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Original Article

Short-term effects of range-of-motion exercise on temporomandibular joints of patients who undergo disc displacement with reduction of temporomandibular joint

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Abstract. [Purpose] We investigated the short-term effects of an exercise therapy program that combined a range-of-motion exercise for the temporomandibular joint with self-traction therapy for patients with temporomandibular joint disorders who undergo disc displacement with reduction of the painful temporomandibular joint. [Participants and Methods] The program involved 31 patients with moderate or higher 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 while bathing for the next 2 weeks, until their next visit. The maximum mouth opening distance and the visual analog scale scores at the first consultation and 2 weeks later were compared to assess the changes in pain on motion and mastication as well as the impact of the program on daily activities. [Results] All symptoms of the patients showed significant improvements after 2 weeks of starting the treatment. [Conclusion] The results of this study suggest that an exercise therapy program combining range-of-motion exercises for the temporomandibular joint and self-traction therapy may be an effective conservative therapy for reducing the pain and obstacles experienced by patients with temporomandibular joint disorders who undergo disc displacement with reduction of the painful temporomandibular joint.

Key words: Temporomandibular joint disc displacement with reduction, Range of motion exercise, Short-term treatment

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INTRODUCTION

Temporomandibular joint disc displacement with reduction (DDwR) is the most common pathology among temporomandibular disorders (TMD)[1, 2)], and the dislocation of the temporomandibular joint disc is said to underlie the mechanism of TMD onset[3, 4)]. It has been reported that TMD patients with DDwR notice temporomandibular noise and pain due to dislocation of the temporomandibular joint disc when carrying out opening and closing movements of the mouth and masticatory movements[5, 6)].

Many treatments are available for DDwR, including splint therapy, bite occlusion therapy, home exercises (HE) and counseling[7)]. Under such circumstances, exercise therapy is now garnering attention, including its clinical benefits. This is because there is a consensus that the current therapeutic goal for TMD is to eliminate the pain and functional disabilities, and conservative therapy is regarded as the best option to achieve this[8)].

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The range of motion exercise for temporomandibular joint (TMJROME) helps improve patient agony from early stages immediately after its implementation by expanding the range of motion of the mandible and reducing pain[9–11]. However, without following up with self-care approaches like self-traction therapy (STT), it is difficult to maintain this temporary state of symptom improvement[12]. As such, we developed a therapeutic program combining the TMJROME performed by the therapist and the STT performed by the patient and showed its favorable therapeutic benefits for temporomandibular joint disc displacement without reduction[11]. The purpose of this pilot study was to evaluate the short-term efficacy of this therapeutic program for DDwR.

PARTICIPANTS AND METHODS

The participants were recruited from the 115 TMD patients that consulted our medical institution between June 2015 and October 2017. Out of the 48 patients diagnosed with DDwR, also known as IIa (co-development of Ia and IIIa conditions) according to the Research Diagnostic Criteria for TMD (RDC/TMD axis I)[13], we selected the 31 patients (17 females: the average age of 34.7 ± 12.3 years, the average height of 158.2 ± 7.2 cm, the average body weight of 53.3 ± 8.6 kg, and 14 males: the average age of 38.2 ± 16.2 years, the average height of 171.9 ± 6.2 cm, and the average body weight of 71.3 ± 6.8 kg) having moderately to severe impediment with the four items of pain-free maximum opening distance, pain on motion, pain on mastication and impediment of daily life. These items have been mentioned by the International Association of Oral and Maxillofacial Surgeons[14] and the American Association of Oral and Maxillofacial Surgeons[15]. The exclusion criteria included patients younger than 18 and older than 71 years old, patients with a history of mandibular fractures, patients taking anti-inflammatory analgesics or have taken it less than two weeks ago to treat other diseases, and patients with other serious medical complications, such as heart diseases, liver diseases, and kidney diseases, or a history thereof.

The patient breakdown by RDC/TMD was IIa + Ia + IIIa (three patients), IIa + Ia (11 patients), and IIa (17 patients). In terms of the pain-free maximum opening distance, a moderate or higher level of the impediment was defined as an incisal distance of less than 34 mm between the upper and lower central incisors, when measured using a caliper. In addition, the extent of pain on motion, pain on mastication, and degree of the impediment of daily life were shown using the Visual Analogue Scale (VAS) having a range from 0−100 mm, where a score of 34 mm or above would indicate a problem and 0 mm was symptom-free. Following the Declaration of Helsinki, patients were asked to provide their voluntary written consent to participate in the study, following a thoroughly informed consent session. This study was also conducted with the approval of the Aichi Gakuin University School of Dentistry Ethics Committee (Approval No. 480).

In this study, patients participated in TMJROME and STT as part of the exercise therapy program. TMJROME was carried out following the method reported by Farrar and McCarty[9]. This approach aims to increase the range of motion of the patient's temporomandibular joint by pulling the patient's mandible in the anterior-lower direction. Specifically, the therapist firmly held the patient's head in the left palm and palpated the impaired mandibular joint using the thumb of the other hand. The therapist then pressed the thumb of the right hand on the right side of the occlusal surface of the molar, held the diaphysis with the other fingers, and then applied force to rotate the mandible in the anterior-lower direction to the extent that the patient was not complaining of pain (Fig. 1a). Each round of traction lasted 15 s, and this was repeated for five rounds. TMJROME was performed just once by the therapist during the first examination.

When performing STT, the patient was seated upright and leaned slightly forward. The patient then held the anterior teeth of the mandible with his/her index and middle fingers, and the mental region with the thumb. In this state, the patient slowly performed mandibular traction to rotate the mandible in the anterior-lower direction. The patient was instructed to apply a

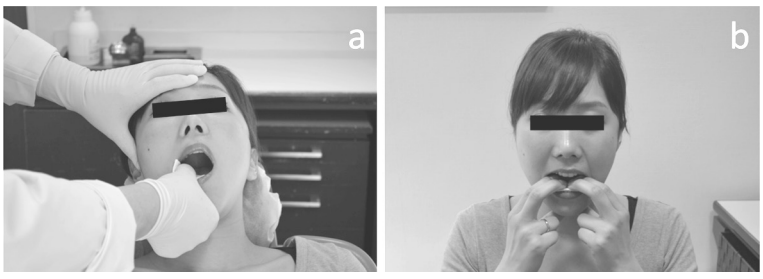

Fig. 1. Range-of-motion exercise for the temporomandibular joint (TMJROME) and self-traction therapy (STT).
a: TMJROME. The therapist firmly holds the head in the left palm and palpates the impaired mandibular joint by using the first finger. The therapist presses the thumb of the right hand on the right 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.

degree of traction force that allowed the patient to feel the stretching of the temporomandibular joint and the masticatory muscles while being pain-free (Fig. 1b). Each session of STT involved repeating 10 s of traction ten times. In this study, patients were instructed to perform a session of STT when awaking and while bathing. Treatments were performed by two dentists, each having four or more years of experience implementing exercise therapy for the temporomandibular joint. As STT is a self-care intervention, the patients needed to comprehend well and implement STT by themselves. To that end, patients were asked to perform STT during the initial re-visit to check that they were performing STT properly at home.

The second visit was scheduled two weeks after the initial examination. To make comparisons with the data from the initial examination, the pain-free maximum opening distance, pain on motion, pain on mastication, and the degree of the impediment of daily life were re-evaluated during the second visit. We performed a statistical analysis of the recorded measurements to investigate the short-term effects of the exercise program. To compare the measurements of each clinical symptom recorded during the initial examination and the second visit, we calculated p-values using the paired t-test and performed Bonferroni correction. For statistical analysis, SPSS Version 19.0 J (IBM Corp., Armonk, NY, USA) for Windows was used, and the statistical significance level was set to less than 5%.

RESULTS

Although the study protocol intended for there to be a gap of two weeks between the first and second visits, the mean interval between the two visits turned out to be 17.5 days (range: 10−39 days). All clinical symptoms measured in this study showed significant improvements at the second visit ($p<0.001$) (Table 1).

DISCUSSION

Conservative therapies such as physiotherapy and bite splint therapy are typical approaches to treating DDwR, and they must all be performed by a therapist. However, there is almost no prior study investigating the efficacy of a therapeutic program that included a self-care regime to maintain the therapeutic effects of the primary intervention[16]. The purpose of this study was to investigate whether our unique exercise program combining TMJROME and STT could bring about early improvement of symptoms in DDwR patients with moderate to severe functional impairment.

Sato et al.[17] investigated the natural progression of the opening distance and pain in the temporomandibular joint and masticatory muscles in DDwR. As a result, although there was no change in the opening distance approximately two years after the investigation, the pain in the TMJ had reduced by 15.7%. In contrast, the pain in masticatory muscles had reduced by 33.3%. In this study, after the passage of the two weeks of the study period, the maximum opening distance increased, pain on motion in the TMJ decreased, and muscle pain during mastication decreased. As such, a comparison of these symptoms with natural progression suggests that this therapeutic program is effective for realizing the early improvement of symptoms.

Wänman et al.[18] evaluated the benefits of HE compared to other treatments in a randomized controlled trial. Their HE program consisted of two training sessions. The first training session was performed following the method reported by Yoda et al.[19], which was an opening and closing exercise of the mouth while sticking out the mandible slightly, conducted for five minutes per day. The second training session was performed according to the method reported by Au et al.[20], where patients carried out 10 s of opening movements of the mandible against the resistance of the hand (isometric exercise), which was repeated ten times per day. This exercise program was carried out for three months continuously before evaluating the benefits. It was reported that ultimately, HE alone did not lead to improvements in TMJ pain and pain on motion. These reports suggest that it is difficult to achieve a favorable therapeutic effect for painful DDwR by home-based exercise therapy alone.

Wänman et al.[18] have also studied the benefits of a treatment program that combined HE with supervised exercises (SE) performed by a therapist. SE combines thermotherapy, exercise therapy, and opening exercises of the mandible (isometric exercise), and it consisted of five minutes of warming, six minutes of exercise therapy, and eight minutes of isometric exercises.

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	44.1 ± 6.3	48.8 ± 6.0	***
PON	44.4 ± 30.3	13.5 ± 18.2	***
POM	54.7 ± 28.8	15.1 ± 19.2	***
IODA	51.2 ± 22.3	15.2 ± 20.5	***

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.

This treatment program was repeated for ten sessions, and the patients were later instructed to continue with the isometric exercise program at home. The therapeutic effects of this program were evaluated three months later, and the authors reported significant improvements in TMJ pain and pain on the motion that had been prevalent at moderate or higher levels before the intervention. Furthermore, Tuncer et al.[21] have discussed the benefits of the treatment program, combining HE and manual therapy (MT) performed by a therapist. As MT, patients underwent 30 min of deep rub massage and myofascial release in the masticatory muscles and neck muscles, jaw exercises intended for the distraction of TMJ and isometric straining of the temporomandibular joint and cervical spine, three times a week for four weeks. As a result, the authors reported that both pains at rest and pain on mastication improved. These reports showed that treatment programs combining home-based treatment performed by the patient and treatment performed by a therapist in the clinic are effective treatments that improve the symptoms of painful DDwR in a timeframe of 1−3 months after the start of treatment. In this study, patient symptoms were evaluated two weeks after the start of treatment, by which time both pains on motion in the TMJ and pain on mastication had reduced. It suggests that the treatment program that we are proposing can expect to improve symptoms at an earlier stage than the treatment programs reported by Wänman et al. and Tuncer et al.

There have also been many studies on the benefits of bite splint therapy for DDwR. Stabilization Splint (SS) or Anterior Repositioning Splint (ARS) have been pointed out as types of splits available, and each of their efficacy has been reported. However, there are not many studies that evaluated the pain level. Baş et al.[22], who examined the benefits of SS, reported that as a result of investigating the changes in maximum opening distance and TMJ pain three months, six months and 12 months after the start of treatment, improvement in symptoms and therapeutic benefits became evident from as early as after three months of wearing SS. Pihut et al.[4] established a laser treatment group as a control to the splint treatment group using ARS, evaluated the pain level in patients using the Verbal Numerical Rating Scale after four weeks and 16 weeks of treatment, and examined the effects in each treatment group. As a result, although remaining at a moderate level, both groups showed mild improvements in pain after four weeks of treatment. In their study, it was recommended that the splint treatment group patients used ARS for 20 h per day. In our study, we examined the benefits of treatments around two weeks after the start of treatment. As such, direct comparisons cannot be made with the results obtained by Baş et al.[22] or Pihut et al.[4], but the VAS measurements indicating the TMJ pain and pain in masticatory muscles decreased, thereby indicating an improvement to mild impairment. This suggests that through adjustment of the treatment period and number of patient visits to the treating institution, this treatment program can expect to improve the symptoms even earlier.

Although both TMJROME and STT are treatments intended to increase the mobility of the temporomandibular joint, it is believed that the treatments provide the benefits of static stretching that improve the flexibility and extensibility of soft tissues, such as surrounding muscles and fascia, tendons and ligaments[12] at the same time. This is likely why the program was able to provide the sort of therapeutic benefits that are not inferior to that achieved by various treatment methods reported in the past[2, 3, 8–10], over a short period of time of only two weeks.

This study was conducted as a pilot study to investigate the therapeutic benefits of an exercise therapy program for DDwR. Going forward, it is necessary to elucidate the benefits of this exercise program further by carrying out a randomized controlled trial with a control group.

In conclusion, the results of our study suggest that our unique exercise program combining TMJROME and STT may reduce TMJ pain and masticatory muscle pain, as well as the degree of the impediment of daily life in a short period of time, and benefit the patients.

Funding and Conflict of interest

There are no conflicts of interest or funding that should be disclosed in relation to this study.

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