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Original Research

Trapeziectomy with Ligament Reconstruction/ Suspensionplasty Compared to Suture Tape Suspensionplasty for the Surgical Treatment of Advanced Thumb Carpometacarpal Osteoarthritis

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Purpose: Trapeziectomy with tendon reconstruction/suspensionplasty (TRS) is the most commonly performed surgical procedure in the United States for treatment of thumb carpometacarpal (CMC) osteoarthritis (OA). Trapeziectomy with suture tape suspensionplasty (STS) has been used recently at the study institution as an alternative surgical treatment option with perceived benefits of earlier return to function and reduced operative time. The purpose of this study was to compare patient outcomes following TRS versus STS for treatment of thumb CMC OA.

Methods: All patients who underwent primary, isolated TRS or STS for treatment of thumb CMC OA between 1/1/2014 and 9/1/2020 were analyzed. We assessed demographics and preoperative and postoperative patient-rated outcome scores including Patient-reported outcomes measurement information system scores as well as pain outcomes, satisfaction, and appearance at a mean of 2.6 years after surgery (minimum 6 months). Time to return to work and activities was compared between groups. Bivariate statistics compared outcomes between groups.

Results: Ninety-four patients were included in the final study cohort, of which 53 underwent TRS and 41 underwent STS. There were no differences in preoperative, postoperative, or final patient-rated outcome scores between groups. Patients reported high global and appearance satisfaction scores at final follow-up in both groups. Mean tourniquet time was 15 minutes (26%) shorter and return to work was on average 3 weeks faster for the STS group.

Conclusions: There were no differences in postoperative patient-rated outcome scores between the STS and TRS groups. The STS group had a shorter surgical time and faster return-to-work after surgery.

Type of study/level of evidence: Therapeutic III.

Thumb carpometacarpal (CMC) osteoarthritis (OA) is the second most common site of osteoarthritis in the hand and increases in prevalence with the aging population.[1–3] Thumb CMC OA affects approximately 26% of men and 34% of women aged ≥70 years and most commonly affects the nondominant hand.[3] Symptomatic thumb CMC OA may notably affect patients' quality of life and may result in up to 50% impairment of upper-extremity function.[4,5] When nonsurgical treatments fail to provide satisfactory symptom relief, surgical intervention for thumb CMC OA may be considered.

Trapeziectomy with ligamentous reconstruction and tendon interposition (LRTI) is the most commonly used surgical technique for treatment of advanced thumb CMC OA in the United States.[6] Classically, the LRTI entails open trapeziectomy followed by flexor carpi radialis tendon suspension of the metacarpal with a space-filling interpositional graft. However, it is one type of procedure that includes trapezium excision and the use of tendon for reconstruction/suspension; the abductor pollicis longus or extensor carpi radialis longus tendons also may be used alternatively for creation of a

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suspensory sling.[5,7] However, despite the popularity of LRTI among practicing hand surgeons, comparative studies have not demonstrated superiority of LRTI over other surgical treatment options including simple trapeziectomy or distraction hematoma arthroplasty.[4,8–11]

Recently, multiple surgical techniques have been described that provide internal suspension of the thumb metacarpal after trapeziectomy without requiring prolonged immobilization or K-wires.[10,12–15] Trapeziectomy with suture tape suspensionplasty (STS), a technology used previously for augmented ligament reconstruction,[16–18] has been used at the study institution for treatment of thumb CMC OA. The STS procedure allows for early mobilization with patients beginning a return to all activities by 6 weeks after surgery. Our group has been satisfied with the STS procedure and the impetus for this study was to better understand the relative outcomes of both procedures. The primary aim of this investigation was to compare patient-reported outcomes (PROs) following trapeziectomy with trapeziectomy with tendon reconstruction/suspensionplasty (TRS) or STS for surgical treatment of thumb CMC OA.

Methods

This institutional review board approved investigation was a retrospective review of all patients who underwent LRTI or STS for the surgical treatment of thumb CMC OA at the study institution between 1/1/2014 and 9/1/2020. Patients potentially eligible for study inclusion were identified through a database query of all patients treated by 1 of 8 fellowship-trained hand surgeons using Current Procedural Terminology codes 25310 and 25447. Inclusion criteria included any patients who underwent primary TRS or STS for the treatment of symptomatic thumb CMC OA refractory to conservative treatment modalities, age >18 years, and a minimum of 6-months of follow-up after surgery. Exclusion criteria included any patients with a history of trauma or prior surgery involving the ipsilateral thumb, patients who underwent any concomitant surgical procedures (eg, carpal tunnel release, trigger finger release, etc) at the time of index TRS or STS, and patients who underwent revision surgery.

The initial query using Current Procedural Terminology codes 25310 and 25447 yielded 448 potentially eligible patients. 94 were able to complete final outcomes questionnaires and were included in the final study cohort (Fig. 1). All surgeries were performed by 1 of 8 hand-fellowship-trained surgeons, of which 85% (80/94 patients) were performed by 4 surgeons. Each of the surgeons performed the ligament and STS procedures. Standardized postoperative protocols are used by all surgeons. The mean age was 64 ± 7 years and the mean duration of symptoms before surgery was 3.4 ± 2.3 years.

TRS surgical technique

The TRS was performed using the flexor carpi radialis in most patients.[19] In some cases a modification of this technique was performed using an abductor pollicis longus suspensionplasty.[7] A short-arm thumb spica splint was applied in the operating room.

TRS postoperative protocol

At 2 weeks, patients were transitioned to a short-arm thumb spica fiberglass cast. The patient was immobilized rigidly in a cast until 4–6 weeks and then transitioned to a removable forearm- or hand-based thumb spica orthosis. Therapy for gentle thumb and wrist motion was initiated at this time and the patient was allowed to initiate strengthening at 8–12 weeks following LRTI. At 3 months after surgery, the orthosis was weaned and the patient was allowed to increase activities gradually as tolerated.

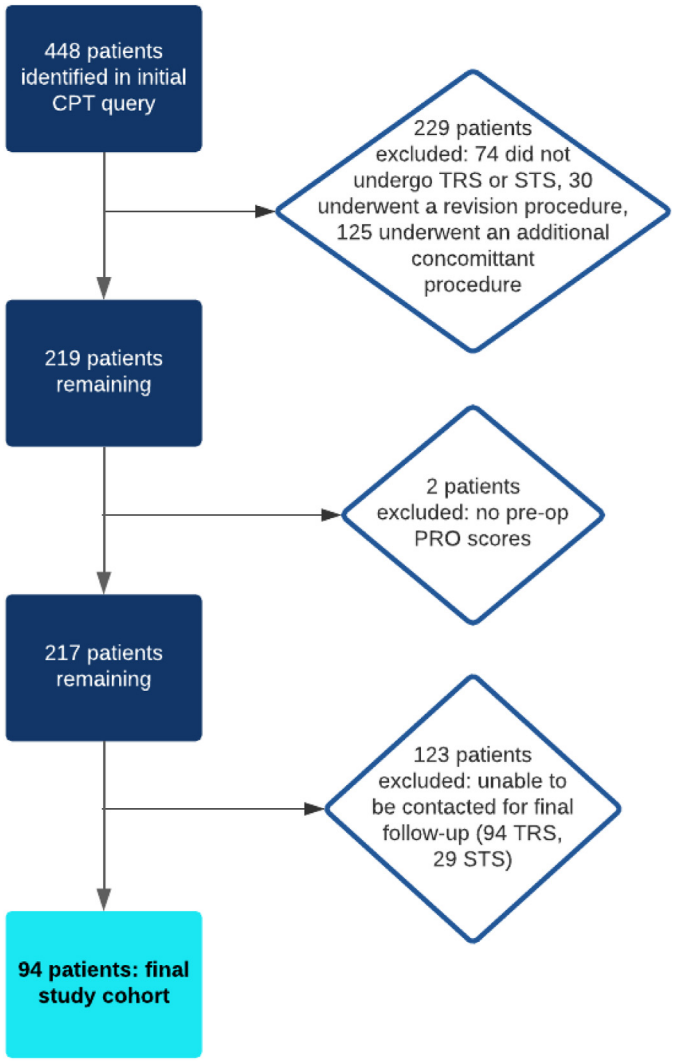

Figure 1. Study cohort selection flowchart.

STS surgical technique

We used a braided, nonabsorbable suture tape (Arthex, Inc) with anchor suspension providing time-zero strength during augmented ligament reconstruction.

A 3–4 cm incision was centered over the dorsal thumb CMC joint. The skin and subcutaneous tissue were incised sharply, ensuring careful protection of all cutaneous nerves and the radial artery. The trapezium was exposed circumferentially and excised. A fully threaded, knotless SwiveLock suture anchor with SutureTape then was inserted in the radial base of the thumb metacarpal, halfway between the dorsal and volar surface of the metacarpal. A second SwiveLock suture anchor then was placed in a similar fashion in the radial base of the second metacarpal. The thumb was positioned with axial traction and adduction to the index ray during placement of the second anchor. Once manual traction on the thumb metacarpal was released, the thumb was held suspended by the internal brace and appropriate tension was verified by assessing maintenance of the trapezial space. After wound irrigation and closure, a sterile dressing and a short-arm thumb spica splint were placed.

Table 1
Demographic Information of Patients Undergoing TRS or STS for Treatment of Advanced Thumb CMC Arthritis

Demographic Factor	TRS	STS
Number of patients (*n*)	53 (56%)	41 (44%)
Hand dominance		
Right	45 (85%)	37 (90%)
Left	6 (11%)	4 (10%)
Ambidextrous	2 (4%)	0 (0%)
Age (y)	64 ± 6.5	63 ± 8.2
Sex		
Female	27 (51%)	56 (63%)
Male	26 (49%)	44 (37%)
Duration of symptoms before surgery		
< 6 mo	2 (3.8%)	0 (0%)
6 mo–1 yr	4 (7.4%)	3 (7.3%)
1–2 yrs	9 (17%)	10 (24%)
2–4 yrs	23 (43%)	16 (39%)
4–6 yrs	13 (25%)	4 (9.7%)
>6 yrs	2 (3.8%)	8 (20%)
Prior conservative measures		
NSAIDs	52 (98%)	41 (100%)
Splinting/bracing	51 (96%)	41 (100%)
Corticosteroid Injections	47 (89%)	36 (88%)
Contralateral symptoms/treatments		
None	20 (38%)	13 (32%)
Yes—conservative (NSAIDs, splinting, injections)	18 (34%)	20 (49%)
Yes—operative (LRTI or CMC arthrodesis)	15 (28%)	8 (20%)

NSAIDs, nonsteroidal anti-inflammatory drugs.

STS postoperative protocol

The patient was seen in therapy at 5–10 days and transitioned into a custom, removable forearm- or hand-based thumb spica orthosis. Therapy for gentle thumb and wrist motion was initiated during this first visit. At 5–6 weeks after surgery, passive thumb motion and progressive strengthening were begun, the orthosis was weaned, and activities were progressed as tolerated.

Data collection and analysis

The medical record was reviewed for demographic information and outcomes of interest for all patients (Table 1). Intraoperative details were reviewed including tourniquet time for all patients. Postoperative complications were classified as either mild, moderate, or severe. Mild complications were characterized as those not substantially affecting patient recovery after surgery (ie, scar tenderness, sensory disturbances, etc). Moderate complications were characterized as those delaying patient recovery after surgery, but not necessitating revision surgery and resolving within 12 months after surgery (ie, symptomatic tendonitis, mild CRPS Type I, neuromas requiring corticosteroid injection, etc). Severe complications were characterized as those resulting in persistent rest pain or impaired hand function at final follow-up, as well as those requiring revision surgical intervention (i.e. severe CRPS Type I, refractory painful neuromas requiring excision, etc).

Patient-reported outcomes measurement information system (PROMIS) physical function v2.0 (PF), upper extremity v2.0 (UE), and pain interference v1.1 (PI)[20] were collected for all patients at their final preoperative visit and at their 2- week, 5–6 week, 2–3 month, and 4–6 month postoperative visits. These PROMIS metrics were administered to each patient during their clinical visits using iPad-based computer adaptive tests. For the final study related follow-up, patients completed the PROMIS instruments, visual analog scale (VAS) questionnaires (pain, satisfaction, appearance), and questions regarding return to work and activities (Table 2). The

Table 2
Investigational Survey Patient-Reported Outcome Measures

Patient-Reported Outcome Measures
Return to work (investigator-designed)
Return to all activities (investigator-designed)
PROMIS upper extremity v2.0[27]
PROMIS physical function v2.0[27]
PROMIS pain interference v.1.1[27]
PROMIS emotional distress—anxiety v1.0[27]
PROMIS emotional distress—depression v.1.0[27]
VAS pain
VAS satisfaction
VAS appearance

VAS scoring was “0” for the lowest rating and “100” for the highest. An electronic version of the survey was created with REDCap, a secure web-based survey administration system.

All study participants were contacted via telephone to complete the investigational survey and obtain final postoperative PRO scores. Patients who elected to complete the investigational survey via telephone completed a verbal consent and were administered the survey using a standardized verbal script. Patients who elected to complete the investigational survey electronically were sent a standardized email containing a direct link to the web-based REDCap interface where study participants were able to access and complete the survey securely. Of the 94 patients within the final cohort, 18 did not complete final VAS satisfaction or appearance questionnaires, 19 did not complete final PROMIS PI questionnaires, 3 did not complete final PROMIS UE questionnaires, and 4 did not complete final PROMIS PF questionnaires (a few patients did not complete multiple questionnaires). A total of 69 patients completed all final PRO questionnaires. There were no differences in demographic factors (Table 1) or complications between patients who did and did not complete individual questionnaires. A total of 37 patients (22 LRTI, 15 STS) were retired or not working before surgery and were not included in the return-to-work analysis. Descriptive statistics and 2-tailed Student’s *t*-tests were used to compare outcomes of interest between groups.

Results

A total of 94 patients were included in the final patient cohort, of which 53 patients underwent TRS and 41 patients underwent STS (Table 1). Patient-reported outcome scores are provided in Figure 2 and Table 3. Final outcome questionnaires were completed at a mean of 2.6 years after surgery (median 2.2 years, range 6 months–5.7 years). There were no differences between the groups in preoperative or postoperative PROMIS scores, nor in change in outcome scores over time (Fig. 2). There were no differences in final PROMIS scores nor final VAS pain, satisfaction, or appearance scores. There were high rates of overall satisfaction and happiness with the aesthetic on final outcomes scores in both groups (Table 3). Mean tourniquet time was 26% shorter for patients who underwent STS (42 ± 11 minutes, $n = 41$) relative to those who underwent TRS (57 ± 16 minutes, $n = 53$; $P<.05$).

A total of 57/94 patients (31 TRS, 26 STS) were employed before surgery and there was no difference in return to work between the groups. Twenty-six of 31 (84%, TRS) and 23/26 (88%, STS) patients returned to work. In addition, there was no difference between groups in return to all activities. A total of 42/53 TRS (79%) and 27/41 STS (66%) patients were able to return to all desired activities after surgery. Patients who underwent STS were able to return to work at a mean of 33 days compared to 54 days for patients who underwent TRS ($P<.05$). There was no difference in the rate of complications between groups (Table 4).

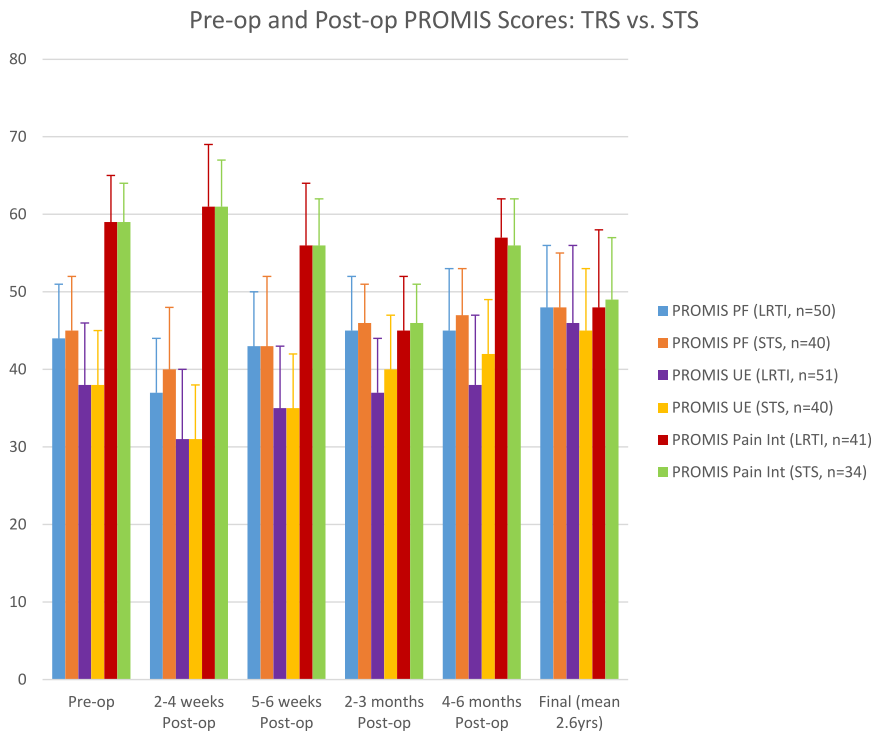

Figure 2. Preoperative and postoperative PROMIS scores: TRS versus STS.

Table 3
Final VAS Outcome Scores—TRS versus STS

	Surgery Type	N	Mean	SD	Significance (*P*)
VAS pain	TRS	53	19	21	.14
	STS	41	27	26	
VAS satisfaction	TRS	42	87	25	.75
	STS	34	85	26	
VAS appearance	TRS	42	87	22	.96
	STS	35	87	22	

Discussion

Surgical management of symptomatic thumb CMC OA has centered around the mainstay of open trapeziectomy to eliminate painful, arthritic bony apposition. The LRTI procedure has become the most commonly used surgical technique for treatment of thumb CMC OA in the United States, with 62% of active American Society for Surgery of the Hand members performing LRTI for treatment of advanced thumb CMC OA.[6] This current study demonstrated reliable short-term outcomes following trapeziectomy with STS without any differences in PROs or complications relative to TRS in the acute postoperative period or at final follow-up of a mean of 2.6 years. There were no differences between groups in the changes in outcome scores over time after surgery, and patients reported high levels of aesthetic and global satisfaction at final follow-up assessment in both groups. The STS procedure was significantly faster to perform and patients returned to work 3 weeks more quickly than those who underwent TRS.

Advocates for LRTI over isolated trapeziectomy for the treatment of thumb CMC OA primarily purport that ligament reconstruction and creation of a suspensory sling may decrease rates of thumb metacarpal subsidence and improve postoperative pinch strength. However, multiple comparative studies and systematic reviews have failed to demonstrate superiority of LRTI over other surgical techniques.[8,10,12,13,21] Gangopadhyay et al[8] examined outcomes of 174 thumbs randomized to undergo simple trapeziectomy, LRTI, or trapeziectomy with palmaris longus interposition. Of the 153 thumbs with ≥5 years follow-up, 78% of patients experienced good results with durable pain relief. However, there were no differences in pain, range of motion, grip and pinch strength, or complications among the 3 groups.[8] In their most recent Cochrane review in 2015, Wajon et al[22] examined outcomes following 7 different surgical procedures for treatment of thumb CMC OA, including LRTI and simple trapeziectomy. The study investigators concluded there was no evidence for superiority of any one procedure over another in pain, physical function, quality of life, adverse events, or treatment failure.[22]

Furthermore, compared to simple trapeziectomy, LRTI has been associated with increased operative time, increased surgical cost, and higher rates of postoperative complications.[9,21,23,24] Patients undergo a lengthy rehabilitation process after surgery, typically requiring rigid immobilization for 4–6 weeks before initiating range of motion exercises, with muscle strengthening initiated only after 3 months. In consideration of the potential associated disadvantages and lack of evidence of superiority of LRTI (or other TRS procedures) over alternate surgical procedures, hand surgeons at the study institution recently began using the STS to provide thumb metacarpal support following trapeziectomy. The STS procedure has been used previously for ligament augmentation during surgical management of a wide variety of conditions, including lateral ankle instability, ankle syndesmotic injuries, and scapholunate ligament injuries.[16–18]

There are a number of advantages of trapeziectomy with STS over TRS for the surgical treatment of thumb CMC OA. First, trapeziectomy with STS requires only a single surgical incision and does not require an additional incision over the volar forearm for tendon harvest. Second, unlike STS, TRS requires autologous harvest of a tendon which generally is well tolerated but rarely may result in volar wrist and forearm pain and cramping, altered wrist kinematics, and increased fatigue with wrist flexion resistance.[25,26]

Table 4
Complications Following TRS versus STS for Treatment of Advanced Thumb CMC Arthritis

Complication	TRS			STS			Total
	Minor	Moderate	Severe	Minor	Moderate	Severe	
Incisional paresthesias or numbness	4			3			7
Incisional erythema	1			1			2
Scar tenderness				2			2
MCP Hyperextension	4[*]		1[†]				5
Thumb MC adduction	1						1
Trigger thumb				1	2	1	4
Carpal tunnel syndrome	1				2	1	4
Pain following traumatic fall	1	1			1		3
Contact dermatitis	1						1
RSN neuritis		2					2
Persistent pain w/o clear etiology requiring CSIs		2			1		3
ECU tendonitis					1		1
De Quervain's			1				1
CRPS type II			1				1
CMC instability & thumb MC subsidence			1				1
Total (% of surgical cohort)	13 (25%)	5 (9%)	4 (8%)	7 (17%)	7 (17%)	2 (5%)	38 (40%)

CSI, computerized tomography gided spine injection; ECU, extensor carpi ulnaris; MC, metacarpal; MCP, metacarpophalangeal; RSN, radial sensory nerve.
[*] No patients were noted to have any MCP joint hyperextension on preoperative physical examination.
[†] Noted to have 25° of MCP joint hyperextension on preoperative physical examination; worsened to >40° after surgery, resulting in a desire to proceed with revision surgery.

Finally, the STS procedure provides stability of the thumb metacarpal at surgery and does not require a lengthy rigid immobilization after surgery. Following STS, patients are immobilized in a surgical splint for 1–2 weeks compared to 4–6 weeks following TRS. Patients are transitioned to a removable orthosis 5–10 days following STS and initiate strengthening at 6 weeks after surgery, compared to initiation of strengthening often at 3 months following TRS.

One important difference between our groups was the length of immobilization. The STS procedure provides immediate, time-zero stability of the thumb metacarpal, inspiring surgeon confidence in initiating a substantially faster rehabilitation process compared to TRS. All patients were able to transition to a removable brace 5–10 days after surgery, and no complications arose in the STS group related to stiffness/decreased mobility secondary to over-constraint of the thumb metacarpal. We were more cautious with the TRS group based on longstanding protocols and concerns regarding tendon healing time. Hutchinson et al[27] conducted a prospective, randomized trial comparing rigid immobilization for 6 weeks versus early mobilization following LRTI and found no differences in subjective or functional outcomes at mean 1.7-year follow-up. However, a recent survey of 823 practicing American Society for Surgery of the Hand members found that >75% of surgeons fully immobilize patients for >2 weeks following LRTI and 45% of surgeons, the largest subgroup, fully immobilize patients for 4-6 weeks following LRTI.[28]Although it is becoming clearer that shorter periods of immobilization following LRTI may offer equivalent outcomes without increasing risk, many hand surgeons continue to prescribe 4+ weeks of immobilization following LRTI. For surgeons harboring persistent concerns regarding the effects of early mobilization on soft tissue healing following LRTI, trapeziectomy with STS may offer a viable surgical alternative with potential relative advantages.

There are several potential limitations in this study. First, this retrospective analysis was dependent upon voluntary completion of questionnaires and, thus, was subject to selection bias based upon patient responsiveness. However, there were no differences in demographic factors or complications between patients who did and did not complete individual questionnaires. Recall bias may have been introduced given the mean time of administration 2.6 years after surgery. Second, not all identified patients contributed data. Thirty-seven of 94 patients were either retired or not working before surgery and were not included in the return-to-work analysis. Third, this study focused on evaluating subjective PROs following surgical intervention for thumb CMC OA. Neither radiographic measurements of subsidence or bony resorption nor objective range of motion or strength measurements between the operative and nonsurgical thumb were included within the outcome measures of interest in this study. Interestingly, radiographic subsidence generally has not been found to correlate with pain or decreased function.[29] Nevertheless, this is an area currently under investigation as part of future studies. Fourth, there was some variability in the TRS procedure performed (the majority with flexor carpi radialis and some with abductor pollicis longus suspensionplasty). And finally, a cost analysis was not performed; the STS faster return to work and surgical times could be considered along with the additional implant costs compared to TRS.

This investigation demonstrated similar outcomes between the TRS and STS procedures for thumb CMC OA. Trapeziectomy with STS demonstrated a shorter surgical time and faster return-to-work time. While our postoperative protocols differed between procedures, patients who express a desire to return to work quickly may prefer trapeziectomy with STS.

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