

# Evaluation of Hamular Notch-Incise Papilla Plane as a Useful Reference in Establishing the Occlusal Plane

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## ABSTRACT

### Background

Establishment of occlusal plane with hamular notch- incisive papilla plane as a useful reference helps to reduce the chairside time taken for jaw relation during complete denture fabrication.

### Objective

To determine the hamular notch-incisive papilla plane (HIP) as a useful reference plane in establishing the occlusal plane.

### Method

This cross-sectional analytical study was conducted among 100 dental students by obtaining the maxillary cast from an impression made. The data collected were entered and analyzed using SPSS version 21. Paired t-test, Independent t-test and Pearson correlation was applied for statistical analysis.

### Result

The vertical distance from hamular notch-incisive papilla plane and occlusal plane at the level of mesio-incisal line angle of maxillary central incisor and mesio-palatal cusp tips of maxillary first molar showed statistically significant difference ( $p < 0.001$ ) on both right and left sides. There was statistically significant difference ( $p < 0.05$ ) between hamular notch-incisive papilla plane and occlusal plane on right and left sides, between right and left mesio-palatal cusp tips of maxillary central incisors from hamular notch-incisive papilla plane. Hamular notch-incisive papilla plane, mesio-incisal line angle of right maxillary central incisor and mesio-incisal line angle of left maxillary central incisor had mild but significant correlation with age. The parallelism between hamular notch-incisive papilla plane and occlusal plane within the range of 2 mm was 62% on right side and 75% on left side.

### Conclusion

Hamular notch-incisive papilla plane can be used as a practical method for establishing the occlusal plane tentatively.

## KEY WORDS

*Hamular notch-incisive papilla plane, Occlusal plane, Surveying*

## INTRODUCTION

The orientation of the occlusal plane plays a crucial role in esthetics, physiologic functions, and denture stability. It should closely replicate the occlusal plane of natural teeth for proper function and aesthetics.<sup>1</sup> Correct height and width are essential for maintaining food control, speech articulation, tongue space, and soft tissue support.<sup>2</sup> An improperly oriented occlusal plane may interfere with the interaction between the tongue and buccinator muscle, leading to issues such as food accumulation or cheek and tongue biting.<sup>3</sup> Several anatomical landmarks, including Camper's plane, inter-pupillary line, retro-molar pad height, and buccinators grooves, have been suggested to help establish the occlusal plane.<sup>4-7</sup>

Despite these landmarks, determining the optimal occlusal plane in edentulous patients remains challenging.<sup>8</sup> The Hamular notch-Incisor papilla (HIP) plane, extending from the hamular notches to the incisor papilla, has been reported as a reliable guide for this purpose.<sup>9-12</sup> Cooperman found that the HIP plane could be used to orient the occlusal plane, and Sugaya et al. suggested it allows for predictable results.<sup>13,14</sup> While studies have shown varying degrees of parallelism between the HIP plane and occlusal plane, there is limited research in Nepal, particularly regarding gender and side-specific differences.<sup>15-20</sup>

This study aims to evaluate the parallelism of the HIP plane with the occlusal plane, contributing to better prosthetic rehabilitation and reducing chairside effort during jaw relation for clinicians. It will also assess gender and side-specific variations, providing insights to optimize occlusal plane orientation in edentulous patients.

## METHODS

This was a hospital based cross-sectional analytical study carried out in the Department of Prosthodontics, College of Dental Surgery, B.P. Koirala Institute of Health Sciences, Dharan, Nepal from February 2020 to August 2020. Population sample was taken from the students who met the inclusion criteria.

According to the study, "Evaluation of Hamular notch-Incisor papilla plane (HIP) as a useful reference in Establishing the Occlusal Plane" carried out among dental students and some patients visiting Department of Prosthodontics, Kantipur Dental College & Hospital by Thapa in 2014, 81.25% of the cases showed parallelism within the range of 2 mm.<sup>19</sup> This study considered 95% confidence interval and 80% power to estimate sample size. In this regard, approximately, in 81% of cases occlusal plane was parallel to the HIP plane. Using formula to estimate sample size,

$n = Z^2pq/L^2$  where,  $Z = 1.96$  at 95% confidence interval  
Permissible error ( $L$ ) = 20% of  $p$  where, power = 80%,  $L = 16.2$ ,  
Proportion ( $p$ ) = 81%, Complement of  $p$  ( $q$ ) = 19%

By putting all these values in given formula, Total sample size =  $n = 90$  (Approx.) To reduce various technical and measurement bias, 10% was added to the calculated sample size which is approximately 9. So, total sample was  $90+9=99 \sim 100$  (Approx.). In total, 100 people were enrolled for the study. Sampling technique used was non-probability purposive sampling.

Ethical clearance was obtained from Institutional Review Committee of B.P. Koirala Institute of Health Sciences, Dharan, Thesis Protocol Evaluation Committee of BPKIHS and Verbal and written informed consent were taken from subjects enrolled in the study.

Inclusion criteria were Nepalese subjects with 28 teeth exclusive of third molars, no history of orthodontic treatment, angle's class I canine and class I molar relationships, absence of anterior or lateral cross bite, no extensive restorations or cuspal coverage, absence of a pathologic periodontal condition, clinically normal arch shapes with minimal dental crowding or spacing (< 2 mm), no history of temporomandibular disorders. Those who did not meet the inclusion criteria were excluded from the study.

The armamentarium required for the study were set-up (Fig. 1). Subjects were seated in upright position on dental chair, hamular notches were located with T- burnisher and marked with indelible pencil. Maxillary impression was made using alginate and cast was poured using dental stone. The base was made using dental plaster in base former. Each maxillary cast was placed on horizontal surface, defined anatomic landmarks of cast was identified and marked with lead pencil. A point on hamular notch, center of incisor papilla, mesio-incisal line angle of central incisors and mesio-palatal cusp tip of first molars was marked on the cast (Fig. 2). The cast was mounted in the surveyor and HIP plane made parallel to the floor by measuring the length of surveying arm with vernier caliper (Fig. 3) and tripodding was done. This measurement was recorded under HIP. Surveying arm was moved upward at the level of the mesio-palatal cusp of first molars and the same area was measured (Fig. 4) and recorded under Hamular notch-incisor papilla plane (HIP) to the mesio-palatal cusp tip of HIP maxillary first molar (R6MP) and incisor papilla plane to the mesio-palatal cusp tip of right maxillary first molar (L6MP). Same was done in relation to mesio-incisal line angle (Fig. 5) and recorded under HIP to the mesio-incisal line angle of right maxillary central incisor (INC-R) and HIP to the mesio-incisal line angle of left maxillary central incisor (INC-L). HIP was subtracted from INC-R & INC-L and noted. HIP was also subtracted from R6MP & L6MP and noted. All the values were recorded and tabulated for statistical analysis.

All the data were handled by the single investigator which was regularly cross checked by the guide and co guides for its accuracy. Collected data were entered in Microsoft Excel 2016. Accuracy of entry was rechecked after every



Figure 1. Armamentarium used in the study.

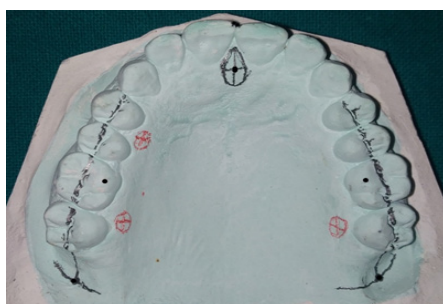


Figure 2. Markings showing the center of incisive papilla, center of right and left hamular notch, mesio-incisal line angle of right and left maxillary central incisors and mesio-palatal cusp tips of right and left maxillary first molars in the dental cast.



Figure 3. Measurement at hamular notch and incisive papilla.

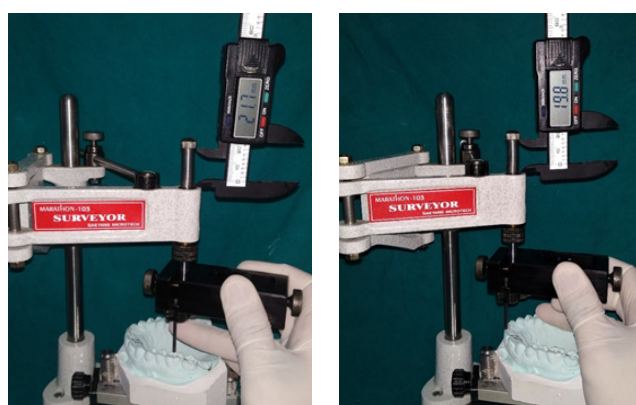


Figure 4. Measurement at mesio-palatal cusp tips of maxillary first molars.



Figure 5. Measurement at mesio-incisal line angle of maxillary central incisors.

ten entries to avoid entry error. The obtained data was converted into Statistical Package for Social Science (SPSS 21) for statistical analysis. Shapiro-Wilk test was used to determine the normality of distribution which revealed normal distribution and the parametric tests were used. For descriptive statistics, percentage, mean and Standard Deviation were calculated and also tabular and graphical presentation were carried out. Paired t-test was used to compare the difference of parameters on right and left sides. Independent t-test was used to assess the difference of parameters in males and females. Pearson correlation was applied to determine the correlation of age with various dentate cast measurements. The tests were applied at 95% confidence interval where p-value was considered as less than 0.05.

## RESULTS

The students of College of Dental Surgery, BPKIHS who met the inclusion criteria were enrolled for the study. The study comprised of 100 subjects in total, out of which majority (57%) were females and 43% were males. The age of the subjects ranged from 18 to 30 years, with mean age of  $23.4 \pm 2.5$  years. The analysis of the distance of HIP to the mesio-incisal line angles and mesio-palatal cusp tips showed that the mean  $\pm$  SD between HIP and mesio-incisal line angle of maxillary central incisor on right ( $4.57 \pm 1.25$ ) and left ( $4.57 \pm 1.26$ ) was found to be similar. While, that between HIP and the right ( $5.91 \pm 1.41$ ) and left ( $5.46 \pm 1.44$ ) mesio-palatal cusp tip was slightly different (Table 1).

Gender-wise comparison of all parameters were statistically analysed using independent t-test which revealed that both male and female had similar measurement in all planes and their difference was not statistically significant ( $p > 0.05$ ).

Table 1. Distance of HIP to the mesio-incisal line angles and mesio-palatal cusp tips.

Variables	Mean $\pm$ SD (mm)	Standard Error of Mean	Minimum (mm)	Maximum (mm)
HIP-INC(R)	$4.57 \pm 1.25$	0.12	2.00	8.20
HIP-R6MP	$5.91 \pm 1.41$	0.14	2.10	10.00
HIP-INC(L)	$4.57 \pm 1.26$	0.12	1.90	7.56
HIP-L6MP	$5.46 \pm 1.44$	0.14	2.60	10.19

(Table 2).

Pearson correlation test was used to determine the relationship between various parameters and age. Association was found to be statistically insignificant ( $p > 0.05$ ) except HIP, INC-R and INC-L which were significantly associated with age ( $p < 0.05$ ) (Table 3). This study revealed low degree of correlation between age and various measurements (Table 3).

Comparison of parameters on right and left side was done

**Table 2. Gender-wise comparison of all parameters (N=100).**

Variables	Gender	Mean ± SD (mm)	P-value
HIP-INC(R)	Male	4.48±1.39	0.54
	Female	4.64±1.15	
HIP-R6MP	Male	6.14±1.65	0.15
	Female	5.73±1.18	
HIP-INC(L)	Male	4.48±1.29	0.54
	Female	4.63±1.24	
HIP-L6MP	Male	5.68±1.66	0.18
	Female	5.29±1.25	

**Table 3. Correlation of age with dentate cast measurements.**

Variables	Pearson correlation with age	p-value
HIP	-0.259**	0.009
INC-R	-0.217*	0.030
INC-L	-0.221*	0.027
R6MP	-0.162	0.108
L6MP	-0.107	0.291
HIP-INC(R)	-0.024	0.811
HIP-R6MP	0.038	0.710
HIP-INC(L)	-0.028	0.782
HIP-L6MP	0.110	0.278

\*\* Correlation is significant at the 0.001 level (2-tailed).

\*Correlation is significant at the 0.05 level (2-tailed).

**Table 4. Comparison of parameters on right and left side.**

Paired Differences						
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	Lower	Upper
Pair 1 vs Pair 2	0.44	1.63	0.16	0.11 0.76	0.11	0.76
Paired Differences						
	Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	Lower	Upper
Pair 1 {HIP-INC(R)} - {HIP-R6MP}	-1.33	1.71	0.17	-1.67 -0.99	-1.67	-0.99
Pair 2 {HIP-INC(L)} - {HIP-L6MP}	-0.89	1.81	0.18	-1.25 -0.53	-1.25	-0.53

using paired t-test. Measurement from HIP to INC (R) and to R6MP was considered as Pair 1 and similar on left side was considered as Pair 2. These were statistically different

from each other ( $p < 0.05$ , 95% CI) with mean difference of -1.33, and -0.89 respectively. Similar difference was obtained when both pair 1 and pair 2 was compared with mean difference of 0.44, which was statistically significant ( $p < 0.05$ ) (Table 4). Parallelism was observed higher in left side (75%) in comparison to right side within the range of  $\leq 2$  mm (Table 5).

**Table 5. Parallelism in right and left sides within the range of  $\leq 2$  mm (N=100).**

Measurements	Frequency N (%)	
	Right side	Left side
$\leq 2$ mm	62%	75%
$> 2$ mm	38%	25%

### DISCUSSION

The reconstruction of the occlusal plane in the edentulous patient helps in the normal function of buccal and lingual musculature along with other surrounding structures.<sup>21</sup> According to Levin, patients also have the adaptive capacity for a slight change of 1 to 2 mm at most in the occlusal plane that can improve the stability for a poor ridge.<sup>22</sup> A study was done by Carey on eight subjects to test masticatory efficiency varying the orientation of the occlusal plane and it was found that function was not appreciably affected and a certain amount of leeway is permissible when orienting the occlusal plane.<sup>23</sup>

The mean distance of incisal edge from HIP was higher for females when compared to males, though the difference was very small. The reason for this difference could be due to difference in size of jaws and teeth between the genders. No statistically significant differences were found between male and female for all parameters. This result was in accordance to the result obtained by Singh et al. and Tippashetty et al.<sup>24,25</sup> This indicates that HIP plane can be used as a guide to establish occlusal plane irrespective of the gender. In the present study, parallelism between HIP to occlusal plane within a range of 2 mm was 62% on right side and 75% on left side. The value obtained in the study by Thapa was 81% and Jayachandran et al. was 75%.<sup>19,20</sup> No absolute parallelism between the occlusal plane and HIP plane was found in present study. This was in accordance with the study by Thapa, while in contrast to a study by Jayachandran et al. in which 15% cases showed absolute parallelism between occlusal plane and HIP plane.<sup>20</sup> This might be due to difference in reference points taken for occlusal plane, difference in measurement methods, evaluation methods and population samples.

The reliability of HIP as a sole reference to orient the occlusal plane is questionable. HIP can be used safely as a reference for occlusal plane determination during fabrication of complete dentures only if combined with

other methods for establishing the occlusal plane. Karkazis et al. and Van Niekerk et al. stated that with increasing experience there is less reliance on the guides rather there is a perception of correctness.<sup>17,26</sup> Although this study was performed on small number (100) of individuals, still the measurements of the teeth and dentate cast dimensions might contribute to the knowledge of these dimensions especially in the Nepalese population.

The limitations of the study include samples were enrolled from within BPKIHS due to the limited time period, which may not be the representative of entire Nepalese population. Study sample was small so it could not be used to generalize the Nepalese population. Centre of hamular notches was subjectively assessed. Angular deviation between occlusal plane and hamular notch-incisive papilla plane was not measured. Comparison with other planes such as camper's plane was not done. Further studies may be needed to establish this concept. However, the results of this study could be used as a baseline guide and would be helpful in planning the concept and treatment plan on larger populations when combined with other methods for determining the occlusal plane.

## CONCLUSION

Majority of sample had parallelism between HIP plane and occlusal plane within the range of 2 mm. Distance of HIP plane to the right and left mesio-palatal cusp tips had significant difference. HIP plane, mesio-incisal line angle of right and left maxillary central incisor had weak but

significant correlation with age. No statistically significant differences were found between male and female for all parameters which indicates that HIP plane can be used as a guide to establish occlusal plane irrespective of the gender. The results of this study show that HIP plane could be used as practical method for establishing the occlusal plane tentatively. It would highly assist the dentists to establish the plane of occlusion even in the absence of patients. This would help reduce the chairside time taken for jaw relation during complete denture fabrication. But, it gives only the cant of occlusal plane and not the exact vertical height. HIP plane should be used along with other methods for establishment of occlusal plane. Further clinical application may be needed to establish this concept with higher sample size and in variety of population sample so that the results can be generalized. These results could be used as a baseline guide and would be helpful in planning the concept and treatment plan on larger populations when combined with other methods for determining the occlusal plane.

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