

To Evaluate and Compare the Position of Frankfort Horizontal Plane and Camper's Plane to Occlusal Plane: An *In Vivo* Study

Asusa C Loli¹, Tarun Kalra², Manjit Kumar³, Ajay Bansal⁴, Abhishek Avasthi⁵

Received on: 11 March 2024; Accepted on: 26 July 2024; Published on: 31 August 2024

ABSTRACT

Aim: This study was undertaken to evaluate and compare the position of Frankfort horizontal plane and Camper's plane to the occlusal plane.

Materials and methods: In this study, 80 subjects aged between 19 and 25 years with normal occlusion were selected from undergraduate and postgraduate students of Bhojia Dental College and Hospital, Baddi, Himachal Pradesh, India. Measurement of the clinical parameters was done using computer software program Screen Protractor version 4.0 and the radiographic (lateral cephalograms) were traced using an X-ray viewer.

Results: It was observed that neither the clinical nor the radiographic (lateral cephalogram) Camper's plane was parallel to the occlusal plane but on comparison it was found that clinical Camper's plane was almost parallel to the occlusal plane.

Conclusion: The study showed that neither the Camper's plane nor the Frankfort horizontal plane was parallel to occlusal plane.

Keywords: Ala-tragus line, Camper's plane, Frankfort horizontal plane, Natural head position, Occlusal plane.

Dental Journal of Advance Studies (2024); 10.5005/djas-11014-0049

INTRODUCTION

The placement of the occlusal plane is important for perfect function and esthetics in complete denture.¹ The prosthodontist plays a major role in restoring natural esthetics and developing compatible occlusion with mandibular movements.²

Dutch scientist Petrus Camper in 1780 developed a line to develop occlusal plane which extends from the alae of the nose to the mid-point of the tragus.³

According to GPT 9 (2017), it is a line that extends from the tragus of the ear to the superior border of the ala of the nose. It serves as a third reference point that is considered parallel with the occlusal plane. This line is approximately 10° to the Frankfort horizontal plane, seen from the mid-sagittal plane.⁴

Frankfort horizontal plane is a line extending from the inferior part of orbit to the superior part of the tragus.

Occlusal plane in edentate patients is difficult to locate compared to dentate patients. The occlusal plane is an important landmark for recording jaw relation. Establishing of occlusal plane is an arbitrary method and recording jaw relations is clinical acumen.

This study was undertaken to compare the relationship of Frankfort horizontal plane and Camper's plane to occlusal plane by photographic and cephalometric radiographs.

MATERIALS AND METHODS

In this study, 80 dentulous subjects aged between 19 and 25 were considered for the study.

With due written consent all the subjects were educated and motivated about procedures and photographs for research work and dental education.

¹⁻⁵Department of Prosthodontics, Bhojia Dental College and Hospital, Baddi, Himachal Pradesh, India

Corresponding Author: Manjit Kumar, Department of Prosthodontics, Bhojia Dental College and Hospital, Baddi, Himachal Pradesh, India, Phone: +91 9914640604, e-mail: manjitkiran@yahoo.co.in

How to cite this article: Loli AC, Kalra T, Kumar M, *et al.* To Evaluate and Compare the Position of Frankfort Horizontal Plane and Camper's Plane to Occlusal Plane: An *In Vivo* Study. *Dent J Adv Stud* 2024;12(2): 97-100.

Source of support: Nil

Conflict of interest: Dr Tarun Kalra and Dr Abhishek Avasthi are associated as the Editorial board members of this journal and this manuscript was subjected to this journal's standard review procedures, with this peer review handled independently of these Editorial board members and their research group.

Inclusion Criteria

Cases with full set of 28 teeth with Angle's class I molar occlusion were included in this study.

Exclusion Criteria

Subject with history of craniofacial surgery/trauma, orthodontic treatment, TMJ disorders, any marked facial asymmetries, congenital facial defects, and any generalized occlusal or incisal wear were excluded from this study.

Method for Soft Tissue Study

Subjects were asked to sit straight with fox plane between two arches. A mirror was kept at a distance to keep the head in natural



Fig. 1: Subject seated and head oriented in natural head position

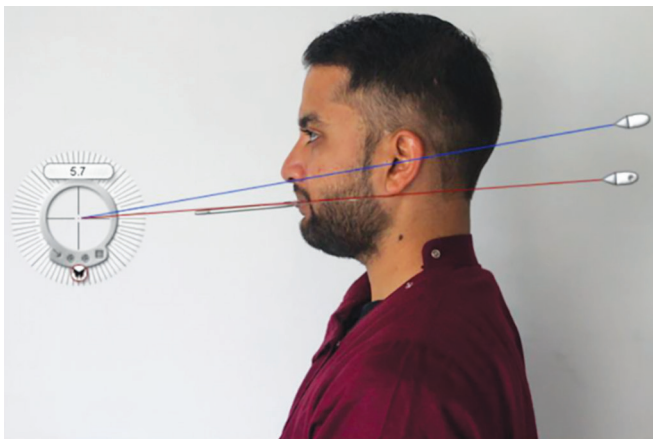


Fig. 2: Measurement of Camper's-occlusal plane (MAOP) photographically using Screen protractor

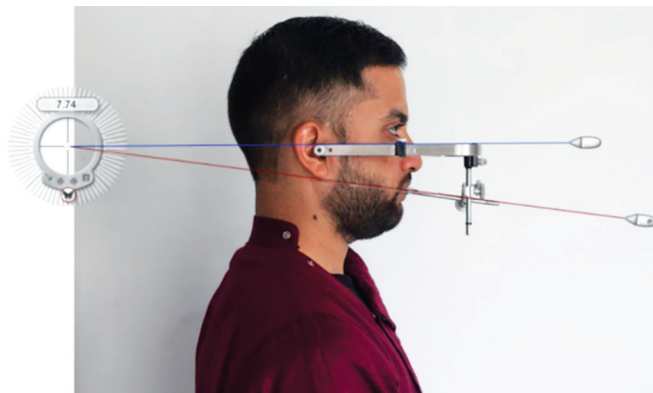
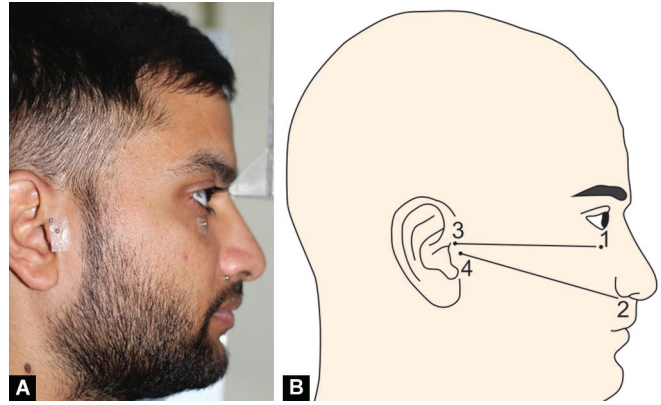


Fig. 3: Measurement of Frankfort horizontal-occlusal plane (FHOP) photographically using screen protractor

position in the same plane as subjects were asked to see their pupil in the mirror (Fig. 1).

- For Camper's plane—Two points were mark on inferior border of ala of nose and center of tragus of ear.
- For Frankfort horizontal plane—Face bow was used.

The subjects' lateral profile photographs were uploaded to a computer, and measurements for recording angles between



Figs 4A and B: Anatomical landmarks marked (A) Image and (B) Illustration 1. Orbitale, 2. Inferior margin of the ala, 3. Tragion, and 4. Middle tragus. Frankfort horizontal plane—line joining 1 and 3. Camper's plane—line joining 4 and 2



Fig. 5: Tracing of the lateral cephalogram

Camper's plane and the occlusal plane, as well as between the Frankfort horizontal plane and the occlusal plane, were conducted on the computer screen (Figs 2 and 3).

Method for Radiographic Study

Stainless steel balls were attached (Fig. 4) on the middle of tragus, Tragion (notch above the Tragus of ear), Inferior margin of ala of nose and Orbitale.

The subject was asked to look straight with lips in a relaxed position. The adjustment of machine was done with exposure value of 75 kVp, 20 mA, for 1second on the panoramic machine (ADVAPEX- DENTOPAN-10 & INX-PAN Delhi India). Tracing of the radiograph was done with middle (M) of the tragus and ala (A) of the nose. For FH plane, Porion (Po) and Orbitale (Or) were joined. Based on Downs's analysis, for Occlusal plane, line was drawn with a scale by bisecting the cusps of first molars and first premolars (Fig. 5).

The angle between MA and OP planes (MAOP) and the angle between FH and OP planes (FHOP) were measured using a protractor. The data collected were statistically analyzed.

RESULTS

The data obtained were subjected to statistical analysis. Table 1 and Figure 5 depicted the descriptive values for the clinical Camper's

Table 1: Descriptive values for Camper's plane and occlusal plane (MAOP), Frankfort horizontal plane, and occlusal plane (FHOP) clinically and radiographically

	n	Mean	Std. deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
a) Clinical MAOP	80	3.2671	1.19121	1.13	8.71	2.5700	3.0250	3.7875
b) Lateral cephalogram MAOP	80	4.631	2.7837	0.0	12.0	2.525	4.000	6.000
c) Clinical FHOP	80	10.3677	4.06180	2.50	20.74	7.2575	10.0200	12.5225
d) Lateral cephalogram FHOP	80	6.968	3.6083	0.0	18.0	4.000	6.500	10.000

Table 2: Comparison of clinical and radiographic reading with Occlusal plane (using student one sample t test)

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean difference	95% Confidence interval of the difference	
					Lower	Upper
a) Clinical MAOP	24.531	79	<0.001	3.26713	3.0020	3.5322
b) Lateral cephalogram MAOP	14.881	79	<0.001	4.6313	4.012	5.251
c) Clinical FHOP	22.830	79	<0.001	10.36775	9.4638	11.2717
d) Lateral cephalogram FHOP	17.271	79	<0.001	6.9675	6.165	7.770

plane and Occlusal plane (MAOP) as 3.2671 and radiographic 4.631 esthetics. The descriptive values of Clinical Frankfort horizontal plane and occlusal plane (FHOP) are 10.3677 and radiographic 6.908, respectively.

The comparison of clinical and radiographic reading with occlusal plane found that there was a variation from 3.0020 to 3.5322° with a mean of 3.26713° for clinical MAOP and variation from 4.012 to 5.251° with a mean of 4.6313° for lateral cephalogram MAOP (Table 2 and Figs 6 and 7). The clinical and radiographic MAOP and occlusal plane have no relation. However, the clinical MAOP has a lower mean and was almost parallel to the natural occlusal plane then the lateral cephalogram MAOP.

There was a variation from 9.4638° to 11.2717° with a mean of 10.36775° for clinical FHOP and a variation from 6.165° to 7.770° with a mean of 6.9675° for lateral cephalogram MAOP. The clinical and radiographic FHOP have no relation with the occlusal plane. However, the lateral cephalogram FHOP has a lower mean and was almost parallel to the natural occlusal plane than the clinical FHOP.

DISCUSSION

For decades, the study of occlusion and masticatory system is a matter of interest in dentistry. The main aim of preventive and restorative dentistry is to achieve an occlusion that is in the coordination of masticatory apparatus, for better function and health of the stomatognathic system. Due to a lack of complete knowledge and tremendous interest various concepts have come up.

In the present *in-vivo* study, clinical relation of Camper's plane and occlusal plane (MAOP) was 3.0250° (median) and the observation was similar to Petricevic et al.⁵ who studied the natural head position and inclination of craniofacial plane and Kuldeep et al.¹ who reported a value of 0.5565° between the occlusal plane and occlusal plane.

The relation between lateral cephalogram Camper's plane and Occlusal plane (MAOP) was found to be 4.012 in the present study. The result is similar to Augsburg⁶ who found an insignificant value of 3.2° for protrusion of maxilla and retrusion of mandible and bi-maxillary protrusion 7.3° and 7.9° for mandibular protraction. In line with this study, Hartono⁷ also found that the mean values of this angle (for various facial forms) amounted to 2.3° for

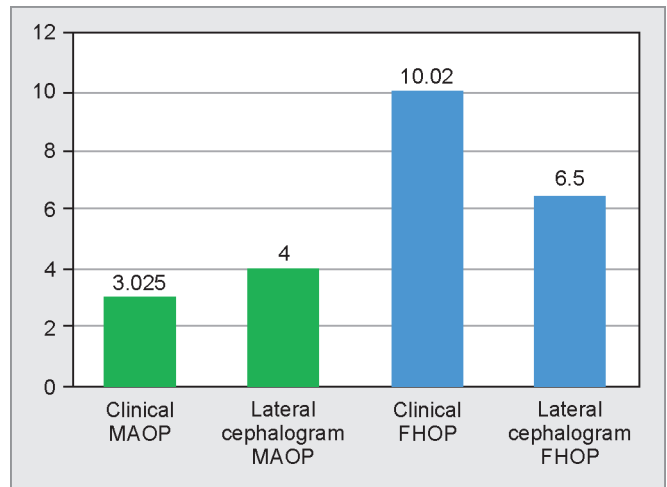


Fig. 6: Descriptive values for Camper's plane and occlusal plane (MAOP), Frankfort horizontal plane, and occlusal plane (FHOP) clinically and radiographically

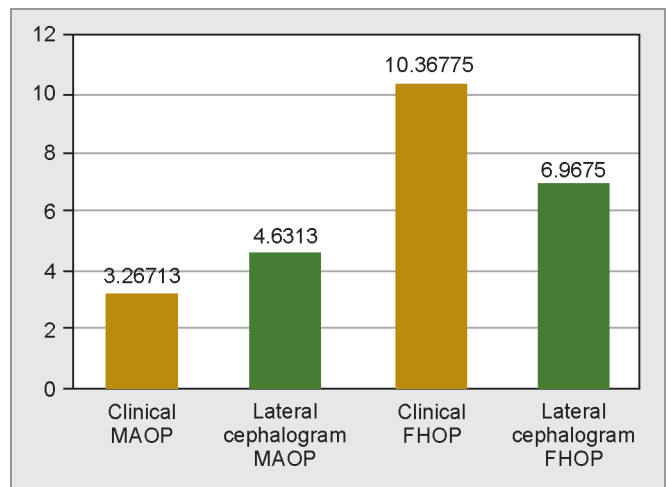


Fig. 7: Comparison of clinical and radiographic reading with occlusal plane (using student one sample t-test)

bi-maxillary protrusion and 3.6° for maxillary protrusion, 1.5° for maxillary protrusion and mandibular retraction, 0.0° for mandibular retraction, 2.5° for bi-maxillary retraction, and 5.6° for mandibular protrusion. Karkazis et al.⁸ studied the angle between occlusal plane and Camper's plane which depends on the posterior referent point. Abrahams and Carey⁹ documented an angle of 9.66° for the identical measurement. Karkazis and Polyzois¹⁰ observed an angle of 2.88°, while Olsson and Posselt¹¹ recorded a measurement of 6.7°. In their study, the angle between the assessed planes was found to be 2.45°. For the Chinese population, Ow et al.¹² noted a value of 8.3°. These findings collectively indicate that Camper's plane and the occlusal plane did not demonstrate parallelism.

The relation between clinical Frankfort horizontal plane and occlusal plane was found to 10°. The result was similar to Petricevic et al.⁵ who reported a value of 11.75°.

The relation between the Frankfurt horizontal and occlusal line (FHOP) was found to be 6.165°. In line with this study, Hartono⁷ and Augsburg⁶ reported statistically significant differences for the value of this angle in different face types. Hughes,¹³ Gonzales and Kingery,¹⁴ Olsson and Posselt,¹¹ Ow et al.,¹² Celebic et al.,¹⁵ and Augsburg⁶ reported this angle from 9 to 11° in different populations.

The comparison of (3.26713°) clinical MAOP and (4.6313°) lateral cephalogram MAOP found that none of the planes was parallel to the occlusal plane but when clinical and radiographic data of MAOP was compared it was found that clinical MAOP was almost parallel to the occlusal plane.

On comparison of clinical FHOP (10.36775°) and lateral cephalogram of FHOP (6.9675°) it was found that both results show no parallelism with the occlusal plane. However, the lateral cephalogram FHOP has a lower mean and was almost parallel to the natural occlusal plane than the clinical FHOP.

Therefore, it can be affirmed that both Camper's plane and the Frankfort horizontal plane were not parallel to the occlusal plane. Consequently, additional clinical parameters should also be considered for establishing the orientation of the occlusal plane.

CONCLUSION

Considering the limitations of the study, the following conclusions were derived:

- Neither the clinical nor the radiographic (lateral cephalogram) Camper's plane was parallel to occlusal plane but on comparison it was found that clinical Camper's plane was almost parallel to the occlusal plane.
- Neither the clinical nor the radiographic (lateral cephalogram) Frankfort horizontal plane was parallel to occlusal plane but on

comparison it was found that radiographic (lateral cephalogram) Frankfort horizontal plane was almost parallel to the occlusal plane.

- Based on the findings of this study, it can be inferred that both Camper's plane and the Frankfort horizontal plane were not parallel to the occlusal plane. Therefore, additional clinical parameters should also be considered for determining the orientation of the occlusal plane.

REFERENCES

1. Kuldeep BND, IV R, Kumar D. Analysis of relation between the Camper's plane and natural occlusal plane in Indian dentulous subjects – A clinical study. *TMU J Dent* 2014;1(2):54.
2. 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):177–182. DOI: 10.1016/s0022-3913(96)90096-7.
3. Carey PD, Dent HD. Occlusal plane orientation and masticatory performance of complete dentures. *J Prosthet Dent* 1978;39(4): 368–371. DOI: 10.1016/s0022-3913(78)80148-6.
4. The glossary of prosthodontic terms. *J Prosthet Dent* 2017;117(5):8–41. DOI: 10.1016/j.prosdent.2016.12.001.
5. Petricevic N, Celebic A, Celic R, et al. Natural head position and inclination of craniofacial planes. *Int J Prosthet* 2006;19:279–280. PMID:16752626.
6. Augsburg RH. Occlusal plane relation to facial type. *J Prosthet Dent* 1953;3(6):755–770.
7. Hartono R. The occlusal plane in relation to facial types. *J Prosthet Dent* 1967;17(6):549–558. DOI: 10.1016/0022-3913(67)90124-2.
8. Karkazis HC, Polyzois GL, Zissis AJ. Relationship between ala-tragus line and natural occlusal plane. Implications in denture prosthodontics. *Quintessence International* 1986;17(4):253–255.
9. Abrahams R, Carey PD. The use of ala-tragus line for occlusal plane determination in complete denture. *J Dent* 1979;7(4):339–341. DOI: 10.1016/0300-5712(79)90147-7.
10. Karkazis HC, Polyzois GL. Cephalometrically predicted occlusal plane: Implications in removable prosthodontics. *J Prosthet Dent* 1991;85(2):258–264. DOI: 10.1016/0022-3913(91)90172-s.
11. Olsson A, Posselt U. Relationship of various skull reference lines. *J Prosthet Dent* 1961;11(6):1045–1049.
12. Ow RKK, Djeng SK, Ho CK. The relationships of upper facial proportions and the plane of occlusion to anatomic reference plane. *J Prosthet Dent* 1989;61(8):727–733. DOI: 10.1016/s0022-3913(89)80051-4.
13. Hughes GA. Facial types and tooth arrangement. *J Prosthet Dent* 1951;1:82–85. DOI: 10.1016/0022-3913(51)90083-2.
14. Gonzalez JB, Kingery R. Evaluation of planes of reference for orienting maxillary casts on articulators. *JADA* 1968;76:329–336.
15. Celebic A, Valentic-Peruzovic M, Kraljevic K, et al. A study of the occlusal plane orientation by intra-oral method (retromolar pad). *J Oral Rehabil* 1995;22:233–236. DOI: 10.1111/j.1365-2842.1995.tb01569.x.