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Original Research Article

Assessment of Occlusal Plane in Angle's Class I, II, III Malocclusion Patient and Relating the Result to Edentulous Patients: A Cephalometric Analysis

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Abstract

Since long there has been persistent controversy among Prosthodontists regarding the Camper's line or Ala-tragus line which helps in establishing the occlusal plane in edentulous patients. Which posterior part of the tragus of ear has to be taken into consideration? It is the superior border of tragus or middle or Inferior border of tragus. Some authors postulate the usage of superior border whereas some postulate the usage of inferior border and very few postulate the usage of inferior border. To solve this controversy the present study was undertaken and we did cephalometric tracing on dentulous patients with different types of malocclusions and applied our results in the edentulous patients. Different Angle's molar relation Class II, Class II and Class III were considered in the study there lateral cephalograms were obtained on which cephalometric tracings were performed and the parallelism of campers line was checked with the occlusal plane with all the three points i.e Superior, middle and Inferior border of tragus of ear. Result revealed that the line drawn from the inferior border was much more parallel to the occlusal plane of dentulous patient than the middle and superior borders.

Key words: Prosthodontists, occlusal, cephalometric.

INTRODUCTION

The prosthodontist is responsible for restoring the natural esthetics of the patient and for developing an occlusion in the complete denture which is compatible with the functional movements of the mandible [1]. The correct orientation of the occlusal plane plays a vital role in optimal functional and aesthetic achievement. From the functional view point, the occlusal table is a milling surface, strategically placed so that the tongue on the lingual side and buccinator muscle on buccal side are able to position the bolus of food onto it and hold it there while mastication takes place. Camper's plane or Ala-tragus line was postulated in 1780 by the Dutch anatomist Peter Camper according to whom it extends from the ala of nose to the centre of the external auditory meatus and is widely accepted as a guide in the orientation of the occlusal plane [2]. Glossary of Prosthodontic Terms-8 (2005) defines 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, 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 [3].

Ideally, the ala-tragus plane is considered to be parallel to the occlusal plane. Even though the ala tragal line called Camper's line (when it is a plane from the inferior border of ala of the nose to the superior border of tragus of each ear) is the most commonly used landmark and the only extra oral landmark used to establish posterior occlusal plane in edentulous subjects, its use 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 line. Also, there have been no studies indicating the method of locating the proper position on the tragus while establishing the occlusal plane in case of various malocclusions.

Hence, the present study was undertaken to determine the relative parallelism of the different ala-tragal lines to the occlusal plane in various dental malocclusions (in order to apply the same for complete

denture patients) and to determine the relative parallelism of the occlusal plane and the ala-tragus line, from different points of origin on the tragus of the ear.

MATERIALS AND METHOD

A total of 30 volunteers, aged between 19 to 24 years were selected with Angle's molar relationship of Class I, Class II, Class III from the patients attending the Oral Medicine department Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow and students of Sardar Patel Post Graduate Institute of Dental & Medical Sciences, Lucknow, (U.P.) INDIA.

Inclusion Criteria

- Fully erupted permanent dentition teeth (at least 28 teeth) in normal occlusion.
- Bilateral Angle's Class I, Class II, Class III molar relationship [4].

Criteria for angle's classification used in the study are:-

Angle's Class 1: The mesiobuccal cusp of the maxillary first molar occludes in the buccal groove of the mandibular first molar [5].

Angle's Class 2: The mesiobuccal cusp of the maxillary first molar occludes mesial to the buccal groove of the mandibular first molar [5],

Angle's Class 3: The mesiobuccal cusp of the maxillary first molar will typically occlude near the embrasure between the mandibular first and second molars [5].

Exclusion Criteria

- Previous history of orthodontic treatment [6].
- Craniofacial surgery/ trauma [7].
- TMJ disorders or any marked facial asymmetries or any gross occlusal or incisal wear.
- Congenital facial defects.
- Any irregular pattern of occlusion like crossbite.
- Mentally unsound patients.
- Extensive restoration which include long span bridges.
- Pathologic drifting of teeth.

Armamentarium used for the study

- Lateral cephalograms (Kodak – TMAT)
- Radio opaque powder(barium sulphate)
- X-ray unit (Planmeca Proline XC Dimax 3, 80 kVA/ 8mA for 0.8s)
- Paint brush
- X ray viewer
- Tracing sheets/Architect's sheet (one side matte 75µm thickness)
- Pencil(0.3mm)
- Scale
- Kidney trays
- Protractor
- Indelible pencil
- 19 Gauge wire (1mm in length)
- Double sided tape
- Automatic processor (DuRR Dental)

Preparation of subject

In order to investigate the inclination of the occlusal plane to the ala tragus line, radio opaque markers were attached to the skin with the help of double sided tape on the tragus of the ear to mark the superior, middle, and inferior tragus points and a paste of barium sulphate on the inferior border of ala of the nose (Refer to Fig-1).

Capturing the lateral cephalograms of the subjects

Right lateral cephalograms were taken of the subjects by a standard technique with the mandible closed in maximum intercuspation [8]. A standard distance of five feet between the x-ray target and mid sagittal plane of the head of subject (Refer to Fig-2) [9].

Cephalometric tracing

The lateral cephalometric radiographs were taken on a Planmeca Proline XC Dimax 3 X‑ray machine. Lateral cephalograms of all the sample subjects were taken from the same X‑ray machine with the subject in the natural head position (NHP), with teeth in maximum intercuspation and lips in response. NHP was obtained by asking the subject to look straight ahead such that the visual axis was parallel to the floor. The radiographs were exposed at 80 kV/8 mA for 0.8s. The film to source distance was 5 ft 2" and the distance between the film and patient's mid‑sagittal plane was 6". The tracings were done on 75 µm lead acetate papers using a 0.3mm HB pencil. A single operator performed the tracings in a standardized manner to avoid errors due to intra‑operator variations (Refer to Fig-3).

PLANES USED IN STUDY

After the completion of the tracing the anterior and the posterior reference points were then joined together with the scale. These planes were marked as-

- Camper's Plane A- Drawn from the superior border of the tragus of the ear to the ala of the nose. (LINE A).
- Camper's Plane B- Drawn from the middle border of the tragus of the ear to the ala of the nose. (LINE B)
- Camper's Plane C- Drawn from the inferior border of the tragus of the ear to the ala of the nose.(LINE C)
- Occlusal Plane- Average plane is established by incisal and occlusal surface of the teeth.
- Sella Gnathion Plane- Sella is marked onto the Architect's sheet followed by Gnathion (Gn) in

the mandible. A line is drawn from sella to gnathion (as per AAO) [5].

The Sella gnathion line bisects all the four lines that is occlusal plane and the three ala tragal lines drawn from the tragus to ala of the nose.

Cephalometric Angles

The sella gnathion line which bisects the four lines forms four angles respectively [6].

- Camper's Plane Angle A- Angle was formed by sella gnathion line on line A which was marked from the superior border of tragus to ala of the nose.
- Camper's Plane Angle B- Angle was formed by sella gnathion line on line B which was drawn from the middle of tragus to the ala of the nose.
- Camper's Plane Angle C- Angle was formed by sella gnathion line on line C which was marked from the inferior border of tragus to the ala of the nose.
- Angle O - Angle was formed by sella gnathion line on the occlusal plane which was drawn from the occlusal and incisal edges of the mandibular teeth.

RESULT AND ANALYSIS FOR ANGLE'S CLASS I MALOCCLUSION

The Occlusal plane angle, Angle A, Angle B and Angle C in Class I malocclusion patients ranged from 48.0-59.0 degree, 40.0-48.0 degree, 42.5-50.0 degree and 45.0-52.0 degree, respectively with mean (± SD) 56.00 ± 3.52 degree, 44.15 ± 2.26 degree, 46.70 ± 2.19 degree and 49.55 ± 2.06 degree,(Refer to fig 1) respectively. In Class I malocclusion patients, the mean angular measurement of Angle O was the highest followed by Angle C, Angle B and Angle A, the least (refer to Fig-4). Conversely, in Class I malocclusion, the mean Angle B and Angle C not differed statistically (46.70 ± 2.19 vs. 49.55 ± 2.06, mean diff.=2.85, t=2.47; p>0.05) though the mean Angle C was 5.8% higher than Angle B (Refer to Table-1).

RESULT AND ANALYSIS FOR ANGLE'S CLASS II MALOCCLUSION

The Angle O, Angle A, Angle B and Angle C in Class II malocclusion patients ranged from 50.0-60.5 degree, 41.5-52.0 degree, 44.0-55.0 degree and 46.0-58.0 degree, respectively with mean (± SD) 56.75 ± 3.06 degree, 47.75 ± 3.75 degree, 50.80 ± 3.97 degree and 52.90 ± 4.35 degree, (Refer to Fig-2). respectively. In Class II malocclusion patients, the mean angular measurement of Angle O was the highest followed by Angle C, Angle B and Angle A, the least (refer to fig 5). Conversely, in Class II malocclusion, the mean Angle B and Angle C not differed statistically (50.80 ± 3.97 vs. 52.90 ± 4.35, mean diff.=2.10, t=1.23; P>0.05) though the mean Angle C was 4.0% higher than Angle B (Refer to Table-2).

RESULT AND ANALYSIS OF ANGLE'S CLASS III MALOCCLUSION

The Angle O, Angle A, Angle B and Angle C in Class III malocclusion patients ranged from 49.0-60.0 degree, 42.0-50.0 degree, 45.5-52.5 degree and 48.5-55.0 degree, respectively with mean (± SD) 53.50 ± 3.48 degree, 45.60 ± 2.42 degree, 48.85 ± 2.20 degree and 51.25 ± 2.28 degree, (Refer to Fig-3) respectively. In Class III malocclusion patients, the mean angular measurement of Angle O was the highest followed by Angle C, Angle B and Angle A, the least (refer to Fig-6). Conversely, in Class III malocclusion, the mean Angle B and Angle C not differed statistically (48.85 ± 2.20 vs. 51.25 ± 2.28, mean diff.=2.80, t=2.37; P>0.05) though the mean Angle C was 5.5% higher than Angle B (Refer to Table-3).

Fig-1: Prepration of the subject

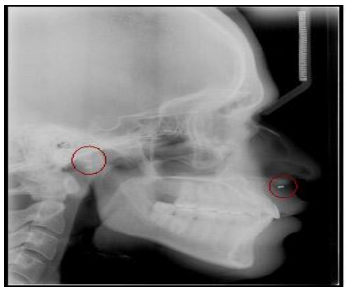

Fig-2: Lateral cephalogram with radio opaque markers

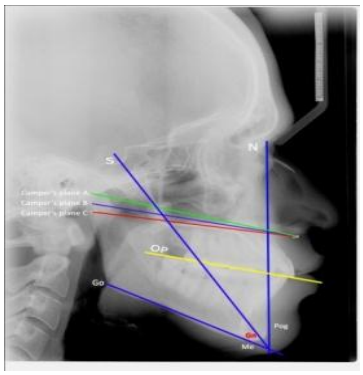

Fig-3: Tracing of lateral cephalograms

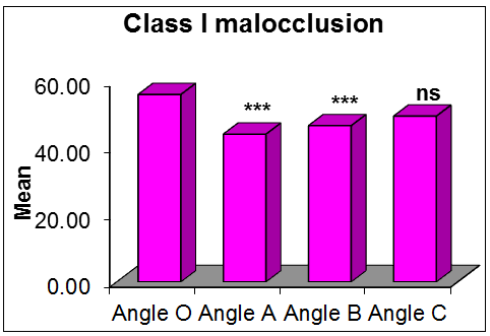

Fig-4: Mean angular measurements in patients of Class I malocclusion

Table-1: Multiple comparisons of mean angular measurements in Class I malocclusion by Bonferroni test

Comparisons	Mean Difference	t value	P Value	95% CI of difference
Angle O vs. Angle A	11.85	10.29	P < 0.001	8.63 to 15.07
Angle O vs. Angle B	9.30	8.07	P < 0.001	6.08 to 12.52
Angle O vs. Angle C	6.45	5.60	P > 0.05	3.23 to 9.67

^{ns}p>0.05 or ***p<0.001- as compared to Angle O

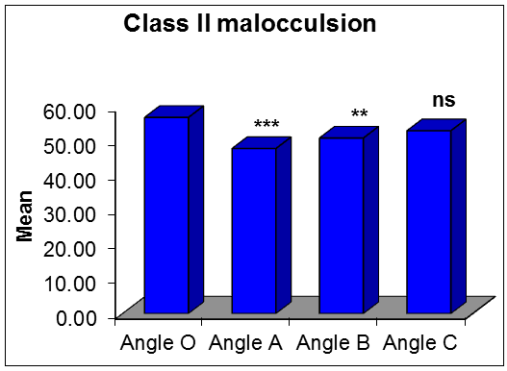

Fig-5: Mean angular measurements in patients of Class II malocclusion

Table-2: Multiple comparisons of mean angular measurements by Bonferroni test

Comparisons	Mean Difference	t value	P Value	95% CI of difference
Angle O vs. Angle A	9.00	5.28	P < 0.001	4.24 to 13.76
Angle O vs. Angle B	5.95	3.49	P < 0.01	1.19 to 10.71
Angle O vs. Angle C	3.85	2.26	P > 0.05	-0.91 to 8.61

^{ns}p>0.05 or ***p<0.001- as compared to Angle O

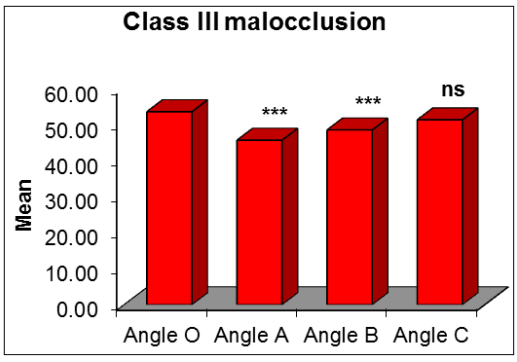

Fig-6: Mean angular measurements in patients of Class III malocclusion.

Table-3: Multiple comparisons of mean angular measurements by Bonferroni test

Comparisons	Mean Difference	t value	P Value	95% CI of difference
Angle O vs. Angle A	7.90	6.67	P < 0.001	4.60 to 11.21
Angle O vs. Angle B	5.05	4.27	P < 0.001	1.75 to 8.36
Angle O vs. Angle C	2.25	1.90	P > 0.05	-1.06 to 5.56

^{ns}p>0.05 or ***p<0.001- as compared to Angle O

DISCUSSION

The study of occlusion and its relationship to the function of masticatory system has been a topic of interest in dentistry since many years. One of the chief aim of preventive and restorative dentistry is to maintain an occlusion that will function in harmony with the other components of the masticatory mechanism, thereby preserving their health and at the same time providing the optimum masticatory function. Several researchers of science have engaged their attention to achieve this objective. Tremendous interest in this area, accompanied by a lack of complete knowledge, has initiated numerous concepts. When all natural teeth are lost, the prosthodontist concerned with the provision of the complete denture has less reliable indicators. The guides in use are often remote from the position of the occlusal plane, diffuse, poorly defined and inconsistent [10].

The orientation of the occlusal plane is lost in patients rendered edentulous and should be relocated if complete dentures are to be aesthetic and to function satisfactorily.

Where the occlusal plane is too high, the tongue cannot rest on the lingual cusps of the lower denture and prevent its displacement. There is also a tendency for accumulation of food in the buccal and lingual sulci. An occlusal plane that is too low could lead to tongue and cheek biting [11].

Soft tissue landmarks for orientation of plane of occlusion in edentulous patients: A range of alternative guides have been proposed by several authors to orient the occlusal plane in complete dentures like Ala-tragus line/ Camper's plane, residual alveolar ridges, lateral border of tongue, retromolar pad, condylar path, buccinators groove, corner of mouth and parotid papilla [8-16].

To meet the requirements of the inclusion and exclusion criteria, the dentulous subjects for this study were selected from patients and the students from the Sardar Patel Post Graduate Institute of Dental And Medical Sciences. It was decided that the age group of the study subjects would be between 18-24 years, as a full complement of teeth with little or no wasting diseases can be found in this age group more readily.

Angle's classification of malocclusion was used to determine the type of dental malocclusion to divide the subject into different groups, and later on they were subjected to cephalometric analysis to divide them into groups of skeletal Class I, Class II and Class III malocclusions. Subjects with wasting diseases like attrition, extensive restorations (long span bridges-greater than 4 units), history of orthodontic treatment and TMJ pathologies were excluded, as these conditions influence the jaw position and ridge relation. Subjects younger than 14 years would not have the full complement of teeth, hence the occlusion cannot be easily determined, and subjects older than 24 years can have wasting diseases, TMJ pathologies, extensive restorations and periodontal problems, making them unsuitable candidates for the study.

Though photographs and lateral cephalograms have been used in earlier studies to determine the suitable plane of occlusion, in the present study right lateral cephalograms were used to study the relationship between the three different Camper's plane and the occlusal plane, as lateral cephalograms can be standardized for all subjects. And also, it was a better method of locating the occlusal plane as compared to photographs [17]. Planmeca lateral cephalograms unit, which was available in the college, was used for the study. Kodak–TMAT films, which provided acceptable lateral cephalograms were used for the study. Automatic processor (DüRR Dental) was used for developing all the lateral cephalograms, and for standardizing the procedure of developing and fixing, and for elimination of inter-operator variations in processing of X-ray films. 1 mm metallic wire strips were used to make the landmarks visible on radiographs and for uniformity, as against the use of lead foil or radiopaque dyes, and also for convenience double sided adhesive tape was used to attach the metallic balls at the superior, middle and inferior positions. This is because it was easier to visualize the positions and it did not cause any inconvenience to the subjects while attaching and removing. To determine the parallelism of different Camper's plane to the occlusal plane, a plane connecting two anatomical landmarks, such that, it intersects all the four planes was essential [i.e. Camper's plane A, Camper's plane B, Camper's plane C and Occlusal plane]. and for this, the Sella and Gnathion were considered (as they are located one above (Sn) and one below (Gn) the occlusal plane, and when these two are joined it would intersect all the four lines) [18, 19].

Hence, the present study was aimed to evaluate the relationship between the natural occlusal plane and camper's plane in normal healthy male and female dentulous subjects.

The data collected from 30 subjects, 10 in each group of Angle's class I, Angle's class II, Angles class III malocclusion, were then subjected to the Test of Variance (ANOVA), and the Bonferoni test to get the angle which is not significantly different from Angle O (formed by Sn-Gn on the occlusal plane).

The results of the study suggested that the PLANE drawn from the inferior border of tragus of ear to the inferior border of ala of nose (CAMPERS PLANE C) was found to be parallel in all the three Angle's malocclusions, the study had a limited numbers of samples of a city. Future studies should include a large geographical area with people having different

facial forms to get to a result as to which posterior reference point is to be taken in to consideration as the posterior end of the ala tragus line.

CONCLUSION

On basis of results noted, statistical analysis and discussion the following can be concluded:

- In Angle's Class I malocclusion group, the Angle C (between Camper plane C and Sella – Gnathion plane) (P > 0.05) was found to be closest to the occlusal plane angle as compared to the Camper planes A & B.
- In Angle's Class II malocclusion group, the Angle C (between Camper plane C and Sella – Gnathion plane) (P > 0.05) was found to be closest to the occlusal plane angle as compared to the Camper planes A & B.
- In Angle's Class III malocclusion group, the Angle C (between Camper plane C and Sella – Gnathion plane) (P > 0.05) was found to be closest to the occlusal plane angle as compared to the Camper planes A & B.
- Amongst, all three Angles Classes I, II and III malocclusion groups the Angle O (between occlusal plane and Sella – Gnathion plane) was found to be similar (P>0.05).

Conflict of Interest: None

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