A Cephalometric Evaluation for Co-relation of Different Facial Types with Occlusal Plane in Dentulous and Edentulous Patients

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Abstract

Background: Accurate occlusal plane orientation is an essential factor in the fabrication of complete denture prosthesis. The present study was prompted by the hypothesis that the cant of occlusion plane varies with facial types in both dentulous and edentulous patients.

Aims: To compare Total Facial Index (TFI), Occlusal Plane-Frankfort Horizontal Plane angle (OP-FHP) and Occlusion Plane-Camper's Plane angle (OP-CP) in dentulous and edentulous patients in different facial types; to find a correlation between TFI, OP-FHP and OP-CP in dentulous patients; and to find a correlation between TFI, OP-FHP and OP-CP in edentulous patients.

Materials and Methods: 66 participants (33 dentulous and edentulous each) were included as study sample. Based on total facial index values, the participants were classified as Mesoprosopic, Euryprosopic and Leptoprosopic facial types. Lateral cephalograms were made for each facial type and OP, FHP and CP were drawn, and OP-FHP and OP-CP were measured. The data was subjected to statistical analysis using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. The stastical tests used in our study included descriptive statistics, ANOVA test, student '*t*' test and Pearson's correlation test. Results: For the dentulous group, a moderately positive correlation was observed between TFI and OP-FHP whereas a negative correlation was observed for OP-FHP and OP-CP. For the edentulous group, the results revealed a negligible or negative correlation for the various parameters assessed.

Conclusion: The use of Camper's plane running from lower border of Ala to superior border of Tragus gives very near the cant of occlusal plane as seen in the natural dentition with three facial types.

Key Words: Camper's plane, Cephalogram, Dentulous, Edentulous, Frankfurt horizontal plane, Plane of occlusion

Introduction

Cephalometric evaluation has served for many years as a valuable adjunct to dental research and diagnosis. Although it's clinical application has been directed largely toward orthodontics, cephalometrics is of special value to prosthodontics in that it can be used to reestablish the spatial position of lost structures such as the teeth. This is achieved by identifying predictable relationships between the teeth and specific reference points used for evaluation of facial growth and development [1].

In the fabrication of complete dentures, one of the most important factors to be considered is the position of the occlusal plane. Various landmarks can be used for locating the occlusal plane in edentulous patients e.g. intra-oral landmarks include: occlusal plane should coincide with the lower one-third of the retromolar pad; occlusal plane should coincide with lateral borders of the tongue; maxillary occlusal plane should be at a distance of 2.56 mm below the parotid papilla; occlusal plane should be 1.37 mm above the commisure of lip; occlusal plane can be established 0.94 mm above the buccinator grooves; Occlusal plane can be established parallel to Hamular-incisive-papilla plane; occlusal plane should be placed parallel to and mid-way between the residual ridges; extra-oral landmarks include: Anteriorly, occlusal plane should be parallel to interpupillary line and 1-3 mm below the resting upper lip; posteriorly, parallel to ala tragal lines. However, the most common method is the use of Camper's plane [2]. Considerable ambiguity revolves around which part of the tragus should be considered as a posterior landmark while recording Camper's plane [3]. Thus, different authors have placed the posterior point on the tragus at different levels: the lowest point of the tragus, the superior point of the tragus, and the midpoint of the tragus [4]. In the present study Camper's plane was marked according to "The Glossary of Prosthodontic terms-8" (GPT-8), which defines camper's plane as a plane established by the inferior border of the ala of the nose and the superior border of the tragus of the external auditory meatus [5].

The present study was prompted by the hypothesis that the cant of occlusion plane varies with facial types (Mesoprosopic,

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Euryprosopic and Leptoprosopic), based on Martin and Saller index [6,7] in both dentulous and edentulous patients. In the present study it was decided to verify the above hypothesis in dentulous patients and to establish a similar co-relation in edentulous patients. Thus, this study was undertaken to compare Total Facial Index (TFI), Occlusal Plane-Frankfort Horizontal Plane angle (OP-FHP) and occlusion plane-Camper's plane angle (OP-CP) in dentulous and edentulous patients in different facial types; to find a correlation between TFI, OP-FHP and OP-CP in dentulous patients; and to find a correlation between TFI, OP-FHP and OP-CP in edentulous patients.

Materials and Methods

A total of 66 participants (33 dentulous and edentulous each) were selected for the study. The age range of the participants included in the study was 22 to 60 years. The dentulous group had participants of age group 22 to 30 years and the edentulous group participants ranged in age from 40 to 60 years. The participants included in both the groups were age and sex matched. The inclusion criteria for dentulous patients were: the presence of 28 to 32 natural teeth in ideal arch alignment with Angles class I molar relationship, pleasing profile and with no history of orthodontic or prosthodontic treatment. For edentulous group, the selection criteria included sound denture-bearing tissues, normal maxillomandibular relationship, and competent lips. Patients with physical disability were excluded from the study.

Anthropological measurements were made by dots and strips of Leukoplast adhesive tape (Smith & Nephew Pty Limited, New South Wales, Australia) on each participant's face in edentulous participants. Total facial height was obtained by measuring the distance between nasion (point in the midline of the nasal root at the nasofrontal suture, the most concave aspect of the bridge of the nose in the midline) and gnathion (the most everted point of the chin in the centerline) with the help of sliding vernier calipers (Micro-Tools, Vacaville, CA, USA). The facial width was obtained by measuring the distance between zygion (the most lateral point of the zygomatic arch) of both sides. Based on the values obtained, Total Facial Index [TFI] was calculated for both dentulous and edentulous groups by dividing the total facial height (nasion to gnathion) by total facial width (zygion to zygion] multiplied by 100. The value obtained for total facial index was used to classify dentulous and edentulous patients as Mesoprosopic, Euryprosopic and Leptoprosopic facial types based on TFI given by Martin and Saller [6,7].

Following the classification of participants according to facial types, lateral cephalograms were made for each facial type for both dentulous and edentulous participants. For all the participants, before taking the lateral cephalogram, two small size steel balls of size 3.17mm were taped using Leukoplast adhesive tape (Smith & Nephew Pty Limited, New South Wales, Australia), one on the inferior border of the alae of the nose and the other on the superior border of the tragus to locate the Camper's plane. Further, for edentulous participants, lead sheet (4×10 mm) (Midland Lead, Derbyshire, UK) was placed longitudinally on the over lapping cusps of the first premolars and first molars of the patient's dentures, to trace

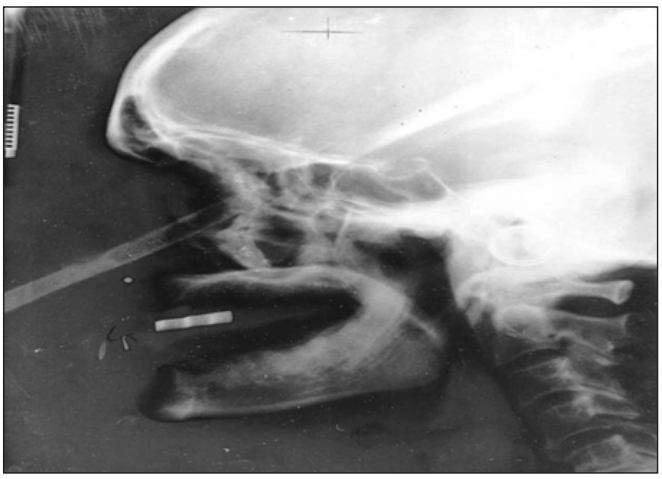

Figure 1*. Cephalogram of an edentulous subject in the study. Radiopaque steel ball and lead sheet can be appreciated in the cephalogram.*

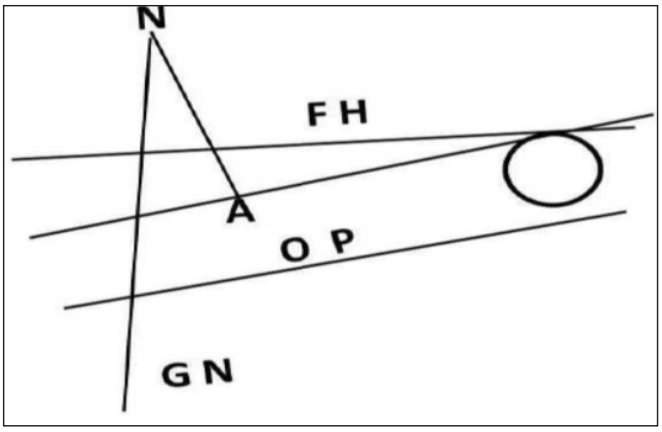

Figure 2. *Tracing of a cephalogram showing the various parameters assessed in the study (N: Nasion, FH: Frankfurt horizontal plane, OP: Occlusal Plane, GN: Gnathion).*

the occlusion plane.

To obtain lateral cephalogram in the natural head position [8,9], a custom made head strap with balancing level device was tied on the forehead (X-Mind Pano Ceph, Soredex Tuusula, Finland). All the cephalometric films were exposed keeping a standard distance of 5 feet between the X-ray target and mid-sagittal plane of the head of the participant. The mid-sagittal plane to film distance was standardized at 15 cm. For dentulous participants, the cephalograms were taken with the participant closing in maximal intercuspation position. For edentulous participants, cephalograms were taken with the dentures placed in the mouth and jaws approximated in centric relation (*Figure 1*). Cephalometric landmarks were traced on a 36 microns polyester single matte paper (Polyester Converters Ltd, London, UK) placed on the illuminated view box (Dentsply, Philadelphia, USA) (*Figure 2*).

The cephalometric points: Orbitale (lowest point on the inferior border of bony orbit), porion (mid-point of upper edge of external auditory meatus) and nasion (the junction of frontonasal suture at the most posterior point on curvature at the bridge of the nose) were determined on the tracings using accepted scientific criteria.

The Plane of Occlusion (OP) was then drawn through the region of the overlapping cusps of the first premolars and first molars (Downs) [10]. The Frankfurt Horizontal Plane (FHP) was also traced extending from the porion to orbitale

Table 1. *Comparison of different parameters under study between dentulous and edentulous subjects.*

Parameter	Dentulous (n=33)		Edentulous (n=33)		"t" value	"*P*" value
	Mean	SD	Mean	SD		
Mesoprosopic						
TFI	85.44	1.37	82.53	0.64	-4.480	**0.001**
OP-FHP	3.73	0.90	5.00	3.39	1.199	0.250
OP-CP	7.91	1.58	10.40	4.72	1.618	0.128
Euryprosopic						
TFI	78.90	1.29	77.90	3.23	-0.965	0.344
OP-FHP	7.45	1.21	7.86	5.17	0.252	0.803
OP-CP	9.37	1.29	8.64	4.70	-0.492	0.627
Leptoprosopic						
TFI	91.67	1.04	91.21	3.90	-0.380	0.708
OP-FHP	10.91	1.64	7.29	3.54	-3.131	**0.005**
OP-CP	8.18	2.14	10.93	3.56	2.253	**0.034**

SD: Standard Deviation; TFI: Total facial index; OP-FHP: Occlusal plane-Frankfort horizontal plane angle; OP-CP: Occlusion plane-Camper's plane angle

points. The Camper's Plane (CP) was drawn by joining the radioopaque balls taped on the inferior border of the ala of the nose and the superior border of the tragus. In the next phase of cephalometric analysis, the OP-FHP angle, and the OP-CP angle were measured to the nearest degree with the help of scale and protractor and noted.

The data was subjected to statistical analysis using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. The statistical tests used in our study included descriptive statistics, ANOVA test, student't' test and Pearson's correlation test. The levels of significance observed were as follows: $P>0.05$: statistically not significant, $P<0.05$: statistically significant, $P<0.01$: statistically highly significant, and $P<0.001$: statistically very highly significant.

Results

Table 1 represents the comparison of different parameters assessed in this study between dentulous and edentulous patients for different facial types. In Mesoprosopic group, TFI revealed a statistically significant difference between dentulous and edentulous participants whereas the other two parameters i.e. OP-FHP angel and OP-CP angle did not reveal any significant difference statistically. For the Euryprosopic facial type, none of the parameters revealed statistically significant difference between the dentulous and the edentulous group. On the contrary, in the Leptoprosopic group, a statistically significant difference was observed for OP-FHP angel and OP-CP angle between dentulous and edentulous participants whereas statistically non-significant difference was observed for TFI.

Table 2 depicts Pearson's correlation coefficient for TFI, OP-FHP and OP-CP in both the groups. For the dentulous group, a moderately positive correlation was observed between TFI and OP-FHP whereas a weak positive correlation was observed for TFI and OP-CP and a negative correlation was observed for OP-FHP and OP-CP. For the edentulous group, the results revealed a negligible correlation for TFI and OP-FHP, a weak positive correlation between TFI and OP-CP, and a negative correlation between OP-FHP and OP-CP. The results indicate that use of Camper's plane running from lower border of Ala to superior border of Tragus gives very near the cant of occlusal plane.

Discussion

Orientation of occlusal plane for complete dentures play a vital role as it provides basis not only for arrangement of teeth but also for obtaining maximum functional stability, esthetics, and phonetics and deglutition [11]. According to Boucher, "If the soft tissues surrounding the dentures are to function as they did for natural teeth, the occlusal plane should be oriented exactly as it was when the natural teeth were present [11,12]. In completely edentulous patients, accurate re-establishment of lost occlusal plane is one entity that has been one of the greatest challenges in prosthetic rehabilitation. Due to its highly subjective nature, no single method seems to be perfect for its re-establishment however Camper's plane has gained privileged popularity with this context [4].

Based on the evaluation of dentate population samples, several authors have suggested that a predictable relationship may exist between certain fixed cranial landmarks and the plane of occlusion [3,13,14]. This finding holds relevance in the field of complete denture therapy since such a correlation could be applied in providing a more accurate method of establishing the plane of occlusion of completely edentulous patients [3]. The present study was prompted by the hypothesis that the cant of occlusion plane varies with facial types in both dentulous and edentulous patients. In the present study it was decided to verify the above hypothesis in dentulous patients and to establish a similar co-relation in edentulous patients, so that the determination of occlusal plane in edentulous patients can be done based on individual patient's facial types. Cephalometric analysis was used to study the various parameters involved in our study.

The findings of the present study reveal that the use of

Table 2. *Correlation Matrix for different measurements among dentulous and edentulous groups (Pearson's correlation coefficient).*

	TFI	OP-FHP	OP-CP
Dentulous			
TFI	1		
OP-FHP	0.432	1	
OP-CP	0.194	-0.661	1
Edentulous			
TFI	1		
OP-FHP	0.001	1	
OP-CP	0.194	-0.661	1

SD: Standard Deviation; TFI: Total facial index; OP-FHP: Occlusal plane-Frankfort horizontal plane angle; OP-CP: Occlusion plane-Camper's plane angle

Camper's plane running from lower border of Ala to superior border of Tragus gives very near the cant of occlusal plane. The findings of our study are in accordance with the study conducted by Hartono [15] who conducted a study to establish a correlation between the occlusal plane and facial types and concluded that a correlation exists between facial types and the location of the occlusal plane. The findings are also in agreement with Mittal [16] who compared the occlusal plane in dentulous and edentulous patients to determine the location of occlusal plane using hard tissue references. He concluded that significant correlation was found between the angulations of the occlusal-maxillary plane in both dentulous and edentulous participants therefore the occlusal−maxillary plane may be considered as a reliable guide for occlusal plane establishment. On the contrary, the results of the present study are in contrast to the findings of van Niekerk et al. [17] and Karkazis et al. [18] who observed an inconsistency in parallelism of occlusal plane with Ala−Tragus plane in the majority of patients making it an unsatisfactory landmark in accurate occlusal plane establishment. Further, D'Souza and Bhargava [19] in their study to assess the reliability of Camper's plane for the establishment of occlusal plane in dentulous and edentulous participants concluded that the reliability of Camper's plane as a guideline to simulate the natural occlusal plane is questionable.

In our study an attempt was made to determine the cant of occlusal plane in edentulous patients based on individual patient's facial types The results obtained in this study indicate that cant of occlusion plane varies with facial types in dentulous participants, but in edentulous participants there was no correlation found between cant of occlusion plane and facial types. The major limitation of our study was a relatively small sample size. Thus, it is recommended to conduct studies with larger sample size to increase the validity and reliability of the results obtained.

Conclusion

Within the limitations of the study, it can be concluded that the use of Camper's plane running from lower border of Ala to superior border of Tragus gives very near the cant of occlusal plane as seen in the natural dentition with three facial types. However, further studies on longer scale need to be conducted to get more comprehensive understanding of this complex phenomenon.

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