Surface Electromyography Reveal Association between Masticatory Muscles with Malocclusion Class I And Class III Skeletal in Javanese Ethnic Patient

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Abstract

Malocclusion can be caused by dentocraniofacial growth abnormalities. These growth abnormalities can be caused by dental, maxillary and/or mandibular conditions (skeletal), a combination of dental and jaw (dentoskeletal). Many factors can influence this growth, including the result of genetic, congenital and environmental. One example that plays an important role is the role of soft tissue or muscles. Aim: To investigate the association between masticatory muscle tone and dental and malocclusion class I and class III skeletal in Javanese ethnic patients.

This study was analytical observational study with cross sectional and total sampling method in Orthodontics Clinic, Faculty of Dental Medicine, Universitas Airlangga Surabaya. In this study, there were 18 patients with class I or malocclusion class III skeletal malocclusion with an age range of 18-21 years in both sexes. Measurement of muscle tone in patients with class I and class III skeletal malocclusion using a surface electromyography on the temporalis, masseter and suprahyoid muscles. The correlation test between masticatory muscle tone and dental and skeletal malocclusions was analyzed using spearman's analysis ($p>0.05$).

It was found that the muscles that significantly affected the malocclusion were the right temporalis muscle, left temporalis muscle, right masseter muscle, left suprahyoid muscle, and right suprahoyid muscle. There was a strong relationship between suprahyoid muscle tone and class III malocclusion ($p>0.05$).

Weak suprahyoid muscle activity affects mandibular growth and can be one of the causes of malocclusion class III skeletal.

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Introduction

Ideal occlusion is a condition where the teeth are properly and neatly located in the correct arch and harmonious relationship is obtained between the upper and lower jaw.[1] Thus, malocclusion can be interpreted as a deviation in the position of the teeth in the dental arch beyond the standard limits that can interfere with aesthetics, masticatory function, swallowing, speech and facial harmony which can be caused by dentocraniofacial growth abnormalities.[2] These growth abnormalities can be caused by dental, maxillary and/or mandibular conditions (skeletal), a combination of dental and jaw (dentoskeletal). Many factors can influence this growth, including the result of genetic, congenital and environmental.[3,4]

Genetic factors can cause malocclusion due to the nature of parents that can be passed on to their children where it does not always lead to harmony. For example, there is an inharmonious relationship between the jaws and teeth due to the disproportion of tooth size and jaw size.[5] In addition, environmental factors can affect growth which also has an effect on malocclusion.[6] An example is the existence of bad habits experienced or carried out by patients during the growth period. If this habit continues until the end of the eruption of permanent teeth

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and at the end of the growth period, then malocclusion can occur or even be more severe. Santos et al. (2012) stated that the habit of sucking pacifiers or sucking fingers resulted in a high prevalence of malocclusion.[7] Grippaudo et al. (2016) also found that mouth breathing was closely related to changes in craniofacial growth patterns which resulted in increased overjet, decreased overjet, anterior or posterior crossbite, open bite and displacement of contact points.[8]

The balanced development of dentofacial structure also affected by the function of the muscles around the mouth. Muscles are important factor that can affect the occurrence of malocclusion. There are several types of masticatory muscles in the mouth area, such as masseter, temporal, medial pterygoid, the muscles of the tongue, buccinator, and orbicularis oris. These muscles in addition to influencing the facial structure, can also play a role in determining tooth position and malocclusion.[9,10] Muscle activity that takes place continuously can be represented by muscle tone. Muscle tone is the electrical activity of muscles and if there is impaired function of the muscles of mastication, the presence or absence of muscle tone can describe this condition. Through electromyograph, masseter muscle tone activity plays a very big role in class II malocclusion. Electromyography is a instrument that is often used to evaluate the function and efficiency of muscles and nerves by recording the electrical potential activity generated by skeletal muscles.[11]

Class III malocclusion, which is usually characterized by a concave profile, can be caused by developmental abnormalities in the maxilla, mandible, or a combination of both.[12,13] In the research of Hartanti et al (2013) it was found that there was a linear change in the position of the mandible which became more backward and downward in class III malocclusion.[14] In the pseudo-class III skeletal malocclusion, there is no genetic factor, but it is caused by a muscular factor, namely mandibular displacement due to local factors causing an anterior crossbite, while in true class III skeletal malocclusion it is strongly influenced by genetic factors.[15]

The success rate of orthodontic treatment depends on the ability of the operator, namely the orthodontist, to analyze the diagnosis and determine the appropriate treatment. In addition, knowing the etiology of malocclusion also plays an important role. Because the cause of malocclusion can be eliminated properly, especially if the cause is still there until treatment takes place.[6] The general aim of this study was to determine the relationship between masticatory muscle tone and dental and skeletal malocclusions in class I and class III in Javanese patients.

Materials and methods

Study Design

This study is an analytic observational study with a cross-sectional model. The design of this study was to compare the orthodontic treatment group with the control group. The study protocol was approved by ethical clearance for human subject study of the Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia with appointment number 773/ HRECC. FODM / XII / 2019 and Ethical Clearance Committee of Dr. Soetomo General Academic Hospital, Surabaya, East Java, Indonesia with number: 1767/KEPK/I/2020. Also, all of the samples has filled the written informed consent form before undergo the examination.

Sampling Criteria

The sample population of this study were Javanese patients with an age range of 18-21 years, male and female, who were undergoing orthodontic treatment at Dental Hospital, Universitas Airlangga, Surabaya. There were 9 class I patients and 9 class III patients. Inclusion criteria were Angle class I and III malocclusions who had never done any orthodontics treatment before full permanent dentitions. The exclusion criteria are Class II Angle's malocclusion, patient with oral bad habits such as tongue thrust swallowing, mouth breathing, lip biting, thumb sucking; supernumerary teeth, Cleft Lip and Palate. The group, based on Angle's malocclusion classification, then divided into Class I (ANB: 0-4º) and Class III malocclusion group (ANB<0º) based on cephalometric radiography (Figure 1). The cephalometry was traced using the Orthovision™ digital program.

Masticatory Muscle Activity Measurement

Measurement of muscle tone was performed using Surface electromyography (Enraf-Nonius Myomed 632X). The first step is to use an alcohol swab, the area where the electrode will be installed is cleaned and dried

using a tissue. The red electrode is the anode (+) which is attached to the origin of the muscle, then the black electrode is the cathode (-) which is placed at the insertion of the muscle. And put the ground electrode on the clavicle bone. Subjects were instructed in a calm position, hands placed on the thighs, feet on the ground/head flat footing in an upright position and the Frankfurt Horizontal (FH) line parallel to the floor. On examination of the temporal and masseter muscles the subject was instructed to clench for 5 seconds then rest for 5 seconds, this cycle was repeated for 5 times and lasted for 50 seconds. In the suprahyoid muscle the subject was instructed to open his mouth wide for 5 seconds, then rest for 5 seconds, this cycle was repeated 5 times for a total of 50 seconds.[11]

Statistical Analysis

All data obtained were examined by averages of Statistical Package for Social Science (SPSS) 23.0 version (IBM Corporation, Illinois, Chicago, US). Mann-Whitney test was done to examine the significant difference between groups ($p<0.05$).

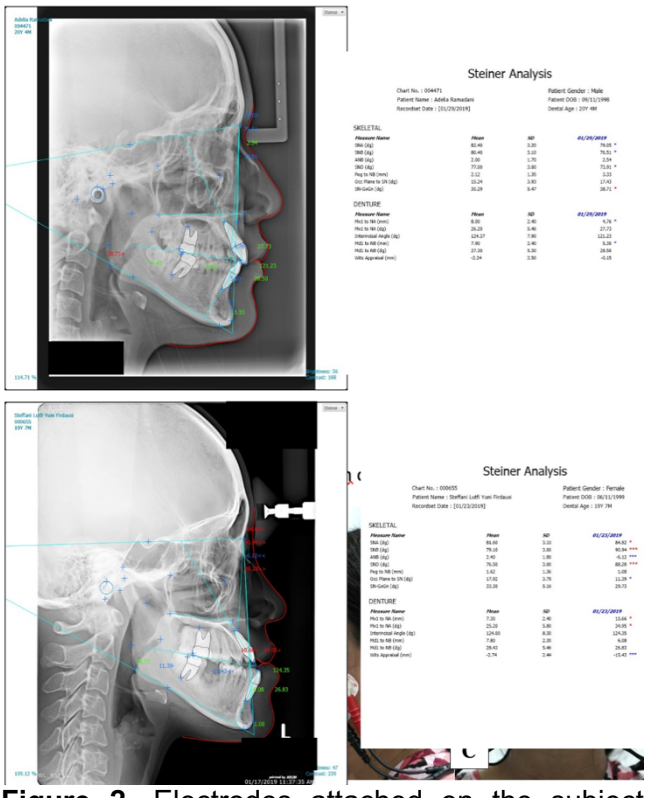

Figure 2. Electrodes attached on the subject during examination of the temporal (A), masseter (B), and suprahyoid (C) muscles.

Results

Clinical results showed muscle activity in class III malocclusion was greater than in class I, except for the left temporalis muscle and both sides of the suprahyoid muscle. There was significant different in muscle tone of temporalis right muscle, masseter right muscle suprahyoid left muscle and suprahyoid right muscle in malocclusion class I and III skeletal (Table 1).

Muscle and Malocclusion Classification		N	Mean	Std. Deviation	P value
Temporalis right	Class I	9	20.0333	8.71651	<0.001*
	Class III	9	92.3778	30.62551	
Temporalis left	Class I	9	59.1111	34.72893	0.145
	Class III	9	33.9000	14.01401	
Masseter right	Class I	9	41.7333	21.76408	<0.007*
	Class III	9	82.6111	25.75929	
Masseter left	Class I	9	45.8667	26.53794	0.121
	Class III	9	64.0222	19.28580	
Suprahyoid right	Class I	9	96.0556	26.18359	<0.001*
	Class III	9	30.7111	13.93211	
Suprahyoid left	Class I	9	70.2111	7.23005	<0.001*
	Class III	9	27.5000	12.39042	

Table 1. Mann-Whitney test result in the masticatory muscle activity of malocclusion class I and class III skeletal in Javanese ethnic patients.
Note: Significant difference with P-value <0.05.

Discussion

In determining orthodontic treatment, aside from making a good diagnosis, it is important to consider the etiology of malocclusion. One of which is abnormalities in masticatory muscle activity. Previous studies on the relationship between muscle activity around the mouth and malocclusion have been conducted and have shown a relationship between orofacial muscles tone and malocclusion class I and II .[11] This is because the normal development of the dentofacial area depends on the normal function of the muscles around the mouth. The imbalance between the orofacial muscles will affect the development of the dentofacial structure.[9,15]

In this study, there was a significant relationship between muscle activity and class I and III malocclusions in the right temporalis muscle, right masseter, and right and left suprahyoid muscles. Where there is a large value in the class III temporalis dextra and sinistra muscles when compared to class I. In addition, both sides of the suprahyoid muscle in class III have a smaller value when compared to class I.

In the temporalis and masseter muscles obtained a large value on one side, namely the right side. The masseter and temporalis muscles are important muscles of mastication because they act on the functions of elevation, proclination, and retraction of the mandible.[16] So when it is related to these results, it can be seen that there is a habit of chewing on one side which results in higher muscle activity on that side than the side that is less used in the chewing function.[17] This is also supported by studies that conducted by Bakke (1993) which states that having the habit of chewing on one side can result in a large muscle bulge on only one side.[18] Furthermore, several studies also found that the masseter muscle in class III plays a role in mandibular development and does not always have a balanced activity.[19-22] This condition can occur due to incoordination of muscle function, occlusal interference, individual habits, and asymmetric interference.[23,24]

In addition, on both sides of the class III suprahyoid muscle values were obtained that were smaller than those of class I. This is in accordance with the research conducted by Petrović et al. (2014) which stated that there was a relationship between class III dental malocclusion and masticatory muscle activity as seen from the weak muscle tone in class III malocclusion.[24] In general, the function of the suprahyoid muscle is to help lift the hyoid bone up and help open the mouth in extremes such as yawning or biting food.[25] If this is related to the results of the study, it is found that the small activity of the suprahyoid muscle indicates a lack of function and use so that it can affect the growth of the mandible. In this study, the activity of the suprahyoid muscle in class III malocclusion is lower than that of class I, so it can be concluded that the relationship between suprahyoid muscle activity in moving the mandible is low.

When looking at the results of muscle measurements without looking at the significance value, the masseter muscle on both sides in class III has a greater value than class I. This is in accordance with Gomes (2008) who found that the masseter muscle in class III plays a role in mandibular development which has an effect on on the increase in the angle of the mandibular plane, ANB, posterior and anterior height, and affect the degree of retrusion or protrusion of the mandible.[26]

The amount of tone in the masticatory muscle can be influenced by teeth that are not located in the correct arch which affects muscle strength, especially if the surface of the tooth involved is abrasion.[16,27] Good tooth contact and maintained occlusal stability will maintain good orofacial muscle tone.[17] The limitation of this study is the sample size that still relatively small, it was only examined the masticatory muscle activity in 18 patients in total of malocclusions class I and III Javanese ethnicity. In the future, it would be better to distinguish the difference role of masticatory muscle and identified their difference in both gender.

Conclusions

Statistically it showed that there was a significant difference in muscle activity between class I and class III malocclusions in the right temporalis, right masseter, right and left suprahyoid muscle. It was also found that the suprahyoid muscle tone in skeletal malocclusion class III has the weakest muscle activity measurement results. From this examination of these muscles, it is hoped that the orthodontist can make a more precise treatment plan.

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Declaration of Interest

The author declare there is no conflict of interest in this study

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