



# Effectiveness of disk repositioning and suturing comparing open-joint versus arthroscopic techniques: a systematic review and meta-analysis

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**Objective.** The aim of this study was to present a systematic review of the effectiveness of discopexy in managing internal derangement of the temporomandibular joint (TMJ).

**Study Design.** We searched MEDLINE through PubMed, SCOPUS, Web of Science, and Cochrane Central Register of Controlled Trials and grey literature accessed through Google Scholar, Openthesis, and hand-searching from inception to July 2020. The search strategy yielded 363 potentially relevant studies. After screening titles and abstracts, 41 full-text articles were assessed for eligibility and 7 studies were included in the meta-analysis.

**Results.** There was an overall decrease in visual analog scale (VAS) pain score of 4.59 cm (95% confidence interval [CI], 2.03–7.16;  $P < .001$ ) during the follow-up time and an overall increase of 10 mm (95% CI, 6.93–13.01;  $P < .001$ ) in mouth opening after TMJ surgeries with discopexy.

**Conclusions.** The available evidence showed an overall decrease in VAS pain score and an improvement in mouth opening after TMJ surgeries with discopexy. Changes in maximal interincisal opening were greater after arthroscopic disk repositioning compared to open-joint procedure. (Oral Surg Oral Med Oral Pathol Oral Radiol 2021;132:506–513)

Temporomandibular disorders (TMD) are a heterogeneous group of conditions affecting the masticatory system characterized primarily by joint and/or muscular pain, joint sounds, and limited or irregular mandibular function.<sup>1,2</sup> Otolaryngologic symptoms may be present and the more severe TMD are associated with a lower quality of life.<sup>3,4</sup> The causes of TMD are complex and multifactorial. Biological, psychological, and social roles appear to be related to the observed association between TMD and female sex.<sup>5,6</sup>

Chronic TMD occur in a subgroup of patients with TMD who do not respond to treatment and are marked by psychological distress, sleep problems, upregulation of the serotonergic pathway, and pain amplification.<sup>7</sup> Treatment is directed toward reducing pain and improving function and includes noninvasive (pharmacotherapy, physiotherapy), minimally invasive (arthroscopy, arthrocentesis), and invasive interventions. In addition, psychotherapy and orthodontics or orthognathic surgery in patients with severe malocclusion appear to improve oral health-related quality of life in patients with TMD.<sup>8</sup>

There is a paucity of evidence-based guidelines for the management TMD, but symptomatic patients should be initially treated by the simplest and least

invasive intervention.<sup>9</sup> Temporomandibular joint (TMJ) surgery is indicated for patients whose symptoms remain severe despite conservative treatment and include disk repair and disk repositioning procedures (discopexy), meniscectomy with or without autogenous implants, condylectomy, condylotomy, and eminectomy. There is evidence that open-joint surgery is superior to arthroscopic in pain reduction in patients with internal derangement (ID) (anchored disk phenomenon, disk displacement with reduction, painful click, and closed lock) of the TMJ, with comparable maximal interincisal opening, mandibular function, and clinical findings (clicking, joint tenderness, and crepitation).<sup>10</sup> However, for patients with disk displacement without reduction, evidence about the clinical effectiveness of conservative or surgical interventions is lacking.<sup>9,11,12</sup>

One of the treatments listed above, discopexy, has been indicated for selected patients with functional TMJ deficits, signs of ID, or evidence of a malpositioned disk on magnetic resonance imaging (MRI).<sup>13</sup> The surgical approach consists of TMJ disk repositioning using Mitek mini anchors (Mitek Anchor, Mitek Products Inc., Westwood, MA, USA) over the condylar head<sup>14,15</sup> or arthroscopic suturing technique,<sup>16</sup> facilitating physiologic movement and function of the joint

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## Statement of Clinical Relevance

The decrease in visual analog scale pain score is associated with improved mouth opening after temporomandibular joint surgeries with discopexy.

structures. Although TMJ disk repositioning surgery seems to improve pain, mouth opening, and patient quality of life, there are no systematic reviews evaluating clinical and patient-centered outcomes related to discopexy in patients with TMD.

The aim of this study was to present a systematic review of the effectiveness of discopexy in managing ID of the TMJ and perform a comparative analysis of the effectiveness of open surgery vs arthroscopy.

## MATERIAL AND METHODS

This review was compiled according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.<sup>17</sup> Institutional review board approval and informed consent were not required for this systematic review and meta-analysis.

### Study characterization

We searched MEDLINE through PubMed, SCOPUS, Web of Science, and Cochrane Central Register of Controlled Trials and grey literature accessed through Google Scholar, Openthesis, and hand-searching from inception to July 2020. Our search was restricted to studies published in full-text versions, with no language restriction. The reference lists of all eligible studies and reviews were also manually scanned to identify additional studies for inclusion. We used free text and MeSH terms related to discopexy (discopexy OR meniscopexy OR “disc plication” OR “disc repositioning” OR “arthroscopic discopexy”) and temporomandibular joint disorders (“temporomandibular joint disorders” OR “temporomandibular joint” OR “TMJ disorders” OR TMJ OR “temporomandibular joint disc”). To expand the number of eligible articles, no filter was used in the search. All obtained references were exported to Mendeley Desktop 1.13.3 (Mendeley Ltd., London, England) software to track potential duplicate records.

### Study selection and eligibility criteria

Two reviewers (T.S.S. and E.N.) independently screened the search results and identified studies that were potentially relevant based on the paper's title and abstract. Relevant studies were read in full and selected according to eligibility criteria. Disagreements between the 2 reviewers were resolved by consensus or by a third reviewer. We included studies that reported clinical outcomes after open-joint procedures with disk repositioning and suturing or arthroscopic disk suturing technique in patients with clinical diagnosis of ID. Randomized controlled trials and prospective and retrospective observational studies with at least 10 patients were included. Outcomes included pain assessed using a visual analog scale (VAS), maximal interincisal opening, and contralateral translational movement. Eligible studies had to report at least 1 of

the outcomes of interest and have a minimum of 6 months of follow-up.

Because there is considerable debate in the literature regarding the improvement or worsening of TMJ symptoms when orthognathic surgery is performed on patients with preexisting TMJ dysfunction,<sup>15</sup> studies combining a disk repositioning procedure with orthognathic surgery were excluded. Patients with temporomandibular ankylosis and hypermobility and those submitted to condilectomy or eminectomy were also excluded.

### Data extraction and analysis

Two independent reviewers (T.S.S. and E.N.) extracted data from the studies using a predefined protocol. We checked information about the year of publication; objective and design; number and characteristics of patients; follow-up period; surgical procedure; and outcome data. For the different outcomes, preoperative and postoperative measurements (mean and standard deviation) were extracted.

Data were extracted either from manuscript figures using (WebPlotDigitizer, version 4.2, San Francisco, CA, USA).<sup>18</sup> or from the manuscript. For studies reporting only median and range of continuous data, means and standard deviations were calculated according to the method suggested in a previous study.<sup>19</sup>

Risk of bias was determined according to the Quality Assessment Tool for Before-After (Pre-Post) Studies With no Control Group developed by the National Institutes of Health.<sup>20</sup> The critical appraisal included 12 questions for different types of bias, including selection bias, information bias, measurement bias, and confounding.

Meta-analyses were performed using generic inverse variance with a random effects model. Effect measures for each outcome of interest were calculated based on mean (standard deviation) change from baseline to follow-up. For each study, the change score was calculated and the associated standard deviation for each group was determined based on baseline and follow-up score by assuming that the correlation between baseline and follow-up was 0.5.<sup>21</sup> A forest plot was used to present the effect sizes and the 95% confidence interval (CI). A 2-tailed *P* value < .05 was used to determine significance. Subgroup analyses were performed according to the surgical procedure.

Statistical heterogeneity was assessed using Cochran *Q* test<sup>22</sup> and quantified by the *I*<sup>2</sup> index.<sup>23</sup> Although funnel plots may be useful tools in investigating small study effects in meta-analyses, they have limited power to detect such effects when there are few studies.<sup>24</sup> Therefore, because of the small number of included studies within the subgroups, a funnel plot analysis was not performed. Leave-one-out sensitivity analysis was conducted by omitting 1 study at a time and examining the influence of each individual study on the

pooled effect size. The analyses were performed using Review Manager v5.3 software (Cochrane Collaboration, Copenhagen, Denmark).

**RESULTS**

**Study selection**

The search strategy yielded 363 potentially relevant studies. After screening titles and abstracts, 41 full-text articles were assessed for eligibility and 7 studies<sup>16,25-30</sup> were included in the meta-analysis. A flow diagram of the study selection process and specific reasons for exclusion are detailed in Figure 1.

**Study characteristics**

All studies included in this systematic review were observational studies; 6 had a prospective design without a control group and 1 was defined as a case series. The total number of patients submitted to TMJ surgery with discopexy was 304. Almost 90% of patients' TMJ ID were diagnosed with disk displacement without

reduction. In 4 studies,<sup>16,26,28,30</sup> patients were submitted to an arthroscopic disk suturing technique, and in 3 studies<sup>25,27,29</sup> an open-joint procedure with disk repositioning was performed. Most studies had a mean follow-up time of 1 year (Table I).

**Risk of bias assessment**

Studies included in this systematic review clearly stated the research question and described information on eligibility criteria. However, the lack of sample size estimation may lead to an increased risk of type II error to detect real differences in outcome measures from the baseline. All studies clearly described the surgical procedures and outcome measurements (Table II).

**Data synthesis**

Four studies<sup>16,25,28,30</sup> provided sufficient data to analyze the changes in pain score from baseline to final follow-up. There was an overall decrease in VAS pain score of 4.59 cm (95% CI, 2.03-7.16;  $P < .001$ ) during the follow-up time. No differences were found in pain intensity after arthroscopic disk repositioning (-4.30 cm; 95% CI, -7.37 to -1.24) and open-joint procedure with disk repositioning and suturing (-5.50 cm; 95% CI, -6.75 to -4.25;  $P = .48$ ; Figure 2).

All studies provided enough data to analyze the changes in maximal interincisal opening from baseline to final follow-up. There was an overall increase of 10 mm (95% CI, 6.93-13.01;  $P < .001$ ) in mouth opening after TMJ surgeries with discopexy. Subgroup analysis showed that changes in maximal interincisal opening were greater after arthroscopic disk repositioning (11.81 mm; 95% CI, 9.18-14.44) compared to open-joint procedure with disk repositioning and suturing (8.39 mm; 95% CI, 6.65-10.12;  $P = .03$ ; Figure 3).

Only 2 studies<sup>16,25</sup> evaluated the contralateral movement as an outcome of interest. An increase in lateral movement was observed in the study using arthroscopic disk repositioning (6.37 mm; 95% CI, 5.68-7.06), but no improvement was found after open-joint procedure (-1 mm; 95% CI, -2.47 to 0.47; Figure 4).

**DISCUSSION**

Disc repositioning surgery is an accepted and commonly performed treatment for TMJ internal derangement. The main goal of discopexy is to stabilize the articular disk in a functional position, restoring the normal condyle-disc relationship.<sup>31</sup> It has been suggested that disc repositioning surgery may lead to a reduction in disk degeneration by eliminating mechanical interferences and facilitating the range of motion<sup>32</sup> with fewer complications than discotomy.<sup>33,34</sup> Although reports have indicated an improvement in pain, mouth interincisal opening, and lateral movement, no systematic reviews were conducted to evaluate the

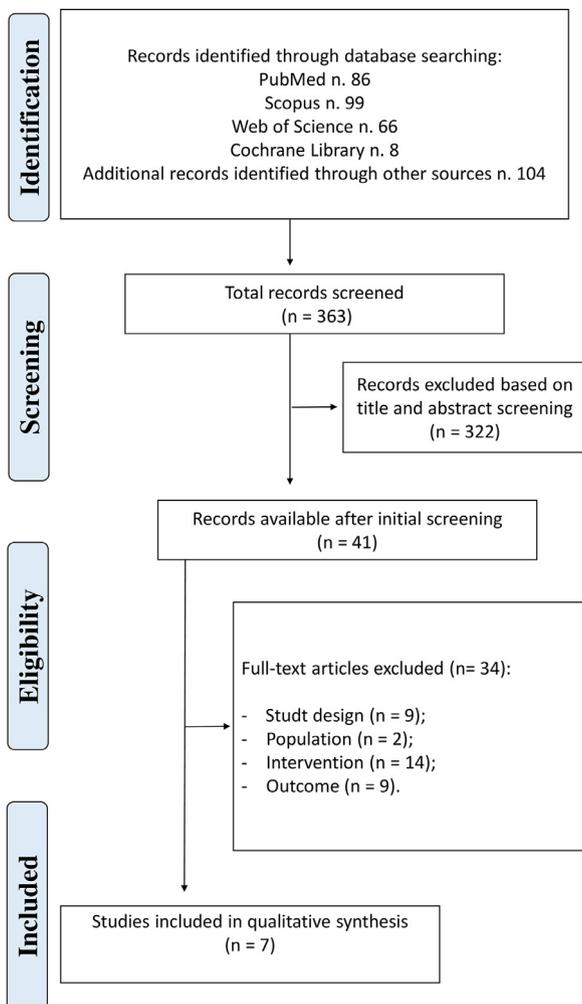


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of screened studies.

**Table 1.** Characteristics of studies included in the meta-analysis

<i>Study</i>	<i>Objective</i>	<i>Design</i>	<i>Sample</i>	<i>Surgery procedure</i>	<i>Outcomes of interest</i>	<i>Main findings</i>
Adame et al. <sup>16</sup>	To evaluate the outcomes of arthroscopic disk repositioning for TMJ internal derangement	Prospective study	16 patients diagnosed with TMJ internal derangement (15 with DDwoR)	Arthroscopic disk suturing technique (double puncture)	Pain, MIO, and lateral movement Follow-up: 1 year	There was a significant reduction in pain intensity and improvement in MIO 1 year after surgery
Hall et al. <sup>25</sup>	To compare the outcomes of 4 surgeries (arthroscopy, condylotomy, discectomy, and disk repositioning) used for the treatment of painful TMJ with internal derangement	Prospective study	54 patients diagnosed with TMJ internal derangement; 12 patients were submitted to disk repositioning (10 with DDwoR)	Open-joint procedure with disk repositioning and suturing	Pain, MIO, and lateral movement Follow-up: 1 year	Disc repositioning resulted in improved pain. One year after surgery, there was a significant increase in MIO, but no differences were found regarding mandibular lateral movement
McCain et al. <sup>26</sup>	To evaluate the outcome of advanced arthroscopic disk repositioning surgical procedure of TMJs presenting varying internal derangements severities and to weight possible correlations with various Wilkes stages	Prospective study	32 patients diagnosed with internal derangement of TMJ (31/42 joints with DDwoR)	Arthroscopic disk suturing technique (double puncture)	Pain and MIO Follow-up: 1 year	Patients with Wilkes II/III were 14.04 times likely to have a successful outcome than Wilkes IV/V. Discepxy resulted in a significant improvement of MIO and pain
Montgomery et al. <sup>27</sup>	To assess the impact of disk repositioning TMJ surgery without arthroplasty on objective and subjective patient treatment outcome parameters	Prospective study	51 patients with intra-articular disorders (38 with DDwoR)	Open-joint procedure with disk repositioning and suturing (single puncture)	Pain and MIO Follow-up: 2 years (mean)	35% of the patients continued to have residual TMJ pain, and a similar percentage continued to need periodic nonsteroidal anti-inflammatory drugs for analgesia. Mean mouth opening was improved by 8 mm
Murakami et al. <sup>28</sup>	To evaluate the outcomes of arthroscopic surgery of the TMJ for various stages of internal derangement	Prospective study	41 patients diagnosed with internal derangement of TMJ (all patients had DDwoR)	Arthroscopic disk suturing technique (double puncture)	Pain and MIO Follow-up: 3 years (minimum)	Postoperatively there was a significant increase in the distance that the jaws opened (from 30.4-43 mm) and a reduction in the VAS (from 46-9 mm)
Sharma et al. <sup>29</sup>	To evaluate the effect of meniscepxy on patients with internal derangement of the TMJ	Case series	10 patients diagnosed with internal derangement of the TMJ (6 with DDwoR)	Open-joint procedure with disk repositioning and suturing (single puncture)	Pain relief and MIO Follow-up: 1 year	Pain relief was reported in all cases. Average mouth opening achieved was 36.2 mm
Zhang et al. <sup>30</sup>	To evaluate the effects of arthroscopic surgery of intra-articular adhesion of the TMJ upper compartment	Prospective study	142 patients diagnosed with TMJ intra-articular adhesion (138 with DDwoR)	Arthroscopic disk suturing technique	Pain and MIO Follow-up: 10 months (mean)	There was a mean improvement in pain score and MIO

TMJ, temporomandibular joint; DDwoR, disk displacement without reduction; MIO, maximal interincisal opening; VAS, visual analog scale.

**Table II.** Risk of bias of the included studies using the Quality Assessment Tool for Before-After (Pre-Post) Studies With no Control Group<sup>20,\*</sup>

Study	1	2	3	4	5	6	7	8	9	10	11	12
Adame et al. <sup>16</sup>	Y	Y	N	NR	N	Y	Y	N	N	Y	N	Y
Hall et al. <sup>25</sup>	Y	Y	N	N	N	Y	Y	N	N	Y	N	N
McCain et al. <sup>26</sup>	Y	Y	N	NR	N	Y	Y	N	N	Y	N	N
Montgomery et al. <sup>27</sup>	Y	Y	N	NR	N	Y	Y	N	N	Y	N	N
Murakami et al. <sup>28</sup>	Y	Y	N	NR	N	Y	Y	N	N	Y	N	N
Sharma et al. <sup>29</sup>	Y	Y	N	NR	N	Y	Y	N	N	N	N	Y
Zhang et al. <sup>30</sup>	Y	Y	N	NR	N	Y	Y	N	N	Y	N	N

Y, yes; N, no; NR, not reported.

\*1 = objective clearly stated; 2 = eligibility criteria clearly described; 3 = representative sample of clinical population of interest; 4 = all eligible participants enrolled; 5 = sample size calculation; 6 = intervention clearly described; 7 = outcome measurements clearly defined; 8 = outcome assessors blinded to the intervention; 9 = loss to follow-up less than 20%; 10 = statistical analysis of change from baseline; 11 = interrupted time series design; 12 = individual-level data.

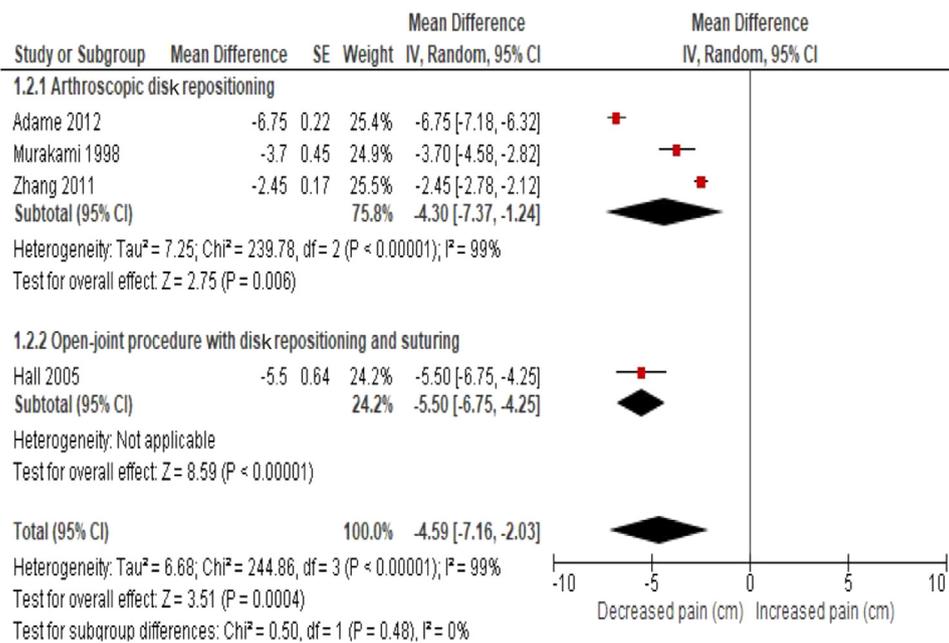


Fig. 2. Mean change in pain score from baseline to final follow-up. CI, confidence interval; SE, Standard error.

effectiveness of discopexy in managing internal derangement of the TMJ.

Pain during joint movement and trismus is one of the most important effects of ID of the TMJ. This systematic review and meta-analysis showed an overall decrease in VAS pain score and an improvement in mouth opening after TMJ surgery with disk repositioning and suturing. Although no differences were found in pain intensity after arthroscopic disk repositioning and open-joint procedure, changes in maximal interincisal opening were greater in patients submitted to arthroscopic surgery.

Arthroscopic disk repositioning with a suturing technique is minimally invasive, well tolerated, and low-cost and can be carried out in a day-case environment.<sup>35</sup> Although there is a marginal risk of causing long-term

joint damage leading to degenerative changes, disk and bony anatomy evaluation are important to ensure better clinical outcomes.<sup>36</sup> If the disk can be recovered, disk preservation surgery is a valid option to eliminate adhesions and to reposition the disk to achieve the correct relationship with the condyle.<sup>29,37</sup> Repositioning the disk between the condylar head and the glenoid fossa could improve acute pain, support tissue regeneration, and provide advantageous mechanical conditions.<sup>16</sup> Higher success rates of arthroscopic discopexy have been found for patients without severe deformation and classified as Wilkes II and III,<sup>26</sup> but contrasting results were shown by Murakami et al., with a success rate of over 90% for patients in stages IV and V.<sup>28</sup>

Because it is technically difficult to perform disk repositioning arthroscopically, open-joint procedure

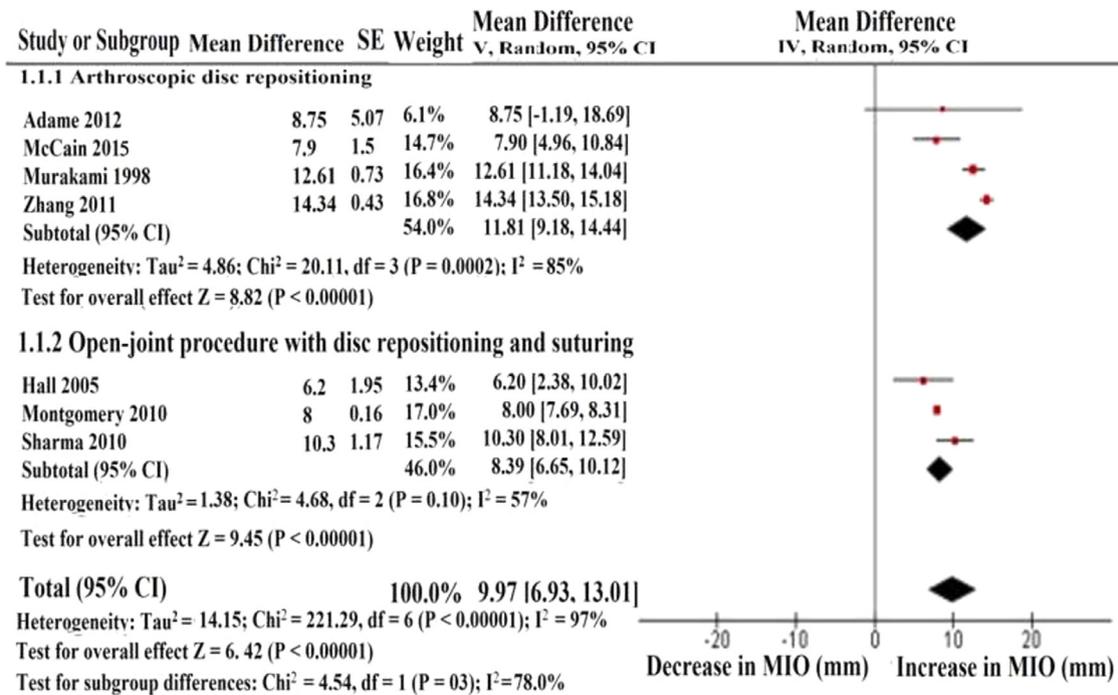


Fig 3. Mean change in maximal interincisal opening from baseline to final follow-up. CI, confidence interval; MIO, maximal interincisal opening; SE, Standard error.

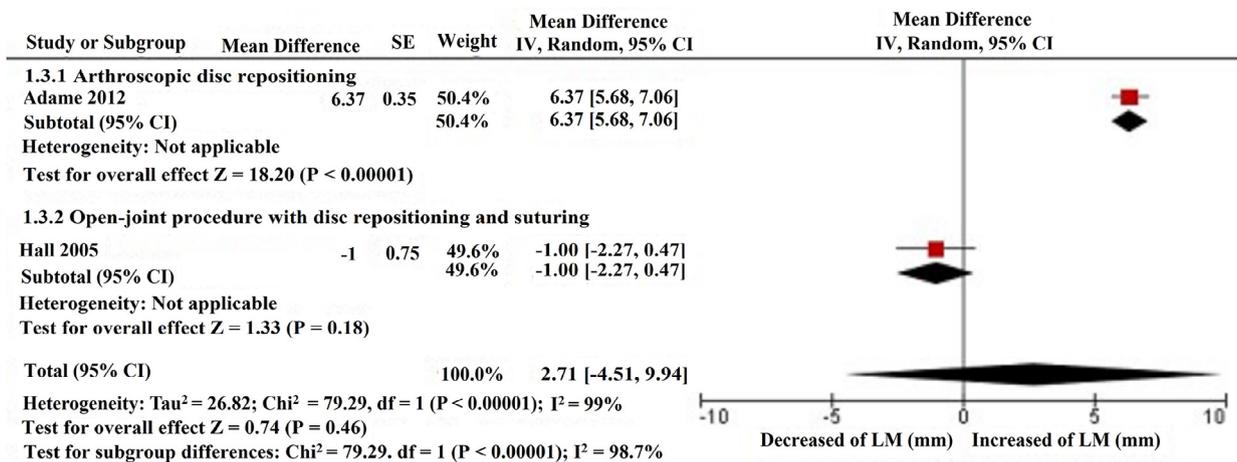


Fig 4. Mean change in contralateral movement from baseline to final follow-up. CI, confidence interval; LM, lateral movement; SE, Standard error.

remains the most common surgical treatment for internal derangement of the TMJ.<sup>25,27,29,38,39</sup> However, this technique has not demonstrated superiority over arthroscopic surgery.<sup>40</sup> In arthroscopic disk repositioning, no damage is made to the surface of the condylar head, avoiding scars and possible late degenerative changes in the cartilage.<sup>16</sup> In addition, in open-joint procedures, arthroplasty should not be performed unless necessary to preserve the fibrocartilage of the articular surface of the joint and to

prevent the formation of any adhesions and the progression of degenerative joint disease.<sup>41</sup>

Although there is evidence of the effectiveness of disk repositioning to improve pain and function, patients who have a muscular component need to be controlled by pharmacologic means and stress reduction.<sup>36</sup> Physiotherapy has been indicated for an effective mouth opening after condylar discopexy and must include TMJ opening and closing exercises.<sup>38</sup> In addition, patients should be submitted to the use of occlusal bite plate therapy during the

postoperative healing phase to maintain an adequate joint space.<sup>42</sup> According to Sharma et al.,<sup>42</sup> strict mandibular immobilization for a week and elastic blockage of the jaws for 2 weeks have been recommended after meniscopexy to avoid pain and suture dehiscence. With a comprehensive rehabilitation, mobility of the TMJ improves significantly during the 6 months after surgery.<sup>29</sup>

Postsurgical MRI has been recommended to check the results of disk repositioning because appropriate positioning and morphologic preservation of the disk are critical for preventing excess remodeling and degenerative changes within the TMJ.<sup>43</sup> In a retrospective MRI analysis, it was found that 89% of patients submitted to open-joint procedure with discopexy using bone anchors had an appropriate disk-condyle relationship 5 years after surgery.<sup>44</sup> Similar results were found in the short term after an arthroscopic suturing technique,<sup>45</sup> which results in increased posterior and superior spaces of the affected joints with changes in the position of the condyles from posterior position to anterior position.<sup>46</sup> However, other studies have found that disk repositioning after TMJ surgery has not been demonstrated in MRI evaluation,<sup>42,47</sup> but there is evidence that disk mobilization may be important in supporting the regeneration of tissues and improving mechanical function of the TMJ.<sup>16,27</sup> In the present systematic review, MRI results were limited and a meta-analysis evaluating the disk-condyle relationship was not performed.

This study has some limitations, which include the lack of head-to-head trials comparing outcomes between arthroscopic disk suturing technique and open-joint procedure with disk repositioning and the lack of studies evaluating clinical and postsurgical MRI findings. In addition, this study focused on suture discopexy, and rigid techniques using screws or pins were not evaluated. Studies have suggested that the retrodiscal tissues do not offer a degree of disk stabilization that could be provided by the rigidity of a titanium anchor in the condyle or using bioresorbable screws.<sup>13,14,42,48</sup> In this systematic review, some studies used a double-pass suture to improve disk stabilization but a subgroup analysis comparing suture techniques was not performed.

The current available evidence showed an overall decrease in VAS pain score and an improvement in mouth opening after TMJ surgeries with discopexy. Changes in maximal interincisal opening were greater after arthroscopic disk repositioning compared to open-joint procedure. Because of the limited number of studies and evidence, further prospective evaluation in a larger patient population with a longer follow-up period is required to more accurately predict the benefits of discopexy.

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