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Improvement of the Pain of Temporomandibular Disorder in Parts of the Human Body through Temporomandibular Joint Correction Treatment

Kiefergelenkskorrektur verbessert Schmerzen verschiedener Lokalisationen bei craniomandibulärer Dysfunktion

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ABSTRACT

Background and Aim Patients with temporomandibular disorder often experience pain in various parts of the body. However, the degree of improvement of patients' pain through temporomandibular joint correction has not been identified in an independent study. This study aimed to identify the symptoms most frequently reported by patients with temporomandibular disorder and determine the degree of pain improvement and structural changes through temporomandibular joint correction.

Methodology Patients who complained of temporomandibular disorder and visited a dental clinic and agreed to participate were included in the study ($n = 85$). The patients were divided into a nontreatment group (Control, $n = 35$) and treat-

ment group (Treatment, $n = 50$) of the temporomandibular joint, and the treatment group received more than 10 correction treatments. All reported locations of pain were recorded preintervention and postintervention of temporomandibular joint correction treatment, and the degree of pain, which measured using a visual analog scale, was also recorded. Simultaneously, X-ray imaging was performed to confirm the structural difference between the pre-temporomandibular joint and post-temporomandibular joint correction treatment.

Result Most of the patients with temporomandibular disorder complained of temporomandibular joint pain (n = 66/85), but the majority complained of neck pain ($n = 61/85$) and shoulder pain ($n = 60/85$). In addition, there were many cases of headache ($n = 26/85$), back pain (n = 25/85), and lockjaw ($n = 22/85$). In rare cases, complaints of facial pain ($n = 2/85$), tinnitus ($n = 2/85$), hip joint pain ($n = 4/85$), knee pain ($n = 5/85$), xeroma ($n = 1/85$), and ear pain ($n = 1/85$) have been reported. After temporomandibular joint correction treatment, the treatment group had significantly lower visual analog scale scores than pretreatment for TMJ pain, headache, shoulder pain, neck pain, back pain, and lockjaw ($p < .0001$). Furthermore, it was confirmed that the balance of the cranial bone and mandibular condyle symmetry in the X-ray image was significantly improved in the TMJ correction treatment group (pretreatment vs. posttreatment, $p < .001$). In the control group, no significant differences were observed pre-and post-intervention in all symptoms and X-ray images.

Conclusion Temporomandibular disorders can cause pain in other parts of the body with an unknown cause. Therefore, these results show that if the pain in other parts of the body cannot be fundamentally resolved, temporomandibular joint correction treatment through the diagnosis of temporomandibular disorder may need to be performed in dental clinics.

ZUSAMMENFASSUNG

Hintergrund und Ziel Patienten mit craniomandibuläre Dysfunktion (CMD) empfinden häufig Schmerzen an verschiedenen Stellen des Körpers. Das Ausmaß der Schmerzverbesserung nach korrektiven Maßnahmen am Kiefergelenk wurde allerdings bislang noch nicht im Rahmen einer eigenständigen Studie untersucht. Ziel der vorliegenden Studie war es, die am häufigsten von Patienten mit CMD genannten Symptome zu erfassen und das Ausmaß der durch Kiefergelenkskorrekturbehandlung erzielten Schmerzverbesserung und strukturellen Veränderungen zu bestimmen.

Patienten und Methodik Patienten, die eine Zahnklinik aufsuchten und über craniomandibuläre Dysfunktion klagten, wurden nach Einwilligung in die Studie aufgenommen (n = 85). Die Patienten wurden in eine Gruppe ohne Behandlung (Kontrolle, n = 35) und eine Gruppe mit Behandlung des Kiefergelenks (Behandlung, n = 50) eingeteilt. Die Patienten der Behandlungsgruppe erhielten mehr als 10 Korrekturbehandlungen. Alle berichteten Lokalisationen wurde vor und nach der korrektiven Kiefergelenksintervention zusammen mit der mittels visueller Analogskala (VAS) gemessene Schmerzstärke erfasst. Gleichzeitig wurden Röntgenaufnahmen angefertigt, um den strukturellen Unterschied zwischen der Situation vor und nach der Kiefergelenkskorrekturbehandlung zu dokumentieren.

Ergebnisse Die meisten Patienten mit craniomandibuläre Dysfunktion klagten über Schmerzen im Kiefergelenk (n = 66/85), mehrheitlich aber auch über Nacken- (n = 61/85) und Schulterschmerzen (n = 60/85). Außerdem gab es viele Fälle von Kopfschmerzen (n = 26/85), Rückenschmerzen (n = 25/85) und Kiefersperre (n = 22/85), wohingegen seltener über Gesichtsschmerzen (n = 2/85), Tinnitus (n = 2/85), Hüftschmerzen (n = 4/85), Knieschmerzen (n = 5/85), trockenes Auge (n = 1/85) und Ohrenschmerzen (n = 1/85) berichtet wurde. In der Behandlungsgruppe fanden sich nach Kiefergelenkskorrekturbehandlung signifikant niedrigere VAS-Scores im Vergleich zu den Werten vor der Behandlung bei Kiefergelenkschmerzen, Kopfschmerzen, Schulterschmerzen, Nackenschmerzen, Rückenschmerzen und Kiefersperre ($p < 0{,}0001$). Weiterhin zeigte sich röntgenologisch in der Gruppe mit Kiefergelenkskorrekturbehandlung eine signifikante Verbesserung des Verhältnisses der Schädelknochen zueinander und der Symmetrie der Gelenkfortsätze des Unterkiefers (vor Behandlung vs. nach Behandlung, $p < 0{,}001$). In der Kontrollgruppe fanden sich bei allen Symptomen und in den Röntgenaufnahmen keine signifikanten Unterschiede zwischen der Situation vor und nach der Intervention.

Schlussfolgerung Die craniomandibuläre Dysfunktion kann Schmerzen unklarer Genese an anderen Lokalisationen im Körper verursachen. Die Ergebnisse zeigen daher, dass bei therapierefraktären Schmerzen in anderen Körperabschnitten gegebenenfalls eine Kiefergelenkskorrekturbehandlung bei diagnostizierter craniomandibuläre Dysfunktion in Zahnkliniken durchgeführt werden sollte.

Introduction

Temporomandibular disorder (TMD) is a term that refers to various clinical problems of masticatory muscles and structures related to the temporomandibular joint (TMJ) [1]. The main symptoms of TMD are pain or joint sounds around the jaw, restriction of mandible movement, and changes in movement patterns [2]. The main symptoms of TMD often coexist with pain in various parts of the body [3–5]. However, it seems that many people are unaware of this, although they are patients with TMD. It is known that only approximately 5 % of people actually receive treatment for TMD, despite research showing that 70 % of the population has at least one symptom of TMD [1]. Therefore, many patients with TMD may not be aware that TMD is progressing because they are unaware of the signs. Furthermore, a patient with pain in the body part associated with TMD suffers constant pain because the cause cannot be found or is idiopathic.

Patients with pain in other parts of the body, whose cause is not confirmed as TMD, cannot receive effective treatment. Therefore,

it is important to accurately and quickly select patients with TMD from patients with pain in other regions of the body. Fundamental treatment of pain in other body parts that accompany TMD prevents the exacerbation of TMD, thus preventing TMD and all pain associated with it from becoming chronic.

As mentioned above, it is important to select patients whose main cause of pain is TMD. For this, data on pain areas and symptoms highly related to TMD are required. The selection of patients with TMD could be used to identify the cause of pain. However, there is no single common complaint that all patients with TMD experienced, as the results of existing studies only report the relationship between headache [4, 5], back pain [3], and tinnitus [6], pain and TMD. Therefore, we tried to identify the symptoms reported most frequently by patients with TMD. We provided evidence of an improvement in pain and structural changes following TMJ correction treatment.

Materials and Methods

Subjects

The study was conducted by stratifying patients who visited the dental clinic for TMJ correction treatment into control and treatment groups. Only data from patients who consented to participate in this study were used. Patients who took drugs continuously or who took drugs during treatment were excluded. In particular, cases in which surgery was performed around the TMJ were excluded. In addition, other physiotherapy treatments were excluded. ▶ **Tab. 1** shows the sex and age of the patients included in the study. This study was approved by the Institutional Review Board of Korea University (approval number: KUIRB-2020–0337–02) and performed following the Declaration of Helsinki.

Data collection

Patients who did not receive treatment within 4 months after initial treatment were classified as the control group, and those who received treatment 10 times or more during the 4 months after the first visit were classified as the treatment group. All patients included in the study recorded all uncomfortable symptoms they felt in their body, including the jaw, and the degree of discomfort was expressed on a visual analog scale (VAS) ranging from 0 to 10, both before and after treatment. X-ray (Pointnix, Point 3D Combi 500 S, Seoul, Korea) images of the patients were taken before and after treatment, respectively. In the case of the control group, symptoms were checked at the first visit and 4 months later and X-ray tomography was performed.

▶ **Tab. 1** Characterization of the participants.

Sex/age	Group		Total
	Control	Treatment	
Female	23	38	61
Male	12	12	24
Age, years (mean)	20–74 (42.52)	16–77 (38)	18–75.5 (39.61)

Clinical treatment

The treatment group received manual therapy for the TMJ at the time of admission and a personalized intraoral splint was worn during the treatment period (▶ **Fig. 5**). The TMJ correction treatment was performed more than 10 times, and patients were recommended to wear a personalized intraoral splint for at least 12 h a day, including sleep time. TMJ correlation treatment is performed by relaxing the tense muscles around the jaw and balancing the left and right sides. The treatment time per TMJ correction session was 10–20 min. Intraoral splints were manufactured to maintain ± 1.6 mm occlusal plane spacing.

X-ray tomography

X-ray tomography was performed to confirm changes in balance of the skull due to TMJ correction. First, the balance of the left and right heights was checked by measuring the slope of the line connecting the left and right articular eminences of the temporal bone before and after the patient's treatment. Under the assumption that the height of the temporal bone placed above the mandibular condyle will also be improved if the balance between the left and right heights of the jaw is improved.

In addition, the state of balance was confirmed by comparing the position of the mandibular condyle at the time of mouth opening on radiography. Upon closing, the mandibular condyle located in the articular fossa behind the articular ridge slides forward at the time of opening. It is normal to move forward more than at the apex. In patients with TMD, these movements do not normally occur during opening, and the positions of the left and right mandibular condyles are often different. The distance from the midline of the articular condyle to the point where the mandibular condyle was located was measured left and right, respectively; the greater the difference between the left and right distances, the worse the symmetry was interpreted [7].

Statistical analysis

All statistical analyses used were performed using SPSS software version 23 (SPSS, Inc., Chicago, IL, USA). A two-way analysis of variance was performed to confirm the correlation between treatment and pain relief and treatment and changes in the balance of the TMJ. All statistical results were expressed as mean ± standard deviation. All statistical significance levels were set at $p < .05$.

Results

Symptoms reported by patients

Among all patients, TMJ pain and sound were the most common complaints, and headache, neck pain, shoulder pain, back pain, and opening disorders were also frequently reported. Some patients complained of facial pain, tinnitus, pelvic pain, knee pain, dry eye syndrome, and ear pain (▶ **Fig. 1**).

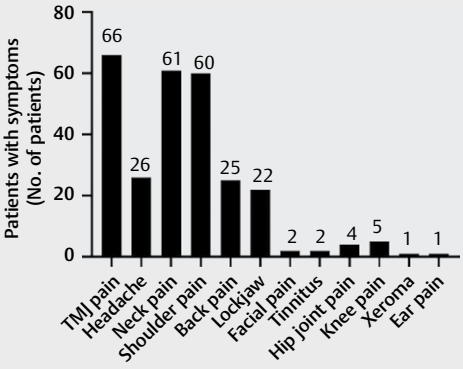
Pain change by TMJ correction treatment in six symptoms

The six items with the highest frequency of complaints were TMJ pain and sound, headache, neck pain, shoulder pain, back pain, and opening disorder. VAS values before and after the treatment of the

patients were compared. In all items, the treatment group had a lower VAS score after treatment than before treatment ($p < .0001$). However, there were no significant differences between the control groups before and after treatment (▶ **Fig. 2**).

Changes in the balance of the skull following TMJ correction treatment

In the treatment group, the slope decreased significantly after treatment compared to before treatment ($p < .001$). However, there was no significant difference between the control groups before and after treatment (▶ **Fig. 3**).



▶ **Fig. 1** Symptoms associated with temporomandibular disorders (TMD) and pain in parts of the body.

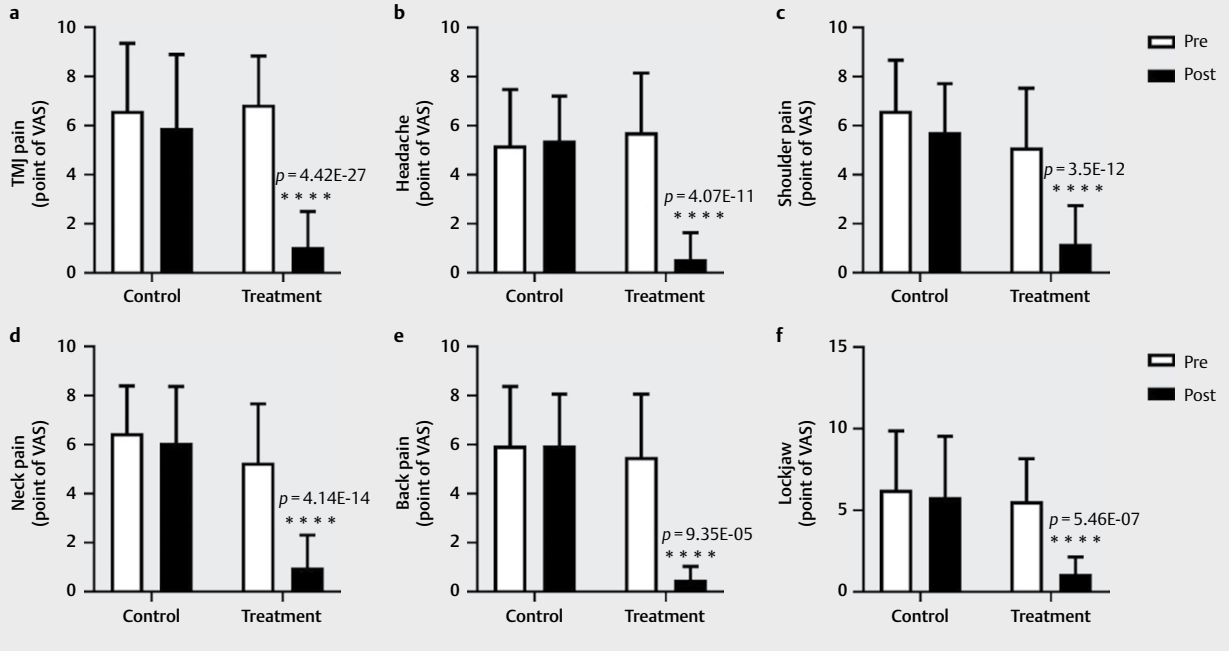
Symmetry changes with TMJ correction treatment

In the treatment group, the difference in the distance between the left and right mandibular condyles on the X-rays was significantly reduced after treatment compared to before treatment ($p < .001$). There were no significant differences between the control groups before and after treatment (▶ **Fig. 4**).

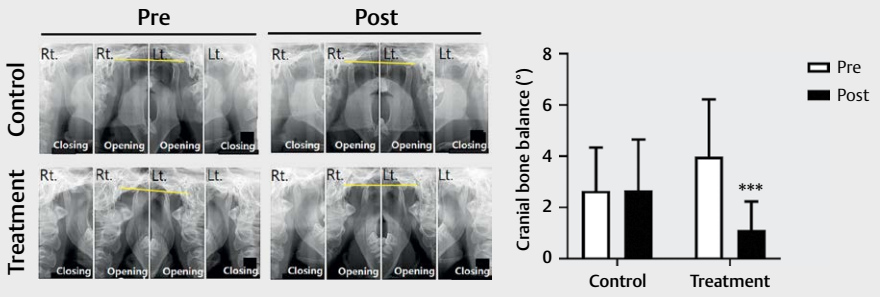
Discussion

In this study, patients with TMD complained of TMJ pain (66 patients). It was found that patients with TMD often complained not only of TMJ but also headache (26 patients), neck pain (61 patients), shoulder pain (60 patients), and back pain (25 patients). In addition, various symptoms are accompanied by facial pain, tinnitus, pelvic pain, knee pain, dry eye syndrome, and ear pain. Based on these results, TMD is believed to be highly related to headache, neck pain, shoulder pain, and back pain, and various other types of pain may also be related to TMD. Therefore, in patients with TMD in this study, we needed to determine whether TMD was the cause of pain in other areas investigated. Although they experience pain in other areas of the body, they are often unaware of having TMD disorders, so this can be an essential consideration.

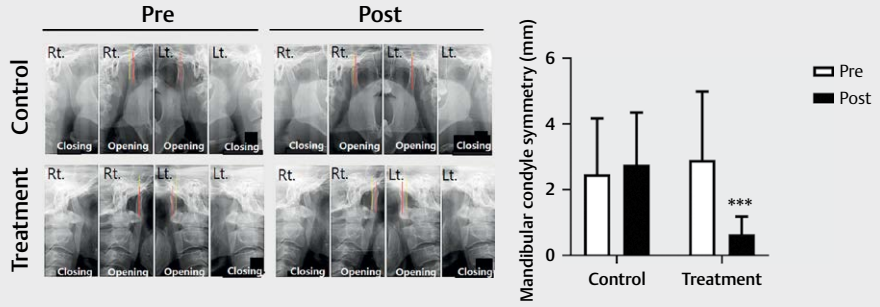
In the case of headaches, compared with the general dental treatment group, the TMD patient group complained of headaches more frequently, and the intensity of the pain was much stronger [8]. This result shows the relationship between headache and TMD, and in this study, tinnitus and dizziness were also common symptoms. Patients with neck and shoulder pain also showed more symptoms and signs of TMD than those who did not [9, 10]. Fur-



▶ **Fig. 2** Changes in pain in other parts of the body through TMD treatment. All data presented as the mean ± standard deviation (M ± S.D.); ****$p < .0001$, pre vs. post.



▶ **Fig. 3** Changes in cranial bone balance after TMJ correction treatment. All data presented as the M ± S.D.; ***p < .001, pre vs. post.



▶ **Fig. 4** Changes in mandibuluar condyle symmetry after TMJ correction treatment. All data presented as the M ± S.D.; ***p < .001, pre vs. post.

thermore, several studies have reported significant associations between TMD and various parts of the body [11, 12].

Several studies have reported associations between TMD and pain in other parts of the body. However, even if the pain is related to TMD, the cause of TMD remains unclear. A clear probability of TMD could be confirmed when symptoms improved with TMJ correction treatment. Therefore, checking for TMD could be a fundamental step in pain intervention. For example, previous studies confirmed the benefits of TMJ correction treatment, such as improvement in tinnitus and headache [5, 6, 13]. However, in the previous three studies, all symptoms of the patients were investigated and the degree of improvement could not be confirmed to be the result of TMD. Although it was suggested that there could be a relationship between tinnitus and the treatment of TMD in an individual study, only one patient with TMD complained of tinnitus in this study. Therefore, as in this study, the areas of pain that patients with TMD complain of were not identified, so this study may be very limited as evidence to claim that TMD is the cause of tinnitus in clinical practice. Furthermore, as in this study, the relationship between TMD and pain in other parts of the body can be said to be clearer only when the degree of improvement in pain experienced by patients with TMD and the degree of improvement in TMD were confirmed. Therefore, our study shows that the six symptoms identified with TMD, such as TMJ pain and sound, headache, neck pain, shoulder pain, back pain, and opening disorder, are closely related to TMD. These symptoms can be said to be the result of the study that strongly supports the relevance of TMD since all of these symptoms showed a significant decrease in pain after treatment of the TMJ (▶ **Fig. 2**).

This study clearly showed that the reduction in pain in other parts of the body through TMJ correction treatment occurred along with the change in the left and right number-average shape of the temporal bone condyle and the restoration of the symmetry of the mandibular condyle during opening (▶ **Fig. 3**). These results are the results of a study suggesting that the improvement through TMJ correction treatment is not an independent improvement of the nervous system, but rather the structural recovery due to the physical change of the TMJ precedes it and then complex factors act to relieve pain in other parts of the body.

As mentioned above, among those diagnosed with TMD, there are many cases in which they are unaware of having TMD. In this study, people with pain in various parts of the body are likely diagnosed with TMD. Therefore, people with chronic pain in multiple parts of the body must be diagnosed with TMD. The results of our study suggest that TMJ correction treatment may fundamentally treat pain, as pain in multiple body parts may be caused by TMD.

Conclusions

In this study, TMD often appeared together with pain in various parts of the body, such as the head, face, neck, shoulders, back, and lower back. Pain improved significantly with TMJ correction.

The causes of various pains that occur in the body could be a result of TMD, and the treatment of TMD can be applied to effectively treat the pain.

Conflict of Interest

The authors declare that they have no conflict of interest.

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