

COMPARISON OF THE OCCLUSAL PLANE AND OTHER REFERENCE POINTS IN DENTATE PATIENTS AND IT'S APPLICATION IN COMPLETE DENTURE FABRICATION- A CEPHALOMETRIC STUDY.

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ABSTRACT:

Background: In natural and artificial dentitions, the plane of occlusion plays a significant role in fulfilling the criteria of function and aesthetics. It is essential to determine the orientation of the plane of occlusion to restore or re-establish the lost occlusal plane as it was initially possible.

AIM: To determine whether a similar correlation exists between the Porion Nasion Anterior Nasal Spine (PoNANS) angle and the occlusal plane-Frankfort horizontal (FH) plane angle.

Materials and Methods: For this in vivo study, twenty healthy dentate individuals aged between 20 – 40 years with Angles class I molar relation having good temporomandibular joint and no congenital or development deformities were selected. Digital lateral cephalograms of the selected individuals were obtained. Cephalometric analyses performed with AUTOCAD software and reference points [Porion (Po), Nasion (N), Anterior nasal spine (ANS), Orbitale (Or)] were marked. PoNANS and occlusal plane-FH plane angles were derived from marked reference points. Graph plotted with resultant values determining the X axis (PoNANS angle) and Y axis (occlusal plane-FH plane). The correlation coefficient was calculated to determine the correlation between the Porion Nasion Anterior Nasal Spine (PoNANS) angle and the occlusal plane-Frankfort horizontal(FH) plane angle. Later, a t-test was applied to determine the significance of the correlation coefficient. Regression analysis was performed, and the equation was derived with the help of which the value of 'Y' can be obtained when the value of 'X' is known.

Results: Results indicated that there is a insignificant correlation between the Porion Nasion Anterior Nasal Spine (PoNANS) angle and the occlusal plane-Frankfort horizontal (FH) plane angle in angle class I patients as the t-test showed statistically insignificant ($p > 0.05$).

Conclusion: There exists a insignificant correlation between the occlusal plane and other cephalometric anatomical reference planes in angle class I patients. It was concluded that with

the help of derived mathematical formula (correlation), the angulation of the occlusion plane in entirely edentulous patients could be determined with the help of the cephalogram.

Keywords: Occlusal plane, Cephalograms, edentulous, dentate, Angles class I, Complete denture, Frankfort Horizontal Plane, cranial reference points.

INTRODUCTION:

In natural and artificial dentitions, the plane of occlusion plays a significant role in fulfilling the essential criteria of function and esthetics. The occlusal plane is present in natural dentition and can be evaluated in the edentulous dentition¹. The occlusal plane is the average plane established by the incisal and occlusal surfaces of the teeth; generally, it is not a plane but represents the planar mean of the curvature of these surfaces². The position of the occlusal plane in denture wearers should be as close as possible to the plane previously occupied by the natural teeth³⁻⁷. Such position of the occlusal plane provides a normal function of the tongue and cheek muscles, thus enhancing the denture stability⁸⁻¹³.

Many methods have been developed to establish the plane of occlusion in complete denture prosthodontics¹⁴. The technique of using the ala-tragus line (Camper's line) to determine the plane of occlusion is well documented¹⁴. Another method, like, the cephalometric evaluation, would be helpful to implement a more effective method for determining the plane of occlusion to decrease the interoperator variance widely found in the profession. The significance of cephalometrics lies in the ability to re-establish the related position of lost structures¹⁵. It is achieved by identifying predictable relationships between the teeth and other cranial landmarks that are not subject to post-extraction changes¹⁵.

Therefore, a correlation may exist between the plane of occlusion of dentulous patients and stable cranial landmarks¹⁵. Cephalometric study reveals a close correlation (i.e., a mathematical formula) between the PoNANS angle and the occlusal plane relative to the Frankfort plane¹⁰.

Thus, this cephalometric study aimed to determine whether a similar correlation exists between the PoNANS angle and the occlusal plane-Frankfort horizontal plane angle and its application in complete denture patient to determine the occlusal plane.

MATERIAL AND METHODS:

The in vivo study was carried out in department of Prosthodontics and crown and bridge in MIDSR dental college, Latur, in between Jan-May 2022 using Carestream 800C dental X-ray machine and AutoCAD software.

METHOD OF SELECTION OF STUDY SUBJECTS

I) INCLUSION CRITERIA:

1. Dentate subjects in the age group of 20 – 40 years have healthy temporomandibular joint function.
2. Mouth opening should be adequate (40-45mm).
3. Subject should have Angles class I molar relation.
4. No deviation of the mandible during the closure of the mandible.
5. Subject should be in a healthy dentate condition.
7. Patient should have no congenital or development deformities and have not undergone any surgical repair in the facial region.

II) EXCLUSION CRITERIA:

1. Subject with poor general health.
2. Subjects with temporomandibular disorders.
3. Subject with lack of adequate neuromuscular control.
4. Subjects with a history of orthodontic treatment.

A total of 20 samples were selected for the study using G*power software. Digital lateral cephalograms were obtained for the selected individuals using the Carestream 800c unit. All the cephalometric films were exposed, keeping a typical distance of 5 feet between the X-ray target

and the mid-sagittal plane of the head of the subject. The cephalometric points Nasion, Orbitale, Anterior Nasal Spine, and Porion were determined. The point Porion (Po) was plotted to coincide with the ear-rods of the cephalostat rather than with its more correct but less frequently visible bony counterpart. The digital lateral cephalometric will be subjected to the AUTOCAD software analysis. The marking was carried out with the help of annotations and measurement tools available in the software.

The plane of occlusion was drawn extending from the mid-incisal point of the maxillary central incisors to the mesio-palatal cusp of the maxillary first molar. The FH plane was marked extending from the porion to orbitale points. The Porion and Nasion points were connected with a straight line, and then Nasion and the Anterior Nasal Spine points¹⁵. In the next phase of cephalometric analysis, the PoNANS angle denoted as 'X' and the occlusal plane-Frankfort horizontal plane angles denoted as 'Y,' was measured and noted.

The measured values were carried out, and the mathematical formula was derived with the help of regression analysis (i.e., Y on X- the axis).

The cephalograms were then traced [Figure 1], and the following points were identified:

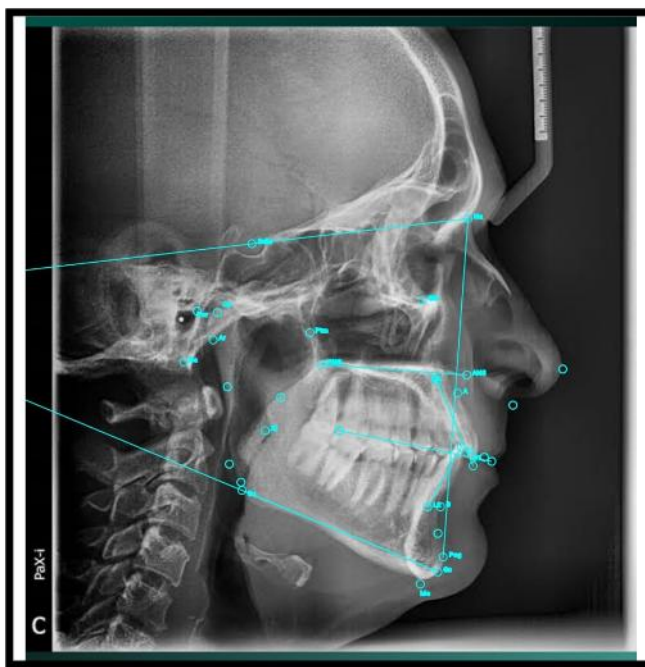
- Porion (Po): Plotted to coincide with the midpoint of the upper contour of the metal rod of the cephalometric.
- Nasion (N): Plotted to the most anterior point of the frontonasal suture in the mid-sagittal plane
- Anterior nasal spine (ANS): Plotted to coincide with the most anterior point of the frontonasal suture.
- Orbitale (Or): Plotted to coincide with the lowest point on the inferior margin of the orbit.
- The Po, N, and ANS points were joined; therefore, the resultant PoNANS angle ('X') was measured.
- The value of 'X' was substituted in the derived mathematical correlation (formulae), and the patient's occlusal plane-FH plane angle ('Y') was calculated.
- Point porion was then considered to which 'Y' angle was drawn, and a line parallel to this line was drawn passing posteriorly through the tragal marking the position of the line as it crossed the tragus was noted in order to identify which part of the tragus was to be

considered as the posterior landmark while determining the plane of occlusion using the ala tragus line (camper's line)

The derived mathematical formula was applied to the completely edentulous patients. The plane of occlusion can be established from the resultant computed value of the PoNANS angle and the FH plane.

Statistical analysis:

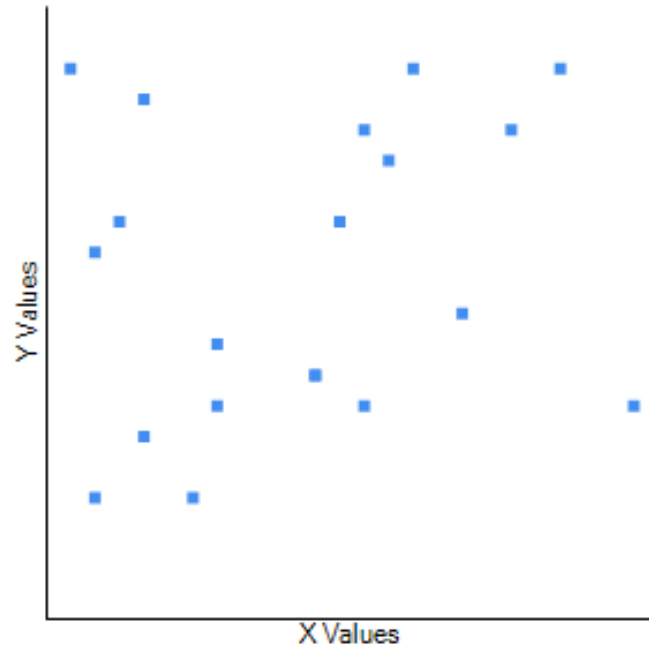
Figure 1: cephalometric tracing with all with all above points



RESULT AND OBSERVATION:

Table 1; shows the means of the PoNANS angles ('X') and the occlusal plane-FH plane angles ('Y') measured and their standard deviations.

Graph 1: shows the values of the 'X' and 'Y' axis.



Correlation coefficient (r) - Karl Pearson's was then calculated with the help of these values. A positive correlation was found, and a t-test was applied to determine the significance of the correlation coefficient, which was found to be insignificant. Regression analysis was then performed, and an equation was derived with the help of which the value of 'Y' can be obtained if the value of 'X' is known.

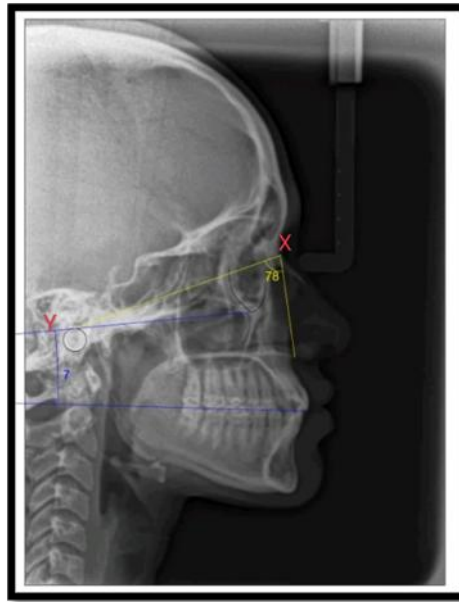
$$\text{Regression analysis is } Y = 0.59(X) \pm 55.83$$

Table 1: Correlation coefficient and t-test for the group:

Total No (N)	PoNANS angle ('X') mean±S.D	Occlusal plane-FHplane angle ('Y') mean±S.D	Correlation coefficient (r)	't' value	'P' value	Significance

20	75.30±6.78	11.30±4.86	0.1916	0.83	0.41	insignificant
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Figure 2: cephalometric tracing in AUTOCAD software.



DISCUSSION:

A prosthodontist is responsible for developing a natural form and function during the fabrication of a complete denture. The plane of occlusion plays a critical factor in determining the success of a complete denture¹⁶. Several methods exist to establish a plane of occlusion in completely edentulous patients. Cephalometric is one method to establish a plane of occlusion in edentulous patients due to stable cranial landmarks that are not subjected to the postextraction changes¹⁷.

Hence, the cephalometric reference points are considered a useful diagnostic tool for analyzing the changes in the jaw, tooth, and face. Based on the evaluation of the dentulous patients, many authors suggested that there may be a correlation between the cranial base and the planes of occlusion¹⁸⁻²⁰. These results suggest that completely edentulous patients can most accurately establish the correlation between the occlusion plane.

According to a cephalometric study by Brian D. Monteith²¹, the angulation of the plane of occlusion in entirely edentulous patients can be derived from the PoNANS angle with the help of mathematical formula based on a cephalogram.

In this cephalometric study, 20 class I dentulous patients aged from 20 to 40 years. The mean value obtained for the PoNANS (X) angle was 75.30 ± 6.78 , and the FH and occlusal plane(Y) angle was 11.30 ± 4.86 . A positive correlation was found between the PoNANS and the occlusion plane. Regression analysis was carried out with these values, and mathematical formula (correlation) was derived. The derived mathematical formula was correlated with the 'X' axis (PoNANS angle) of the same dentate patients in the study result shows that the 'Y' axis value shows the 1 to 2-degree variation. Hence, if the PoNANS angle(X) were to be considered 77 degrees, then the computed values of 'Y' would be 12 to 14 degrees.

A pilot study was carried out in edentulous patients to establish the relationship between the computed angulation of the plane of occlusion and the ala tragus line (Camper's plane). It was found that the formula could indeed be used to project which part of the tragus was considered the posterior landmark. This information could be beneficial at the diagnostic stage and significantly reduce interoperative variation in using the ala tragus line to establish the plane of occlusion.

A long-term in vivo study on a large sample size should be conducted further to evaluate the clinical application of the derived mathematical formula. As the study was conducted on dentate patients, its application in edentulous patients needs to be evaluated. The study was carried out on 2D (lateral cephalogram), showing limitations such as superimposition of images, elongation, etc²². To overcome these limitations, 3-D (CBCT) imaging should be preferable. Several different craniofacial landmarks, such as palatal plane, PoNPNS, etc., also can be used for the study.

CONCLUSION:

In 20 samples (subject), a positive correlation is found between the porion-nasion-anterior nasal spine (PoNANS) angle ('X') and the occlusal plane-FH(Frankfort Horizontal) plane angle ('Y'). With the help of regression analysis, the mathematical formula (correlation) was derived from the above correlation. The formula was:-

$$Y = 0.59(X) \pm 55.83$$

The derived mathematical formula was applied to the completely edentulous patients. The plane of occlusion can be established from the resultant computed value of the PoNANS angle and the FH plane.

This study concluded that, with the help of derived mathematical formula (correlation), the angulation of the occlusion plane in entirely edentulous patients could be determined with the help of the cephalogram. This derived mathematical formula (correlation) can be applied to all completely edentulous patients.

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