Chapter

Review of Current Practice for Temporomandibular Joint Meniscopexy Surgery

Omar Sheikh, Matin Ali Madadian and Amanveer Benning

Abstract

Disc repositioning for temporomandibular joint dysfunction (TMD) is a known and established procedure. Indications for the surgery and outcomes vary. A review of the available literature on the indications, surgical technique, and outcomes of TMJ Meniscopexy as a means of management of temporomandibular joint disease was performed. This was carried out using PubMed, MEDLINE, Scopus, and Google Scholar and was limited to the past 11 years using key medical search terms relevant to the subject area while being consistent with our exclusion criteria. The search yielded a total of 23 articles containing 3 reviews, 6 technical notes, 11 retrospective studies, and 3 prospective studies. Multiple techniques were described in the literature including arthroscopic techniques (n = 4), open suturing techniques (n = 4), mini-anchor techniques (n = 9), and splint-assisted surgery (n = 1). Several variables were used to determine success including both qualitative and quantitative measures determined clinically, through MRI or via patient questionnaire. When considering various combinations of these functional outcomes, all studies showed a significant improvement post-operatively. This demonstrates the success of disc repositioning procedures as an option in certain cases of TMD. Although there is evidence to show improvement in functional outcomes associated with Meniscopexy as a means of TMD management, there remains to be a lack of high-level evidence to further support this.

Keywords: temporomandibular joint, meniscoplasty, meniscopexy, disc repositioning, temporomandibular joint dysfunction

1. Introduction

Temporomandibular joint dysfunction (TMD) is the most common cause of non-odontogenic pain in the oro-facial region, having a significant impact on quality of life [1].

TMD is a common term used to describe a range of disorders affecting the temporomandibular joint. TMD can affect the temporomandibular joint (TMJ), the jaw muscles, or both, TMD has also been associated with ear and neck pain. Patients demonstrate clinical signs such as pain from the TMJ, muscle pain, TMJ sounds including clicking and crepitus, restricted mouth opening and deviation on mouth opening or closing [2].

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) presented by Dworkin and LeResche in 1992 classified TMD patients

according to their physical diagnosis (axis I) and pain-related disability and psychological status (axis II). Axis I is divided into three groups. Group I is muscle disorders, Group II disc displacements and Group III consists of joint disorders as seen in the box below [3] (**Table 1**, **Figure 1**).

Classification systems have been conceived to further classify and delineate the specific groups discussed above. The Wilkes classification is used to classify TMJ Internal Derangement (**Table 2**).

The causes of TMD are wide and varied due to the homogeneity demonstrated in the classification. They include a wide range of direct injuries, such as fractures of the mandibular condyle, systemic diseases, including as immune mediated arthritis, growth disturbances and tumours. Non-functional movements of the mandible such as bruxing and tooth-clenching are clinically correlated with a variety of jaw muscle symptoms and are associated with internal joint disk derangements. It has been postulated however that these behaviours are not established causes of TMD but may only be propagating factors [5].

Malocclusion, previously thought to be causative is no longer widely established as an important factor in TMD. It has also been demonstrated that orthodontic treatment neither increases nor decreases the chances of developing TMD [5].

Different approaches have been described for the management of TMD depending on severity and aetiology. Initial management is non-surgical. This can range from physical therapy, occlusal appliance therapy, drug therapies, intra-articular injections, diet alteration and life style adaptation. Studies have demonstrated 70–80% of cases can be treated successfully with non-surgical interventions [4, 6].

Occlusal splint therapy has been reported with success. Various types of splints exist with distinctive indications and functions. The stabilisation splint is widely used; it is a hard acrylic splint and provides a temporary and removable ideal occlusion. Affording an occlusion reduces atypical muscle activity and produces neuromuscular balance to the TMJ [7].

Occlusal modification was proposed as a treatment however meta-analysis showed no evidence that it was beneficial in the management of TMD. Physiotherapy has been shown to be beneficial for a select group of patients [6].

Should conservative management strategies prove unsuccessful they may be followed by surgical intervention. These include menisectomy, disc repositioning, condylotomy and joint replacement. These procedures are aggressive and invasive with risks and complications of their own. Arthocentsis is considered less invasive and refers to lavage of the upper joint space, hydraulic pressure and manipulation to liberate adhesions and improve motion. Another less invasive procedure, TMJ arthroscopy is widely undertaken [8].

A review of arthroscopy and arthrocentesis found no statistically significant difference between these interventions in terms of pain, however a statistically significant difference in favour of arthroscopy was discovered in maximum incisal opening. The review concluded that there is insufficient reliable evidence to either encourage or disprove the use of arthrocentesis for treating patients with TMD and that further high quality studies are needed before firm conclusions can be stated [9].

Disc repositioning as a treatment for internal derangement of the temporomandibular disc was first reported to have been performed by Annandale in 1887 [10]. However, it was not until Wilkes first described the nature of the temporomandibular joint (TMJ) in TMD using arthrography in 1987 that surgical procedures such as disc repositioning were accepted as a means of management [11]. Notably, McCarty and Farrar were first to describe a rationale and technique for arthroplasty and disc repositioning for internal derangement of the TMJ in 1988 [12]. Since then, there

Group I—Muscle disorders	Group II—Disc displacements	Group III—Joint disorders
Ia. Myofascial pain: • Report of pain or ache in the jaw, temples, face, preauricular area, or inside the ear at rest or during function. • Pain on palpation of temporalis, masseter, lateral pterygoid area • At least one of the painful sites must be on the same side as the complaint of pain.	**IIa. Disc displacement with reduction:** • Reciprocal clicking in TMJ (click on both vertical opening and closing, occurring at point 5 mm greater than interincisal distance on opening than closing and is eliminated on protrusive opening), reproducible on 2 out of 3 consecutive trials • Clicking in TMJ either opening or closing, reproducible on 2 out of 3 consecutive trials, • Click during lateral excursion or protrusion, reproducible on 2 out of 3 consecutive trials.	**IIIa. Arthralgia:** • Pain in one or both joint sites (lateral pole and/or posterior attachment) during palpation • Pain in the region of the joint, pain in the joint during maximum unassisted opening, pain in the joint during assisted opening, and pain in the joint during lateral excursion • For a diagnosis of simple arthralgia, coarse crepitus must be absent.
Ib. Myofascial pain with limited opening: • As above with painless unassisted mandibular opening less than 40 mm. • Maximum assisted opening (passive stretch) less than 5 mm greater than painless unassisted opening.	**IIb. Disc displacement without reduction with limited opening:** • History of significant limitation in opening; • Maximum unassisted opening less than 35 mm; • Passive stretch increases opening by less than 4 mm over maximum unassisted opening • Contralateral excursion less than 7 mm and/or uncorrected deviation to ipsilateral side on opening • Absence of joint sound or presence of joint sounds not meeting criteria for disc displacement with reduction.	**IIIb. Osteoarthritis of the TMJ:** • Arthralgia as defined in IIIa; • Either coarse crepitus in the joint or radiologic signs of arthrosis.
	IIc. Disc displacement without reduction, without limited opening: • History of significant limitation of mandibular opening; • Maximum unassisted opening greater than 35 mm • Passive stretch increases opening by greater than 5 mm over maximum unassisted opening; • Contralateral excursion greater than 7 mm; • Presence of joint sounds not meeting criteria for disc displacement with reduction; • Where available, arthrography or magnetic resonance reveals disc displacement without reduction.	**IIIc. Osteoarthrosis of the TMJ:** • Absence of all signs of arthralgia; • Either coarse crepitus in the joint or radiologic signs of arthrosis.

Table 1.
RDC/TMD criteria for axis I diagnoses [3].

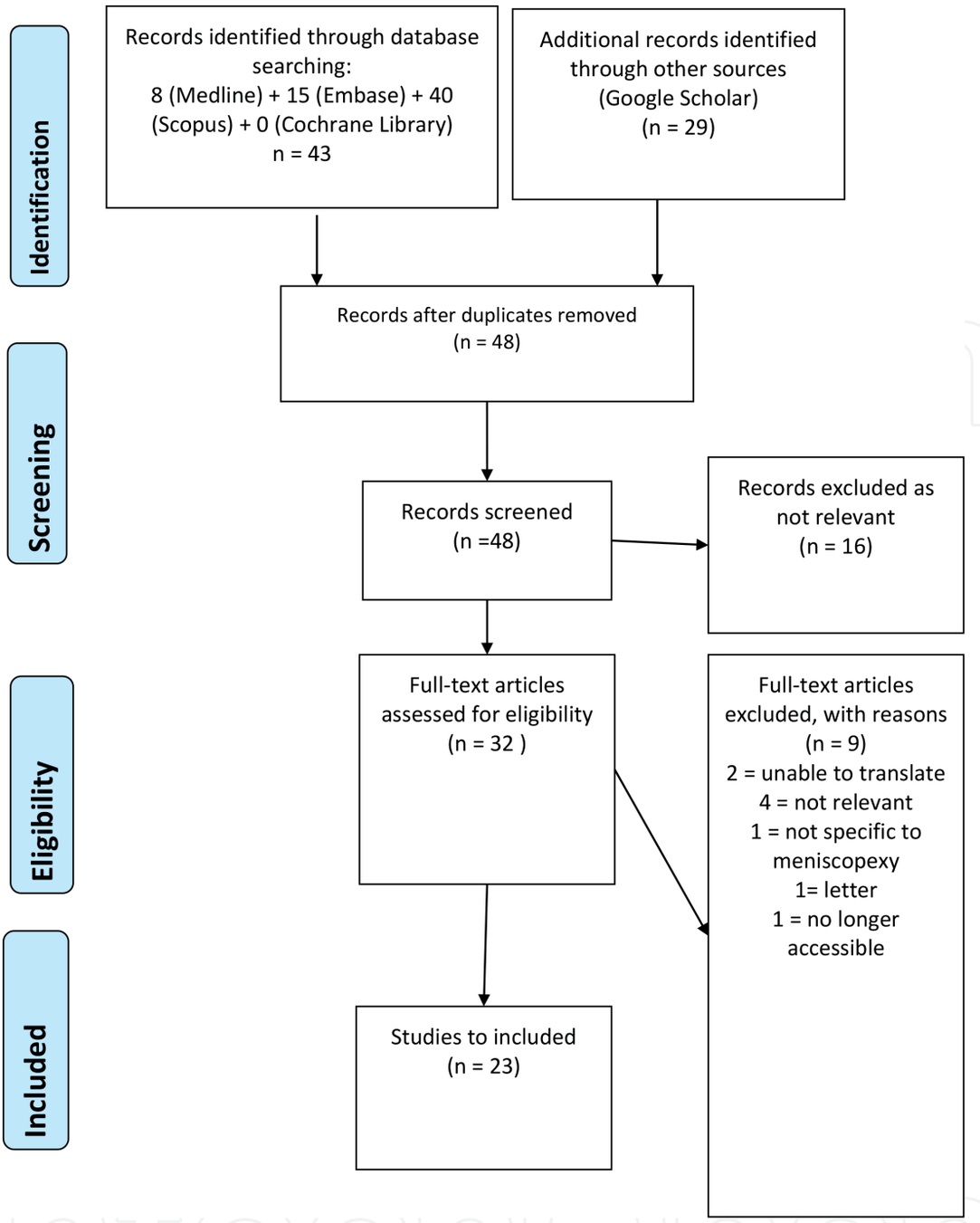

Figure 1.
PRISMA flow diagram, illustrating method by which screening of articles was undertaken.

have been multiple variations and modifications in technique that have been proposed by surgeons, each in an attempt to improve outcome [13]. Examples of such innovations are the introduction of orthopaedic suture anchors to with the hope of stabilising the disk more reliably and the advent of arthroscopy as an approach to repositioning the disc [14, 15].

The authors aim to look at current practice for meniscopexy, give an overview of the different TMJ articular disc repositioning techniques described as well as analysing clinical studies to establish their success by looking at measured functional outcomes. This enables us to scrutinise different approaches allowing us to conclude as to whether Meniscopexy remains to be a viable treatment modality in the management of TMD.

Stage	Clinical	Imaging	Surgical
I Early	Painless clicking. No restricted motion	Slightly forward disc, reducing. Normal osseous contours	Normal disc form. Slight anterior displacement. Passive incoordination (clicking)
II Early/Intermediate	Occasional painful clicking. Intermittent locking. Headaches	Slightly forward disc, reducing. Early disc deformity. Normal osseous contours	Anterior disc displacement. Thickened disc
III Intermediate	Frequent pain. Joint tenderness, headaches. Locking. Restricted motion. Painful chewing	Anterior disc displacement. Reducing early progressing to non-reducing late. Moderate to marked disc thickening. Normal osseous contours	Disc deformed and displaced. Variable adhesions. No bone changes
IV Intermediate/Late	Chronic pain, headache. Restricted motion	Anterior disc displacement non-reducing. Marked disc thickening. Abnormal bone contours	Degenerative remodelling of bony surfaces. Osteophtyes. Adhesions. Deformed disc without perforation
V Late	Variable pain. Joint crepitus. Painful function	Anterior disc displacement non-reducing with perforation and gross disc deformity. Degenerative osseous changes	Gross degenerative changes of disc and hard tissue. Perforation and multiple adhesions

Table 2.
The Wilkes classification [4].

2. Methods

Evidence was searched, using the Ovid Medline, Embase, Scopus and Cochrane Library medical databases. A literature search was carried out, in accordance with Prisma guidelines, on the PubMed/MEDLINE database as well as SCOPUS, Embase, Cochrane library medical databases and Google Scholar using key medical subject headings (MeSH) relevant to TMJ meniscopexy restricted to the past 11 years from the time of writing of this paper (**Table 3**).

The Key Terms we used included:

- Temporomandibular joint disorders
- TMD
- Temporomandibular joint
- TMJ
- Meniscopexy/Discopexy

Type	No. of Articles (%)
Review	3 (13)
Technical Note	6 (26)
Retrospective	12 (52)
Prospective	2 (9)

Table 3.
Articles found within literature search classified by type (published between 28/10/2008 and 28/10/2019).

- Meniscoplasty
- Disc Repositioning

We further scrutinised the list of papers using our inclusion criteria (below) to yield 23 relevant papers.

Inclusion criteria:

- Articles must be directly relevant to the to be evaluated
- Articles must be peer-reviewed
- Articles must be written in English
- Articles must be less than 11 years old (i.e., all articles published after 28/10/2008)
- Quantitative and Qualitative studies can be included

Excluded papers were patents, letters, articles not pertaining to meniscopexy treatment, articles not in the English language and those outside the stated timeline.

Of the 23 papers, we found 3 review articles, 12 retrospective studies, 2 prospective studies and 6 technical notes.

3. Methods

3.1 Indications for disc repositioning

Meniscopexy has been indicated in cases of anterior displacement of the TMJ articular disc without reduction, in an effort to slow progression to more advanced TMJ-related symptoms [16]. There are, however, a range of various surgical techniques that may be employed for TMD management, thus it is important to delineate where meniscopexy may be used in preference to these. Disc repositioning is favoured in patients who have not responded to initial non-surgical treatment [17] or diagnostic arthroscopy/arthrocentesis [18].

Studies have also attempted to identify causes of TMD that may have a more favourable surgical outcome with meniscopexy. One prospective cohort study looked at the stage of internal derangement of the articular disc according to the Wilkes classification as a factor in determining success using Meniscopexy in management. Patients had previously undergone both conservative and primary arthroscopic treatment with lysis and lavage of the superior joint space. Patients were classified into two groups, Wilkes Stages II and III and Wilkes Stages IV and

V and underwent arthroscopic disc repositioning surgery to reduce and fix the articular disc. The primary successful outcome was determined by absence of pain at 12 months postoperatively. The study found an 86.7% success rate for the Wilkes II/III group in comparison to 25% for the Wilkes IV/V group [18].

This suggests meniscopexy as being an effective means of management for earlier stages of internal derangement, but less successful with increasing degenerative changes of the TMJ. A literature review of discectomy versus preservation of the articular disc evaluated current evidence to determine a rationale for meniscopexy versus removal/replacement of the disc. Adequate remaining anatomy and mobility of the disc, with minimal damage or perforation was key to the decision to preserve [19, 20].

Surgical management of disc displacement without reduction arising acutely following facial trauma without condylar fracture where no TMJ symptoms existed prior to the event was evaluated. Evidence suggests that there is a more rapid progression of disease following acute displacement. There is a much weaker response to conservative treatment and greater chance of developing osteoarthiritis or even ankylosis of the joint, with fast degeneration of the condyle within the first 3 months. Such adverse degenerative changes in some patients would justify surgical intervention at an earlier stage rather than prolonged conservative treatment as first line management where necessary. Eight8 patients were offered disc repositioning surgery and seven total joint replacement following rapid onset of end-stage disease. The study observed patients following trauma, after both conservative treatment and surgery. All patients demonstrated limited maximum interincisal opening (MIO) and deterioration of the condyle as seen on MRI following initial conservative treatment, with significant improvement in MIO post-operatively [21].

Studies like this are useful in demonstrating the place for meniscopexy within the surgical armamentarium when managing TMDs. They give an appreciation where the procedure is most effective and can be indicated as a first line of approach. From the literature search there are no studies available that investigate the efficacy of meniscopexy over other techniques at various stages of disease. More data is required to inform surgeons of circumstances where meniscopexy has the best outcome.

3.2 Surgical technique

There are multiple surgical approaches described in the literature to TMJ articular disc repositioning, which can be broadly classified into three areas:

- Meniscopexy through an open incision or arthrotomy (described in 4 articles within our search) [16, 19, 22, 23]

- Meniscopexy with the use of suture anchors or mini-anchors to aid disc fixation (described in 10 articles within our search) [13, 15, 24–31]

- Arthroscopic meniscopexy (described in 4 articles within our search) [3, 14, 17, 32]

Disc repositioning techniques first developed, such as that initially described by McCarty and Farrar in 1988, rely on an endaural open incision to access the TMJ, which remains to be the approach of choice for many surgeons. Dissection is carried out to access the disc and is released anteriorly, repositioned and subsequently sutured, either to the capsule or auricular cartilage. This technique is favoured by many due to its relative ease, providing a better view of the disc and its attachments, making the anterior release and suturing of the disc more predictable, compared to arthroscopic surgery [16].

Modifications of this technique have been introduced, with the use of mini suture anchors screwed into the condyle, in the hope of achieving better long-term fixation and stability of the reduced disc. A variety of orthopaedic suture anchors have been used for this purpose, most commonly the Mitek [29] and Arthrex mini-anchors [15], however alternatives have also demonstrated success, such as one study that reports the use of orthodontic mini-screws [24]. Such techniques aim to offer a predictable long-term result, however, may not be most appropriate where it is difficult to insert a screw into the condyle, such as in the small, resorbed or osteoporotic condyle [16].

Arthroscopic repositioning of the disc and suturing provides an alternative to procedures involving an open incision. Arthroscopy is a more minimally invasive approach, permitting the selective operation on articular disc without causing damage to the other tissues of the TMJ, as well as reducing risk of iatrogenic facial nerve injury which can be associated with open surgery (arthrotomy). Surgically, this involves the creation of three portals, one for the arthroscope and two for instrumentation permitting the passing of a suture through the disc. This technique, despite its conservative nature, is mainly limited by its technical difficulty, and is best performed by an experienced surgeon to ensure a long-term stable outcome [16, 17, 32].

One article also reported the use of a modified meniscopexy technique, whereby a splint was used by patients for a period before surgery, opening the joint space. An anterior-repositioning splint was during the surgical procedure to place the mandible into an ideal relationship with the maxilla. The disc is finally repositioned and sutured anteriorly and laterally to the capsular ligament using an open preauricular approach. Patients then wear the splint postoperatively which is gradually made smaller and narrower, slowly reducing the joint space to its normal anatomical size with the aim of reducing displacement or relapse of the disc repositioning [22].

3.3 Outcome variables

Several outcome variables were used as measures post-surgery. These included maximal interincisal opening (MIO), post-operative pain using the visual analogue scale (VAS) or questionnaire, changes in diet consistency, mandibular range of motion, joint clicking (including other noises), the use of medications, joint loading signs, MRI to evaluate disc position, disc rupture, and muscular pain.

3.3.1 Maximal Interincisal opening (MIO)

MIO is the measurement of the distance between the incisal edges of maxillary central incisors to mandibular central incisors at maximum mouth opening. During anterior disc displacement, mandibular opening becomes limited, thus corrective meniscopexy should increase mouth opening in successful cases allowing MIO to be an indicator for success (**Table 4**).

When comparing the different techniques used in the studies, the greatest increase in mean MIO was seen for patients who had undergone arthrotomy using Mitek mini-anchors compared to arthroscopic techniques [17, 18, 21, 26, 28]. However, it should be noted that the severity of TMD within the patient cohorts is likely to differ, with higher Wilkes' classifications having further disc degeneration and thus limited mouth opening. Further to this, cohort size has implications on reliability of the results, with smaller cohorts being less reliable to compare surgical techniques based on outcomes. Rajkumar et al. found that MIO increased most significantly, in patients with disc displacement without reduction (DDwoR), within the first month after surgery, with significantly smaller increases seen up to 6 months post-operatively. Although it is difficult to compare between these studies

Name of study	Technique	Number of patients	Preoperative MIO mean (mm)	Postoperative MIO mean (mm)	Follow-up period (time post-op)
He et al. [21]	Disc repositioning/ Total joint replacement	8/7	19.8	33.9	Not specified
McCain et al. [18]	Arthroscopic suture meniscopexy	32	30.0	37.9	12 months
Ruiz Valero et al. [28]	Open Meniscopexy using Mitek anchors	50	23.5	38.3	Not specified
Goizueta Adame et al. [17]	Arthroscopic Meniscopexy using posterior double pass suture	16	31.1	39.9	12 months
Göçmen et al. [26]	Open Meniscopexy using Mitek anchors	7	22.8	31.5	12 months
Rajkumar et al. [24]	Open Meniscopexy with orthodontic anchors	3 patients with DDwoR*	25.6	35.0 39.6	1 month 6 months

**DDwoR, disc displacement without reduction.*

Table 4.
Pre-operative and post-operative mouth opening.

due to differing techniques used and other difference in key variables, similar trends can be seen from the values provided, highlighting the importance of correct disc position in mechanical action of the mandible.

3.3.2 Pain

Pain can be used as a subjective measure of surgical outcomes. Within the studies we looked at, there were three methods of measuring pain: using a questionnaire to give a pain score out of 10, using the Visual Analogue Scale (VAS) or by reporting the percentage of patients with pain pre and post operatively. These have been summarised in the table as average values within the patient cohorts (**Table 5**).

Overall, all studies showed an improvement in pain scores on follow up. The VAS was the most commonly used measure of quantifying pain improvement post-operatively. This can be said to be due to its relative simplicity and quantitative nature. However, there has been debate with regards to its validity. Patients may report pain with a certain degree of bias and also may not be able to report pain relief reliably owing to difficulties in recalling previous pain experiences, hence quantitative comparison is challenging [33]. Some studies looked at the simple absence/presence of pain: Ruiz Valero et al. demonstrated a significantly smaller number of patients presenting with painful TMJ symptoms 12 months post-operatively (pre-100%, post-8%). McCain et al. also looked at pain medication use among patients at pre-operative assessment (15/32 patients) and at last visit (6/32) as a secondary

Study	Surgical technique	No. of patients in cohort	Pre-op pain	Post-op pain	Follow-up period (time post-op)
McCain et al. [18]	Arthroscopic suture Meniscopexy	32	VAS score for joint function* 41.9	VAS score for joint function* 71.5	Not specified
Ruiz Valero et al. [28]	Open Meniscopexy with Mitek anchors	50	100% of patients	8% of patients	12 months
Sheikh et al. [22]	Splint assisted Meniscopexy	30	See separate table below	See Separate table below	8.5 years
Abramowicz et al. [23]	Not specified	18	9/10	1.3/10	20 years
Goizueta Adame et al. [17]	Arthroscopic Meniscopexy using posterior double pass suture	16	VAS score 7.6	VAS score 0.9	12 months
Sharma et al. [19]	Open Meniscopexy using Suture	10	Not specified	100% "Pain relief"	12 months
Göçmen et al. [26]	Open Meniscopexy with Mitek anchors	7	VAS Score 7.9	VAS score 0.6	12 months
Rajkumar et al. [24]	Open Meniscopexy with orthodontic anchors	10	Not specified	3.5	6 months

**This paper only presented scores for successful surgeries. Visual analogue scale in this paper ranged from 0 to 100 rather than 0 to –10, 0 indicating maximum pain and 100 no pain.*

Table 5.
Pre-operative and post-operative pain.

outcome variable. The subjective nature of pain presents difficulty when data gathering techniques are employed. Furthermore, only two articles measuring pain as an outcome variable in our search followed-up patients for more than 12 months [22, 23]. More studies are needed to look into more long-term data as a measure of success, especially with concerns of patients going on to develop secondary joint diseases in the long-term following disc-repositioning procedures [34]. Also, more sensitive means of pain measurement can be considered to establish pain relief post-operatively, if this is to be used as a primary outcome variable, such as the McGill pain questionnaire [35].

Sheikh et al. investigated pain using a different method. They asked patients about the frequency of pain compared to the severity as a measure of outcomes and found improvements from constant pain to rare and no pain. The table illustrates the distribution of pain frequency pre and post operatively [22] (**Table 6**).

This study looked at the pre and post-operative frequency of pain in 30 patients at a mean of 8.5 years post-op. Although the data illustrates a clear reduction in the frequency of pain within the cohort of patients, it would have been further enhanced by quantitative measures of frequency (e.g. pain occurring between 5 and 10 times per day, etc.). Currently, the interpretation of the terms used to describe pain by patients remains subjective. Further to this, if more data points were collected throughout the post-op period, the course of recovery could be monitored. Nevertheless, frequency of pain remains to be an interesting and useful alternative when measuring pain.

Frequency of pain	Pre-operatively (% of patients)	Post-operatively (% of patients)
Constant	66.67	3.33
Moderate	10	6.67
Occasionally	6.67	33.33
Rare	10	33.33
None	6.67	23.33

Table 6.
Pre-operative and post-operative pain distribution.

3.4 Mandibular range of motion

Arguably this is one of the most important outcomes as a patient's quality of life is greatly determined by this (ability to speak and chew). Goizueta Adame et al. specifically used lateral movements of the mandible as an outcome variable. They found on average in a cohort of 16 patients, the average lateral movement increased from 3.9 mm pre-op to 10.3 mm post-op [17].

Moreover, within the cohort patients looked into by Rajkumar et al., three patients had disc displacement without reduction and their lateral mandibular movements were recorded pre-op and at 6 months post-op. The pre-op average was 1.67 mm increasing to 4.67 mm at 6 months. However, this small patient size cannot be used to determine trends within the data. Further to this, other mandibular movements such as protrusion and retrusion could have been recorded over the long term throughout the studies, in order to create a more complete picture of mandibular function [24].

3.5 Evaluation of disc position using MRI post-operatively

Four studies used MRI evaluation post-operatively looking at disc positioning and condylar changes, as a means to qualify the effectiveness of TMJ meniscopexy procedures.

Zhang et al. conducted a study with 81 patients with internal derangement of the articular disc, ranging from Wilkes III to V that underwent meniscopexy using bone anchors for fixation. MRI was performed 1–7 days post-operatively to evaluate the position of the disc as poor (none or only reposition in one sagittal plane), good (reposition in two2 sagittal planes) or excellent (reposition in three sagittal planes). They termed a successful outcome as good or better and found that 77 patients were excellent, 1 patient had good outcome and 3 patients had poor outcomes, suggesting a 96.3% success rate using bone anchors in arthrotomy [27].

Comparable results are seen in a study of 764 joints treated with an arthroscopic disc repositioning technique, with 729/764 joints deemed as having an excellent outcome [32]. In this particular study however, the specific suture technique was not described, making comparison difficult.

Such data proves that various techniques can be effectively used to reposition the disc accurately into its anatomic position. However, the efficacy of the techniques described can be attributed to the skill of the operator, and such results may not be reproducible universally. Furthermore, while this data gives a good indication of how well the disc is reduced immediately post-operatively, more information regarding long-term relapse would be useful to determine success. The study also gives no mention of post-operative pain or function. Outcomes that are more important to patients than knowing their disc is in the correct position.

Rajkumar et al. conducted MRI assessment at 6 months for 10 patients managed with meniscopexy with orthodontic mini-screws, finding stable positioning of the disc and lack of progression of arthritic changes of the condyle on evaluation [24]. Zhou et al. when using MRI scans to follow up patients post-operatively found 4.7% of patients relapsed with anterior disc displacement. Of the 149 patients, 5 relapsed after 1 year and 2 after 2 years [25]. However, further studies investigating the long-term follow up of all cases is required to accurately ascertain incidence of relapse.

Other outcomes such as reduction in joint noises, increase in diet consistency, muscle pain and joint loading signs were also looked at in a few isolated studies as a means to assess the success of surgery. However, there were not enough studies available to effectively use these to determine outcomes.

4. Discussion

From the results of our search it is reasonable to conclude that there is data to support the efficacy of meniscopexy for the management of temporomandibular joint dysfuction. Studies evaluating various techniques of articular disc repositioning demonstrated a successful outcome in the majority of cases, with little evidence to prove otherwise. However, there are certain limitations present in the literature available:

- There is a lack of high-level evidence to evaluate outcomes.
- There is limited evidence looking at long-term follow up of patients who have received meniscopexy.
- No study currently compares the efficacy of meniscopexy directly relative to other surgical techniques available (*e.g.* arthroscopy/arthrocentesis or total joint replacement) to establish its superiority in similar groups of patients.
- There is a lack of consistency in outcome variables evaluated and method in which these were determined, as well as surgical techniques used between papers. Some studies did not describe technique used. Therefore, it is difficult to compare and collate the results of various studies.
- Many of the procedures described are sensitive techniques, and therefore results may not necessarily be reproducible across centres or among different operators.

4.1 Levels of evidence

According to the *Oxford Centre for Evidence-Based Medicine* 2011 guidelines on levels of evidence in healthcare research [36], the highest levels of evidence consist of systematic reviews of randomised trials *(Level I)* or randomised trials or observational studies with dramatic effect *(Level II)*. The difficulty in conducting randomised, controlled trials prospectively to evaluate outcomes of surgery in this field limit the quality and certainty of conclusions that can be made with regards to effectiveness.

4.2 Follow-up

Our literature search only yielded 2 articles following up patients for more than 12 months after having received disc repositioning surgery, neither of which was

conducted prospectively [22, 23]. Concerns exist with regard to long-term outlook of this surgery, specifically incidence of relapse, reoccurrence of symptoms and secondary joint disease [34, 37]. Well-designed, prospective studies of patients receiving meniscopexy with prolonged follow-up are required to address these concerns.

4.3 Comparison to other techniques

No one surgical technique in the management of advanced TMD seems to predominate, with multiple options described in the literature. Where procedures such as arthrocentesis of the joint space are successful in the management of internal derangement, the role of disc position in the pathology of TMD should be questioned [37]. Ribeiro et al. [38] found articular disc displacement without symptoms to be a common occurrence in the general population (34% of subjects) when conducting an MRI study of 56 asymptomatic volunteers. Other authors [39, 40] have also questioned the role of disc position in TMJ pathology, arguing that pathological changes such as synovitis, osteoarthritis and adhesions to be the causative agents of symptoms, which should be treated separately.

However, in instances where there is no response to other treatment, there seems to be benefit in meniscopexy. This suggests there may still be a place for disc mobilisation, with many patients showing immediate improvement in mechanical function potentially leading to better regeneration of the tissues [17].

Other surgeries performed such as discectomy, joint replacement procedures and various other arthrotomies may also be beneficial in particular circumstances [20]. Since a single procedure has not yet been identified as being preferable in all instances of TMD, the role of the surgeon then becomes to identify the modality which will achieve the best outcome on a case-by-case basis.

To establish the place of meniscopexy relative to other techniques at the operator's disposal research is required comparing surgical modalities. Despite positive findings no study exists offering a direct comparison between repositioning the disc and alternative procedures.

4.4 Technical limitations

A number of different approaches are described to reposition the articular disc, some of which are more technically demanding. No study was found directly comparing the efficacy of different techniques. This is also hard to determine since the efficacy of certain techniques will largely depend on the skill of the operator [13]. For instance, excellent outcomes have been reported with arthroscopic disc repositioning and suturing techniques [32]. However, such results may not be reproducible due to this technically demanding technique, resulting in data that is not universally acceptable [16].

5. Conclusion

Despite the fact that an increasingly greater proportion of TMD is being managed conservatively and minimally invasively, there remains a place for surgical procedures in refractory cases. There is evidence in the literature to suggest meniscopexy is an effective procedure in the management of some instances of TMD, however high-level evidence is lacking. Outcome variables between papers varied, making comparison difficult. In addition, it is apparent that many other techniques are available at a surgeon's disposal, many of which may be more effective than attempts to reposition the disc. Therefore, case selection is vital when deciding to

use meniscopexy as a primary means of management, something which is currently largely based on clinical experience. More research into the pathological processes underlying TMD is required to allow surgeons to make more justified and informed decisions on appropriate means of management for each individual case.

Author details

Omar Sheikh*, Matin Ali Madadian and Amanveer Benning
Kings College Hospital, London, United Kingdom

*Address all correspondence to: osheikh@nhs.net

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