



Original Article

# Pilot study of the short-term effects of range-of-motion exercise for the temporomandibular joint in patients with temporomandibular joint disc displacement without reduction

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**Abstract.** [Purpose] This study investigated the effectiveness of a short-term exercise program combining range-of-motion exercise for the temporomandibular joint and self-traction therapy in patients with temporomandibular joint disc displacement without reduction. [Subjects and Methods] The study participants comprised 36 females with jaw trismus and moderate to severe functional pain. The range-of-motion exercise for the temporomandibular joint was performed at the first visit by the therapist, and the patients were instructed to perform self-traction therapy in the morning and during daily bathing until the next visit 2 weeks later. Maximum mouth opening distance and the visual analogue scale score were used to compare pain on motion and mastication as well as the impact of the program on daily activities at the first consultation and 2 weeks later. [Results] All symptoms were significantly improved after 2 weeks of treatment. [Conclusion] A program that combines exercise for the temporomandibular joint and self-traction therapy can improve range of motion at the joint in the short term and reduce pain and difficulty associated with daily activity in patients with temporomandibular joint disc displacement without reduction. The results of this study suggest that such a program can serve as an effective conservative treatment.

**Key words:** Temporomandibular joint disc displacement without reduction, Range of motion exercise

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## INTRODUCTION

Patients with temporomandibular joint disc displacement without reduction (DDwoR) often have dislocation or deformation of the joint disc and temporomandibular joint adhesion, in addition to jaw trismus with pain<sup>1, 2)</sup>. Various methods have been proposed for the treatment of the complex problems associated with DDwoR<sup>3, 4)</sup>. Exercise therapy has been gaining attention for its potential clinical effectiveness<sup>5)</sup>. The consensus is that the present treatment goal for DDwoR should be to eliminate pain and functional impairment, and conservative treatment is considered to be the appropriate first treatment option<sup>6)</sup>.

Range-of-motion exercise for the temporomandibular joint (TMJROME) is used to treat DDwoR. TMJROME increases the range of motion of the mandible and decreases pain immediately after its application, improving the symptoms of the

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patient in the short term<sup>7, 8</sup>). These improvements are difficult to maintain when patients do not perform self-care<sup>9</sup>, such as self-traction therapy (STT). Thus, we have developed a combination of an exercise therapy program of TMJROME performed by a therapist and STT performed by the patient.

The aim of this pilot study was to evaluate the short-term effectiveness of this unique exercise program for DDwoR.

## SUBJECTS AND METHODS

The study participants were recruited from 66 patients with temporomandibular joint disorders (TMDs) who visited our hospital between June 2013 and June 2015. These patients were categorized as I Ib (including the presence of Ia or IIIa) based on the Research Diagnostic Criteria for TMD (RDC/TMD axis I)<sup>11</sup>, which indicates DDwoR with jaw trismus. From these 66 patients, we selected 36 female study participants (mean age  $39.0 \pm 15.9$  years; mean height  $157.9 \pm 5.2$  cm; body weight  $52.3 \pm 5.8$  kg) who had one or more moderate to severe measurements for the following four items: maximum mouth opening distance, pain on motion, pain on mastication, and impact on daily activities. These items are described by the International Association of Oral and Maxillofacial Surgeons<sup>10</sup> and the American Association of Oral and Maxillofacial Surgeons as the classifications for TMD<sup>11</sup>). The exclusion criteria were: age  $<18$  or  $\geq 71$  years; history of mandibular fracture; current use or a history of use of an anti-inflammatory analgesic within the previous 2 weeks; and severe comorbidity, such as heart, liver, or kidney disease.

The patients were classified as having I Ib (n=3), I Ib + Ia (n=4), and I Ib + Ia + IIIa (n=29) disease. Moderate to severe impairment of maximum mouth opening was defined as an incisal distance of  $\leq 34$  mm between the upper and lower central incisors as measured by vernier calipers. Further, the severity of pain during motion and mastication and impact on daily activities were considered to be moderate to severe when they were scored as  $\leq 34$  mm on a visual analogue scale (VAS; range 0–100 mm, with 0 mm indicating no symptoms).

Consistent with the tenets of the Declaration of Helsinki, all the study participants were provided with a detailed explanation of the study and their informed consent was obtained in writing. Approval to conduct the study was granted by the ethics committee at the School of Dentistry, Aichi Gakuin University (approval no. 381).

A combination of TMJROME and STT was assigned as an exercise program. TMJROME was performed following the Farrar and McCarty method<sup>7</sup>), the aim of which is to increase the range of motion of the mandible by using traction in the anterior-lower direction. Using this technique, the therapist firmly supports the head of the patient in the left palm and uses the middle finger to palpate the impaired mandibular joint. The therapist presses the thumb of the right hand on the occlusal surface of the left-sided molar and holds the diaphysis with the other fingers, and then applies a force to rotate the mandible in the anterior-lower direction (Fig. 1a). Force is applied carefully so as not to be painful for the patient. Each application of traction lasts for 15 s and is repeated five times. TMJROME was performed by the therapist on only one occasion at the time of the initial visit.

During the STT component of this program, the patient sits upright while leaning slightly forward. The patient holds the anterior teeth of the mandible with the index and middle fingers and the mental region with the thumbs (Fig. 1b). The patient slowly performs mandibular traction such that the mandible rotates in the anterior-lower direction. Patients are instructed to perform these traction exercises gently to avoid generating pain but to still feel stretching in the mandibular joint and masseter muscles (Fig. 1b). A single session of STT consisted of 10 repetitions, with each repetition comprising 10 s of traction.

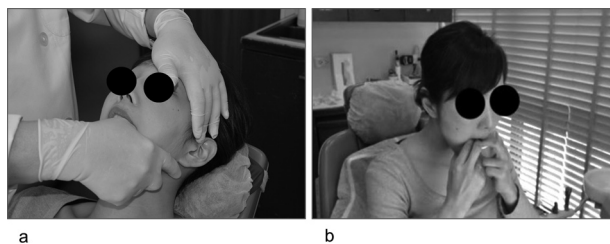
In the present study, the patients were instructed to perform one session of STT in the morning and another daily while bathing. The treatments were performed, demonstrated, and explained by two dentists, each of whom had more than 3 years of experience in exercise therapy for the temporomandibular joint. At the second visit, the participants were asked to perform STT to confirm that the therapy was performed appropriately during the intervening 2 weeks when the patients were applying the therapy at home.

The second visit was scheduled for 2 weeks after the first visit. The clinical parameters of maximum mouth opening distance, pain on motion, pain on mastication, and impact on daily activities were evaluated again for comparison with the data from the first consultation.

Statistical analysis of the measurements recorded was carried out to investigate the short-term effects of the exercise program. The paired t-test and Bonferroni correction method were performed to compare the values recorded for each clinical symptom between the first consultation and the second visit. The statistical analysis was performed using SPSS version 19.0.J for Windows (IBM Corp., Armonk, NY, USA). A p-value of  $<0.05$  was considered to be statistically significant.

## RESULTS

Although the study protocol stipulated 2 weeks between the first and second visits, the mean time interval between the two visits was 12.6 (range 8–18) days. All clinical symptoms measured in the study were significantly improved ( $p < 0.001$ ) at the second visit (Table 1).



**Fig. 1.** Range-of-motion exercise for the temporomandibular joint (TMJROME) and self-traction therapy (STT)

a: TMJROME. The therapist firmly holds the head in the left palm and palpates the impaired mandibular joint by using the middle finger. The therapist presses the thumb of the right hand on the left side of the occlusal surface of the molar, holds the diaphysis with the other fingers, and then applies force to rotate the mandible in the anterior-lower direction. b: STT. The patient sits upright while leaning slightly forward. The patient holds the anterior teeth of the mandible with the index and middle finger, and the mental region with the thumbs. The patient slowly performs bouts of mandibular traction such that the mandible rotates in the anterior-lower direction.

**Table 1.** Significant differences in clinical symptoms between the first visit and second visit (Unit: mm)

	First visit	Second visit
	M ± SD	M ± SD
MOD	30.4 ± 5.6	40.5 ± 5.2 ***
PON	53.1 ± 23.0	27.4 ± 24.5 ***
POM	60.7 ± 27.8	28.3 ± 28.2 ***
IODA	49.4 ± 28.4	24.3 ± 26.5 ***

M: mean; SD: standard deviation; MOD: maximum opening distance; PON: pain on motion; POM: pain on mastication; IODA: impact on daily activities; \*\*\*p<0.001 clinical symptoms between first visit and second visit

## DISCUSSION

The present study investigated the short-term effects of a unique exercise program for TMD in female patients with DDwoR and jaw trismus. The clinical symptoms measured in the study were the maximum mouth opening distance, pain on motion, pain on mastication, and impact on daily activities at an initial visit and a follow-up visit 2 weeks later. We found that all clinical symptoms had significantly improved by the second visit.

Manipulation, pharmacologic therapy, and occlusal splint therapy are typical conservative treatments used for DDwoR, and all need to be performed by therapists. Few studies have investigated the effectiveness of treatments involving self-care to maintain the treatment effect<sup>5</sup>). Thus, the aim of this study was to investigate whether a unique exercise program combining TMJROME and STT could result in early improvements in the symptoms of DDwoR with moderate to severe impairment.

Kurita et al. investigated the natural course of maximum mouth opening distance in patients with DDwoR over a period of 2.5 years<sup>12</sup>). They found an average value of approximately 30 mm at the first measurement, which increased to 42 mm at the end of the observation period, indicating that the mouth opening distance increased with time. In the present study, the maximum opening distance was more than 40 mm after approximately 2 weeks, suggesting that the treatment program could be effective for early improvement when compared with the natural course of maximum mouth opening distance.

In another study, Yoshida et al. investigated the effectiveness of a treatment that combined administration of a nonsteroidal anti-inflammatory drug (NSAID) and TMJROME<sup>13</sup>). They reported that more than 73% of their study participants were able to achieve a mouth opening distance of  $\geq 38$  mm at 2 weeks after the start of treatment. In the present study, 72% (26/36) of the participants were able to achieve this mouth opening distance after treatment, suggesting a comparable treatment effectiveness without use of NSAIDs.

Pain associated with DDwoR is often measured as mandibular joint pain alone. Few studies have considered the different levels of pain experienced separately with different functional movements, such as pain on mouth opening or pain during mastication. Yoshida et al., who evaluated the effectiveness of combined therapy using NSAIDs and TMJROME, used a VAS to assess mandibular pain and reported that the average score of participants who were able to achieve a mouth opening distance  $\geq 38$  mm was 31 mm. Although the VAS was not used to measure mandibular pain in our study, the average VAS score for pain on mouth opening and pain during mastication was 30 mm at the second visit. Thus, our study results are comparable to those of Yoshida et al; further, the maximum opening distances were similar<sup>13</sup>).

Tajima et al. recommended treatment consisting of mouth-opening exercises with administration of NSAIDs when pain is present. They evaluated the maximum mouth opening distance, pain on mouth opening, pain on mastication, and impact on daily activities<sup>14</sup>). They reported a maximum mouth opening distance of 32 mm and VAS scores of 41 mm for pain on opening, 35 mm for pain on mastication, and 32 mm for interference with daily living. Further, in another study, Nascimento et al. performed anesthetic block of the auriculotemporal nerve or a combination of anesthetic block and physical therapies in patients classified as group II or IIIa according to the RDC/TMD<sup>10</sup>), and compared the effectiveness of these treatments based on the VAS score after 1 week<sup>15</sup>). They reported that the VAS score improved significantly to 44 mm at 1 week after starting treatment and to 12 mm at 4 weeks after starting treatment. However, the above treatments have also been reported to have adverse effects. Tajima et al. reported that 11% of their study participants experienced gastrointestinal side effects from taking

NSAIDs<sup>14</sup>), and Nascimento et al. reported that 30% and 2% of their subjects developed paralysis of the temporal branch of the facial nerve and hematoma, respectively, due to the anesthetic block<sup>15</sup>.

In our study, there were no adverse effects at 2 weeks after the start of treatment, and the average VAS scores related to pain and impairment of daily life were 30 and 26 mm, respectively. Thus, our findings suggest that a unique program combining TMJROME and STT may be an optimal initial treatment for DDwoR. This combination can improve symptoms without the need for more invasive surgical procedures and the associated complications.

Although both TMJROME and STT are treatments used to improve the mobility of the mandibular joint<sup>16</sup>), we believe that they can also improve the flexibility and elasticity of surrounding soft tissues, including muscles, fascia, tendons, and ligaments. This may be the mechanism via which the treatment effect was seen to be comparable with that of other treatment methods<sup>3, 5, 8, 9, 13, 14</sup>) during a short time period of approximately 2 weeks in the present study.

The treatment effect of the exercise therapy program presented in this study was evaluated only in female study participants. Thus, further study is required to investigate the effectiveness of the treatment in male patients. Further, it is necessary to clarify the effect of this exercise program by investigating its immediate benefit and by conducting a randomized controlled trial with a control group.

In conclusion, our results suggest that a unique exercise program that combines TMJROME and STT may increase the mobility of the mandibular joint, decrease pain, and impact favorably on the ability to perform daily activities in the short term.

### *Conflict of interest*

None.

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