



Treatment of scaphotrapezial trapezoidal osteoarthritis with resection of the distal pole of the scaphoid

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Objective: The aim of this study was to describe the surgical technique for resection of the distal quarter of the scaphoid and compare the results of patients treated by resection with patients treated by resection with insertion of a pyrocarbon implant.

Methods: The study included 9 wrists treated by resection-only and 8 wrists treated by resection with implant. Average follow-up period was 77 (range: 24 to 130) months. Wrist motion and pinch strength were measured and pain was evaluated using the visual analog scale (VAS). Radiographic classification was performed according to Crosby's classification system and the radiolunate (RL) angle was measured pre- and postoperatively.

Results: Postoperative VAS pain scores were 2.1 and 2.6 in the resection-only and implant group, respectively. Pain scores decreased significantly in both groups ($p=0.007$ and $p=0.01$, respectively). The mean RL angle increased from 14° to 30° in the resection-only group ($p=0.008$). In the STPI implant group, there was an increase in the mean RL angle from 21° to 23° ; however, this difference was not significant ($p=0.75$).

Conclusion: Application of a pyrocarbon implant appears to be useful for pain relief and may help prevent secondary deformities in the treatment of scaphotrapezial trapezoidal arthritis.

Key words: DISI; resection of the distal pole of the scaphoid; scaphotrapezial trapezoidal arthritis; STPI prosthesis.

Scaphotrapezial trapezoidal (STT) osteoarthritis is a common degenerative disease of the articulation between the scaphoid, trapezium and trapezoid. It was first described in 1978 by Crosby et al.^[1] Although usually associated with osteoarthritis of the trapeziometacarpal (TM) joint, it can be an isolated pathology or an incidental radiographic finding.^[2]

Recently it has been determined that a non-dissociative form of dorsal intercalated segment instability (DISI) may exist concurrent with STT osteoarthritis.

^[3] Ligament disruption and scaphoid shortening related to the arthritis may result in scaphoid extension and lunocapitate malalignment in the absence of a true scapholunate and lunotriquetral ligament lesion.^[3] In addition, there is an association with STT osteoarthritis and capitulunate (CL) osteoarthritis.^[3] However, STT osteoarthritis was not associated with radioscapoid arthritis generally seen in scaphoid nonunion advanced collapse (SNAC) and scapholunate advanced collapse (SLAC) lesions. It is speculated that the CL arthritis

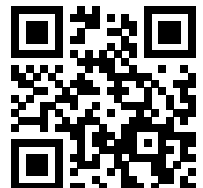
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may be a secondary effect of chronic DISI.^[3]

The aim of this study was to report the results of the resection of the distal quarter of the scaphoid using the volar approach and compare the results of patients treated by only resection and by resection with the application of a scaphoid trapezium pyrocarbon implant (STPI) for STT osteoarthritis.

Patients and methods

Patients diagnosed with STT osteoarthritis between January 2002 and June 2011 were analyzed retrospectively. The study included 17 wrists (11 right and 6 left) of 16 patients (mean age: 63 years; range: 53 to 78 years). Patients with idiopathic STT osteoarthritis who underwent resection of the distal quarter of the scaphoid using the volar approach with or without the application of STPI and who were followed up for a minimum of two years were enrolled in the study. Patients with post-traumatic STT osteoarthritis and patients whose radioscaphoid joint showed radiographic signs of degeneration were excluded. All patients had wrist pain centered at the STT joint. Wrist extension and radial deviation were limited. All patients reported tenderness over the flexor carpi radialis (FCR) tendon during forced wrist flexion. All patients reported reduced grip strength.

The decision for surgery was made after unsuccessful conservative treatment with oral anti-inflammatory drugs and thumb spica splint for 6 weeks. Prior to surgery, patients were informed about the procedure. The decision to use the STPI was made according to the patient's preference. The resection-only group consisted of 9 wrists and the STPI implant group 8 wrists. Informed consent was taken from each patient before being enrollment.

Under axillary block anesthesia, a longitudinal skin incision was performed on the volar aspect between the FCR tendon and the radial artery. After reaching the plane of radiocarpal joint, a longitudinal incision was performed on the STT joint distal to the radioscaphocapitate ligament. The distal quarter of the scaphoid was then resected perpendicular to the axis of the scaphoid. Having removed the distal portion of the scaphoid, fluoroscopic control was performed in maximum radial deviation in order to confirm the absence of impingement between the radial styloid and the remaining portion of the scaphoid. In the resection-only group, this step was followed by the proper closure of the layers. In the implant group, the appropriate implant size was calculated using trial implants under fluoroscopic control. The prosthesis, after being housed, should be mobile and

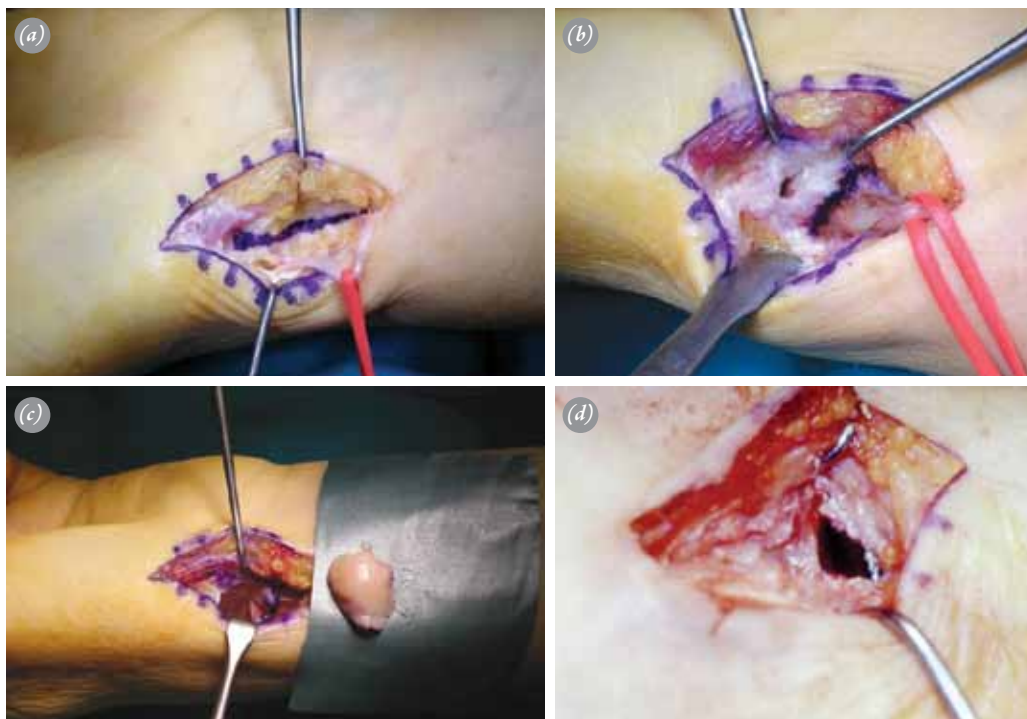


Fig. 1. (a) After the skin is incised between the FCR tendon and radial artery, capsule is incised longitudinally to visualize STT joint and (b) the scaphoid is osteotomized perpendicularly to its axis. (c) After the resection of the distal pole of the scaphoid, (d) a proper-sized STPI is put in the cavity between the scaphoid, trapezium and trapezoid. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

self-stabilizing and should not impinge on the radial styloid (Fig. 1). The implant was then put in place. In both techniques, after the suturing of the capsule and the skin, the wrist was immobilized in 20° of extension and the thumb carpometacarpal joint in 45° of adduction and flexion with a thumb spica splint.

On the 1st postoperative day, the wrist was checked for edema and splint position. After 15 days, the splint was exchanged with a removable one and the patients were instructed to perform active and passive motion exercises for the TM joint. The removable splint was worn for another 3 weeks.

Wrist motion was measured both pre- and post-operatively and was expressed as the ratio between the wrist flexion-extension arc of the involved and the contralateral hand. Measurements were taken by the senior author (AM) using a goniometer. In the patient who was operated bilaterally, wrist motions were expressed as the ratio between the postoperative and preoperative global wrist motions. Pinch strengths were postoperatively recorded using a JAMAR® hydraulic pinch gauge. Pinch strength values were expressed in ratio in respect to the contralateral wrist. Pinch strengths of the bilateral patient were expressed as the ratio between the preoperative and postoperative values.

Pain scoring was performed preoperatively and post-operatively using the visual analog scale (VAS) (10 mm line with verbal anchors of 0 as 'no pain' and 10 as 'the worst possible pain'). Every patient was asked a 'yes or no' question about their satisfaction with the treatment.

For all patients, posteroanterior, lateral and oblique radiographs were taken as standard visualization of the STT joint. Radiographic classification was performed according to Crosby's classification system (Table 1).^[1] The radiolunate (RL) angle was measured on radiographs. Radiographic controls were repeated at the 3rd, 6th and 12th months and the final follow-up for the normal positioning of implants, secondary arthritic changes and DISI development. Angular measurements were performed by the hospital's musculoskeletal radiologist. All angles were measured accurately using our institution's radiology software (SynchroMed®).

The STPI is made of graphite coated with pyrocarbon (STPI; Tornier-BioProfile, Montbonnot-Saint-Martin, France). This material was developed for nuclear applications as a coating for nuclear fuel from a collaboration between the French Commission for Atomic Energy and the US company General Atomics in the 1960s. Carpal implants were developed in the 1990s. This prosthesis has a button-like shape, with one convex

Table 1. Crosby's classification.^[1]

Stage	Description
0	Normal joint
1	Slight joint space narrowing, sclerosis
2	Marked joint space narrowing, osteophytes <2 mm
3	Osteophytes >2 mm, subchondral cysts, ankylosis

and one concave surface. The convex shape adapts to the trapeziotrapezoid joint surface. The implant comes in two sizes: 14 mm and 16 mm in diameter.

Continuous variables were expressed as mean±standard deviation and range. The Mann-Whitney U test was used to compare nonparametric continuous variables between two groups while the Wilcoxon test was used to compare the preoperative and postoperative values of the same group. A p value of less than 0.05 was considered statistically significant. As the two hands in the bilateral case were regarded as independent from each other, conventional statistical methods were applied.

Results

The mean follow-up time was 77 (range: 24 to 130) months. In the resection-only group, 2 wrists had Stage 2, and 7 had Stage 3 disease. In the STPI group, 4 wrists were Stage 2 and 4 were Stage 3.

Preoperative mean VAS score of the resection-only and STPI groups were 8.2 (range: 7 to 9) and 8.5 (range: 7 to 9), respectively. At the final follow-up, the mean VAS scores were 2.1 (range: 1 to 3) in the resection-only group and 2.6 (range: 1 to 8) in the STPI group. In both groups, the decreases in the VAS scores were statistically significant (p=0.007 and p=0.01, respectively). One patient in the STPI group had a postoperative VAS of 8 due to reflex sympathetic dystrophy.

The ratio of wrist flexion-extension arc of the involved wrist in respect to the contralateral side after the operation were 83% (range: 70% to 90%) in resection-only group and 87% (range: 80% to 90%) in the STPI group.

Pinch strengths slightly decreased in all patients, with the exception of the patient with a postoperative VAS of 8 who lost 50% of his strength. The average decreases in pinch strengths were 12% (range: 10% to 20%) in the resection-only group and 32% (range: 10% to 50%) in the STPI group.

In the resection-only group, mean RL angle was 14° (range: 8° to 30°) preoperatively and 30° (range: 21° to 32°) postoperatively (Fig. 2a-d). The mean pre- and postoperative RL angles found in the STPI group



Fig. 2. (a) Preoperative posteroanterior and (b) lateral views of a patient treated with resection arthroplasty only. (c) The articular surfaces of the scaphoid and lunate are well preserved. (d) However, the DISI deformity is still obvious after 6 years. (e) Preoperative posteroanterior and (f) lateral views of a patient treated with resection and STPI. (g) The implant is well positioned (h) and there is still no DISI deformity after 34 months.

were 21° (range: 4° to 37°) and 23° (range: 5° to 33°), respectively (Fig. 2e-h). The increase in the RL angle in the resection-only group was statistically significant ($p=0.008$) whereas the increase in STPI group was not significant ($p=0.75$).

All patients, with the exception of one who developed reflex sympathetic dystrophy, were satisfied with their operation.

No implant dislocation or any adverse reaction to the implant material was observed. Patient data and evaluation values are given in Table 2.

Discussion

The common goal of all treatment options for STT osteoarthritis is pain reduction. Surgical techniques described for STT osteoarthritis include arthrodesis of the STT joint, resection of the distal pole of the scaphoid

(with or without biological tissue interposition), interposition of a silicone spacer and arthroscopic debridement.^[2,4-7] Although the application of a silicone implant was initially thought to be a valid alternative to fusion, its use has been widely abandoned due to complications such as implant fracture and reactive synovitis.^[6,8-10] Arthroscopic debridement may be considered a minimally invasive technique for pain relief.^[4] However, there is not enough evidence on the long-term results of this technique.

Arthrodesis of the STT joint has been used for over 30 years. It offers good pain relief and preservation of motion and strength.^[11] However, the long-term results of STT arthrodesis are mixed.^[5] In a case series with a 5-year follow-up, Fortin and Louis reported the development of secondary arthritic changes at the TM and radiocarpal joints.^[12] Another important complication

Table 2. Patient data and evaluation values.

Sex	Age	Side	Stage	Pre-operative VAS	Post-operative VAS	Mobility (%) [†]	Pinch strength [§]	Pre-operative RL angle	Post-operative RL angle	Follow-up (months)	Satisfaction
Female	67	Right	3	8	2	90	10	30°	38°	130	Yes
Female	58	Left	3	9	3	90	10	9°	21°	122	Yes
Male	56	Right	2	7	2	85	10	8°	29°	110	Yes
Female	74	Right	3	8	1	90	10	15°	30°	106	Yes
Female	76	Right	3	9	2	80 [‡]	15	14°	30°	103	Yes
Female	78	Left	3	9	3	80 [‡]	10	12°	32°	86	Yes
Female	61	Left	3	7	1	80	10	14°	30°	98	Yes
Female	69	Left	2	8	3	70	20	10°	28°	90	Yes
Female	59	Left	3	9	2	75	15	15°	30°	25	Yes
Male*	69	Right	2	9	3	90	10	12°	12°	121	Yes
Male*	57	Right	3	9	1	90	10	12°	18°	66	Yes
Female*	58	Left	3	9	8	85	50	12°	12°	60	No
Female*	59	Right	2	8	2	85	10	28°	24°	53	Yes
Female*	60	Right	3	7	1	90	10	8°	9°	51	Yes
Female*	53	Right	3	8	2	80	25	19°	15°	34	Yes
Female*	61	Right	2	9	3	90	20	11°	19°	24	Yes
Female*	59	Right	2	9	2	85	10	30°	28°	24	Yes

*: Patients who had STPI.

†: The ratio of the global wrist motions of the involved and the contralateral hand.

‡: The ratio of the preoperative and postoperative global wrist motions in the patient operated bilaterally. A radiolunate angle between -15° and 15° is accepted as normal.

§: Percentage of the decrease in pinch strength postoperatively.

seen in STT arthrodesis is nonunion which has been reported as between 4% and 29%.^[2,11,13,14] Excision of the distal pole of the scaphoid with or without soft tissue interposition has also achieved good results in terms of pain relief without compromising function.^[5,15-18]

Another main concern about the treatment of STT osteoarthritis is the accompanying DISI deformity, seen in 25 to 50% of cases, and the occurrence or worsening of midcarpal instability.^[1,3,19] Garcia-Elias reported that excisional arthroplasty might worsen instability and cause DISI deformity in patients with dorsal midcarpal instability due to the termination of the flexion moment exerted on the scaphoid and the unopposed extension movement on the lunate caused by the resection of the distal pole of the scaphoid.^[15] The indications of excision-alone arthroplasty are therefore limited to isolated STT osteoarthritis cases.^[15] The increased DISI pattern was also observed with the soft tissue interposition technique.^[5] It can be hypothesized that, although the interposed tissue is known to adapt mechanically to its new environment, this may not be enough to transmit the flexion moment from the trapezium and trapezoid to the scaphoid.^[5]

A new pyrocarbon implant has been recently introduced with promising results for the arthroplasty of the

STT joint.^[16-18] For our patients with STT osteoarthritis, resection of the distal pole of the scaphoid was performed, either with or without STPI application. In both groups, satisfactory pain relief was achieved in all but one patient. However, in this patient, we did not consider the postoperative pain to be directly related with the implant or the surgical technique due to its generalized nature.

Implantation of an STPI to fill the space created after distal scaphoid resection is thought to transmit the flexion force, counteracting the extension forces and thus keeping the lunate in physiological position. To support this hypothesis, Pequignot et al. showed that angular measurements were not altered in patients treated with the application of STPI.^[18] Similarly, we did not see a significant increase in RL angle in our patients treated with STPI. In addition, we observed that the application of STPI decreased DISI deformity in the 4 patients with a preoperative RL angle of over 15°. On the other hand, all RL angle values increased significantly in patients treated with resection alone.

A decrease in the average pinch strength was observed. While this decrease would be equal in both groups, the decrease was more prominent in the STPI group as one patient who developed reflex sympathetic

dystrophy lost half of his preoperative pinch strength. This may be attributed to the relatively long follow-up time in our study and the fact that older patients are prone to become weaker with increasing age.

Dislocation is a possible risk with the STPI technique. Pegoli et al. reported a dislocation rate of 10%, which they believed was due to inadequate resection of the distal scaphoid and related with the learning curve.^[17] However, Pequignot et al. and Low et al. did not report any implant dislocation in their patient series.^[16,18] In our opinion, the volar approach and careful resection of the distal scaphoid and optimal closure of the capsule may prevent the occurrence of dislocations.

Although the shorter follow-up time in the STPI group can be considered a limitation of this study, our results were satisfactory in terms of pain reduction and preservation of motion and strength.

In conclusion, resection of the distal quarter of the scaphoid with the use of STPI appears to be a valid technique and to constitute an alternative to STT arthrodesis for the treatment of STT osteoarthritis. This technique helps to avoid complications such as nonunion, impingement, motion limitation, secondary instability and mechanical stress with consequent arthritic changes.

Conflicts of Interest: No conflicts declared.

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