

## A Cephalometric Study To Evaluate Position Of The Occlusal Plane In Natural Dentition As Related To Other Craniofacial Planes

### Abstract

**Background :** Success of complete denture depends on many factors and among those factors, orientation of the plane of occlusion is an important one. The occlusal plane is lost in edentulous patients and should be relocated if complete dentures are to function satisfactorily

**Aim :** This study aimed at determining the most reliable ala-tragus line as a guide for the orientation of the occlusal plane in complete denture patients by use of cephalometric landmarks on dentate volunteers.

**Design :** Analysis was made for prosthodontically related craniofacial reference lines and angles of lateral cephalometric radiographs taken for 50 dentulous subjects adults. The subjects included in the study were both male and female with age group ranging from 18-25 years

**Results :** Occlusal plane angle formed between the occlusal plane and Camper's plane had the lowest mean value with AT2, which represents the measure taken from middle border of the tragus of the ear with score of 2.70

**Conclusion :** The middle ala tragal line was most parallel to occlusal plane followed by lower ala tragal line and upper ala tragal line was least parallel to occlusal plane in the sample population. So, it can be concluded that the inferior border of the nose with the middle border of the tragus was most accurate in orienting the occlusal plane in the sample population.

### Key Words

Occlusion; cephalometric; plane; orientation

### Introduction

The position of the occlusal plane forms the basis for ideal teeth arrangement, and fulfills the necessary mechanical, aesthetic and phonetic requirements, and aid in respiration and deglutition.<sup>[1]</sup> From the functional viewpoint, the occlusal table is a milling surface, strategically placed so that the tongue on the lingual side and the buccinator muscle on the buccal side are able to position the food bolus onto it and hold it there while mastication takes place. Faulty orientation of the occlusal plane in fixed or removable prostheses not only jeopardizes this interaction between tongue and buccinators muscle but also result in food collection in the sulcus, and in biting of the cheek or tongue.<sup>[4]</sup>

If the occlusal plane is incorrectly located, it results in malfunctions of the soft structures. An occlusal plane that is too high forces the tongue into a new position that is higher than its normal position. This causes the tongue to lose much of its functions. Furthermore, the higher position of the tongue causes the floor of the mouth to raise and create undue pressure on the border of the lingual flange. All of this can lead to disruption of the normal position of the

floor of the mouth and result in a partial loss of the border seal. An occlusal plane that is too high creates unnecessary troubles, while an occlusal plane that is slightly low causes no problems for denture patients.<sup>[6]</sup> But if the occlusal plane is placed too low, it would lead to tongue and cheek biting.<sup>[4]</sup>

It is generally agreed that in the anterior region the vertical height of the occlusal plane is governed by esthetic requirements<sup>[2], [7]</sup> and less frequently by functional demands.<sup>[2]</sup> However, there are contrasting views with regard to the orientation of the occlusal plane in the posterior region.<sup>[7]</sup> There are differences in the literature concerning which part of the tragus to use, since some researchers believe in using the lower border of the tragus, others believe in using the middle part of the tragus, and still others believe in using the upper part.<sup>[5]</sup>

### Materials And Methods

The present study was carried out on young dentulous students and patients visiting the outpatient department of the institute. The subjects included in the study were both male and female with age group ranging from 18-25 years. A total number of 50 subjects were included

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in the study. The criteria for selection of these patients were as follows.

### Armamentarium used

1. Cephalograph using Planmeca (ProlineCeph PM 2002)
2. Tracing sheets (Acetate)
3. Viewing box (Conventional)
4. Geometry box
5. Adhesive tape
6. Radiopaque markers (Lead foil and Metal pallets)
7. Sticky wax (Maarc)
8. Indelible pencil (HB)

The patient was seated on the dental chair in an upright position. A point T1 was marked on the superior aspect of the tragus and another point T2 at the middle aspect of tragus and T3 at the inferior aspect of the tragus. The distance between T1 and T3 was measured with the help of divider and scale. Lead foil was cut in the shape of a equilateral triangle having dimensions equal to the length of the tragus (T1 to T3) marked on each subject. Triangular lead foil was placed in

front of tragus of ear on left side, with base of the triangle away from tragus and the apex of the triangle pointed posteriorly to the tragus so that the lowest angle between the occlusal plane and ala-tragus line at the superior, middle, and inferior border of the tragus could be identified. The lowest point on the inferior margin of the ala of the nose was identified and marked. Small metal pallet were attached on the lowest point of the left ala of the nose with the help of adhesive tape. Very small metal pallets were also attached to the incisal tip of left maxillary central incisor and mesiopalatal cusp tip of the left maxillary molar, with the help of sticky wax. Radiographs were obtained with the subject in standing position. After the cephalogram was obtained, tracing was done by placing radiograph on the conventional viewing box.

The cephalometric points used in the study were as follows.

1. Point A (Ala)
2. Point T1 (Point on the superior border of tragus)
3. Point T2 (Point on the middle border of tragus)
4. Point T3 (Point on the inferior border of tragus)
5. Point O (Orbitale)
6. Point P (Porion)
7. Point ANS (anterior nasal spine)
8. Point PNS (posterior nasal spine)

The cephalometric planes used in the study were as follows.

- Camp I Plane (A-T1)
- Camp II Plane (A-T2)
- Camp III Plane (A-T3)



Cephalometric Tracing

Frankfort horizontal plane (O-P)  
Maxillary Plane (ANS-PNS)

For the purpose of comparison, angles rather than linear measurements were used, since angles can be compared directly in individuals of different sizes without need of an index.

### The angles studied were

- Camp I- Occlusal Plane angle
  - Camp II- Occlusal Plane angle
  - Camp III- Occlusal Plane angle
  - Frankfort Horizontal Plane – Occlusal Plane angle
  - Maxillary Plane - Occlusal Plane angle
- The data thus obtained was subjected to statistical analysis.

### Results

The angular measurements obtained between the various ala-tragal lines (AT1, AT2, AT3) to occlusal plane. The maximum and minimum values of angles formed by occlusal plane and AT1 are 16 degrees and zero degree with majority of observations above ten degrees. The maximum and minimum values of angles formed by occlusal plane and AT3 were 16 degrees and zero degree with majority of observations below ten degrees.

The maximum and minimum values of angle formed by occlusal plane and AT2 were 10 degrees and zero degree with majority of observations below 5 degrees. This clearly shows that in maximum number of subjects AT2 had minimum range of variation. The angular measurement was obtained between Maxillary plane and Frankfurt plane to Occlusal plane. The maximum and minimum values of angles formed by Occlusal plane and Maxillary plane were 15 degrees and zero degree with majority

of observations above ten degrees. The maximum and minimum values of angles formed by Occlusal plane and FH Plane were 16 degrees and zero degree with majority of observations above ten degrees. So no significant correlation could be seen between these two planes and the Occlusal plane. So from these observations it could be inferred that no significant correlation was seen between these two planes and the Occlusal plane. The tabulated results showed a significant difference between the angles formed by the three Ala tragus lines, Maxillary plane and FH plane to the Occlusal plane. The highest mean angle of Occlusal plane was with AT1 followed by Maxillary plane (ANS-PNS), Frankfurt horizontal plane (P-O), AT3 and AT2. So occlusal plane angle formed between the occlusal plane and Camper's plane had the lowest mean value with AT2, which represented the measure taken from middle border of the tragus of the ear with score of 2.70. The highest value was measured in the mean angle formed with AT1 was 9.540. The mean angle formed with AT3, Maxillary plane, FH plane were 4.80, 8.90, 8.40 respectively

### Discussion

Complete dentures are constructed to function in the mouth as an integral part of the masticatory system; therefore, they should be designed to conform to the patient's physiologic jaw relations. The plane of occlusion forms one essential physiologic concept of jaw relation and occlusion. The plane of occlusion in complete dentures has often been oriented anteriorly to fulfill aesthetic requirements and posteriorly parallel to Camper's line, which is a horizontal line drawn through the lower part of the nose and the orifice of the ear.<sup>[3]</sup>

According to surveys<sup>[8]</sup>, occlusal plane orientation differs considerably among various schools in Japan, the US, and Canada; however, the most widely used method in determining the plane of occlusion was the ala-tragus line method. Zarb et al suggested anatomical landmarks that clinically determine the plane of occlusion. They said that the occlusal plane should be parallel to the hamular notch-incisive papilla plane, whereas other researchers have reported a close relationship between the ala-tragus line and occlusal plane.<sup>[8]</sup>

Many investigations have been carried out to compare the occlusal plane orientation before extraction of natural

Angle Between Occlusal Plane In Subjects And At1, At2, At3, Maxillary Plane And Frankfurt Horizontal Plane

Various Planes	N	Mean	Standard Deviation	Standard Error Of Mean
AT1	50	9.5400	3.91861	0.55418
AT2	50	2.7000	2.60494	0.36839
AT3	50	4.8200	4.24115	0.59979
Ans-pns	50	8.9800	3.77689	0.53413
O-P	50	8.4000	3.44046	0.48655

### Student T – Test

Various Planes	T	Degree of freedom	P-Value	Mean Difference	95% confidence interval of the difference	
					Lower	Upper
AT1	17.215	49	0.001**	9.5400	8.4263	10.6537
AT2	7.329	49	0.001**	2.7000	1.9597	3.4403
AT3	8.036	49	0.001**	4.8200	3.6147	6.0253
ANS-PNS	16.812	49	0.001**	8.9800	7.9066	10.0534
O-P	17.264	49	0.001**	8.4000	7.4222	9.3778

teeth and when artificial teeth were arranged so that the artificial occlusal plane paralleled the ala-tragus line. In the literature, there is controversy in defining the ala-tragus line or the Camper's plane, which is considered the most popular plane used to orient the occlusal plane in edentulous patients. Definition of the Camper's line causes confusion, because the exact reference points are controversial. For example, the Glossary of Prosthodontic Terms states that the Camper's line runs from the inferior border of the ala of the nose to the superior border of the tragus, while according to Spratley it runs from the center of the ala to the center of the tragus. Basker et al, Grant and Johnson, and Neill and Naim provide only pictorial representation, illustrating Camper's line as extending to a point, not at the superior border, but at the center of the tragus of the ear, corresponding to the definition of Ismail and Bowman.<sup>[9]</sup>

The result of this study is in agreement with a study done by Solomon et al who found that Camper's plane was parallel to the occlusal plane when the tragus reference point was situated between the superior border and the middle of the tragus. Spratley states that Camper's line runs from the center of the ala to the center of the tragus. Neill and Naim provide only pictorial representation, illustrating Camper's line as extending to a point, not at the superior border, but at the center of the tragus of the ear, corresponding to the definition of Ismail and Bowman.<sup>[9]</sup> Van Niekerk et al used the inferior border of the tragus as the posterior border of the ala-tragus line, whereas Glossary of Prosthodontic Terms<sup>[10]</sup> states that the Camper's line runs from the inferior border of the ala of the nose to the superior border of the tragus. This study additionally also focused on to explore the possible correlation between the angle formed by the intersection of the occlusal and maxillary planes and similarly if any significant correlation existed between occlusal plane and Frankfurt horizontal plane. The ANS-PNS line represents the skeletal base. The results showed no correlation with occlusal plane. No evidence was found that any of the two studied parameters (Frankfurt horizontal plane, Maxillary plane (ANS-PNS) could be used as a reliable guideline for determination of the occlusal plane in the population included in the study. However the study was carried out on a

local population and further studies can be carried out on a larger sample size. Secondly, different head forms were not considered as a part of the study, so, further studies can be carried out on subjects with different head forms.

### Conclusion

Within the limitations of the present study following conclusions could be drawn

1. The middle alatrugal line was most parallel to occlusal plane followed by lower alatrugal line and upper alatrugal line was least parallel to occlusal plane. So, it can be concluded that the inferior border of the nose with the middle border of the tragus was most accurate in orienting the occlusal plane in the sample population.
2. Frankfurt horizontal plane and Maxillary plane did not show any correlation with the occlusal plane. So it can be concluded these planes cannot be used as a reliable guideline for the determination of occlusal plane in the sample population.

### Summary

Complete dentures are constructed to function in the mouth as an integral part of the masticatory system; therefore, they should be designed to conform to the patient's physiologic jaw relations. The plane of occlusion forms one essential physiologic concept of jaw relation and occlusion. The plane of occlusion in complete dentures has often been oriented anteriorly to fulfill esthetic requirements and posteriorly parallel to Camper's line, which is a horizontal line drawn through the lower part of the nose and the orifice of the ear. Success of complete denture depends on many factors and among those factors, orientation of the plane of occlusion is an important one. The occlusal plane is lost in edentulous patients and should be relocated if complete dentures are to function satisfactorily. The position of the occlusal plane forms the basis for ideal teeth arrangement, fulfills the necessary mechanical, aesthetic and phonetic requirements and aid in respiration and deglutition. The study was aimed at determining which of the three positions on the tragus, that is superior, middle or inferior, when joined with the inferior border of the ala of the nose enabled the clinician to establish an

ala-tragal line that was most parallel to the natural occlusal plane, in dentulous subjects so that this reference could be used to determine the occlusal plane in edentulous patients during the fabrication of complete dentures. Also this study was aimed to find out any relationship between occlusal plane and other craniofacial planes such as Frankfurt horizontal plane and Maxillary plane but did not show any correlation with the occlusal plane, however the middle alatrugal line was most parallel to occlusal plane.

### References

1. Silverman, S. I.: Denture prosthesis and Functional anatomy of the maxillofacial structure, J Prosthet Dent 1956; 6:305-331.
2. Celebic A, Valentic-Peruzovic M, Kraljevic K, Brkic H.A. study of the occlusal plane orientation by intra-oral method. J Oral Rehab 1995; 22: 233-236.
3. Karkazis H.C., Polyzois G.L. and Zissis A.J. Relationship between ala-tragus line and natural occlusal plane. Implication in denture prosthodontics. Q J Dent 1985; 17: 253.
4. Monteith B.D. A Cephalometric method to determine the angulation of the occlusal plane in edentulous patients. J. Prosthet Dent 1985; 54:81.
5. Yahia H. Ismail and John F. Bowman. Position of the occlusal plane in natural and artificial teeth. J Prosthet Dent 1968; 20:407-411.
6. Wright, C.R., Swartz, W.H., and Godwin, W.C.: Mandibular Denture Stability, Ann Arbor, 1961, The Overbeck Company.
7. Carey PD. Occlusal Plane orientation and masticatory performance of complete denture. J Prosthet Dent 1978; 39:368
8. Simpson JW, Hesby RA, Pfeifer DL and Pelleu GB, Jr.: Arbitrary mandibular hinge axis location. J Prosthet Dent 1984; 51(6): 819-822.
9. Simpson JW, Hesby RA, Pfeifer DL and Pelleu GB, Jr.: Arbitrary mandibular hinge axis location. J Prosthet Dent 1984; 51(6): 819-822.
10. Spratley MH: A simplified technique for determining the occlusal plane in full denture construction. J Oral Rehabil 1980; 7(1): 31-33.

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