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Original article

Patient functional outcomes with trapeziectomy alone versus trapeziectomy with TightRope®

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ABSTRACT

Purpose of the study: We assess whether patient functional outcomes with the use of a tightrope in conjunction with trapeziectomy are better than traditional trapeziectomy alone.
Methods: Retrospective study of 56 trapeziectomies in 53 patients; 26 trapeziectomies alone without additional procedures, and 30 trapeziectomies performed in conjunction with tightrope suspensionplasty. All patients were scored using Quick DASH, Patient-Rated Wrist Evaluation and Nelson base of thumb arthritis scores pre- and post-operatively.

Results: Significant improvements were seen with both operations using all three scoring systems. However, there was no statistically significant difference in post-operative scores between the two operations.

Study design: Retrospective comparative study.

Level of evidence: III

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1. Introduction

Thumb carpometacarpal joint (CMCJ) osteoarthritis is a common problem in middle-aged and elderly adults, particularly females. The thumb CMCJ is the second most common site of degenerative osteoarthritis in the upper limb,¹ but due to its profound importance on hand function, it is the most common site for which surgery is sought.²

A newly developed surgical technique to address CMCJ osteoarthritis is a suture-button (SB) suspensionplasty, supplemented with using a mini-tightrope to maintain trapezium height and prevent subsidence of the thumb metacarpal into

the CMC space after full or partial trapeziectomy^{3,4}. A recent study suggested good outcomes with the use of this technique at a minimum of 2-years follow-up.⁵ However to the best of our knowledge, there is as yet no published data comparing patient outcomes with the use of a tightrope suspensionplasty versus traditional trapeziectomy alone.

We present a retrospective study comparing symptomatic and functional patient outcomes of traditional trapeziectomy alone versus trapeziectomy with SB suspensionplasty using the Mini-TightRope® (Arthrex, Naples, FL)⁶ for symptomatic thumb CMCJ osteoarthritis. Our null hypothesis was that use of the tightrope is no better than traditional trapeziectomy alone.

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2. Patients and methods

A retrospective study of patients in our institution who had undergone a trapeziectomy for thumb CMCJ osteoarthritis in the 3-year period between January 2010 and December 2012 was conducted.

2.1. Inclusion and exclusion criteria

Inclusion criteria for the study were: (a) operation performed in our institution within the specified time frame, (b) patient available for follow-up, (c) patient informed consent to participation in the study and (d) minimum of 6-months follow-up post-operatively.

Additional specific exclusion criteria were: (a) patients with additional procedure(s) performed (e.g. ligament reconstruction or tendon interposition).

2.2. Data collection

Operative data was collected from our online hospital database and from the coding department. Patient notes were manually searched and the operative reports used to ensure patients were grouped correctly for analysis.

Patients were placed in one of two groups:

(1) Trapeziectomy performed alone without any other procedure, (2) Trapeziectomy performed in conjunction with tightrope suspensionplasty.

Patients were scored on their pre- and post-operative symptoms and functionality using three validated scoring systems. Scoring was performed at the time of latest follow-up. The scoring systems used were the QuickDASH,⁷ the patient-related wrist evaluation (PRWE)⁸ and Nelson base of thumb arthritis scores.⁹ QuickDASH is a fully validated hand and wrist score, and the Nelson score is a validated disease-specific score for base of thumb arthritis.

All tightrope suspensionplasty operations were performed by a single surgeon in our department (TS) using the technique described below. Traditional trapeziectomy alone operations were performed by multiple surgeons within our department.

2.3. TightRope® suspensionplasty surgical technique

The technique utilizes a dorsal approach to the trapezium with total excision of the trapezium. A second dorsal incision is made between the base of index and middle finger metacarpal protecting the branches of the superficial radial nerve. Under fluoroscopy control, a 1.6 mm k-wire is advanced through four cortices from the ulnar aspect of base of the index metacarpal to the dorsoradial aspect of thumb metacarpal and overshot. A 2.7 mm cannulated drill is used over the k-wire to drill the bone tunnel, and after passing through the four cortices, is left 4 cm short of the end of the k-wire. This allows retrograde application of the red tube cover over the k-wire and abutting the drill end. As the drill is withdrawn, the plastic tube follows through, maintaining alignment and access to the four drill holes. The number 2 FiberWire Mini-TightRope®, threaded twice over between the suture-button and toggle to make a 4-strand construct, is advanced through the bone tunnel from

the ulnar aspect the index metacarpal to the radial aspect of thumb metacarpal via a leading guide pin jammed into the red tube as it is passed through, thus avoiding missing the drill holes and protecting from inadvertent needle-stick injury. The toggle is then flipped and the construct tensioned as required under direct fluoroscopy control, checking the position of suspension of the thumb metacarpal while placing a McDonald's periosteal elevator between the thumb and index metacarpals to prevent over-tightening. A preliminary double knot is tied which allows testing via axial loading to ensure the base of the metacarpal does not touch the scaphoid. This knot can be loosened and retied as necessary. Once a good position with correct tensioning is achieved, the TightRope® position is secured by tying a 4-throw knot on the suture-button on the ulnar side, with the FiberWire knot-tails cut to 1 cm long and buried between the metacarpals. The periosteum is closed over this, preventing the FiberWire cores irritating the skin, and the wound closed and protected appropriately.

Post-operatively, patients are placed in a plaster of Paris backslab for 2 weeks, at which point a fabricated custom thermoplastic orthosis is supplied for use at night and for protection only. Patients are given active wrist, thumb and finger exercises and advised to begin using hand for light activities (washing, dressing, writing, combing hair) at 2 weeks. They are reviewed again at 3 and 4 weeks where gentle grip strengthening exercises are commenced. At 6 weeks, patients are encouraged to progress to medium activities (unscrewing jars, door handles, holding a pint). At 9 weeks, patients are progressed to return to all activities without restriction.

2.4. Trapeziectomy alone surgical procedure

Traditional simple trapeziectomy is performed in our institution by multiple surgeons using the same technique. A single dorsal incision approach to the trapezium is performed, and the trapezium is completely excised. No additional procedure, such as a k-wiring, is undertaken.

Post-operatively, patients are placed in a plaster of Paris backslab for 2 weeks, at which point their wound is reviewed and if there are no wound problems, patients are placed in a complete plaster of Paris for a further 4 weeks. At 6 weeks, patients are given a fabricated thermoplastic orthosis for use at night and for protection, and start active range of movement exercise. Grip strengthening begins at 8 weeks, and return to unrestricted function is encouraged at 12 weeks.

2.5. Statistical analysis

Paired t-test was used to compare pre- and post-operative scores, and two-sample t-test to compare post-operative scores between the two groups. A p-value of <0.05 considered as evidence of a statistically significant difference.

3. Results

A total of 73 trapeziectomy operations were performed in the time period of this study, on a total of 69 patients (4 patients had both hands operated on within this time period). A total of

Table 1 – Patient demographics in each group.

	Trapeziectomy alone	Trapeziectomy tightrope
Total number of operations (patients)	30 (28)	26 (25)
F:M ratio	2.7: 1	3.3: 1
Mean age (range), years	65.2 (42–84)	65.5 (53–78)
% operated on dominant hand	53.3	50

17 cases on 16 patients were excluded from the study for the following reasons:

- six patients had either ligament interposition or tendon transfer performed simultaneously,
- eight patients, accounting for nine operations (one bilateral) were not contactable or unavailable for follow-up,
- two patients did not give consent for inclusion in the study.

A total of 56 operations in 53 patients were therefore included in the study. 30 operations in 28 patients were included in the trapeziectomy with tightrope suspensionplasty group, and 26 operations in 25 patients in the trapeziectomy alone group.

Table 1 shows patient demographics in each group, including female:male ratio, age at time of operation, and % of operation on dominant hand. The mean follow-up was 13.8 months (range 6–23) in the tightrope group, and 26.4 months (range 6–40) in the trapeziectomy alone group.

When comparing pre- and post-operative scores for the trapeziectomy only group, there was a significant improvement in mean post-operative scores, found with all three scoring systems. Table 2 summarizes these scores; in the QuickDASH and the PRWE scores, a higher score indicates more severe symptoms or functional disability; in the Nelson score, a higher score indicates less severe symptoms and better functional ability.

When comparing pre- and post-operative scores for the tightrope suspensionplasty group, there was again a significant improvement in mean post-operative scores, found with all three scoring systems. Table 3 summarizes these results.

However, when comparing overall mean post-operative scores between the trapeziectomy only group and the tightrope suspensionplasty group, no statistically significant difference was found in any of the three scoring systems. Table 4 summarizes these results. Pre-operative scores between the groups were also statistically the same, as shown in Table 5.

Table 2 – Pre- and post-operative scores for the trapeziectomy only group (n = 26).

	Pre-op score*	Post-op score*	p-Value
QuickDASH	62.8 (14.9)	23.0 (21.8)	<0.001
PRWE	80.0 (13.1)	28.9 (26.9)	<0.001
Nelson	28.5 (13.7)	76.2 (22.2)	<0.001

* Scores are presented as mean (standard deviation); $p < 0.05$ = significance.

Table 3 – Pre- and post-operative scores for the tightrope suspensionplasty group (n = 30).

	Pre-op score*	Post-op score*	p-Value
QuickDASH	59.6 (11.7)	14.1 (19.3)	<0.001
PRWE	80.6 (9.5)	19.9 (23.6)	<0.001
Nelson	31.1 (12.1)	81.7 (20.3)	<0.001

* Scores are presented as mean (standard deviation); $p < 0.05$ = significance.

Table 4 – Post-operative scores for both the trapeziectomy only and the tightrope suspensionplasty groups.

	Trapeziectomy only (n = 26)	Tightrope suspensionplasty (n = 30)	p-Value
QuickDASH	23.0 (21.8)	14.1 (19.3)	0.111
PRWE	28.9 (26.9)	19.9 (23.6)	0.196
Nelson	76.2 (22.2)	81.7 (20.3)	0.336

* Scores are presented as mean (standard deviation); $p < 0.05$ = significance.

Table 5 – Pre-operative scores for both the trapeziectomy only and the tightrope suspensionplasty groups.

	Trapeziectomy only (n = 26)	Tightrope suspensionplasty (n = 30)	p-Value
QuickDASH	62.8 (14.9)	59.6 (11.7)	0.372
PRWE	80.0 (13.1)	80.6 (9.5)	0.850
Nelson	28.5 (13.7)	31.1 (12.1)	0.469

* Scores are presented as mean (standard deviation); $p < 0.05$ = significance.

In the tightrope suspensionplasty group, two patients subsequently had further operations on the same CMCJ. One patient required removal of tightrope and suture-button at 9 months post-operatively due to on-going symptoms and swelling around the joint—histology confirmed foreign-body reaction to the tightrope material. The other patient required a revision of the initial operation after 6 months due to on-going symptoms and evidence of tightrope failure on radiographs, with insertion of a new tightrope. She has subsequently been doing well.

At the time of follow-up, no patients in the trapeziectomy only group had required any further operations on the same CMCJ. There were no other complications to report in either group.

4. Discussion

CMCJ osteoarthritis is a debilitating disease because dysfunction and pain in this joint affects many activities of daily living. Initial non-operative treatment options for this condition include non-steroidal anti-inflammatory drugs (NSAIDs), physiotherapy and orthoses, and intra-articular steroid injections. The indication for operative treatment is the failure of conservative measures to provide adequate symptomatic relief and preservation of function.

Various surgical procedures have to date been published for this condition, including volar ligament reconstruction, joint arthrodesis or total joint arthroplasty, and trapeziectomy either alone or with tendon interposition and/or ligament reconstruction.^{10,11} Studies have yet to show a demonstrable advantage of any one procedure over another.¹²

The use of a SB technique and tightrope has previously been described in foot and ankle surgery, for stabilization of the distal tibiofibular syndesmosis, fixation in Lisfranc injury, and correction of hallux valgus deformity. Its use in CMCJ osteoarthritis with partial or complete trapeziectomy has been described over the last few years.

Traditionally, trapeziectomy alone would often be accompanied by the use of Kirchner-wire fixation of the first metacarpal to prevent subsidence into the newly-created space, allowing hematoma and subsequently scar tissue formation to fill this gap. One hypothesized advantage of the use of a tightrope is that comparable levels of stability could be achieved, while allowing earlier mobilization thus reducing the post-operative recovery and rehabilitation period.⁵ Indeed a study on cadaveric models showed comparable results between traditional k-wire fixation and SB suspensionplasty in terms of maintenance of post-trapeziectomy space height and prevention of first metacarpal subsidence.⁴

This study is the first of its kind to compare functional patient outcomes with the use of a SB and tightrope suspensionplasty versus traditional trapeziectomy alone for thumb CMCJ osteoarthritis, using validated scoring systems. In the SB tightrope group, our mean post-operative QuickDASH score of 14.1 ± 19.3 is comparable to results published by Yao et al.⁵ Our study has a larger patient cohort, albeit with a shorter length of follow-up. However, while there was a significant improvement in post-operative scores compared to pre-operative scores in both patient groups in our study, we found no statistically significant evidence that the use of a tightrope had better functional patient outcomes than traditional trapeziectomy alone.

The improvement in patient outcomes with trapeziectomy alone was also statistically significant, in keeping with previously published literature.¹² Indeed this procedure, despite its disadvantages including prolonged immobility and risk of pin-tract infection where a k-wire is used as an additional procedure, has good long-term outcomes.¹³

A Cochrane Database review in 2009¹² on surgery for CMCJ osteoarthritis concluded that while no one procedure of those published at the time and included in the review had any additional benefit over another, the simplest approach – trapeziectomy alone – had fewer complications than other surgical techniques. Further studies since have also failed to show any additional benefit with the use of additional procedures, such as ligament reconstruction and tendon interposition.¹⁴

In our study, we found fewer complications and fewer cases of re-operation in the trapeziectomy alone group compared to the tightrope group. One patient required tightrope removal due to what was likely a foreign-body reaction to the material. Similar reactions have previously been reported in patients following the use of tightrope in ankle fixation.¹⁵

While this study appears to show no additional functional advantage to the use of a tightrope in conjunction with

trapeziectomy for thumb CMCJ arthritis, there are some other factors to consider. The use of a tightrope suspensionplasty allows earlier rehabilitation and shorter period of immobility, allowing patients to return to function quicker. This in itself may confer an advantage to patients, particularly those who are active individuals or in employment. There is also a cost issue, with the tightrope costing approximately \$500.⁵ However as suggested previously,⁵ it may be that the added benefits of this more rapid rehabilitation to the patient may justify the increase in cost. A cost-benefit analysis including analysis of lost work-hours may be helpful to further assess the implications of this.

The present study has its limitations. By the virtue of its retrospective nature, there may well be recollection bias on the part of patients, who were questioned often a long time after their respective operations. While the cohort numbers in this study are larger than previously published data on SB and tightrope suspensionplasty, the raw numbers are still relatively small and the study may therefore be underpowered to produce results of statistical significance. The relatively short length of follow-up, particularly in the tightrope group, is also a limitation to this study. This reflects the fact that the tightrope suspensionplasty procedure has only been performed in our institution for the last 2 years, and only by a single surgeon (TS). Another potential confounding factor are the multiple surgeons performing the trapeziectomy-only operation. We have also not assessed radiographic outcomes and while this may not affect functional outcomes, more rapid subsidence in one group or the other might be an important finding. Finally, we have not considered any objective functional measurements in this study, such as grip and pinch strengths.

5. Conclusions

On the basis of the results of this study, it seems that the use of a tightrope does not appear to confer any functional benefit to patients in the short-term when compared to the traditional trapeziectomy alone procedure for thumb CMCJ osteoarthritis. However, further research in the form of a large-scale prospective randomized controlled study with longer-term patient follow-up, along with cost-analysis studies, are recommended to further evaluate whether this relatively novel procedure confers any long-term functional benefits to patients.

Conflicts of interest

The authors have none to declare.

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