numbers in parentheses indicate cases of bone resorption around the screws

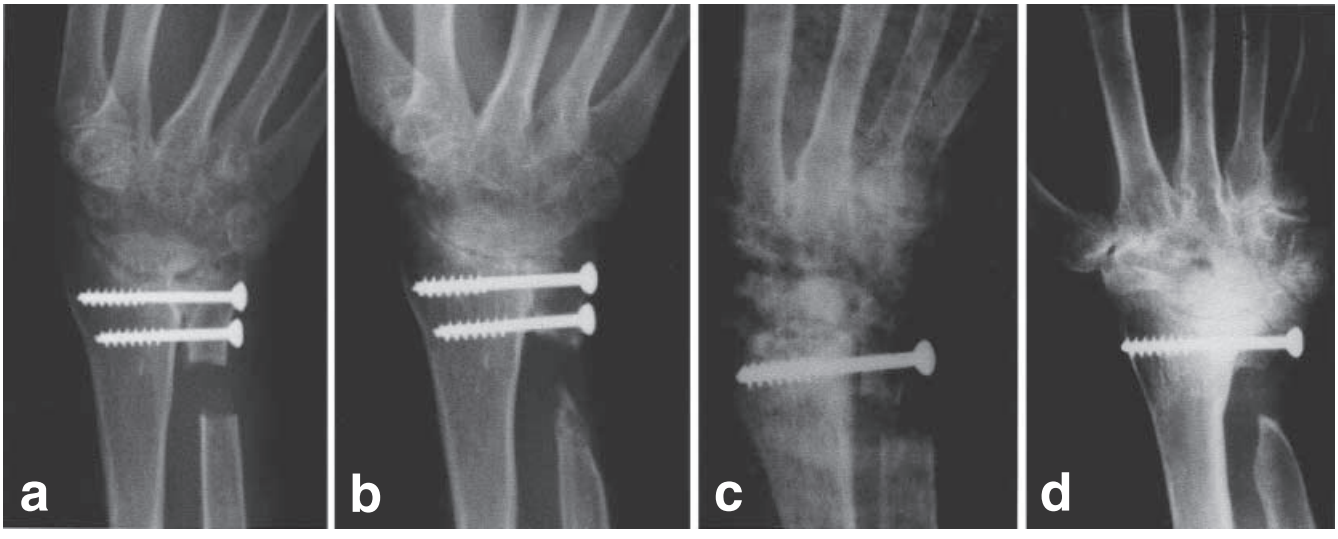

Fig. 2. X-ray films in two cases of bone resorption around metal screws. **a**, **b** 41-year-old female. **a** 2 weeks, and **b** 2 years after the operation. **c**, **d** 67-year-old female. **c** 2 weeks, and **d** 2 years after the operation

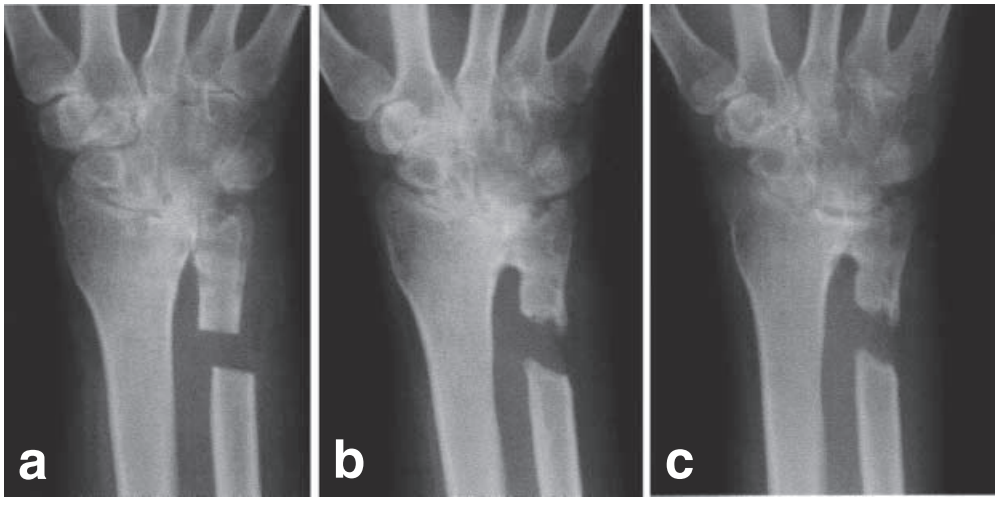

Fig. 3. X-ray films of the case of a 51-year-old female with PLLA screws. **a** 2 weeks, **b** 2 years, and **c** 4 years and 6 months after the operation

translation. Recently, the S–K procedure, or radiolunate arthrodesis,[13] has been recommended to avoid the disadvantages of the Darrach procedure. Since 1989, we have used the S–K procedure for rheumatoid patients with pain on motion of the distal radioulnar joint and limited external rotation of the forearm with or without ruptured finger extensor tendons. However, we considered that this procedure was not suitable for patients with an unstable radiocarpal joint.

Absorbable screws made of PLLA, which are strengthened by a drawing technique,[14–17] have been used to fix fractured bones in clinical cases.[18] High-pressed extrusion-strengthened PLLA screws have recently been developed. A mechanical test showed that the initial strength of screws made of high-pressed extrusion PLLA was greater than that of draw-strengthened PLLA screws.[19] We used these screws in treating patients with rheumatoid arhtritis.

No complications were reported with PLLA screws, and the fixation stability of the screws was adequate to form a good bone union. Changes in the shape of the ulnar head occcurred more frequently in the metal screw group. Bone resorption around the screws was not observed in the PLLA group, but was observed in five wrists in the metal screw group. Resorption occurred regardless of the disease severity of the rheumatoid arthritis. It was reported that the stiffness of the metal screws was much higher than that of cortical bone, but the stiffness of high-pressed extrusion PLLA screws was only slightly higher.[20] We speculate that the use of very stiff metal might lead to osteoporosis, and result in bone resorption around metal screws.

Based on our results, we believe that PLLA screws were absorbed naturally, and that the distal ulnar head regained its original strength. We thus conclude that absorbable screws are more useful than metal screws in the S–K procedure for rheumatoid patients.

References

1. Darrach W. Anterior dislocation of the head of the ulna. Ann Surg 1912;56:802–3.
2. Darrach W. Partial excision of the lower shaft of the ulna for deformity following Colles' fracture. Ann Surg 1913;57:764–5.
3. Gonçalves D. Correction of disorders of the distal radio-ulnar joint by artificial pseudoarthrosis of the ulna. J Bone Joint Surg 1974; 56B:462–4.
4. Yonemoto K, Inoue K, Hutami T, Aritomi H, Shimajiri I. Radiological evaluation of rheumatoid wrist reconstruction using shelf plasty procedure: the role of preservation of the end of the ulna (in Japanese). J Jpn Soc Surg Hand 1993;9:839–42.
5. Sauvé L, Kapandji M. Nouvelle technique de traitement chirurgical des luxation rechidivantes isolees de l'extremite inferieur du cubitus. J Chir 1936;47:589–94.
6. Buck-Gramcko D. On the priorities of publication of some operative procedures on the distal end of the ulna. J Hand Surg 1990; 15B:416–20.
7. Kapandji AI. The Sauvé–Kapandji procedure. J Hand Surg 1992;17B:125–6.
8. Taleisnik J. The Sauvé–Kapandji procedure. Clin Orthop 1992;275:110–23.
9. Sugiyama M, Katsube S, Yamauchi Y. Sauvé–Kapandji procedure for rheumatoid wrist (in Japanese). J Jpn Soc Surg Hand 1993; 9:843–6.
10. Osaka Y, Abe M, Doi M, Ishizu T, Onomura T. Sauvé–Kapandji procedure on the rheumatoid wrist (in Japanese). J Jpn Soc Surg Hand 1993;9:847–51.
11. Yonemoto K, Inoue K, Saito S, Hutami T, Aritomi H. Study of Sauvé–Kapandji procedure in the rheumatoid wrist (in Japanese). J Jpn Soc Surg Hand 1994;10:912–5.
12. Ochi T, Iwase R, Yonebobu K, Matsukawa M, Yoneda M, Yukioka M, et al. Natural course of joint destruction and fluctuation of serum C1q levels in patients with rheumatoid arthritis. Arthritis Rheum 1988;31:37–43.
13. Della Santa D, Chamay A. Radiological evolution of the rheumatoid wrist after radio-lunate arthrodesis. J Hand Surg 1995;20B: 146–54.
14. Matsusue Y, Yamamuro T, Yoshii S, Oka M, Ikeda Y, Hyon SH, et al. Biodegradable screw fixation of rabbit tibia proximal osteotomies. J Appl Biomater 1991;2:1–12.
15. Matsusue Y, Yamamuro T, Oka M, Shikinami Y, Hyon SH, Ikeda Y. In vitro and in vivo studies on biodegradable ultra-high-strength poly (L-lactide) rods. J Biomed Mater Res 1992;26:1553–67.
16. Hanafusa S, Matsusue Y, Yasunaga T, Yamamuro T, Oka M, Sikinami Y, et al. Biodegradable plate fixation of rabbit femoral shaft osteotomies: a comparative study. Clin Orthop 1994;315:262–71.
17. Matsusue Y, Hanafusa S, Yamamuro T, Sikinami Y, Ikeda Y. Tissue reaction of bioabsorbable ultra-high-strength poly (L-lactide) rods: a long-term study. Clin Ohthop 1994;317:246–53.
18. Yamamuro T, Matsusue Y, Uchida A, Shimada K, Shimozaki E, Kitaoka K. Bioabsorbable osteosynthetic implants of ultra-high-strength poly (L-lactide): a clinical study. Int Orthop (SICOT) 1994;18:332–40.
19. Matsushita T, Nakamura K, Shiro R, Takazawa H, Tsuji K, Kurokawa T. Initial strength of high-pressed extrusion poly-L-lactide screw. Biomed Mater Eng 2000;10:199–204.
20. Matsusue Y. Bioabsorbable ultra-high-strength poly (L-lactide) osteosynthetic implants (in Japanese). Orthop Surg 1995;46:269–76.