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ORIGINAL ARTICLE

Analysis of Relative Parallelism Between Hamular-Incisive-Papilla Plane and Campers Plane in Edentulous Subjects: A Comparative Study

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Abstract The study was undertaken to evaluate the parallelism between hamular-incisive-papilla plane (HIP) and the Campers plane. And to determine which part of the posterior reference of the tragus i.e., the superior, middle or the inferior of the Camper's plane is parallel to HIP using digital lateral cephalograms. Fifty edentulous subjects with well formed ridges were selected for the study. The master casts were obtained using the standard selective pressure impression procedure. On the deepest point of the hamular notches and the centre of the incisive papilla stainless steel spherical bearings were glued to the cast at the marked points. The study templates were fabricated with autopolymerizing acrylic resin. The subjects were prepared for the lateral cephalograms. Stainless steel spherical bearings were adhered to the superior, middle, inferior points of the tragus of the ear and inferior border of the ala of the nose using surgical adhesive tape. The subjects with study templates were subjected to lateral cephalograms. Cephalometric tracings were done using Autocad 2010 software. Lines were drawn connecting the incisive papilla and hamular notch and the stainless steel spherical bearings placed on the superior, middle and inferior points on the tragus and the ala of the nose i.e., the Campers line S, Campers line M, Campers line I. The angles between the three Camper's line and the HIP were measured and recorded. Higher mean angulation was recorded in Campers line S –HIP (8.03) followed by Campers line M-HIP (4.60). Campers line I-HIP recorded the least angulation (3.80). The HIP is parallel to the Camper's plane. The Camper's plane formed with the posterior reference point as inferior point of the tragus is relatively parallel to the HIP.

Keywords Occlusal plane · Campers plane · Ala-tragus line · Hamular-incisive-papilla plane

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Introduction

Orientation of the occlusal plane is one of the most important clinical procedures in prosthodontic re-habilitation of edentulous patients. Due to its effect on aesthetics, function and denture stability, it should be reconstructed as identical as possible to the occlusal plane of missing natural teeth [1–4, 9]. While recording maxillomandibular relation, various intraoral and extraoral landmarks are utilized for establishing occlusal plane such as the upper lip, lateral margins of the tongue, retromolar pad, parotid papilla, buccinators groove [2, 5, 7, 8, 10]. Though, none of these methods proved its accuracy to perfection. However, the Camper's plane or the ala-tragus line (ATL) remains the most widely used guide and well-documented method for occlusal plane orientation [3, 6].

The Glossary of Prosthodontic Terms defines Campers plane or ATL as 'the line from the inferior border of the ala

of the nose to the superior border of the tragus of the ear' [5]. The anterior landmark is stable but variations exist in the use of posterior reference point's i.e., whether to use superior part of the tragus, middle part of the tragus or inferior part of the tragus.

Cooperman stated that hamular-incisive-papilla plane (HIP) plane can quite predictably reproduce occlusal plane. The HIP plane was found to be essentially parallel to the occlusal plane of the worn dentitions in large majority of cases. These landmarks appeared to be least affected by residual ridge resorption and remained visible. This plane may be used in the determination of inclination of occlusal plane during complete denture construction [7, 8]. But, it is difficult to establish the occlusal plane intraorally using HIP plane.

Aims and Objectives

The study was undertaken to evaluate the parallelism between HIP and the Campers plane. And also to determine which part of the posterior reference of the tragus i.e., the superior point, middle point or the inferior point of the Camper's plane is parallel to HIP plane using digital lateral cephalograms.

Materials and Methodology

Fifty edentulous subjects between age group 40–65 years with well formed residual ridges i.e., Order II and III, visiting Department of Prosthodontics, V. S. Dental College & Hospital, Bangalore, were included in the study. Subjects with severely resorbed residual ridges i.e., Order IV–VI, Flabby ridges, oral diseases like oral submucous fibrosis, temporomandibular disorders, Systemic diseases like neuromuscular diseases, uncontrolled diabetes, osteoporosis etc. were excluded from the study. The ethical clearance was obtained from the institution ethical board.

Materials Used

Stainless steel spherical bearings, Autopolymerizing acrylic resin DPI RR, Indelible marker, Surgical adhesive tape, Cephalostat-Planmeca promax dimax3 ceph, Software-Autocad 2010.

Study Method

Fabrication of Temporary Denture Base

The impressions were made using the standard selective pressure impression procedure advocated by Boucher. The

Fig. 1 Master cast with three stainless steel spherical bearings—one at incisive papilla and two on *right* and *left* Hamular notches

Fig. 2 Study template

hamular notches were marked intraorally using T-burnisher and indelible marker and the markings were transferred to the impression. The impressions were casted using dental stone. 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, utilizing cyanoacrylate glue (Fig. 1). The study templates were fabricated with autopolymerizing acrylic resin using the sprinkle-on method. After polymerization study template with the stainless steel spherical bearings were retrieved, excess flash was trimmed around the borders and finished (Fig. 2).

Preparation of the Subjects for Lateral Cephalograms

The study templates were tried in the subjects and were evaluated for extensions and accurate fit. The markings were made on the superior, middle and inferior points of the tragus of the right ear using indelible marker. The surgical adhesive tape was adhered on the tragus of the ear and the markings were transferred to the surgical adhesive tape. Stainless steel spherical bearings were adhered to the markings thus obtained on the adhesive tape. A stainless

Fig. 3 Preparation of the subjects for lateral cephalogram

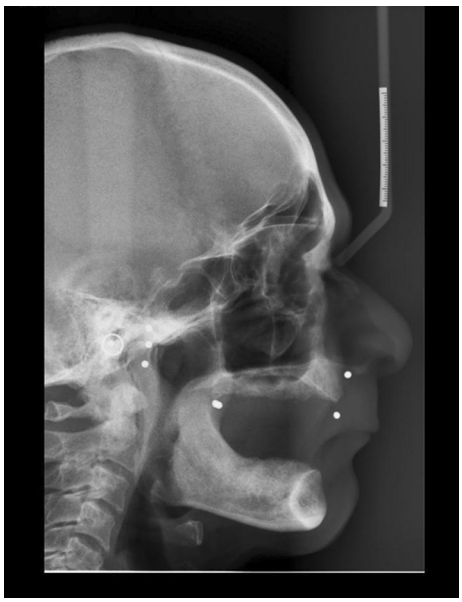

Fig. 4 Lateral cephalogram

steel spherical bearing was also placed at the inferior border of the ala of the nose using surgical adhesive tape (Fig. 3).

Lateral Cephalograms

Subjects with study templates were subjected to lateral cephalograms using Planmeca promax dimax3 ceph machine with exposure parameters 68 kV, 5 mA, 12.1 s, 0.0 m Gy cm^2.

Cephalometric Tracing

Cephalometric tracings were done using Autocad 2010 software and the soft copy of the cephalogram (Fig. 4).

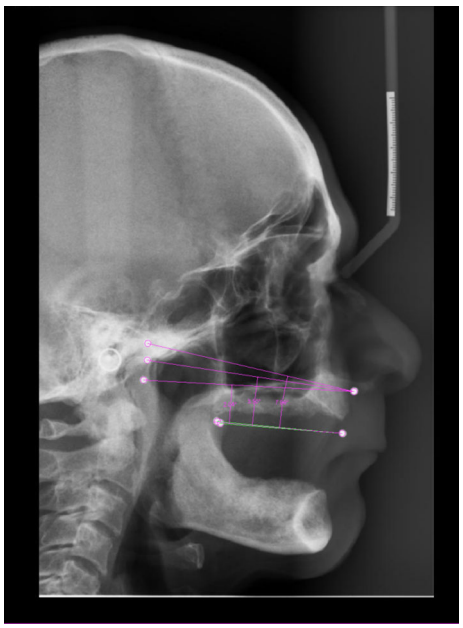

Fig. 5 Cephalometric tracing

Lines were drawn connecting the incisive papilla and the right hamular notch (HIPR), and the incisive papilla and the left hamular notch (HIPL). A line bisecting these two lines was established as the HIP. Three lines were drawn connecting the stainless steel spherical bearings placed on the superior, middle and inferior points on the tragus and the ala of the nose (Fig. 5). These lines were therefore marked as Campers plane S, Campers plane M and Campers plane I respectively.

The angles between the Campers plane S, Campers plane M, Campers plane I and the HIP i.e., CPS-HIP, CPM-HIP and CPI-HIP respectively were measured and recorded.

Results

The edentulous subjects consisted of 32 men and 18 women aged 40–60 years. Lateral cephalograms were taken for all the subjects. The angles were measured between the Campers plane S, Campers plane M, Campers plane I and the HIP i.e., CPS-HIP, CPM-HIP and CPI-HIP respectively using autocad software. The values were subjected to statistical analysis. The differences in angular values were analyzed by ANOVA test and post–hoc test of Bonferroni (Tables 1, 2, 3; Fig. 6).

Discussion

The assessment of the occlusal plane has been performed by comparing the inclination of occlusal plane with

Table 1 Descriptive Statistics for the angles between the Campers plane S, Campers plane M, Campers plane I (Superior, Middle, Inferior point of tragus) and the Hamular-Incisive-Papilla plane

Angulation	*n*	Mean	Std. deviation	Std. error	95 % confidence interval for mean		Min	Max	*P* value
					Lower bound	Upper bound			
Campers plane—S and HIP plane	50	8.03	3.88	0.55	6.92	9.13	0.10	16.18	<0.001*
Campers plane—M and HIP plane	50	4.60	2.86	0.40	3.79	5.42	0.23	12.04	
Campers plane—I and HIP plane	50	3.80	3.28	0.46	2.87	4.73	0.48	14.72	

* Significant difference

Table 2 ANOVA–comparison of angular measurements

Source	df	Sum of squares (SS)	Mean (SS)	F	*P* value
Between groups	2	503.022	251.511	22.185	<0.001*
Within groups	147	1,666.512	11.337	–	–
Total	149	2,169.534	–	–	–

* Significant difference

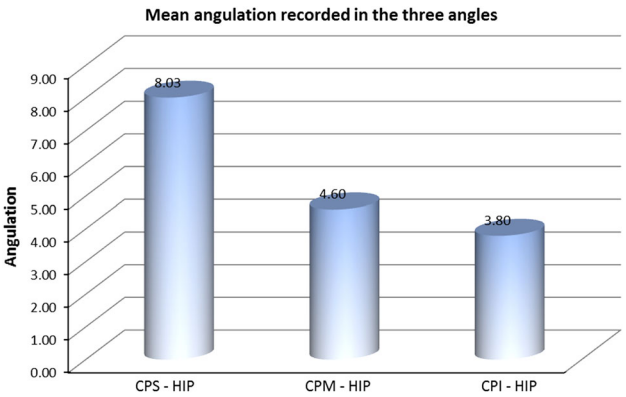

Fig. 6 Mean angular measurements of CPS-HIP, CPM-HIP, and CPI-HIP

selected craniofacial reference planes like Frankfort horizontal plane and Campers plane using lateral cephalograms and photographs. The Campers plane or the ATL remains the most widely used guide and well-documented method for occlusal plane orientation in completely edentulous patients. Controversy exists regarding the consideration of posterior reference points.

Katayoun Sadr and Firas A.M. AL Quran stated that the ala-tragus line with posterior reference point as superior border of the tragus is parallel to the occlusal plane and was most accurate in orienting the occlusal plane [2, 4].

Sivakumar Jayachandran stated that, HIP plane can quite predictably reproduce occlusal plane [16]. Robert B. Sloane, H. Rich, stated that HIP plane may be used in determination of inclination of occlusal plane during complete denture construction [11, 12]. As it is difficult to establish this plane intraorally, this study was undertaken to evaluate the parallelism between Hamular notch incisive papilla plane and the Campers plane.

Photographs and Lateral Cephalograms have been used in earlier studies to determine the plane of occlusion [4, 9, 11, 13–16]. Since mid-1980s Digital systems have improved considerably and can provide the information more effectively than can film-based imaging [17, 18]. In the present study digital lateral cephalogram was used to study the relationship between three Campers plane and HIP plane. To reduce manual errors Cephalometric tracings were done using Autocad 2010 software on the cephalogram. The lines were traced and angles were recorded.

Table 3 Multiple comparisons (post-hoc test) using Bonferroni test

Dependent variable: angulation Bonferroni						
(I) Angle	(J) Angle	Mean difference			95 % confidence interval	
		(I–J)	Std. error	Sig.	Lower bound	Upper bound
Superior	Middle	3.42160*	0.67340	0.000	1.7908	5.0524
	Inferior	4.22280*	0.67340	0.000	2.5920	5.8536
Middle	Superior	−3.42160*	0.67340	0.000	−5.0524	−1.7908
	Inferior	0.80120	0.67340	0.708	−0.8296	2.4320
Inferior	Superior	−4.22280*	0.67340	0.000	−5.8536	−2.5920
	Middle	−0.80120	0.67340	0.708	−2.4320	0.8296

* The mean difference is significant at the 0.05 level

The mean values obtained for the angle CPS-HIP were maximum as compared to the mean values obtained for CPM-HIP and CPI-HIP. The mean values obtained for the angle 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.

In order to find out among which pair of angles there exist a significant difference, we carried out multiple comparisons (post-hoc test) using Bonferroni method.

The difference in mean angulation between CPS-HIP and CPM-HIP, CPS-HIP and CPI-HIP is found to be statistically significant ($P < 0.001$). However, the difference in mean angulation between CPM-HIP and CPI-HIP is not statistically significant ($P > 0.001$).

It is evident from the results that, the Campers plane formed with the posterior reference point as inferior point of the tragus is relatively parallel to the HIP (CPI-HIP). As per the results of multiple comparisons there is no statistically significant difference between CPM-HIP and CPI-HIP. CPI and CPM are considered to be relatively parallel to the HIP.

Limitations

Ridge relationship was not categorized.

Conclusion

Determination of the plane of occlusion in edentulous patients plays a vital role in the success of complete denture rehabilitation. HIP has been essentially found to be parallel to the natural dentition. Though there are several methods to establish the plane of occlusion, Campers plane seems to be the most widely used guideline. This study gives a guideline for establishing the occlusal plane. In the present study digital lateral cephalogram were used, and to reduce manual errors, cephalometric tracings were done using Autocad 2010 software. Within the studied population, the Campers plane formed with inferior border of the ala of the nose to the posterior reference point as inferior point of the tragus is relatively parallel to the HIP in the selected age group.

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