



Relationship between the Occlusal Plane corresponding to the Lateral Borders of the Tongue and Ala-tragus Line in Edentulous Patients

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ABSTRACT

Aim: Definitions of the ala-tragus line (ATL) cause confusion, because the exact points of reference for this line do not agree. This study determined the relationship between the prosthetic occlusal plane (OP) corresponding to the lateral borders of the tongue and ATL which was established by using the inferior border of the ala of the nose and (1) the superior border of the tragus (ATL 1), (2) the tip (ATL 2) and (3) the inferior border of the tragus (ATL 3).

Materials and methods: Neutral zone moldings using phonation and autopolymerizing acrylic resin were recorded and leveled with the lateral borders of the tongue. Lateral cephalometric radiographs were taken of each subject by a standard method. Tracings were obtained on acetate paper to show the prosthetic OP and the three ATLs. The relationship between the prosthetic OP and each of ATL was measured for each subject. Mean and standard deviation values were then calculated for the relationship. Statistical analysis was performed using repeated measure analysis of variance followed by Bonferroni pairwise comparisons and Student's t-test ($\alpha = 0.05$).

Results: Significant difference was found between the three mean angles ($p = 0.001$). There was no significant difference between the mean angle ($5.00^\circ \pm 4.38$) formed by OP and ATL 2, and the mean angle ($4.90^\circ \pm 3.50$) formed by OP and ATL 3 ($p = 1.00$) which revealed the smallest.

Conclusion: The findings of this study indicated that ATLs, extending from the inferior border of the ala of the nose to (1) the tip of the tragus of the ear, and (2) the inferior border of the tragus presented the closest relationship to the prosthetic OP corresponding to the lateral borders of the tongue.

Clinical significance: When the ATL is used for orientation of the OP in denture construction, it would seem preferable to define it as running from the inferior border of the ala of the nose to the tip or to the inferior border of the tragus of the ear.

Keywords: Edentulous, Ala of the nose, Tragus of the ear, Occlusal plane, Lateral borders of the tongue, Neutral zone, Phonation.

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INTRODUCTION

The occlusal plane (OP) is important in dentistry but is difficult to determine exactly in the edentulous patient. An erroneous orientation of the OP may result in tongue and cheek biting, or food accumulation in the sulcus and instability of the dentures.^{1,2} Many techniques of establishing the OP have been reported in the literature but no single agreed-upon method has been shown to be accurate for reliably determining it. Studies that have compared natural and prosthetic OP are also numerous.^{1,3,4} Other studies have analyzed and discussed a wide variety of landmarks to show whether they are suitable to use as a reference for OP orientation.⁵⁻¹¹ Extraoral landmarks that have been suggested to orient the OP are the interpupillary line, and Camper's line or ala-tragus line (ATL).⁹ Commonly used intraoral landmarks are the lips and the commissures, residual ridges, retromolar pad, hamular notch-incisive papilla plane, lateral borders of the tongue and the buccinator grooves.^{5-7,9,10,12-14} While Nissan, Barnea, Zeltzer and Cardash¹⁵ suggest to consider intraoral structures during OP determination, Spratley¹⁶ believes that the intraoral landmarks are valuable guides for the experienced clinicians but they are rather difficult to follow by students.

Although the technique for using the ATL is well documented, there is some controversy over whether to take the superior border, the tip, or the inferior border of the

tragus of the ear as posterior reference points to define ATL.⁹ Improper use of these landmarks may compromise the functional and esthetic result of prosthetic restorations. The purpose of this study was to determine the relationship between the prosthetic OP corresponding to the lateral borders of the tongue, and ATL which was established by using the inferior border of the ala of the nose and (1) the superior border of the tragus (ATL 1), (2) the tip (ATL 2) and (3) the inferior border of the tragus (ATL 3).

MATERIALS AND METHODS

Complete dentures were constructed for each subject using the neutral zone concept.¹⁷ The neutral zone was molded using phonation and autopolymerizing acrylic resin (Formatray; Kerr Corp, Orange, Calif).¹⁸ To locate the OP, a pointed pencil was used to mark the height of the inferior lip at rest, the commissures of the lip, and the most concave line produced bilaterally on the lingual surface of the molding, in the molar regions. Excess material was trimmed away with a carbide bur. The maxillary occlusion rim was adjusted according to esthetics and phonetics, and the maxillomandibular relations were recorded. Lateral cephalometric radiographs were taken of each subject by a standard method. Tracings were obtained on acetate paper to show the prosthetic OP and the three ATLs (Fig. 1). The relationship between the prosthetic OP and each of ATL was measured for each subject. Mean and standard deviation values were then calculated for the relationship.

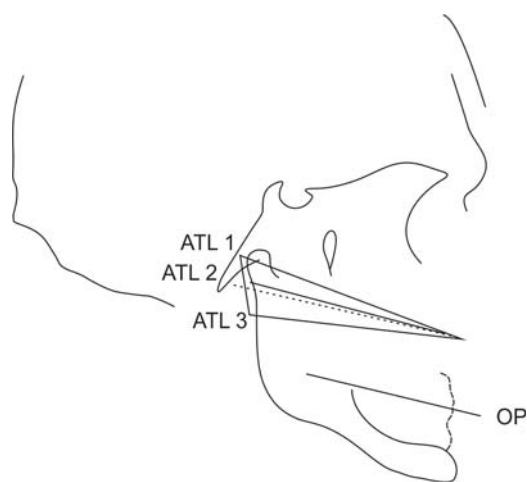


Fig. 1: Tracing of a cephalogram showing the position of the prosthetic occlusal plane and the three ala-tragus lines; ATL 1: Ala-tragus line extending from the inferior border of the ala of the nose to the superior border of the tragus of the ear; ATL 2: Ala-tragus line extending from the inferior border of the ala of the nose to the center of the tragus of the ear; ATL 3: Ala-tragus line extending from the inferior border of the ala of the nose to the inferior border of the tragus of the ear; OP: prosthetic occlusal plane corresponding to the lateral borders of the tongue

After this study received institutional review board approval, 20 edentulous subjects were studied after completion of neutral zone dentures. Subjects ranged in age from 51 to 91 with a mean age of 70.05. The criteria for selection of these subjects were advanced mandibular ridge resorption (Class V, Atwood) and absence of clinical temporomandibular joint symptoms.¹⁹ During preliminary evaluation, none of the subjects showed signs of phonetic problems with their existing dentures. All the subjects were fully informed of the nature of the study. Most of them agreed to take part, but a few were skeptical as they did not want anything to happen to their new dentures. To get round the problem, the final occlusal wax rims were duplicated and used for this study. Two months after delivery of the dentures, when patient adaptation had been achieved and the prostheses were deemed satisfactory by the patient, duplicates of the final occlusal wax rims were inserted into the subject's mouth and standard lateral cephalometric radiographs of each subject were made with a cephalostat (Panoramic Corporation PC 1000, Forwayne-Indiana USA, range capability of 70-90 kV, at 10 mA for 0.4-5.0 seconds). The cone film distance used was 5 feet. Exposure was 80 to 90 kV at 10 mA for 1.5 to 2 seconds in accordance with the subject's physical stature. All radiographs were taken with the rims in centric occlusion. The landmarks used in this study were as follows:

1. *ATL 1:* The line extending from the inferior border of the ala of the nose to the superior border of the tragus of the ear.
2. *ATL 2:* The line extending from the inferior border of the ala of the nose to the tip of the tragus of the ear.
3. *ATL 3:* The line extending from the inferior border of the ala of the nose to the inferior border of the tragus of the ear.
4. *Prosthetic occlusal plane:* The line extending from the mesioincisal angle of the maxillary central incisor to the mesioincisal angle of the maxillary first molar.

Identification of the exact points of reference on the radiographs was made possible by using small radiopaque ball-shaped pellets (1 mm in diameter). The pellets were attached with adhesive tape to the inferior border of the ala of the nose and to the three posterior points of reference for the ATL. The prosthetic OP was identified by penetrating the metal pellets in the maxillary wax rim at the site of the mesioincisal angle of the maxillary first molar and the mesioincisal angle of the maxillary central incisor. Tracings were made on acetate paper from all the radiographs. The deviation between the prosthetic OP and each of the ATL was measured two times by each of the authors. The angles formed in the anterior region were given a positive value.

The statistical analysis was performed by a software program (SPSS for Windows, version 16.0, Chicago, IL). Repeated measure analysis of variance followed by Bonferroni pairwise comparisons were conducted to explore differences between mean angles. To find out if ATL 1, ATL 2, or ATL 3 was parallel to prosthetic OP, Student's t-test was used comparing each mean angle with the value 0°. Significance level was set at 0.05.

RESULTS

Table 1 lists the relationship between the prosthetic OP and ATL 1, ATL 2 and ATL 3 for all 20 subjects. Statistical analysis of results is shown in Table 2. Significant difference was found between the three mean angles (p = 0.001). The mean angle (9.35° ± 5.99) formed by OP and ATL 1 was significantly the highest (p < 0.02). There was no significant difference between the mean angle (5.00° ± 4.38) formed by OP and ATL 2 and the mean angle (4.90° ± 3.50) formed by OP and ATL 3 (p = 1.00).

No parallelism was found between the prosthetic OP and ATL 1 (p < 0.001) or ATL 2 (p < 0.001) or ATL 3 (p < 0.001).

DISCUSSION

For years, researchers have been studying landmarks that can better guide the clinician in establishing the OP in complete denture construction; the tongue is one of those;²⁰ however, a few investigated its relationship with other reference structures or with the natural OP.²⁵ To locate the OP after the registration of the neutral zone, Beresin and Schiesser level the molding with the height of the inferior lip anteriorly, the commissures laterally, and a point

one-half to two-thirds the height of the retromolar pad posteriorly.¹⁷ They check afterwards the correctness of its height by comparing it with the lateral borders of the tongue when the tongue is at rest. The height of the OP should be 1 to 2 mm below the greatest convexity of the lateral borders of the tongue. Yasaki levels the bicuspid region of the mandibular occlusion rim on the same plane as the margin of the tongue when the mandible is at rest and the posterior region terminates at the anterior margin of the retromolar pad.¹² Hickey, Zarb and Bolender observed that by so doing, the height of the resultant OP conforms to tongue, cheek and corner of the mouth activities, which will enhance denture stability.¹³ It is evident that the tongue is a very important landmark to consider establishing the OP. Recording a neutral zone is an excellent method to determine at which level should correspond the OP; however, the clinical technique of recording neutral zone in complete denture patients requires significant experience for the clinician to become proficient.²¹⁻²⁴

Table 2: Statistical analysis of results

Type of composite	Mean	Standard deviation	Bonferroni pairwise comparisons*
Angle (degrees) between OP and ATL 1	9.35	5.99	a
Angle (degrees) between OP and ATL 2	5.00	4.38	b
Angle (degrees) between OP and ATL 3	4.90	3.50	b

*Same letters indicate no significant difference

Table 1: Relationship between the prosthetic occlusal plane and the ATL

Subject	Angle (degrees) between OP and ATL 1	Angle (degrees) between OP and ATL 2	Angle (degrees) between OP and ATL 3
21	8	1	7
22	23	18	12
23	11	7	2
24	6	1.5	4
25	10.5	3	5.5
26	24	13	11
27	8	1.5	9
28	5	1	3
29	3	2	7
30	14.5	10	5
31	10.5	6.5	2.5
32	9	4	1.5
33	9.5	5	0.5
34	1.5	4	9
35	10.5	4.5	2.5
36	8	3	2.5
37	1	4	7.5
38	8.5	4	0.5
39	12	6.5	1
40	3.5	0.5	5

Because of its relative easiness of utilization, the ATL remains one commonly used provisional guide to establish the OP; however, definitions of the ATL cause confusion, because the exact points of reference for this line do not agree. Results of this study have shown no parallelism between the prosthetic OP and any of the defined ATL. The deviations formed between ATL 2 and ATL 3 and the prosthetic OP were respectively $5.00^\circ \pm 4.38$ and $4.90^\circ \pm 3.50$, and no statistical difference was found between these two angles ($p = 1.00$). Other study have demonstrated the close relationship between the natural OP and ATL 2 and ATL 3.⁹ In 2001, Bassi, Deregibus, Previgliano, Bracco and Preti reported the angle formed by the prosthetic OP corresponding to the lateral borders of the tongue and ATL 2 to be 11.3° .²⁵ Results of this study have shown only 5.00° for the same angle. The discrepancy between the two values is appreciable. This may be due to a different methodology in leveling the OP with the lateral borders of the tongue. Bassi leveled the mandibular wax occlusal rim without recording a neutral zone.

From the results of this study, it can be inferred that use of the ATL may be clinically a useful reference line for the initial orientation of the OP, but it should be taken only as an approximation. Final determination of it is governed by other criteria. If used, it would seem preferable to define it as running from the inferior border of the ala of the nose to the tip or to the inferior border of the tragus of the ear.

CONCLUSION

The findings of this study indicated that ATLs, extending from the inferior border of the ala of the nose to (1) the tip of the tragus of the ear and (2) the inferior border of the tragus presented the closest relationship to the prosthetic occlusal plane corresponding to the lateral borders of the tongue.

CLINICAL SIGNIFICANCE

When the ATL is used for orientation of the occlusal plane in denture construction, it would seem preferable to define it as running from the inferior border of the ala of the nose to the tip or to the inferior border of the tragus of the ear.

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