Evaluation and Management of Scaphoid-Trapezium-Trapezoid Joint Arthritis

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KEYWORDS

- Scaphoid-trapezium-trapezoid (STT) joint • Arthritis • Cause • Treatment • Outcomes
- Complications

KEY POINTS

- Degenerative arthritis at the articulation of the scaphoid, trapezium, and trapezoid (STT or triscaphe joint) is a relatively common degenerative disease of the wrist; isolated STT arthritis was found in 83% of cadaver wrists with an average age of 84 years.
- STT joint arthritis is not always symptomatic and often is an incidental finding on radiographs.
- The onset of symptoms, pain, loss of grip strength, and thumb function, usually is insidious and slowly progressive. Radial-sided wrist and thumb pain, swelling, and tenderness over the STT joint frequently are present.
- Suggested risk factors include age (>40 years of age), gender (more common and worse in women), heredity, and joint injury.
- Initial treatment is nonoperative; if nonoperative treatment fails, improvements in pain and motion can be obtained with a variety of operative procedures.

INTRODUCTION

Degenerative arthritis at the articulation of the scaphoid, trapezium, and trapezoid (STT or triscaphe joint) is a relatively common degenerative disease of the wrist and often is an incidental finding on radiographs. Isolated STT arthritis has been described in from 9% of 697 wrists in patients older than 50 years of age[1] to 83% in a cadaver study of 73 wrists with an average age of 84 years.[2] In an anatomic study of 393 cadaver wrists with an average age of 67 years, Viegas and colleagues[3] showed an average frequency of 20% of wrists with some degree of arthrosis at the STT articulation. Tomaino and colleagues[4] reported a scaphotrapeziotrapezoid arthritis rate of 62% by assessing the joint during trapeziectomy. By comparing the rate of arthritis seen during trapeziectomy to that assessed on preoperative radiographs, they concluded that radiographs were 44% sensitive and 86% specific for scaphotrapeziotrapezoid arthritis. Katzel and colleagues[5] found a 64% rate of scaphotrapeziotrapezoid arthritis in 896 radiographs.

The cause of STT arthritis is not completely understood, but multidirectional joint instability is thought to be a likely cause. The onset of symptoms, pain, loss of grip strength, and thumb function, usually is insidious and slowly progressive. Radial-sided wrist and thumb pain, swelling, and tenderness over the STT joint also may be present. Suggested risk factors include age (>40 years of age), gender (more common and worse in women), heredity, and joint injury.

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STT arthritis usually is not an isolated condition and frequently coexists with thumb trapeziometacarpal arthritis. Ferris and colleagues[1] noted an association between STT arthritis and static dorsal intercalated segment instability (DISI) deformity in their radiographic analysis of 697 wrists. More recently, Tay and colleagues[6] evaluated 24 wrists in 16 patients with STT arthritis and DISI deformity and noted that the scaphoid was extended in these patients rather than flexed as usually seen in DISI; they proposed that STT arthritis is a marker for nondissociative carpal instability.

ANATOMY

The scaphoid bridges the proximal and distal carpal rows on its radial side and articulates with the scaphoid fossa of the distal radius, the lunate, the capitate, the trapezium, and the trapezoid (Fig. 1). The scaphoid distal pole is dome shaped, which transfers load from the thumb and radial side of the hand to the radioscaphoid and scaphocapitate joints. Superior to and lateral to the scaphoid, the trapezium articulates with the scaphoid and the base of the first metacarpal through its unique saddle-shaped joint surface. Medially, the trapezoid articulates with the trapezium and the scaphoid as well as the capitate and also provides articulation for the base of the second metacarpal. Moritomo and colleagues[7] described the interfacet ridge of the distal scaphoid, which is aligned from radiodorsal to ulnar-volar and was present in 81% of cadaver wrists studied. The major ligaments of the STT articulation include the trapeziotrapezoid, the trapezoid-capitate, and the STT ligaments. The STT ligament has been identified as the major anatomic stabilizer of the STT joint. The capitate-trapezium ligament originates from the trapezium and inserts into the volar waist of the capitate and deepens the socket of the STT joint. The scaphotrapezial and trapeziotrapezoid volar ligaments help stabilize the joint, and the dorsolateral STT ligament stabilizes and links the joint to the rest of the midcarpus.

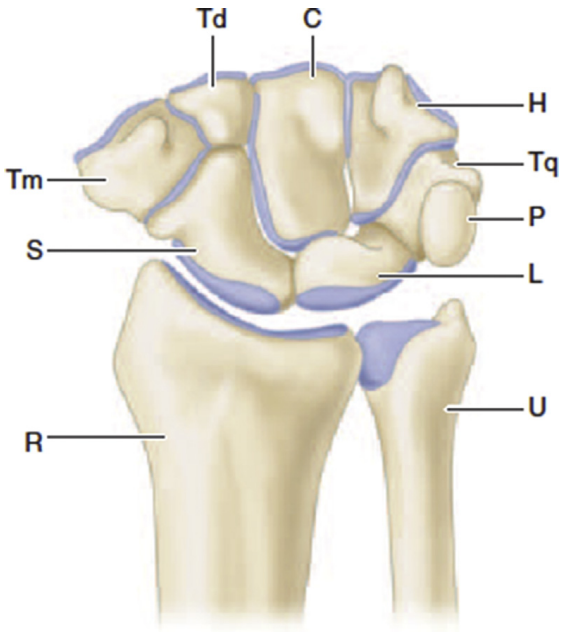

Fig. 1. Radiocarpal joint. C, capitate; H, hamate; L, lunate; P, pisiform; R, radius; S, scaphoid; Td, trapezoid; Tm, trapezium; Tq, triquetrum; U, ulna. (*From* Cannon DL. Wrist disorders. In: Azar FM, Beaty JH, Canale ST, editors. Campbell's operative orthopaedics, 13th edition. Philadelphia: Elsevier; 2017; with permission)

CLASSIFICATION

For many years, the radiographic classification designed by Crosby and colleagues[8] has been the most frequently used staging system: stage 0, normal joint; stage 1, slight joint space narrowing, and sclerosis; stage 2, marked joint space narrowing, osteophytes less than 2 mm; stage 3, osteophytes greater than 2 mm, subchondral cysts, and ankylosis. More recently, White and colleagues[9] described a classification system similar to that of Eaton and Littler[10] for carpometacarpal arthritis of the thumb (Fig. 2): stage 1, joint narrowing (compared with that of other intercarpal joints in the same radiograph), with or without subcortical sclerosis; stage 2, cystlike luciences with or without osteophytes; stage 3, complete joint space narrowing or bone-bone apposition without evident space within the cartilage.

CLINICAL PRESENTATION

Pain and weakness with grip strength reduction when performing tasks such as opening a jar are common complaints of patients with STT arthritis. Contrary to the dull ache often described with thumb carpometacarpal joint (CMC) joint arthritis, the pain often is sharp and occurs with certain particular movements.

Patients with isolated STT osteoarthritis may present with basilar thumb pain over the volarly located scaphoid tubercle or with dorsal radial-sided wrist pain. A painful bony prominence or fullness, corresponding to the STT joint, can be appreciated just distal to the radioscaphoid joint along the radial-dorsal side of the wrist and is similar in appearance to that seen in symptomatic scapholunate advanced collapse (SLAC) wrist deformity; however, the wrist dorsal prominence and synovitis associated with STT arthritis are

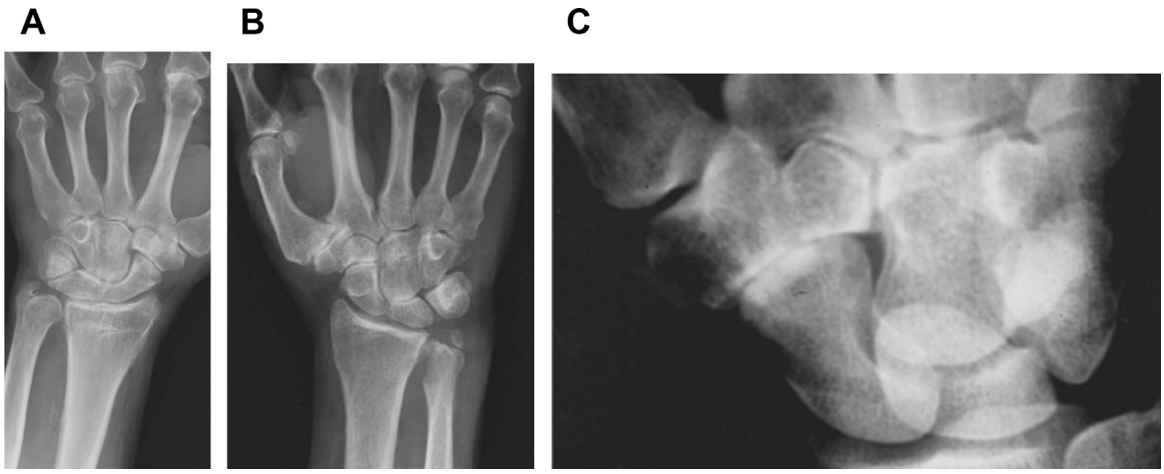

Fig. 2. Classification of STT arthritis. (*A*) Stage 1: narrowing of the joint space. (*B*) Stage 2: more severe narrowing, small osteophyte on the trapezium. (*C*) Stage 3: bone-bone apposition of the STT joint with subcortical sclerosis of the STT. In this case, the capitolunate joint space is abnormally narrow. (*From* White L, Clavijo J, Gilula LA, et al. Classification system for isolated arthritis of the scaphotrapeziotrapezoidal joint. Scand J Plast Reconstr Surg Hand Surg 2010;44(2):112–117; with permission.)

characteristically slightly more distal and ulnar than that associated with radioscaphoid degenerative processes. A radial grind test, in which the wrist is radially deviated to load the STT joint, also can elicit pain (Fig. 3).[11] Patients may present with tendonitis along the flexor carpi radialis (FCR) tendon as it courses under the trapezial ridge to its distal insertion at the second metacarpal base. Degenerative changes, osteophyte formation, and local synovitis often can irritate this tendon, leading to tendonitis and possible rupture.

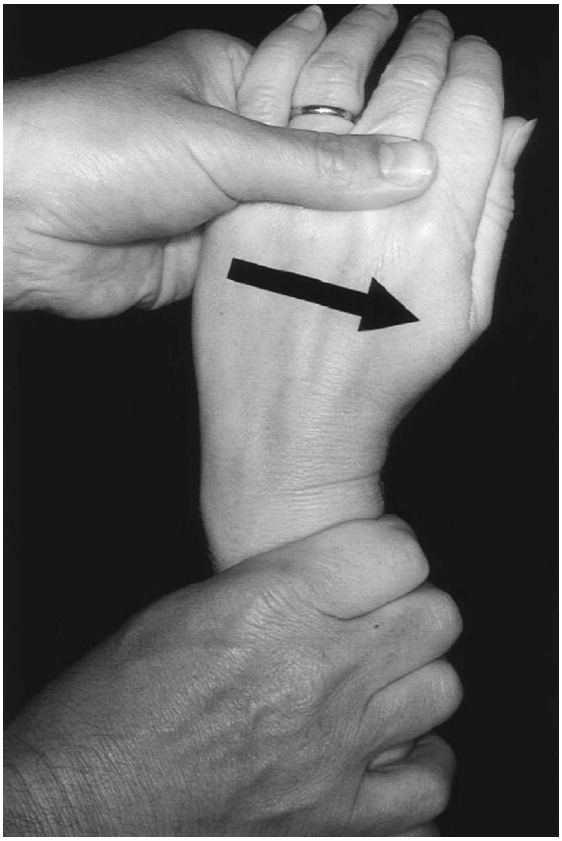

Fig. 3. Radial grind test. Pain is reproduced by passive radial deviation. Arrow indicates direction of force applied to hand. (*From* Davey PA, Belcher HJCR. Scapho-trapezio-trapezoidal joint osteoarthrosis. Curr Orthop 2001;15:220–228; with permission.)

Differentiating between concomitant thumb CMC and STT arthritis can be difficult.[4] Concomitant trapeziometacarpal and STT osteoarthritis occurred in 60% of specimens in a cadaver study.[12] When both are present, the difficulty is determining if neither, one, or both joints are symptomatic and responsible for the patient's complaints. The basilar thumb pain in STT arthritis usually is more medial and proximal than the trapezial-metacarpal joint symptoms, which are commonly referred to the thenar eminence. In addition, isolated STT arthritic pain may not be exacerbated by the physical examination maneuvers often associated with thumb CMC arthritis, such as hyperadduction/hyperextension or the thumb CMC joint grind test.[4,13] These findings may help differentiate between STT joint pain and thumb CMC joint pain. Local injection of corticosteroid and lidocaine into either the thumb CMC joint or STT joint can be both diagnostic and therapeutic. Similar to thumb CMC osteoarthritis, not all patients with STT osteoarthritis are symptomatic,[14] and clinical examination may not correlate with the radiographic findings.

RADIOGRAPHIC EVALUATION

Plain radiographs in 3 planes often are adequate for diagnosis of STT osteoarthritis.[14] A specific STT view can be obtained with the wrist in

maximal extension and ulnar deviation with the palm facing the radiograph cassette.[15] The radiograph beam is directed perpendicular to and approximately 2.5 cm medial to the base of the thumb carpometacarpal joint (Fig. 4). The prevalence of STT osteoarthritis is relatively high as demonstrated in 1 study that evaluated radiographs in a cohort of patients presenting for any complaint.[16] Increasing age, presence of a scapho-lunate gap of more than 3 mm, and the presence of thumb CMC joint osteoarthritis were associated with STT osteoarthritis.

A wide range of data has been reported regarding the effectiveness of diagnosing STT arthritis with radiographs, but, in general, radiographs likely underestimate the true prevalence of STT arthritis. Brown and colleagues[12] found only a 39% agreement between radiographic and visual STT arthritis in cadaver specimens. Glickel and colleagues[17] found 66% concordance between intraoperative findings and plain radiographs.

CAUSE AND DIFFERENTIAL DIAGNOSIS OF SCAPHOID, TRAPEZIUM, AND TRAPEZOID ARTHRITIS

STT arthritis usually develops insidiously without apparent cause and often is associated with other several diagnoses. Ferris and colleagues[1] and Tay and colleagues[6] suggested an association between STT osteoarthritis and static DISI deformity. The causality of this relationship is unclear, and whether STT osteoarthritis leads to a DISI deformity or vice versa is speculative.

Chronic scapholunate (SL) ligament insufficiency leading to SLAC wrist and DISI deformity can result in STT arthritis,[16,18] despite reports of an inverse relationship between STT osteoarthritis and SLAC wrist.[19] In this scenario, the STT ligaments (scapho-trapezium ligament and capitate-trapezium ligament, in particular) experience increased strain from the increased flexion moment seen on the scaphoid and proximal migration of the capitate through the SL gap.[18,20] Over time, this could result in STT joint degeneration and subsequent pain. Crystalline arthropathy also can lead to SLAC wrist deformity[21] and subsequent STT arthritis.[22]

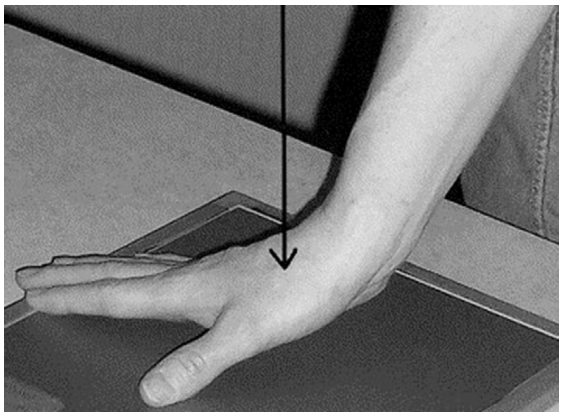

Fig. 4. STT radiographic view. (*From* Wollstein R, Wandzy N, Mastella DJ, et al. A radiographic view of the scaphotrapezium-trapezoid joint. J Hand Surg Am 2005;30(6):1162; with permission.)

Interestingly, isolated STT osteoarthritis, without SL widening, also can eventually result in a DISI deformity. DISI deformity often is associated with type I lunate morphology, where the lunate has a single articulation with the capitate.[23] STT arthritis may occur because type I lunate morphology is a less stable configuration for the proximal row,[24] whereas type II lunates have both a capitate and a hamate articulation and are more stable.[23] Shortening of the radial carpal column (scaphoid, trapezium, and trapezoid) secondary to cartilage thinning and bone loss at the STT joint may lead to scaphoid extension in an attempt to maintain carpal height. Eventually, the scaphoid is unable to maintain appropriate length from STT joint space loss, and the intermediate column (capitate and lunate) progressively collapses with resultant lunate extension and dorsal subluxation of the capitate.[25] With repetitive stress, the scaphoid-lunate ligament may attenuate to create a true DISI deformity.

Chronic midcarpal instability also can lead to STT arthritis, and the presence of midcarpal instability will impact surgical treatment; lateral radiographs should be carefully evaluated during the initial patient workup. A posterior drawer stress examination under fluoroscopy can be used to determine the presence of posterior midcarpal instability nondissociative, where the head of the capitate can subluxate or dislocate over the posterior lip of the lunate[26] (see Fig. 6). The dorsal midcarpal capsuloligamentous structures are hyperlax or insufficient, leading to dorsal instability. In theory, as the capitate subluxates dorsally, the scaphoid and lunate are forced into further extension, and shear stresses are increased at the STT joint. These increased and progressive repetitive loads exacerbate the STT joint degeneration.[26]

TREATMENT OF SCAPHOID, TRAPEZIUM, AND TRAPEZOID ARTHRITIS

Conservative treatment should be the initial treatment of STT arthritis and involves splinting,

bracing, activity modification, anti-inflammatory medication, and steroid injections for pain relief. Failure of conservative treatment is the main indication for surgery. Treatment regimens should be tailored to the patient's physical demands, and surgical management plans may directly address the STT joint or concomitant instability patterns if present.

Distal Scaphoid Excision and Variations

Distal scaphoid excision with several variations has been described for idiopathic, symptomatic STT osteoarthritis as long as there is no midcarpal instability present. Advantages include a technically easier operation, less immobilization, faster recovery for the patient, and potentially less complications compared with arthrodesis.[26] The procedure does carry its own risks. Performing a distal scaphoid resection with midcarpal instability could further destabilize the carpus from "unlinking" the distal carpal row, resulting in a more pronounced DISI deformity.[26] Arthritic degeneration between the scaphoid, lunate, and capitate articulation is another contraindication because of load transfer from the STT joint to the central midcarpal joint after distal scaphoid excision.[27,28] A dorsal radial or palmar approach can be used, with the palmar approach favored if FCR tendonitis is present to allow for examination of the tendon and possible tenolysis with excision of inflamed tenosynovium.[26] The plane of the scaphoid osteotomy is parallel to the trapezium-trapezoid proximal articular surface, with the wrist in neutral and the scaphoid at 45° to the radius. The original recommendation was for the excision to be no greater than one-quarter of the scaphoid (approximately 6 mm)[28]; however, more recent studies suggest that 3 mm of resection may be more appropriate.[29] Minimizing resection is important for preservation of the proximal origins of the dorsolateral STT and anteromedial scaphocapitate ligaments, which originate at both medial and lateral corners of the scaphoid tuberosity.

Several techniques have been described to fill the void after distal scaphoid excision and to maintain scaphoid stability and avoid excessive extension. FCR tendon interposition[30] and implant arthroplasty using a pyrocarbon implant[31–33] (Fig. 5) have been attempted. Tightening the volar radioscaphoid ligament, which functions as a tether, or tightening the dorsal scaphotrapezial capsule also helps avoid excessive scaphoid extension, although extension often occurs postoperatively to some degree.[26]

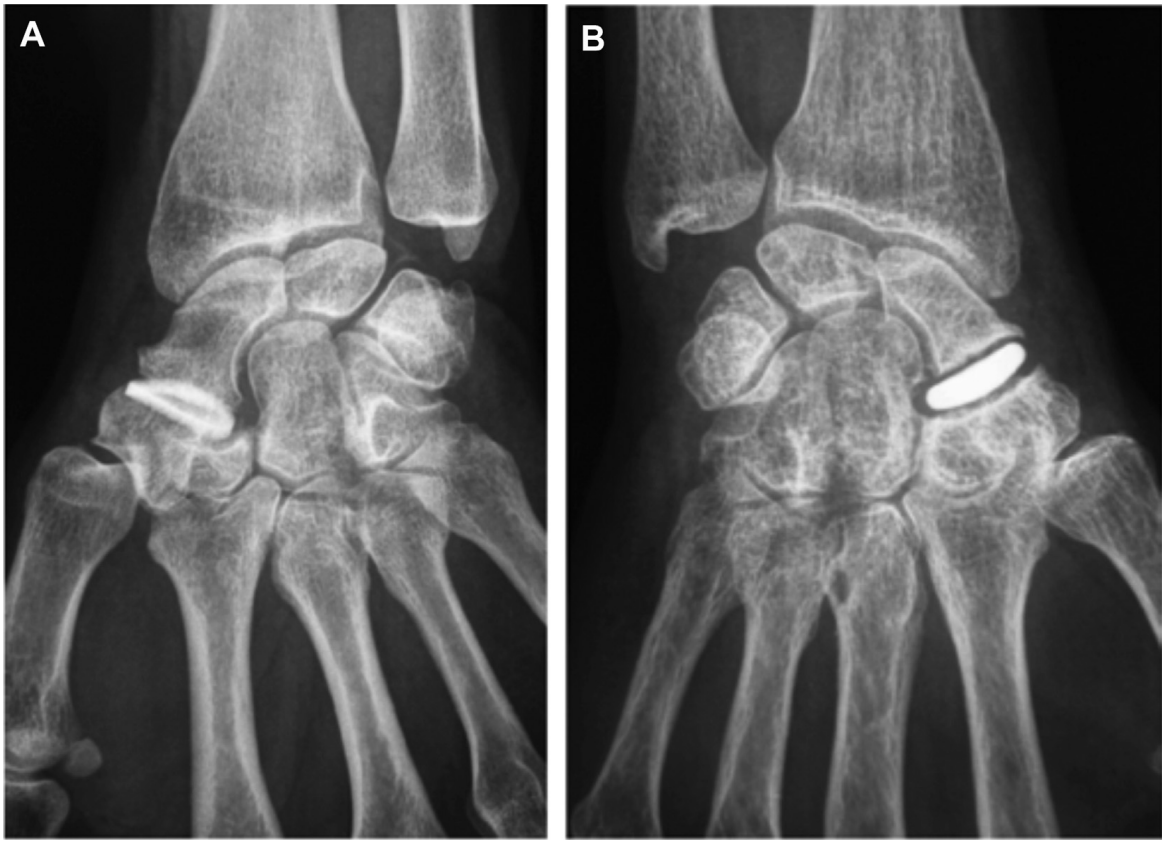

Fig. 5. Pyrocarbon implants for STT osteoarthritis. (*A*) Pyrocardan implant. (*B*) STPI implant. (*Reproduced from* Bellemère P. Pyrocarbon implants for the hand and wrist. Hand Surg Rehabil 2018;37(3):143. Copyright © 2018 published by Elsevier Masson SAS. All rights reserved.)

Arthroscopic techniques have been described for distal scaphoid excision.[34] Arthroscopic distal scaphoid excision may allow less immobilization and quicker recovery by minimizing local soft tissue dissection. A 1.9-mm arthroscope is recommended given the spatial constraints of the STT joint. The ulnar STT portal (ulnar to the tendons of the first dorsal compartment) is used as the working portal, and the midcarpal radial portal is used as the viewing portal (Fig. 6).[35] A volar portal can be used, as described by Carro and colleagues,[35] if there is difficulty visualizing the dorsoulnar portion of the STT joint. The sequence of the procedure is systematic and begins with a diagnostic arthroscopy, followed by joint debridement and synovectomy, and completed after resection of the distal scaphoid.[34] An open approach is still required if tendon interposition or implant arthroplasty is desired. A limited debridement of only synovitis, chondral flaps, and rim osteophytes, rather than distal scaphoid excision has also been described.[36]

Trapeziectomy and Variations

Total trapeziectomy is another option for treating STT osteoarthritic pain and is a popular procedure if there is symptomatic concomitant thumb CMC osteoarthritis. The ligament reconstruction, tendon interposition (LRTI), or some variant thereof, which is commonly used to treat thumb CMC osteoarthritic pain, also can be done for isolated recalcitrant STT arthritis.[37,38] Other variations include LRTI with partial excision of the proximal articular surface of the trapezoid (recommended 2 mm of resection) alone[39] or with interposition using a dermal graft[40] or the FCR tendon in the scaphotrapezoid space by placing a bone anchor into the trapezoid.[8,40] The rationale for treating STT pain with the trapezial resection techniques is to avoid scaphoid resection and minimize iatrogenic midcarpal instability[30]; however, carpal collapse and DISI deformity or abnormal extension of the scaphoid in the presence of a normal SL angle can still occur after trapeziectomy[41] (Fig. 7).

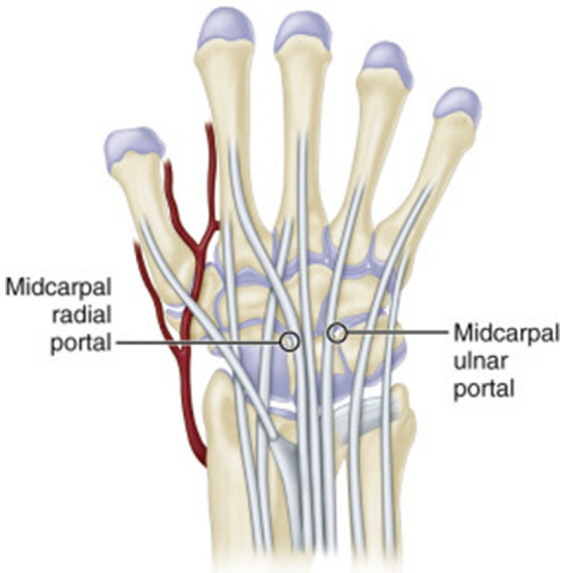

Fig. 6. Midcarpal portals for arthroscopy. (*From* Cannon DL. Wrist disorders. In: Azar FM, Beaty JH, Canale ST, editors. Campbell's operative orthopaedics, 13th edition. Philadelphia: Elsevier; 2017; with permission.)

Scaphoid, Trapezium, and Trapezoid Arthrodesis

STT joint arthrodesis was initially described by Peterson and Lipscomb[42] in 1967 and was later popularized by Watson,[14,43,44] who advocated the procedure based on his successful results. Concerns over nonunion and ability to reproduce consistent results and outcomes have made some surgeons apprehensive of this technique. A contraindication is the presence of radioscaphoid joint degenerative changes, where fusion of the STT joints would lead to increased load transfer to this already arthritic joint. The key to the procedure is to fuse the bones in normal alignment, with the scaphoid angle occurring at 40° to 60° of flexion relative to the long axis of the radius, in the sagittal plane.[45] Restoring normal alignment optimizes postoperative range of motion by avoiding impingement that can occur if the scaphoid is extended. Watson and colleagues[42] recommended routine radial styloidectomy to avoid impingement. Construct options for fusion include Kirshner wire fixation, plates and screws, headless screws, and shape memory (compression) staples (Fig. 8).

OUTCOMES

Distal Scaphoid Excision

Excision is an effective surgical option that can provide reliable results and is a technically easier procedure, allows shorter immobilization, and avoids complications related to union.

In the study by Garcia-Elias and colleagues[46] of 21 wrists, 9 received no fibrous interposition and 12 wrists had capsular or tendon tissue to fill the defect. At follow-up, 13 wrists were pain free, whereas 8 had occasional mild discomfort. Grip was an average of 84%, and pinch strength was an average of 92% of the contralateral side. Mean range of movement was 118° of flexion-extension, with grip strength improved by 26% ($P = .001$) and pinch strength

Fig. 7. A 51-year-old, right-hand-dominant man with persistent wrist pain after suture suspension thumb arthroplasty. (*A*, *B*) Residual scaphoid trapezoid joint space loss and dorsally subluxed capitate. (*C*, *D*) Intraoperative fluoroscopy shows easily reducible midcarpal joint. (*E*, *F*) After scaphoid excision and midcarpal fusion and supplementation of deficient trapezoid with scaphoid graft.

improved by 40% ($P = .001$). Of note, the wrists with no fibrous interposition showed significantly greater flexion-extension (mean 127°) than those with interposition (mean 113°) ($P = .04$).[27,46]

Wessels[47] reduced or eliminated pain in 54 of 56 patients with open excision of the distal 3 to 4 mm of the scaphoid and capsulorraphy.

Resection and Implant Arthroplasty

Most studies indicate that resection and implant arthroplasty have similar clinical results. Postoperative visual analogue scale (VAS) pain scores were 2.1 and 2.6 in the resection-only and implant groups, respectively. Pain scores decreased significantly in both groups ($P = .007$ and $P = .01$, respectively). The mean radiolunate (RL) angle increased from 14° to 30° in the resection-only group ($P = .008$). In the scaphoid trapezium pyrocarbon implant (STPI) group, there was an increase in the mean RL angle from 21° to 23°; however, this difference was not significant ($P = .75$).[32–34,48]

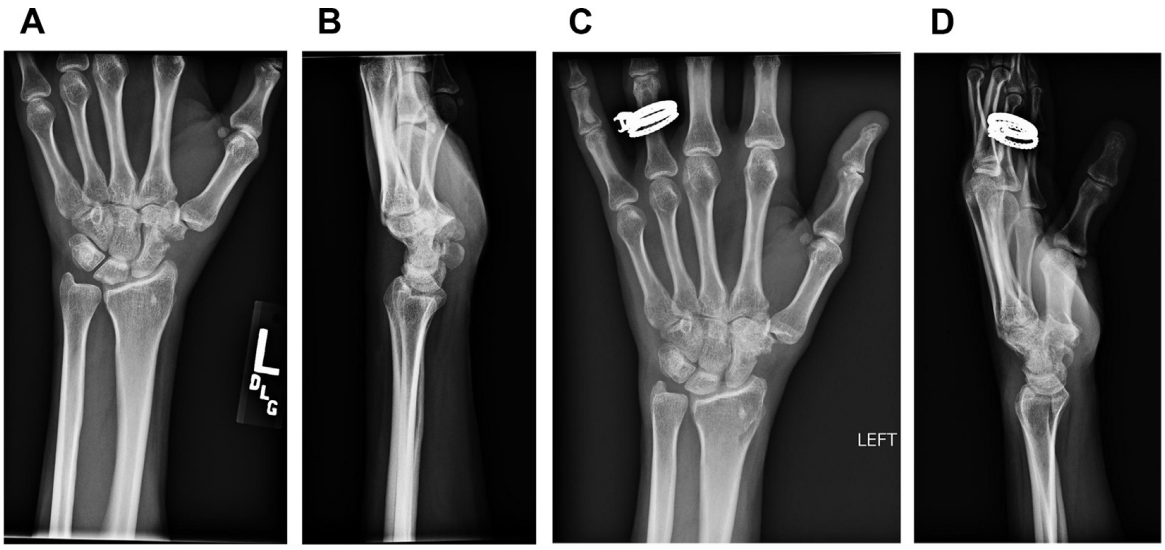

Fig. 8. A 53-year-old, right-hand-dominant woman with a ruptured FCR tendon and STT arthritis. (*A*, *B*) Appearance after allograft interposition of the scaphotrapezial joint. (*C*, *D*) After successful management of residudal pain with STT fusion.

Arthroscopic Treatment

In a study of 17 wrists, the average VAS score improved from 6.1 to 1.7 after surgery. The average grip strength improved from 18 to 19 kg. Pinch strength improved from 2.5 to 4.4 kg, and Patient-Related Wrist Evaluation (PRWE) score improved from 52 to 32.[29] Another study also demonstrated relief of pain in a series of 8 patients with isolated STT osteoarthritis, where 6 patients had complete relief and 1 patient had a decrease in symptoms.[49]

Ashwood and colleagues[36] reported good short-term follow-up (average follow-up 36 months) for pain relief in a series of 10 patients who underwent arthroscopic debridement of synovitis, chondral flaps and rim osteophytes, without distal scaphoid excision. VAS pain scores improved in all patients, with 9 patients reporting excellent to good results and 1 patient reporting fair results because of inability to achieve normal range of motion. The severity of arthritis was not noted in the study.

Ligament Reconstruction Tendon Interposition

Andrachuk and Yang[39] described their results of ligament reconstruction tendon interposition (LRTI) in 12 wrists for isolated STT joint osteoarthritis. Although their sample group was small and statistically insignificant, patients' symptoms, grip, and pinch strength were improved.

In 14 consecutive patients treated with trapeziectomy/LRTI for isolated scaphotrapeziotrapezoid osteoarthritis of the wrist, the median pain intensity was 0 on a 0 to 10 VAS, both at rest and with activity, mean grip strength averaged 24 kg, and pinch strength averaged 5 kg.[38] The disabilities of the arm, shoulder, and hand (DASH) score was 16, and a modified Mayo Wrist Score was 84. Correlation between the degree of scaphotrapezoid osteoarthritis and pain at rest, pain with activity, and DASH score was not significant. These findings suggest that trapeziectomy/LRTI is an effective procedure for treating isolated scaphotrapeziotrapezoid osteoarthritis. In comparison to Andrachuk and Yang's results,[39] these results suggest that the addition of partial trapezoid excision is not imperative for effective treatment of isolated STT osteoarthritis. Trapeziectomy and LRTI have been reported not to affect carpal alignment.[38]

Tomaino and colleagues[4] studied 37 patients with trapezial excision and compared the results between 23 patients with trapezial excision and proximal trapezoid excision for combined CMC and STT joint osteoarthritis with those of 14 patients with trapeziectomy only for isolated CMC joint osteoarthritis. There was no increased morbidity with the combined procedure. The differences in postoperative grip and pinch strengths between the 2 groups were not statistically significant. Trapeziectomy and partial trapezoidal excision produced good pain relief and motion with low morbidity and complication rates.

Scaphoid, Trapezium, and Trapezoid Arthrodesis

In Watson and Hempton's series,[43] triscaphe fusion was performed using three 0.045-inch Kirschner wires in 13 patients, 7 of whom had degenerative changes of the STT joint.

Outcomes were good overall, with a flexion-extension arc of 104° and stated pain relief. Watson and Hempton[43] produced one of the earliest comprehensive reports on the operative treatment of STT arthritis in 1980. This arthrodesis was reported to ''leave the wrist strong with minimal loss of motion.'' Another description of 5 STT arthrodeses for degenerative joint disease, with an average of 3 years of follow-up, reported fair patient satisfaction.[8]

Meier and colleagues[50] treated 111 patients with STT fusion, 83 of whom were available for evaluation at an average follow-up of 4 years. Eight patients of the STT osteoarthritis group (n = 11) had the best Mayo Wrist Score (71 points) compared with the other groups. In these patients, grip strength averaged 84% of the opposite hand and wrist flexion-extension averaged 90% compared with the preoperative motion. Pain at rest and activity decreased to 78% and 63%, respectively. Other studies have shown STT joint arthrodesis to be a valid therapeutic treatment with satisfactory results.[51]

STT arthrodesis is associated with several complications that likely limit its universal use for treatment of recalcitrant STT osteoarthritic pain. The overall complication rate in a large series of patients (800 wrists) with STT fusion was 13.4%.[38]

COMPLICATIONS OF OPERATIVE TREATMENT

In general, the surgical approach can place surrounding sensory nerves and the radial artery at risk.[47] One study noted superficial radial neuromas in situ in 7 patients out of 800, who presumably required surgical treatment.[52]

Flexor Tendon Rupture

Flexor tendon rupture has been reported after distal scaphoid excision. Deren and colleagues[53] suggested that a sharp bony remnant of the distal scaphoid eroded through the volar capsule, which led to attritional rupture of the adjacent flexor digitorum profundus and flexor digitorum superficialis tendons to the index finger. They recommended smoothing any sharp bony prominence after the osteotomy to avoid this complication. FPL rupture can also occur through this same mechanism.[27]

Dorsal Intercalated Segment Instability and Midcarpal Misalignment

A DISI deformity can occur after distal scaphoid excision, especially if midcarpal instability is present. Garcia-Elias and colleagues[28] found that distal scaphoid excision consistently led DISI deformity in their series but did not find any correlation between the patients' functional outcomes and the DISI deformity. Iida and colleagues[29] found an increased carpal deformity (defined as a capitate-lunate angle >15°) when greater than 3 mm of distal scaphoid was excised. There has been a slightly lower reported incidence of carpal misalignment with the use of a pyrocarbon implant.[32,48] In theory, by filling the resected space, the implant can possibly restore the flexion moment of the scaphoid to neutralize the lunate from the extension forces exerted by the triquetrum. Pequignot and colleagues[48] found that angular measurements were not altered in patients treated with a scaphoid-trapezial pyrocarbon implant; however, implants may be associated with higher rates of complications with an 8% to 10% rate of implant dislocation.[48] Alternatively, trapeziectomy with LRTI did not affect carpal alignment in a series published by Langenhan and colleagues.[38]

Nonunion

Nonunion was the most common complication (4%) in a series of 36 patients published by Watson and colleagues.[44] A subsequent larger series also published by Watson and colleagues[52] reported a relatively low nonunion rate; however, this has not been reproduced by others. Another group found a much higher nonunion rate with 5 out of 19 wrists (26%) treated with STT arthrodesis. Four of these wrists required revision surgery.[54] Subsequent studies reported nonunion rates of 24%[55] and 16%.[56] Vascularized bone graft from the radius has been used to try to minimize the probability of nonunion, with reported radiologic union reliably occurring at 8 to 12 weeks postoperatively.[57]

Radial Styloid Impingement

Symptomatic radial styloid impingement can occur after STT arthrodesis secondary to altered carpal kinematics and inability of the scaphoid to flex and clear with radial deviation. One study reported radial impingement in 31 out of 93 STT fusions (33%), with a higher incidence seen in patients who were treated for rotatory subluxation of the scaphoid.[58] Partial radial styloidectomy provided resolution of pain and impingement, leading the investigators to recommend this to be performed routinely with all STT arthrodesis.[27,52,58]

Adjacent Joint Arthrosis and Degeneration

Adjacent joint arthrosis and degeneration are concerns after any arthrodesis. Fortin and

Louis[56] found that progressive arthrosis of the radial-carpal and trapezial-metacarpal joint occurred in a study of 14 patients with an average follow-up of 5 years after STT fusion. There was arthrosis in 6 patients at the radiocarpal joint and 4 patients at the trapezial-metacarpal joint. Three of these 10 patients underwent additional surgery, including carpometacarpal arthroplasty and radiocarpal fusion. The investigators noted that fusion of the scaphoid within acceptable alignment did not preclude development of arthrosis.

Reflex Sympathetic Dystrophy

Reflex sympathetic dystrophy can occur after STT arthrodesis and was reported in 29 patients (3.6%) in his series of 800 patients. These patients were treated with conservative management, and long-term outcome of this complication was not provided.[52]

SUMMARY

Degenerative arthritis at the articulation of the STT (or triscaphe joint) is a relatively common degenerative disease of the wrist. Pain and weakness with grip strength and when performing tasks such as opening a jar are common complaints of patients with STT arthritis. Conservative treatment should be the initial treatment of STT arthritis and involves splinting, bracing, activity modification, anti-inflammatory medication, and steroid injections for pain relief. Failure of conservative treatment is the main indication for surgery, which may include distal scaphoid excision, with or without filling of the void after excision, trapeziectomy, STT arthrodesis, or STT implant arthroplasty. Improvements in pain and motion can be obtained with most of these described techniques, although none is without a set of subsequent complications, which may be difficult to salvage with a secondary operation. Hence, initial conservative approaches to patients with STT arthritis are advised, and the anticipated surgical outcomes, including technique-specific complications, are discussed with appropriate surgical candidates.

REFERENCES

1. Ferris BD, Dunnett W, Lavelle JR. An association between scaphotrapezio-trapezoid osteoarthritis and static dorsal intercalated segment instability. J Hand Surg Br 1994;19(3):338–9.
2. Bhatia A, Pisoh T, Touam C, et al. Incidence and distribution of scaphotrapezo-trapezoidal arthritis in 73 fresh cadaveric wrists. Ann Chir Main Memb Super 1996;15(4):220–5.
3. Viegas SF, Patterson RM, Hokanson JA, et al. Wrist anatomy: incidence, distribution, and correlation of anatomic variations, tears, and arthrosis. J Hand Surg Am 1993;18:463–75.
4. Tomaino MM, Vogt M, Weiser R. Scaphotrapezoid arthritis: prevalence in thumbs undergoing trapezium excision arthroplasty and efficacy of proximal trapezoid excision. J Hand Surg Am 1999;24:1220–4.
5. Katzel EB, Bielicka D, Shakir S, et al. Carpal and scaphotrapeziotrapezoid arthritis in patients with carpometacarpal arthritis. Plast Reconstr Surg 2016;137:1793–8.
6. Tay SC, Moran SL, Shin AY, et al. The clinical implications of scaphotrapezium-trapezoidal arthritis with associated carpal instability. J Hand Surg Am 2007;32(1):47–54.
7. Moritomo H, Viegas SF, Nakamura K, et al. The scaphotrapezio-trapezoidal joint. Part 1: an anatomic and radiographic study. J Hand Surg 2000;25A:899–910.
8. Crosby EB, Linscheid RL, Dobyns JH. Scaphotrapezial trapezoidal arthrosis. J Hand Surg Am 1978;3:223–34.
9. White L, Clavijo J, Gilula LA, et al. Classification system for isolated arthritis of the scaphotrapeziotrapezoidal joint. Scand J Plast Reconstr Surg Hand Surg 2010;44:112–7.
10. Eaton EG, Littler JW. Ligament reconstruction for the painful thumb carpometacarpal joint. J Bone Joint Surg Am 1975;55:1655–66.
11. Davey PA, Belcher HJCR. Scapho-trapezio-trapezoidal joint osteoarthrosis. Curr Orthop 2001;15:220–8.
12. Brown GD III, Roh MS, Strauch RJ, et al. Radiography and visual pathology of the osteoarthritic scaphotrapezio-trapezoidal joint, and its relationship to trapeziometacarpal osteoarthritis. J Hand Surg Am 2003;28(5):739–43.
13. Wolf JM. Treatment of scaphotrapezio-trapezoid arthritis. Hand Clin 2008;24:301–6.
14. Wollstein R, Watson HK. Scaphotrapeziotrapezoid arthrodesis for arthritis. Hand Clin 2005;21:539–43.
15. Wollstein R, Wandzy N, Mastella DJ, et al. A radiographic view of the scaphotrapezium-trapezoid joint. J Hand Surg Am 2005;30:1161–3.
16. Scordino LE, Bernstein J, Nakashian M, et al. Radiographic prevalence of scaphotrapeziotrapezoid osteoarthritis. J Hand Surg Am 2014;39:1677–82.
17. Glickel SZ, Kornstein AN, Eaton RG. Long-term follow-up of trapeziometacarpal arthroplasty with coexisting scaphotrapezial disease. J Hand Surg Am 1992;17:612–20.
18. Roberts C, Porter M, Wines AP, et al. The association of scapho-trapezio-trapezoid osteoarthritis and scapholunate dissociation. Hand Surg 2006;11:135–41.

19. Wollstein R, Clavijo J, Gilula LA. Osteoarthritis of the wrist STT joint and radiocarpal joint. Arthritis 2012;2012:242159.
20. van der Westhuizen J, Mennen U. A working classification for the management of scapho-trapezium-trapeziodosteo-arthritis. Hand Surg 2010;15:203–10.
21. Doherty W, Lovallo JL. Scapholunate advanced collapse pattern of arthritis in calcium pyrophosphate deposition disease of the wrist. J Hand Surg Am 1993;18:1095–8.
22. Saffar P. Chondrocalcinosis of the wrist. J Hand Surg Br 2004;29:486–93.
23. McLean JM, Turner PC, Bain GI, et al. An association between lunate morphology and scaphoid-trapezium-trapezoid arthritis. J Hand Surg Eur Vol 2009;34:778–82.
24. Galley I, Bain GI, McLean JM. Influence of lunate type on scaphoid kinematics. J Hand Surg Am 2007;32:842–7.
25. Lluch AL, Garcia-Elias M, Lluch AB. Arthroplasty of the scaphoid-trapezium-trapezoid and carpometacarpal joints. Hand Clin 2013;29:57.
26. Garcia-Elias M. Excisional arthroplasty for scaphotrapeziotrapezoidal osteoarthritis. J Hand Surg Am 2011;36:516–20.
27. Deans VM, Naqui Z, Muir LT. Scaphotrapeziotrapezoidal joint osteoarthritis: a systematic review of surgical treatment. J Hand Surg Asian Pac Vol 2017;22:1–9.
28. Garcia-Elias M, Lluch A, Saffar P. Distal scaphoid excision in scaphoid-trapezium-trapezoid arthritis. Tech Hand Up Extrem Surg 1999;3:169–73.
29. Iida A, Omokawa S, Kawamura K, et al. Arthroscopic distal scaphoid resection for isolated scaphotrapeziotrapezoid osteoarthritis. J Hand Surg Am 2019;44:337.e1-7.
30. Moreno R, Bhandari L. FCT interposition arthroplasty for concomitant STT and CMC arthritis. Tech Hand Up Extrem Surg 2019;23:10–3.
31. Gauthier E, Truffandier MV, Gaisne E, et al. Treatment of scaphotrapezio-trapezoid osteoarthritis with the Pyrocardan® implant: results with a minimum follow-up of 2 years. Hand Surg Rehabil 2017;36:113–21.
32. Marcuzzi A, Ozben H, Russomando A. Treatment of scaphotrapezial trapezoidal osteoarthritis with resection of the distal pole of the scaphoid. Acta Orthop Traumatol Turc 2014;48:431–6.
33. Low AK, Edmunds IA. Isolated scapotraeziotrapezoid osteoarthritis: preliminary results of treatment using a pyrocarbon implant. Hand Surg 2007;12:73–7.
34. Pegoli L, Pozzi A. Arthroscopic management of scaphoid-trapezium-trapezoid joint arthritis. Hand Clin 2017;33:813–7.
35. Carro LP, Golano P, Farinas O, et al. The radial portal for scaphotrapezio-trapezoid arthroscopy. Arthroscopy 2003;19:547–53.
36. Ashwood N, Bain GI, Fogg O. Results of arthroscopic debridement for isolated scaphotrapeziotrapezoid arthritis. J Hand Surg Am 2003;28:729.
37. Wolf JM, Delaronde S. Current trends in nonoperative and operative treatment of trapeziometacarpal osteoarthritis: a survey of US hand surgeons. J Hand Surg Am 2012;37:77–82.
38. Langenhan R, Hohendorff B, Probst A. Trapeziectomy and ligament reconstruction tendon interposition for isolated scaphotrapeziotrapezoid osteoarthritis of the wrist. J Hand Surg Eur Vol 2014;39:833–7.
39. Andrachuk J, Yang SS. Modified total trapezial and partial trapezoidal excision and ligament reconstruction tendon interposition reduces symptoms in isolated scaphotrapezial-trapezoid arthritis of the wrist. J Hand Surg Eur Vol 2012; 37:637–41.
40. Warganich T, Shin AY. A technique for the management of concomitant scaphotrapezoid arthritis in patients with thumb metacarpotrapezial arthritis: interposition arthroplasty with a capitate suture anchor. Tech Hand Up Extrem Surg 2017;21:71–4.
41. Yuan BJ, Moran SL, Tay SC, et al. Trapeziectomy and carpal collapse. J Hand Surg Am 2009;34:219.
42. Peterson HA, Lipscomb PR. Intercarpal arthrodesis. Arch Surg 1967;95:127–34.
43. Watson HK, Hempton RF. Limited wrist arthrodesis. I. The triscaphoid joint. J Hand Surg Am 1980;5:320–7.
44. Minamikawa Y, Peimer CA, Yamaguchi T, et al. Ideal scaphoid angle for intercarpal arthrodesis. J Hand Surg Am 1992;17:370–5.
45. Watson HK, Weinzsweig J, Guidera PM, et al. One thousand intercarpal arthrodesis. J Hand Surg Br 1999;24:307–15.
46. Garcia-Elias M, Lluch AL, Farreres A, et al. Resection of the distal scaphoid for scaphotrapeziotrapezoid osteoarthritis. J Hand Surg Br 1999;24:448–52.
47. Wessels KD. Arthroplasty of osteoarthritic triscaphe (distal scaphoid) joint. Oper Orthop Traumatol 2004;16:48–58.
48. Pequignot JP, D'asnieres de Veigy L, Allieu Y. Arthroplasty for scaphotrapezio-trapezoidal arthrosis using a pyrolytic carbon implant. Preliminary results. Chir Main 2005;24:148–52 [in French].
49. Normand J, Desmoineaux P, Boisrenoult P, et al. The arthroscopic distal pole resection of the scaphoid: clinical results in STT arthritis. Chir Main 2012;31:13.
50. Meier R, Prommersberger KJ, Krimmer H. Scaphotrapezio-trapezoid arthrodesis (triscaphe arthrodesis). Handchir Mikrochir Plast Chir 2003;35:323–7.
51. Srinivasan VB, Matthews JP. Results of scaphotrapeziotrapezoid fusion for isolated idiopathic arthritis. J Hand Surg Br 1996;21:378–80.
52. Watson HK, Wollstein R, Joseph E, et al. Scaphotrapeziotrapezoid arthrodesis: a follow-up study. J Hand Surg Am 2003;28:397.

53. Deren ME, Mitchell CH, Weiss AC. Flexor tendon ruptures after distal scaphoid excision for scaphotrapeziotrapezoid osteoarthritis. Hand (N Y) 2017;12:NP152–6.
54. Frykman EB, Ekenstam FA, Wadin K. Triscaphoid arthrodesis and its complications. J Hand Surg Am 1988;13:844–9.
55. McAuliffe JA, Dell PC, Jaffe R. Complications of intercarpal arthrodesis. J Hand Surg Am 1993;18:1121–8.
56. Fortin PT, Louis DS. Long-term follow-up of scaphoid-trapezium-trapezoid arthrodesis. J Hand Surg Am 1993;18:675–81.
57. Nemoto T, Inagaki K. Scaphotrapeziotrapezoid fusion for arthritis with vascularized bone grafting from the radius. J Hand Surg Eur Vol 2011;36:820–1.
58. Rogers WD, Watson HK. Radial styloid impingement after triscaphe arthrodesis. J Hand Surg Am 1989;14(2 Pt 1):297–301.