

Comparative Efficacy of Suture Suspensionplasty versus LRTI: A Systematic Review on Functional Outcomes and Surgical Efficiency

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Received: August 05, 2026; Accepted: August 12, 2026; Published: August 19, 2026

ABSTRACT

Introduction: Suture suspensionplasty (SS) is a minimally invasive surgical technique for treating thumb carpometacarpal (CMC) arthritis, characterized by pain, stiffness, and reduced grip strength. Unlike ligament reconstruction and tendon interposition (LRTI), SS avoids the need for tendon harvest and bone grafting. This review aimed to compare SS and LRTI in terms of functional outcomes, radiographic measures, complications, and operative efficiency.

Methods: A systematic review was conducted following PRISMA guidelines. PubMed, EMBASE, Cochrane Library, and Google Scholar were searched for studies published between 2015 and 2025. Inclusion criteria were comparative studies of SS versus LRTI or trapeziectomy in adults (≥ 18 years) with primary thumb CMC osteoarthritis (Eaton-Littler stages II–IV). Outcomes included patient-reported scores (DASH, PRWE), objective measures (grip and pinch strength), radiographic outcomes (metacarpal subsidence), complications, and operative time. Study selection involved independent title/abstract screening and full-text review, and data extraction followed a standardized protocol.

Results: Database searches identified 25 studies ($n = 1,427$). After exclusions, 21 studies were included. Pain relief, function, and DASH scores were comparable between SS and LRTI. Radiographic outcomes showed mixed findings, with some studies indicating less metacarpal subsidence with SS. SS consistently demonstrated procedural advantages, including shorter operative times, a single-incision approach, and elimination of tendon harvest or implantable hardware. Complication rates were similar across procedures.

Conclusion: SS provides clinical outcomes equivalent to LRTI while offering procedural efficiency and minimal invasiveness. Short-term functional recovery may be faster, although variability in study design and limited long-term data highlight the need for standardized prospective studies.

Keywords: Suture Suspensionplasty, LRTI (Ligament Reconstruction and Tendon Interposition), Thumb Carpometacarpal Osteoarthritis, Trapeziectomy

Introduction

Thumb carpometacarpal (CMC) arthritis, also known as basal joint arthritis, is the degeneration of the articular cartilage

between the first metacarpal base and trapezium. This condition is the second most common site of osteoarthritis in the hand and the most commonly studied surgery for osteoarthritis of the hand. Thumb CMC arthritis is characterized by pain at the thumb base with pinching and gripping, weakness, stiffness, and decreased grip strength in older adults. It is more common in women than in men [1]. Some contributing anatomic factors

Citation: Raven Hollis MD, Emily T Yan, DO, Rachel Safo, Kiana C Allen, Jacob Niehaus, et al. Comparative Efficacy of Suture Suspensionplasty versus LRTI: A Systematic Review on Functional Outcomes and Surgical Efficiency. J Ortho Physio. 2026. 4(3): 1-6. DOI: doi.org/10.61440/JOP.2026.v4.58

may be degeneration of anterior oblique ligament, also known as the volar Beak ligament, and dorsoradial ligaments [2]. This frequently presents with dorsal subluxation at the CMC joint, leading to a compensatory hyperextension deformity of the thumb metacarpophalangeal joint.

The prevalence of CMC joint arthritis has driven a demand for an effective, minimally invasive procedure that improves upon the well described surgeries involving tendon harvest. Suture suspensionplasty involves suspending the first metacarpal and anchoring it to the second metacarpal using a suture, no longer requiring a bone graft or tendon harvest (Figure. 1). This technique has been compared to ligament reconstruction and tendon interposition (LRTI), the most widely used surgical technique for treating thumb CMC arthritis [3]. Several studies have suggested that suture suspensionplasty may yield better outcomes compared to LRTI and have found that suture suspensionplasty may yield better outcomes than LRTI, with the potential advantages of a less invasive technique, shorter immobilization time, and early functional recovery [1-4]. However, some studies also indicate no significance in one procedure versus the other [5-7]. Many current studies are limited by short follow up durations, so although immediate and short-term results are promising, more research is needed to study the efficacy of the procedure after many years [6-8].

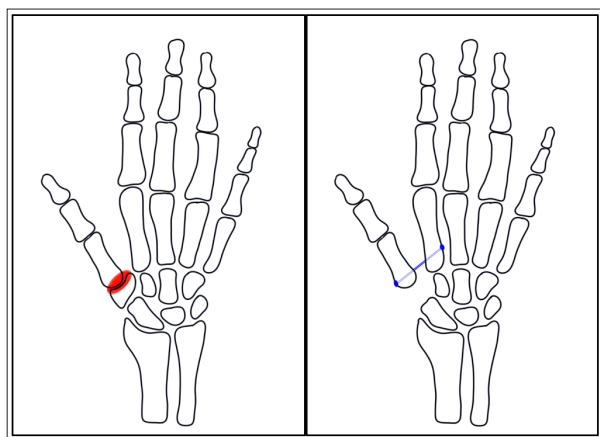


Figure 1: Illustration Demonstrating Suture Suspensionplasty for Cmc Joint Arthritis. (Left)

Thumb CMC or basal joint. (Right) Status post trapeziectomy with suture fixation between 1st and 2nd metacarpal bases.

The current contradictory findings and limited reported long-term outcomes emphasize the need for a comprehensive review to better analyze the efficacy and benefits of suture suspensionplasty over LRTI [9-14]. The goal of this study is to provide a comprehensive overview of the current literature on the treatment of CMC arthritis with suture suspensionplasty in comparison to LRTI, with particular attention to clinical outcomes, radiographic findings, complications, and long-term durability.

Methods

A systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Electronic databases including PubMed,

EMBASE, and Cochrane Library were systematically searched for potentially relevant studies.

Studies were selected based on the Population, Intervention, Comparison, and Outcome (PICO) framework for research queries. The study population was adults (≥ 18 years) undergoing primary surgical management for thumb CMC joint osteoarthritis, specifically Eaton-Littler Stage II-IV. The study intervention was suture suspensionplasty with trapeziectomy. The comparisons were LRTI or trapeziectomy alone. Primary outcomes included patient-reported functional outcomes (e.g. DASH, PRWE scores), objective measures (e.g. grip strength, pinch strength), radiographic outcomes (e.g. metacarpal subsidence), postoperative complication rates, and overall operative time.

Suture suspensionplasty has several distinct techniques to provide fixation following trapeziectomy. Commonly reported constructs for suture suspensionplasty included metal suture buttons, PEEK suture anchors, and all-suture anchors. Metal suture button constructs, such as the TightRope technique, typically use cortical buttons connected by high-strength suture across the thumb and index metacarpals. PEEK anchors are biostable, nonmetallic corkscrew implants with an elastic modulus similar to bone, commonly used as an alternative to metal buttons. PEEK anchor techniques are often preferred for knotless fixation of soft tissue or sutures to bone, avoiding any potential discomfort from hardware prominence. Variations also exist in the number of fixation points, metacarpal trajectory, and use of supplemental reconstruction. Although these techniques share the common goal of maintaining trapezial space height and stabilizing the thumb ray, differences in implants and surgical execution may limit direct comparison across studies.

Inclusion criteria were primary source literature published in peer-reviewed journals in English between 2015 and 2025. This included randomized controlled trials, prospective and retrospective cohort studies, and observational case studies or series. Exclusion criteria included secondary source literature such as systematic reviews and meta-analyses as well as studies without specific mention of suture suspensionplasty techniques.

Study selection was performed through independent title and abstract screening followed by full-text assessment by multiple reviewers. Data extraction utilized a standardized protocol to collect study characteristics, demographic information, surgical details, and outcome measures. Any discrepancies were resolved through discussion amongst the reviewers.

Results

The database search yielded a total of 25 studies that included a total of 1,427 patients. Once duplicates were removed and inclusion and exclusion criteria were applied, a total of 21 studies were included in the final analysis. The PRISMA diagram is shown in Figure 2.

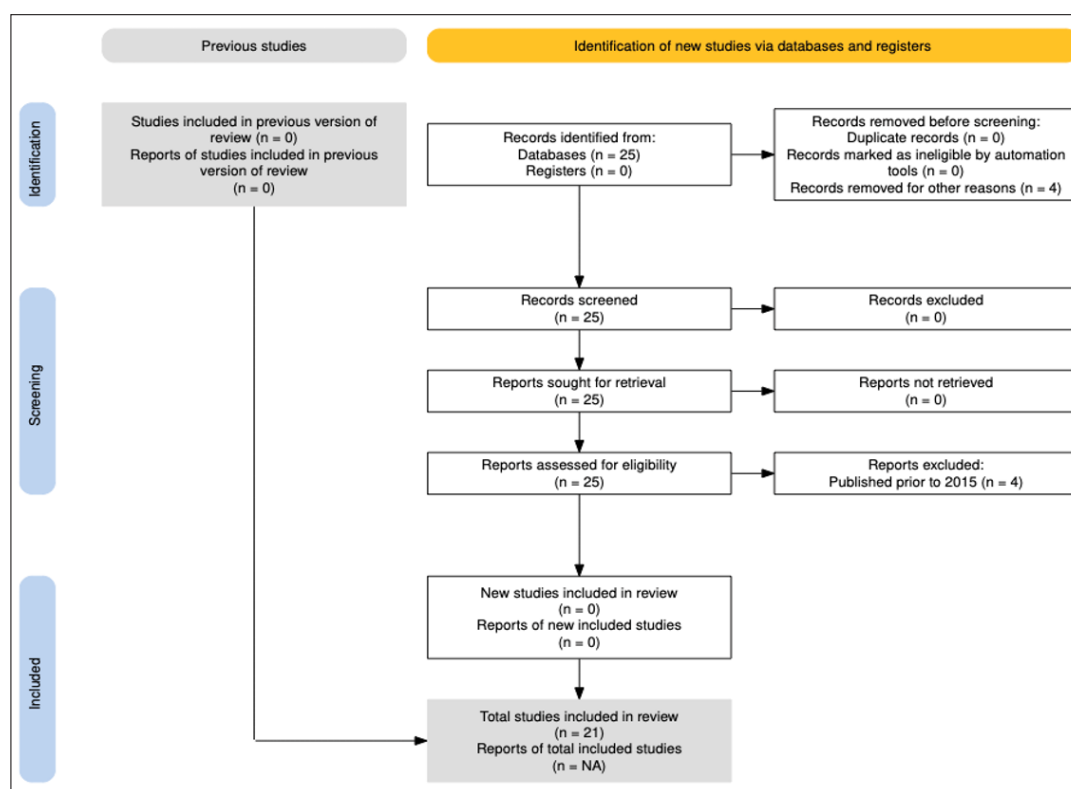


Figure 2: PRISMA 2020 Flow Diagram.

The diagram illustrates the process of study identification, screening, eligibility assessment, and inclusion in the review. A total of 21 studies met the inclusion criteria and were included in the qualitative synthesis.

When reviewing the included studies, the clinical outcomes were comparable between SS and LRTI. Postoperative pain scores did not demonstrate a statistical significance between techniques at follow up time points. There was similar equivalence found in the following outcomes: grip strength, pinch strength, and patient-reported outcomes.

The radiographic outcomes were found to demonstrate more variability. Studies report comparable maintenance of trapezial space height between groups, while others noted reduced first metacarpal subsidence in patients undergoing SS.

Research shows that SS consistently demonstrated technical advantages. In comparison with LRTI, SS is associated with shorter operative times, a single incision approach, and avoidance of tendon harvest.

The findings of the studies are summarized in Table 1.

Table 1: Summary of Studies Included in Review

Study	Sample Size	Study Design	Key Findings
Choi et al., 2025	26	Comparative cohort study	The modified suture suspension with dermal allograft interposition method offers similar outcomes (clinical and radiographic) compared with traditional LRTI. The technique reduces surgical time and avoids tendon harvest issues. This technique appears to be a promising alternative to LRTI for treating thumb CMC arthritis.
DeGeorge et al., 2018	70	Retrospective cohort study	Suture-button suspensionplasty requires more operative time compared with trapeziectomy and FCR. To APL tendon imbrication. The addition of a suture-button suspensionplasty results in better preservation of trapezial space height and trapezial space ratio at greater than 1 year of follow-up. However, no improvement in functional outcomes following suture-button suspensionplasty was noted compared with trapeziectomy and tendon imbrication alone.
DelSignore et al., 2021	90	Retrospective cohort study	SS technique yields good to excellent long-term clinical outcomes. Advantages include shorter operative time, a single incision, minimal cost, and no need for tendon harvesting, pin fixation, or implantable hardware.

Ferrao et al., 2020	28	Retrospective chart review	No surgical procedure is proven to be superior to another for the treatment of basal thumb arthritis (Eaton III and IV), and trapeziectomy and SS showed good function and radiographic outcomes.
Fones et al., 2024	42	Retrospective cohort study	Patients who underwent trapeziectomy with SS had similar functional and radiographic outcomes at an average of 2.1 years after surgery compared with other techniques used for treatment of symptomatic thumb CMC joint arthritis.
Grasser et al., 2024	32	Randomized controlled trial	This study did not suggest any clinically relevant differences in the postoperative patient-reported outcome measures or objective clinical measurements between LRTI and SS, although LRTI patients had a faster return to work/activity and lower complication rates.
Lachnisht et al., 2024	22	Retrospective cohort study	2 patients continued to experience persistent basilar thumb pain, 2 patients had transient radial nerve neuropraxia. Trapezial space height dropped 53% provides durable, effective long-term outcomes with sustained improvements in strength, motion, and patient-reported function.
Lee et al., 2020	35	Retrospective cohort study	SS technique had several advantages including minimal invasive approach, short operative time, cost-effectiveness, and early mobilization. SS can be used as an effective, alternative stabilization method after a complete trapeziectomy.
Mirza et al., 2021	75	Retrospective chart review	The degree of metacarpal subsidence did not significantly affect functional outcomes. The modified technique allows for a shorter immobilization period without the need for tendon grafts or anchors.
Munsch et al., 2023	23	Retrospective chart review	Both LRTI and SS resulted in a comparable trapezial height reduction. After 5 months post-op, LRTI and SS thumb metacarpal subsidence was equivalent.
Oczelik et al., 2019	21	Prospective cohort study	Benefits of arthroscopic hemi-trapeziectomy with SS include control of lateral subluxation and instability, pain relief with hand function, and low morbidity.
Pistorio et al., 2020	77	Retrospective cohort study	SS provided effect pain relief and early range of motion as well as maintain stability and prevent proximal migration of the first metacarpal.
Rivetti et al., 2024	104	Retrospective cohort study	SS had shorter tourniquet times and less postoperative radiographic subsidence as evidenced by larger postoperative FMSS.
Roman et al., 2016	19	Retrospective case series	SS provides trapezial suspension without sacrificing the FCR tendon or needing fascia lata or dermal grafts for interposition. The suspension is stable, allowing for earlier motion and faster/more complete strength recovery. Potential risks are overtightening of the TightRope leading to loss of abduction and fracture of the metacarpals.
Satria et al., 2023	3	Retrospective case series	Compared to traditional trapeziectomy alone, this method provides better metacarpal support and lower risk of collapse. Operative rehabilitation with early mobilization is important for restoring function. SS is safe, cost-effective, and clinically effective.
Shah et al., 2015	1	Case report	The patient had stable thumb alignment, improved function and no recurrent dislocations. ROM and grip strength were satisfactory. No hardware complications.
Shinya et al., 2023	33	Retrospective cohort study	Considering this study investigated partial trapeziectomy, the authors conclude that the amount of trapeziectomy is important for thumb function. The combination procedure resulted in better function due to the formation of scar tissue in the trapeziectomy space. Metacarpal subsidence can lead to thumb function loss, thus ruling against excessive trapeziectomy procedures (compared to total trapeziectomy).
Shonuga et al., 2023	112	Prospective cohort study	The authors concluded that using TightRope suspensionplasty may result in “less subsidence and better clinical outcomes.” The authors still question why subsidence relates to the clinical outcome because subsidence did not correlate with VAS pain score nor lateral pinch strength. Further studies are needed to determine the cost-effectiveness and long-term outcomes (greater than 1 year) of TightRope suspensionplasty.
Weiss et al., 2019	320	Retrospective cohort study	Suture suspensionplasty provides comparable clinical results and several advantages over many current techniques that are described in the literature. Advantages include shortened operative time, inherent stability of the thumb metacarpal height, and no necessity for K-wire fixation, tendon transfers, or implants.
Wolf et al., 2021	130	Retrospective cohort study	Trapeziectomy with APL suspension-interposition arthroplasty provides predictable long-term outcomes, with patients reporting comparable pain and function between the operated and unoperated sides. The lack of significant correlation between trapezial space and pinch strength suggests that joint subsidence may not directly impact functional outcomes.

Yao et al., 2017	14	Retrospective cohort study	Favorable outcomes (improvement in range of motion and pain relief) of SBS remain durable over time. Our results show that the improvement in strength may also be expected over time when using SBS after trapeziectomy for the treatment of thumb CMC joint OA.
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Discussion

CMC arthritis is the degeneration of the articular cartilage between the first metacarpal base and trapezium. Carpometacarpal (CMC) arthritis of the thumb is the second most common degenerative condition of the hand with a prevalence of 15% in adults older than 30 [8]. CMC arthritis can initially be treated non-operatively with NSAIDs, bracing, and physical therapy. Additionally, corticosteroid injections can be administered into the joint that have been shown to relieve pain. If conservative treatment fails, patients can undergo surgical options such as a suture suspensionplasty (SS), LRTI, trapeziectomy alone, implant arthroplasty and joint fusion. Weiss et al describes the technique as using a non-absorbable suture in a figure of eight configuration through the FCR tendon to the APL tendon. This suspends the thumb metacarpal in space. Recent studies suggest that between SS and LRTI, the clinical outcomes are the same, while SS offers the added benefits of shorter operative time and no necessity for a tendon transfer [1-3]. Fones et al demonstrated that SS had similar functional and radiographic outcomes after surgery as compared to other techniques [5]. Clinically, SS provides comparable outcomes to LRTI [5-7].

Despite potentially beneficial outcomes of shorter operative times with suture suspensionplasty techniques, limitations and concerns should be considered when evaluating these techniques. One concern is the increased operational cost of using suture buttons or suture tape devices, which encompass variations of suspensionplasty techniques. Geurin et al reported that suture-tape suspension can exceed procedural costs of over \$4,000, making it one of the more expensive approaches for thumb CMC arthroplasty [9]. However, cost considerations vary substantially across suture suspensionplasty techniques. Certain anchorless, suture-only techniques, such as those described by DelSignore and Weiss, do not require suture buttons, anchors, or suture tape implants and may offer a lower-cost alternative while still providing favorable clinical outcomes [1-3]. Therefore, cost-effectiveness should be evaluated on a technique-specific basis, as implant-based and suture-only suspensionplasty procedures may have different economic profiles.

The systematic review has a few limitations that should be considered when interpreting the finding. Systematic reviews use a retrospective, observational research design, and as such are subject to systematic and random error [9]. In addition, differences in surgical techniques, surgeon experience, protocols, can cause limitations in the different surgical approaches to Thumb carpometacarpal (CMC) arthritis. Suture suspensionplasty encompasses different surgical techniques, including suture button suspensionplasty, suture-only suspensionplasty, and APL suspensionplasty, which can introduce variability when comparing outcomes. These limitations highlight the need for more standardized prospective trials comparing these techniques. Sample sizes between each study were variable, which can also be considered. There are also limitations with utilizing PRISMA due to possible literature discrimination [15-17]. Outcome

measures, such as DASH score, pinch strength, and grip strength, also varied across studies. In addition, patient populations and follow-up duration contribute to the heterogeneity of the review.

Conclusion

This systematic review demonstrates that suture suspensionplasty provides comparable clinical outcomes to LRTI in the management of thumb carpometacarpal osteoarthritis. Across 21 studies, patient-reported outcomes, grip and pinch strength, and postoperative pain scores were largely equivalent between the techniques [18-24]. The studies suggest that suture suspensionplasty may demonstrate technical advantages such as shorter operative time and earlier mobilization. Although early and midterm outcomes are slightly favorable for suture suspensionplasty, the majority of studies had follow-up under 5 years, limiting conclusions regarding long-term durability despite some studies reporting extended outcomes [5-8]. Additionally, future studies should evaluate the comparative cost-effectiveness of different suspensionplasty techniques, as implant utilization varies considerably among procedures and may influence overall healthcare costs.

Future randomized controlled trials with extended follow-up periods are necessary to clarify long-term outcomes, complication profiles, and functional sustainability. Overall, suture suspensionplasty represents a viable and potentially advantageous alternative to LRTI in appropriately selected patients with thumb CMC osteoarthritis.

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