Relationship of Occlusal Planes and Growth Patterns in Skeletal Class I Malocclusion

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ABSTRACT

Introduction: The occlusal plane (OP) plays a crucial role in orthodontic diagnosis and treatment planning. The position of the mandible, smile esthetics, masticatory function and stability of the treatment are affected by occlusion. The morphology and inclination of the OP varies among individuals. It varies among sagittal and vertical patterns. There are scarce literatures regarding the relationship of occlusal planes and growth patterns in Class I malocclusion in Nepali sample.

Objective: To evaluate the relationship of anterior and posterior occlusal planes and growth patterns in skeletal Class I malocclusion.

Materials and Method: This is an observational cross-sectional study with 60 subjects of age range 12-49 years with skeletal Class I relation. The samples were selected from the lateral cephalograms of patients visiting the Department of Orthodontics, Kantipur Dental College. The ANB angle was measured to assess the sagittal jaw relationship and the Jarabak ratio to determine the growth pattern. Anterior occlusal plane (AOP) and posterior occlusal plane (POP) were drawn and measured with different horizontal planes. The measurements were compared among all the groups to evaluate the relationship between AOP and POP with different growth patterns. Descriptive statistics were calculated for each parameter. One way ANOVA was performed to determine association followed by Bonferroni test. Pearson's coefficient test was done to evaluate the correlation between the parameters.

Results: There was significant association of anterior and posterior occlusal planes with Sella-Nasion, Frankfort Horizontal, and Mandibular planes in various growth patterns in skeletal Class I malocclusion. The means of AOP, POP and OP difference in Class I malocclusion were 16.45°, 17.25° and -1.02° respectively.

Conclusion: Occlusal plane forms and inclinations vary according to the growth patterns. There is significant association between skeletal parameters with anterior occlusal plane and posterior occlusal plane, demonstrating the relationship between skeletal patterns and the vertical deviations of occlusal planes.

Keywords: Anterior occlusal plane; growth pattern; Jarabak ratio; lateral cephalogram; posterior occlusal plane; sagittal relationship.

INTRODUCTION

Occlusal plane plays a crucial role in orthodontics.[1-4] Jack Dale has addressed the occlusal plane as the "workbench of orthodontics".[2] The form and inclination of OP varies individually and are related to the esthetics, function and stability of the stomatognathic system.

OP is represented as a two-dimensional segmentation of a three dimensional phenomenon in lateral cephalogram. Downs in 1948 defined occlusal plane as a line bisecting the occlusion of first molars and central incisors.[5] For the precise explanation of occlusion plane, Fushima et al. divided the maxillary occlusal plane into AOP and POP. AOP is a line drawn from incisal edge of the upper central incisor to the cusp tip of upper second premolar. POP is a line drawn from cusp tip of the upper second premolar to the midpoint of upper second molar at the occlusal surface.[1]

Previous studies related AOP and POP to horizontal planes demonstrated mandibular retrognathism and prognathism in association to AOP and POP,[1] but did not show the relationship of occlusal planes and growth patterns in skeletal Class I malocclusion. Thus, this study aims to evaluate the relationship of AOP and POP and growth patterns along with the corelation between these parameters and growth pattern in skeletal Class I malocclusion using lateral cephalogram.

MATERIALS AND METHODS

This is an observational cross-sectional study using secondary data of the Department of Orthodontics,

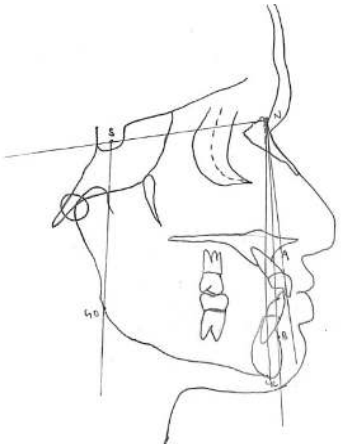

Figure 1: Cephalometric Landmarks for determining ANB angle and Jarabak Ratio

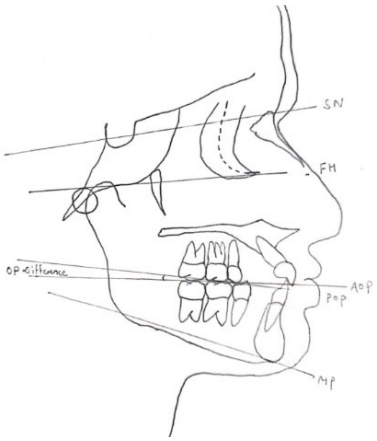

Figure 2: Horizontal planes (Sella-Nasion,Frankfort Horizontal,Mandibular Plane,Anterior and Posterior occlusal plane)

Kantipur Dental College and Hospital, Kathmandu. The study was conducted in July 2022 after obtaining the ethical clearance (IRC Ref no. 15/022). The sampling technique was non-probability convenience sampling. A total of 60 subjects were selected meeting the inclusion criteria set for the study.

Based on the study done by Amatya et al.,[10] sample size was calculated as;

$$N = 2 \times (Z\alpha + Z\beta)^2 \times SD^2/Mean^2$$

where,

N= No. of sample calculated

Zα = 1.96

Zβ= 1.65 in 95% power

P= Average of standard deviation from a similar study

D=Difference of mean in the similar study

Sample size (N) = $2 \times (1.96 + 1.65)^2 \times (4.81)^2/(5.77)^2 = 18.10 \sim 18$

The sample size was determined as 60 (20 Samples each for normal, horizontal and vertical growth pattern) summing the 10% permissible error.

Data information sheet was used to collect the information from the samples. Lateral cephalograms were traced on matte acetate tracing paper on a view box using transilluminated light. The landmarks and measurements were taken manually. Cephalometric scale and divider were used for linear and angular measurements. Steiner's ANB angle[11] was utilized to classify the skeletal malocclusion. Radiographs were again divided into normal, vertical and horizontal growth patterns according to Jarabak ratio (Figure 1).[12]

Data were collected and analyzed using SPSS V21. Descriptive statistics including mean, standard deviation were calculated for each parameter. One way ANOVA was done to determine the association among AOP and POP and different horizontal planes. Pearson's correlation coefficient test was performed to evaluate the correlation among the parameters. p Value <0.05 was considered statistically significant.

RESULTS

The sample comprised of lateral cephalogram of 60 subjects (25 male and 35 female) aged 12-49 years. The descriptive statistics of angular parameters in skeletal Class I malocclusion is presented in Table 1.

The mean angulations of FH-POP, SN-AOP, SN-POP, MP-AOP, and MP-POP except FH-AOP were increased in vertical grower compared to normal and horizontal grower as shown in Figure 3.

Table 1. Descriptive statistics of angular parameters in skeletal Class I malocclusion

Parameters	FH-AOP	FH-POP	OP difference (FHAOP - FHPOP)	SN-AOP	SN-POP	MP-AOP	MP-POP
Mean	16.90	20.52	-1.02	22.05	27.48	20.90	15.57
Standard deviation	6.016	5.689	7.439	3.814	5.600	4.753	3.310

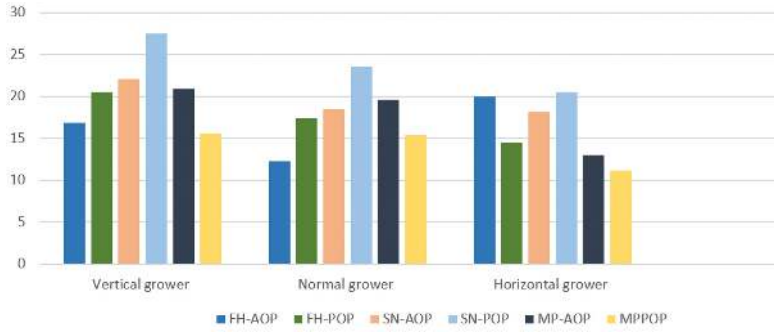

Figure 3: Mean of angular measurements in various growth patterns

Table 2 shows the association between anterior and posterior occlusal planes with different horizontal planes in various growth patterns in skeletal Class I malocclusion.

The result obtained from One-way ANOVA test was statistically significant which was followed by Post hoc Bonferroni test. The result from the test is presented in Table 3.

Table 2: One way ANOVA for determining association among different angular parameters

Parameter	f value	p value
SN-AOP	3.896	0.026*
SN-POP	10.1014	0.000*
FH-AOP	7.933	0.001*
FH-POP	7.305	0.001*
MP-AOP	11.695	0.000*
MP-POP	5.784	0.000*

* Significant at p<0.05

Table 3: Bonferroni test for multiple comparisons in various growth patterns

Parameter	Measurement	p value
FH-AOP	Vertical vs Normal grower	0.056
	Vertical vs Horizontal grower	0.340
	Normal vs Horizontal grower	0.001*
FH-POP	Vertical vs Normal grower	0.160
	Vertical vs Horizontal grower	0.001*
	Normal vs Horizontal grower	0.244
SN-AOP	Vertical vs Normal grower	0.080
	Vertical vs Horizontal grower	0.044*
	Normal vs Horizontal grower	1.000
SN-POP	Vertical vs Normal grower	0.075
	Vertical vs Horizontal grower	0.000*
	Normal vs Horizontal grower	0.124
MP-AOP	Vertical vs Normal grower	1.000
	Vertical vs Horizontal grower	0.001*
	Normal vs Horizontal grower	0.001*
MP-POP	Vertical vs Normal grower	1.000
	Vertical vs Horizontal grower	0.011*
	Normal vs Horizontal grower	0.019

* Significant at p<0.05

Table 4: Correlation of various angular measurements with Jarabak Ratio

Jarabak Ratio	FH-AOP	FH-POP	SN-AOP	SN-POP	MP-AOP	MP-POP
Pearson's coefficient	**-0.080**	-0.378**	-0.348**	-0.412**	-0.486**	-0.424**
p Value	**0.544**	0.003	0.006	0.001	0.000	0.001

* Significant at $p<0.05$

When correlating Jarabak ratio with FH-POP, SN-AOP, SN-POP, MP-AOP and MP-POP; the parameters had negative correlation except FH-AOP (Table 4).

DISCUSSION

Occlusal plane affects craniofacial form, growth, masticatory function, malocclusion, mandibular morphology and position, esthetics, and TMJ. The relationship of the occlusal plane to the sagittal pattern as assessed by various studies noted the varying degree of the occlusal plane inclination.[1,4,5]

From the present study, mean angulation value of AOP, POP and OP difference in Class I malocclusion were 16.45°, 17.25° and -1.02° respectively. Fushima et al. conducted a similar type of study where they found mean of AOP and POP to be 10° and 14.9° respectively. This observed difference could be the result of variation in genetic and environmental factors. Similarly a study published in 2011 by Acharya,[15] found the difference in mean angulation of FH-CP (Camper's line) between Nepali and Indian population. The report suggested ethnic difference especially in upper face result for the increased values in Nepali sample as compared to Indian sample. The present study demonstrated mean angulation of different parameters were greater among vertical growers compared to normal and horizontal growers. The result suggested of implementing different treatment protocols for stable treatment according to the growth patterns.

The present result demonstrated a significant association between AOP and POP with Sella Nasion, Frankfort Horizontal and Mandibular Plane in different growth patterns in skeletal Class I malocclusion. This was similar to the results by Hassouna et al.[9] In the present study, negative correlation was found between Jarabak ratio and angular parameters in various growers.

The study was conducted among the 60 subjects, which does not represent a whole range of population. The present study is conducted using lateral cephalogram, which is two dimensional image. Thus further research using three dimensional diagnostic aid to demonstrate relationship of occlusal planes and growth pattern in various skeletal malocclusions among large population would provide more accurate and precise information.

CONCLUSION

There is significant association between horizontal planes with anterior and posterior occlusal planes, demonstrating the relationship between skeletal patterns and the vertical deviations of occlusal planes. Similarly, Jarabak ratio and FH-POP, SN-AOP, SN-POP, MP-AOP and MP-POP have negative correlation, i.e. increase in Jarabak ratio causes to decrease in the these parameters and vice versa. Thus, the anterior occlusal plane and posterior occlusal plane inclination should be considered in patients for the orthodontic diagnosis andtreatment planning.

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CONFLICT OF INTEREST

None.

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