# The effect of occlusal splint treatment on the temporomandibular joint dysfunction patient

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## ABSTRACT

Pain is the most common complaint that is often seen in temporomandibular joint dysfunction patients. The pain complaints generally originated from the muscle spasm due to masticatory muscle hiperactivity which is one of the main causes of the temporomandibular joint dysfunction. The muscle spasm can be detected by using Electromyography (EMG) technique. EMG is an equipment used to study electrical potential changes by using electrodes placed or inserted into the skeletal muscle. The research was performed to 9 temporomandibular joint dysfunction patients at the Prosthodontic Specialist Clinic of the Faculty of Dentistry Universitas Padjadjaran Bandung who had been treated by occlusal splint. In this research, the EMG measurement was performed using the surface electrodes before and after wearing occlusal splint for 2 weeks. The measurement that was performed at the Electro Biomedical Laboratory ITB is aimed at revealing and comparing the changes in the amount of contraction activities in the superficial masseter and anterior temporal muscles. The test results show that there is a statistically significant decrease in the contraction activities of the masticatory muscles after 2 week of wearing occlusal splint. In addition, there is also a correlation between the decrease in the electromyogram descriptive value in the masticatory muscles and the decrease in the temporomandibular joint dysfunction symptoms. Therefore, electromyography technique can be applied as an alternative measurement method that is objective and reliable in diagnosing temporomandibular joint dysfunction.

**Key words:** Electromyography, masticatory muscle byperactivity, *occlusal splint, temporomandibular* joint dysfunction

## INTRODUCTION

The stomatognathic system is a functional unit that performs masticatory tasks such as swallowing food, speaking and esthetics. This system includes teeth, supporting tissues, masticatory muscles, nervous system, blood circulation, ligaments, temporomandibular joint

(TMJ), lips, cheeks, palates, and tongue.[1] In other words, the stomatognathy system consists of three main components, i.e. TMJ components, masticatory muscles, and dental occlusion. These components are interrelated and coordinated by the central nervous system. If one of the components is abnormal, the stomatognathic system will not be able to do its function well.

TMJ dysfunction is a well known chronical orofacial pain often seen by dentists and other health care workers. Pain is one of the most common complaint seen among TMJ dysfunction patients. The pain is commonly originated from TMJ and masticatory muscle dysfunctions.[2]

According to Laskin[3], the observation shows that the pain complained by patients is mostly originated from masticatory muscle hyperactivity. Shi[4] suggested from his experimental and clinical findings that muscle hyperactivity is the main cause of TMJ dysfunction. The diagnosis is made based on the existence of pain and masticatory muscle tenderness as well as TMJ tenderness, clicking, deviation, limited jaw movement and rigidity in shoulder, neck, and head muscles.

Besides the main symptoms, there are also some additional symptoms such as headache, ear complaints that include hearing disturbance, tininus, ear pain and sinus pain as well as rigidity in neck and head muscles. The additional symptoms often make patients seek for treatment from the wrong medical providers. They go to the neurologist, ENT, or other specialists. The concern and confusion usually occur when patients feel that their effort does not bring any positive improvement.[5]

It is reported that the increasing prevalence of TMJ dysfunction is observed, especially in developing countries. TMJ dysfunction can attack people in any age, although those who are under 40 years old is more susceptible. This disorder is seen more often in women than men with a comparison of 4:1.[6] According to a research conducted by Mardjono[1], the TMJ disfuction prevalence among adults in Jakarta is 79.3%. Based on the results of Ai and Yamashita[2], from 254 patients with any facial pain and mandibular disorder complaints, 210 patients are identified and diagnosed as having TMJ dysfunction. Of all those patients, 90% experience tenderness in the masticatory muscles.

There are various methods for TMJ dysfunction examination that have been used including palpation, visualization, auscultation and radiology methods. Based on the information above that stated that TMJ dysfunction correlates with muscle activities, an instrument to record related muscle electrical activities, namely Electromyography (EMG), is needed.

In EMG examination, there is an increase in muscle electrical activities on the side that shows symptoms. EMG is an instrument that is used to study changes in the electrical potentials by using electrodes that is applied or inserted into the skeletal muscle.[7] EMG recording will describe muscle electrical activities and give information on the strength of the muscle contraction when the muscles contract isometrically or in the occlusion position.[8,9] The isometric contraction is found in a strong bite and in this kind of contraction there is no change observed in terms of muscle length.

EMG is an alternative measurement method that is objective and reliable. EMG can help evaluating patients objectively to determine whether they have TMJ dysfunction or not. According to Mohl et.al.[10], EMG examination on masticatory muscles can be used routinely as a part of TMJ dysfunction diagnosis and treatment step. Ramjford and Ash[11] stated that EMG can be used as an examination instrument to observe and measure masticatory muscle hyperactivity. Based on the existing statements, the use of EMG is aimed at observing the asymmetrical patterns in muscle activities in the form of increased contraction that usually occurs simultaneously with TMJ dysfunction to help evaluating patients objectively before and after treatment.[10]

There are a lot of experts that have written about TMJ dysfunction treatment. The data shows that the effectivity splint is more apparent compared to other therapies. According to Okeson[12], the function of splint is to reduce muscle activities caused by parafunction while Kaplan and Assael[13] wrote about the functions of occlusal splint that include eliminating occlusion disorder, stabilizing teeth and joint relationship, relaxing muscles, eliminating parafunction, protecting teeth from abrassion and reducing TMJ load. The TMJ dysfunction patients who visit the Prosthodontic Specialist Clinic of Faculty of Dentistry, UNPAD, receive treatment using occlusal splint to eliminate the complaints. Okeson[12] wrote that the effectivity of splint in reducing TMJ dysfunction symptoms is 70-90%.

Based on the above information, the writer performed a research to TMJ dysfunction patients before and after using occlusal splint for 2 weeks by using surface EMG to interpret superficial masticatory muscle contraction activities in masseter and anterior temporal muscles during maximum bite at intercuspation. Superficial masseter and anterior temporal muscles are selected because those muscles function as elevator muscles that play significant role in maximum bite. It is expected that the results of this research will contribute to the knowledge and technology in stomatognathy field and dentistry field in Indonesia.

## MATERIALS AND METHOD

This research is a quasi experimental study using surface EMG. From this method, information on EMG descriptive changes in recording both side superficial masseter and anterior temporal muscles activities during maximum bite in intercuspation position before and after using occlusal splint for 2 weeks is collected. The population in this study consists of patients or people who have temporomandibular dysfunction symptoms who visit Prosthodontic Specialist Clinic of the Faculty of Dentistry, UNPAD, during the period of June 2006 to December 2006.

The sample size of the study consists of 9 persons or patients (7 women and 2 men). The sampling technique used is the purposive sampling with the folowing consideration: (1) Adult, 17-40 years old, men and women; (2) Have complete dentition or lost only one tooth; (3) Have never used occlusal splint; (4) Have never joined physiotherapy; (5) Have a normal physical posture; (6) No growth and development abnormalities; (7) No external trauma, infection, tumor, etc; (8) Willing to participate as sample in this study; and (9) patient who experience at least three of the temporomandibular joint dysfunction symptoms according to the following criteria:[9] pain and/or tenderness in some of the masticatory muscles, temporomandibular pain, facial pain, head pain, joint pain when opening mouth widely, deviation, restriction in opening and movement of the mouth, and clicking.

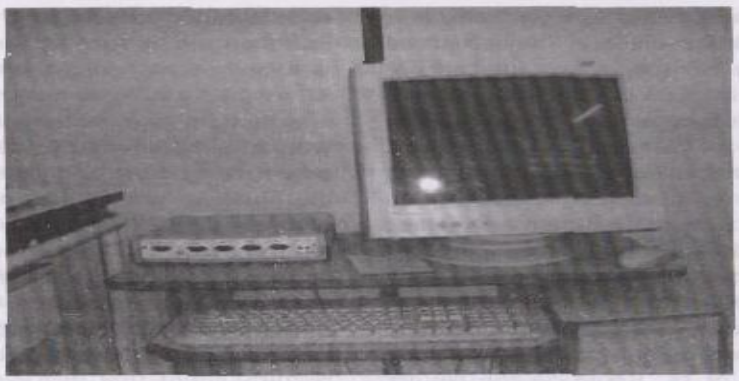

Figure 1. EMG BIOPAC computer system PC under Windows monitor & 98 devices

Figure 2. Electrode installation and EMG examination in patient
Left: EMG examination of superficial maseter muscle, Right: EMG examination of anterior temporalis muscle

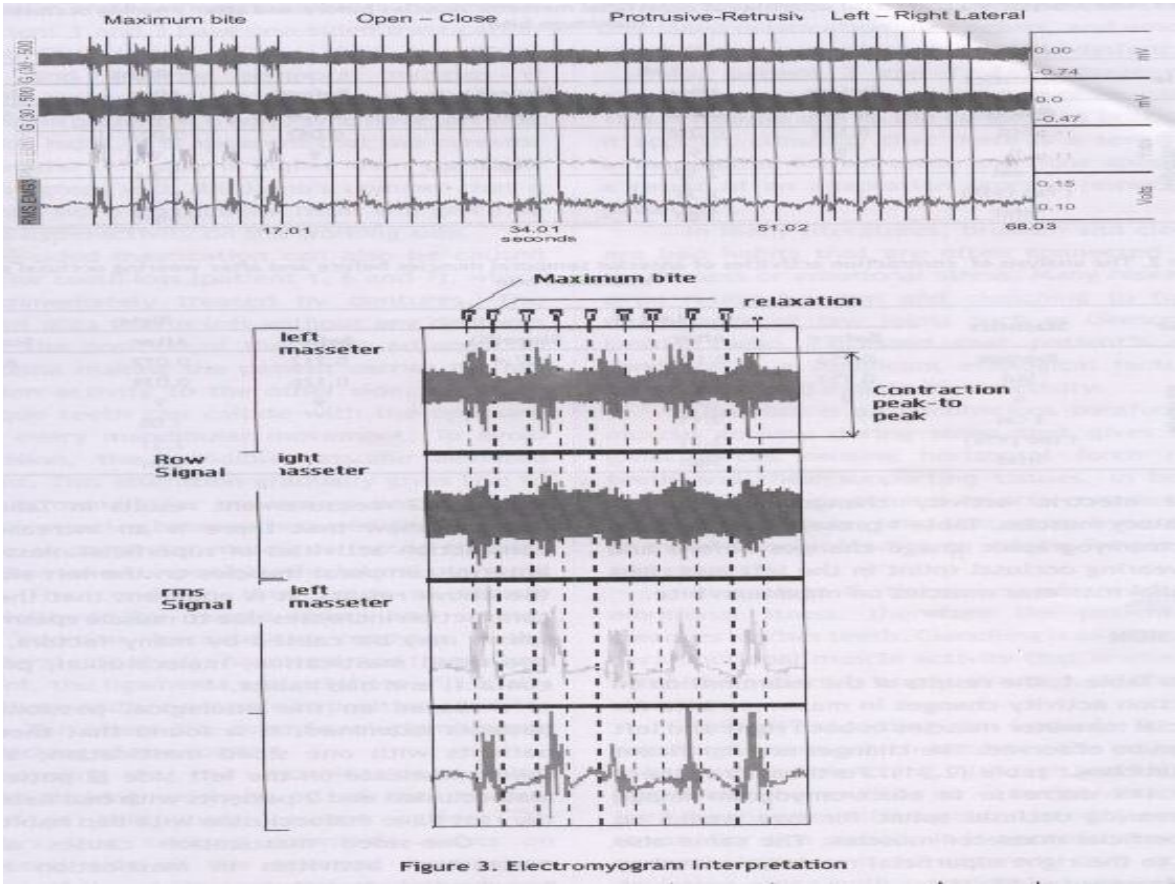

Figure 3. Electromyogram Interpretation

**RESULT**

EMG examination on superficial masseter and anterior temporal muscles was done on the right and left side by asking the patient to move the muscles with maximum intercuspation (isometric contraction) four times in each muscle using volt unit.

The data are then calculated statistically, such as: average value and standard deviation (std), and activity changes of muscle contraction before and after wearing splint for 2 weeks, as shown in Table 1 and Table 2. Those tables also show examination result with t statistic, to observe electric activity changes in four of masticatory muscles. Table 1 presents the analysis of electromyographic image changes before and after wearing occlusal splint in the left and right superficial masseter muscles on maximum bite.

Table 1. The analysis of contraction activities of superficial masseter muscles before and after wearing occlusal splint on maximum bite

| Muscle | Statistics | Left | | | Right | | |
|---|---|---|---|---|---|---|---|
| | | Before | After | Slope(%) | Before | After | Slope(%) |
| Maseter superfisial | Average | 0.150 | 0.080 | 49.41 | 0.134 | 0.061 | 55.28 |
| | Std | 0.128 | 0.046 | | 0.082 | 0.023 | |
| | n | 9 | 9 | | 9 | 9 | |
| | t cal | | 2.57 | | | 2.64 | |
| | t tab (95%) | | 2.31 | | | 2.31 | |
| | Sifat | | Sign | | | Sign | |

Table 2. The analysis of contraction activities of anterior temporal muscles before and after wearing occlusal splint on maximum bite

| Muscle | Statistics | Left | | | Right | | |
|---|---|---|---|---|---|---|---|
| | | Before | After | Slope(%) | Before | After | Slope(%) |
| Temporalis Anterior | Average | 0.253 | 0.112 | 57.4 | 0.212 | 0.077 | 63.56 |
| | Std | 0.153 | 0.068 | | 0.126 | 0.039 | |
| | n | 9 | 9 | | 9 | 9 | |
| | t cal | | 3.11 | | | 3.08 | |
| | t tab (95%) | | 2.31 | | | 2.31 | |
| | Sifat | | Sign | | | Sign | |

## DISCUSSION

In Table 1, the results of the examination on contraction activity changes in maximum bite for superficial masseter muscles in both right and left sides can be observed. The changes are significant t calculation > t table (2,31). Furthermore, there is a 49.41% decrease in electromyogram image after wearing occlusal splint for two weeks on left superficial masseter muscles. The same also applies to the right superficial masseter muscles, with a decrease of 55.28%.

In Table 2, the results from the examination of contraction activity changes in maximum bite for anterior temporal muscles in both right and left side can be observed. The changes are significant with t calculation > t table (2,31). Furthermore, there is a 57.4% decrease in electromyogram image after wearing occlusal splint for two weeks on left anterior temporal muscles. The same also applies to the right anterior temporal muscles, with the decrease of 63.56%. EMG measurement results in Table 1 and Table 2 show that there is an increase in the contraction activities of superficial masseter and anterior temporal muscles on the left side. From the above results, it is apparent that the muscle contraction increases due to muscle spasm. Muscle spasm may be caused by many factors, such as one sided mastication, malocclusion, premature contact, and bad habits.[1,12]

Based on the etiological possibility of 9 patients examined, it is found that there are 5 patients with one sided mastication, and 3 of them masticate on the left side (2 patients with malocclusion and 2 patients with bad habits), and the rest have malocclusion with bad habits.

One-sided mastication causes abnormal contraction activities in mastication muscles, because there is imbalance between the two sides of jaws. Superficial masseter muscles in the working side are more active than the superficial masseter in the non working side. In addition, the activities of temporal muscles in working side exceed those in the non working side. Based on that fact, to reach an optimum masticatory efficiency, it is necessary to compensate the heavier activities of the muscles in the working side. If the activities gradually exceed muscle physiological tolerance, the muscles will experience fatigue leading to dysfunction monitored by surface EMG, before and after wearing occlusal splint.

Of the 9 patients examined, all of them complained of a dull pain when opening the mouth widely and during mastication. After wearing occlusal splint for 2 weeks, 6 patients said that they did not feel pain after wearing the splint, and the rest said that they felt their pain decreased. Thfs agrees with Pertes[17], who said that occlusal splint is usually believed to decrease the loads on joint structure, and can reduce the severity. The decrease of joint loads can also reduce muscle hyperactivity. Therefore, occlusal splint can greatly assist in reducing temporomandibular join pain.

From the observation of 9 patients, during mouth opening, 4 patients (patient 3,4,5 and 8) experience vertical movement restriction (trismus) with a distance of less than 30 mm. However, it is still possible to make impression in those patients. They stated that they feel stiffness and difficulty in opening the mouth in the morning. Muscle fatigue factor is the strongest suspicion. After wearing occlusal splint for 2 weeks, all complaints disappear.

Besides vertical restriction, there is also a bias/deviation in horizontal mandibular line (except in patient 5). This kind of bias can be detected by observing the position of mandibular midline against the upper facial midline during mouth opening and closing. If both midlines are steady in a perpendicular plane, it means the line is normal. This bias often exists in unilaterally or bilaterally (left and right), so the line will be in a "zig-zag" form.[1] After wearing splint for 2 weeks, patient 1 and 9 feel that the symptoms disappear. Beside wearing splint, it is also necessary to train patients to assume a normal line.

The anterior temporal muscle contraction activities before wearing occlusal splint seems to be strongest in cases where headache is the most common symptoms in the temporomandibular joint dysfunction. The headache caused by the muscle tissue is referred as muscle tension headache. From 9 patients who experience chronic pain and chronic headache and after wearing occlusal splint for 2 weeks, 5 of them are healed and the other four experience reduced symptoms. The EMG results after the occlusal splint is worn for 2 weeks also show a significant reduction.

Most patients experience stiffness on the shoulders and neck. On palpation, the trapezius muscle is shown as experiencing spasm and discomfort. The muscles in the shoulder and neck areas that are easy to palpate are sternocleidomastoid and trapezius muscles. Those muscles are not the main muscles in mandibular movement but they have an important role in mandibular function.[3] According to McNeill et al.[18], this disorder is often found in the neck and head area. It is estimated that^ around 40% of the temporomandibular joint dysfunction cases are chronic. After wearing occlusal splint for 2 weeks, most of patients experience reduced pain and masticatory muscle and temporomandibular joint tenderness. They also experience less jaw movement restriction and shoulder, neck and head muscle stiffness. Only a small change is observed for clicking and jaw deviation because these abnormalities also need physical training in addition to the occlusal splint. In 3 patients, the stiffness on the shoulder area does not show much improvement so they need to receive physiotherapy treatment to ease the stiffness.

The accuracy and the precision of the masticatory muscle EMG measurement and recording results can be affected by several factors such as the skill and accuracy of the observation, the movement velocity of each patient, and the tiredness of the operator's eyes.

Another factor that may cause the difference in the study results is the technical factor or other uncontrollable variables during the study. The shift in electrode position or the inappropriate electrode position caused by patient's hair position may make the electrodes unable to record anterior temporal muscle electrical activity precisely and accurately. In addition, patients' misunderstanding or unclear explanation from the operator in terms of study protocols as well as limited sample size may also affect the results of the study.

This study also shows that electromyography can be used as a valid and accurate recording method for masticatory muscle contractions that can be applied in the clinical setting.

## CONCLUSION

Electromyography can be applied as an additional instrument in diagnosis to observe and measure masticatory muscle hyperactivity and to help evaluating patients objectively before and after treatment. The statistical test results on left and right superficial masseter and anterior temporal muscle contraction activity changes show a significant reduction after occlusal splint treatment. This means that wearing occlusal splint for two weeks in patients with temporomandibular dysfunction will lead to better improvement. From the study results,

it is evident that after wearing occlusal splint the symptoms of temporomandibular dysfunctions, especially head pain, joint pain, tinnitus and trismus, are reduced.

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