

# A Cephalometric Study on the Relationship Between the Occlusal Plane, Ala-Tragus and Camper's Lines in Subjects with Angle's Class I, Class II and Class III Occlusion

Manesh Lahori · Rahul Nagrath · Niti Malik

Received: 21 June 2012 / Accepted: 4 November 2012 / Published online: 22 November 2012  
© Indian Prosthodontic Society 2012

**Abstract** Considering the importance of the occlusal plane orientation in complete denture prostheses, a study was conducted on the relationship between this plane with ala-tragus and Camper's lines in soft tissue among individuals with class I, class II and class III occlusion. The aim of the present study was to define the best soft tissue index by which the location and inclination of the occlusal plane in complete dentures could be established. A total of 60 subjects were selected for the study. Lateral cephalograms of these subjects were obtained. Tracings and analysis was done to confirm to the skeletal relationship of subjects to be class I (normal), class II (prognathic maxilla) and class III (retrognathic maxilla). 20 Subjects of each group were screened for further analysis. Radiopaque markers were attached to the intended points on soft tissue and then standard lateral cephalograms were obtained from each subject. The angles between the following lines were measured: Occlusal line, Camper's line (ala-porion), AT1 (ala-superior border of tragus), AT2 (ala-mid-tragus) and AT3 (ala-inferior border of tragus). The mean values and standard deviations were calculated for all the groups. The mean values calculated were subjected to repeated ANOVA test and significance was evaluated. Comparison of the results by the ANOVA test exhibited a significant difference. In class I subjects, it was evaluated that in 75 % individuals, the posterior reference point was found to be the mid-tragus; of class II subjects, in 60 % individuals, the

posterior reference point was found to be the mid-tragus; and of class III subjects, in 75 % individuals, the posterior reference point was found to be the inferior border of tragus.

**Keywords** Occlusal plane · Camper's line · Occlusion

## Introduction

Orientation of the occlusal plane is one of the most important clinical procedures in prosthodontic rehabilitation of edentulous patients. Because of its effect on aesthetics, function and denture stability, it should be reconstructed as identical as possible to the occlusal plane of missing natural teeth [1]. According to *The Glossary of Prosthodontics Terms* (eighth edition) [2], occlusal plane has been 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”.

There are various methods that utilize intraoral and extraoral landmarks for orientation of the occlusal plane. The use of the ala-tragus line to orient the occlusal plane is advocated by some authors. However, there is some controversy on the posterior point of reference of the ala-tragus line [3].

*The Glossary of Prosthodontics Terms* (eighth edition) [2] states that the ala-tragus line runs from the inferior border of the ala of the nose to some defined point on the tragus of the ear, usually considered to the tip of the tragus. It does not stipulate which part of the tragus should be used as the posterior landmark.

According to contemporary concepts, position of the occlusal plane in denture wearer should be same as it was present in their dentulous subjects [4].

---

**Electronic supplementary material** The online version of this article (doi:10.1007/s13191-012-0215-9) contains supplementary material, which is available to authorized users.

---

M. Lahori (✉) · R. Nagrath · N. Malik  
Department of Prosthodontics, KD Dental College and Hospital,  
Mathura, UP, India  
e-mail: maneshlahori@gmail.com

Considering the probable difference between the inclination of the occlusal plane in Angle's class II and class III as compared to class I subjects, the present study was performed to determine the relationship between the occlusal plane, ala-tragus and Camper's line on dentulous subjects and to distinguish the posterior point of reference of ala-tragus line in Angle's class I, class II and class III subjects.

## Aims and Objectives

### Aim

The aim of the study is to define the best soft tissue index (keeping anterior reference point as inferior border of ala constant and distinguishing the posterior reference point of tragus), by which the location and inclination of the occlusal plane in complete dentures can be established.

### Objectives

1. To evaluate the relation of ala-tragus line to natural dentition.
2. To evaluate the ala-tragus line as a guide to determine the occlusal plane in edentulous patient.
3. To correlate its inclination with cephalometric landmarks.
4. To distinguish the posterior reference point of ala-tragus line in skeletal class I, class II and class III subjects.

## Materials and Method

### Criteria for Selection of Dentulous Subjects

1. Completely dentulous subjects with Angle's class I, class II and class III occlusal relationship.
2. Subjects in the age group between 19 and 25 years.
3. Pleasing profile (no facial asymmetry and craniofacial anomaly)
4. SNA, SNB and ANB angles (with ANB = 2–4° for class I subjects, ANB >4° for class II and ANB <1° for class III subjects), taken into consideration for classifying subjects into class I, class II and class III.

### Criteria for Exclusion of Dentulous Subjects

1. Attrition.
2. Temporomandibular joint pathologies.
3. Extensive restorations in the posterior segments of the maxillary or mandibular arch.

4. History of orthodontic treatment.
5. Periodontally compromised patients.
6. More than one molar or premolar missing.
7. Restoration or crown on the anterior teeth.

## Methodology

A total of 60 subjects were selected for the study. Lateral cephalograms of these subjects were obtained. Tracings and analysis was done to confirm the skeletal relationship of subjects to be class I (normal), class II (prognathic maxilla) and class III (retrognathic maxilla). 20 Subjects of each group were screened for further analysis.

The patients were seated upright on the dental chair, with the head unsupported. The superior, middle and inferior border of tragus and lower border of the ala of the nose were marked with indelible pencil. Pinheads were adhered against the marks (Fig. 1), bonded on facial surface of distobuccal cusp of maxillary first molar and labio-incisal margin of maxillary central incisor (Fig. 2). The subjects were positioned in the cephalostat and right lateral cephalogram were taken by standard technique with mandible closed in the maximum intercuspation.

Once the lateral cephalograms were taken a digital cephalometric analysis was done. All tracings and measurements of the points, lines and angles were done in the analysis in accordance with certain definitions.

### Digital Cephalometric Analysis

#### (A) Points

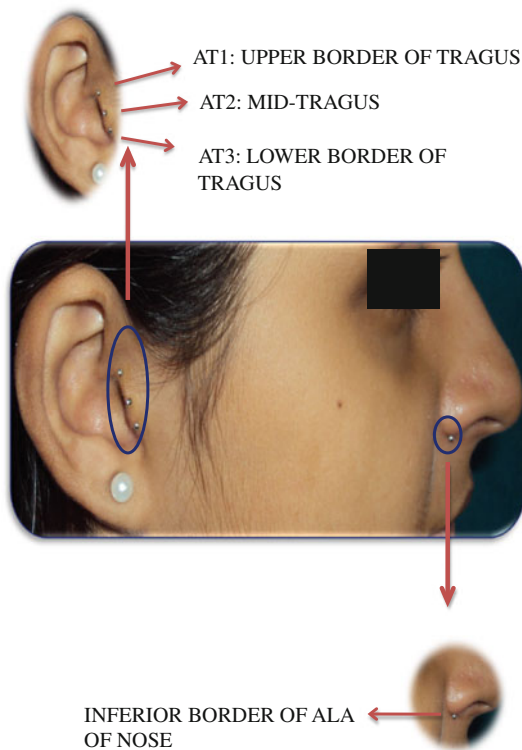
1. Point A (A): The point of deepest concavity on the anterior profile of the maxilla.
2. Point B(B): The point of deepest concavity on the anterior surface of the mandibular symphysis.
3. Nasion (N): The most anterior point on the fronto-nasal suture.
4. Sella (S): The midpoint of the sella turcica.

#### (B) Cephalometric Planes

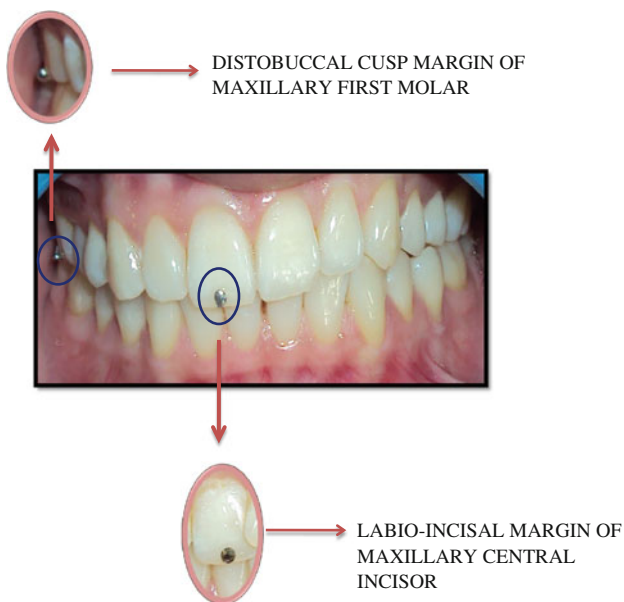
1. Occlusal plane (OC): Line joining the incisal edge of the maxillary central incisor to the distobuccal cusp apex of the maxillary first molar.
2. Camper's line: Lower border of ala of nose to porion.
3. AT1: Lower border of ala of nose to superior border of tragus.
4. AT2: Lower border of ala of nose to mid-tragus.
5. AT3: Lower border of ala of nose to inferior border of tragus.

#### (C) Angular Measurements

Analysis 1: To Confirm the Skeletal Relation of the Subject (Fig. 3).

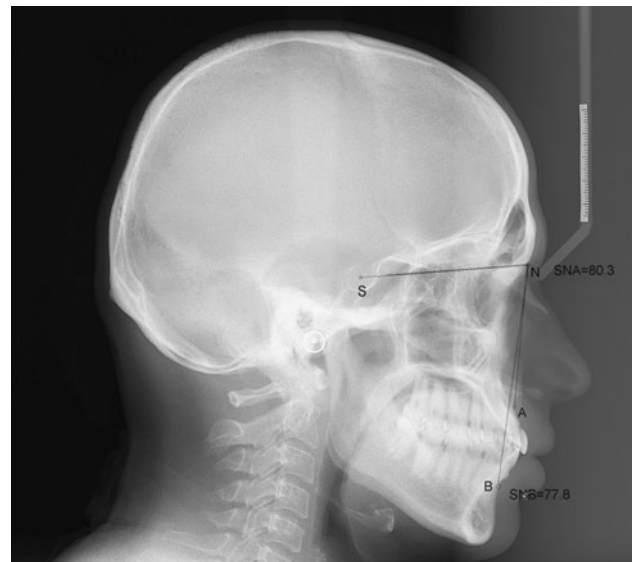


**Fig. 1** Radio-opaque markers placed on the patient extraorally



**Fig. 2** Radio-opaque markers placed on the patient intraorally

1. SNA angle: It is the angle formed by the intersection of S.N. plane and a line joining nasion and point A.
2. SNB angle: It is the angle between the S.N. plane and a line joining nasion and point B.
3. ANB angle: SNA–SNB.



**Fig. 3** Cephalogram after analysis 1

**ANALYSIS 2:** After Placement of Radio-Opaque Markers (Fig. 4)

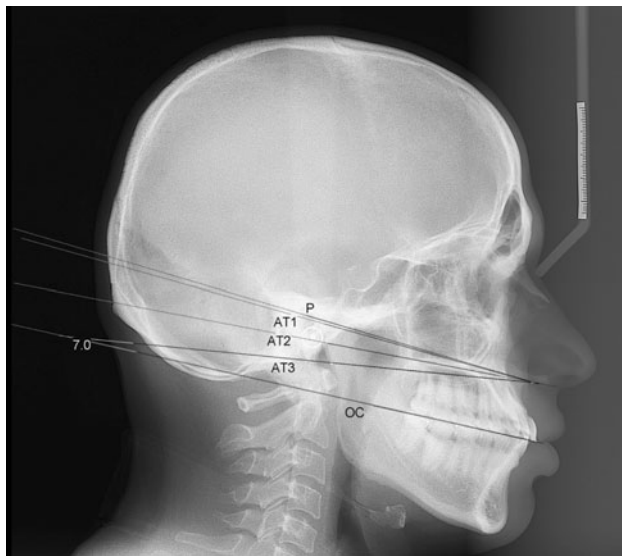
1. OC–AT1: Angle between occlusal plane and upper ala-tragus line
2. OC–AT2: Angle between occlusal plane and middle ala-tragus line.
3. OC–AT3: Angle between occlusal plane and lower ala-tragus line.
4. OC–P: Angle between occlusal plane and camper's plane.

## Results

### Statistical Analysis

1. To compare the relative parallelism of the ala tragus and Camper's plane to occlusal plane. All the data was collected and then the mean values were calculated for all the groups.
2. The mean values calculated were subjected to repeated ANOVA test and significance was evaluated.
3. Frequency and percentage calculations were done for each group to evaluate the variations of posterior reference points of dentulous subjects of each class I, class II and class III groups.

*For class I subjects*, the mean value for OC–AT1 were calculated to be as  $-4.4500$ , for OC–AT2 to be as  $-1.1000$ , for OC–AT3 to be as  $2.3000$  and OC–P to be as  $-6.5000$ . Standard deviation for OC–AT1 were calculated to be as  $3.25212$ , for OC–AT2 as  $3.00701$ , for OC–AT3 as  $3.54074$  and for OC–P as  $2.98240$  (Table 1).



**Fig. 4** Cephalogram after analysis 2

**Table 1** Mean values of class I subjects

Parameters	Mean (°)	Standard deviation (SD)	Minimum value	Maximum value
OC–AT1	–4.4500	3.25212	–13.00	–1.00
OC–AT2	–1.1000	3.00701	–8.00	2.00
OC–AT3	2.3000	3.54074	–6.00	7.00
OC–P	–6.5000	2.98240	–14.00	–3.00

It was evaluated that in 75 % of subjects, the posterior reference point was found to be the mid-tragus, in 15 % subjects to be inferior border of tragus and in 10 % subjects to be superior border of tragus (Supplementary material, Graph 1).

For class II subjects, the mean value for OC–AT1 were calculated to be as –4.6500, for OC–AT2 to be as –1.1500, for OC–AT3 to be as 2.3000 and OC–P to be as –6.6500. Standard deviation for OC–AT1 were calculated to be as 2.03328, for OC–AT2 as 1.89945, for OC–AT3 as 2.07998 and for OC–P as 1.87153 (Table 2).

It was evaluated that in 60 % of subjects, the posterior reference point was found to be the mid-tragus, in 35 % subjects to be inferior border of tragus and in 5 % subjects to be superior border of tragus (Supplementary material, Graph 2).

For class III subjects, the mean value for OC–AT1 were calculated to be as –5.8000, for OC–AT2 to be as –3.1000, for OC–AT3 to be as 0.4000 and OC–P to be as –8.2000. Standard deviation for OC–AT1 were calculated to be as 2.70672, for OC–AT2 as 2.71254, for OC–AT3 as 2.58335 and for OC–P as 3.28634 (Table 3).

It was evaluated that in 75 % of subjects, the posterior reference point was found to be the inferior border of

**Table 2** Mean values of class II subjects

Parameters	Mean (°)	Standard deviation (SD)	Minimum value	Maximum value
OC–AT1	–4.6500	2.03328	–9.00	–1.00
OC–AT2	–1.1500	1.89945	–5.00	2.00
OC–AT3	2.3000	2.07998	–2.00	6.00
OC–P	–6.6500	1.87153	–11.00	–4.00

**Table 3** Mean values of class III subjects

Parameters	Mean (°)	Standard deviation (SD)	Minimum value	Maximum value
OC–AT1	–5.8000	2.70672	–10.00	–3.00
OC–AT2	–3.1000	2.71254	–9.00	0.00
OC–AT3	0.4000	2.58335	–5.00	4.00
OC–P	–8.2000	3.28634	–16.00	–4.00

**Table 4** Repeated Anova test

	F value	P value	NS/S
Class I	400.330	0.000	S
Class II	618.083	0.000	S
Class III	219.203	0.000	S

tragus and in 25 % subjects to be mid-tragus (Supplementary material, Graph 3).

The mean values calculated were subjected to repeated ANOVA test and results were found to be significant (Table 4).

**Discussion**

The plane of occlusion has been recognized as an essential functional part of the craniofacial skeleton. Due to absence of any concrete intraoral or extraoral anatomical landmark, its determination is prone to subjective variation. Different authors have advocated the use of various landmarks for its determination. Guidelines such as the position of the tongue, retromolar pad, and Stenson’s duct bisecting the space between the residual ridges have been advocated [5].

The use of the ala-tragus line (Camper’s line) as a guideline has gained popularity since it is easily visualized, thus making the determination of plane of occlusion more convenient. Many studies have been carried out to determine the relationship between the plane of occlusion and the Camper’s plane [6].

A review of literature reveals that debate exists over the exact definition of the ala-tragus or Camper’s line. Most of the controversy revolves around which tragal reference is

to be considered as a posterior landmark during orientation of the plane of occlusion. Van Niekerk et al. [7] constructed the plane of occlusion according to their subjective criteria of esthetics, function, and comfort. The established plane of occlusion was then checked against the ala-tragus line only at the final denture insertion appointment. Their results showed a close relationship between the two planes if the tragal reference of the ala-tragus line was dropped to the inferior border of tragus.

According to Boucher [8], “It seems to be obvious that if the soft tissue surrounding the denture is to work around as they did around natural teeth, occlusal plane should be oriented exactly as it was when the natural teeth were present”. It has been suggested that such position of the occlusal plane enhance denture stability and functional value. Occlusal plane forms a basis for ideal teeth arrangement and also fulfils the necessary mechanical, esthetic requirement and aid in deglutition [9].

The current study was conducted on the relationship between the occlusal plane with ala-tragus and Camper’s line and also to distinguish the posterior reference point of ala-tragus line in class I, class II and class III subjects.

In order to investigate the inclination of the occlusal plane to the ala-tragus line, radio-opaque markers were attached to the skin to mark the superior, middle and inferior tragus points in the dentulous groups. The lines reflected between these points and the lower edge of ala of nose was used as reference. Radio-opaque markers were also attached intraorally over the facial surface of the distobuccal cusp margin of the maxillary first molar and the labio-incisal margin of maxillary central incisor. Subsequently right lateral cephalograms were obtained from each subject.

Results were found to be significant and are in accordance with the previous studies conducted by Rostamkhani et al. [1], Van Niekerk et al. [7], Karkazis and Polyzois [10], Singh [11], and Hindocha et al. [6].

## Conclusion

All the observations were analyzed and following conclusions were drawn:

1. In class I subjects, it was evaluated that in 75 % individuals, the posterior reference point was found to

be the mid-tragus, in 15 % individuals to be inferior border of tragus and in 10 % individuals to be superior border of tragus.

2. In class II subjects, it was evaluated that in 60 % individuals, the posterior reference point was found to be the mid-tragus, in 35 % individuals to be inferior border of tragus and in 5 % individuals to be superior border of tragus.
3. In class III subjects, it was evaluated that in 75 % individuals, the posterior reference point was found to be the inferior border of tragus and in 25 % individuals to be mid-tragus.
4. It can be concluded that the tragal difference in this study population was more towards the mid-tragus and inferior border of tragus. Therefore, the orientation of the plane of occlusion with the posterior landmark as superior border of tragus may be considered as questionable, based on the findings of this study.

## References

1. Rostamkhani F, Sahafian A, Kermani H (2005) A cephalometric study on the relationship between the occlusal plane, ala-tragus and Camper’s lines, in patients with Angle’s class III malocclusion. *J Dent* 2(2):46–49
2. Academy of Denture Prosthetics (2005) The glossary of prosthodontic terms, 8th edn. *J Prosthet Dent* 94(1):10–92
3. Sharry J (1993) Complete denture prosthodontics, 2nd edn. *Int J Prosthodont* 6:259
4. Spratley M (1980) A simplified technique for determining the occlusal plane in full denture construction. *J Oral Rehabil* 7:31–33
5. Ismail Y (1968) Position of the occlusal plane in natural and artificial teeth. *J Prosthet Dent* 20(5):407–411
6. Hindocha A, Vartak V, Bhandari A, Dudani M (2010) A cephalometric study to determine the plane of occlusion in completely edentulous patients: part I. *J Ind Prosthodont Soc* 10(4):203–207
7. Niekerk F, Miller V, Bibby R (1985) The ala tragus line in complete denture prosthodontics. *J Prosthet Dent* 53(1):67–69
8. Boucher CO (1953) Occlusion in prosthodontics. *J Prosthet Dent* 3(5):633–656
9. Zarb G (1998) Boucher’s prosthodontic treatment for edentulous patients, 10th edn. CV Mosby, St. Louis, pp 296–309
10. Karkazis H, Polyzois G (1987) A study of the occlusal plane orientation in complete denture construction. *J Oral Rehabil* 14:399–404
11. Singh G (2010) Ala tragus line: a cephalometric evaluation. *Int J Prosthet Dent* 1(1):1–5