Mandibular Manipulation for the Treatment of Temporomandibular Disorder

Betania Mara Franco Alves, MD,* Cristiane Rufino Macedo, MD,* Eduardo Januzzi, MD,* Eduardo Grossmann, MD,† Alvaro Nagib Atallah, MD,* and Stella Peccin, MD*

Abstract: The aim of this study was to conduct a systematic review to identify the randomized clinical studies that had investigated the following research question: Is the mandibular manipulation technique an effective and safe technique for the treatment of the temporomandibular joint disk displacement without reduction? The systematic search was conducted in the electronic databases: PubMed (Medical Publications), LILACS (Latin American and Caribbean Literature in Health Sciences), EMBASE (Excerpta Medica Database), PEDro (Physiotherapy Evidence Database), BBO (Brazilian Library of Odontology), CENTRAL (Library Cochrane), and SciELO (Scientific Electronic Library Online). The abstracts of presentations in physical therapy meetings were manually selected, and the articles of the ones that meet the requirements were investigated. No language restrictions were considered. Only randomized and controlled clinical studies were included. Two studies of medium quality fulfilled all the inclusion criteria. There is no sufficient evidence to support the effectiveness of the mandibular manipulation therapy, and therefore its use remains questionable. Being minimally invasive, this therapy is attractive as an initial approach, especially considering the cost of the alternative approaches. The analysis of the results suggests that additional high-quality randomized clinical trials are necessary on the topic, and they should focus on methods for data randomization and allocation, on clearly defined outcomes, on a priori calculated sample size, and on an adequate follow-up strategy.

Key Words: Mandibular manipulation, temporomandibular disorders, disk displacement, meta-analysis, Cochrane

More than 120 million individuals worldwide suffer from severe facial pain with limitation of mouth opening as a consequence of disk displacement without reduction (DDWR) of the temporomandibular joint (TMJ). The TMJ may be affected by several conditions, including not only disk displacements (DDs) but also degenerative disease (osteoarthritis), inflammatory arthritis, and synovitis. The studies on TMJ also show that the prevalence of temporomandibular disorder (TMD) symptoms ranges from 10% to 76%, depending on the methods used for data collection. Despite the discrepancy of the symptoms, it may be safely stated that TMD commonly affects the general population, being more prevalent within the population of individuals ranging from 20 to 40 years of age.

Clinically, the DDWR of the TMJ may be associated with significant pain, important limitation of the articular function, and consequent impairment of masticatory functions. This condition may be caused by altered structural relations or by misalignment between the disk and the mandibular head during mandibular translations as a consequence of the described above, the disk is not reduced to its anatomical position. Approximately 2% of the individuals with TMD present with the closed lock of the TMJ, with significant limitation of the mandibular function.

The current systematic review tried to answer the following question: Is the MM therapy an effective and safe technique for the treatment of DDWR? Randomized or quasi-randomized controlled studies (RCT and quasi-RCT) were identified in PubMed (Medical Publications), LILACS (Latin American and Caribbean literature in health sciences), EMBASE (Excerpta Medica Database), PEDro (Physiotherapy Evidence Database), BBO (Brazilian Library of Odontology),
CENTRAL (The Cochrane Library), and SciELO (Scientific Electronic Library Online). Descriptors and synonymous were used to identify MM, as well as DD with and without reduction. Filters for narrowing the search to identify randomized and controlled studies were used. The strategy was customized according to each database.

The studies included in the research were all the RCT and quasi-RCT studies that mentioned MM and that presented enough information to be assessed (Fig. 2).27,28 Studies were all assessed according to the Cochrane methodology. The additional inclusion criteria stated that the participants of the studies should be 18 years or older and should have had a clinical or imaging diagnosis of DDWR and interventions consisting of MM alone or in association with other conservative treatments (anti-inflammatory medication, exercises, cognitive interventions, and others), surgical treatment (arthroplasty and arthroscopy), and placebo.

Assessed outcomes were reduction of pain, as measured by at least one of the following: visual analog scale (VAS), McGill Pain Questionnaire, or by the symptom severity index (SSI); and daily limitation of normal activities, as assessed by the Mandibular Function Impairment Questionnaire and by the Craniomandibular Index (CMI). The secondary outcome was the maximal mouth opening measured in millimeters.

Two independent reviewers (B.M.F.A. and C.R.M.) identified the studies that were suitable and extracted the data. Discrepancies were resolved by consensus or, when necessary, by a third investigator (E.J.). The standard data extraction form was used. Reviewers were not blinded by author, affiliation, or journal. Studies were assessed for the potential risk for biases (Tables 1 and 2). Reviewers also assessed the quality of the methods used by the studies.

The subjects of the studies who received MM (physical medicine and rehabilitation) were grouped as receiving “physical therapy.” The other subjects who underwent other interventions, (palliative care, control, arthroscopic surgery, and medical managing) were labeled as “others.”

The software RevMan 5.0, offered by Cochrane Collaboration, was used to conduct the meta-analysis. Continuous variables were summarized using mean and SD.

The mean difference was used for the outcomes related to similar parameters and assessed with the same instruments. The standard mean difference (SMD) was used for estimated effects and measurements of variability for continuous variables between groups, The SMD is used as summary statistics in meta-analysis, transforming the results of different studies with a similar outcome in a uniform scale before combining them.29 The following equation was used to calculate SMD:

\[
SMD = \frac{\text{Mean difference of results between groups}}{\text{SD of results among participants}}
\]

### Table 1. Risk of Bias in the Study of Minakuchi et al. 2001

<table>
<thead>
<tr>
<th>Item</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper allocation of treatment</td>
<td>Low</td>
<td>Computer-generated allocation list</td>
</tr>
<tr>
<td>Blinding to allocation</td>
<td>Moderate</td>
<td>Not described</td>
</tr>
<tr>
<td>Handling of missing data</td>
<td>Low</td>
<td>Drops of 15%, without apparent differences between groups; intent-to-treat assessment</td>
</tr>
<tr>
<td>Other biases</td>
<td>Low</td>
<td>Not identified</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Low</td>
<td>Pain was primary outcome, and measurements were accepted and validated</td>
</tr>
<tr>
<td>Blinding for measurements</td>
<td>Low</td>
<td>Blinding was effective</td>
</tr>
</tbody>
</table>

### Table 2. Risk of Bias in the Study of Schiffman et al.28

<table>
<thead>
<tr>
<th>Item</th>
<th>Assessment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper allocation of treatment</td>
<td>Moderate</td>
<td>Not described in the article (random blocks)</td>
</tr>
<tr>
<td>Blinding to allocation</td>
<td>High</td>
<td>Sealed envelopes opened after inclusion in study</td>
</tr>
<tr>
<td>Handling of missing data</td>
<td>Low</td>
<td>Drops of 9.4%, without apparent differences between groups; intent-to-treat assessment</td>
</tr>
<tr>
<td>Other biases</td>
<td>Low</td>
<td>Nonidentified</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Low</td>
<td>Pain was the primary outcome, and measurements were accepted and validated</td>
</tr>
<tr>
<td>Blinding for measurements</td>
<td>Low</td>
<td>Blinding was effective</td>
</tr>
</tbody>
</table>
RESULTS

From the 238 identified studies, 28 were included in the first attempt. However, only 2 of them satisfied the inclusion criteria: Minakuchi et al\textsuperscript{15} and Schiffman et al\textsuperscript{18} (Fig. 3).

Some studies were excluded for being case reports,\textsuperscript{30–37} whereas others were for being case series,\textsuperscript{38,39} others conducted a non-randomized clinical study,\textsuperscript{40} others reported retrospective data,\textsuperscript{12,41} whereas others were review articles,\textsuperscript{42–53} others discussed other types of intervention, and Minakuchi et al\textsuperscript{54} did not report any outcome that would suit our revision interests (Fig. 3).

General Description of the Studies

The 2 studies included herein enrolled 175 patients (15 men and 160 women), with their age ranging from 18 to 65 years. All patients had DDWR as per the MRI. Control groups were similar regarding their baseline characteristics. The inclusion criteria used for the original studies were as follows: pain when opening the mouth and/or functional impairment. The criteria for diagnosing DDWR followed those proposed by Orsini et al\textsuperscript{55} and Wilkes.\textsuperscript{56} Patients were excluded when they did not consent in participating in the study, when they had been previously submitted to TMD treatment, or when they presented a severe systemic rheumatic disease.

In the study of Minakuchi et al\textsuperscript{15} the comparisons were made between controls, general care plus nonsteroidal anti-inflammatory medications, and physical medicine, which included MM, occlusal techniques, and nonsteroidal anti-inflammatory medications. Schiffman et al\textsuperscript{18} compared groups submitted to medical management of arthroscopic surgery with postsurgical rehabilitation and arthroplasty with postsurgical rehabilitation. The rehabilitation used the MM as physical therapy. Minakuchi et al\textsuperscript{15} followed up the patients for 2 months, and these patients were assessed at baseline and at 1, 4, and 8 weeks after the treatment. Schiffman et al\textsuperscript{18} followed up patients for 60 months, and the assessments were made at baseline and at the 3rd, 6th, 12th, 18th, 24th, and 60th months after the treatment.

The VAS scores were used to assess pain in the TMJ area;\textsuperscript{15} the SSI was used to assess the severity of the pain, and CMI\textsuperscript{18} and daily activity limitation (DAL) score were used to assess mandibular function. A millimetric scale was used to measure mouth opening.\textsuperscript{15} The sample of Minakuchi et al\textsuperscript{15} presented 155 dropouts, and Schiffman et al\textsuperscript{18} had 9.4\% without a significant difference between the groups in each study. The intent-to-treat analysis was used. Sample size calculations were not presented. Minakuchi et al\textsuperscript{15} reported 10 exclusions during the study, and patients were lost to follow-up. Schiffman et al\textsuperscript{18} reported 10 exclusions after randomization, but 8 were reexamined after 5 years, and data were used for post hoc analyses.

Assessment of the Quality of the Studies

The measurements of the studies were conducted by blind examiners to the treatment group,\textsuperscript{15,18} and the examiner had no contact with the participants, with the exception of those who were in the follow-up visits.\textsuperscript{18} Regarding randomization, the risk of bias was low in the study of Minakuchi et al,\textsuperscript{15} as the allocation was generated by a computer software,\textsuperscript{15} whereas in the study of Schiffman et al\textsuperscript{18} the risk was questionable, because randomization was determined by random blocks (author personal clarification). There is a possible chance for bias when the concept of blinding is taken into consideration. The study of Minakuchi et al\textsuperscript{15} has possible chance of bias, because its methods are not clear, and Schiffman et al\textsuperscript{18} using sealed envelopes only until registration was concluded, posed a high risk of bias. Regarding end points, the risk of bias was low for both studies; pain was the primary outcome, and the methods of assessment are standard and validated ones. Dropout rates were 15\% for Minakuchi et al\textsuperscript{15} and 9.4\% for Schiffman et al\textsuperscript{18}. 
Incomplete data pose low risk of bias in both studies, because retention was high, and no differences in dropout as a function of treatment arm were seen. Furthermore, intent-to-treat analyses were used. Other significant biases were not identified (Tables 1 and 2). Our assessment is presented in Figure 4.

### Efficacy of Interventions

### Rehabilitation Versus Medical Management at 60 Months.

No significant differences in pain outcomes were seen using SSI (mean difference [MD], 0.04; 95% confidence interval [CI], −0.08 to 0.16; \( P = 0.52 \)). No significant differences were seen regarding mandibular function (CMI) (MD, 0.19; 95% CI, −0.08 to 0.10; \( P = 0.82 \)).

### Rehabilitation Versus Arthroscopic Surgery at 60 Months.

No difference in pain were seen using the SSI scale (MD, −0.10; 95% CI, −0.22 to 0.02; \( P = 0.11 \)). No differences were seen for mandibular function (CMI) (MD, −0.03; 95% CI, −0.12 to 0.06; \( P = 0.50 \)).

### Rehabilitation Versus Arthroplasty at 60 Months.

No difference in pain was seen using the SSI scale (MD, −0.06; 95% CI, −0.19 to 0.07; \( P = 0.36 \)). No differences were seen for mandibular function (CMI) (MD, −0.03; 95% CI, −0.12 to 0.06; \( P = 0.51 \)).

### Physical Medicine Versus Palliative Care at 8 Weeks.

Mouth opening (in millimeters) was not statistically different across groups (MD, 2.80; 95% CI, −2.95 to 8.55; \( P = 0.34 \)). Pain (VAS) was not statistically different across groups (MD, −2.60; 95% CI, −10.09 to 4.89; \( P = 0.50 \)). Mandibular function (DAL) was not statistically different across groups (MD, 1.80; 95% CI, −0.13 to 3.73; \( P = 0.07 \)).

### Physical Medicine Versus Controls at 8 Weeks.

Mouth opening (in millimeters) was not statistically different across groups (MD, 1.40; 95% CI, −3.94 to 6.74; \( P = 0.61 \)). Pain (VAS) was not statistically different across groups (MD, −3.50; 95% CI, −8.05 to 1.05; \( P = 0.13 \)). Mandibular function (DAL) was not statistically different across groups (MD, 1.30; 95% CI, −0.90 to 3.50; \( P = 0.25 \)).

### Meta-Analysis

A total of 46 individuals were formally tested for MM, and 112 were tested for other interventions. Both studies,15,18 nonsignificantly, suggested that the conservative therapy was more effective for pain control and functional improvement. For pain control, differences nonsignificantly favored conservative therapy (SMD, −0.27; 95% CI, −0.61 to 0.08; \( P = 0.13 \)) using VAS and SSI (Fig. 5). Similarly, nonsignificant differences favored conservative therapy regarding the improvement of the mandibular function (SMD, 0.29; 95% CI, −0.06 to 0.64; \( P = 0.10 \)), using CMI and DAL (Fig. 6).

### DISCUSSION

Our study assessed whether MM, alone or associated with other conservative therapies, is effective and safe for the treatment of acute and chronic DDWR. Only 2 studies fulfilled the inclusion criteria.15,18 We found no significant difference between the groups treated with MM and the ones that underwent surgical intervention and/or other conservative therapies regarding the relief of pain, mouth opening, and mandibular function. The systematic revision was conducted according to the Cochrane methodology, and the studies evaluated had no language barrier, and only randomized and controlled studies were included.

The use of meta-analyses usually enhances the degree of confidence on the results as the size of the sample increases, and consequently, it increases the possibilities of detecting differences when compared with the results of individual studies. In both the studies analyzed here and in the results of the meta-analysis, MM was nonsignificantly associated with the alleviation of pain and betterment of functionality when compared with other functions. One of the studies included here was conducted in Japan in 2001,15 and the other in the United States in 2007.18 The studies had methodological differences, but their findings agreed noticeably.

Both studies15,18 conducted clinical assessment and MRI and used criterion standard and validated tools for assessment.55,57-59 They therefore likely reflect clinical reality.

Our findings are difficult to be put into context, because studies on the topic are limited. Only 1 Cochrane review on the topic was found, and it compared the intra-articular injection of sodium hyaluronate versus other injections (steroids or others) or placebo in the treatment of TMD.60 The results being inconclusive.60 Another systematic review was found in PubMed, assessing exercise, manual therapy, electrotherapy, relaxation, and biofeedback in the treatment of TMD, concluding that active exercises and manual mobilization may be effective in improving, at least in the short term, mouth vertical opening in patients with TMD.61

---

© 2013 Mutaz B. Habal, MD
The study of Sato et al\textsuperscript{22} assessed the natural evolution of nontreated DDWR, showing that spontaneous resolution may be expected within 12 months, mainly in young patients. They also found that, during the studied period, the position of the articular disk was not likely to change. Other authors also assessed the natural evolution of nontreated DDWR and found that 42.5\% of participants became asymptomatic, and 32.5\% improved (although did not become asymptomatic) after 2.5 years.\textsuperscript{20} The authors, however, suggested that the time necessary to spontaneous remission is too long, implying that the treatment may be necessary, because a significant proportion of the patients (33\%) presented no betterment, and 58\% persisted with the symptoms.

The findings of Minakuchi et al\textsuperscript{15} suggest that patients with anterior DDWR are likely to improve when submitted to a conservative treatment, and no significant difference was found among the groups tested or the controls. Schiffman et al\textsuperscript{18} also found that the patients felt better regarding the pain shortly after treatment, regardless of the group. Randomized controlled trial data from Minakuchi et al\textsuperscript{13} are in agreement with long-term data previously published.\textsuperscript{52,63} Accordingly, the null hypothesis cannot be rejected, because no difference was seen for the investigated procedures for the treatment of TMD.

The lack of evidence from large, good-quality interventional studies in physical therapy is a barrier for evidence-based clinical decisions. Results from our study need to be cautiously interpreted, as there are few studies included, and none of them properly defined the sample size a priori, raising question about their statistical power to detect changes. Data on outcomes are also limited and come from studies where the intervention was evaluated as a single procedure or had a very short follow-up. Therefore, our conclusions have limitations, and this is not because of the quality of the review, but because of an inherent limitation given by the number of studies. Nonetheless, our findings are of relevance by highlighting the need of additional good-quality studies, because systematic data from only 175 patients certainly do not reflect a disease that affects 2\% of the global population.

Mandibular manipulation in association with other conservative therapies may be considered and is sometimes suggested as the first choice for the treatment of anterior DDWR of the TMJ, because it is minimally invasive and inexpensive, avoiding unnecessary surgical procedures. However, evidence for its use is missing, and further studies are suggested. Because good-quality evidence is also lacking for the alternatives, the intervention can be pragmatically used as an initial therapy. We therefore emphasize the need for additional studies that will frame clinical rationale. Studies should stratify DDWR in acute and chronic and by disability (mild, moderate, or severe impact). Studies should assess single interventions, rather than combination, and follow-up needs to be adequate.

REFERENCES
