Arthrocentesis and viscosupplementation as treatment modalities for arthralgia of the temporomandibular joint
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Chapter 2

Lavage therapy versus non-surgical therapy for the treatment of arthralgia of the temporomandibular joint: a systematic review of randomized controlled trials


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Abstract

Objective To carry out a systematic review of randomized controlled trials (RCTs) to investigate in patients with arthralgia of the temporomandibular joint (TMJ) the effectiveness of TMJ lavage compared to non-surgical treatment with regard to pain intensity and mandibular range of motion.

Methods The electronic databases Cochrane Controlled Trials Register (1960-2012), PubMed/Medline (1966-2012) and EMBASE (1966-2012) were systematically searched for relevant RCTs. References of relevant articles were searched for additional studies, as well as citing reports. Two authors independently performed data extraction using predefined quality indicators. Relevant outcome data included pain reduction, using a visual analogue scale (VAS) or a pain score from 0-10, and maximal mouth opening (MMO) before and six months after treatment. Included trials were combined using fixed and random effects meta-analysis.

Results Three RCTs (222 patients) were included for meta-analysis. The statistically significant overall standardized mean difference (SMD) (P<0.001) with regard to pain intensity was -1.07 (95% CI=-1.38, -0.76) in favor of TMJ lavage. The MMO did not change significantly (P>0.05, SMD=0.05 (95% CI=-0.33, 0.23)).

Conclusions The results suggest that with regard to pain reduction lavage of the TMJ may be slightly more effective than non-surgical treatment. However, this difference is not likely to be clinically relevant.
Introduction

Degenerative diseases of the temporomandibular joint (TMJ) often involve significant pain and reduced range of motion of the mandible. Because of its chronic nature, the disease often has considerable impact on the patient's quality of life.\(^1\)\(^2\) In the TMJ, osteoarthritis usually occurs in combination with internal derangements like disc displacement with or without reduction (closed lock).\(^3\)\(^-\)\(^5\) In the case of internal derangements the intra-articular disc acts as an obstacle for normal movement resulting in clicking and locking.\(^6\) Especially in older patients with longer locking duration and less interincisal opening there is a high incidence of adhesion formation in the upper joint space reducing the range of motion of the mandible.\(^7\)

Therapeutic modalities for TMJ osteoarthritis can be divided into surgical and non-surgical therapies. Non-surgical treatment usually implies explication of the process involved, soft diet, mandible movement exercises, physiotherapy, and possibly splint therapy.\(^8\)\(^-\)\(^9\) When non-surgical treatment is unsuccessful, surgical interventions such as minimally invasive procedures (i.e. arthrocentesis or arthroscopy) or open joint procedures may be considered.

In 1975 Ohnishi introduced arthroscopy as a minimal invasive technique allowing direct visualization of the joint structures and at the same time performance of lysis and lavage of the upper joint space.\(^10\)\(^,\)\(^11\) To date, TMJ arthroscopy has been reported to be an effective and reliable technique for the treatment of closed lock.\(^12\) Arthrocentesis of the TMJ is a minimally invasive lavage of the upper joint space using two communicating needles that are introduced in the upper compartment of the joint. This procedure has proven to be highly efficient for resolving pain of the TMJ caused by adherence or friction and is considered to be successful in approximately 70% of the patients with symptomatic TMJ osteoarthritis.\(^13\)\(^,\)\(^14\) In the past decade, arthroscopy and arthrocentesis have been applied with increasing frequency to treat TMJ internal derangements that failed to improve after non-surgical treatment.\(^15\)

In 1996 Fridrich investigated the effect on pain reduction of lavage of the TMJ with and without arthroscopy. Arthroscopy and arthrocentesis seemed to be equally effective in reducing pain, which was confirmed by more recent studies as well.\(^16\)\(^-\)\(^21\) However, not all of these studies were properly designed (i.e. randomized controlled trials), and most of them lacked a control group. Guo et al. were the first to systematically search for the effectiveness of arthrocentesis of the TMJ compared to arthroscopy.\(^19\) The main outcome of this study was again confirmative to the assumption that arthroscopy and arthrocentesis are equally effective with regard to pain. But here as well, the included studies lacked a non-surgical control group.

Given this, to date a more relevant question, to the patient as well as to the clinician, is how effective is lavage of the TMJ (i.e. arthrocentesis or arthroscopy) compared to non-surgical therapy. Indeed, if lavage of the TMJ and non-surgical therapy appear to be equally effective in reducing the symptoms, than the indication for this minimally invasive treatment would be doubtful, and would become more dependent on factors like cost-effectiveness and treatment duration. Despite the relevance of this question,
this has not been reviewed systematically. Part of this question was investigated in the systematic review of Rigon et al. who estimated the effect of arthroscopy compared to other treatment modalities. However, arthroscopy seems to have no added value in effectiveness compared to arthrocentesis, and both treatment options are based on the same principle of lavage of the joint. Therefore, an important part of the available evidence for the effectiveness of TMJ lavage is missed out in their review, as arthrocentesis was not included as thesaurus term in their search strategy.

Therefore, the following research objection was formulated a priori, using the PICOS approach: to investigate in patients with arthralgia of the TMJ (P) the effectiveness of TMJ lavage (i.e. arthrocentesis or arthroscopy) (I) compared to non-surgical treatment (C) with regard to pain and mandibular range of motion (O). To achieve this objective, exclusively randomized, controlled trials (S) were reviewed.

Materials and methods

Study selection, assessment of eligibility criteria, data extraction, and statistical analysis were specified in advance.

Retrieval of published studies
In order to retrieve articles investigating the efficacy of lavage as treatment for TMJ arthropathies, a highly sensitive search strategy was performed in the databases of Medline (1966-2012), Embase (1966-2012) and Cochrane Central Register of Controlled Trials (CENTRAL) (1960-2012), with last search February 24th 2012. Because databases are organized by trees of specific thesaurus terms (medical subject headings (MeSH) or EMTREE terms), these trees were searched for relevant entry terms. The search strategy regarding the applied thesaurus terms (i.e., MeSH in Medline and CENTRAL, and EMTREE terms in Embase) and text words in these databases is shown in table 1. Furthermore reference lists and citing reports of relevant articles were checked for missing articles to complete the search. Then titles, abstracts and keywords of all identified reports were screened to determine whether they were relevant to the topic under study. Relevant articles were included for full-text article eligibility assessment.

Inclusion and exclusion criteria
Randomized controlled trials investigating the effectiveness of lavage compared to non-surgical therapy for the treatment of TMJ arthropathy were included. Two reviewers (LMV, JHS) independently evaluated reports for eligibility. No language restrictions were applied throughout the article selection procedure.

Quality assessment: Risk of bias
Two reviewers (LMV, JHS) independently assessed the quality of each study. Strengths and weaknesses of the study design, implementation, and data analysis of each study were analyzed. Disagreements on quality items were resolved by discussion.
Table 1. Literature search strategy

**Search strategy Medline and CENTRAL**

<table>
<thead>
<tr>
<th>#</th>
<th>Search term</th>
</tr>
</thead>
<tbody>
<tr>
<td># 1</td>
<td>temporomandibular joint</td>
</tr>
<tr>
<td># 2</td>
<td>temporomandibular joint disorders</td>
</tr>
<tr>
<td># 3</td>
<td>myofascial pain syndromes</td>
</tr>
<tr>
<td># 4</td>
<td>craniomandibular disorders</td>
</tr>
<tr>
<td># 5</td>
<td>#1 OR #2 OR #3 OR #4</td>
</tr>
<tr>
<td># 6</td>
<td>arthrocentesis</td>
</tr>
<tr>
<td># 7</td>
<td>arthroscopy</td>
</tr>
<tr>
<td># 8</td>
<td>endoscopy</td>
</tr>
<tr>
<td># 9</td>
<td>#6 OR #7 OR #8</td>
</tr>
<tr>
<td># 10</td>
<td>#5 AND #9</td>
</tr>
</tbody>
</table>

Entry terms were used as MeSH terms and as free text words also

**Search strategy Embase**

| # 1| temporomandibular joint                         |
| # 2| temporomandibular joint disorder               |
| # 3| myofascial pain                                |
| # 4| craniomandibular                               |
| # 5| #1 OR #2 OR #3 OR #4                            |
| # 6| arthrocentesis                                  |
| # 7| arthroscopy                                     |
| # 8| endoscopy                                       |
| # 9| #6 OR #7 OR #8                                  |
| # 10| #5 AND #9                                       |

Entry terms were used as EMTREE terms as well as free text words

Abbreviations:  
CENTRAL = Cochrane central register of controlled trials  
MeSH = Medical Subject Headings

Assessment items were:

1. Sequence generation and concealed allocation
2. Size and composition of the studied groups
3. Blinding of participants, clinicians and investigators
4. Application of inclusion and exclusion criteria for subjects
5. Description of loss-to-follow-up
6. Adequacy of statistical analysis

Assessment items were scored ‘adequate’, ‘unclear’, or ‘inadequate’. ‘Adequate’ indicates a low risk of bias, ‘unclear’ indicates a lack of information or uncertainty with regard to the potential bias and ‘inadequate’ indicates a high risk of bias due to inadequate handling of
the item. Sequence generation and allocation concealment were considered ‘adequate’ if
the investigators could not suspect what treatment was next, prior to allocation. Size and
composition of the groups were considered ‘adequate’ if the size of different treatment
groups was approximately equal and age and gender were equally distributed across
groups. Furthermore, in case of different diagnoses, these had to be distributed equally
across the treatment groups as well. Blinding of participants, clinicians and investigators
was considered ‘adequate’ if at least the investigators that analyzed the results were
blinded for which group received which treatment. Blinding of the participants and
clinicians could usually not be established due to the nature of the treatment modalities.
Application of inclusion and exclusion criteria for subjects was considered ‘adequate’ if
these were described properly prior to the inclusion of subjects. Description of loss-to-
follow-up was considered ‘adequate’ if the number of withdrawals of each group was
mentioned. Statistical analyses were considered ‘adequate’ if all subjects were analyzed
in the treatment group to which they were allocated, regardless of the treatment they
received.

Data extraction and outcome measures
Data from the included trials were extracted independently by two reviewers (LMV, JHS).
Main outcome data in each study consisted of sample size, measurements of pain and
mandibular range of motion and their standard deviations (SD), at baseline and at six
months follow-up. These data were calculated using individual patient data if those
could be retrieved by contacting the authors. Otherwise, the published data were used.
Relevant items for the data extraction also included study design, diagnosis, treatment
modalities, follow-up period, dropout reports and statistical analysis used.

Statistical analysis
All analyses were based on the reported data of the included studies or the raw data if
retrieved from the authors. As pain intensity and MMO are continuous variables, standard
mean differences (SMD) and corresponding SDs were calculated for each study. For both
outcome measurements heterogeneity was calculated separately using $I^2$ statistics, which
gives the percentage of total variation across trials that can be attributed to heterogeneity
rather than to chance. Meta analysis was performed providing the overall SMD and
95% confidence interval (CI) for pain intensity and MMO by using a fixed effects model.
Depending on the $I^2$ statistics a random effects model was performed when eligible.

Results

756 articles were identified in Medline. Out of 190 identified articles in Embase, 146
were additional to the articles identified in Medline. In the Cochrane Central Register of
Controlled Trials three additional articles were identified out of 35. Of the articles selected
for full-text article eligibility assessment, all cited references and all citing reports were
checked, which did not result in additional articles (figure 1).
Included studies
All included studies \(^{4,23,24}\) were randomized controlled trials investigating the effectiveness of TMJ lavage compared to non-surgical treatment. Of these three included studies Diracoğlu et al. \(^{23}\) and Stegenga et al. \(^{4}\) used a VAS or pain scale to measure pain intensity and MMO for measurement of the range of motion of the mandible. Only Schiffman et al. \(^{24}\) did not report a pain score or the MMO before and after treatment. By contacting the authors of all three included studies, individual patient data, as well as additional information with regard to the quality of the study, was retrieved of only one of the three studies. \(^{24}\) The authors of the other two studies \(^{4,23}\) did not provide additional information. The individual patient data included the pain score and MMO data that were missing in the report of Schiffman et al. \(^{24}\) The major characteristics of the included studies are summarized in table 2.

Figure 1. Flow chart of the study selection procedure
Excluded studies

Out of the nine articles included for full text reading, three articles matched the inclusion criteria. Out of the six excluded articles, 17,25-29 four articles were excluded because the study design was not a randomized controlled trial. 17,25,26,28 Furthermore, three of the six excluded studies were lacking a non-surgical control group. 25,27,29 The major characteristics of the excluded studies are summarized in table 3.

Description of the included studies

An overview of the extracted data and risk of bias assessment of included studies is shown in table 2, and of the studies that were excluded after application of the in- and exclusion criteria in table 3.

Table 2. Extracted data of included studies

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Diracoğlu 2009</th>
<th>Schiffman 2007</th>
<th>Stegenga 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence generation and concealed allocation</td>
<td>U</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Size and composition of the studied groups</td>
<td>A</td>
<td>A</td>
<td>U</td>
</tr>
<tr>
<td>Blinding of participants, clinicians and investigators</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>Application of inclusion and exclusion criteria for subjects</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Description of loss-to-follow-up</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Adequacy of statistical analysis</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Design</td>
<td>RCT</td>
<td>RCT</td>
<td>RCT</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>DDw/oR*</td>
<td>Closed lock stage III or IV</td>
<td>Arthrosis</td>
</tr>
<tr>
<td>Patients</td>
<td>120 (10 loss to follow-up)</td>
<td>81 (11 loss to follow-up)</td>
<td>21</td>
</tr>
<tr>
<td>Treatment modality</td>
<td>Arthrocentesis (AS) Combination of splint, hot pack and home exercising (NS)</td>
<td>Arthrocentesis (AS) Rehabilitation (NS) Medical Management (MM)</td>
<td>Arthrocentesis (AS) Non-surgical (NS)</td>
</tr>
<tr>
<td>Follow-up (months)</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Pre and post treatment mean VAS or pain score</td>
<td>AS: 6.3 (SD 2.3) - 1.5 (SD 1.8) NS: 5.7 (SD 2.4) - 4.4 (SD 2.3)</td>
<td>AS: 6.8 (SD 2.1) - 3.3 (SD 2.2) NS: 6.0 (SD 2.0) - 2.9 (SD 2.2) MM: 5.6 (SD 2.5) - 3.0 (SD 1.9)</td>
<td>AS: 56 (SD 21) - 11 (SD 15) NS: 34 (SD 17) - 9 (SD 14)</td>
</tr>
<tr>
<td>Pre and post treatment mean MMO</td>
<td>AS: 31.2 (SD 7.0) - 37.9 (SD 6.5) NS: 29.9 (SD 4.8) - 35.5 (SD 6.4)</td>
<td>AS: 33.4 (SD 7.6) - 41.0 (SD 8.2) NS: 32.0 (SD 4.6) - 42.2 (SD 6.4) MM: 32.5 (SD 5.2) - 39.9 (SD 5.2)</td>
<td>AS: 27.6 (SD 4.2) - 34.2 (SD 3.6) NS: 31.4 (SD 3.8) - 39.5 (SD 5.5)</td>
</tr>
</tbody>
</table>

A = Adequate, U = Uncertain, I = Inadequate

*Disc displacement with or without reduction

RCT: randomized controlled trial
Diraçoğlu et al. 23 enrolled 120 patients (104 females, 16 males) with the diagnosis disc displacement without reduction. The study design was a quasi-randomized single blind prospective study comparing arthrocentesis with conventional treatment consisting of a combination of splint therapy, hot pack, and a home exercise program. Patients were allocated to one of the treatment modalities according to their admission to the TMJ unit (consecutively one to each group). The arthrocentesis group consisted of 54 patients (51 females, 3 males). 56 patients (49 females, 7 males) underwent conventional treatment. The mean age in these groups was 33.4 (range 15-63) and 34.8 (range 17-61), respectively. Baseline VAS for pain intensity and baseline MMO were similar in both groups. Post treatment assessments were performed after 1, 3 and 6 months. No withdrawal of patients was reported. Improvement from baseline was tested in each group by paired t tests. Repeated measures of analysis of variance (ANOVA) were used for intergroup comparison.

Schiffman et al. 24 included 106 patients with disc displacement without reduction with limited mouth opening (closed lock). The study design was a randomized single blind prospective trial comparing medical management, rehabilitation, arthroscopic surgery with post-operative rehabilitation and arthroplasty with post-operative rehabilitation. Patients were randomly allocated to one of the treatment modalities, based on a concealed randomization schedule. According to the intention-to-treat analysis, 29 patients (26 females, 3 males, mean age 33.7, SD 1.8) were analyzed in medical management, 25 patients (25 females, mean age 30.0, SD 1.7) in rehabilitation, 26 patients (22 females, 4 males, mean age 31.8, SD 1.7) in arthroscopy and 26 patients (25 females, 1 male, mean age 31.4, SD 1.9) in the arthroplasty group. Pain intensity and mandibular range of motion were measured in this study, but were not reported in the published article. These measurements were retrieved by contacting the authors. Post treatment assessments were performed after three, six, 12, 18, 24 and 60 months. In the Rehabilitation and the arthroscopic surgery group 2 patients were loss to follow-up. In the Arthroplasty surgery four patients were loss to follow-up. Improvement from baseline was tested in each group by paired t tests. Repeated measures of analysis of variance (ANOVA) were used for intergroup comparison.

Stegenga et al. 4 recruited 21 patients (19 females, 2 males, mean age 23.7 years, SD 6.7, range 17-41) with arthrosis of the TMJ. The study design was a randomized controlled trial comparing arthroscopic surgery followed by post-operative physical therapy to non-surgical treatment. Patients were randomly assigned to one of the treatment groups. The arthroscopic surgery group consisted of nine patients. The non-surgical group contained 12 patients. Post treatment assessments were performed after four weeks and six months.
Table 3. Extracted data of excluded studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Diagnosis</th>
<th>Patients/joints</th>
<th>Treatment modality</th>
<th>Follow-up (months)</th>
<th>Pre and post-treatment mean VAS/pain score</th>
<th>Pre- and post-treatment mean MMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goudot</td>
<td>Prospective clinical trial</td>
<td>TMJ pain and dysfunction syndrome</td>
<td>708</td>
<td>Physiotherapy (Ph) Psychological therapy (Ps) Arthroscopy/Arthrocentesis (AS)</td>
<td>12</td>
<td>Not available</td>
<td>Not available</td>
</tr>
<tr>
<td>Hall</td>
<td>Controlled prospective clinical trial</td>
<td>Painful TMJ with internal derangement</td>
<td>54/78</td>
<td>Arthroscopy (AR) Condylectomy (C) Discectomy (D) Disc repositioning (DR)</td>
<td>12</td>
<td>AR: 5.3 (SD 3.7) - 0.8 (SD 1.2) C: 6.6 (SD 2.2) - 1.7 (SD 3.3) D: 7.0 (SD 2.3) - 1.7 (SD 3.3)</td>
<td>AR: 31.2 (SD 8.6) - 42.3 (SD 7.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C: 34.9 (SD 11.1) - 44.3 (SD 9.7) D: 32.0 (SD 6.0) - 39.3 (SD 4.7)</td>
<td></td>
</tr>
<tr>
<td>Kurita</td>
<td>Prospective outcome</td>
<td>DDw/or1</td>
<td>28/35</td>
<td>ALL2 Non-surgical (NS)</td>
<td>20</td>
<td>ALL: 56.6 (SD 27.1) -7.6 (SD 8.7) NS: 39.3 (SD 31.3) - 9.7 (SD 8.6)</td>
<td>ALL: 23 (SD 5.9) - 38.6 (SD 7.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NS: 30.7 (SD 10.6) - 41.9 (SD 5.5)</td>
<td></td>
</tr>
<tr>
<td>Miyamoto</td>
<td>RCT</td>
<td>Internal derangement Stage III or more Wilkes stage III with closed lock</td>
<td>101/104</td>
<td>ALL2 ALLCR3</td>
<td>12</td>
<td>Pain score in: Mild, Medium or Severe ALLCR: 27 (SD 5) - 44 (SD 5)</td>
<td>ALL: 26 (SD 4) -44 (SD 4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AS: 4.8 (SD 2.5) - 1.7 (SD 1.1) AR: 5.7 (SD 2.5)</td>
<td>AS: 30.6 (SD 5.8) - 42.5 (SD 5.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AR: 27.5 (SD 5.8) - 42.1 (SD 5.3) NS: 5.1 (SD 2.8) NS: 29.8 (SD 7.5)</td>
<td></td>
</tr>
<tr>
<td>Murakami</td>
<td>Prospective clinical trial</td>
<td></td>
<td>108/116</td>
<td>Arthrocentesis (AS) Arthroscopic surgery (AR) Non-surgical (NS)</td>
<td>12</td>
<td>AS: 30.6 (SD 5.8) - 42.5 (SD 5.6) AR: 27.5 (SD 5.8) - 42.1 (SD 5.3) NS: 5.1 (SD 2.8) NS: 29.8 (SD 7.5)</td>
<td></td>
</tr>
<tr>
<td>Politi</td>
<td>RCT</td>
<td>Chronic closed lock</td>
<td>20</td>
<td>Arthroscopic surgery (AR) Open surgery (OS)</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Disc displacement with or without reduction
2 arthroscopic lysis and lavage
3 arthroscopic lysis and lavage plus arthroscopic anterolateral capsular release
At the six months evaluation, data could be obtained from all patients. Repeated measure multivariate analysis of variance (MANOVA) was carried out to test possible differences between the types of treatment (effect: treatment-type) as well as pre- versus post-treatment differences (effect: pre-vs-post). When a significant difference was found, post-hoc univariate ANOVA was used to detect the relative contribution of the component variables.

Effects of interventions

**Individual study results**

With regard to the VAS values, Diraçoğlu et al. \(^{23}\) found that these were significantly more reduced in the arthrocentesis group after six months than in the non-surgical group (\(P<0.01\)). Differences between groups in improvement of MMO were not significant after six months (\(P>0.05\)). At within group analysis, both groups showed significant improvement at six months compared to baseline for VAS scores as well as for the MMO (\(P<0.01\)).

In the study of Schiffman et al., \(^{24}\) VAS values were not significantly more reduced in the arthrocentesis group after six months than in the non-surgical group (\(P=0.14\)). Differences between these two groups in improvement of MMO were not significant as well after six months (\(P=0.52\)).

The results of the study of Stegenga et al. \(^4\) show, with regard to the VAS values, that these were significantly more reduced in the arthrocentesis group after six months than in the non-surgical group (\(P<0.05\)). Differences between groups in improvement of MMO were not significant after six months (\(P>0.05\)). Improvement was significant for both groups after six months compared to baseline for VAS values as well as MMO (\(P<0.001\)).

**Pooled treatment effect results**

The SMDs of the individual studies were pooled using a fixed effects-model. There was a very high degree of inconsistency when a fixed effects model was applied, and a low degree of inconsistency among the trials for the random effects model (\(I^2 = 88.2\% \text{ fixed and } 0.0\% \text{ random}\) with regard to pain intensity and also a very low degree of inconsistency (\(I^2 = 0.0\% \text{ fixed and } 0.0\% \text{ random}\) with regard to MMO. Regarding the pooled SMD of the VAS scores, there was a significant difference between TMJ lavage and non-surgical treatment at the 6-month post treatment assessment compared to baseline (\(P<0.001\)). The overall SMD was -1.07 (95% CI=-1.38, -0.76). However, the pooled effect of MMO did not differ significantly between TMJ lavage and non-surgical treatment at the 6-month post treatment assessment compared to baseline measurements (\(P>0.05, \text{ SMD}=0.05\) (95% CI=-0.33, 0.23)). The SMDs of the individual studies and the pooled SMD are shown in figures 2 (VAS) and 3 (MMO). In the forest plots shown, for the studies of Diraçoğlu et al. \(^{23}\) and Stegenga et al. \(^4\) a comparison was performed between the non-surgical group and the arthrocentesis group. With regard to the study of Schiffman et al., \(^{24}\) the rehabilitation group and the medical management group were combined to one non-surgical group, because rehabilitation and medical management are both non-
surgical treatment options. This combined non-surgical group was compared with the arthrocentesis group. The pooled SMD was also calculated for when only the rehabilitation group or only the medical management group was applied as non-surgical group in the study of Schiffman et al.\textsuperscript{24} However, this did not significantly influence the pooled SMD.

![Figure 2. Forest plot of the pooled effect sizes of the pain scales (random effects model)](image)

<table>
<thead>
<tr>
<th>Study</th>
<th>Standardized Mean diff. (95% CI)</th>
<th>% Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diraçoğlu</td>
<td>-1.79 [-2.24, -1.35]</td>
<td>48.0</td>
</tr>
<tr>
<td>Schiffman</td>
<td>-0.19 [-0.67, 0.29]</td>
<td>41.4</td>
</tr>
<tr>
<td>Stegenga</td>
<td>-1.20 [-2.15, -0.26]</td>
<td>10.6</td>
</tr>
<tr>
<td>Overall (95% CI)</td>
<td>-1.07 [-1.38, -0.76]</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 3. Forest plot of the pooled effect sizes of the MMO (random effects model)](image)

<table>
<thead>
<tr>
<th>Study</th>
<th>Standardized Mean diff. (95% CI)</th>
<th>% Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diraçoğlu</td>
<td>0.08 [-0.30, 0.45]</td>
<td>55.7</td>
</tr>
<tr>
<td>Schiffman</td>
<td>-0.17 [-0.65, 0.31]</td>
<td>34.1</td>
</tr>
<tr>
<td>Stegenga</td>
<td>-0.34 [-1.22, 0.53]</td>
<td>10.3</td>
</tr>
<tr>
<td>Overall (95% CI)</td>
<td>-0.05 [-0.33, 0.23]</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

Overall, the robustness of the evidence to determine the effectiveness of lavage of the TMJ compared to non-surgical treatment with regard to outcome measurements for pain and mandibular range of motion is questionable. Three randomized controlled trials compared lavage of the TMJ directly to non-surgical therapy modalities. The overall quality of these studies was adequate, although there were several serious limitations. Although the three most prominent databases were searched, possibly important studies were missed being not included in one of these databases. Only one study\textsuperscript{24} reported randomization concealment, whereas another study\textsuperscript{23} reported non-concealment of the allocation. Two of the three included studies\textsuperscript{4,23} did not explicitly state that analysis of data adhered to intention-to-treat principle, which could lead to overestimation of the treatment effect. One of the studies had a small sample size,\textsuperscript{4} and as the data of the three eligible studies were pooled, still only 85 patients who received TMJ lavage attended the six months post treatment assessment. This sample size is still rather small and depends largely on the study of Diraçoğlu et al.\textsuperscript{23} Furthermore, none of the included studies reported blinding of the investigators that analyzed the results, for which group received
which treatment. Blinding of the participants and clinicians could not be established due to the nature of the treatment modalities. Follow-up period of the studies was at least six months, which is considered sufficient with regard to the outcome measurements of interest of this review. Indeed pain relief and improvement of mandibular range of motion should occur and stabilize within six months to indicate a treatment modality effective in treating arthralgia of the TMJ.

The aim of the meta-analysis reported here was to estimate treatment effects with more precision than is possible in a single study. Nevertheless, differences between lavage and non-surgical treatment seem to be very small. And although differences in VAS scores appear statistically significant, their clinical relevance may be negligible, as it reflected only 1.07 points on the VAS. Limitations for the meta-analysis are differences in diagnosis and variety of treatment modalities within the non-surgical treatment groups across studies. Due to the variety of treatment modalities in the non-surgical groups, some treatment modalities within these groups may have contributed more to the non-surgical group mean than others. Consequently, the difference between the effectiveness of TMJ lavage may be overestimated for some non-surgical treatment modalities and underestimated for others. Furthermore, one of the studies 20 did not report loss to follow-up, which introduces risk of bias if there were unreported withdrawals.

Conclusions

Implications for practice
This is the first meta-analysis that compared lavage of the TMJ to non-surgical treatment modalities for TMJ arthropathy. The findings reported in this review suggest that with regard to pain reduction lavage of the TMJ may be slightly more effective than non-surgical treatment. By contrast, superiority of lavage of the TMJ with regard to improvement in mandibular movement, could not be supported by the available evidence. Since lavage of the TMJ may be slightly more effective, these findings may indicate that lavage of the TMJ may be a useful alternative in cases where pain is the most prominent symptom.

Implications for research
In this systematic review only VAS scores for the measurement of pain intensity and MMO scores were extracted from the studies for a pooled effect size calculation. Because in particular pain and decreased range of mandibular motion are usually the main complaints of the patients suffering from TMJ arthropathy, these two variables seemed most accurate for determining the effectiveness of arthroscopy or arthrocentesis. However, to provide a more complete picture for the effectiveness of TMJ lavage, it may be worthwhile to include cost effectiveness of the different treatment modalities and patient satisfaction as well.
References


