

Assessment of Bilateral Symmetry of the Ala Tragus Line and its Reliability for Determining the Occlusal Plane Orientation: An in Vivo Study

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Abstract

Background: Occlusal plane evaluation and placement establishes the basis for the prosthetic rehabilitation of occlusion using ala tragus plane most commonly. In routine practice dentists record the ala-tragus plane by marking same tragal points on both sides of the patient's face. Considering the presence of bilateral asymmetries in most of the individuals, the certainty of bilateral symmetry of ala-tragus plane is absurd. The purpose of this study was to validate the bilateral symmetry of the ala-tragus plane by evaluating the differences between the levels of ala tragus line on left and right side of the face.

Material and Method: 120 dentate individuals of age 45yrs and above were selected. Placing a fox plane intraorally; left and right lateral profile photographs were taken. The photographs were analyzed using Auto Cad computer software for difference between the levels of ala tragus line on both sides.

Results: There was evident difference between the mean values on both sides and there was no parallelism when comparing bilaterally. The line joining the ala and the midpoint of tragus had the lowest mean difference.

Conclusion: Within the limitations of the study, it can be concluded that there are asymmetries on ala-tragus planes on both sides of the face. If not taken into consideration this can result in inappropriate analysis of occlusal plane, hampering the prosthetic occlusion. Hence, the routinely practiced technique of marking the same tragal points on both sides of the face is questionable.

Key Words: ala-tragus line, occlusal plane orientation, Camper's Line, occlusal plane

Introduction

Determination of occlusal plane establishes the rationale for the maxilla-mandibular relation and aids in fulfilling functional, esthetic and phonetic requirements while fabrication of a complete denture.[1] The coordination between the components of oro- facial articulatory complex can be jeopardized if the occlusal plane orientation is improper.[2] Occlusal plane is defined as "The average plane established by the incisal and occlusal surfaces of the teeth; generally, it is not a plane but represents the planar mean of the curvature of these surfaces" (GPT-9).[3] The plane formed after joining the incisal edges of the mandibular central

incisors to the disto-buccal cusps of the mandibular first molars is the occlusal plane.[4] Some methods of determining the occlusal plane in clinical practice include: Positioning the occlusal plane 1 to 3 mm below the resting lip anteriorly and parallel to the ala-tragus line posteriorly;[5] marking the occlusal plane parallel to and midway between the residual ridges;[6] positioning the occlusal plane at the level of the lateral border of the tongue;[7] terminating the occlusal plane posteriorly at the middle or upper third of the retromolar pad;[7] and orienting the occlusal plane with the buccinator grooves and the lip commissures.[5] Various methods have been followed by clinicians and researchers to establish the occlusal plane while recording maxillomandibular relationship, but none of them can be proved to be accurate.

In edentulous individuals the most routinely followed technique for orientation of the occlusal plane is to make it parallel to the inter-pupillary line anteriorly and ala-tragus plane or Camper's line posteriorly.[8] It has been documented in literature and observed in routine practice that dentists record the ala-tragus plane by marking same points on the tragus of both sides of the patient's face. Contradictory to this clinical practice, it is generally agreed that there are gross facial asymmetries on bilateral sides of every individual.[9] Considering this fact, the certainty of bilateral symmetry of ala-tragus plane is absurd. The asymmetries can hamper the occlusal plane and emerge as a tilted occlusion in the prosthesis. To validate the bilateral symmetry of the ala-tragus plane, this study examines the variations between the left and right side of the ala-tragus plane.

When it comes to precision of marking the point on the tragus, it is obscure as to which among the upper, middle and lower point is to be selected.[4] This has been a point of uncertainty among clinicians while marking the ala-tragus line. Therefore this study also evaluates the most appropriate point on tragus, which can be used as a point of reference while marking ala-tragus line.

The objective of this study was to validate the bilateral symmetry of the ala-tragus plane by evaluating the differences between the levels of ala tragus line on left and right side of the face and also to access the relationship between occlusal plane and three levels of ala tragus line in dentate patients.

Materials and Method:

A total of 120 individuals of age 45yrs and above were selected. Participants had Angle's Class I molar relation with full complement of teeth present. Participants did not have any history of maxillofacial surgery or orthodontic treatment.[10] Individuals with poor systemic health, bone or skin disease, craniofacial anomalies, malocclusions, advanced periodontal diseases, wasting diseases of teeth were not included in the study.[11] Individuals having any removable or fixed oral prosthesis with missing natural teeth were excluded. Informed consent was obtained from all the individuals.

In the study, a Canon digital camera model no. 1300D with a resolution of 20.1 mega pixels was used. Fox plane was placed intraorally touching the incisal edges of upper anterior teeth and cusps of posterior teeth.[11] The subjects were asked to hold the fox plane in the position with their thumb. Placing a tripod at a fixed distance of one meter from the patient, the height of the camera was adjusted and left and right lateral profile photographs were taken with subject sitting in natural head position and back straight (Fig1&2).

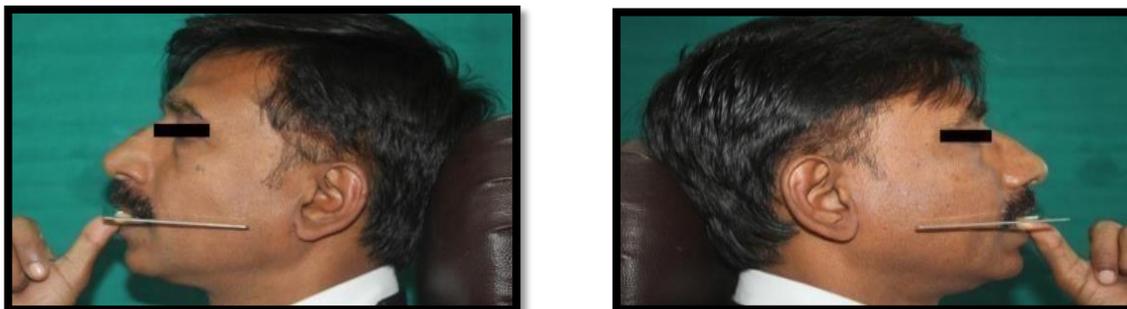


Fig 1&2: Left and right lateral profile photographs of the subject.

Anatomical landmarks marked on photographs for the study were the inferior border of ala of nose, lines joining superior, middle and inferior margins of tragus to inferior border of ala of nose and line corresponding to arms of fox plane representing occlusal plane.[11] Auto Cad 2014 (Student Version) computer software was used to analyze the images (Fig 3). Following observations were noted from each subject: Difference between the levels of ala tragus line between right and left side and most parallel relationship between the arms of fox plane and three different levels of ala tragus line. The data obtained was subjected to statistical analysis using Anova and post-hoc test.

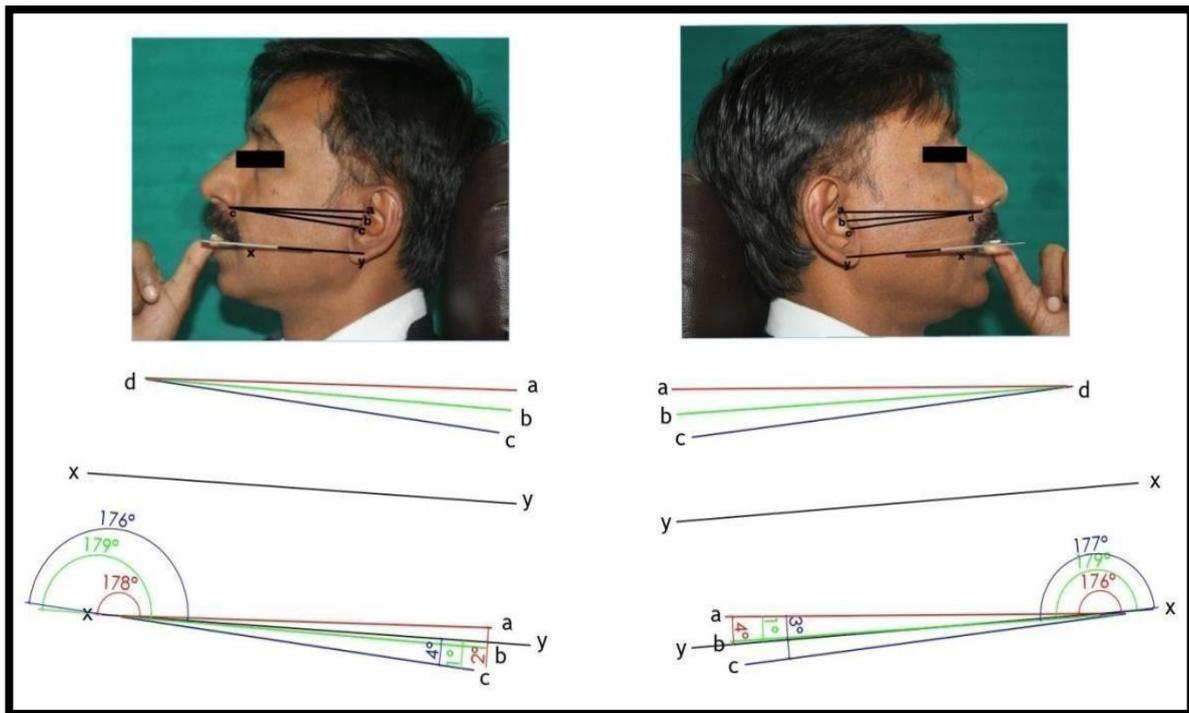


Fig 3: Anatomical landmarks marked on the photographs and analysis of angulations performed with Auto cad software.

Results:

After the statistical analysis, the results were tabulated and represented in a graphical form. The values of the ala-tragus line from left side did not coincide with the values from the right side. Table 1 show that there is evident difference between the mean values of left and right side. It also shows the range of values of each point on the tragus with maximum and minimum values from left and right side on three different points of tragus.

		Mean	Std. Deviation	Minimum	Maximum
Right	A	2.6500	4.61938	-8.00	12.00
	B	-.3333	4.48777	-11.00	9.00
	C	-3.4417	4.55369	-16.00	6.00
	Occlusal plane	0.000	0.000	.00	.00
Left	A	3.2500	4.09191	-8.00	12.00
	B	-.0583	4.06108	-12.00	9.00
	C	-3.2750	4.06659	-15.00	5.00
	Occlusal plane	0.000	0.000	.00	.00

Table 1

When comparing the groups amongst themselves, post hoc test (table 2) shows the angles between the occlusal plane and all three points on the tragus are significantly different from zero and so it can be concluded that no parallelism exists between the occlusal plane and the ala tragus line. However, the results show that the line joining the ala and the middle margin of tragus (point b), had the lowest mean difference and the strongest tendency to be parallel to the occlusal plane.

Side	Angle	Angle	Mean Difference	P value
Right	A	b	2.98333*	0.001**
		c	6.09167*	0.001**
		Occlusal plane	2.65000*	0.001**
	B	a	-2.98333*	0.001**
		c	3.10833*	0.001**
		Occlusal plane	-.33333	.914
	C	a	-6.09167*	0.001**
		b	-3.10833*	0.001**
		Occlusal plane	-3.44167*	0.001**
	Occlusal plane	a	-2.65000*	0.001**
		b	.33333	.914
		c	3.44167*	0.001**
Left	A	b	3.30833*	0.001**
		c	6.52500*	0.001**
		Occlusal plane	3.25000*	0.001**
	B	a	-3.30833*	0.001**
		c	3.21667*	0.001**
		Occlusal plane	-.05833	.999
	C	a	-6.52500*	0.001**
		b	-3.21667*	0.001**
		Occlusal plane	-3.27500*	0.001**
	Occlusal plane	a	-3.25000*	0.001**
		b	.05833	.999
		c	3.27500*	0.001**

Table 2

Discussion:

Accurate orientation of the occlusal plane in edentulous patients renders a challenge to the clinicians. During the reconstruction, relating the occlusal plane to the maxillary plane is recommended rather than mandibular plane because it has fixed orientation to many craniofacial planes.[11] Following the fixed maxillary plane as a reference, the occlusal plane can also be relocated back to the same position as it had been previously situated, which enables normal functioning of the stomatognathic system.

Numerous reference planes and landmarks have been suggested to rehabilitate the occlusal plane, out of which Camper's Plane is the most commonly used plane. Camper's plane was first associated with occlusal plane by Clapp in 1910.[12] Since then many researchers have documented their observations regarding ala-tragus plane. This routinely practiced technique involves marking of same points (superior, middle or inferior) bilaterally on the tragus, which does not consider the parameters of bilateral facial asymmetry.

When taking in consideration the bilateral symmetry of the face, very few individuals have an exactly symmetric right and left side of the face. Similarly it goes with the ala and tragus. There

can be variations on the ala tragus plane on both sides of the face in the same individual. So in such situation, it will not be accurate to take the same posterior reference points on both sides of the tragus. This aspect of bilateral asymmetry between the ala-tragus planes has not been investigated and there is lack of literature in this area.

Our study revolved around evaluating the symmetry of the ala-tragus line on left and right side. 120 dentulous individuals, with presence of complete dentition and age 45 yrs and above participated in the study. These age parameters were selected keeping in mind that this age group consists of individuals approaching geriatric transformations and so their facial changes would be similar to edentulous patients. Left and right lateral profile photographs of each subject were taken with fox plane placed intraorally touching the incisal edges of upper anterior teeth and cusps of posterior teeth. The ala and tragal landmarks were marked on the photographs and Autocad software was used to evaluate the angles of the ala tragus plane with the occlusal plane. The left and right profile photographs of each individual were compared for the difference in the degrees of the ala-tragus plane and it was observed that in most of the individuals, the planes on the left side did not match the planes on the right side.

Counting only on the ala-tragus plane and not considering the minute bilateral asymmetries of the individuals can result in improper analysis of the occlusal plane in many individuals. This can further disharmonize the masticatory patterns and oro-facial musculature causing temporomandibular problems in individuals.[13] Fore sighting this problem, there emerges a need for an alternative technique to orient the ala-tragus plane in edentulous patients.

Another matter of concern regarding the ala-tragus plane is the controversy while selecting the posterior point on tragus (superior, middle or inferior) to locate the Camper's plane. Many researchers have worked in this area and proved different reliable points according to their observations. Boucher describes it as "The line running from the inferior border of the ala of the nose to the superior border of the tragus of the ear." [14] Anthony [15], Miller [16] and Lloyd [17] also concur to Boucher's definition. The upper border of tragus was also used by Trapozzano as reference point for marking occlusal plane.[18] A study was carried out by Sadr et al. in which subjects were photographed in natural head positions which concluded that the superior border of the ala-tragus was parallel to the occlusal plane.[19] A radiographic study was carried out by Al Quran et al. in complete denture patients to determine the most authentic ala-tragus plane as a guide for directing the occlusal plane and came to the conclusion that the superior ala-tragus plane was the most reliable plane among the three.[20] The Glossary of Prosthodontic terms also defines it as a line running from the inferior border of the ala of the nose to the superior border on the tragus of the ear.[3]

Ismail and Bowan have suggested it to be a line passing from the ala of nose to the middle of the tragus.[21] As per anthropological measurements on skulls, Wilder advocates it as a line advancing from the center of the tragus to the external auditory meatus.[22] According to Spratley it is a line running from the center of the ala to the middle of the tragus.[23] Solomon et al. studied 2,048 forms of tragus and concluded the posterior reference of ala tragus to be present between the superior and middle of the tragus.[24]

Van Niekerk et al. believed that sufficient space could be provided for arrangement of posterior teeth when using the inferior border of tragus as the posterior end of the ala-tragus line.[25] It is a line proceeding from the ala of the nose to the inferior border of the tragus as stated by Simpson et al.[26]

On calculating the mean of values of the posterior reference points (superior, middle and inferior) on the tragus of different individuals, our study also evaluated the most accurate point on the tragus which can be undertaken while establishing the occlusal plane. After the statistical analysis, it was evident that the plane most parallel to occlusal plane in Chhattisgarh population was the plane joining the ala of the nose to the mid-point of the tragus.

In the past, authors have used the custom-made occlusal analyzer to study the relationship of the ala-tragus line to the occlusal plane in natural dentition. Shigli et al. have termed the custom-made device as "occlusal plane relator" in which anterior plane indicator line was joined to right and left ala-tragus line indicator using a hinge joint and Fox plane was used as the occlusal plane indicator.[27] Both the planes were held together using a vertical arm.

Gupta and Singh designed the custom-made “occlusal plane analyzer”, [28] which had metal plates denoting inter-pupillary line and left and right ala-tragus line indicator joined to Fox plane using four long screws at the ends of the occlusal plane indicator. A metal key was used to move the metal plates up and down. Shetty et al. used custom-made occlusal plane analyzer which lacked an anterior reference plate. They joined two metal plates as the right and left ala-tragus line indicators using a Tofflemire retainer which was laser welded to the extraoral arm of Fox's plane. [29]

None of the occlusal plane devices mentioned in the literature compensate for the asymmetry between the left and right side of the ala-tragus plane. There is need of an adjunct to the ala-tragus plane to compensate for the bilateral asymmetry of the face and obtain an accurate occlusal plane.

Conclusion:

Within the limitations of the study, it can be concluded that there are asymmetries on ala-tragus planes on left and right side of the face and if not taken into consideration these can result in inappropriate analysis of occlusal plane, hampering the occlusion of the prosthesis. Hence, it should not be mandatory to take same points on both sides of ala-tragus for every individual. The dental graduates should also be made aware of the fact that facial asymmetries can affect the ala-tragus plane and this consideration should be made part of the routine practice. After evaluating the values from the subjects, it can also be concluded that the posterior plane most parallel to the occlusal plane in Chhattisgarh population is the plane that passes from the middle of the tragus. This study opens horizons for further research and explains the drawbacks of the routinely followed practices. Hence we can conclude that there is a necessity for modifications to the existing techniques that do not take the bilateral facial asymmetries in consideration.

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