

An evaluation of relation between the relative parallelism of occlusal plane to ala-tragal line and variation in the angulation of Po-Na-ANS angle in dentulous subjects: A cephalometric study

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Abstract

Aims: The aim was to evaluate if any correlation exists between variation in angulation of Po-Na-ANS angle and relative parallelism of the occlusal plane to the different tragal levels of the ear in dentulous subjects.

Methodology: A total of 200 subjects were selected for the study. A custom made occlusal plane analyzer was used to determine the posterior point of the ala-tragal line. The lateral cephalogram was shot for each of the subjects. The points Porion, Nasion, and Anterior Nasal Spine were located and the angle formed between these points was measured.

Statistical Analysis Used: Fischer's exact test was used to find the correlation between Po-Na-ANS angle and relative parallelism of the occlusal plane to the ala-tragal line at different tragal levels.

Results: Statistical analysis showed no significant correlation between Po-Na-ANS angle and relative parallelism of an occlusal plane at different tragal levels, and an inferior point on the tragus was the most common.

Conclusion: Irrespective of variations in the Po-Na-ANS angle, no correlation exists between the variation in the angulations of Po-Na-ANS angle and the relative parallelism of occlusal plane to the ala-tragal line at different tragal levels. Furthermore, in a large number of subjects (54%), the occlusal plane was found parallel to a line joining the inferior border of the ala of the nose and the inferior part of the tragus.

Key Words: Ala-tragal line, occlusal plane, Po-Na-ANS angle

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INTRODUCTION

The basic motor functions of the stomatognathic system and its initial form, size, and position are determined by genetic factors. Individual characteristics such as intermaxillary

relations, the occlusal plane, cusp form, centric relation index, incisal guidance are formed during growth and development, due to the functional stimulation of surrounding tissues and

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the influence of external factors. All these structures, records, and normal tonus of the muscles manipulating the masticatory mechanism are permanently destroyed in completely edentulous patients.^[1]

One of the main aims of prosthodontic rehabilitation is developing an occlusion which is compatible with all the functional movements of stomatognathic system. The correct orientation of occlusal plane plays a vital role in the optimum esthetic achievement and forms an essential component of balanced articulation and should be determined as close as possible to the plane previously occupied by the natural teeth.

There are various methods that utilize intraoral and extraoral landmarks for orientation of the occlusal plane, out of which the popular and most commonly used technique is orienting the occlusal plane parallel to ala-tragus line. Many studies have been done to evaluate the relation between relative parallelisms of occlusal plane to the ala-tragal line. ^[2] Ghosn *et al.*,^[3] Koller *et al.*,^[4] Rostamkhani *et al.*,^[5] and Sharifi and Rostamkhani.^[6] in their study found out that the occlusal plane had a stronger tendency to be parallel to the line joining the ala of the nose and inferior border of the tragus. Braun *et al.*^[7] in their study of the human dental arch form concluded that Camper's plane was found to be parallel to the occlusal plane when the tragal reference point was situated between the superior border and the middle of the tragus. Miller,^[8] Kumar *et al.*,^[9] Sadr and Sadr^[10] defined it as a line running from the inferior border of the ala of the nose to the superior border of the tragus.

As from the conclusions drawn above by different authors the precise location of the occlusal plane in an edentulous subject is a controversial issue and more controversial is the exact definition of ala tragus line in relation to its position posteriorly at the position of the tragus of the ear. Cephalometry is of special value to prosthodontics, in that it can be used to re-establish the correct position of lost structures, in the orofacial region. This can be achieved by identifying a predictable relationship between the teeth and other cranial landmarks not subjected to postextraction changes.^[11]

This study is an attempt to see if any correlation exists between variation in the angulation of Po-Na-ANS angle (angle formed between Porion, Nasion, and Anterior Nasal Spine) and the relative parallelism of occlusal plane to the ala-tragal line at different tragal levels.

METHODOLOGY

This study was carried out on 200 subjects comprising both males and females.

Inclusion criteria

- Subjects from Yenepoya University
- Age group 18–25 years in which facial growth has completed
- Full complement of healthy and natural teeth
- No history of orthodontic treatment.

Exclusion criteria

- Periodontally compromised teeth
- Teeth grossly attrited or abraded
- Presence of fixed or removable partial dentures
- Gross malalignment of teeth
- Missing teeth.

Subjects were randomly selected from the students of Yenepoya University. Ethical approval for this study was obtained from Research Ethics Committee of the Yenepoya University. The subjects voluntarily agreed to participate in the study after the outline of the proposed research were distributed to them in a subject information/consent sheet. The study was completed in 1½ years.

The study was done in two parts

In the first part, a custom made occlusal plane analyzer was used to find the relative parallelism of occlusal plane to the ala-tragal line at different tragal levels of the ear. The occlusal plane analyzer was fabricated using a fox plane, and two rectangular plates which consisted of the extraoral part. The advantage of this instrument is that the rectangular plate always remains parallel to the extraoral arm of the fox plane, as both are attached to the tofflemire at 90° angulation [Figure 1].

The subject was seated on the dental chair in an upright position. Two lines were drawn on the superior most and the inferior most points on the tragus with an indelible pencil. The distance between these two points was then measured with a digital caliper. The value obtained was divided by three and was

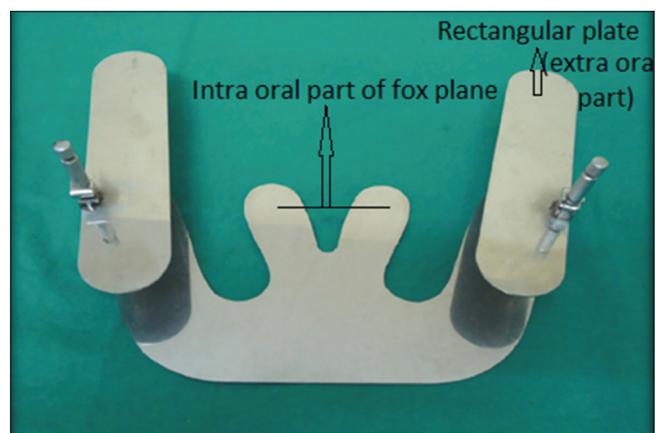


Figure 1: Custom made occlusal plane analyzer

used to divide the area between superior most and inferior most parts of the tragus into three equal halves, namely the superior, middle, and the inferior, respectively [Figure 2].

The intraoral part of the custom made occlusal plane analyzer was placed in the subject's mouth so that it touched the incisal edges of the maxillary central incisors and the mesiopalatal cusp of the first molars [Figure 3]. The instrument was held steadily with one hand and the vice knob was rotated so that the rectangular arm moved up until its Anterior portion coincided with the lower border of the ala of the nose. The position of the posterior part of the rectangular arm was then noted, as to whether it coincided with the superior, middle or the inferior part of the tragus. This location was noted for all the subjects and the data tabulated for further statistical analysis.

The second part of the study was to measure the angulation between Porion, Nasion, and Anterior Nasal Spine. For this, lateral cephalometric radiographs of the subjects were shot by the standardized Planmeca Promax Cephalostat machine on a standard Kodak C-Mat Green Sensitive 8 inch × 10 inch film. (Exposure parameters were set at 70 kVp, 10 mA, and 1 s). The cephalometric points were located in the lateral cephalogram.

Porion

The superior most point of the image of the cephalostat of the ear rod. As used in the study, porion is a machine point rather than an anatomic structure.^[12]

Nasion

The most Anterior point of the suture at the junction of frontal and nasal bone.

Anterior Nasal Spine

Point on the lower contour of the nasal spine where the vertical thickness is 3 mm.

The angle between the points Porion, Nasion, and Anterior Nasal Spine was measured using RadiAnt DICOM viewer [Figure 4].

Statistical analysis

The two sets of data obtained, that is, the relative parallelism of the occlusal plane to the ala-tragal line at different tragal levels and Po-Na-ANS angle were correlated using the Fisher's exact test.

The correlation between gender and Po-Na-ANS angle was calculated using *t* test.

RESULTS

In the 200 subjects studied, the location on the tragus that was found to be the most common was inferior. The second most

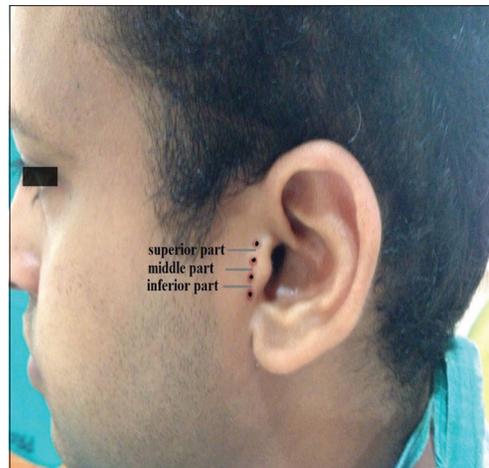


Figure 2: Tragus divided equally into three parts: Superior, middle, and inferior

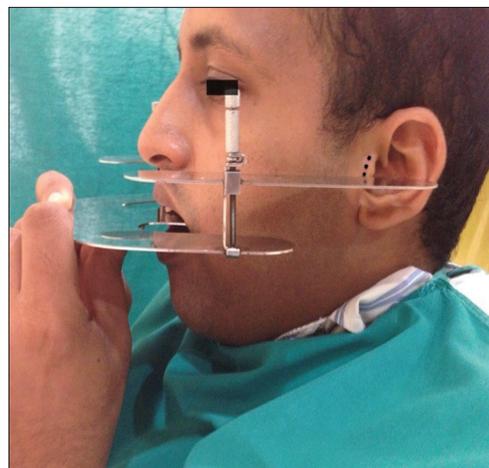


Figure 3: Custom made occlusal plane analyzer positioned to determine posterior part of the tragus

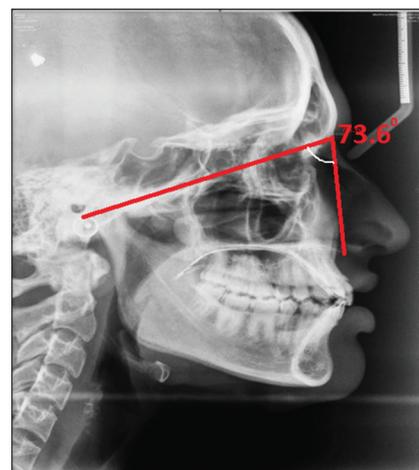


Figure 4: Pictorial representation of the angle between the points Porion, Nasion, and Anterior Nasal Spine measured using RadiAnt DICOM viewer

common location was the middle part of the tragus followed by superior [Figure 5].

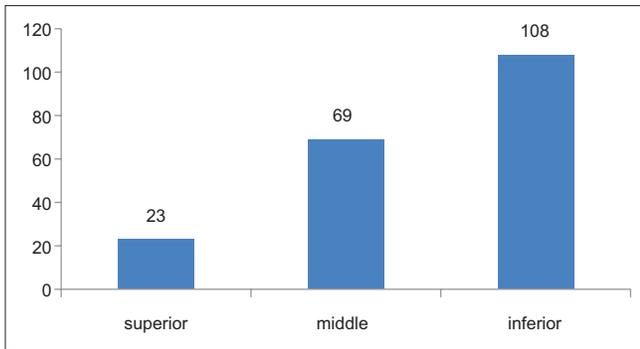


Figure 5: The percentage of location of the posterior reference of the custom made occlusal plane analyzer on the tragus

Table 1: Mean Po-Na-ANS angle among male and female and P value

Gender	n	Po-Na-ANS angle mean	SD	P (t-test)
Male	97	70.999	3.8971	0.034!
Female	103	72.201	4.0575	

SD: Standard deviation

Table 2: The correlation between the variation of angulation of Po-Na-ANS angle and relative parallelism of the occlusal plane to the ala-tragal line at different tragus levels

Position of ala-tragus line with respect to tragus	Po-Na-ANS angle (%)			Total
	Steep	Medium	Shallow	
Superior	3	11	9	23
	15.0	50.0	35.0	100.0
Middle	7.7	10.3	16.4	11.5
	17	36	16	69
Inferior	24.6	52.2	23.2	100.0
	43.6	34.0	29.1	34.5
Total	19	59	30	108
	17.5	53.4	29.1	100.0
Total	48.8	55.7	54.5	54.0
	39	106	55	200
	19.5	53.0	27.5	100.0
	100.0	100.0	100.0	100.0

A classification system was given for Po-Na-ANS angle:

- Shallow angle - Below 70°
- Medium angle - 70–75°
- Steep angle - Above 75°.

Of the 200 subjects, when the angulations of Po-Na-ANS angle were measured, 28% of the total subjects were found to be under Shallow angle, 53% under Medium, and 19% were under Steep angle.

When the variation in the angulation of Po-Na-ANS angle was correlated with gender, 30% of the male subjects showed Shallow angle, 54.6% Medium, and 14.4% Steep angle. In females, 21.3% showed Shallow angle, 51.5% Medium, and 24.3% Steep angle, respectively [Figure 6]. On statistical analysis, females (24.3%) showed statistically significant ($P = 0.034$) steeper Po-Na-ANS angle in comparison to males (14.4%) [Table I].

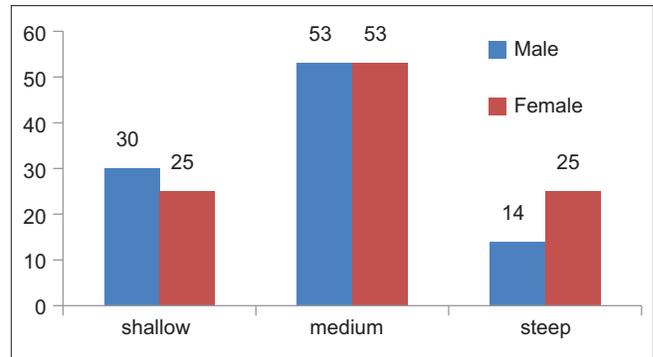


Figure 6: The correlation of Po-Na-ANS angle with gender

According to Fisher’s exact test, no significant correlation exists between variation in angulation of Po-Na-ANS angle and the relative parallelism of occlusal plane to ala-tragal line at different tragal levels [Table 2].

DISCUSSION

The null hypothesis was rejected because there was no significant correlation between Po-Na-ANS angle and relative parallelism of occlusal plane to the line joining the inferior border of the ala of nose with different tragal levels of the ear.

Definitions of the ala tragus line are a cause of confusion due to disagreement on the exact point of reference, on the ala and the tragus. Different authors have different opinions about the location of the line in relation to the position on the tragus as being superior, middle or inferior. Hence, an attempt was made in this study to evaluate if any correlation exists between variation of the Po-Na-ANS angle and the three positions on the tragus that is superior, middle or inferior, when joined with the inferior border of the ala of the nose. This enables us to establish an ala-tragal line that is most parallel to the natural occlusal plane, in dentulous subjects, so that this reference can be used to determine the occlusal plane in edentulous patients during the fabrication of complete dentures.

The results of this study showed that in majority of the 200 subjects, that is, 54.0% of the total, the occlusal plane was found parallel to a line joining the inferior border of the ala of the nose and the inferior part of the tragus. These results is in accordance with the study done by Van Niekerk *et al.*,^[13] Simpson *et al.*,^[14] Shaikh *et al.*,^[15] who suggested the inferior border of the tragus point as a posterior reference point in complete denture fabrication, while Karkazis and Polyzois^[16] Ismail and Bowman,^[17] Spratley^[18] in their study used middle of the tragus as the posterior reference point of ala-tragal line and Abrahams and Carey,^[19] Miller^[8] in their study, accepted posterior landmark of ala-tragal line as the superior border of the tragus of the ear.

Po-Na-ANS angle has been used as a representative of angular relationship between the cranial base and vertical axis of nasomaxillary complex, because the commonly used SNA angle has little practical value when applied to edentulous condition because the sella turcica is such a variable structure and the A point is of no use once the maxillary tooth is lost.^[20] Po-Na-ANS angle is the angle encompassed by the cephalometric points: Porion: The superior most point of the image of the cephalostat of the ear rod. Nasion: The most Anterior point of the suture at the junction of frontal and nasal bone. Anterior Nasal Spine: Point on the lower contour of the nasal spine where the vertical thickness is 3 mm.

There is no literature which provides a classification for Po-Na-ANS angle. From the results obtained a new classification was devised.

The angulations that were recorded for the 200 subjects were classified into Shallow, that is, below 70°, Medium, that is, between 70° and 75°, and Steep, that is, above 75°. Of the 200 subjects, 53% were found to be under Medium angle, 27.5% under Shallow, and 19.5% under a Steep angle. Statistical analysis comparing the Po-Na-ANS angle and gender showed $P = 0.034$ which was significant, indicating higher steeper values in females in comparison with males.

For all the three classes of the Po-Na-ANS angle, the inferior border of the tragus was found to be the most common location of the posterior end of the ala-tragal line, which accounted for 48.8% of the total in Steep, 55.7% in Medium, and 54.0% in Shallow, and these results were statistically insignificant.

CONCLUSION

On the basis of the results obtained, the following conclusions are drawn:

- In majority of the subjects, the occlusal plane was found parallel to a line joining the inferior border of the ala of the nose and the inferior part of the tragus
- Po-Na-ANS angle was found to be steeper in females than males
- Among the subjects with Steep, Medium, and Shallow angulations, the most common location of the posterior end of the ala-tragal line was the inferior part of the tragus, which accounted for 48.8%, 55.7%, and 54.5%, respectively, thus, according to the results of this study, irrespective of variation of the angulations of Po-Na-ANS angle, no correlation exists.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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