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Orginal Article

MEAN VALUE OF THE ANGLE AMONG THE THREE VARIANTS OF ALATRAGUS LINE AND OCCLUSAL PLANE IN DENTATE SUBJECTS

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ABSTRACT

Objectives: *To determine the mean value of angle among the three variants of ala-tragus line (ATL) and OP in dentate individuals and to identify which among the three variants is parallel to OP.*

Materials and Methods: *This descriptive cross-sectional study included 190 subjects of both gender with age range 20-40 years fulfilling the inclusion criteria. Left Profile photograph of the participant was taken with a digital camera (Canon 600D) in natural head position holding Fox OP between teeth. Image was analyzed using Adobe Photoshop CS6 software and most parallel relationship determined between the 3 variants of ala- tragus line and arm of the fox OP. Statistical analysis of the data was done using SPSS version 20.*

Results: *Out of 190 participants, males formed 53.7% whereas females formed 46.3%. The mean age was 29.5±5.35 (SD) yrs. A total of 109 patients fell within the 20-30 years. The three variants of ATL were found to be at a considerable angle to OP. Angle ≤ 5° was considered to be parallel for this study. Inferior variant of ATL (ATL-I) was found to have least angle with OP (mean value 3.56° ± 1.17). The relationship between the OP and three variants of ATL was stratified among age and gender and was found to be non-significant.*

Conclusion: *In maximum subjects, the ATL-I was found to be parallel to be the OP suggesting inferior border of the tragus to be the reference point for the ATL.*

Key words: *OP, Ala-tragus line, complete denture, Reference line, OP orientation*

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INTRODUCTION

The mutual plane formed by the incisal and occlusal surfaces of teeth, known as the Occlusal Plane (OP), has been a subject of debate regarding its orientation in complete denture fabrication. Over time, various techniques and landmarks have been utilized by clinicians and researchers to establish this plane[1]. Among these, the ala-tragus line (Camper's plane) has gained widespread acceptance as a reliable method for determining the OP[1,2]. However, there exists ambiguity in defining the ala-tragus line (ATL), as different references provide varying points of reference[3]. For instance, Boucher describes Camper's plane as, extending from the inferior border of the ala of the nose to the superior border of the tragus of the ear, while another definition defines it from the center of the ala to the center of the tragus[4].

Facial and anatomical measurements, despite individual diversity, can aid in executing and plan-

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ning rehabilitation treatments effectively[5]. The accurate establishment of the OP is crucial in making complete dentures, as it forms an integral part of mechanically balanced articulation[6]. Studies indicate that aligning the OP parallel to the ATL during maximum clenching optimizes bite force, whereas inclining the OP posteriorly by approximately 5 degrees reduces this force. Faulty orientation of the OP can lead to challenges in tongue and buccinator interactions. If the OP is too high, it may cause denture displacement by the tongue, whereas a low OP could result in tongue and cheek biting. Research findings suggest that the ala-tragus line (ATL-I) with inferior tragus' border tends to align more closely with the OP compared to the superior (ATL-S) and middle (ATL-M) borders[1-3].

Studies by Chaturvedi et al. Nayar S et al. and Ghosn et al. have explored the angles formed between the OP and different points of the ala-tragus line, providing valuable insights into OP orientation in dentulous individuals. However, local studies specific to our population are lacking, highlighting the need for further research to establish reference values for complete denture fabrication. This data can significantly contribute to improving patient comfort and satisfaction in dental treatments, thereby enhancing trust in healthcare providers and reducing the risk of complete denture failure due to improper OP planning.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at the Department of Prosthodontics, Khyber College of Dentistry Peshawar over seven months. Throughout this time duration, 190 patients aged 20 to 40 who met the inclusion criteria were selected. Individuals satisfying both the inclusion and exclusion criteria were requested to participate in the research. After obtaining informed consent, participants were directed to hold a Fox plane, coated with dental wax, between their teeth. Left profile pictures of all participants were taken using a digital camera while they stood in a natural head position (canon 600D with a focal length of 50mm). Photographs were taken from a fixed distance of one meter from the patient's mid-sagittal plane. These images were analysed and the most parallel relationship determined between the arm of the fox plane and three different levels of ala-tragus line by using Adobe Photoshop CS6 software. The angle and parallelism between the three lines (ATL-S, ATL-M, ATL-I) and OP was determined. Data thus obtained was subjected to statistical analysis (Figure 1).

Data analysis was done through SPSS version 20. The mean and standard deviation were determined for continuous variables, i.e., age and the angle between the three lines (ATL-S, ATL-M, ATL-I) and OP. Frequency and percentages were calculated for categorical variables like gender and different parallelism with Line OP of the three variants of ala-tragus angle (Yes/No). One way ANOVA was used to compare the difference between three variants of ala-tragus angle with OP. In case of significance post hoc analysis using schefe test was conducted. The analysis was done using ANOVA for each gender and age groups to see effect modifications. The confidence interval was kept at 95%. Parallelism of ATL with Line OP was stratified among age and gender to see effect modifiers. This post stratification analysis was done through chi square test, where p value ≤ 0.05 was considered as significant. All the data was presented in the form of table and charts.

RESULT

In this study, data from 190 subjects fulfilling the inclusion criteria were collected over a period of seven months using consecutive non-probability sampling technique. Out of 190 subjects, males were 102 (53.7%) and females 88 (46.3%). Male to female ratio was 1.15:1. The mean age of the subjects calculated was 29.5±5.35 (SD) yrs. The age range was between 20-40 years.

There were 53 (27.9%) patients in the age group 20-25, 56 (29.5%) belonged to the age group 26-30, 49 (25.8%) belonged to the age group 31-35, and 32 (16.8%) belonged to the age group 36-40. The details of frequency of age distribution are shown in Figure 2.

The Table 1 shows distribution of gender in the different age categories for this study. As is shown in the table, majority of the female subjects in the study belonged to the age group of 31-35 years where as majority of the male subjects belonged to the age group of 26-30 years.

The angles between the OP and the superior, middle, and inferior ala tragus were significantly different from zero indicating lack of parallelism

between the OP and the ala tragus line. For the purpose of this study, angles less than 5 degrees between the OP and any variant of ATL was considered to be parallel. The results exhibited lowest mean value (3.56 ± 1.17) for the ATL-I demonstrating stronger inclination to be parallel to the Fox plane. The mean angle between the OP and ATL-S, OP and ATL-M and the angle between the OP and ATL-I are shown in Table 2.

It is evident that the ATL with the inferior point of tragus of the ear as a reference point has more tendency for parallelism with OP with 94% falling within the range i.e. equal to or less than 5 angle between the two lines. The parallelism of the three variants of the ATL with the OP among gender statistically non-significant (p value < 0.005). Statistically no significant difference was found between the parallelism of 3 variants of ATL with age (p value < 0.005). One way ANOVA test was applied to assess the comparison between the three variants of ATL and OP. The analysis was done using ANOVA for each gender and age group to check for any effect modifications. The confidence interval was kept at 95%. Statistically no significant relation was found between the variants of ATL and OP (Table 3).

Fig 1: Demonstrating the 3 variants of ATL and Fox OP

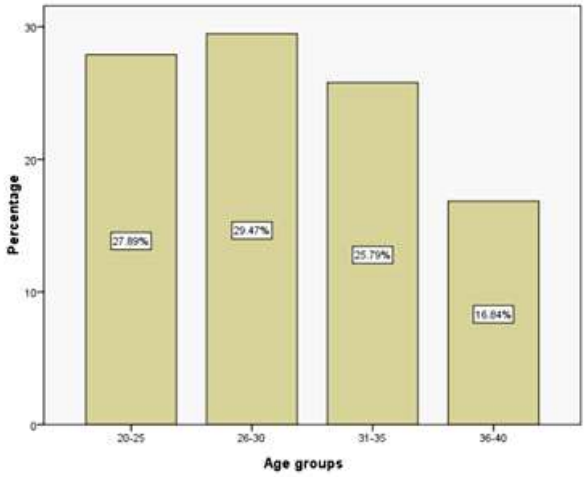

Fig 1: Demonstrating the 3 variants of ATL and Fox OP

DISCUSSION

Improving the functionality of tasks like swallowing, chewing, speech, and appearance is crucial in dental care. Levin's research highlights that aligning the Occlusal Plane (OP) with the original plane of natural teeth enhances these functions[3]. Although some variation is permissible without major impact, many studies have aimed to pinpoint the lost natural OP in edentulous patients using radiographic and clinical methods[13]. Our study employed a simple, non-invasive photographic technique to capture subjects' images, ensuring minimal distortion. We also standardized distances and head posture for accuracy similar to the method employed by Kumar et al[7]. Subjects aged 20-40 years were chosen due to their complete natural dentition during this period, minimizing tooth loss-related variables[7].

Results of this study showed no consistent alignment between the natural OP and different ATL variants, as reported by various authors. Variations in angles between OP and ATL points were observed,

Table 1: Gender distribution in the age groups

Age group (years)	Gender		Total (N)
	Male (N)	Female (N)	
20-25	26	27	53
26-30	31	25	56
31-35	18	31	49
36-40	27	05	32
Total	102	88	190

Table 2: Mean angle between the OP and the three variants of ala-tragus line

Angle	Mean	Standard Deviation	Range
ATLS	5.96	1.41	5.6
ATLM	4.67	1.24	5.0
ATLI	3.56	1.17	4.5

highlighting the complexity of this relationship[2,3]. Our findings align closely with studies by Ahmed et al.[8] and Nayar et al.[2] emphasizing the importance of considering specific ATL points for different age groups during OP orientation in edentulous patients. Nayar et al reported highest angle for the superior variant of the ATL with the OP (9.66 ± 4.29). The findings of our study (5.96 ± 1.41) were relatively closer to that reported by M Ahmed (8.5 ± 3.69)[2,8].

Previous research has documented that the angle between OP and ATLM is 2.75 degrees ± 3.64[3] and 2.88 degrees ± 3.54[4]. In a separate study conducted by Carole Abi-Ghosn et al. this angle was reported to be 3.27 degrees ± 2.54[3]. In our study, the mean angle between OP and ATLM was measured to be 4.67 degrees ± 1.24. These findings indicate a close correlation between the two planes, as evidenced by the relatively narrow range of values observed. Unlike our study, where the posterior reference point of ATL is positioned inferiorly to the tragus, Solomon et al. proposed that ATL (Camper's plane) runs parallel to the occlusal plane when the tragal reference point is positioned between the superior border and middle of the tragus[11].

Ahmed et al. observed a deviation of 2.89 degrees ± 2.57 between the natural OP and the ATLI. They noted that the ATLI exhibited closest alignment with the OP[8]. Similarly, Nayar et al.'s study echoed these findings, reporting that a line extending from inferior border of the tragus to the ala of the nose demonstrated closest relationship with the OP in both genders, closely paralleling the Fox OP[2]. Their mean value of 3.91 degrees ± 1.19 closely resembled our study's findings. This similarity may be attributed to the consistent methodologies employed in analyzing the relationship between the OP (represented by the Fox Plane) and the three variants of ATL. Additionally, Shetty et al. also observed parallelism between the ATL and OP when the inferior point on the tragus was selected as the posterior reference point[9].

Stratification of parallelism between the three variants of ATL and the OP across different age groups was conducted to explore potential effect modification, significance level of $p \leq 0.05$. However, statistically no significant relationship could be established. In contrast, Shaikh et al. reported a significant influence of age on the relationship between the natural OP and ATL. They observed distinct associations between different age groups and the alignment of ATL. Specifically, in the young adult age group, the OP demonstrated a stronger parallelism with ATL when the inferior border of the tragus was utilized as the posterior reference point. This suggests that inferior border of the tragus should be considered as the posterior reference point for establishing OP in completely edentulous patients within this age group. In contrast, for middle-aged and older individuals, both the middle and superior borders of the tragus could be used as posterior reference points when orienting the OP. However, further research is necessary to clarify the accurate relationship between age and the orientation of the OP. It is also emphasized that a single level of ATL should not be universally applied when establishing the OP for completely edentulous patients. Instead, consideration of different levels of the ala tragus line based on age is recommended[10,11].

In our study, statistically no significant relationship could be established between the natural OP and ATL when stratified by gender, with significance level set at $p \leq 0.05$. However, Gupta et al. reported findings that contrast with ours. In their study population, they found that 72% of male subjects had the middle point of the tragus as the posterior reference point for ATL, while a majority of females exhibited parallelism to the OP with the middle point of tragus as the posterior reference point[10,11].

CONCLUSION

In the majority of subjects, the natural OP was observed to align parallel to Camper's plane, with the anterior reference point being the ala of the nose and the posterior reference point being the inferior point of the tragus, considering parallelism as an angle less than 5°. Based on the findings of our study, we suggest using the inferior border of the tragus as the posterior reference point for the ATL. However, the positioning of OP should ultimately be guided by experienced clinical judgment, taking into account factors such as aesthetics, functionality, and denture stability. It's important to remember that the determination of the OP is influenced by functional dynamics rather than any static relationship. Therefore, it's advisable to select the OP based on a combination of anatomical landmarks, aesthetics, speech clarity, comfort, and functional requirements.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	FS, AK, AQ, BQ, AF, NI
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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.