

Comparison of Parallelism of Different Levels of Ala-Tragus Lines to Occlusal Plane in Dentate Subjects via Cephalometric Analysis: A Cross-sectional Study

MANASVI JAMWAL¹, SANJEEV MITTAL², URVASHI SUKHIJA³,
JEEWAN BACHAN DHINDSA⁴, JASKIRAT SINGH⁵, MANINI MONICA⁶



ABSTRACT

Introduction: In prosthodontics, fabrication of Complete Denture (CD) is a challenging task because numerous factors have to be taken care of while rehabilitating the patients. The establishment of Occlusal Plane (OP) should be adaptable with the functional activity of the stomatognathic system.

Aim: To ascertain the parallelism of different levels of ala-tragus lines to the OP in class 1 occlusion among dentate subjects via cephalometric analysis.

Materials and Methods: A cross-sectional study was conducted in the Department of Prosthodontics, Maharishi Markandeshwar College of Dental Sciences and Research, Mullana, Ambala, February 2020 to September 2021. A total of 100 subjects were included in the study which included 50 males and 50 females. The various cephalometric parameters traced were Sella (S), Gnathion (Gn), OP, Anterior Nasal Spine (ANS). Metallic balls were placed

on the lower border of ala of nose and tragus which was divided into three parts: Superior (S), Middle (M), and Inferior (I). Lateral cephalograms were shot for all subjects. The data collected was tabulated for easy interpretation and subjected to statistical analysis using Analysis of Variance (ANOVA), post-hoc test.

Results: The mean angular measurement of angle I was highest followed by angle OP, angle M and least in angle S in both males and females. The comparison of the mean angle S was found to be significant ($p < 0.001$) when subjected to one way ANOVA test, there was non-significant difference observed between angle OP and Angle I in males (p -value 0.464), and Angle OP and Angle M in females (p -value 0.984).

Conclusion: Clinically, from the present cephalometric study it can be suggested that in males, the inferior point on the tragus and in females, the middle point on the tragus can be used to mark the Camper's plane.

Keywords: Campers plane, Dentulous, Lateral cephalogram, Plane of occlusion

INTRODUCTION

In today's fast changing world, the demand for facial aesthetics and harmony has come to the forefront, thus increasing the desire of an individual for an improved smile and more aesthetically pleasing facial appearance along with all the customary functions, hence the vertical orientation and proportions play an extensive role in facial uniformity [1]. In prosthodontics, fabrication of CD is quite an arduous task because numerous mechanical and biological factors have to be kept in mind while performing the rehabilitation procedures. For the best possible prognosis in completely edentulous patients, the occlusion should be established in such a way that it is adaptable with the functional activity of the stomatognathic system [2].

According to Kurth, "the horizontal OP is undoubtedly the most important single plane to be determined in CD" [3]. Generative Pre-trained Transformer (GPT)-8 defines OP as "The average plane made by the incisal and occlusal surfaces of the teeth. Mostly, it constitutes the planar mean of the curvature of these surfaces but it is not a plane, the surface of wax occlusal rims contoured to guide in the arrangement of the denture teeth, a flat metallic plate used in arranging denture teeth" [4]. The orientation of the OP anteriorly and posteriorly affects physiologic functions inside the oral cavity along with aesthetics. An adequate height and width of the OP is necessary for the adequate buccolingual exchange and control of food bolus, plus speech along with articulation, space which the tongue occupies and soft tissue support [5]. Various publications suggest that the ala-tragus or Camper's plane is parallel to OP but there is a certain level of controversy as to which point on the tragus can be used while marking this line [6].

The aim of this study was to determine the parallelism of different levels of ala-tragus lines to the OP in class 1 occlusion using various tragus markings i.e., inferior, middle and superior.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Department of Prosthodontics including crown and bridge, Maharishi Markandeshwar College of Dental Sciences and Research, Mullana, Ambala, February 2020 to September 2021. This study was approved by the Institutional Research Committee and Institutional Ethical Committee (Project No. 1569, dated 14.12.2019).

Total of 100 dentate subjects, 50 males and 50 females were included in the study according to following inclusion and exclusion criteria using OpenEpi software version 3.

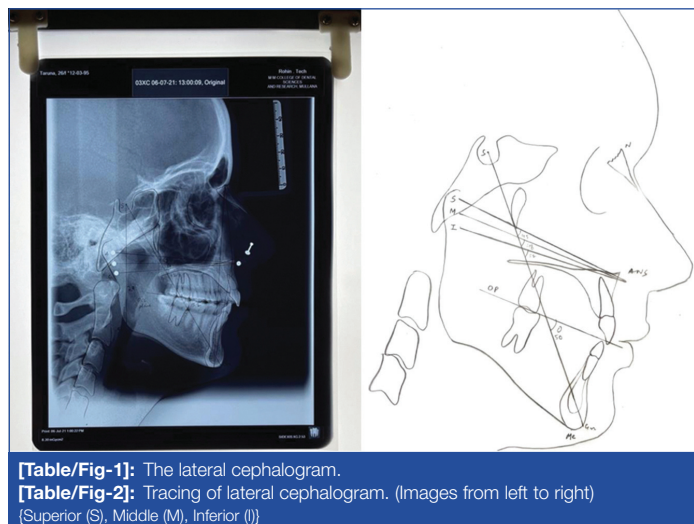
Inclusion criteria: Subject's having a full complement of permanent dentition (excluding 3rd molars), subjects with angle's class 1 molar relationship, subjects in age group of 18-30 years.

Exclusion criteria: Conditions with loss of tooth structure like attrition, periodontal disease etc., history of Temporomandibular Joint (TMJ) disorders, large scale restorations like bridges (which included more than four units) in the maxillary/mandibular posterior arch, any history of ongoing or previous Orthodontic treatment, any congenital facial defects and facial asymmetries.

Study Procedure

On every subject, digital vernier calliper was used to measure the exact length of the tragus. Three points were marked on the tragus, the superior, middle and inferior using an indelible pencil, lower border of

the ala of the nose was also marked. The radiopaque markers/metallic balls having a diameter of 1 mm were adhered to these markings using double sided tape, so that these points were radiopaque and visible on the radiograph [Table/Fig-1]. For the sake of uniformity, right side of the subject's face was chosen while making the markings. Subjects were then positioned in cephalostat (Lateral cephalogram X-ray unit), a standard distance of five feet was kept between the X-ray target and mid sagittal plane of the head. Lateral cephalograms were taken by a standard technique with the mandible closed in maximum intercuspation. Processing was done using an automatic processor. After developing, the cephalograms were visualised on an X-ray viewer and traced using acetate films [Table/Fig-2].



[Table/Fig-1]: The lateral cephalogram.
[Table/Fig-2]: Tracing of lateral cephalogram. (Images from left to right) (Superior (S), Middle (M), Inferior (I))

Procedure for evaluation of occlusal plane parallelism with Campers plane:

The anatomical points used in the cephalograms were:

- Sella (S) was marked from the deepest point in the middle of the sella tursica contour.
- Gnathion (Gn) was marked as the lowest point on the anterior margin of the lower jaw in the mid-sagittal plane.
- Mid-incisal point of the maxillary central incisors to the mesio-palatal cusp of the maxillary first molar was the anatomical landmarks used to mark the OP.
- Superior (S), middle (M) and inferior (I) points were traced on the tragus.

(1) Cephalometric planes

- Plane of occlusion: was traced as a line extending from the mid-incisal point of the maxillary central incisors to the mesio-palatal cusp of the maxillary first molar.
- Camper plane S- was marked as a line joining lower border of ala of the nose to superior border of tragus.
- Camper plane M- was marked as a line joining lower border of ala of the nose to middle border of tragus
- Camper plane I- was marked as a line joining lower border of ala of the nose to inferior border of tragus
- S-Gn plane- was marked as a plane joining anatomical point Sella to Gnathion. The protractor was kept on the S-Gn plane intersecting the OP and the angles were marked [2].

(2) Cephalometric angles

- Camper's plane angle S- is formed when S-Gn plane intersects Camper's plane S
- Camper's plane angle M- is formed when S-Gn plane intersects Camper's plane M
- Camper's plane angle I- is formed when S-Gn plane intersects Camper's plane I
- Angle OP- is formed when S-Gn plane intersects OP [2].

STATISTICAL ANALYSIS

The data collected was tabulated for easy interpretation and subjected to statistical analysis using ANOVA, post-hoc test using Statistical Package for Social Sciences (SPSS) software.

RESULTS

The sample size comprising of 50 males and 50 females had a mean (standard deviation) age: 23.91(6.23) years. The mean angular measurement of angle I was highest followed by angle OP, angle M and least in angle S in both males and females [Table/Fig-3].

Angle	Male		Mini-mum	Maxi-mum	Female		Mini-mum	Maxi-mum
	Mean±SD				Mean±SD			
Angle S	45.92	3.492	39	57	47.78	4.057	39	57
Angle M	49.84	3.616	42	60	51.62	4.125	42	60
Angle I	53.44	3.459	46	63	55.48	4.273	46	64
Angle OP	52.44	3.111	43	58	51.92	4.203	43	69

[Table/Fig-3]: Descriptive statistics of various angles in males, females.

The comparison of the mean angles was found to be significant (p<0.001) when subjected to one way ANOVA test [Table/Fig-4]. In order to find out which angle is not significantly different from angle OP, multiple comparison (post-hoc) were carried out test using Bonferroni Tukey's method. From multiple comparison table [Table/Fig-5], present study showed that in males, there was a significant difference between angle OP and angle S, angle M. however, difference was insignificant (p-value 0.464) between angle OP and angle I. Therefore, present study concluded that angle I is nearest to angle OP.

Subjects	F-value	p-value	NS/S
Male	48.007	0.001	S
Female	28.540	0.001	S

[Table/Fig-4]: Anova statistical analysis for comparison of angles in males, females. NS: Non significant; S: Significant; *Statistically significant

Subjects	Angle	Mean diff. (I-J)	Std. Error	p-value	95% confidence interval of the difference	
					Lower	Upper
Male	Angle S	6.520*	0.685	<0.001	4.75	8.29
	Angle M	2.600*	0.685	0.001	0.83	4.37
	Angle I	-1.000.	0.685	0.464	-2.77	0.77
Female	Angle S	4.140*	0.833	<0.001	1.98	6.30
	Angle M	0.300	0.833	0.984	-1.86	2.46
	Angle I	-3.560*	0.833	<0.001	-5.72	-1.40

[Table/Fig-5]: Multiple comparisons of mean angular relationship of occlusal plane Angle OP (I) with ala-tragus angle S, M and I (J) using post-hoc test of Tukey's in males, females.

Similarly, in females, there was no significant difference (P. 984) observed only between angle OP and angle M, therefore angle M is nearest to angle OP [Table/Fig-3].

DISCUSSION

In the present study, it was seen that for males, the inferior point, whereas, for females, the middle point on the tragus was the most accurate point for marking ala-tragus line for establishing OP. Since, time immemorial, prosthodontists have always faced different challenges during the fabrication of CD in order to meet the physiological, esthetic and functional needs of various patients. The process of rehabilitating completely edentulous patients involves establishing the plane of occlusion and vertical dimension which is an important determinant that helps in the prognosis of a case [6-9].

In CD, the proper height of the OP is very important as it helps the dentures to be functionally and esthetically acceptable to patients. In the anterior region, it helps in proper phonetics and better esthetics, whereas in the posterior region it forms a surface to chew on. Any differences in OP can disturb the harmony between tongue, buccinator muscle and mandibular teeth [4]. Although there are various guidelines used to establish the plane of occlusion, ala-tragus seems to be the most commonly used. Various studies [4,7,10,11] have shown that the tragus can be divided into three points/parts that is the superior, middle and inferior which can be used to further establish the OP. For this, various methods intraoral and extraoral have been proposed by different authors [2,6]. The retromolar pad area, parotid papillae, buccinator groove, Hamular notch Incisive Plane (HIP), commissure of lips are included under intraoral landmarks or planes. The accuracy of these landmarks based on their location and identification intraorally is still controversial.

It has been found that the Camper's plane is most frequently used to locate the posterior OP and interpupillary line is also most frequently used to establish the anterior OP [3]. Nissan J et al., Sadr K et al., Gupta R et al., Rajawat I et al., have advocated the use of superior border of tragus as a specification to mark the ala-tragus line [12-15]. Shigli K et al., Bondekar V et al., Abi-Ghosn C et al., have suggested using the middle part of the tragus as a reference for marking ala-tragus line [10,16,17]; whereas Karkazis HC et al., Rostamkhani F et al., Chaturvedi S et al., Kumar S et al., Shetty S et al., have advocated that the inferior border of tragus should be used as a posterior reference point to establish the ala-tragus line [18-22]. For this study right lateral cephalograms were used to study the relationship between the three camper planes and OP. These lateral cephalograms were a standardised modality for all subjects as they helped us to study the relationship between different cranial reference planes plus it was a better method of determining the OP in comparison to digital photographs [7,11,23-24].

Angular measurements are used in cephalometric analysis which are relatively reliable over years and are less affected by age. They can give us valuable information about the orientation of OP in dentulous and edentulous subjects [25]. It was seen that angle S, M and I were significantly higher in females as compared to males, angle OP was not found to be significantly different across gender, when compared using independent t test. On the other hand, angle S, M and I were higher in males as compared to females in a study by Chaturvedi S et al., [20].

In males, on comparing angle OP with angle S, M and I, insignificant difference was observed between angle OP and I which means inferior point marked on tragus is the most appropriate point for marking ala-tragus line. The results of the present study for males are in agreement with studies done by, Karkazis HC et al., Rostamkhani F et al., Chaturvedi S et al., Kumar S et al., Shetty S et al., who found that OP in dentulous subjects was parallel to the line drawn from ala of the nose to inferior border of tragus [18-22]. In females, on comparing angle OP with angle S, M and I, insignificant difference is observed between angle OP and M. Results of the present study for females are in agreement with studies conducted by Shigli K et al., Bondekar V et al., and Abi-Ghosn C et al., who advocated using the middle part of tragus as a reference point for marking the ala-tragus line [10,16,17]. Gandhi N et al., conducted a study in 100 subjects where it was found that the inferior point on tragus was the most accurate point for marking ala-tragus line [25]. In contradiction to the present study, Chaturvedi S et al., and Kumar S et al., advocated that there was no significant influence of sex for the determination of the OP as difference in sex does not cause any discrepancies in the angular

relationship between FH plane and ala-tragus line as well as the OP and ala-tragus line [20,21].

Limitation(s)

Notable limitations of the current study are that the effect of age on the ala of nose and tragus was not considered as it could have an effect on the orientation of OP in elderly edentulous subjects. Also, the present study included subjects with class I malocclusion only, so its use is limited in class II and class III subjects. Examination of only two dimensions of face was carried out in the lateral cephalograms; clinical information and soft tissue dimensions were not included. All of these factors can be researched on in the upcoming years.

CONCLUSION(S)

Within the limitations of the present study, it was concluded that in males, the inferior point, whereas, in females, the middle point on the tragus is the most accurate point for marking ala-tragus line for establishing OP. Cephalometric analysis can be used as a reference to understand the direction of the treatment planning.

REFERENCES

- Maskey S, Shrestha R. Cephalometric approach to vertical facial height. *Orthod J Nepal*. 2019;9(1):54-58.
- Venugopalan S, Satishbabu C, Rani M. Determination of the relative parallelism of occlusal plane to three ala-tragal lines in various skeletal malocclusions: A cephalometric study. *Indian J Dent Res*. 2012;23(6):719-25.
- Kurth LE. Posterior occlusal plane in full denture construction. *J Am Dent Assoc*. 1940;27:85-93.
- GPT-8 Glossary of Prosthodontic Terms, Edition 8, *J Prosthet Dent*. 2005;94:01-92.
- Allen LR. Improved phonetics in denture construction. *J Prosthet Dent*. 1958;8:753-63.
- Monteith BD. A cephalometric method to determine the angulation of the occlusal plane in edentulous subjects. *J Prosthet Dent*. 1985;54:81-86.
- Hartono R. The occlusal plane in relation to facial types. *J Prosthet Dent*. 1967;17(6):549-58.
- Bassi F, Deregibus A, Previgliano V, Bracco P, Preti G. Evaluation of the utility of cephalometric parameters in constructing complete denture. Part I: Placement of posterior teeth. *J Oral Rehabil*. 2001;28(3):234-38.
- Çiftçi Y, Kocadereli I, Canay Ş, Şenyılmaz P. Cephalometric evaluation of maxillomandibular relationships in patients wearing complete dentures: A pilot study. *Angle Orthod*. 2004;75(5):821-25.
- Shigli K, Chetal BR, Jabade J. Validity of soft tissue landmarks in determining the occlusal plane. *J Indian Prosthodont Soc*. 2005;5(3):139.
- Ogawa T, Koyano K, Suetsugu T. Characteristics of masticatory movement in relation to inclination of occlusal plane. *J Oral Rehabil*. 1997;24(9):652-57.
- Nissan J, Barnea E, Zeltzer C, Cardash HS. Relationship between occlusal plane determinants and craniofacial structures. *J Oral Rehabil*. 2003;30(6):587-91.
- Sadr K, Sadr M. A study of parallelism of the occlusal plane and ala-tragus line. *J Dent Res Dent Clin Dent Prospects*. 2009;3(4):107.
- Gupta R, Aeran H, Singh SP. Relationship of anatomic landmarks with occlusal plane. *J Indian Prosthodont Soc*. 2009;9(3):142.
- Rajawat I, Venkataramana V, Patil P, Guram G, Gupta N, Lau M, et al. A cephalometric evaluation for co-relation of different facial types with occlusal plane in dentulous and edentulous patients. *Oral Health Dent Manag*. 2014;13(4):1188-91.
- Bondekar V, Wagh SB, Attal PN, Pandey VR. Evaluation of relation between occlusal plane and ala-tragus line with the help of cephalometry. *J Adv Med Dent Scie Res*. 2015;3(6):S43.
- Abi-Ghosn C, Zogheib C, Younes R, Makzoum JE. The ala-tragus line as a guide for orientation of the occlusal plane in complete dentures. *J Contemp Dent Pract*. 2014;15(1):108.
- Karkazis HC, Polyzois GL. Cephalometrically predicted occlusal plane: Implications in removable prosthodontics. *J Prosthet Dent*. 1991;65(2):258-64.
- Rostamkhani F, Sahafian A, Kermani H. A cephalometric study on the relationship between the occlusal plane, ala-tragus and Camper's lines, in patients with Angle's class III malocclusion. *Front Dent*. 2005;2(2):46-49.
- Chaturvedi S, Thombare R. Cephalometrically assessing the validity of superior, middle and inferior tragus points on ala-tragus line while establishing the occlusal plane in edentulous patient. *J Adv Prosthodont*. 2013;5(1):58-66.
- Kumar S, Garg S, Gupta S. A determination of occlusal plane comparing different levels of the tragus to form ala-tragal line or Camper's line: A photographic study. *J Adv Prosthodont*. 2013;5(1):09-15.
- Shetty S, Shenoy KK, Ninan J, Mahaseth P. An evaluation of relation between the relative parallelism of occlusal plane to ala-tragal line and variation in the angulation of Po-Na-ANS angle in dentulous subjects: A cephalometric study. *J Indian Prosthodont Soc*. 2015;15(2):168.
- Sinobad D. The position of the occlusal plane in dentulous subjects with various skeletal jaw-relationships. *J Oral Rehabil*. 1988;15(5):489-98.

[24] D'Souza NL, Bhargava K. A cephalometric study comparing the occlusal plane in dentulous and edentulous subjects in relation to the maxillomandibular space. *J Prosthet Dent.* 1996;75(2):177-82.

[25] Gandhi N, Daniel S, Kurian N. Cephalometric study of the position of ala-tragus line in relation to Frankfort horizontal plane and occlusal plane among Ludhiana population. *Indian J Dent Sci.* 2017;9(3):165-69.

PARTICULARS OF CONTRIBUTORS:

1. Postgraduate, Department of Prosthodontics Including Crown and Bridge, Maharishi Markandeshwar College of Dental Sciences and Research, Ambala, Haryana, India.
2. Professor, Department of Prosthodontics Including Crown and Bridge, Maharishi Markandeshwar College of Dental Sciences and Research, Ambala, Haryana, India.
3. Professor, Department of Prosthodontics Including Crown and Bridge, Maharishi Markandeshwar College of Dental Sciences and Research, Ambala, Haryana, India.
4. Senior Lecturer, Department of Prosthodontics Including Crown and Bridge, Maharishi Markandeshwar College of Dental Sciences and Research, Ambala, Haryana, India.
5. Reader, Department of Orthodontics and Dentofacial Orthopaedics, RKDF Dental College, Bhopal, Madhya Pradesh, India.
6. Postgraduate, Department of Prosthodontics Including Crown and Bridge, Maharishi Markandeshwar College of Dental Sciences and Research, Ambala, Haryana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Manasvi Jamwal,
Hostel 8, Maharishi Markandeshwar University, Room No. 29, Ambala, Haryana, India.
E-mail: jamwal.manasvi@gmail.com

PLAGIARISM CHECKING METHODS: [\[Jan H et al.\]](#)

- Plagiarism X-checker: Sep 05, 2022
- Manual Googling: Oct 15, 2022
- iThenticate Software: Dec 08, 2022 (19%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Sep 04, 2022**

Date of Peer Review: **Oct 17, 2022**

Date of Acceptance: **Dec 09, 2022**

Date of Publishing: **Mar 01, 2023**