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CEPHALOMETRIC COMPARISON OF FRANKFORTS HORIZONTAL PLANE AND OCCLUSAL PLANE WITH VARIATIONS IN ALA-TRAGUS LINE

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ABSTRACT:. The glossary of prosthodontic terms defines occlusal plane as an 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 surfaces. Another definition defines it as the surface of wax occlusion rims contoured to guide in the arrangement of denture teeth. Ala-tragus line according to the glossary of prosthodontic terms is defined as a line running from the inferior border of the ala of the nose to some defined point on the tragus of the ear, usually considered to be the tip of the tragus. It is frequently used, with a third point on the opposing tragus, for the purpose of establishing the ala-tragus plane. Ideally, the ala-tragus plane is considered to be parallel to the occlusal plane. The occlusal plane is at an angle of approximately 10 degrees relative to the Frankfort horizontal plane, when viewed in midsagittal plane. No precise, scientific method exists for determining the level of the occlusal plane in edentulous patients. Several principles have been postulated for determining the occlusal plane. The use of ala-tragus line to orient the occlusal plane has been controversial. This controversy is primarily due to disagreement on the exact point of reference for this line.Therefore the main objective of this study was to find out a reference line most parallel to the natural occlusal plane so that this reference point on the tragus can be used to determine the occlusal plane during the fabrication of complete denture

KEYWORDS: Frankfort horizontal plane, Occlusal plane, Ala - tragus line,Cant of occlusal plane.

INTRODUCTION

The discovery of X-rays in 1895 by Roentgen revolutionized dentistry. It provided a method of obtaining the inner cranio-facial measurements with quite a bit of accuracy and reproducibility. Cephalometric radiography is a standardized and reproducible form of skull radiography. The use of cephalometrics in prosthodontics has been advocated by orthodontists for some time. Recently, its introduction into prosthetic treatment planning has become evident, and attempts have been made to establish cephalometric norms. In addition, cephalometric studies are extremely useful in the long-term evaluation of prosthetic reconstructive procedures. Lateral cephalometric radiographs, also referred to as lateral “cephs,” display numerous cranial, facial, and oral anatomic structures imaged from lateral aspect[2, 3].

The inclination of the occlusal plane is one of the key factors governing occlusal balance. Determination of inclination of the occlusal plane is an important step before construction of equilibrated complete dentures because bilaterally balanced occlusion and good esthetics are the situation of choice. No precise, scientific method exists for determining the level of the occlusal plane in edentulous patients. Several principles have been postulated for determining the occlusal plane. The use of ala-tragus line to orient the occlusal plane has been controversial. This controversy is primarily due to disagreement on the exact point of reference for this line. Spartley describes it as running from the centre of ala to the centre of the tragus. Sharry recommends the concept without defining or illustrating it. Texts by Basker et al., Grant and Johnson, and Neill and Naim depict the ala-tragus line pictorially as extending to a point at the centre of tragus of ear[5].

The form of the occlusal plane is directly related to specific functional requirements. In addition to alignment of teeth in relationship to the arc of closure for best resistance to loading, it should permit ease of access for positioning the food on the occlusal surfaces. So establishment of the correct plane of occlusion is important because of its importance to coordinated function of the entire masticatory system.The purpose of this study is to find out a reference line most parallel to the natural occlusal plane so that this reference on the tragus can be used to determine the occlusal plane during the fabrication of complete denture.

Materials and methods

This study was carried out on 40 subjects within the age limit of 18-25 years. Subjects with Presence of 28 to 32 natural teeth in an ideal alignment, with Angle's class I molar relationship,with no missing teeth or replacement for the same and with normal profile are selected. Subjects treated orthodontically and with history of temperomandibular disorders are excluded from this study.

Lateral cephalograms were taken with the patient positioned within the cephalostat using adjustable bilateral ear rods placed within each auditory meatus in standing position. The patient's Frankfort plane (line connecting the superior border of the external auditory meatus and the infraorbital rim) was oriented parallel to the floor. The midsagittal plane of the patient to the target distance was 60 inches (5ft) and the film to the midsagittal plane was 18 cm. central ray was coinciding with the ear rod of the cephalostat**.(Fig.1)**

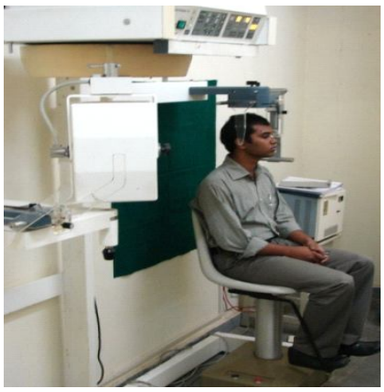

Fig.1. Cephalostat used for the study

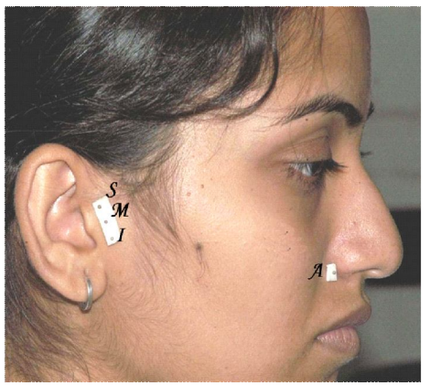

Fig.2. Stainless steel balls on the ala-tragal landmarks

Superior, middle and inferior points of the tragus were identified and stainless steel balls were attached in those points**.(Fig.2.)** All the cephalograms were traced on the X-ray viewer. Acetate 0.003 inch thickness film was used and tracing was done using 0.3 mm Hb lead pencil. To minimize tracing error and to obtain accurate tracing, tracings were made with the help of an orthodontist.

Established cephalometric landmarks, planes and angle used in the study (Fig .3, Fig .4, Fig .5, Fig .6)

Landmarks used:

***Or: Orbitale* –** the lowest point on the inferior rim of the orbit.
***Po: Porion* –** the most superiorly positioned point of the external auditory meatus located by using the ear rods of the cephalostat (mechanical porion).

Planes used:

***FH: Frankfort horizontal plane* –** extends from porion to orbitale.
***OP: Occlusal plane* –** line bisecting the overlapping cusps of the first molars and the incisal overbite.

Angle used:

***COO: Cant of occlusal plane* –** is a measure of the slope of the occlusal plane to the Frankfort horizontal.

Constructed landmarks, planes and angles used in this study

Landmarks used:

S*: Superior point of the tragus*
M: *Middle point of the tragus*
I*: Inferior point of the tragus*
A*: Inferior point of the ala of the nose*

Planes used:

SA: line running from the superior point of the tragus to the inferior border of the ala of the nose.
MA: line running from the middle point of the tragus to the inferior border of the ala of the nose.
IA: line running from the inferior point of the tragus to the inferior border of the ala of the nose.

Angles Used:

SFH - angle formed between SA and FH.
MFH - angle formed between MA and FH.

Fig.3. Lateral cephalogram

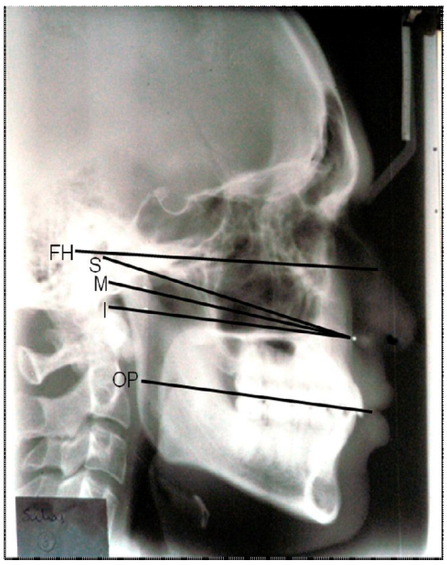

Fig.4. Tracings on Lateral cephalogram

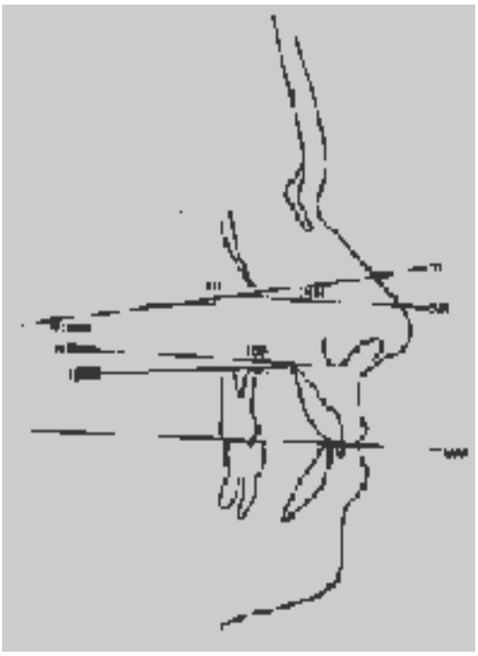

Fig.5. Angles MFH, IFH and IOP

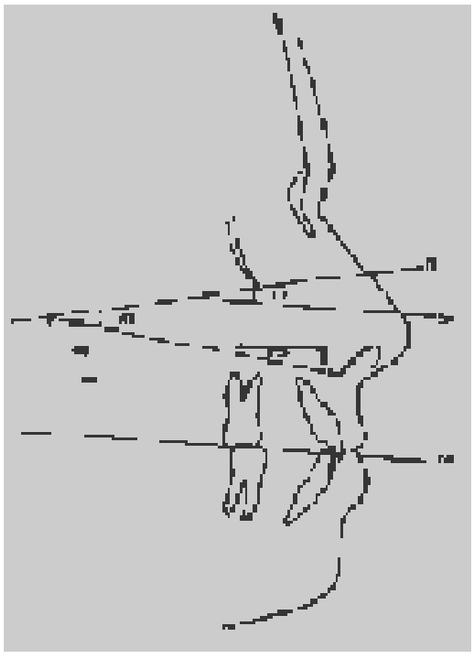

Fig.6. Angles COO, SFH and SOP

IFH - angle formed between IA and FH.
SOP - angle formed between SA and OP.
MOP – angle formed between MA and OP.
IOP – angle formed between IA and OP.

Results and statistical analysis

Mean, median and standard deviation values of COO, SFH, MFH and IFH were found out. Mean value of COO was 8.6650 with a standard deviation of 0.9646 whereas mean of SFH was 16.350 with a standard deviation of 2.6751 which was much higher than COO values. MFH and IFH values were found to be close to COO values, MFH values being closer.

Karl Pearson coefficient was studied

r = Karl Pearson coefficient of correlation
P = Probability

P < 0.05 – significant
P < 0.01 – highly significant
P < 0.001 – very highly significant
P > 0.05 - not significant

Correlation studies showed (1) negative correlation between COO and SFH. (2) Positive correlation between COO and MFH (3) the correlation between COO and IFH was not significant.

Table I shows values of mean, standard deviation and median of **COO** (cant of occlusal plane), **SFH** {angle between ala-tragus line (with superior border of tragus as posterior reference) and Frankfort – horizontal plane}, **MFH** {angle between ala-tragus line (with midpoint of tragus as posterior reference) and Frankfort horizontal plane} and **IFH** {angle between ala-tragus line (with inferior point of tragus as posterior reference) and Frankfort horizontal plane},**SOP** (angle between **SA** and **OP**), **MOP** (angle between **MA** and **OP**) and **IOP** (angle between **IA** and **OP**). **Table II** to **Table IV** shows correlation and probability between **COO** and **SFH**, **COO** and **MFH**, **COO** and **IFH**. **Histogram 1**: Showing the mean, standard deviation and median values of **COO, SFH, MFH, IFH, SOP, MOP, IOP**

Discussion

Occlusal plane position is the primary link between function and esthetics. From a mechanical point of view, the occlusal plane should be located in a direction perpendicular to the occlusal bite force. This position leads to the stability of dentures supported by resilient tissue. It also determines the extent of exposure of posterior teeth. Hence location of the occlusal plane in edentulous subjects is very crucial.

The technique of using the ala-tragus line (camper's line) to establish the occlusal plane is well documented. However, definitions of the ala-tragus line cause confusion, because the exact points of reference do not agree. Sharry recommends the concept without defining it or illustrating it. Texts by Bhasker, Tomlin, Grant and Johnson and Neill and Nairn depict ala-tragus line pictorially as a line extending to a point at the center of the tragus of the ear. Winkler and Heartwell have recommended the use of superior border as tragal reference for ala-tragus line. Boucher's prosthodontic treatment for edentulous patients is very uncertain in not exactly specifying which part of tragus should be taken as reference. The Glossary of prosthodontic terms defines the ala-tragus line as a line running from the inferior border of the ala of the nose to some defined point on the tragus of the ear. Therefore the choice in locating camper's plane is based on any one of these landmarks.

In this study, an attempt was made to identify the tragal landmarks and compare it with the occlusal plane in dentulous subjects to find out a line most parallel to the natural occlusal plane. The median values of COO, SFH, MFH and IFH were 9.0^0, 15.75^0, 10.0^0 and 7.00^0 respectively. Since the SFH median value was too high compared to COO, it was concluded not to take superior border of tragus as the posterior reference in ala-tragus line. MFH median value was found to be more close to COO values than IFH values. MFH median value was 10^0 when COO value was $9.0^{0.}$ The cant of occlusal plane in Downs study showed a mean angulation of 9.5^0. In this study, the same value is 10^0. This variation may be due to differences in ethnic group.

Correlation values showed negative correlation between COO and SFH and positive correlation between COO and MFH. 93% of MFH values coincided with COO and 53% of IFH values coincided with COO. In an earlier study of 2048 tragi forms, it was founded that camper's plane was parallel to the occlusal plane when the tragus reference point was situated between the superior border and the middle of the tragus and not from the usual hitherto recommended reference points.

CONCLUSION

A study was conducted to identify the tragal landmarks and compare it with the occlusal plane and Frankfort horizontal plane in dentulous subjects to find out a reference line most parallel to the natural occlusal plane. 40 subjects within the age group of 18-25 years were investigated.Tragal landmarks were identified and lead points attached to stickers were placed on the landmarks and cephalograms were taken. Cephalograms were traced and the three ala-tragus lines were compared with the Frankfort horizontal and the occlusal plane. The results showed significant correlation between the ala-tragus and

Table-I. Mean, standard deviation and median of different angles and planes used in the study

PARAMETER	N	MEAN	STANDARD DEVIATION	MEDIAN
COO	40	8.6650	0.9646	9.0
SFH	40	16.350	2.6751	15.75
MFH	40	9.545	0.71	10.0
IFH	40	6.8750	2.0056	7.0
SOP	40	8.48	2.66	8.0
MOP	40	2.90	2.03	2.25
IOP	40	2.85	1.66	3.0

Table.II. correlation and probability between COO and SFH

	SFH
r COO	-.191
P COO	-.238

Table.III. correlation and probability between COO and MFH

	MFH
r COO	.296
P COO	0.000

Table.IV. correlation and probability between COO and IFH

	IFH
r COO	-.054
P COO	.741

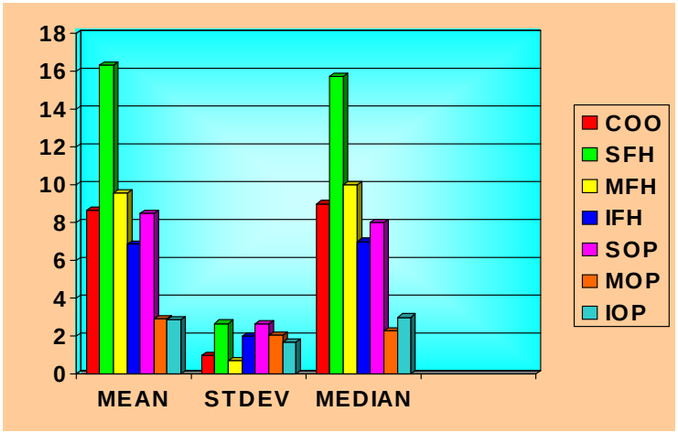

Fig.1. Histogram showing Mean , Standard deviation and Median of different angles and planes

Frankfort horizontal plane when the midpoint of tragus was taken as the posterior reference for ala-tragus line.

From the results of the study, the following conclusions are drawn.The posterior reference point of the tragus for obtaining parallelism between ala-tragus line and the occlusal plane was found to be the midpoint of tragus in dentulous individuals. Since this study was conducted in younger individuals, it is desirable that further investigations are necessary on elder individuals to confirm the above findings

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