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Original Article

A cephalometric study to establish the relationship of the occlusal plane to the three different ala-tragal lines and the Frankfort horizontal plane in different head forms

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ABSTRACT

Background: The aim of the study is to compare the relationship of the occlusal plane to 3 different ala-tragal lines, namely the superior, middle and inferior lines, in individuals having different head forms and its relation to the Frankfort horizontal plane.
Methodology: A total of 75 lateral cephalometric radiographs of subjects with natural dentition, having full complement of teeth, between the age group of 18–25 were screened and selected. Lateral cephalogram were made for each subjects in an open mouth position. Prior to making the lateral cephalogram, radiopaque markers were placed on the superior, middle and inferior tragus points and on the inferior border of the ala of the nose. Cephalometric tracing was done over each cephalogram.
Results: In mesiocephalic head form the middle ala-tragal line was most parallel to the occlusal plane having a mean angle of (1.96°). In dolichocephalic headform, the superior ala-tragal line was most parallel to the occlusal plane having a mean angle of (0.48°). In brachycephalic head form, the middle ala-tragal line was most parallel to the occlusal plane having a mean angle of (2.08°). The mean angulations of occlusal plane to FH plane is 11.04°, 10.16° and 10.60° in mesiocephalic, dolichocephalic and brachycephalic head forms, respectively.
Results and conclusion: The study concludes that the middle ala-tragal line can be used as a reference for the mesiocephalic head form and the superior ala-tragal line for the dolichocephalic and brachycephalic head form as a reference to establish the occlusal plane.

1. Introduction

Orientation of the occlusal plane is an essential part of clinical complete denture preparing procedures. Considering the importance of the accurate establishment of its location and the effect of its inclination on function, aesthetics and speech, a method to guarantee its conformity with the occlusal plane of the missing teeth seems necessary [1,2].

There is no unified opinion on the position and determination of the occlusal plane in denture construction, as there are significant individual variations in their inclination and neither are there unique and reliable referent structures for their estimation. Many advocate the application of roentgencephalometry during orientation of the occlusal plane in relation to the other reference planes of the head in edentulous patients [3].

Occlusal plane mainly helps in achieving esthetics and phonetics anteriorly, while posteriorly it forms chewing surface, where tongue and buccinators muscle are able to position the food bolus onto it and holds it during mastication. Faulty orientation of occlusal plane will hamper this orientation between the tongue and buccinators muscle resulting in food accumulation in the sulcus or leading to cheek and tongue biting and thus hampering the stability of the denture [4].

There are several landmarks for establishing the occlusal plane in the process of fabricating a complete denture prosthesis. An accepted concept is that the occlusal plane should be parallel to a line drawn from the lowest point of the ala of the nose to the superior border of the external auditory meatus or tragus. Trapozzano used the upper border of the tragus as a reference

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point. Swenson and Prothero felt that the variations found there were so frequent that it cannot be relied upon. R. Hortono found it a common practice to place the occlusal plane halfway between the maxillary and mandibular ridges parallel to the Frankfort plane. The orientation of the occlusal plane differs with different head forms. Brodie assumed that the face swings out from under the cranium with advanced age, and that great changes can take place in the facial structure during growth, which may have a marked influence on occlusion [5,6].

Though Camper's line is the most commonly used extraoral landmark to establish occlusal plane in edentulous subjects, it still remains controversial. This controversy is primarily due to the disagreement on the exact point of reference on the tragus (superior, middle or inferior) to establish the ala-tragal lines.

Since the position of the ala-tragal line with relation to the tragus is still debatable and since there exists a definite alteration in the arch form in individuals having different head forms. This study attempts to verify if any of these ala-tragal lines could be taken as a definitive external reference, to establish the occlusal plane and to study if there exists any variation in their relationships among the various head forms, viz the mesiocephalic, dolichocephalic and the brachycephalic.

Since it is stated that the occlusal plane is set at an angle of approximately 10 degrees relative to the Frankfort horizontal plane, when viewed in the mid-sagittal plane [1], this study also aims at cephalometrically evaluating the relationship of occlusal plane to the Frankfort horizontal plane in the three different head forms.

2. Materials and methods

Seventy-five dentulous subjects were screened and selected from the outpatients and students of Coorg Institute of Dental Sciences Virajpet. Inclusion criteria were as follows: patients with full complement of teeth (third molar excluded), age group of subjects between 18 to 25 years, subjects were grouped according to their head forms, having an equal distribution of 25 each in three different groups namely – mesiocephalic, dolichocephalic and brachycephalic. Exclusion criteria were as follows: subjects having undergone any orthodontic treatment, malocclusion, periodontal disease, tooth attrition.

Armamentarium which were used for the study were: digital extraoral radiographic machine (Sirona Orhtophos xg5), lateral cephalogram X-ray film, digital X-ray printer (KONIKA MINOLTA DRYPRO A32), 2 mm diameter lead sticker – 4No's, double sided adhesive tape, tracing sheet, led pencil – 0.3, paper clips, X-ray view box.

Lateral cephalograms were made for each of the subjects in an open mouth position. Prior to making the lateral cephalogram 1 mm diameter lead sticker were placed on the superior, middle and inferior tragus points and on the inferior border of the ala of the nose. The patients were positioned on the cephalostat as mentioned in its operator manual. Right side lateral cephalogram were made for each subject. The cephalogram thus obtained were subjected to cephalometric tracing using standard protocols and the following skeletal reference lines were traced:

- Frankfort horizontal plane (FH plane) – line connecting the portion to orbitale;
- occlusal plane (OP) – line connecting the tip of the maxillary central incisor to the cusp tips of the maxillary fist molar;
- ala-tragal lines – lines connecting the superior, middle and inferior points of the tragus to the ala of the nose, as established by the radiopaque markers.

SAT – superior ala-tragal line.
MAT – middle ala-tragal line.
IAT – inferior ala-tragal line.

The relative parallelism between the occlusal plane to three different ala-tragal lines and Frankfort horizontal plane were studied by measuring the angle between them. The angles were measured with the help of a scale and protractor.

Statistical analysis: data was analyzed using one sample '*t*' test and ANOVA test.

3. Results

The results obtained after analyzing the cephalometric tracing of the different samples are tabulated in Tables 1–5.

Tables 1–3 demonstrate the statistical comparison of occlusal plane to three different ala-tragal lines and its relation to FH plane in three different head forms. Table 4 demonstrates the statistical comparison of occlusal plane to FH plane in three different head form. Table 5 demonstrates the consolidated values of all the subjects irrespective of their head forms.

Statistical analysis: null hypothesis: the computed mean value is not significantly different from the given mean value i.e. $\mu = \mu 0$.

Table 1
Statistical summary of the angular relationship of occlusal plane to SAT, MAT, IAT and FH plane in mesiocephalic head form.

Occlusal plane	Mean	Standard deviation	SE of mean	*P*-value
SAT	−3.12	4.48	0.90	0.001[a]
MAT	1.96	3.97	0.79	0.011[a]
IAT	2.64	3.84	0.77	0.001[a]
FH plane	11.04	1.54	0.31	<0.001[a]

SAT: superior ala-tragal line; MAT: middle ala-tragal line; IAT: inferior ala-tragal line; FH plane: Frankfort horizontal plane.
[a] Denotes that computed mean is significantly different from observed/given/actual mean.

Table 2
Statistical summary of the angular relationship of occlusal plane to SAT, MAT, IAT and FH plane in dolichocephalic head form.

Occlusal plane	Mean	Standard deviation	SE of mean	*P*-value
SAT	0.48	2.33	0.47	0.268
MAT	1.56	2.60	0.52	0.003[a]
IAT	4.28	3.34	0.67	<0.001[a]
FH plane	10.16	0.80	0.16	<0.001[a]

SAT: superior ala-tragal line; MAT: middle ala-tragal line; IAT: inferior ala-tragal line; FH plane: Frankfort horizontal plane.
[a] Denotes that computed mean is significantly different from observed/given/actual mean.

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