J Int Acad Phys Ther Res 2012; 3(2): 413-478
ISSN 2092-8475
www.iaptr.org
http://dx.doi.org/10.5854/JIAPTR.2012.10.30.475

Comparison on the Effects of Masseter Muscle Tension on Restricted Movement in the Temporomandibular Joint

The purpose of this study is to identify the level of masseter muscle tension according to the levels of restricted movement and pain in the temporo-mandibular joint(TMJ), thereby verifying the fact that excessive masseter muscle tension can be a cause for restricted movement and pain in the TMJ. The subjects of this study were 81 men and women in their 20s and 30s, who feel uncomfortable with their masticatory function on the preferred chewing side. The subjects were measured in terms of the range of motion (ROM) and deviation of the TMJ and the degree of pain in the affected region. The ROM and deviation of the TMJ were measured using the Global Posture System(GPS) after instructing each subject to open his/her mouth to the fullest and taking photos of the subject with a digital camera. The tension of the masseter muscle was measured with a Pressure Threshold Meter(PTM). After the measurements, in order to compare the ROM of the TMJ, the subjects were divided into two groups based on the ROM of above 35mm and below 35mm. For the deviation and pain, based on the average of total subjects, the subjects were divided into two groups of above and below average. Thereafter, the levels of masseter muscle tension were compared between each pair of groups. According to the results, when each variable was compared between the respective two groups, in terms of the deviation, the pressure pain threshold(PPT) of the masseter muscle revealed a statistically significant difference($p<.05$). However, the ROM and pain showed no statistically significant difference. Consequently, masseter muscle tension may cause restricted movement in the TMJ. In particular, the deviation and tension in the masseter muscle is considered to be a factor that causes deviation in the TMJ.

Key words: *Masseter Muscle; Temporomandibular Joint; ROM; Joint Deviation*

Young Sook Bae[a], Yong Nam Park[b]

[a]Gacheon University, Incheon; [b]Hu Nae Ri Therapeutic Education Center, Jeongseon-gun

Received : 13 June 2012
Accepted : 2 September 2012

Address for correspondence
Yong Nam Park, PT, MS
Hu Nae Ri Therapeutic Education Center, 6-8 Gatanaraenmal-gil, Sindong-eup, Jeongseon-gun, Gangwon-do, Korea
Tel: 82-33-563-1103
E-mail: till87@hanmail.net

INTRODUCTION

The Temporomandibular joint(TMJ) includes ligaments, muscles, nerves, and blood vessels. The muscles that move the TMJ consist of temporalis, masseter, medial pterygoid, and lateral pterygoid muscles. These muscles enable mouth opening-closing, lateral movement, forward and backward movements, and rotational movement(1). The TMJ is a unique bi-condylar joint involved in mastication and speech, and critical for normal mouth functions. While the mandible should move in alignment with the teeth, when the movement of the TMJ on one side becomes abnormal, the asymmetrical movement of the mouth being tilted to one side can occur when an individual opens the mouth(2). Restricted movements in the TMJ can occur due to the excessive activity of the muscles of mastication, external injuries, emotional stress, and malocclusion. These are reported to occur from a complex set of causes rather than one specific cause(3). Among them, the muscle tension resulting from the excessive activity of the muscles of mastication is considered to influence restricted movement in the TMJ. The degree of muscle tension can be measured in terms of the pressure pain threshold(PPT), and a higher degree of tension results in a lower PPT. Among the muscles of mastication, those that can be measured based on the PPT are masseter and temporalis muscles. The masseter muscle of healthy people is noted to have a lower pain threshold than the temporalis muscle(4).

In this background, this study intended to identify the level of masseter muscle tension according to the levels of restricted movement and pain in the TMJ, thereby suggesting that excessive masseter muscle tension can be a cause for restricted movement and pain in the TMJ.

METHODS

Subjects

The study subjects were 29 men and 52 women in their 20s and 30s, who feel uncomfortable with their masticatory function on the preferred chewing side. The subjects underwent the measurements of the ROM and deviation of the TMJ and the degree of pain in the affected region. In order to qualify for the subjects, the candidates had to have no orthopedic diseases such as external injuries or degenerative diseases and be under neither medication nor physical therapy. In addition, the individuals who understood the purpose of this study and were capable of understanding and complying with the testor's instructions were selected (Table 1).

Table 1. Characteristics of the subjects

Sex	Female	Male	All subjects
Age(year)	23.91±2.07	24.35±0.89	24.83±1.55
Weight(kg)	49.87±5.19	57.00±2.16	55.2±7.60
Height(cm)	161.36±4.36	170.3±1.25	164.15±5.28
Duration(month)	20.47±4.23	19.04±7.11	19.33±11.14
ROM(mm)	29.12±3.71	35.25±6.71	30.96±4.02
Deviation(°)	3.85±2.79	1.99±0.82	2.60±1.84
Pain	3.81±1.24	3.05±0.98	3.32±1.22

Procedures

Weight and height were measured for all subjects. Afterward, each subject completed the measurement of the ROM and deviation in the TMJ and the assessment of occlusion. Based on the results, the level of masseter muscle tension was quantified for all subjects. To measure the level of muscle tension, tenderness in the masseter muscle was recorded using a reliable and valid pressure threshold meter(PTM)(5). To measure the level of masseter muscle tension, the tester turned each patient's head to the left and right in the supine position and identified the side which the patient is uncomfortable with in the TMJ. After vertically placing a PTM on the belly of the patient's masseter muscle on the affected side, the tester gradually applied pressure on the belly, and then pressed for five seconds. At the moment when pain began, the tester paused and used the indicated pressure. The experiment was repeated three times at the pressure level of 0.2 lbs, and the average of the measured values was used for an analysis value. The measurement unit was kg/cm^2.

For the ROM and deviation of the TMJ, the tester instructed each subject to open his/her mouth to the fullest and took photos of the subject with a digital camera. Thereafter, the respective values were measured using the Global Posture System(GPS, Chinesport, Italy), a body alignment analysis program. To obtain the ROM, the gap between the median lines of the upper and lower teeth was measured. The measurement unit was mm. As for the deviation, the deviated angle derived from connecting the median lines of the upper and lower teeth was measured. To measure the degree of pain for the subjects, a visual analogue scale(VAS) was employed with 0 indicating no pain and 10 very severe pain. The duration was measured in terms of the duration for which the subject had discomfort in the TMJ.

After the measurements, given that the standard ROM of the TMJ when an individual functionally opens the mouth ranges from 35m to 40mm(6), the level of masseter muscle tension was compared by dividing the subjects into two ROM-based groups of above 35mm and below 35mm. For the deviation and pain, the subjects were divided into two groups based on the average of total subjects. Afterward, the level of masseter muscle tension was compared between each pair of groups.

Data Analysis

Statistical analyses were performed using SPSS (version 14) for Window(Spss Institute Korea, Seoul, Korea), and the variables were presented as the value of Mean±SD. In order to analyze the comparison of masseter tension in terms of the ROM, deviation and pain in the TMJ between the two groups, an independent t-test was conducted. The statistical significance level was set at $p<.05$.

RESULTS

After measuring the ROM, deviation, and pain of the TMJ in all subjects, the subjects were divided into two

groups for each variable. The ROM-based groups were divided based on the ROM of above 35mm and below 35mm, and the pain-based groups were divided based on the VAS of above 3 and below 3. According to the comparison of each pair of groups, the averages of each pair of groups showed a highly statistically significant difference($p<.01$). In terms of the deviation, the two groups divided based on above 2.6° and below 2.6° had a statistically significant difference($p<.05$).

When each variable was compared between the two respective groups, in terms of the deviation, the PPT of the masseter muscle showed a statistically significant difference($p<.05$). However, no statistically significant differences were observed in the ROM and pain.

The above results confirmed the fact that masseter muscle tension can become a factor that causes the deviation of the TMJ.

Table 2. Comparison on the PPT of the masseter muscle in terms of the ROM, deviation and pain

Group		Mean±SD	PPT(kg/cm²)
ROM(mm)	〉 35(n=53)	40.28±0.46	20.70±0.78
	〈 35(n=28)	30.00±0.36**	20.16±0.72
Deviation(°)	〉 2.6(n=48)	3.40±2.28	2.00±0.52
	〈 2.6(n=33)	1.82±0.90*	3.12±0.53**
Pain(score)	〉 3(n=51)	4.14±0.69	2.36±0.78
	〈 3(n=30)	2.16±0.74**	2.85±0.37

*p<.05, **p<.01 compared to the value in the inter-group
PPT; pressure pain threshold on the masseter muscle

DISCUSSION

Humans chew numerous times a day. The body part used during this activity is the TMJ. This joint is used about 1,500 to 2,000 times daily(7). As the TMJ works as the central axis of every jaw movement, it plays a highly important role in performing jaw functions such as chewing food and speaking. As this implies, the TMJ used with numerous repetitions daily also commonly causes functional impairment. Moreover, the functional impairment occurs in different manners according to gender and age. While the risk factors for temporomandibular joint dysfunction(TMD), in other words, pain and restricted movement in the TMJ, include gender and age, the dysfunction is mainly known to occur more frequently in the 15 to 45 age group and women over men(8). This study also had more female subjects with 59 people(73%) than male subjects, confirming that gender is a risk factor for restricted movement and, particularly, women have more cases of deviation than men.

In addition, the function of the masseter muscle that is involved in chewing also performs an important role. The masseter muscle is composed of three layers; superficial, middle, and deep layers. This muscle is engaged in the motions of lifting the jaw upward and sticking it forward, while its main function is chewing(9). The length of the muscle's insertion area can change in proportion to its movement. Moreover, the active tension resulting from excessive movements can be influenced by muscle stretching.

Active tension in the skeletal muscle is reported to be capable of shortening more than 50% of the muscle's optimal length(10). From this aspect, a high degree of active tension may result in a reduced level of stretching, which can cause functional restriction by influencing jaw movements. If such functional restriction continues, it can also cause problems due to the decline in ROM.

Van Eijden et al.(11) noted that when individuals open their mouth to the fullest, the length of the temporalis muscle increases about 80% and the length of the masseter muscle increases about 60%(12). Such a report may suggest that when the lengths of the temporalis and the masseter, which are the muscles that are activated during mouth closing, are increased appropriately during mouth opening, the normal ROM of the TMJ can be maintained. Therefore, if active tension is created on one side or both sides due to the excessive use of the masseter muscle, the muscle's length is shortened to less than 50% of its optimal length, which in turn can cause ROM restrictions during mouth opening.

Additionally, the masseter muscle with a three-layer structure is reported to be not stretched at regular levels when the madibular moves. For this reason, this muscle can influence the jaw movement in the ipsilateral area(13).

This means that the excessive tension of the masseter muscle on both sides can restrict the motion of opening the mouth. Moreover, excessive tension on the preferred chewing side can limit the movement to a specific side, which is likely to cause deviation. The above report shows similar findings to the present study. Therefore, the masseter muscle is likely to cause restricted movements. In particular, masseter muscle tension on one side is considered to be a factor that causes deviation.

CONCLUSION

The intent of this study was to identify the level of masseter muscle tension according to the levels of restricted movement and pain in the TMJ, and thereby suggest that excessive tension is a cause for restricted movement and pain in the TMJ.

For the subjects who have discomfort in the TMJ, the variables of ROM, pain, and deviation were measured, and the PPT of the masseter muscle was measured. After the measurements, for each variable, the subjects were divided into two groups, and then the PPT of the masseter muscle was compared. As a result, no differences were found in the ROM and pain, whereas a statistically significant difference was detected in the deviation.

The above results confirmed the fact that masseter muscle tension can become a factor that causes the deviation of the TMJ. Furthermore, the excessive tension of the masseter muscle on one side is considered to have a greater influence on the deviation rather than the ROM and pain.

However, this study has the limitation that it was conducted on the subjects in their 20s and 30s, and thus cannot be applied to other age groups. Moreover, while the TMJ is a bicondylar joint, the present study only obtained the measurement results of the masseter muscle on one side. Therefore, follow-up studies will be necessary to compensate for the current limitations.

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