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The Effect of Relaxation Exercises for the Masticator Muscles on Temporomandibular Joint Dysfunction (TMD)

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Abstract. [Purpose] The purpose of this study was to identify the influence of relaxation exercises for the masticator muscles on the limited ROM and pain of temporomandibular joint dysfunction (TMD). [Subjects and Methods] The subjects were 10 men and 31 women in their 20s and 30s. They were randomly divided into no treatment, active exercises and relaxation exercise for the masticator muscle groups. The exercise groups performed exercises three times or more a day over a period of four weeks, performing exercise for 10 minutes each time. Before and after the four weeks, all the subjects were measured for ROM, deviation, occlusion, and pain in the temporomandibular joint. [Results] ROM, deviation and pain showed statistically significant in improvements after the intervention in the active exercise and relaxation exercise for the masticator muscle groups. Deviation also showed a statistically significant difference between the active exercise and relaxation exercise groups. [Conclusion] The results verify that as with active exercises, relaxation exercises for the masticatory muscles are an effective treatment for ROM and pain in TMD. Particularly, masticatory muscle relaxation exercises were found to be a treatment that is also effective for deviation.

Key words: Masticator muscle, Relaxation exercise, Temporomandibular joint dysfunction

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INTRODUCTION

Humans move the temporomandibular joint 1,500–2,000 times daily, making it one of the most used joints in the human body[1)]. The temporomandibular joint is a unique bicondylar joint which is used in mastication and speech, and is critical for normal mouth function. The maximum mouth opening distance is a generally accepted measurement of temporomandibular joint mobility and function[2)]. In the movement of the temporomandibular joint, the lower jawbone and the teeth should interact in alignment. In addition, when the mouth is open, the normal range of motion should be 40–60 mm[3)] Scott[4)] reported that the critical functional opening of the mouth is 35–40 mm. In particular, although the lower jawbone should move in alignment with the teeth, when the movement of the temporomandibular joint on one side is abnormal, an asymmetric movement can occur, in which the mouth opens lopsidedly[5)].

Limited range of motion (ROM) in the temporomandibular joint can result from causes such as excessive movement of the masticatory muscles, external injury, emotional stress, and malocclusion. Rather than a single cause, a combination of various causes may develop the symptom[6)]. Limited ROM in the temporomandibular joint can accompany symptoms such as pain, crepitus, headache, and tinnitus. Such symptoms are called temporomandibular joint dysfunction (TMD). The main symptoms of TMD are limited ROM and pain which are known to be experienced by 65–80% of the population[7)]. Therefore, quality of life may be affected, with a negative effect on social function and emotional health[8)].

A number of studies have investigated treatments for the motional dysfunction and pain in temporomandibular joint, encompassing massage[9)], electrotherapy[10)], active exercise[11, 12)], and manipulation therapy[13)]. Their results are also being applied in clinical practice.

The purpose of this study was to identify the influence of masticatory muscle relaxation exercises on the limited ROM and pain of temporomandibular joint dysfunction, to confirm that excessive tension of masticatory muscles can be a cause of limited ROM and pain in the temporomandibular joint, and to suggest treatment guidelines for TMD.

SUBJECTS AND METHODS

Subjects

This study selected 10 men and 31 women in their 20s and 30s, who were had limited ROM and pain in the temporomandibular joint or were feeling discomfort which their masticatory function. The subjects were randomly divided into no treatment, active exercise and masticatory muscle relaxation exercise groups. The subjects had limited ROM and crepitus in the temporomandibular joint, but had no or-

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thopaedic diseases, such as external injuries or degenerative diseases, and weren't being treated with drugs or physical therapies for limited ROM, pain or crepitus. In addition, the subjects were selected from amang those who understood the purpose of this study and were capable of understanding and complying with the tester's instructions. All subjects understood the purpose of this study and agreed to participated in this research. All participants signed an informed consent approved by the Institutional Review Board.

Methods

Weight and height of all subjects were measured. Then, each subject was assessed for pain, deviation and ROM of the temporomandibular joint (TMJ) and degrees of occlusion were evaluated. The range of joint motion of maximal opening of TMJ was measured in millimeters as the distance between the median clefts of the upper and lower teeth using a goniometry[14]. If it is less than 35 mm, TMJ is considered to have limited ROM[15]. To measure the deviation of TMJ, the subjects opened their mouths to the maximum and were then photographed with a digital camera. Analysis of the images was performed using the Global Posture System (GPS, Chinesport, Italy), a body alignment analysis program. The deviation of the angle connecting the median clefts of the upper and lower teeth was measured in degrees.

For the degree of occlusion, the subjects were instructed to bite a stick with their incisor, and the distance between the upper and the lower bite-mark in millimeters. A larger value indicates a corresponding deeper bite. The degrees of pain of the subjects was measured on a visual analogues scale, with 0 corresponding to no pain 10 corresponding to.

For the masticatory muscle relaxation exercise used in this study, the subjects were instructed to evenly bring their lips together, put the front one-third of their tongue on the roof of their mouth with their upper and lower teeth not in contact with each other, and then apply a light force to the tip of the tongue with the tip of the tongue not touching the teeth[16]. The subjects were instructed to maintain this position as long as they could (Fig. 1).

The control group received no treatment. The active exercise group performed an opening-and-closing movement that commonly used in the treatment of TMD[17]. The subjects were instructed to put their hands on the temporomandibular joint and to open their mouths slowly. Then, they had to maintain this position for about 5–10 seconds, and then return to the original position. The exercise groups performed their exercises three times or more a day over the period of four weeks, for 10 minutes at each time. At the end of the four weeks, all the subjects were again measured for ROM, deviation, occlusion, and pain in temporomandibular joint.

Statistical analyses were performed using SPSS version 14 for Windows (SPSS Institute Korea, Seoul, Korea) and the results are presented as Mean±SD.

In order to analyze the changes in ROM, deviation, occlusion, and pain in the temporomandibular joint between the pre- and post-test, the paired t-test was used for the changes within each group and an ANOVA was used for comparison among the three groups. The Scheffe test was used as a post hoc test. Statistical significance was accepted for values of as $p<0.05$.

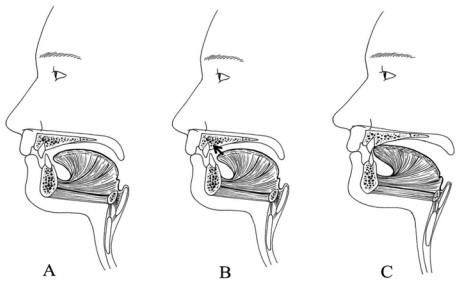

Fig. 1. Relaxation exercise of Masticator Muscle. A: before exercise, B: put the front one-third of tongue on the roof of mouth and apply a light force to the tip of the tongue while the tip of the tongue doesn't touch the teeth. C: during exercise, to maintain this position as long as they can.

RESULTS

The characteristics of the 40 participants in this study are shown Table 1. Both the active exercise group and the masticatory muscle relaxation exercise group showed statistically very significant improvement ($p<0.01$), but there were no changes in the no treatment group. In the comparison of the three groups, the active exercise, masticatory relaxation exercise and no treatment group all showed were a significant differences in variance ($p<0.01$). The deviation caused by the asymmetry of motion on both sides of the joint exhibited a statistically significant change between the pre- and post-test in the masticatory muscle relaxation exercise group ($p<0.01$). The deviation also showed a statistically significant difference in the comparison between the active exercise and masticatory muscle relaxation exercise group ($p<0.01$). This result confirmed that the masticatory muscle relaxation exercise was more effective for deviation.

The degree of occlusion exhibited no statistically significant changes between pre- and post-test in the two exercise groups. However, the muscle relaxation exercise group showed a larger decline. As for pain, both the masticatory muscle relaxation exercise group ($p<0.01$) and the active exercise group ($p<0.05$) showed statistically significant declines, however, the comparison of the two groups found no statistically significant difference between them (Table 2).

These results verify that as with active exercises, muscle relaxation exercises are an effective treatment for the ROM and pain. Particularly, muscle relaxation exercises were found to be a treatment that is also effective for deviation.

DISCUSSION

The purpose of this study was to identify the influence of masticatory muscle relaxation exercises on ROM and pain in the temporomandibular joints, and thereby suggest treatment guidelines for TMD. Influential factors in TMD include gender and age. Specifically, women and the age

Table 1 . Characteristics of subjects

	No treatment (n=11)	Active exercise (n=16)	Relaxation exercise of Masticator muscle (n=14)	All subjects (n=41)
Female	8	13	10	31
Male	3	3	4	10
Age (year)	22.4±6.1	22.6±2.4	23.1±1.5	23.2±6.9
Weight (kg)	54.5±7.0	55.2±7.6	57.1±6.9	55.9±5.4
Height (cm)	168.2±4.8	164.3±6.1	166.2±8.1	166.8±7.4
Duration	9.8±7.6	11.2±4.1	10.4±7.0	10.1±6.3

Table 2 . Comparison of ROM, deviation, occlusion and pain in the TMJ within group, between groups, and between pre- and post-test

	Group	Pre-test	Post-test
ROM (mm)	1	37.4±3.8	38.1±4.2
	2	33.0±8.0	$40.7\pm6.4^{**++}$
	3	32.2±9.6	$43.4\pm11.9^{**++}$
Deviation (°)	1	5.6±4.7	5.2±3.9
	2	7.8±2.7	$6.6\pm2.9^{++}$
	3	7.6±2.6	$5.6\pm3.0^{**+\,++}$
Occlusion (mm)	1	2.1±1.4	2.2±0.9
	2	3.0±0.9	2.9±0.8
	3	2.9±1.0	2.8±0.6
Pain	1	4.3±0.7	4.0±0.8
	2	4.3±0.6	$2.6\pm0.7^{*++}$
	3	4.5±0.4	$2.0\pm0.6^{**++}$

1: No treatment, 2: Active exercise, 3: Relaxation exercise of masticator muscle
*p<0.05 compared to pretest; **p<0.01 compared to pretest;
$^{+}$p<0.01 compared to the active exercise group;
$^{++}$p<0.01 compared to the no treatment group

group of 15 to 45 are known to be at greater risk of TMD[18]. This study had more female subjects than male subjects, 31 females (78%), which substantiates that gender is an influential factor in TMD.

The major symptoms of TMD include pains in the masticatory muscles, tenderness on pressure, joint sounds with jaw opening, and limited mandibular movements. The temporomandibular joint is surrounded by ligaments, muscles, nerves, and blood vessels[19]. The masticatory muscles which move the temporomandibular area are composed of the temporalis, masseter, medial pterygoid, and lateral pterygoid. These muscles enable mouth opening and-closing, lateral movement, and forward and backward movement[14], and excessive tension or imbalance of muscles can limit the joint movements, possibly resulting in limited ROM, a major symptom of TMD.

Özkan & Özkan[20] investigated and reported TMD symptoms including crepitus, disc displacement, and trigger points in the masticatory muscles. Among the symptoms, trigger points in the temporalis, masseter, medial pterygoid, and lateral pterygoid muscles were found to account for a high proportation symptoms. Trigger points occur due to the muscle contraction induced by prolonged excessive tension, and indicate the small segments within muscles, where tenderness on pressure and pain exist[21]. Pain is a factor that limits movement. Our results confirm that both the active and masticatory muscle relaxation exercises reduce pain and increase ROM up to the normal range as suggested by Friction & Shiffman[3]. Our results also confirm that both exercises are effective for pain[12] and limited ROM, suggesting that ROM increased because pain was reduced. The increase in ROM can be explained by the active exercise and the masticatory muscle relaxation exercise, which involve opening and closing movements, being effective at pain reduction. The major cause of TMD is known to be problems in the masticatory muscles[22]. This study also confirmed that limited ROM and pain, the main symptoms of TMD, stem from the masticatory muscles. This study found revealed that the masticatory muscle relaxation exercise resulred in a significantly greater reduction in pain than the active exercise. This outcome suggests that masticatory muscle relaxation exercises are a more effective intervention than active exercises for limited ROM and pain in TMD.

The deviation of the temporomandibular joint has been suggested to be the result of imbalance in the jaw-opening muscles, or the spasm of the jaw-opening muscles on the side opposite to the deviation[5]. In the present study,

there was no change in deviation after the active exercise, whereas a statistically significant decline in deviation was observed after the masticatory muscle relaxation exercise. Consequently, we consider that masticatory muscle relaxation exercises are effective for reducing the deviation of the temporomandibular joint, and that excessive tension in the masticatory muscles is the cause of the deviation.

In a previous study, Möller suggested that when the pain of masticatory muscles is reduced[23], the adjustment of relevant joints is enabledincreasing its/their stability. In the presenr study, a relatively larger reduction in occlusion was achieved through the masticatory muscle relaxation exercise, implying that masticatory muscle relaxation exercises are an effective intervention, even in the condition of deep bites.

Our results suggest that excessive tension in the masticatory muscles are a closely correlated with pain, deviation, and ROM of the temporomandibular joint. We consider the limited ROM and pain of TMD are triggered by excessive tension in the masticatory muscles, and thus, masticatory muscle relaxation exercises and active exercises can be effective interventions. The masticatory muscle relaxation exercise is static, and the active exercise is active. The reduction of tension in the masticatory muscles suggests that static exercise is a more effective treatment than active exercise. Therefore, masticatory muscle relaxation exercise is more effective than active exercise at reducing pain and improving ROM.

The masticatory muscle relaxation exercise resulted in a statistically significant decline in the deviation caused by unilateral problems in the joint as well. Moreover, this exercise gave positive results in occlusion as well. Therefore, the results suggest this exercise would be beneficial as a TMD interventional treatment in clinical practice. Our study results have limitations in that they can't be generalized to patients outside the age groups of the 20s and 30s, or to TMD involving lesions within the muscles. Thus, further research will be necessary to complement the present work.

REFERENCES

1) Mackowiak P: Relief of pain from headache and TMJ. New York: Manhattan Printing, 1989, pp 1–49.
2) Walker N, Bohanannon RW, Cameron D: Discriminant validity of temporomandibular joint range of motion measurement obtained with a ruler. J Orthop Sports Phys Ther, 2000, 30: 484–492. [Medline]
3) Fricton JR, Shiffman EL: The craniomandibular index: validity. J Prosthet Dent, 1987, 58: 222–228. [Medline] [CrossRef]
4) Scott B, Butterworth D, Lowe D, et al.: Factors associated with restricted mouth opening and its relationship to health-related quality of life in patients attending a maxillofacial oncology clinic. Oral Oncol, 2008, 44: 430–438. [Medline] [CrossRef]
5) Friedman MH, Weisberg J: Application of orthopedic principle in evaluation of the temporomandibular joint. Phys Ther, 1982, 62: 597–603. [Medline]
6) Buescher JJ: Temporomandibular joint disorder. Am Fam Physician, 2007, 76: 1477–1482. [Medline]
7) Epker J, Gatchel RJ, Ellis E: A model for predicting chronic TMD: practical application in clinical settings. J Am Dent Assoc, 1999, 130: 1470–1475. [Medline]
8) Dworkin SF, Huggins K, Willson L, et al.: A randomized clinical trial using research diagnostic criteria for temporomandibular disorders: axis I to target clinic case for a tailored self-care TMD program. J Orofac Pain, 2002, 6: 48–63.
9) Pierson MJ: Changes in temporomandibular joint dysfunction symptoms following massage therapy: a case report. Int J Ther Massage & bodywork, 2011, 4: 37–47.
10) Linde C, Isacsson Gf, Jonsson B: Outcome of 6-week treatment with transcutaneous electric nerve stimulation compared with splint on symptomatic TMJ disc displacement with reduction. Acla Odonlal Scand, 1995, 53: 92–98. [CrossRef]
11) Nicolakis P, Erdogmus CB, Kopf A, et al.: Effectiveness of exercise therapy in patients with internal derangement of the temporomandibular joint. J Oral Rehabil, 2001, 28: 1158–1164. [Medline] [CrossRef]
12) Nicolakis P, Erdogmus B, Kopf A, et al.: Exercise therapy for craniomendibular disorders. Arch Phys Med Rehabil, 2000, 81: 1137–1142. [Medline] [CrossRef]
13) Minagi S, Nizaki S, Sato T, et al.: A Manipulation technique for treatment of anterior disk displacement with reduction. J Prothet Dent, 1991, 65: 686–691. [Medline] [CrossRef]
14) Norkon CC, White DJ: Measurement of joint Motion: A guide to goniometry, 4th ed. Philadelphia: F.A. Davis company, 2009, pp 409–424.
15) Gottleb RJ, Lautar CJ: Temporomandibular joint dysfunction revisited: comprehensive treatment options. Access, 2001, 15: 48–54.
16) Uppgarrad RO: Taking control of TMJ: Your total wellness program for recovering from temporomandibular joint pain, whiplash, fibromyalgia, and related disorder. Oakland: New Harbinger Publication, 1999, pp 35–50.
17) How to cure TMJ with jaw exercise. http://www.wikihow.com/Cure-TMJ-with-Jaw-Exercises (Accessed Aug. 10, 2012).
18) Poveda Roda RP, Bagán JV, Fernández MD, et al.: Review of temporomandibular joint pathology. Part I: classification, epidemiology and risk factors. Med Oral Patol Oral Cir Bucal, 2007, 12: E292–E298. [Medline]
19) Temporomandibular joint dysfunction. Overview, assessment & treatment. http://www.claycox.net/rolfing_2.htm (Accessed Apr. 27, 2012).
20) Özkan NÇ, Özkan F: The relationship of temporomandibular disorders with headaches: a retrospective analysks. Agri, 2011, 23: 3–17.
21) Gunn CC: The Gunn Approach to the treatment of chronic pain: Intramuscular Stimulation for Myofascial Pain of Radiculopathic Origin, 2nd ed. Philadelphia: Churchill Livingstone, 1996, pp 51–65.
22) Goharian RK, Neff PA: Effect of occulsal retainer on temporomandibular joing and facial pain. J Prosthet Dent, 1980, 44: 206–208. [Medline] [CrossRef]
23) Möller E, Sheikholeslam A, Lous I: Response of elevator activity during mastication to treatment of functional disorders. Scand J Dent Res, 1984, 92: 64–83. [Medline] [CrossRef]