Original Article

Association of Posterior Nasal Spine (PNS) to Sella Turcica Measurement and Skeletal Malocclusions

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Abstract

Objective: To determine the association between a measurement from sella turcica to posterior nasal spine (PNS) and skeletal malocclusion with subjects in normal vertical relationship.

Methods: It was analytical, measurement-based, observational design in which samples from 122 patients were collected from department of orthodontics at the dental OPD of Karachi Medical and Dental College and Abbasi Shaheed Hospital, Karachi. Non-probability consecutive sampling technique was used. Sample selection was based on inclusion criteria that included, no previous history of orthodontic treatment, age limit starting from 12 years of age till 30 years. The exclusion criteria for study included, any syndromic or cleft lip and palate subjects, patients with history of trauma and patients with facial asymmetry. All the patients were examined by the author. After thorough history and clinical examination for evaluating the inclusion and exclusion criteria patients were recruited for the study. Verbal informed consent was taken from the patients then the lateral cephalogram was recorded, taken in centric relation, was surveyed and classified by observation into the three categories of malocclusion on the basis of skeletal classification of malocclusion. All measurements were recorded under ample light and comfortable position. All the findings were recorded by the primary author.

Result: One-way analysis of variance (ANOVA) was applied to see the association of PNS to sella and malocclusion. Mean value is 44.96, 45.21 and 49.00 for the class I, II and III of skeletal malocclusion patients respectively. P-value is < 0.05 which that there is association between PNS to sella and vertical class malocclusion.

Conclusion: It has been established that there is a positive association between PNS to sellaturcica linear measurement and skeletal malocclusions. It is noted as that mean value of linear measurement from sella to posterior nasal spine (PNS) is 44.96mm, 45.21mm and 49.00mm for the class I, II and III of skeletal malocclusion cases respectively. This can help in diagnosis and treatment planning.

Keywords: Sella, skeletal malocclusion, facial asymmetry and orthodontic treatment

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Introduction

The correlation between cranial base configuration, facial prognathism and retrognathism has been of interest to anthropologists, particularly in relation to racial differences. D Neaux used the basicranial axis on sagittal sections of dried skulls to elucidate racial variation, whereas A Gong was one of the first researchers to suggest the possibility of an association between this variable and malocclusion. Bjork, using cephalometric radiographs, demonstrated the existence of a relationship between cranial base morphology and jaw relationship.

The cranial base forms the floor of the cranial vault and extends from the foramen caecum anteriorly to the basioccipital bone posteriorly. It is essentially a midline structure comprising parts of the nasal, orbital, ethmoid, sphenoid, and occipital bones. Sella turcica lies near the centre of the cranial base and divides it into anterior (sella to nasion) and posterior (sella to basion) limbs. Although the cranial base largely develops in cartilage (chondrocranium), it depicts both neural (from sella to foramen caecum) and somatic types of growth patterns.

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Postnatal growth, especially after early childhood, in the anterior segment is mainly due to enlargement of the frontal sinuses and surface remodelling in the nasion region. Posteriorly there is interstitial growth at the spheno-occipital synchondrosis (SOS). The maxilla appears attached to the anterior segment and the mandible to the posterior segment. It would be reasonable to assume, just from this geometric relationship, that any change in flexion would alter maxillary and mandibular positions relative to the cranial base as well as to each other. This in turn may influence the skeletal pattern and type of malocclusion.

A number of studies have attempted to identify craniofacial differences between the classes of malocclusion. Sanggarnjanavanich et al., using articulate to represent the posterior limit of the cranial base, described a linear relationship between the cranial base angle and prognathism with the angle systematically reducing from class II, via class I, to class III individuals. The sample consisted of 46 boys and 50 girls (age range 10.24 to 11 years) in each of the four classes of malocclusion categorized using Angle's classification.

MA Frand in a longitudinal cephalometric study using a sample of 85 children from the Belfast Growth Study, found the cranial base angle to be the best discriminator between Angle's class I and class II cases. They also stated that the cranial base angle at age five years was an accurate predictor of the eventual occlusal type of the patient at age 15 in approximately 73% of patients.

A China study involved 83 subjects (male: 27; female: 56; age: 18.4 ± 4.2 SD years) from Hong Kong, who were classified into 3 sagittal discrepancy groups on the basis of their A point, nasion, B point (ANB) angle. A cephalometric analysis of the angular and linear measurements of their cranial and jaw bases was carried out. The morphological characteristics of the cranial and jaw bases in the three groups were compared and assessments were made as to whether a relationship existed between the cranial base and the jaw base discrepancy. Significant differences were found in the cranial base angles of the three groups. Skeletal class II cases presented with a larger Cranial-base angle (NSBa), whereas skeletal class III cases presented with a smaller NSBa.

A Bedoya after evaluating 24 images of young patients with type II, division 1 malocclusion using helical spiral cone beam computed tomography (CBCT), it was concluded that relationships exist between the cranial base structures, the structures that determine the sagittal position of the maxilla, mandible and chin, and the cervical vertebrae complex and hyoid bone.

More recently, Balos et al. that the glenoid fossa was more posteriorly positioned in class II than in class III subjects, whereas Singh et al. found a closing of the cranial base angle in class III cases.

R Sharma, conducted a study with a total sample size of 95 subjects, could find no correlation between the cranial base angle and Angle's class I or class II malocclusion.

J Soni using material from the Burlington Growth Center, found that large cranial base angles were associated with class II malocclusion, but small angles were related to Angle's class I, rather than class III subjects. P Ngan used a cross-sectional sample selected on the basis of a class III molar relationship on cephalometric radiographs to compare with a longitudinal class I sample from the Bolton-Brush study. They also found no association between cranial base angle and type of malocclusion. Similarly, British Standards Institution incisor method, was unable to show significant differences between the cranial base morphology of class I and class III cases, which led her to conclude that the relationship between cranial base morphology and class III malocclusion was tentative. The class III cases in this study were all classified as suitable for treatment by orthodontics alone.

B Ali the association of sella turcica bridging and various dental anomalies has been an area of interest for researchers. Orthodontic records comprising standard-quality lateral cephalograms and dental panoramic radiographs were selected. The frequencies of complete and partial calcification of sella in the patients were 8 (25.8%) and 17 (54.8%), respectively, whereas those in the controls were 0 and 36 (51.4%), respectively. The frequency of sella bridging was significantly higher in subjects with canine impaction than in the controls.

Clearly the cranial base angle is not the only factor involved in determining malocclusion. D Petrovic suggested that a number of factors determine or influence static jaw position and, consequently, the degree of prognathism in individual cases. These factors included the cranial base angle, the extent to which the mandible and maxilla moved forward in relation to the cranium, and the amount of surface bone deposition along the facial profile from nasion to menton.

The medial end of the posterior border of the horizontal plate of palatine bone is sharp and pointed, and, when united with that of the opposite bone, forms a projecting process, the posterior nasal spine for the attachment of the musculus uvulae. Posterior nasal spine serves as a cephalometric landmark.

Posterior nasal spine on the lateral cephalogram indicates that posterior nasal spine also has variation in length and width similar to anterior nasal spine. Posterior nasal spine is difficult in order to trace on the cephalogram when there is unerupted teeth, then the posterior nasal spine can be found in the middle of the floor of nasal cavity as well as the inferior side of the palatine bone. Its clinical significance is that posterior nasal spine is utilized in the construction of occlusal plane as one of the reference points. It is utilized for the evaluation of horizontal development pattern by means of FH-Palatal plane angle

Dental crowding is one of the frequent chief complaints of patients seeking orthodontic treatment. There are so many reasons for malocclusion. These factors could be of skeletal, dental or soft tissue in origin. These include tooth size, tooth shape, dental arch dimensions, oral and perioral musculature, mandibular and maxillary body lengths and direction of growth of the jaws etc.

Several studies have been carried out to examine the various skeletal, dental and soft tissue factors that may be related to dental arch crowding. Some studies reported the correlation of tooth size with dental crowding while others correlated arch dimensions.

The significance of the cranial base in the development of class III malocclusion remains uncertain. Cranial base morphology differed statistically for all age-wise comparisons. Graphical analysis revealed that the greatest differences in morphology occurred in the posterior cranial base region, which generally consisted of horizontal compression, vertical expansion, and size contraction. The sphenoidal region displayed expansion, while the anterior regions showed shearing and local increases in size. It is concluded that the shape of the cranial base differs in subjects with class III malocclusion compared with the normal class I configuration, due in part to deficient orthocephalization, or failure of the cranial base to flatten during development.

Clearly the cranial base angle is not the only factor involved in determining malocclusion. Petrovic[14] suggested that a number of factors determine or influence static jaw position and, consequently, the degree of prognathism in individual cases. These factors included the cranial base angle, the extent to which the mandible and maxilla moved forward in relation to the cranium, and the amount of surface bone deposition along the facial profile from nasion to menton.

Knowledge of skeletal malocclusions is an everyday protocol for orthodontic practice, little research will be dedicated to the examination of the relationship between the linear length of sella to PNS and different skeletal malocclusions. Up till now, no such research has been conducted and it will help the clinician to find the skeletal relationship between maxilla and mandible with the help of the above-mentioned linear measurement.

Patients and Methods

It was an analytical, measurement-based observational study. Research work was conducted at the department of orthodontics at the dental OPDs of both, Karachi Medical and Dental College and Abbasi Shaheed Hospital, Karachi, six months after approval of synopsis. Sampling technique was non-probability consecutive. Sample size was calculated by using WHO calculator on the basis of pilot study taking statistics of PNS to sella distance as 42.8167 + 4.9869 mm in margin of error at the confidence of interval 95% the calculated sample size was 122. Inclusion criteria was no previous history of orthodontic treatment. Age limit starting from 12 years of age till 30 years during which maxilla is well developed as well as cranial base. Exclusion criteria was any syndromic or cleft lip and palate subjects, patient with history of trauma, and patients with facial asymmetry.

Data was collected from 122 patients that were examined by a single researcher. After taking demographic information and clinical examination subjects were recruited on the basis of inclusion criteria. Verbal informed consent was taken from the patients after which the lateral cephalogram was recorded, taken in centric relation, was surveyed and classified by observation into the three categories of malocclusion on the basis of skeletal classification of malocclusion. All measurements were recorded under ample light and comfortable position. All the findings were recorded by single researcher under the observation of her supervisor in order to avoid observer bias. All measurements were recorded on a predesigned proforma.

To test the hypotheses descriptive and inferential statistical method is applied. To test the association between PNS to sella and vertical malocclusion one-way analysis of variance was applied. To see the gender differences in oral health of the patients, independent sample t-test was applied.

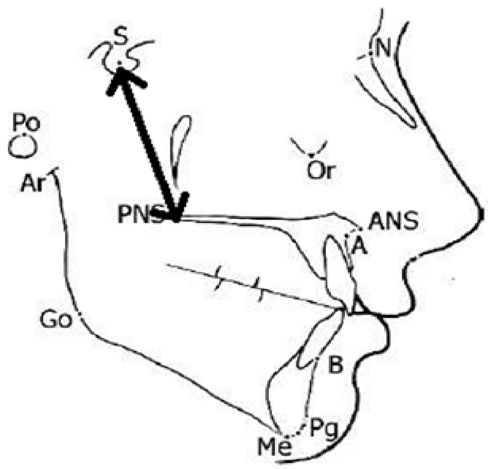

Fig 1. Cephalometric outlines and landmarks: A, point A; ANS, anterior nasal spine; Ar, articulare; B, point B; Go, gonion; Me, menton; N, nasion; Or, orbitale; PNS, posterior nasal spine; Pg, pogonion; Po, porion; S, sella.

A line will be drawn from sella to PNS. Then it will be correlated to the type of skeletal malocclusion.

Norm for this is 56 + 4 for male subjects and 51 + 3 for female subjects.

1) Skeletal Class I is when maxilla and mandible are in a normal relation and is taken as ANB = 2 + 2 degree

2) Skeletal Class II is when mandible is in a distal relation to maxilla and is taken as ANB > 4 degree.

3) Skeletal Class III is when mandible is in a mesial relation to maxilla and is taken as ANB < 1.

To determine the vertical measurements, sella nasion to mandibular plane (SNMP) was taken as an angle form between sella-nasion line and mandibular plane. Its norm is 32 + 4 degree.

Results

Independent sample t-test was applied to see skeletal class for malocclusion and gender differences present. Mean value and Standard deviation for male participant was 1.94 and 0.64 and mean value and Standard deviation for female participant was 1.50 and 0.62 respectively with number of participants being 34 males and 88 females. P-value is 0.60 which shows that result is insignificant and there is no gender difference present in vertical malocclusion of patients.

Table 1 represents the result for association between PNS to sella and vertical malocclusion. One-way analysis of variance (Anova) was applied to see the association of PNS to sella and malocclusion. Mean value is 44.96, 45.21 and 49.00 for the class I, II and III of skeletal malocclusion patients. P-value is < 0.05 which shows that the association between PNS to sella and vertical class malocclusion is significant.

Table 1. One-way Anova is applied to see the association between posterior nasal spine to sella and skeletal malocclusion

	N	Mean
Class I	58	44.96
Class II	52	45.21
Class III	12	49.00

The result of this study shows p-value is 0.002 which shows that result is significant and there is association present between PNS to sella and skeletal malocclusion.

Discussion

A study was done which concluded that glenoid fossa was more posteriorly positioned in class II than in class III subjects. However, one more study was done in which it was noted that closing of the cranial base angle in class III cases.

Another study was done which showed different results. A research was done on 95 participants and it was noted that no correlation between the cranial base angle and Angle's class I or class II malocclusion was present.

A research was done which showed that cranial base angle may not be directly translated to the mandibular articulation. It should be noted that the temporo-mandibular joint is positioned. It was found in this research that there is significant association present between PNS to sella and skeletal malocclusion with the p-value > 0.05. Many of the researches are done for determining relationship of vertical malocclusion with cranial base angle or PNS to sella. It has been observed during this research that different jaw size have a relationship with vertical malocclusion. It was found out in previous researches that cranial base angle is not the only factor involved in determining malocclusion. In a research it was suggested that a number of factors determine or influence static jaw position and, consequently, the degree of prognathism in individual cases. These factors included the cranial base angle, the extent to which the mandible and maxilla moved forward in relation to the cranium, and the amount of surface bone deposition along the facial profile from nasion to menton.

At the lateral edges of the cranial base and is, in fact, considerably separated spatially from the mid-sagittal plane on which cephalometric analysis are based. The correlation analysis also suggests a relationship between mandibular position and the magnitude of cranial base flexure. The smaller the cranial base angle, the more forward the mandibular position. It is impossible to establish cause or effect from the findings since other factors may also be present.

The maxilla is equally affected by the angle, which suggests a more fundamental role for the cranial base in determining facial prognathism than that indicated by mere geometry. In the finding it is important to realize that angular correlations, which share a line or point, are not devoid of topographical influence.

Not many difficulties were encountered during the research procedure. However, limited researches were available regarding the malocclusion association to posterior nasal spine and sella turcica distance. More work needs to be done in this context.

It is important to note that other factors may get involved in the association between PNS to sella and vertical malocclusion as the mandibular size and cranial base angle may also play in the contribution in the association. It cannot be said as a cause and effect study. Many of the previously mentioned studies showed different finding for the vertical malocclusion angle.

Conclusion

It has been established that there is a positive association between PNS to sella turcica linear measurement and skeletal malocclusions. It is noted as that mean value of linear measurement from sella to posterior nasal spine (PNS) is 44.96 mm, 45.21 mm and 49.00 mm for the class I, II and III of skeletal malocclusion cases respectively. P-value is < 0.05 which shows that the association between PNS to sella and skeletal malocclusions is significant. Therefore, it can be considered as one of the important variables that can help in diagnosis and treatment plan.

Conflict of Interests

Authors have no conflict of interests and received no grant/funding from any organization.

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