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Original Research

Long-Term Results of Suture-Button Suspensionplasty in the Treatment of Thumb Carpometacarpal Arthritis: A Minimum 10-Year Follow-Up

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Purpose: Combined trapeziectomy and suture-button suspensionplasty (SBS) is a common and well-established surgical treatment for thumb carpometacarpal (CMC) osteoarthritis. Although short and mid-term follow-up studies have shown promising outcomes with patients retaining excellent range of motion and strength, long-term data are lacking. The aim of our study was to assess the long-term outcomes of patients who underwent SBS surgery for thumb CMC arthritis, with a minimum follow-up period of 10 years.

Methods: We evaluated 17 patients, at least 10 years after undergoing SBS surgery for thumb CMC arthritis. We measured grip and pinch strength, range of motion, and trapezial space height and compared it with the respective values measured on the routine postoperative 3-month follow-up visit. All patients have additionally completed the Quick Disabilities of the Arm, Shoulder, and Hand questionnaire.

Results: The study included 11 women and 6 men with an average age of 60.3 ± 6.4 years and a mean follow-up of 137.4 ± 11.4 months after surgery. The mean Quick Disabilities of the Arm, Shoulder, and Hand score was 9 (range: 0–40.9) at the long-term follow-up, compared with 26.2 (range: 4.5–75) recorded 3 months after the surgery. Grip and pinch strengths were 116% and 111% of the 3-month postoperative value, respectively. Radial abduction and palmar abduction were 98% and 94% of the 3-month postoperative value, respectively. Kapandji scores were either equal or higher than the previously documented scores. Average height of the trapezial space was 69% of the previous postoperative measurement.

Conclusions: Our findings demonstrate that patients who underwent SBS surgery for thumb CMC osteoarthritis achieve excellent long-term outcomes by maintaining favorable subjective and objective results, despite some radiographic subsidence over time. These results indicate SBS to be an effective and durable technique for the long-term management of thumb CMC osteoarthritis.

Type of study/level of evidence: Therapeutic IV.

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Thumb carpometacarpal (CMC) joint osteoarthritis is a common condition that becomes more prevalent with age.^{1–3} Initial treatment options include activity modification, orthosis placement,

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nonsteroidal anti-inflammatory medications, and intra-articular steroid injections.^{4,5} If nonsurgical treatments fail to provide sufficient symptom relief, surgical intervention may be considered. Various surgical procedures are available for CMC joint osteoarthritis, including metacarpal extension osteotomy, CMC joint arthrodesis, hemiarthroplasty or total joint arthroplasty, and trapeziectomy with different techniques including ligament reconstruction and tendon interposition (LRTI), abductor pollicis longus suspensionplasty, hematoma distraction arthroplasty, suture suspension, and suture-button suspensionplasty (SBS). Some procedures have been associated with higher complication rates, but no conclusive evidence has been found to establish the superiority of

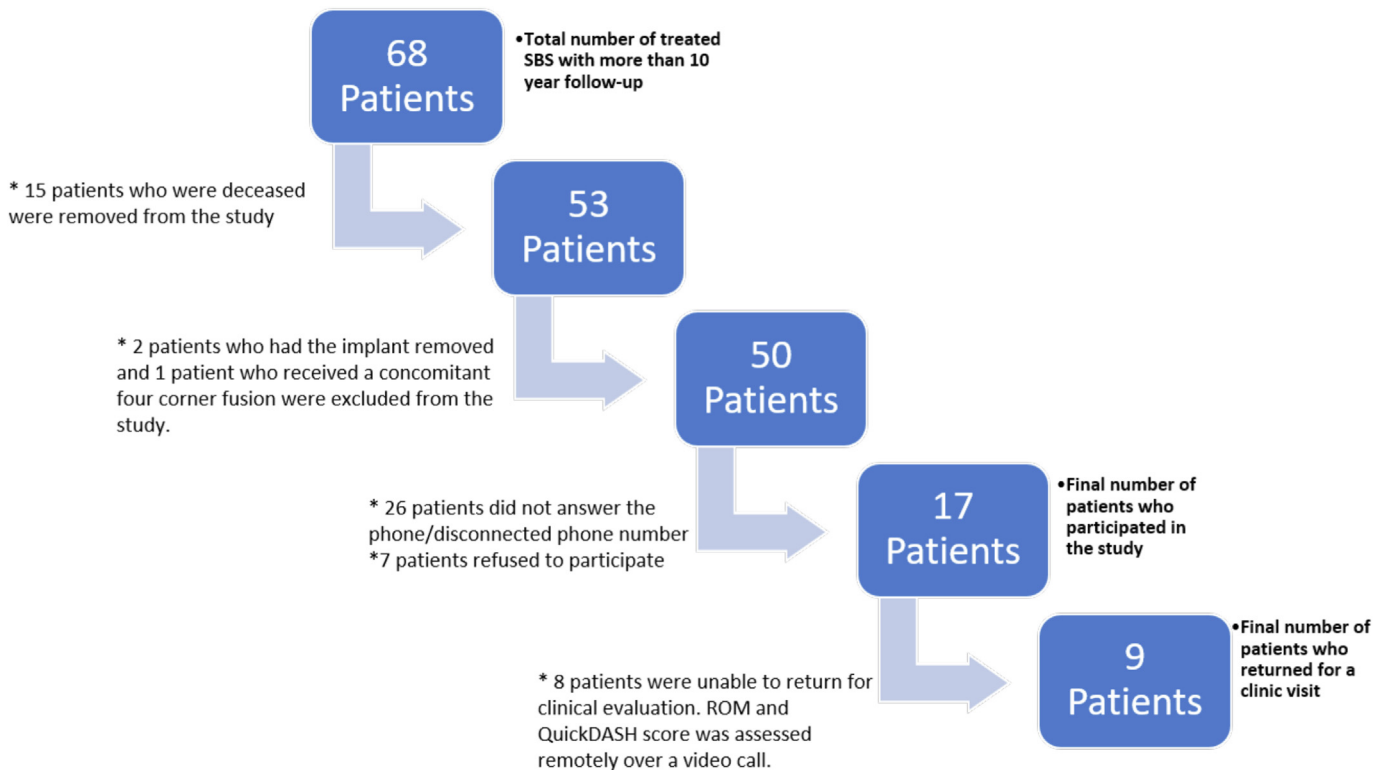


Figure 1. The flowchart showing how patients were included in this study (unavailable/unable to contact).

one procedure over another.^{6–12} The primary common aspect among these techniques is the removal of the CMC joint's articulation, either through bone removal or arthrodesis.^{6–12} However, the specific surgical techniques for the treatment of thumb CMC joint osteoarthritis vary globally.

In some practices, full or hemitrapeziectomy combined with suspension of the thumb metacarpal using a suture-button device has been adopted as the preferred procedure for the surgical treatment of thumb CMC joint osteoarthritis as it is in our practice.^{10,13,14} Existing research shows promise in the outcome of SBS based on short-term and intermediate follow-up data, but to date, no published outcomes beyond 5 years have been reported.^{10,15–23} As such, the long-term efficacy and potential complications of SBS and other surgical interventions remain inadequately investigated. This article aims to address the dearth of long-term follow-up research by reporting the long-term outcomes of SBS performed by a single surgeon in a cohort of patients with a mean follow-up of 11.4 years.

Methods

This study received approval from our institutional review board. We reviewed the charts of all 68 patients who underwent SBS for the treatment of CMC osteoarthritis by a single fellowship-trained hand surgeon at our institution between 2009 and 2013, with a minimum follow-up period of 10 years. Patients had decided on operative intervention after at least 6 months of nonsurgical treatment. After excluding 15 patients who were known to be dead, 2 patients who had the implant removed due to a symptomatic implant or decreased range of motion and 1 patient who had a concomitant 4-corner fusion, a total of 50 patients were eligible for the study (Fig. 1). Of those eligible, 17 patients who underwent 22 SBS surgeries for symptomatic thumb CMC osteoarthritis were reachable and agreed to participate in our

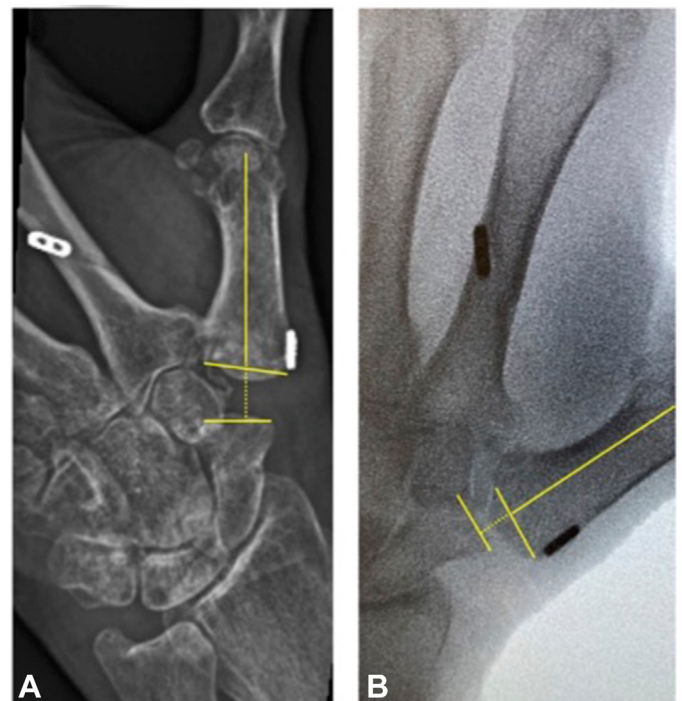


Figure 2. The method of calculating trapezial space height represented by the yellow-dashed line on an AP thumb radiograph. **A** Thumb radiograph 3 months after surgery. **B** Thumb radiograph at a minimum of 10 years after surgery.

study. All patients who were reachable were offered a virtual visit if they could not come in person. Of these 17 patients, 9 patients who underwent 13 SBS surgeries were able to return for clinical examination and radiographic imaging. During the clinical

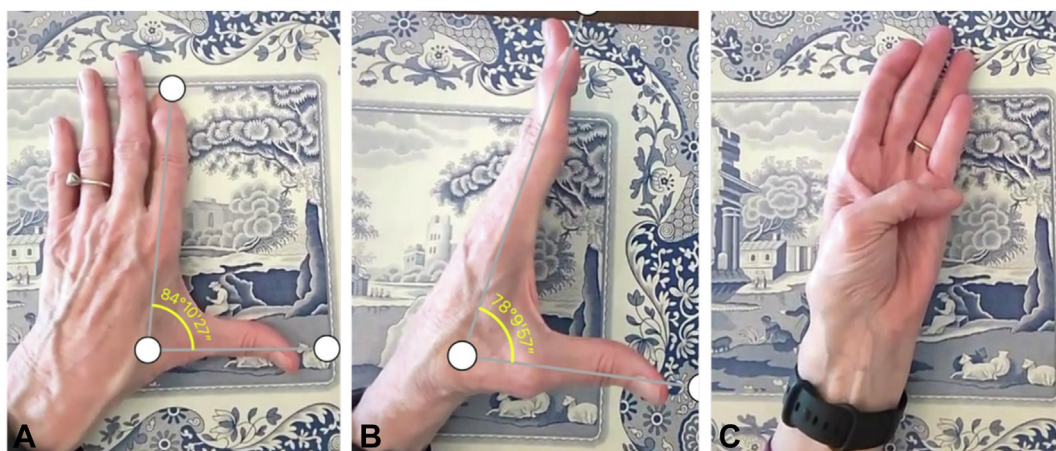


Figure 3. Representative images of a patient's thumb ROM measurements performed remotely using a digital angle measurement tool (Angle Meter 360). **A** Radial abduction, **B** Palmer abduction, **C** Opposition.

examination, range of motion (ROM) was measured using a goniometer, grip and pinch strength were recorded in kilograms, and radiographic images were obtained to evaluate metacarpal subsidence. We described the outcome as a percentage of the corresponding documented measurements from the 3-month postoperative follow-up visit. Trapezial space height, expressed as a percentage of the trapezial space height from the 3-month postoperative x-ray, represented the long-term metacarpal subsidence. Trapezial height was defined as the distance between the metacarpal base and the distal scaphoid or residual trapezium (Fig. 2). The remaining 8 patients were unable to physically attend, and therefore, Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) score and ROM were assessed remotely over a video call, using a method that has been previously validated.^{24,25} Patients received both verbal and visual instructions on the video as to the desired thumb position; thereafter, screenshots were taken in maximal radial abduction and palmar abduction. Images were

blindly displayed at random on a computer screen, and angles were measured by one of the investigators using a digital angle measurement tool (Angle Meter 360; Fig. 3). For these patients, we were unable to obtain strength and radiographic measurements. For every patient, we recorded demographic data and preoperative Eaton stage, type of trapeziectomy, concomitant metacarpophalangeal joint procedure, length of follow-up, and postoperative complications. In addition, 8 patients had no documented QuickDASH scores from their 3-month postoperative visit, with one of them missing the Kapandji score from the same period.^{10,26}

Surgical technique

We used the surgical technique as previously described.^{10,27} Briefly, a dorsal approach to the thumb CMC is used, branches of the dorsal radial sensory nerve are identified and protected, the

Table 1
Patient Demographics and Outcomes

SBS Procedure	Patient	Gender	Age (y)	Operated Side	Dominant Side	Revision/Primary	Eaton Stage	Trapeziectomy	Concurrent MCPJ Procedure	Follow-Up (mo)	Radial Abduction (3 Mo Postop)	Radial Abduction (≥ 10 y postop)
1	1	M	68	Left	Right	2°		Full	None	146	85	65
2	2	F	83	Right	Right	1°	4	Full	None	149	65	70
3				Left	Right	1°	4	Full	None	136	65	65
4	3	F	65	Right	Right	1°	4	Full	Capsulodesis	147	65	75
5				Left	Right	1°	4	Full	Arthrodesis	121	40	55
6	4	M	64	Right	Right	1°	3	Full	None	127	90	75
7	5	F	78	Right	Right	1°	4	Full	Arthrodesis	126	40	40
8	6	F	66	Right	Right	1°	2	Hemi	None	147	90	80
9	7	M	76	Right	Right	1°	4	Full	None	148	90	80
10	8	F	70	Right	Right	1°	4	Full	None	139	80	90
11				Left	Right	1°	4	Full	None	142	80	90
12	9	F	70	Right	Right	1°	3	Hemi	None	138	80	75
13				Left	Right	1°	4	Full	None	123	65	65
14	10	M	60	Left	Right	1°	3	Hemi	None			
15	11	F	62	Right	Left	1°	2	Hemi	None			
16	12	F	76	Left	Right	1°	4	Full	None			
17	13	M	76	Left	Right	1°	4	Full	Arthrodesis			
18	14	F	69	Left	Right	1°	3	Full	None			
19	15	F	65	Left	Right	1°	3	Hemi	None			
20	16	F	65	Right	Right	1°	3	Hemi	None			
21	17	M	73	Right	Right	1°	3	Hemi	None			
22	18	F	97	Right	Right	1°	4	Full	Capsulodesis			
Mean			71.4							139	72	71

1, primary; 2, revision; MCPJ, metacarpophalangeal joint; mo, months; na, not available; postop, postoperative.

* Calculated as the radiographic trapezial space measured at least 10 years after surgery divided by the space measured at the 3-month postoperative follow-up visit*100.

first dorsal extensor compartment is released, and capsulotomy of the dorsal capsule is performed with the development of flaps from either side. The trapezium is released from its surrounding attachments, and a corkscrew trapeziectomy tool is inserted into it to serve as a joystick. Using a McGlammy elevator, the trapezium is excised. A second incision is then made on the dorsal aspect of the second metacarpal, the dorsal branch of the dorsal radial sensory nerve is identified and protected, and dissection is used to reach the dorsoulnar portion of the proximal diaphysis of the second metacarpal. Using a C-clamp targeting guide, a 1.1 mm tapered suture-passing guidewire is drilled approximately 4 mm distal to the base of the thumb just dorsal to the abductor pollicis longus insertion and parallel to the joint surface aiming toward the second metacarpal at the metadiaphyseal junction. After an appropriate position is confirmed under fluoroscopy, the Mini-TightRope (Arthrex Inc.) is passed through the nitinol loop, and the guidewire is pulled through from the thumb to exit the ulnar aspect of the second metacarpal. The first button is placed on the thumb metacarpal base. The second button placed over the sutures is then snugly secured to the ulnar cortex of the second metacarpal with a provisional knot tied in the correct tension. The thumb ROM is clinically examined to ensure that there is no overtensioning of the suspensoplasty, as that may potentially limit radial abduction and cause painful impingement of the thumb metacarpal into the second metacarpal base. Live fluoroscopy is used to check for both subsidence and impingement. After appropriate tensioning, the final knots are tied, the button is buried under the second dorsal interosseous muscle, and the wounds are then closed in a standard fashion. The patient was placed in a short arm thumb spica orthosis without the IP joint included for a week, and ROM exercises were initiated thereafter with a hand therapist. At the 1-week visit, patients are made a custom thumb spica orthosis where the IP joint is free and is used during activity and at night.

Results

The mean age at the time of operation was 60.3 ± 6.4 years (range: 50–71 years). All patients were followed up for a minimum of 10 years, with a mean follow-up of 137.4 ± 11.4 months (range:

164–121 months). However, 11 patients were women, and 6 were men. Of a total of 22 SBS procedures, 10 were performed on dominant thumbs and 12 on nondominant thumbs. However, 21 were primary interventions and 1 was a revision case after a failed interposition CMC arthroplasty (Table 1). The mean QuickDASH score was 9 (range: 0–40.9), compared with the mean 3-month postoperative score of 26.2 (range: 4.5–75), resulting in a mean QuickDASH score improvement of 17.7 (range: 2.3–54.5; Table 2). In total, 4 patients experienced complications or residual symptoms. Two patients had transient superficial radial nerve neuropathia. Of the 2 patients who continued to experience from persistent basilar thumb pain after surgery (9.1%), one was a revision case after a previously failed interposition arthroplasty. The other patient exhibited signs of scaphotrapeziotrapezoidal arthritis after undergoing a hemitrapeziectomy with SBS and eventually required revision surgery with a complete trapeziectomy, which led to the resolution of her symptoms (Table 2). Of note, for patients with signs of scaphotrapeziotrapezoidal arthritis, we will excise approximately 3 mm of proximal trapezoid. None of the patients included in this study who underwent the procedure for primary thumb CMC osteoarthritis reported any complications.

Regarding ROM, mean radial abduction and palmar abduction were 98% and 94%, respectively, of the range measured at the 3-month postoperative follow-up visit. Kapandji scores were either equal to or higher than the scores previously recorded. One patient had no documented postoperative score.

Of the 17 patients, many lived several hours away, and only 9 were able to come in person for radiographic and grip/pinch strength evaluation. A radiographic review demonstrated the trapezium height space to be 69% of the height measured at the postoperative period. In other words, for more than a minimum of 10 years, the metacarpal base has subsided by a mean of 31%. Average grip and pinch strength, as a percentage of the 3-month postoperative, values were 116% and 111%, respectively (Table 1).

Discussion

Our study aimed to assess the long-term outcomes of combined trapeziectomy and SBS for thumb CMC osteoarthritis. Although

Table 1 Continued.

%	Palmar Abduction (3 mo postop)	Palmar Abduction (≥10 y postop)	%	Kapandji Score (3 mo postop)	Kapandji Score (≥10 y postop)	%	Grip Strength (3 mo postop)	Grip strength (≥10 y postop)	%	Pinch Strength (3 mo postop)	Pinch Strength (≥ 10 y postop)	%	*Trapazial Space (%)
76	90	60	67	9	10	111	32	28	87	9	7	78	74
108	45	60	133	10	10	100	18	24	133	7	6	86	77
100	50	55	110	10	10	100	29	23	79	7	6	86	64
115	80	80	100	9	10	111	32	26	81	6	6	100	74
137	60	50	83	8	9	125	17	20	118	4	7	175	54
83	90	65	72	9	9	100	23	35	152	4	6.5	162	91
100	70	50	71	na	6	na	14	14	100	5	6	120	54
89	80	75	94	9	9	100	20	34	170	4	6.5	162	88
89	90	80	89	9	9	100	25	38	152	8	8	100	92
112	90	80	89	9	9	100	18	26	144	4.5	5	111	59
112	90	75	83	9	9	100	18	20	111	6	4.5	75	50
94	80	85	106	9	9	100	21	22	105	4.5	4	89	67
100	70	70	100	9	9	100	20	16	80	3.5	3.5	100	51
101	76	68	92	9	9	104	22	25	116	5.5	5.8	111	69

Table 2
Short-Term and Long-Term QuickDASH Scores and Complications

SBS procedure	Patient	Age (y)	Follow-Up (mo)	QuickDASH Score (3 mo Postop)	QuickDASH Score (≥ 10 y Postop)	QuickDASH Score Improvement	Complications/Residual Symptoms
1	1	56	146	22	15.9	6.1	Residual basilar thumb pain
2	2	70	149	na	0	na	
3		71	136	4.5	0	4.5	
4	3	53	147	na	11.3	na	Transient SRN neurapraxia
5		55	121	40.9	11.3	29.5	
6	4	53	127	25	13.6	11.3	
7	5	68	126	na	2.2	Na	
8	6	53	147	18.1	0	18.1	
9	7	64	148	na	6.8	Na	
10	8	58	139	na	11.3	Na	
11		58	142	na	15.9	Na	
12	9	58	138	17.5	29.5	12	
13		59	123	75	40.9	34.1	
14	10	64	130	15.9	9.1	6.8	
15		65	125	11.4	9.1	2.3	
16	11	50	135	54.5	0	54.5	Revised d/t residual basilar thumb pain
17	12	62	164	9	0	9	
18	13	66	125	13.6	4.5	9.1	
19	14	57	150	25	9	16	Transient SRN neurapraxia
20	15	53	138	na	0	na	
21	16	63	123	34	0	34	
22	17	71	152	na	7.5	na	
Mean			137	26.2	9	17.7	

d/t, due to; mo, months; na, not available; postop, postoperative; SRN, superficial radial nerve.

short and mid-term follow-up studies have previously reported promising results with patients retaining excellent ROM and strength,^{10,15–23} there remains a lack of long-term data to evaluate the durability and efficacy of this surgical approach. Our investigation involved 17 patients who underwent 22 SBS procedures for thumb CMC arthritis, with a minimum follow-up period of 10 years. The results showed consistently favorable subjective and objective outcomes, confirming SBS as an effective and durable technique for the long-term management of thumb CMC osteoarthritis.

To better understand the effectiveness of SBS in the long term, it is essential to compare it with other surgical techniques commonly used for thumb CMC osteoarthritis, such as LRTI, and other forms of suspensionplasty and other procedures that aim to treat the symptoms of CMC osteoarthritis such as CMC total joint arthroplasty and arthrodesis. However, LRTI, introduced in the 1980s, has shown promising long-term results in some studies, with patients reporting improvements in pain and function even at 10 years after surgery.^{28–31} However, reports of complications have been complicated, such as tendon ruptures and tendonitis as well as altered wrist kinematics, which may affect the long-term outcomes.^{32–34} Additionally, LRTI involves harvesting and using tendons, making it a more complex procedure with potential donor site morbidity. Other forms of suspensionplasty, involving the use of biological and nonbiological materials or allografts for metacarpal suspension, have also been explored in the literature.^{35,36} Although these techniques aim to provide biological incorporation, they may carry risks of graft rejection or implant failure over time.^{35–37} Total joint arthroplasty is a joint replacement procedure that aims to restore joint function by replacing the damaged joint surfaces with prosthetic components. It is considered in cases of severe CMC osteoarthritis with joint degeneration. However, the long-term outcomes of this procedure are subject to wear and loosening of prosthetic components over time.^{38,39} CMC joint arthrodesis involves fusing the joint to eliminate motion and alleviate pain. Although this procedure can provide pain relief, it sacrifices joint motion, which may limit hand function, especially in activities requiring fine motor skills.⁴⁰

The advantages of SBS are that has a faster recovery period compared with other techniques, as it is a less invasive procedure.

Given the immediate stability provided to the thumb ray with placement of the SBS, no prolonged period of immobilization is required, and the patients may start rehabilitation as soon as the soft tissues have recovered (1 week). This accelerates the recovery for these patients as evidenced by the fact that the majority of the strength is regained by the time of the 3-month follow-up. This technique has been found to have excellent short- and medium-term outcomes.^{9,10,27,41–44} However, concerns have been raised about the lack of biological incorporation, such as using tendons, which might contribute to long-term failure. Nevertheless, our study's results show that despite some radiographic subsidence, which was evaluated in 9 patients (13 hands), the metacarpal remains suspended in the long term, likely due to the formation of scar tissue and adaptive changes within the joint. In this study, we found that the average height of the trapezial space showed some radiographic subsidence at 31% of the previous postoperative measurement. The observed change in trapezial height over the 10-year follow-up period is not appreciably different from the change in trapezial height reported in our previous study at 5 years, which was 71%.¹⁰ This similarity in subsidence rates between 5 and 10 years postoperatively suggests that there may not be a substantial additional decrease in trapezial height beyond the initial 5-year period and that this level of suspension may be durable long term.

Clinically, patients undergoing SBS fared comparatively well in the long term when compared with other techniques, demonstrating sustained improvements in ROM, strength, and functional ability.^{31,45} Although our study provides valuable evidence for the effectiveness of SBS in the long-term management of thumb CMC OA, we acknowledge the limitations of the research, including the small sample size and the lack of a control group. Selection bias could have influenced the findings of this study, as 17 of the 50 eligible patients agreed to participate in the final assessment. Several factors contribute to this, including the transient nature of our practice's population, the considerable distance some patients had to travel for the procedure, and the extended 10-year follow-up period. Additionally, the inability to get in touch with some patients due to them not answering the phone and having outdated contact information led to a lower response rate, potentially impacting the study's results and the accuracy of reported complications. Six (12%) patients had

disconnected phone lines of the phone numbers listed in their chart, and 21 (42%) patients did not answer despite being called 3 times with voicemails being left. Furthermore, this study did not investigate the long-term outcomes of patients who were not included in the research, leaving us unaware of whether these unexamined patients experienced suboptimal results. These limitations may impact the generalizability of the results. Therefore, future studies with larger sample sizes and longer follow-up periods will be crucial to further validate these findings and strengthen the evidence base for the management of thumb CMC osteoarthritis.

In conclusion, even with our small sample size, we are encouraged by our results that support SBS as an effective and reliable surgical option for the long-term management of CMC osteoarthritis. Despite concerns about the lack of biological incorporation, our results demonstrate favorable long-term outcomes, with patients achieving and maintaining improvements in pain relief, ROM, strength, and functional ability. SBS compares well with other techniques, and although larger studies are needed to corroborate our findings, the data presented here contribute to the growing body of evidence supporting the use of SBS in the treatment of thumb CMC osteoarthritis.

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