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ORIGINAL STUDY

The surgical management for isolated scaphotrapeziotrapezoid (STT) osteoarthritis : a systematic review of the literature

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We performed a systematic review to find out the safety and efficacy of various procedures for isolated scaphotrapeziotrapezoid osteoarthritis. Eleven articles were included. The most common procedure was arthroplasty with pyrocarbon implant (28%), followed by resection of distal pole of scaphoid with proximal trapezium and trapezoid resection (18%). The other procedures included trapeziectomy with ligament reconstruction and tendon interposition (LRTI) (14%), arthroscopic resection of distal scaphoid (11%), trapezium and trapezoid resection with LRTI (10%) and arthrodesis (10%).

Complications were noted in 18 (15%) patients. The most common complication (7.5%) was asymptomatic dorsal intercalated segmental instability (DISI) followed by dislocation of the pyrocarbon implant (3%). Fusion resulted in decreased range of motion and grip strength. The distal scaphoid resection was related to high rate of DISI. Although the pyrocarbon implant has a higher dislocation rate which requires revision surgery, this complication is avoidable with good surgical technique. Arthroplasty with pyrocarbon implant may be the first choice in younger patients.

Keywords : Scaphotrapeziotrapezoid ; osteoarthritis ; treatment ; isolated ; surgical procedures ; STT ; complications ; efficacy ; safety.

INTRODUCTION

The radial sided wrist pain has a wide differential diagnosis. Identifying and effectively managing the condition contributing the most to patient's symptoms is therefore imperative. The usual presentation of scaphotrapeziotrapezoid osteoarthritis (STT OA) is pain on radial side of wrist or base of the thumb *(22)*. The pain is usually worse with activities, which load the joint e.g. grasping, and rotating activities *(4)*. The condition is relatively common in females after fifth decade of life *(19, 21)*. The other common condition with pain at base of thumb in same age group is first carpometacarpal (CMC) joint arthritis. A thorough physical examination and radiographic assessment should differentiate between the STT and first CMC joint arthritis *(11)*.

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In a previous study Higginson et al. *(10)* studied 1711 radiographs of patients aged over 30 years. They reported the prevalence of isolated STT arthritis as 1%. 81% of the patients with radiographic STT arthritis were females. Among all the patients who had radiographic evidence of STT arthritis only 69% were symptomatic. The disruption of scapholunate ligament was associated with severity of symptoms. However, majority of the patients with STT arthritis did not have evidence of scapholunate ligament disruption, leading to the conclusion that the disruption the ligament is not the cause of STT arthritis. Instead the scapholunate ligament disruption could be a sequel of the advanced degenerative process at the STT joint.

Pain is the common symptom among patients with symptomatic STT arthritis. A variety of conservative measures have been reported to reduce the pain. Nonsteroidal anti-inflammatory drugs, steroid injections, splints and physiotherapy help with symptom management *(7, 24)*. However surgical intervention may be indicated in patients who have persistent pain interfering with activities of daily living. Several surgical procedures have been described in the literature with various success rates. The current literature fails to provide guidance on comparison of these procedures in terms of their success and safety. The purpose of this systematic review was therefore to explore the literature and find if it can guide the treating surgeons in their decision-making when surgically treating patients with STT arthritis. The following questions were agreed among the reviewers for this systematic review :

1. What patient groups need surgical treatment?
2. What are the current common procedures being used for isolated STT osteoarthritis?
3. How effective are the individual modalities (comparison in terms of functional outcomes)?
4. How safe are these modalities i.e. what is nature and rate of complications?
5. What are the suggestions to reduce these complications?
6. What is the rate of revision surgery with each modality?
7. What is the period of immobilisation/ rehabilitation for each procedure type?

MATERIALS AND METHODS

Two independent reviewers performed the literature search. We used Medline, Embase, Google Scholar, Ovid and Science Direct as search engines. The key words for the literature search were; scaphotrapeziotrapezoid, STT, arthritis, isolated, treatment, surgery, outcome, complications, procedures, management, immobilisation and rehabilitation. We looked for human studies in the English language published between 1967 to 2017 (past 50 years)

The inclusion criteria were :

1. Clinical studies only
2. Studies with operative management of the STT arthritis
3. Studies where the indication for surgery was isolated scaphotrapeziotrapezoid arthritis.
4. Studies mentioning at least two outcome measures
5. Studies with a minimum follow up time of 6 weeks.
6. Technical reports if the follow up and outcomes were mentioned
7. Case reports if the patients were followed and the outcomes or complications were clearly mentioned.

The following criteria were used to exclude the studies :

1. Biomechanical studies
2. Studies where treatment was non-surgical
3. Technical reports with no patient or no follow up
4. Studies where a specific procedure was performed for a variety of indications and the cases of STT arthritis could not be isolated to specifically look for their outcome
5. Personal opinions
6. Studies with no patient involvement.

The initial search produced 75 titles. We reviewed the abstracts of 75 articles and 17 abstracts were excluded. The full text articles were reviewed for 58 articles. After reviewing the full articles 11 articles were selected for the final review and 47 articles excluded with a reason. Figure 1 shows the flow diagram for inclusion of studies according to PRISMA (preferred reporting items for systematic reviews and meta-analyses) guidelines *(15)*. Both

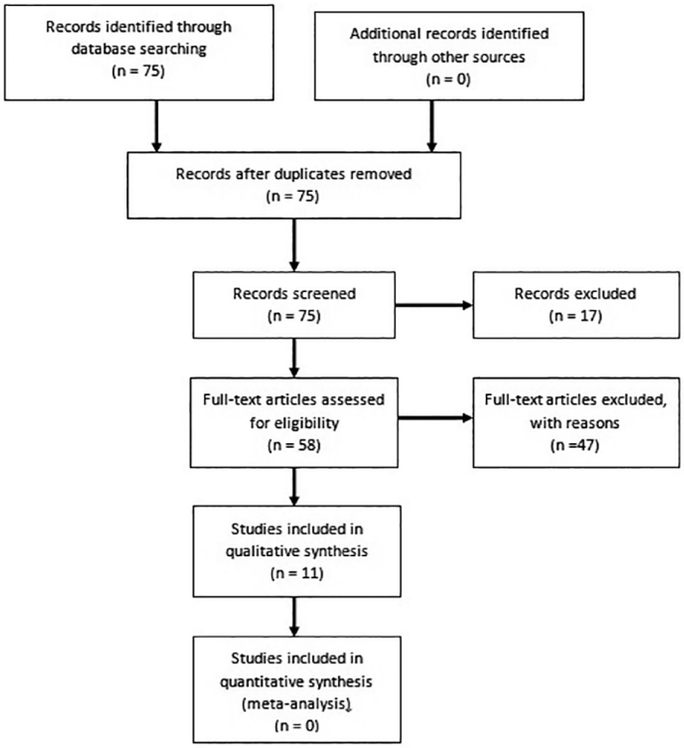

Figure 1. — Inclusion of studies for the review according to PRISMA guidelines.

the reviewers then agreed on the nature of data to be captured to find the answers for primary questions of the review.

We collected the information about outcome measures and how the authors recorded the changes as result of surgical interventions. Most of articles used mean and range values to record the changes. Only two papers *(1,8)* used statistical tests to show statistically significant improvement. Table III shows the surgical procedures in the order of number of patients for each procedure type with the changes in outcome measures.

Table I. — Selected studies

Author	Journal	Year	Study Type
Srinivasan	Journal of hand surgery Br.	1996	Prospective case series
Garcia-Elias	The Journal of Hand Surgery Am.	1999	Retrospective case series
Ashwood	The Journal of Hand Surgery Am.	2003	Prospective case series
Pegoli L	Journal of hand surgery Br.	2006	Prospective case series
Low A	Hand Surgery .	2007	Case series
Corbin C	The Journal of Hand Surgery Eur.	2009	Case report
Garcia-Elias	The Journal of Hand Surgery Am.	2011	Case report
Nemoto T	The Journal of Hand Surgery Eur.	2011	Case series
Mathoulin C	Hand Clinic	2011	Case series
Andrachuk	The Journal of Hand Surgery Eur.	2012	Retrospective case series
Langenham R	The Journal of Hand Surgery Eur.	2014	Retrospective case series

Table II. — Procedure types and number of cases treated with each procedure

Procedure type	Number of wrists	%age
Excision of distal scaphoid and proximal trapezium and trapezoid with or without insertion of capsule	21	18%
Arthroscopic distal pole of scaphoid resection and pyrocarbon interposition implant	17	15%
Open distal scaphoid resection and pyrocarbon interposition implant	15	13%
Trapeziectomy and LRTI	16	14%
Arthroscopic resection of distal pole of scaphoid	13	11%
Excision of entire trapezium and proximal 1/4th of trapezoid + LTRI using entire FCR tendon	12	10%
Arthroscopic debridement	10	9%
STT fusion	8	7%
STT fusion with vascular bone graft	3	3%
Excision of distal scaphoid	2	2%

RESULTS

We found 11 articles that fulfilled our selection criteria *(1,2,3,7,8,12,13,14,17,18,20)*. Table I shows the articles selected for this review. There were three retrospective case series, three prospective case series. In three case series, there was no mention whether these were retrospective or prospective studies. We also included two case reports. We did not find any comparative study.

There were 112 cases and 117 wrists treated surgically for scaphotrapeziotrapezoid osteoarthritis. There were 94 (84%) females and 18 (16%) male patients. The age range was 30-85 years and average age was 59.5 years. The average follow-up time was 30 months (range 2-80 months). All the patients failed to respond to non-operative measures. The common non-operative methods included splints, steroid injections and non-steroidal anti-inflammatory drugs (NSAIDS). The main indication for surgery was persistent pain, although decreased range of movement and decreased strength were recorded by some authors as persistent symptoms before the surgery.

The review showed a variety of surgical procedures for the treatment of STT osteoarthritis. Table II shows types surgical procedures and number of patients treated with each procedure.

The most common procedure was arthroplasty with pyrocarbon interposition implant. We subdivided this procedure into two subgroups depending whether it was done arthroscopically or by an open technique. In one study the authors used both arthroscopic and open technique *(18)*. In the other study the authors used arthroscopic resection alone in 50% of the patients and arthroscopic resection with pyrocarbon implant insertion in remaining 50% *(14)*. Whether open or arthroscopic, arthroplasty with pyrocarbon implant insertion made 28% of all the procedures *(13,14,18)*.

The second most common procedure was resection of distal pole of scaphoid with or without excision of proximal trapezium and trapezoid *(8)*. This group made 18% of all the patients. They used both the dorsal and palmer approach. With the dorsal approach the capsular flap was interposed in the joint for nine patients. With palmer approach the flexor carpi radialis tendon was interposed in the joint for three patients. In the remaining cases the joint space was left empty.

The third most common procedure was trapeziectomy with ligament reconstruction and tendon interposition (LRTI) *(12)*. This group made 14 % of all the patients treated surgically. Distally pedicled slip of the flexor carpi radialis was used to stop first metacarpal migration after excision of trapezium.

Arthroscopic resection of the distal pole of scaphoid was performed in 11% of the patients *(14)*. The resection was performed using sucking mechanical drill through 1-2 midcarpal portal. The authors suggest that at least 2- 3 millimetres of distal scaphoid should be resected.

Total trapezial and partial trapezoidal excision with LRTI was performed in 10 % of the patients

Table III. — Efficacy of various procedures

Procedure type	Pain	Range of motion	Grip strength	Statistical test
Excision of distal scaphoid and proximal trapezium and trapezoid with or without insertion of capsule	Improved	No change	Improved ($p = 0.001$)	Student's t test
Arthroscopic distal pole of scaphoid resection and pyrocarbon interposition implant	Improved	Improved	Improved	
Open distal scaphoid resection and pyrocarbon interposition implant	Improved	Improved	Improved	
Trapeziectomy and LRTI	Improved	Not compared with pre-op	Not compared with pre-op	
Arthroscopic resection of distal pole of scaphoid	Improved	Improved	Improved	
Excision of entire trapezium and proximal 1/4th of trapezoid + LTRI	Improved ($p < .0001$)	Improved ($P < .05$)	Improved (not statistically significant)	Paired student's t test
Arthroscopic debridement	Improved	Improved	Improved	
STT fusion	Improved	Slight reduction	Reduced	
STT fusion with vascular bone graft	Improved	Reduced	Improved	NA
Open excision of distal scaphoid	Improved	Slight reduction	Reduced	NA

Table IV. — Complications of various procedures

Procedure	Number of wrists	Number of complications
Excision of distal scaphoid and proximal trapezium and trapezoid with or without insertion of capsule	21	10
Arthroscopic distal pole of scaphoid resection and pyrocarbon insertion	17	3
Open distal scaphoid resection and pyrocarbon interposition implant	15	1
Trapeziectomy and LRTI	16	1
Arthroscopic resection of distal pole of scaphoid	13	0
Excision of entire trapezium and proximal 1/4th of trapezoid + LTRI using entire FCR tendon	12	0
Arthroscopic debridement	10	0
STT fusion	8	1
STT fusion with vascular bone graft	3	0
Excision of distal articular convexity of scaphoid	2	1

(1). The entire trapezium and proximal quarter of the trapezoid were resected. Whole of the FCR tendon was then used for ligament reconstruction and tendon interposition.

Arthroscopic debridement alone was performed in 9 % of the patients *(2)*. In this procedure, no bone was removed. The inflamed synovium, chondral flaps, and rim osteophytes were excised using arthroscopic burr and resector.

Despite the fact that fusion is the common procedure for pathologies around the STT joint, only one paper met our inclusion criteria *(20)*. Dorsolateral approach was used in all the cases. The authors used autologous graft from iliac crest. The joints were then fixed with Kirschner wires.

STT fusion with vascular bone graft was done in 3 % of the patients *(17)*. After refreshing the STT joint surface, a vascular bone graft (VBG) was harvested from the distal radius. The vascular supply was from the 1,2 intercompartmental supraretinacular artery. The graft was secured with Kirschner wires.

Finally, 2 % of the patients were treated by open excision of distal scaphoid *(3,7)*. In both cases, anterior approach was used.

The common outcome measures used by all the studies were pain, range of movement and grip

strength. We therefore analysed these outcomes to assess the beneficial effect of surgery.

Table III shows the results in terms of improvement in pain, range of motion and grip strength. It is important to note from table III that only two papers used statistical tests to demonstrate improvement in the outcome *(1,8)*. The rest of the papers described any changes with mean and range values. Improvement in pain was reported by all the studies. Only one patient who had STT fusion, experienced constant pain. This patient was later found to have a non-union. Range of motion reduced in fusion and open excision of distal scaphoid. The procedures which resulted in improved range of motion were arthroplasty with pyrocarbon implant, arthroscopic debridement, arthroscopic resection of distal scaphoid and excision of trapezium and part of trapezoid with LRTI. The grip strength reduced slightly in STT fusion and open resection of distal scaphoid. There was no change in grip strength in patients with trapeziectomy and LRTI. In all other procedures, there was improvement in grip strength.

The period of immobilisation ranged from 3-6 weeks with average period of 4 weeks. Only in the arthroscopic debridement group, gentle mobilisation was permitted immediately after surgery. Maximum immobilisation (6 weeks) was reported in fusion procedures.

We analysed the complications in relation to the type of procedures as well as the to the total number of complications. Table IV shows the complications

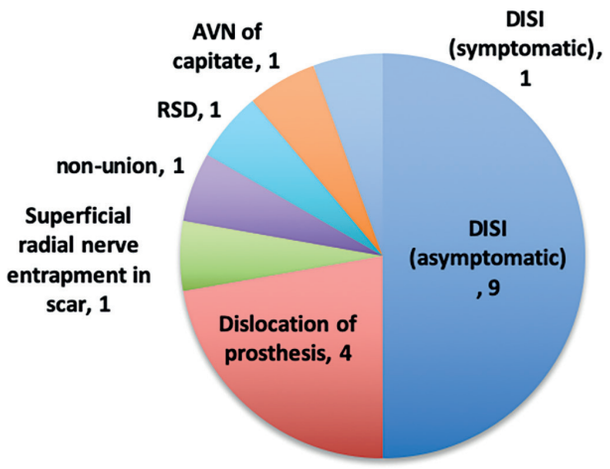

Figure 2. — Nature of complications

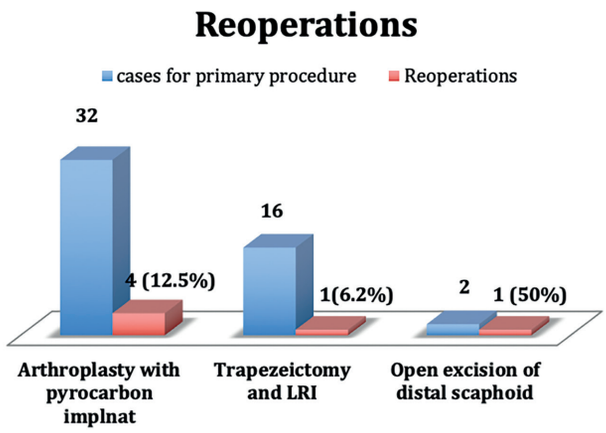

Figure 3. — Reoperations in relation to primary procedure

in relation to type of procedures. There were 18 (15%) complications in 117 procedures. However not all the complications were symptomatic. Asymptomatic dorsal intercalated segmental insta-bility (DISI) was seen in 9 (7.5%) patients. Out of these nine patients, eight had excision of distal scaphoid with proximal trapezium and trapezoid excision, and one patient had open excision of distal scaphoid.

Symptomatic complications were noted in 9 (7.5%) of cases. Four patients (3%) had dislocation of pyrocarbon implant. The other symptomatic complications were non-union (1), reflex sympathetic dystrophy *(1)*, superficial radial nerve entrapment in scar *(1)*, avascular necrosis of capitate *(1)* and symptomatic DISI (1). Figure 2 shows nature and relative proportion of complications.

Reoperations were reported in 6 (5%) patients. The most common indication for reoperation was dislocated pyrocarbon implants. This was seen in 4 patients. All these patients needed reoperation to relocate the implant. One patient who had entrapped superficial radial nerve in the scar needed release of the nerve. Another patient who developed symptomatic DISI following resection of distal scaphoid needed lunate-capitate fusion. Figure 3 shows primary procedures and number of cases, which needed reoperation.

DISCUSSION

The scaphotrapeziotrapezoid (STT) joint is part of the midcarpal joint of the wrist. The joint is made proximally by the scaphoid and distally by

the trapezium and trapezoid *(22)*. It is essentially a plane joint and only minimal gliding movements occur in the joint at the extreme of wrist movements *(20)*. The osteoarthritis in this joint may be primary or secondary to a variety of conditions. The anatomical variations, which may contribute to primary osteoarthritis, are high anatomic or radiographic trapezium-trapezoid (TT) inclination and/or an underdeveloped capitate-trapezium ligament *(16)*. The degenerative changes are seen commonly on the ulnar part of scaphoid articular surface and central and radial aspect of trapezoid *(16)*. Westhuizen et al. *(22)* proposed a working classification of the scaphotrapeziotrapezoid osteoarthritis (STT OA). They suggested four types of arthritis. In type I, only STT joint is involved. Type II includes type I and first carpometacarpal joint involvement. Type III has type I and scapholunate ligament involvement or rupture. Type IV includes type I with radiocarpal involvement. In our view the isolated STT arthritis is either type I or type III. The review therefore did not include the articles where there was involvement of other joints with STT OA. The differentiation between these two types (Type I and Type III) may not be easy but has implications for type of surgical intervention. The patients with scapholunate ligament involvement or rupture (type III) are prone to develop dorsal intercalated segmental instability with distal scaphoid resection *(7,22)*. Therefore, it has been suggested that in patients with either pre-existing dorsal instability or dorsal instability demonstrated intraoperatively after resection of distal scaphoid arthrodesis should be selected. *(7,9,22)*.

This systematic review shows that the average age of the patients needing surgery is 59.5 years. The incidence of the disease may be higher in the elderly but the patients who need surgery are generally in the peri-retirement period. The symptoms are usually aggravated by gripping and rotatory activities. It could be that most of the elderly patients are satisfied with conservative measures due to their limited activity level. Also 84% of the patients were female. It is unclear why the STT OA is more common in females.

Surgical treatment is indicated when conservative measures have been exhausted. Pain has been described as the most common complaint and is localised on the radial side of the wrist or at base of thumb *(4,6)*. In our review, all the patients failed to respond to non-operative measures including splints, steroid injections, physiotherapy and anti-inflammatory medications. The obvious question then arises about the optimum surgical procedure to treat recalcitrant STT osteoarthritis. The current evidence does not support a single procedure to be the best in terms of safety and efficacy. This systematic review shows that there are broadly ten different procedures currently being used to treat STT osteoarthritis. Having said that the fusion procedures can be grouped together. Similarly, the distal scaphoid open or arthroscopic resection can be considered as same procedures. The open and arthroscopic arthroplasty with pyrocarbon implant are also essentially the same procedure. By grouping procedures in this way, we are left with seven procedure types currently being used to surgically manage STT osteoarthritis. Although STT arthrodesis is common procedure for pathologies around scaphoid, for isolated STT osteoarthritis we have found only one study which fulfilled our inclusion criteria *(20)*. In another study STT arthrodesis was performed for STT OA and a variety of other indications *(23)*. These patients were all studied as a single group and it was not possible to collect the data separately for patients who had STT fusion for STT OA.

A recent systematic review performed by Dean et al *(5)* for surgical treatment of STT OA showed a variety of procedures being performed for STT OA. Their inclusion criteria were not strictly restricted to the isolated STT OA. In some of their selected studies, the indications for various procedures were wide including instability, Kienbock's disease and scaphoid non-union. They concluded that arthrodesis may not be the gold standard as there are good results from newer procedures. But they could not suggest what is the most effective surgical treatment.

Our review shows that the most common complication is dorsal intercalated segmental insta-bility (DISI). This was seen in 10 patients *(3,7,8)*. However, it is worth mentioning that only one patient was symptomatic and was treated with lunate-capitate fusion *(3)*. This complication was

noted in patients who had resection of the distal scaphoid either in isolation or with resection of proximal trapezium and trapezoid. It is possible that some patients have occult instability before surgery, which is then worsened by resection of distal scaphoid. Garcia-Elias et al. *(10)* suggests ruling out dorsal midcarpal instability under fluoroscopic control before surgery by posterior drawer test. If the capitate is not subluxing dorsally then distal scaphoid resection can be successful. However, if there is already midcarpal instability then the fusion procedure may be preferred.

The most common symptomatic complication was dislocation of the pyrocarbon implant. This was reported in 4 out of 32 patients who had this procedure *(13,14,18)*. In all these cases the authors attributed the reason for the dislocation to inadequate surgical technique. They think that if the distal scaphoid is not resected sufficiently then the prosthesis may dislocate *(14)*. However, one can raise the question whether the design of the prosthesis can be improved to prevent this complication.

Another important factor to consider is the immobilisation period. As the results of our review show that average age of the patient needing surgery is 59.5 years. The patients with manual jobs will obviously prefer shorter time of immobilisation. Fusion procedures require longer periods of immobilisation as well as some reduction in the range of movement. Therefore, for relatively younger patients arthrodesis may not be the first choice when considering surgery. Fusion is also technically challenging and may require bone graft with potential morbidity of the graft harvest site. Having said that, fusion cannot be completely dismissed. For certain patient groups fusion may be the ideal procedure. This is especially true in patients with midcarpal instability. Also in the elderly patients who are not concerned about loss of movement and simple measures have failed, fusion can be the attempted as the final salvage procedure.

On the other hand, in relatively young and active patients, arthroplasty with pyrocarbon implants may be the ideal procedure. The problem of implant dislocation should be minimised with adequate surgical technique. Arthroscopic debridement is a simple procedure with a very short rehabilitation period. However, this is a temporary measure and future procedures may be needed in these patients.

The review has some limitations which are worth mentioning. Firstly, most the studies are either prospective or retrospective case series without any comparative analysis. Secondly, as shown in table III the statistically significant improvement was mentioned only in two papers and majority of the papers mentioned any change in terms of mean and range values. Therefore, currently it is hard to generally prove the superiority of one procedure over the other.

In conclusion, this systematic review shows that, pain is the most common indication for surgical intervention. There are a variety of surgical procedures for recalcitrant isolated STT osteoarthritis. However, there is no comparative study to prove the superiority of one procedure over the other. From the cases series, it is obvious that distal scaphoid resection is associated with significant risk of dorsal instability. The authors suggest fusion procedures for patients where midcarpal instability is suspected or as a salvage procedure in case of failed arthroplasty. In younger patients motion preserving procedures (arthroplasty, arthroscopic debridement, trapeziectomy and LRT) can be attempted. In future, research comparing different procedures may provide strong evidence in favour of one procedure over the others.

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