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THE MASTICATORY EFFICIENCY OF COMPLETE DENTURE WEARERS WITH OCCLUSAL PLANE ORIENTATION USING CAMPER'S LINE WITH DIFFERENT LEVELS OF THE TRAGUS

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ABSTRACT

Peter Camper described ala-tragus line for orientation of antro-posterior occlusal plane and defined it as a line running from the lower border of the ala of the nose to the tragus of the ear. Camper never mentioned exact point of reference for this line of the tragus of the ear; superior, inferior or middle. The aim of this study was to evaluate the effect of changing the posterior reference point of ala-tragus line on masticatory efficiency of complete denture wearers.

Subjects and method : Ten completely edentulous patients were selected. For each patient new complete denture was constructed. The denture anterior teeth were set to meet the esthetic needs with minimal incisal guidance as much as possible. Posterior anatomic form teeth were arranged in balanced articulation with the posterior occlusal plane follow the ala tragus line at the middle point of tragus. Then, the denture posterior segments were exchanged twice to orient occlusal plane parallel to the ala tragus line at the superior and the inferior points of tragus, respectively. After three months of each new and modified denture use, masticatory efficiency test was carried out.

Results: There were no significant differences of all masticatory efficiency parameters (when patients were chewing apple, peanut and carrot) with the occlusal plane oriented parallel to the Camper's line using the three levels of the tragus.

Conclusion: According to the results of the present study, the use of any posterior point of tragus for occlusal plane orientation is acceptable at the point of masticatory efficiency.

INTRODUCTION

Correct orientation of the occlusal plane plays a vital role in providing optimal esthetic and functional satisfaction. Improper orientation of this plane jeopardizes the coordination between the components of oro-facial articulatory complex. It can also lead to instability of dentures, tissue alteration and untimely bone resorption [1].

The posterior occlusal plane should be located according to mechanical requirement for stability of denture and preservation of the supporting structures. There are contrasting views in regard to the

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orientation of the occlusal plane in posterior region [2]. Some dentists position the occlusal plane parallel to and mid-way between the residual ridges [3,4]. Roberts[5] recommended positioning it halfway between the maxillary and mandibular ridges parallel to the Frankfort plane. Still other dentists recommend placing the occlusal plane so that it terminates posteriorly at the medial 2/3rd of the retromolar pad [3,6]. Others used the buccinators grove and commissure of the lips to orient the occlusal plane in the mandibular arch [7]. While, the hamular notch- incisive papilla plane [8] and ala-tragus line [9-10] have been used to orient the occlusal plane in the maxillary arch.

Peter Camper described ala-tragus line for orientation of antro-posterior occlusal plane and defined it as a line running from the lower border of the ala of the nose to the tragus of the ear. Camper never mentioned exact point of reference for this line on the tragus of the ear; superior, inferior or middle. This definition of the ala-tragus line has created confusion[9].

Many studies investigated the exact point of reference in relation to the natural occlusal plane. Boucher[3] and others[9-12] used the superior border of the tragus of the ear as the reference point. They concluded that, the ala-tragus line, extending from the inferior border of the ala of the nose to the tip of the tragus of the ear presented the closest relationship to the natural occlusal plane.

The Glossary of Prosthodontic terms defined the ala-tragus as 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. It is frequently used, with a third point on the opposing tragus, for the purpose of establishing the ala tragus plane. Ideally the ala-tragus plane is considered to be parallel to the occlusal plane[13]. The ala-tragus line as running from the center of the ala to the center (middle) of the tragus was found in other studies to be parallel to the natural occlusal plane[14-16]. A study done by Shigli et al. [17] using a custom made occlusal plane relator concluded that the line drawn from the ala of the nose to the middle of the tragus was found to be parallel to the maxillary occlusal plane.

Dentulous individuals were evaluated to establish the definite correlation between camper's plane and natural occlusal plane. On an investigation made on 100 patients with natural dentition found that a line extending from the lower border of the ala and the center of tragus as a posterior landmark was parallel to the natural occlusal plane in 78% of patient. While the use of the same anterior landmark and lower border of the tragus of the ear was parallel to the natural occlusal plane in only 21%, and to the upper border of tragus in 1%. The authors concluded that the use of the ala tragus as indicator of the occlusal plane cannot be applied in all patients. One must use the center of the tragus of the ear and check its accuracy by the use of other methods [18].

Many other studies[, 19-25] found out that the occlusal plane is parallel to the line drawn from the lowest point of the ala of the nose to the lower border of the tragus. They concluded that this line could provide sufficient space for the arrangement of maxillary posterior teeth. Kumar et al[, 26] found that the line joining from ala to the lower border of the tragus was parallel to the occlusal plane in 53.3% of the subjects. In 26% occlusal plane was parallel to the ala to middle border of tragus and in 20.7% occlusal plane was parallel to the ala to upper border of tragus. In subjects with small tragus either middle or lower border of the tragus may be used to determine the level of occlusal plane.

The effects of occlusal plane on masticatory function (biting force, masticatory muscle activity, biting efficiency) after bimaxillary orthognathic surgery were evaluated. It was concluded that the value of EMG was related to the changes in the occlusal plane, and the biting efficiency was affected by the postoperative occlusal plane angle. However, normalization of the occlusal plane might not play a major role in masticatory function [27].

An experimental design of a study was conducted to assess the effect of occlusal plane inclination on biting force and efficiency. It was found that the biting force and the efficiency of biting force exertion and muscle activity during maximum clenching was the greatest when the occlusal plane was made parallel to the ala-tragus line. Muscle activity during clenching at various given forces was least when the occlusal plane was made parallel to the ala-tragus line. They concluded that anteroposterior inclination of the occlusal plane tends to affect the biting force, and the method with the ala-tragus line seems to be the most reasonable for occlusal plane orientation[28].

Searching in literature, there is no study evaluated the effect of occlusal plane orientation on the masticatory efficiency of complete denture wearers. This study was designed to evaluate the effect of occlusal plane orientation for complete denture using camper's plane with different levels of the tragus on masticatory efficiency.

SUBJECTS AND METHODS

Ten completely edentulous patients, 7 males and 3 females, ranging in age from 47 to 65 years, were selected from the prosthodontic clinic Faculty of Dental Medicine, Al-Azhar University. All of the patients have normal jaw relationship, well developed ridges, and were assessed clinically to have normal temporomandibular joints (TMJs). For each patient, new complete denture was constructed following the standard technique used in the removable prosthodontic department.

At the jaw relation recording stage, the anterior occlusal plane was adjusted to be parallel to the interpupillary line and the posterior occlusal plane was oriented parallel to the ala-tragus line. A fox plane was used to make the posterior occlusal plane parallel to this line running from the inferior border of the ala of the nose to the middle (center) of the tragus of the ear (Fig. 1). A spring ear face bow (Teledyne Hanau, Whip Mix Corporation, USA) record was used to mount the maxillary cast on a semi-adjustable articulator (Teledyne Hanau, Buffalo, New York, USA). The mandibular cast was mounted to the articulator using centric interocclusal wax record. Protrusive interocclusal record was used to adjust the horizontal condylar guidance of the articulator, while the lateral condylar path angle was calculated from the Hanau formula L=H/8+12 (L is the lateral condylar path angle and H is the horizontal condylar path angle).

Acrylic denture teeth with the appropriate shade, form and size were selected. The denture anterior teeth were set to meet the esthetic needs with minimal anterior guidance as much as possible. The posterior anatomic form teeth were arranged in balanced articulation. The complete denture was processed, finished, polished, inserted into the patient's mouth and followed-up.

Fig. (1) Orientation of the posterior occlusal plane parallel to a line running from the inferior of the ala of the nose to the middle point (center) of the tragus of the ear.

After three months of each new complete denture use, the masticatory efficiency test was carried-out. Then, the denture posterior segments were exchanged twice to orient occlusal plane parallel to the ala tragus line at the superior and inferior points of tragus, respectively. After three months of each modified denture use, masticatory efficiency test was performed.

The posterior segment of the maxillary and mandibular dentures was exchanged by grinding of the anatomic teeth and at least 2 mm of the acrylic base. Wax rims were made to replace the posterior teeth. The maxillary posterior occlusal plane of the wax rim was adjusted intra-orally as required. New ear face-bow record and centric relation record were performed and used for denture mounting on the articulator. Then, posterior anatomic form teeth of the same mold of the original denture were arranged in balanced articulation. The posterior segments were waxed-up and processed in self curing acrylic resin.

Masticatory efficiency was evaluated using the method described by Feine et al[29], khamis et al[30], and baraka and Mohamad[31] as follow:

One cubic cm of raw carrot and apple and one grain of peanut were chewed and swallowed in a normal rate and the following parameters were recorded

- Number of chewing strokes up to first swallow
- Number of chewing strokes until the mouth was free of food
- Number of swallows until the mouth was free of food
- Time in second elapsed until the first swallow
- Time in second elapsed until mouth was free of food

Five samples of each test food were chewed and the means of the five records for each parameter were used. The results were analyzed statistically, the means, stander deviations and paired T test were calculated to assess the difference between the masticatory efficiency of the different occlusal planes used.

RESULTS

The mean, standard deviation and p value of paired sample T-test of all masticatory efficiency parameters; (number of strokes to first swallow, number of strokes till mouth empty, number of swallows till mouth empty, time to first swallow, and time to mouth empty) when patients were chewing apple, peanut and carrot with the three points of ala-tragus lines are shown in tables 1, 2 and 3.

TABLE (1) Comparison between the masticatory efficiency for dentures made using the superior and middle tragus for occlusal plane orientation.

Food	Variables	Superior tragus		Middle tragus		P
		Mean	SD.	Mean	SD.	
Apple	No. of strokes to 1st swallow	15.0000	4.61880	18.1000	2.51440	.079
	No. of strokes to mouth empty	24.1000	4.06749	22.8000	2.52982	.402
	No. of swallows to mouth empty	2.6000	.51640	2.3000	.48305	.196
	Time to 1st swallow (Sec)	11.1000	1.91195	12.6000	1.77639	.086
	Time to mouth empty (Sec)	21.5000	5.08265	21.5000	2.71825	1.00
Peanut	No of strokes to 1st swallow	27.5000	4.17000	31.7000	6.34298	.097
	No of strokes to mouth empty	42.5000	5.40062	44.5000	5.98609	.443
	No of swallows to mouth empty	4.1000	.73786	4.0000	.81650	.777
	Time to 1st swallow (Sec)	21.9000	5.36346	28.1000	2.92309	.005
	Time to mouth empty (Sec)	33.9000	10.24641	37.6000	1.83787	.276
Carrot	No of strokes to 1st swallow	34.8000	7.95543	46.7000	2.86938	.0001*
	No of strokes to mouth empty	55.6000	7.67680	50.0000	9.27362	.159
	No of swallows to mouth empty	6.3000	2.05751	5.1000	.99443	.114
	Time to 1st swallow (Sec)	28.4000	5.37897	31.6000	5.66078	.211
	Time to mouth empty (Sec)	46.1000	4.95424	48.2000	4.46716	.333

TABLE (2) Comparison between the masticatory efficiency for dentures made using the superior and inferior tragus for occlusal plane orientation.

Food	Variables	Superior tragus		inferior tragus		P
		Mean	SD.	Mean	SD.	
Apple	No of strokes to 1st swallow	15.0000	4.61880	17.3000	2.21359	.179
	No of strokes to mouth empty	24.1000	4.06749	21.6000	2.36643	.114
	No of swallows to mouth empty	2.6000	.51640	2.2000	.42164	.075
	Time to 1st swallow (Sec)	11.1000	1.91195	13.8000	3.01109	.030*
	Time to mouth empty (Sec)	21.5000	5.08265	21.2000	2.14994	.866
Peanut	No of strokes to 1st swallow	27.5000	4.17000	39.7000	3.43350	.0001*
	No of strokes to mouth empty	42.5000	5.40062	49.7000	6.91295	.019
	No of swallows to mouth empty	4.1000	.73786	4.0000	.94281	.795
	Time to 1st swallow (Sec)	21.9000	5.36346	27.7000	2.75076	.009*
	Time to mouth empty (Sec)	33.9000	10.24641	37.3000	2.00278	.328
Carrot	No of strokes to 1st swallow	34.8000	7.95543	47.2000	4.58984	.001*
	No of strokes to mouth empty	55.6000	7.67680	48.4000	5.54176	.028
	No of swallows to mouth empty	6.3000	2.05751	5.1000	.99443	.121
	Time to 1st swallow (Sec)	28.4000	5.37897	32.9000	4.14863	.052
	Time to mouth empty (Sec)	46.1000	4.95424	46.8000	6.77905	.795

TABLE (3) Comparison between the masticatory efficiency for dentures made using the middle and inferior tragus for occlusal plane orientation.

Food	Variables	Middle tragus		inferior tragus		P
		Mean	SD.	Mean	SD.	
Apple	No of strokes to 1st swallow	18.1000	2.51440	17.3000	2.21359	.460
	No of strokes to mouth empty	22.8000	2.52982	21.6000	2.36643	.288
	No of swallows to mouth empty	2.3000	.48305	2.2000	.42164	.628
	Time to 1st swallow (Sec)	12.6000	1.77639	13.8000	3.01109	.295
	Time to mouth empty (Sec)	21.5000	2.71825	21.2000	2.14994	.788
Peanut	No of strokes to 1st swallow	31.7000	6.34298	39.7000	3.43350	.004*
	No of strokes to mouth empty	44.5000	5.98609	49.7000	6.91295	.089
	No of swallows to mouth empty	4.0000	.81650	4.0000	.94281	1.000
	Time to 1st swallow (Sec)	28.1000	2.92309	27.7000	2.75076	.756
	Time to mouth empty (Sec)	37.6000	1.83787	37.3000	2.00278	.731
Carrot	No of strokes to 1st swallow	46.7000	2.86938	47.2000	4.58984	.774
	No of strokes to mouth empty	50.0000	9.27362	48.4000	5.54176	.646
	No of swallows to mouth empty	5.1000	.99443	5.1000	.99443	1.000
	Time to 1st swallow (Sec)	31.6000	5.66078	32.9000	4.14863	.566
	Time to mouth empty (Sec)	48.2000	4.46716	46.8000	6.77905	.593

SD= Standard deviation. **** Sig. (p < 0.05).***

There were no significant differences in most of the masticatory efficiency parameters (number of strokes to first swallow, number of strokes till mouth empty, number of swallows till mouth empty, time to first swallow, and time to mouth empty) when patients were chewing apple, peanut and carrot with the three points of the tragus.

DISCUSSION

Boucher[3] stated that the teeth must be placed in exactly the same position as the natural teeth, which they are to replace. It is generally agreed that in the anterior region, the vertical height of the occlusal plane is governed by esthetics and less frequently by functional requirement. On the other hand, there are contrasting views in regard to the orientation of the occlusal plane in posterior region[2].

The use of ala-tragus line has been a topic of debate since past many years. Several clinical investigations have been conducted but till now, literatures did not support which part of tragus should be used for construction of occlusal plane in edentulous patients. Some authors suggested the use of superior border of tragus[11, 12] as reference point whereas some authors suggest use of middle or inferior point of tragus for this line [18, 19]. Therefore, it's quite evident that significant controversy exists in this matter.

The orientation of the occlusal plane influences physiologic functions within the oral cavity. The proper height and width of the occlusal plane is essential for the adequate buccolingual exchange and control of food, speech articulation contacts, tongue space, esthetics and buccal soft tissue support. Faulty orientation of the occlusal plane will jeopardize this interaction between tongue and buccinator muscle[26]. Occlusal plane should be oriented in such a way as to leave enough space for the tongue, as it plays a major role in speech. The posterior level of the occlusal plane is important for mandibular function and maintenance of the temporomandibular joint[33]. Owing to the importance of occlusal plane orientation on the masticatory function, the masticatory efficiency test is one of the main objectives of this study.

In the masticatory efficiency test in this study different food textures (apple, peanut and carrot) were used. The masticatory efficiency test used in this study was documented by Kawich[32]. This method was proved to be a valid measure of masticatory efficiency. In contrast to other techniques it is practical applicable for all types of foods and allows patients to chew and sallow normally[32].

Fox plane is the simplest and most widely used instrument to aid in determining occlusal plane. It's use is very rapid and simple. It is less bulky than other instruments. Therefore, fox plane was used in the present study [(15).]

The results of the present study showed that there were no significant differences in most of the masticatory efficiency parameters (number of strokes to first swallow, number of strokes till mouth empty, number of swallows till mouth empty, time to first swallow, and time to mouth empty) when patients were chewing apple, peanut and carrot with the three points of tragus.

The ala-tragus line is the most controversial landmark in occlusal plane orientation. However, this extra-oral landmark is reliable as both its ends do not change with age. Shaikh et al[9] concluded that a definite relationship exists in between age and level of ala tragus line. Nonetheless, the superior, middle and inferior part of the tragus and the ala of the nose have proved to show parallelism with the occlusal plane. Therefore, a combination of more than one landmark should be used along with the ala-tragus line for orienting the occlusal plane.

Success of prosthesis is a combination and harmony between different components of stomatognathic system .Either one cannot be neglected at expense of other .So ,the use of any point in tragus for occlusal plane orientation is accepted taking into consideration the other factors and landmarks which may affects the antro-posterior occlusal plane.

CONCLUSION

According to the results of the present study, the use of any point of tragus (superior middle or inferior) as a posterior point for antro-posterior occlusal plane orientation in ala tragus line, has no significant effect on masticatory efficiency in complete denture wearer.

Therefore, a combination of more than one landmark should be used along with the ala-tragus line for orienting the occlusal plane, taking into consideration the other factors that may affect the establishing the antro-posterior occlusal plane as inter arch space and concept of mechanically balanced articulation and normal function of the tongue and cheek muscles, thus enhancing the denture stability.

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