

The Influence of Masseter Muscle Size on Occlusal Plane in Dentulous Subjects- An Ultrasonographic Study

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Abstract

Purpose: The main objective of this study was to assess the relationship between the masseter muscle thicknesses ultrasonically and its influence on orientation of occlusal plane to ala tragus line radiographically in dentulous subjects.

Materials and methods: 20 subjects fulfilling the inclusion criteria of 1) Angle's class 1 occlusion 2) No history of any orthodontic treatment 3) No missing teeth except for third molars 4) No neuromuscular and TMJ disorders were selected for this study. With the approval of the institutional review board, lateral cephalograms of the face and ultrasonogram of the masseter muscle was done on the subjects. Frankfurts horizontal plane, ala tragus line (superior, middle and inferior) and occlusal plane was traced on the lateral cephalograms. Masseter muscle thickness of all the subjects was measured bilaterally by the ultrasonogram and the average value obtained from the bilateral reading was taken as the thickness of the individual. These readings were compared with the orientation of occlusal plane with the ala tragus

line of that subject. The obtained readings were tabulated. Karl Pearson correlation analysis was performed to find out relationship between occlusal plane orientation with the ala tragus line and masseter muscle thickness.

Results: A statistically significant relationship couldn't be found between any of the variables. Occlusal plane coincided with lower ala tragus line in subjects with thick masseter muscle.

Conclusion: The findings of this study indicate that the masseter muscle thickness has an influence on the occlusal plane and its orientation in relation to the ala tragus line.

Keywords: Campers plane, Ala Tragus line, masseter muscle, jaw relations, complete dentures

Introduction

Masticatory muscles form a part of the stomatognathic system and they play a very important role in the growth and shaping of the jaws. Melvin Moss functional matrix theory states that, "a bone is grown and remodelled under the influence of the surrounding musculature."¹ Consistent with this fact, few studies have shown the relation of masseter muscle to various craniofacial structures,

including jaws.^{2,3,4} Such a relation to jaws might have an influence on the occlusal plane.

Occlusal plane is the average plane established by the incisal and occlusal surfaces of the teeth.⁵ Orientation of occlusal plane is of utmost importance during fabrication of complete dentures as it will help the dentures to work in harmony with the surrounding stomatognathic system for aesthetic appearance⁶ and also for achieving occlusal balance.⁷ Lack of occlusal plane orientation in complete dentures might lead to problems like tongue & cheek biting, unstable denture bases, accumulation of food in buccal and lingual sulci⁸ and ultimately temporomandibular joint disturbances.

Till date, various methods of orienting the occlusal plane in complete denture fabrication have been suggested. Some of them are, orientation following anatomic landmarks like buccinators groove,⁹ lateral margins of the tongue,¹⁰ upper lip, corners of mouth,¹¹ placing the occlusal plane parallel and exactly in the middle of the residual alveolar ridges,¹² positioning it halfway between the maxillary and mandibular ridges parallel to the Frankfort plane;¹³ positioning it based on the relative size and shape of maxillary and mandibular arches,¹⁴ orienting the occlusal plane posteriorly to two thirds the height of retromolar pad;¹⁵ using parotid papillae to determine the occlusal plane;¹⁶ orienting the occlusion plane to ala tragus line posteriorly and interpupillary line anteriorly;¹¹ orientation along hamular notch incisive papillae plane;¹⁷ and even cephalometric landmarks have been used in orienting the occlusal plane.¹⁸

Orienting the occlusal plane to ala-tragus line is the most commonly followed method amongst all.⁶ Ala tragus line or camper's line is a line running from the inferior border of the ala of the nose to some defined point on the tragus of the ear, usually considered to be the tip of the tragus.⁵ However, there is lack of clarity as to which part of the

tragus has to be taken into consideration for Camper's line. Different authors have put forward conflicting opinions; Zarb & Bolender⁹ did not specify about the tragus level, Boucher,¹⁹ Lloyd,²⁰ Anthony²¹ and Miller²² suggested following the superior part of the tragus. Authors like Ismail and Bowman²³ suggested using the middle part of tragus. Some authors have also suggested the use of inferior part of tragus.^{24,25} This confusion suggests a need to develop a standard reference point on the tragus of the ear for drawing Camper's line in order to orient the occlusal plane.

In the wake of knowledge that masticatory muscles might have an influence on craniofacial structures, an attempt was made in this study for the first time to examine the role of masseter muscle thickness in the orientation of occlusal plane to Camper's line in dentulous subjects. The main objective of this study was to assess the relationship between the masseter muscle thickness ultrasonically and its influence on orientation of occlusal plane to Camper's line radiographically in **dentulous subjects**.

Materials and methods

This study was approved by the institutional ethical committee of the Narayana Dental College and Hospital and was sufficiently explained to the subjects based on the committee's regulations. Informed consent was obtained from all subjects before they participated in the study.

This study consisted of 20 male subjects with age of 24 ± 4 years who were the students of Narayana Dental College and Hospital. All the subjects selected for this study met the following criteria 1. Angle's class 1 occlusion 2. No history of any orthodontic treatment 3. No missing teeth except for third molars; 4. No neuromuscular and TMJ disorders. The following investigations were done on all the subjects.

Radiographic Analysis

Conventional lateral cephalograms of all the subjects in centric occlusion were taken with radiographic markers placed at the superior, middle, inferior border of the tragus and at the ala of the nose. The following tracings were done on the cephalogram. 1. Frankfurt's horizontal plane 2. Ala Tragus line 3. Occlusal plane. (Fig. 1)

Ultrasound imaging of masseter muscle

The subject's masseter muscle thickness bilaterally was measured using an ultrasonograph (Philips HD11XE Ultrasound) present in the Department of Radiology at Narayana medical college, Nellore. The method used was similar to the one employed by Killiardi and Kallebo.²⁶ All the subjects were examined by the same operator using real time scanner. The measurements were done with the probe of the ultra-sonogram placed at the thickest part of the masseter muscle taking care that it was placed perpendicular to the skin over the muscle, because obliquely placed probe could give exaggerated readings. To avoid tissue compression a generous amount of conductive gel was used under the probe. Ultrasonic imaging to record the masseter thickness on both sides was done with the subject seated in a relaxed position with the masseter muscle in maximum clenched state (CSA-clenched) at maximum intercuspation. The thickness of the masseter muscle was measured real time on the screen of the ultra-sonogram by tracing the muscle's border using the systems cursor, and the distance between the muscle borders was measured to obtain the thickness of the muscle (Fig. 2). Each measurement was done twice to avoid any errors with an interval of 5min between the readings and the mean of the two readings was considered as the thickness per side. Final reading of the individual was calculated by taking the mean of the masseter muscle thickness obtained from both the right and left side. These

readings were compared to the orientation of occlusal plane with the ala tragus line of that subject.

Results

Table 1 shows the masseter muscle thickness of all subjects along with the occlusal plane orientation to ala tragus line. The thickness of muscle ranged from 10mm to 18mm with an average of 14.6 mm. The values obtained were subjected to karl pearson correlation analysis. A statistically significant relationship couldn't be found between the variables. As the thickness of muscle increased, the occlusal plane was more parallel to lower part of ala tragus line.

Discussion

Functional matrix theory explains that muscles have an influence on the growth of bone which includes the jaws¹ and the fact that this influence on the jaws might have an effect on the orientation of the occlusal plane, shows that a study needs to be done to find out the association of masseter muscle thickness and occlusal plane orientation in relation to the ala tragus plane level.²⁶ Masseter as we know is the most prominent and strongest muscle attached to the lower jaw and thus it could be expected to have a greater influence on the lower jaw than the other muscle making it the reason to be chosen for this study.

Many studies have been done in the past correlating the masseter muscle thickness to various facial and cephalometric landmarks.^{3,26} But as of now there exists no study correlating the masseter muscle thickness to the occlusal plane orientation. This existence of relation between masseter muscle thickness and occlusal plane orientation will also help us to find an accurate method to orient the occlusal plane to Camper's plane which unto this date is also confusion. MRI, CT, Ultrasonography are various techniques used for measuring the thickness of masseter muscle.^{2,3,4,26,27,28} Of these ultrasonography was used to measure the thickness of the masseter muscle in

this study, as it is an easy technique, affordable, non-invasive and reliable as it provided accurate readings. The present study has shown that the average muscle thickness in contracted state showed a negative correlation with the occlusal plane level. Thus as the masseter muscle thickness increased the occlusal plane tends to be more oriented towards the lower ala tragus line and vice versa. These findings couldn't be compared to any studies as this study being the first of its kind. Henceforth in individuals with larger or thicker masseter muscle the occlusal plane might be oriented more to the lower part of ala tragus line and in individuals with thin masseter muscle the occlusal plane might be oriented to superior part of ala tragus line.

Killiardis & Kalebo , Gionhaku& Lowe in their studies found that large masseter muscle was associated with flat occlusal plane and small gonial angle. Larger masseter muscle was associated with brachycephalic face, a tendency for parallelism between jaws and plane of occlusion more parallel to ala tragus line.^{2,4,26,28}

A statistically significant karl pearson correlation couldn't be seen between the masseter muscle thickness in contracted state and the occlusal plane orientation to the ala tragus line. The possible explanation for this might be because of the limited number of samples that were chosen for this study. Observational studies comparing anatomic planes, landmarks to anatomic structures usually require larger number of subjects for obtaining a statistically significant finding because of the wider variation of measurement seen in the anatomic structures of all the subjects. The findings of this study indicate that there seems to exist a relationship between the occlusal plane orientation to ala tragus line and masseter muscle thickness. Occlusal plane which is lost in completely edentulous patients needs to be oriented back to the same position for prosthesis to function harmoniously within the stomatognathic system. All the methods used for

orienting the occlusal plane in the edentulous patients as of now are usually ineffective and inaccurate as these methods are universally same for all the patients and using the same method for all patient isn't right because each patient has their own anatomical variation. Hence there needs to be a custom technique for each individual patient so that the occlusal plane can be oriented accurately back to its original place. Even though the finding of this study can't be made conclusive but it has thrown a light on the way to orient the occlusal plane individually for each patient. Patients with thicker masseter muscle can have their occlusal plane oriented towards the lower ala tragus line and in patients with thinner masseter muscle can have the occlusal plane oriented towards the upper ala tragus line.

Further studies need to be done on the above topic for more conclusive evidence and an accurate method for orienting the occlusal plane in edentulous patients. Studies including larger number of subjects and also on subjects from different geographical areas needs to be done. Male and female subjects were not differentiated in this study. The influence of other masticatory muscles on the jaws and the occlusal plane orientation also needs to be investigated.

Conclusion

The findings of this study indicate that the masseter muscle thickness has an influence on the occlusal plane and its orientation in relation to the ala tragus line. Thicker masseter muscle influenced the occlusal plane to be oriented more towards the lower part of tragus and thinner masseter muscle to be oriented towards superior part of tragus.

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Legends Table and Figure

Table -1

S. No.	Masseter muscle thickness contraction average	Occlusal plane to ala tragus line
1	17mm	lower
2	18mm	lower
3	14mm	middle
4	11mm	superior
5	16mm	lower
6	16mm	lower
7	12mm	middle
8	10mm	lower
9	16mm	superior
10	15mm	middle
11	17mm	superior
12	12mm	lower
13	12mm	middle
14	15mm	lower
15	18mm	lower
16	16mm	lower
17	14mm	lower
18	13mm	middle
19	17mm	lower
20	14mm	lower

Figure 1: Lateral cephalogram with the tracing of Frankfurts horizontal plane (F-H), ala tragus line [superior(T1-A), middle(T2-A) and lower level(T3-A)] and occlusal plane(O-P).

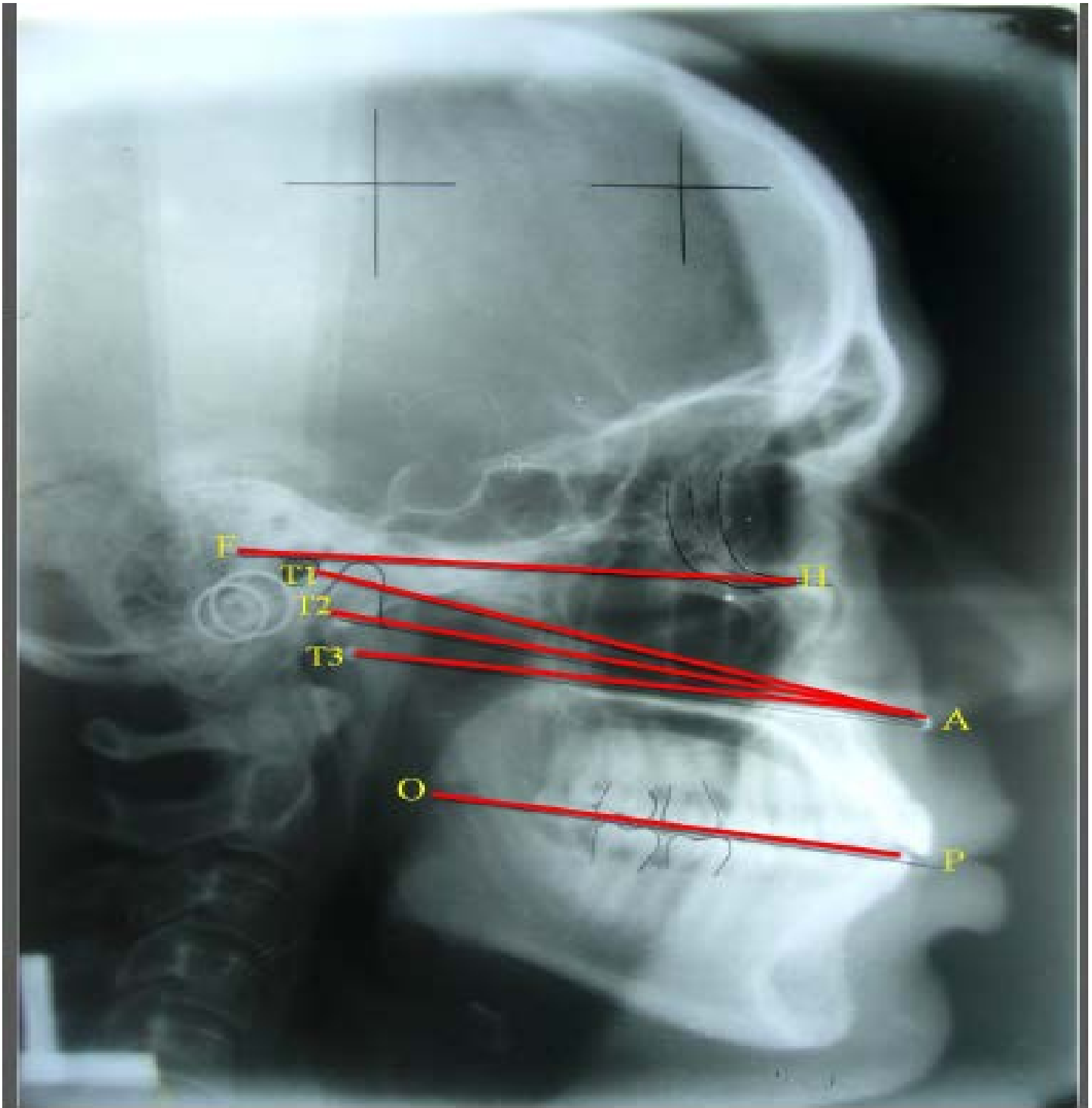


Figure 2: Thickness of masseter muscle measured on screen using ultrasonogram by tracing the muscle border.

