ANGULAR RELATIONSHIP BETWEEN THE PALATAL PLANE AND ANTERIOR CRANIAL BASE IN DIFFERENT SAGITTAL SKELETAL RELATIONSHIPS IN NORTH KERALA POPULATION: A CEPHALOMETRIC STUDY

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Abstract

Anteroposterior jaw relationship is a useful parameter for orthodontic treatment planning. Angular and linear measurements both have been proposed and used in orthodontic cephalometrics to assess jaw relationships. There is unreliability over the years as the angular measurements change with the facial height, jaw inclination, and the variable positions of Nasion. So, the objective of our study was to assess the angular anteroposterior jaw relation in a sample of the north Kerala population using the palatal plane as a reference line.

Key words: *cephalometric analysis, palatal plane, anterior cranial base, population study , SN plane*

INTRODUCTION

1 Cephalometric analysis is one of the mainstays of diagnosis in orthodontics. It entails in evaluating lateral cephalometric radiographs with cephalometric indices. The linear and angular measurements have been established and incorporated into a variety of analyses to study the relationship between maxillary and mandibular structures. it also aids the clinicians in the diagnosis and formulation of an appropriate orthodontic treatment plan

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. The A point, Nasion, and B point (ANB) angles are widely used cephalometric indices for correlating and assessing sagittal skeletal relationships.
Several authors have noted discrepancies between the interpretation of this angle and the apparent jaw relation. Wits appraisal is one of the popular and widely used techniques. It was developed to address the shortcomings of the ANB angle. Wits appraisal works by connecting points A and B to the occlusal plane.
The SN plane is another name for the anterior cranial baseline and is constructed by connecting the Sella Tursica and the Nasion. The anterior nasal spine and the posterior nasal spine are connected to form the palatal plane (PP). The angle formed by these planes demonstrates the PP's relationship to the anterior cranial base (PP-SN angle). According to Nahomi, the PP-SN angle value is proportional to the size of the upper face. However, his results show that the PP-SN angle is 45% less in open bite cases than in normal patients. He concluded that the PP-SN angle, along with the mandibular plane (MP) angle (SN-MP), basal plane angle (PP-MP), and linear vertical facial measurements aids in the diagnosis and identification of the malocclusions in the vertical dimension. Benyahia et al. and Eslami et

al. attempted to study and correlate whether the PP-SN angle could be a determining parameter in the decision for surgery or camouflage approach for the management of skeletal class III patients.

However, these authors were unable to ascertain any such correlation. To date, no study has attempted to quantify the PP-SN angle in the North Kerala population. The objective of this research was to quantify the relationship of the Palatal Plane to the anterior cranial base in different skeletal sagittal relationships among the North Kerala population. Thus this study aims to provide basic guidelines for its use in North Kerala individuals.

MATERIALS AND METHODS

This short study was conducted in the Department of Orthodontics, Educare Dental College, Malappuram in January 2024. The radiographs were taken by the same operator, using the same equipment, and with the same exposure parameters. The radiographs were selected for evaluation in this investigation based on the following inclusion criteria:

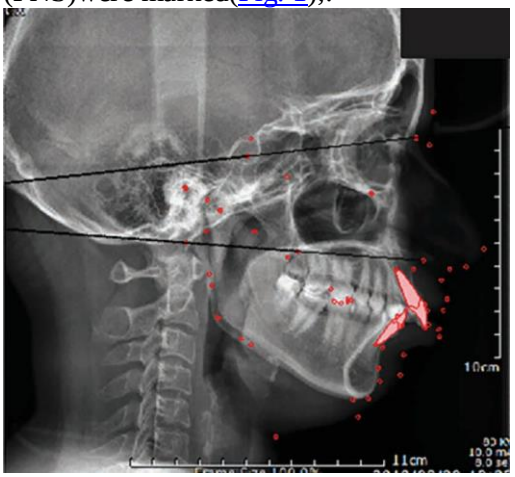
SAMPLE

The criteria for inclusion were patients visiting the department fulfilling the following criteria:
1. North Kerala individual
2. Standardized cephalometric technique
3. Patients below 25 years
4. Good general health status

The exclusion criteria were:
1. Unacceptable quality of radiographs
2.Craniofacial anomalies
3. Previous orthodontic/orthognathic treatment.
4. Congenitally missing and impacted teeth

CEPHALOMETRIC ANALYSIS

The cephalograms were traced on the Dolphin software . To prevent inter-operator bias, tracing of the landmarks was performed by a single operator and then rechecked by other investigator. A sample of calculated and samples were collected using the convenience sampling method. Lateral cephalometric radiographs of each individual were taken in a natural head position. Radiographs were traced and Sella (S) Nasion (N), Anterior Nasal Spine (ANS), and Posterior Nasal Spine (PNS)were marked(Fig. 1);.



(Fig. 1); PP-SN angle measurement being recorded

The Palatal plane was constructed by joining ANS and PNS. SN plane was drawn connecting S to N. The angular measurements were ta and presented as mean.

CLASSIFICATION OF SAMPLE

Each subject's sagittal skeletal relationship was assessed and evaluated using the β angle measurement (Fig. 2); a β angle of 27–35° was associated with skeletal class I relationships, a β angle of <27° was associated with skeletal class II relationships, and a β angle of >35° was associated with skeletal class III sagittal relationship. Based on this measurement, the subjects were grouped into three groups. Subjects with class I skeletal base relationship were grouped into group I, subjects with class II skeletal base relationship were grouped into group II, and subjects with class III skeletal base relationship were grouped into group III.pt having open bite and deep bite were also noted and mean value is calculated.

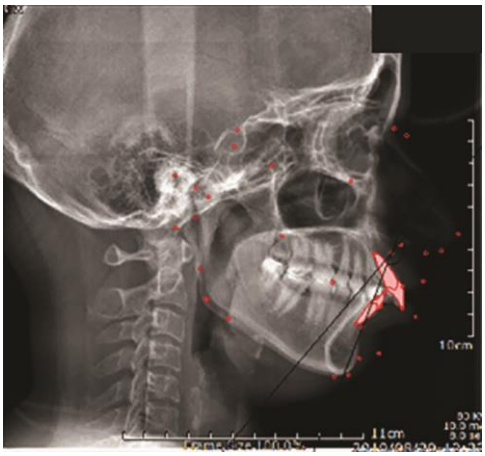


Fig. 2: β angle measurement being record

EVALUATION OF THE PP-SN ANGLE

The Dolphin software was used to construct the PP and SN planes, and the angle formed by the intersection of these planes was measuredfor each subject.

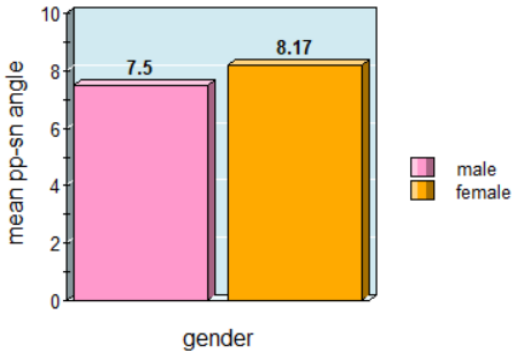


Fig 3 – graph showing the variation of palatal plane angle and angles classes of malocclusion

STATISTICAL EVALUATION

According to the inclusion criterion, the radiographs of 250 patients (145 females and 105 males) were included in the study (mean age—20-year-old; range—18–25-year-old) (Table 1).

parameters	*Number of samples*	*Mean age (years)*	*Mean PP-SN angle (in degrees)*
Male	*105*	*20±2*	*7.5±2º*
female	*145*	*22±2.9*	*8.17±3º*
Total	*250*	*21±2.45*	*7.94±2.5º*

Table 1: Mean age and mean PP-SN angle of the sample

The measured data showed a normal distribution based on the results of the Kolmogorov–Smirnov and Shapiro–Wilks tests. As a result, parametric tests were used to assess the measured data. The descriptive statistics revealed that the overall sample had an average PP-SN angle was 7.94° ± 2.5°(Table 1 and fig 3). Females had a higher mean PP-SN angle of 8.17±3°, whereas males had a lower mean PP-SN angle of 7.5±2°.

The mean PP-SN angle measured among patients in group I was 7.82º ± 4°, the mean among subjects in group II was 7.21° ±3°, and the mean among subjects in group III was 8.62° ± 2° (Table 2 and fig 4). The mean PP-SN angle of group III was the highest followed by the mean of group I , the group III had the lowest mean value .

parameters	*Number of samples*	*Mean age (years)*	*Mean PP-SN angle (in degrees)*
Class I	*105*	*20º±2*	*7.8±4º*
Class II	*74*	*18º±3.9*	*7.21±3º*
Class III	*71*	*21º±4*	*8.62±2º*
total	*250*	*19º±9.9*	*7.87±3*

Table 2: Mean age and mean PP-SN angle of the sample in groups

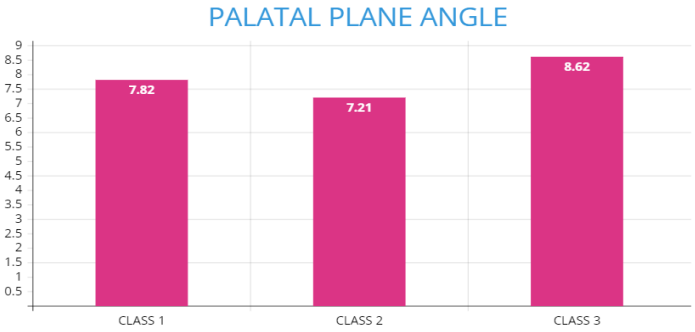


Fig 4 – graph showing the variation of palatal plane angle and angles classes of malocclusion

The mean PP-SN angle measured among patients open bite was 8.2º ± 4°, the mean among subjects in deep bite was 7.3° ±3. (Table 3 and fig 5)

parameters	*Number of samples*	*Mean age (years)*	*Mean PP-SN angle (in degrees)*
Open bite	*50*	*20±2*	*8.2±2º*
Deep bite	*100*	*22±2.9*	*7.3±3.5º*

Table 3: Mean age and mean PP-SN angle of the open bite and deep bite sample

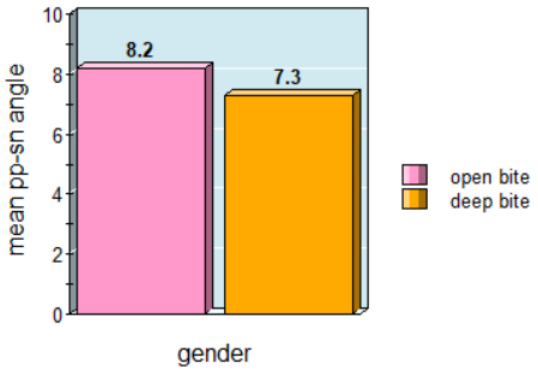


Fig 5 – graph showing the variation of palatal plane angle and angles classes of malocclusion

DISCUSSION

The main objective of this is to find the relation between the PP and the anterior cranial base in different sagittal skeletal relationships in the North Kerala population.

Chung and Mongiovi conducted a longitudinal study for Caucasian class I untreated cases in PP-SN angle from the age of 9 to 18 years in boys and girls and identified no significant age-related changes. This is similar to the observation made in the present study of no significant difference in the PP-SN angle in both genders.

Dibbets, in his study of the Caucasian population, did not identify a significant difference in the PP-SN angle among the different angle classes of malocclusion.

The average PP-SN angle identified for group III observed in the present study was significantly lower compared to the observations made by Benyahia et al. and Eslami et al. in the French and Iranian populations, respectively. This difference could be due to the different inclusion criteria in both these studies, as the ANB angle was utilized to classify patients having skeletal class III sagittal skeletal base relationship. These authors were also unable to infer that the PP-SN angle played a factor in the choice to choose surgery or a camouflage technique in the care of skeletal class III patients.

In the study conducted by Nahoum to made, the following conclusions in his study made among Caucasian subjects; the PP-SN angle is smaller by at least 4° in open bite malocclusions, and the PP-SN angle is related to the size of the upper face. Thus, he postulated that it is a key diagnostic tool for orthodontists along with other linear and angular measurements, to identify, assess, and evaluate malocclusions in the vertical dimensions. Maia et al. observed no long-term alterations in the PP-SN angle following surgical-orthodontic treatment of open bite malocclusion. Independent evaluation shows that the skeletal class I and skeletal class II groups had substantial but small alterations immediately after treatment and in the long-term postoperative phase. Frost et al. reported no significant changes to the PP-SN angle in the surgical-orthodontic correction of retrognathia.

Palatal plane inclination has a greater impact on the growth pattern of many individuals. In cases of open bite, where the posterior end of the palate is tipped down along with the maxillary molars, which acts as a fulcrum to rotate the mandible downwards and backward. The greater degree of angulation between the mandibular plane and the palatal plane also necessitates the overgrowth of the dentoalveolar portion to mask the malocclusion

Similarly, in cases where the palatal plane is too steep, PP values tend to increase leading to its unreliability. Other limitations include that the study was carried out in a single institute with a small sample size for a short duration. Other cephalometric parameters such as the Frankfort Horizontal Plane, Mandibular plane, and Sella–Nasion (SN) plane were not considered in the present study.

RESULTS

The palatal plane angle in the given population was found to be 7.94±2.5º. Out of 250 patients, 105 (42%) were male and 145 (58%) were female ranging from 10 to 25 years. The palatal plane angle was found to be higher in females 8.17±3º compared to males 7.5±2ºrespectively. Individuals were categorized as class 1 (7.8±4º), class 2 (7.21±3º), and class 3 (8.62±2º) (FIG 3) .50 patients having open bite had a PP angle of 8.2±2º, and 100 patients having deep bite had a PP angle of 7.3±3.5º.

CONCLUSION

The investigation was able to quantify the average PP-SN angle of the North Kerala population at 7.94±2.5º degrees. The difference in PP-SN angle in patients with different sagittal skeletal relationships was more in class 3 with 8.2±2º degrees compared to class 1 (7.8±4º) and class 2 (7.21±3º). This study also could identify any gender-associated differences in the PP-SN angle was found to be more in females 8.17±3º compared to men (7.5±2º). The inclination of the palatal plane is very variable. Larger basal plane angles are mostly common with open bite cases, which is due to both the mandibular plane as well as palatal plane.

50 patients having open bites had a PP angle of 8.2±2º and 100 patients who had deep bites had a PP angle of 7.3±3.5º. Palatal plane inclination has a greater impact on growth patterns. In cases of open bite, the posterior end of the palate is tipped down along with the maxillary molars, which acts as a fulcrum to rotate the mandible downwards and backward. The overgrowth of the dentoalveolar portion is often shown by the greater angulation of the palatal plane and mandibular plane which can mask the malocclusion. This is not true in the case of open bite. Vertical patterns of growth have detrimental effects on the musculature surrounding the chin, namely the mentalis muscle. In a vertical growth pattern, there is stretching of the mentalis muscle due to backward mandibular rotation forcefully closing the lower lip. This in turn enforces its aberrant forces onto the lower teeth, and in turn, gets trapped underneath the upper anterior teeth, as in the case of class II division I. Cangialosi in his studies shows palatal plane angle to be coincident with open bite and deep bite.

Thus, from the present study, it is suggested that the sagittal jaw relation about the palatal plane (LPP) can be utilized as an adjunctive criterion for proper diagnosis besides the ANB angle and the Wits appraisal. Over time several methods to asses sagittal jaw relation has been proposed but each has its limitations. So there is a need to use additional cephalometric analysis whenever possible before arriving at any diagnosis and treatment plan. Since we were able to quantify the difference in PP-SN angle among the different groups of skeletal classification, but we weren't able to further subdivide these classifications into retrognathia or prognathia of either the maxilla or mandible, which could have broadened the scope of understanding into the difference in PP-SN angle among the groups. Also, the differences due to growth and treatment-related changes to the PP-SN angle in the study population could not be studied due to the limitation of the study design. We hope further studies into the subject can help clarify this unexplored realm. With the rising popularity of the use of temporary anchorage devices and surgical interventions in orthodontics, research is required to further study the role of the PP-SN angle as a diagnostic and prognostic tool.

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