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Scaphotrapeziotrapezoid fusion: long-term follow-up study

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Abstract The long-term effectiveness of scaphotrapeziotrapezoid (STT) fusion is still controversial. We evaluated our clinical and radiological results of 30 STT fusions in 30 patients (average age 41 years; 23 males, 7 females). The follow-up period averaged 84 months. The indications were Kienböck's disease ($n = 23$), isolated STT arthrosis ($n = 6$), and dislocation of the trapezium ($n = 1$). A total of 26 simultaneous associated procedures were performed. Excisional arthroplasty of the lunate was done in all 23 patients with Kienböck's disease. Of the 30 total patients, 5 had postoperative pain ranging from mild to severe; 4 patients were dissatisfied with the results. Postoperative ranges of motion of the wrist were 84% of extension and 91% of flexion compared with preoperative motion. The postoperative grip strength improved to 27 kgf from the preoperative value of 18 kgf. Altogether, 26 patients returned to their previous activities. All patients obtained uneventful STT fusion in an average of 11.2 weeks. Eight patients (27%) experienced postoperative complications; seven had radioscaphoid arthroses, five had trapeziometacarpal arthrodeses, and one had a flexor pollicis longus tendon rupture. Although radioscaphoid arthrosis occurred in 23% of this series after STT fusion, the results suggest that it is an effective procedure for Kienböck's disease and isolated STT arthrosis.

Key words Scaphotrapeziotrapezoid fusion · Osteoarthrosis · Kienböck's disease

Introduction

Scaphotrapeziotrapezoid (STT) fusion has recently become a popular surgical treatment for carpal instability,[1,3,19] intercarpal arthrosis,[11,15,17] Kienböck's disease,[12,14,17] and carpal bone fracture-dislocation.[11] Despite the wide acceptance of STT fusion, the long-term effectiveness of this procedure is still controversial. In 1986 Watson et al.[19] reported on the results of STT fusion for rotary subluxation of the scaphoid in 30 patients followed an average of 47 months. All patients returned to their previous vocational or avocational levels, and no patient had degenerative changes in the adajacent joints. On the other hand, several reports have questioned the long-term effectiveness of STT fusion and have cited a significant incidence of complications, including progressive carpal arthrosis, nonunion, intractable pain, styloscaphoid impingement, and progressive medial carpal translation.[5–10]

The purpose of this study was to assess the long-term follow-up of patients who underwent STT fusion for either Kienböck's disease or isolated STT arthrosis and one dislocated trapezium.

Materials and methods

Materials

Between 1982 and 1995 we performed 30 STT fusions in 30 patients. The average age of the patients at the time of surgery was 41 years (range 17–71 years). There were 23 males and 7 females. The dominant hand was involved in 21 patients and the nondominant hand in 9. All patients were right-handed. The follow-up period averaged 84 months (range 60–182 months); all patients had more than 5 years of follow-up. Diagnoses were Kienböck's disease (23 patients), isolated STT arthrosis ($n = 6$), and dislocation of the trapezium ($n = 1$). Patients with Kienböck's disease were classified according to Lichtman's five-stage preoperative classification.[9] All were in the advanced stage of Kienböck's disease: 7 in stage IIIA, 12 in stage IIIB, and 4 in stage IV.

In the case with dislocation of the trapezium, open reduction and internal fixation had been performed

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prior to STT fusion. There were 26 associated procedures, including 23 excisional arthroplasties with insertion of a coiled palmaris longus and 3 radial styloidectomies; all were performed simultaneously with the STT fusion. Excisional arthroplasty and insertion of a coiled palmaris longus was done in all patients with Kienböck's disease. Radial styloidectomy was also performed in three patients with Kienböck's disease.

Methods

Surgical techniques

The surgical technique used was in accordance with the previous description, with three Kirschner wires placed in a retrograde fashion.[11,12,16] A transverse incision over the dorsoradial aspect of the wrist was recommended by Watson and Hempton,[16] but we preferred a dorsal oblique incision centered over the joint space between the scaphoid and trapezium. The articular cartilage and subchondral bone of the three joints were removed to expose cancellous bone. Cancellous bone from the iliac crest was grafted into the joint spaces to prevent shortening of the carpus. In patients with Kienböck's disease, reduction of the scaphoid to a normal orientation (approximately 45%) was attempted before pin fixation but following removal of the lunate and implantation of a coiled palmaris longus tendon. Intraoperative radiographs were routinely obtained to determine the scaphoid position. Postoperative immobilization usually involved the use of an above-elbow thumb-spica cast for 4 weeks followed by application of a below-elbow thumb-spica cast for 2–6 weeks. Active physiotherapy was begun after removal of the cast. After solid fusion was obtained, passive stretching exercises for the wrist and fingers should be added.

Follow-up included a patient interview and examination to assess pain, functional limitations, range of motion, grip strength, and work status. Grip strength was measured by means of the Jamar dynamometer.

Subjective assessment

Patients were asked to assess the pain in the wrist using a score of 1–4 (1, no pain; 2, slight or occasional pain; 3, moderate pain that required occasional analgesics; 4, severe pain requiring regular analgesics). They were asked to rate their satisfaction as well (1, complete satisfaction; 2, partial satisfaction; 3, dissatisfaction).[4]

Objective assessment

The Buck-Gramcko score for objective evaluation of total wrist fusion for each patient was modified and employed for STT fusion (Table 1).[2] Three patients finally underwent a total wrist fusion. Therefore objective evaluation score was determined prior to the total wrist fusion in these three patients.

Table 1. Modified Buck-Gramcko/Lohmann score for objective evaluation of STT fusion

Criteria	Score[a]
Range of motion of wrist	
>70% (of the unaffected wrist)	3
>50%	2
>30%	1
<30%	−1
Functional use of hand	
Full function	2
Limitation of special use	1
Limitation of daily activities (change job)	0
Pain during function	
Freedom from pain	2
Pain during heavy work	1
Pain during all activities	0
Grip strength	
75%–100% (of normal side)	2
50%–75%	1
<50%	0
Subjective	
Improved	1
Worsened	−2
Total	

STT, scaphotrapeziotrapezoid
[a] Excellent, 9–10; good, 7–8; satisfactory, 5–6; poor, <5

Radiological assessment

Radiographs were obtained at least every 2 weeks after the STT fusion until confirmation of solid union. Radiographs at follow-up were evaluated to determine union, radioscaphoid angle, and progression of intercarpal or radiocarpal arthrosis. The radioscaphoid angles were measured on the lateral films with the wrist in neutral position. To determine the scaphoid axis, a line is drawn connecting the proximal (dorsal) and distal (palmar) convexities of the bone. The radioscaphoid angle is determined by measuring the longitudinal axes of the scaphoid and radius. Tomograms were obtained if it was difficult to determine union.

Statistical analysis

Statistical comparison of the obtained data was performed using paired *t*-tests. A statistically significant difference was considered when P was <0.05.

Results

Subjective assessment

The postoperative mean pain score ± standard error was 1.4 ± 0.3. Five patients reported pain scores: 2 in one patient, 3 in one, and 4 in three. The mean satisfactory score was 1.2 ± 0.2. Four patients were dissatisfied with the results (satisfaction score of 2 in two patients

and 3 in two patients). The remaining 26 patients said they would undergo the same procedure again.

Objective assessment

Preoperative range of motion (ROM) of the wrist in 30 wrists averaged 45° ± 15° in extension and 43° ± 14° in flexion. Postoperatively, the ROM of the wrist averaged 38° ± 16° in extension and 39° ± 14° in flexion. The combined postoperative ROM of the wrist was 55% ± 7% of the unaffected wrist. Preoperatively, the grip strength in 30 wrists averaged 18 ± 10 kgf. The postoperative grip strength improved to 27 ± 12 kgf (76% of the unaffected wrist). This postoperative improvement showed statistical significance ($P < 0.05$).

After STT fusion, 17 patients returned to their previous jobs. Six housekeepers were able to perform their daily activities as well as before the operation. Three patients had retired. Subsequently, 26 patients returned to their previous activities; the remaining 4 patients changed their jobs to lighter work. The Buck-Gramcko mean score was 7.1 ± 1.5 — at the lower limit of the "good" range.

Radiological assessment

All patients underwent STT fusion uneventfully. Kirschner wires were removed on average at 9.3 weeks (range 6–12 weeks) postoperatively. Cast immobilization was applied on average for 8.3 weeks (range 6–10 weeks). Bone union was obtained at an average of 11.2 weeks (range 8–14 weeks).

Whereas the preoperative average radioscaphoid angle was 68° (range 47°–90°), the postoperative radioscaphoid angle averaged 53° (range 10°–77°). In five patients the arthrodesis was in a less-than-optimal position (radioscaphoid angle was 70° or more) despite attempted reduction to a normal orientation from scaphoid malrotation.

Postoperative complications

Of the 30 patients, 8 (27%) experienced postoperative complications. Arthroses were present in seven patients (23%): five at the radioscaphoid joint and two at the trapeziometacarpal joint. In these cases degenerative changes had been present in four patients with stage IV Kienböck's disease. Slight to moderate development of degenerative changes occurred in these four patients. Therefore, postoperative arthrosis was found in three wrists after the procedure: one at the radioscaphoid joint and two at the trapeziometacarpal joint. Arthrosis was determined on the basis of joint space narrowing, cortical sclerosis, and hypertrophic changes at the joint. Three of five patients with arthrosis at the radioscaphoid joint underwent total wrist fusion subsequently. The remaining two patients with arthrosis at the radioscaphoid joint refused a further procedure. Of the 30 patients with normal trapeziometacarpal joints beforehand, 2 developed symptomatic arthrosis at the trapeziometacarpal joint of the thumb postoperatively. Trapeziometacarpal arthroplasty is planned.

In the remaining patient, the flexor pollicis longus tendon ruptured 3 months after STT fusion. The cause of this rupture was not clear, although the postoperative bony prominence at the STT joint was thought to be cause. Tenorrhaphy using a free tendon graft resulted in excellent motion of the thumb. There were no pin tracts or serious infections.

Discussion

Watson and Ryu[18] stated that they had not observed any degenerative changes after 492 STT fusions over a 16-year period. Based on 23 months of follow-up data, however, Rogers and Watson[13] reported that radial styloid impingement occurred in 21 of 93 cases after successful STT fusion; 17 patients subsequently underwent partial radial styloidectomy. On the basis of these findings, they recommended that a partial radial styloidectomy be performed simultaneously with STT fusion. Kleinman and Carroll[8] reported a 52% complication rate for STT fusions performed to alleviate chronic scapholunate instability. Progressive carpal arthrosis was the most frequent complication, noted in 19% of their series. The progressive arthrosis occurred when reduction of the scaphoid malrotation had been unsuccessful.

Fortin and Louis[5] reviewed a series of 14 patients who underwent scaphoid-trapezium-trapezoid fusion for chronic scapholunate instability or isolated arthrosis. Eleven patients had complications, including radiocarpal arthrosis (six patients), trapeziometacarpal arthrosis (four patients), and nonunion (three patients). They emphasized the importance of the uncorrected radioscaphoid angle as a factor in the development of arthrosis at the radioscaphoid joint, as their patients with an angle of >70° had progressive radioscaphoid changes.[5] There is also a correlation in our series between the postoperative radioscaphoid angle and radioscaphoid arthrosis. Of our 30 patients, 7 developed degenerative arthrosis, 5 at the trapeziometacarpal joint. Of the five patients with radioscaphoid arthrosis, three had radioscaphoid angles of >70%. Two had angles of 10° and 45°, respectively. Of the four patients who complained postoperatively of moderate and severe pain, three had a radioscaphoid arthrosis due to overcorrection of the scaphoid. This suggests that overcorrection may be a risk factor in the development of

radioscaphoid arthrosis by accentuating the load through the scaphoid fossa of the radial articular surface.[12] Anatomic reduction of the scaphoid at the time of surgery appears to be of clinical importance for reconstituting physiologically acceptable joint motion.

The occurrence of arthrosis at the radioscaphoid joint in this study is much lower than in other reports.[5–8,10] The reason is not clear, however. The constitution of diseases in our series is quite different from that of others, as most of those in our series were Kienböck's disease, in contrast to scapholunate dissociation in other series. Radioscaphoid angles in Kienböck's disease are smaller than those in patients with scapholunate dissociation, which may explain the fewer radioscaphoid angles of $>70°$ and the lower occurrence of radioscaphoid arthrosis.

The score in seven patients with osteoarthrosis was 5.2 ± 1.8, whereas that in the remaining 23 patients without osteoarthrosis was 7.7 ± 1.4. The difference showed statistical significance ($P < 0.05$). This result suggests that the existence of osteoarthrosis is a considerable negative factor influencing clinical results.

In the current study there were no delayed unions or nonunions at the fusion site, whereas postoperative nonunion of the STT fusion is relatively high in other reports (e.g., 15% in Kleinman and Carroll's series[8] and 21% in Fortin and Louis's series).[5] Neither the surgical method of arthrodesis nor the duration of immobilization appeared to be factors, according to Fortin and Louis.[5] Long-term follow-up of all STT fusions showed that half of their patients had significant residual symptoms, functional limitations, or both.[5]

Conclusions

Fusion of the STT remains a useful procedure for treating Kienböck's disease and isolated STT arthrosis, although arthrosis at the radioscaphoid or trapeziometacarpal joint occurred in 23% of patients.

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