



## **Cephalometric Evaluation to Determine the Relationship between Hamular Notch Incisive Papilla Plane and Camper's Plane' in North-Indian Population (An *In-vivo* Study)**

**Pallavi Srivastava<sup>1</sup>, Abhishek Gaur<sup>1</sup>, Fauzia Tarannum<sup>1\*</sup>, A. K. Verma<sup>1</sup>,  
Mariyam Ali<sup>1</sup>, Pratibha Katiyar<sup>1</sup> and Kaushik Kumar Pandey<sup>1</sup>**

<sup>1</sup>Department of Prosthodontics, Career Post Graduate Institute of Dental Sciences, Lucknow, India.

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors PS, AG, FT and AKV designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MI and PK managed the analyses of the study. Author KKP managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aim and Objective:** To determine the relationship between Hamular-Notch Incisive Papilla Plane and Camper's Plane in edentulous patients. Also to know the relation between occlusal plane and ala- tragal line from superior, middle and inferior border of tragus to the inferior border of ala of nose.

**Materials and Method:** To assess the relationship between the occlusal plane and ala tragal line a template was made and subjects with template were subjected to lateral cephalograms and tracings were analyzed using Autocad software.

\*Corresponding author: E-mail: [fauzia077@gmail.com](mailto:fauzia077@gmail.com);

**Results:** Campers plane formed with the posterior reference point as an inferior point of the tragus was relatively parallel to the HIP (CPI-HIP). As per the results of multiple comparisons, there was no statistically significant difference between CPM-HIP and CPI-HIP. CPI and CPM were considered to be relatively parallel to the HIP.

**Conclusion:** In male and female both age group  $\geq 55$  years, it was inferred that the Camper's plane I [i.e. the plane drawn from the lower border of ala of nose to the inferior border of tragus] was relatively more parallel to the occlusal plane. In the age group  $< 55$  years, it was inferred that the Camper's plane M [i.e. the plane drawn from the inferior border of ala of nose to the middle border of tragus] was relatively less parallel to the occlusal plane.

*Keywords: Campers plane; cephalograms; HIP plane; autocad software.*

## 1. INTRODUCTION

The orientation of the occlusal plane is a critical step in prosthodontic rehabilitation of edentulous patients.

The orientation of the occlusal plane influences esthetics, physiologic functions and denture stability. It should be reconstructed as parallel as possible to the occlusal plane of missing natural teeth [1]. The proper height and width of the occlusal plane are essential for the adequate bucco-lingual exchange and control of food, speech articulation contacts, tongue space, esthetics and buccal soft tissue support [2].

Faulty orientation of the occlusal plane will jeopardize the interaction between tongue and buccinator muscle. If the occlusal table is too high, it will cause food collection in the sulci and if it is too low it will result in cheek and tongue biting [3]. Hence, the present study is undertaken to determine the relationship between 'Hamular Notch Incisive Papilla plane i.e. occlusal plane and ala-tragus line i.e. Camper's plane in north-indian population.

## 2. MATERIALS AND METHODS

Edentulous subjects visiting the Department of Prosthodontics and Crown & Bridge, Career Post

Graduate Institute of Dental Sciences and Hospital; Lucknow, were included in the present cephalometric study.

The study has involved Forty Edentulous healthy subjects including male and female of age group between 45 to 65 years rehabilitated with completes dentures. All the subjects were explained in this study and approval from ethical committee was taken.

Edentulous Subjects are divided into two groups: A and B based on age (45-65 yrs) and gender. Psychologically healthy and Co-operative patients with healthy TMJ and skeletal class – I ridge relation were included in the study.

### 2.1 METHODOLOGY

**A. Fabrication of template:** (Fig. 1) The impressions were made using the standard selective pressure. On the master cast, the deepest point of the hamular notches and the centre of the incisive papilla were marked on the cast. Three stainless steel spherical bearings were glued to the cast at the marked points. The study templates were fabricated with autopolymerizing acrylic resin using the sprinkle-on method and it was finished & polished by the same person.



**Fig. 1. Cold cure acrylic resin, stainless steel balls, template**

**B. Preparation of the subjects for lateral cephalograms:**

(Fig. 2) Subject preparation was done by the same person. The study templates were tried in the subjects for its proper fit. The markings were made on the superior, middle and inferior points of the tragus of the right ear using an indelible marker. The double sided adhesive tape adhered on the tragus of the ear and the markings were transferred to the double-sided adhesive tape and then stainless steel spherical bearings were adhered to the markings on the tape and the inferior border of the ala of the nose using double sided adhesive tape.

**C. Lateral cephalograms:** Subjects with study templates were subjected to lateral cephalograms (Fig. 2) using Satelac X-Mind PanoCeph X-Ray Machine after their consent, for lateral cephalograms and Kodak –TMAT films were used for the study. Automatic processor (DÜRR Dental) was used for developing all the lateral

cephalograms, to standardize the procedure of developing and fixing and to eliminate inter-operator variations in the processing of X-ray films.

**D. Cephalometric tracings:**

Cephalometric tracings were done using Autocad 2010 software. (Fig. 3). Four horizontal lines were drawn named as Camper's line Superior (CPS), Camper's line Middle (CPM), Camper's line Inferior (CPI) and HIP line. Now on the HIP line one fixed point was taken on hamular notch (point-H) and one fixed point was taken on the ala of the nose (point-A; fixed anatomical landmark). From point-H a perpendicular line at 90° was drawn which intersects the camper's line at CPS, CPM and CPI. The point where this perpendicular line intersects on CPS, CPM and CPI was named as B1, B2 and B3 respectively. The other perpendicular line was drawn from the fixed point-A on HIP line making 90° angle. The point where this line intersects on HIP line is named as point-I1.



Fig. 2. Preparation of patients for lateral cephalograms

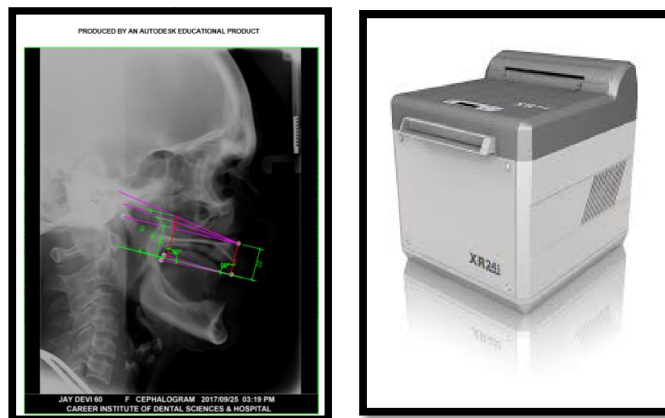


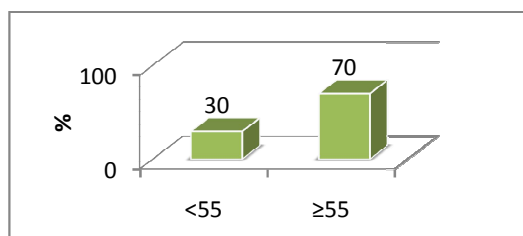
Fig. 3. Cephalometric tracings done using autocad 2010 software and (Durr Dental – XR25S) automatic processor

The distance between point-I1 to point-A was considered as **control**. And the distance between point-H to point-B1, point-B2 and point-B3 is considered as **variables**. The distance between point-I1 to point-A, point-H to point-B1, point-H to point-B2 and point-H to point-B3 were measured using Autocad-2010 software. Observations showed that the mean value of distance between each point, point-I1 to point-A (control) is  $16.53 \pm 5.01$ . Mean value of distances of variables are point-H to point-B1 is  $26.40 \pm 6.23$ ; point-H to point-B2 is  $22.38 \pm 5.36$ ; point-H to point-B3 is  $18.00 \pm 4.81$  respectively. The mean differences between the variables and control were calculated to be (I1A – HB1, I1A – HB2, I1A – HB3) ( $9.87 \pm 4.98$ ,  $5.85 \pm 4.34$ ,  $1.52 \pm 3.76$ ) respectively. The mean value of distance which was closer to I1A was considered as nearest parallel to hamular-notch incisive papilla plane (i.e Camper's plane-I).

The Study: The data from the forty cephalometric tracings were collected and was subjected to statistical analysis to see which of the three Ala-tragal lines i.e. Camper's plane S, Camper's plane M, Camper's plane I was closer to the occlusal plane. The Camper's plane distance which was closer to the occlusal plane was considered to be relatively more parallel to the occlusal plane.

### 3. RESULTS AND OBSERVATIONS

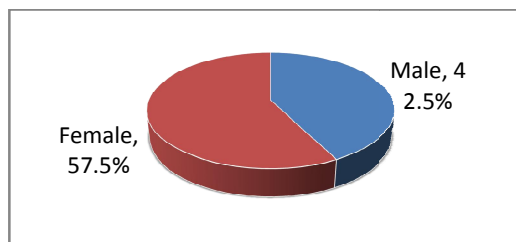
**Statistical analysis:** Unpaired t-test was used to compare the points between age groups and gender. The Wilcoxon rank sum test was used to compare the difference between variable and control points. The Pearson correlation coefficient was calculated between variables and control point. The  $p$ -value  $< 0.05$  was considered significant. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).



**Fig. 5. Distribution patients according to age**

Table 1 & Fig. 5 shows the distribution of patients according to age. Majority of patients were  $\geq 55$  years (70%). The mean age of patients was  $55.75 \pm 4.41$  ranging from 48-65 years.

Table 3 & Fig. 6 shows the distribution of patients according to gender. More than half of patients were females (57.5%).



**Fig. 6. Distribution of patients according to gender**

### 4. DISCUSSION

The establishment of the occlusal plane is prone to subjective variation due to the absence of any prominent landmark. Guidelines such as Lower Edge of Upper Lip Sheldon Winkler [4], Alveolar Ridges Boucher [5], Buccinators Groove Lundquist and Luther [6,7] and Stenson's Duct bisecting the space between the residual ridges have been advocated by various authors as landmarks in orienting the occlusal plane.

In fabrication of complete denture prosthesis the occlusal plane is kept parallel to a line drawn from the lowest point of Ala of nose to the external auditory meatus. This line is known as the Camper's line after Petrus Camper, a dutch anatomist, who in 1786 located on skulls and living heads [8]. Various authors have placed the posterior point of camper's line on the tragus at different levels. *Clapp, Tench, Kurth, Boucher and Sheldon Winkler* placed this point at the superior point of tragus [4,5,6]. Landa and Augsburg placed it on the midpoint of the tragus [9], Dalvey, Harton, Chow and Clark placed this point at the lowest point of the tragus [10,11]. In spite of so many methods actual method followed is still based on an individual's judgment in different situation.

The Glossary of Prosthodontics (GPT) – 9 define Camper's plane is a plane established by the inferior border of the ala of the nose and the superior border of the tragus of each ear, Camper's plane used by prosthodontist to estimate the occlusal plane for edentulous patients. [12] Sivakumar J stated that HIP plane can quite predictably reproduce occlusal plane. [13] Robert B. Sloane, H. Rich, stated that HIP plane may be used in the determination of inclination of the occlusal plane during complete denture construction [14,15].

**Table 1. Master chart**

Subject	Distance between Camper's plane & hamular incisive papilla plane	variable control	Difference between variable and control	Near to parallel parallel	Gender	Age
1	Ts = 30 Tm= 26 Ti=21	Al= 22	8 4 -1		F	60
2	Ts=33 Tm=28 Ti=23	Al=24	9 4 -1	Near to parallel	M	50
3	Ts= 34 Tm= 29 Ti=23	Al= 17	17 12 6	Near to parallel	M	55
4	Ts=27 Tm=24 Ti=20	A=26	1 2 -6	Near to parallel	F	60
5	Ts=31 Tm=27 Ti=22	A=28	3 1 -6	Near to parallel	F	59
6	Ts=37 Tm=30 Ti= 23	A=15	22 15 8	Near to parallel	M	62
7	Ts=31 Tm=28 Ti=24	A=18	13 10 6	Near to parallel	F	54
8	Ts=26 Tm=22 Ti=19	A=23	3 -1 -4	Near to parallel	F	59
9	Ts=20 Tm=15 Ti=10	A=12	8 3 -2	Near to parallel	M	48
10	Ts=26 Tm=23 Ti=19	A=19	7 4 0	Near to parallel	M	52
11	Ts=36 Tm=28 Ti=20	A=24	12 4 -4	Near to parallel	F	53
12	Ts=25 Tm=22 Ti=18	A=22	3 0 -4	Near to parallel	F	48
13	Ts=28 Tm=24 Ti=20	A=13	15 11 7	Near to parallel	M	57
14	Ts=19 Tm=14 Ti=10	A=12 mm	7 2 -2	Near to parallel	F	54
15	Ts=26 Tm=23 Ti=19	A=17	9 6 2	Near to parallel	F	65

The use of the ala-tragus line (Camper's line) as a guideline has gained popularity for the establishment of the occlusal plane since it is easily visualized, thus making the determination of plane of occlusion more convenient. Although

ala-tragus line is the most commonly used and only extra-oral landmark to establish the occlusal plane, still remains controversial because of the disagreement on the exact position of reference on the tragus. Studies have shown that all the

three positions of the tragus i.e. Superior, Middle and Inferior has been considered to determine the ala-tragal lines to establish the plane of occlusion. The incorrect posterior reference point of camper's plane may increase the steepness of the occlusal plane thus fabrication of balanced denture would be difficult [1].

**Table 2. Distribution of patients according to age**

Age in years	No. (n=40)	%
<55	12	30.0
≥55	28	70.0
Mean±SD (Range)	55.75±4.41 (48-65)	

**Table 3. Distribution of patients according to gender**

Gender	No.(n=40)	%
Male	17	42.5
Female	23	57.5

Thus in this study, superior, middle, inferior border of tragus has been used as parameters to compare its parallelism to the occlusal plane for orientation jaw relation. As it is difficult to establish this plane intra-orally, this study was undertaken to determine the relationship between HIP-Plane (occlusal plane) and Camper's plane in edentulous patients in north Indian population by using cephalometric tracings. In this study, we had a sample size of 40 edentulous subjects between 45 to 65 years.

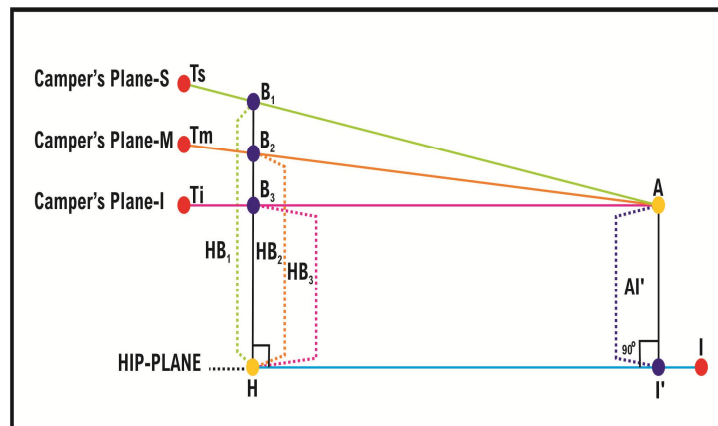
In this study right Lateral Cephalograms was used to compare the relationship between the three different Camper's plane and Hamular-

Notch Incisive Papilla Plane as lateral cephalograms were able to be standardized for all the subjects as it was a better method of locating the occlusal plane. Satelac X-Mind PanoCeph X-Ray Machine, for lateral cephalograms and Kodak –TMAT films (ideal for Lateral Cephalograms) were used for the study.

Automatic processor (DüRR Dental) was used for standardizing the procedure of developing and fixing of cephalograms. The subjects were prepared for Lateral Cephalograms after placing the template in each patient's mouth and cephalometric tracings for all the subjects were carried out using Autocad 2010 software.

To determine the relationship of different Camper's plane to the Hamular notch incisive papilla plane(HIP), four horizontal lines were drawn named as camper's line Superior(CPS), Camper's line Middle(CPM), Camper's line Inferior(CPI) and HIP line.

Now on the HIP line one fixed point was taken on hamular notch (point-H) and one fixed point was taken on the ala of the nose (point-A). From point-H a perpendicular line was drawn which intersects the camper's line at CPS, CPM and CPI. The point where this perpendicular line intersects on CPS, CPM and CPI was named as B1, B2 and B3 respectively. The other perpendicular line drawn from the fixed point-A on HIP line. The point where this line meets on HIP line is named as point-I1. The distance between point-I1 to point-A was considered as control. The distance between point-H to point-B1, point-B2 and point-B3 are considered as variables.



**Fig. 4. Diagrammatic representation of the relationship of different Camper's plane to the Hamular notch incisive papilla plane (HIP)**

**Table 4. Comparison of difference between variable and control**

	<b>Difference (Mean±SD)</b>	<b>p-value<sup>1</sup></b>
Tragus superior point -control point	9.87±4.98	0.001*
Tragus middle point -control point	5.85±4.34	0.001*
Tragus inferior point -control point	1.52±3.76	0.01*

<sup>1</sup>Wilcoxon rank sum test, \*Significant

The distance between point-I1 to point-A, point-H to point-B1, point-H to point-B2 and point-H to point-B3 were measured using Autocad-2010 software. Observations showed that the mean value of distance between each point, point-I1 to point-A (control) is 16.53±5.01. Mean value of distances of variables are point-H to point-B1 is 26.40±6.23; point-H to point-B2 is 22.38±5.36; point-H to point-B3 is 18.00±4.81 respectively. The mean differences between the variables and control were calculated to be (I1A – HB1, I1A – HB2, I1A – HB3) (9.87±4.98, 5.85±4.34, 1.52±3.76) respectively. The mean value of distance which was closer to I1A was considered as most parallel to hamular-notch incisive papilla plane (i.e Camper’s plane-I).

There was significant (p=0.001) positive correlation between variable points and control point. (Table 4). The mean values obtained for the different CPS-HIP were maximum as compared to the mean values obtained for CPM-HIP and CPI-HIP. The mean values obtained for the CPI-HIP were minimum. Hence, the ala-tragus line (Campers plane I) joining the ala of the nose to the inferior point on the tragus of the ear was relatively parallel to the HIP.

The comparison of tragus superior, middle and inferior point with age of the subjects was done. We found that Tragus superior point was insignificantly (p>0.05) higher in the age >55 (26.43±6.19) than <55 (26.33±6.59) (shown in Fig. 5 and Table 2).

The comparison of tragus superior, middle and inferior and control was done based on gender. Tragus superior point was insignificantly (p>0.05) higher in males (28.29±6.20) than females (25.00±6.01) (Table 8 & Fig. 8). Tragus middle and the inferior point was insignificantly higher in male than female (Fig. 6 and Table 3).

It was evident that, subjects (age group of >55 years) in female patients the ala-tragal line running from the lower border of ala of nose to inferior position of tragus were relatively parallel to the occlusal plane. In male subjects (age group of <55 years) the ala-tragal line running from the lower border of ala of nose to middle

position of tragus was relatively parallel to the occlusal plane.

Since the anatomical landmarks varies in subjects with different age group and gender. Thus in the study the statistical analysis between the control and variable was done in different age groups and gender of subjects.

Hence, as the distance of tragus inferior (Camper’s plane I) and control, and the Comparison of difference between variable and control point, was least at camper's plane-I, so it was inferred that the Camper's plane I [i.e. the plane drawn from the lower border of ala of nose to the inferior border of tragus was relatively parallel to occlusal plane. It was evident from the results that, the Campers plane formed with the posterior reference point as inferior point of the tragus was relatively parallel to the HIP (CPI-HIP). As per the results of multiple comparisons, there was no statistically significant difference between CPM-HIP and CPI-HIP. CPI and CPM were considered to be relatively parallel to the HIP.

**5. CONCLUSION**

Camper’s plane seems to be most widely used for establishment of occlusal plane in denture fabrication. Although one of the three ala-tragal lines [i.e. Camper’s plane S, Camper’s plane M and Camper’s plane I] was absolutely parallel to the occlusal plane in edentulous subjects with different age group and gender.

In male and female both age group >55 years, it was inferred that the Camper’s plane I [i.e. the plane drawn from the lower border of ala of nose to the inferior border of tragus] was relatively more parallel to occlusal plane. In the age group <55 years, it was inferred that the Camper’s plane M [i.e. the plane drawn from the lower border of ala of nose to the middle border of tragus] was relatively less parallel to occlusal plane.

**CONSENT**

Subjects with study templates were subjected to lateral cephalograms (fig-2) using Satelac X-



Mind PanoCeph X-Ray Machine after their consent

### ETHICAL APPROVAL

All the subjects were explained this study and approval from ethical committee was taken.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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