

Relationship of anatomic landmarks with occlusal plane

Original Article

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ABSTRACT

Purpose: Evaluation of relationship between various anatomical landmarks and the occlusal plane in the natural dentition that could be used for establishing the occlusal plane in complete dentures. **Methods:** The study comprised of 100 dentulous subjects with all healthy permanent teeth in normal arch form and alignment. Three instruments were custom-made for the purpose: the occlusal plane analyzer to check the parallelism of the ala-tragus lines, and the interpupillary line, the buccinator groove relator and the level analyzer for the level of the linea alba buccalis with the occlusal plane. For the retromolar pad area a metallic scale was used. **Results:** Within limitations of this study, it was observed that, only 13% subjects showed occlusal plane parallel to the interpupillary line. The posterior reference point of Camper's line was middle point for 72% of males and superior point for 80% of females. Intraorally, 68% of subjects have the occlusal plane at the same level as that of buccinator groove and 77% of the subjects had the occlusal plane at the middle one-third of retromolar pad area. **Interpretation and Conclusions:** It was concluded that: the occlusal plane is parallel to Camper's plane posterior reference point as the superior point of tragus in females and middle point in males. The occlusal plane is not generally parallel to the interpupillary line. Intra-orally, the level of buccinator groove is reliable, while variations in retromolar pad area make it an unreliable landmark for orienting the occlusal plane.

KEY WORDS: Buccinator groove, camper's line, occlusal plane, interpupillary line, retromolar pad area

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INTRODUCTION

The desire to look good and feel healthy is not limited by age. Since time immemorial, dentists have faced the challenge of providing accord between function and esthetics. The occlusal plane, lost in patients rendered edentulous, should be relocated if complete dentures are to be esthetically and functionally satisfactory.

GPT (July 2005)^[1] defines occlusal plane as "the 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. Functionally, the inclination of the occlusal plane is one of the key factors governing occlusal balance and phonation. Esthetically, the anterior occlusal plane takes on a fundamental role.

Considering the importance of the accurate

establishment of the location and inclination of occlusal plane on function, esthetics and speech, a method to conform it to the occlusal plane that existed in the natural teeth seems necessary. Various authors have advocated different methods for the orientation of the occlusal plane. Most important and accurate of these is pre-extraction record, eg: profile photographs, lead wire, acrylic face mask, dentulous casts etc. Unfortunately, these records are generally not available.

Numerous authors, since the beginning of complete denture fabrication, have proposed several landmarks to help define the level of occlusal plane. Various planes like Frankfurt horizontal plane, Camper's line, Palatal line, Occlusal line, Mandibular line, Interpupillary line, Hamular notch incisive papilla (H.I.P. plane) etc. have been suggested. Many intraoral landmarks like commissures of the mouth by Gillis^[2] in 1933, Incisive papilla by Robert N. Harper^[3] in 1948, parotid papilla

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by P. F. Foley and G. H. Latta^[4] in 1985, upper lip line by Rahn and Heartwell^[5] in 1986, height of the retromolar pad, the lateral borders of the tongue etc. have also been suggested

In 1979, H. Okane^[6] found that during clenching maximum biting force was greatest and muscle activity was least when the occlusal plane was made parallel to the ala-tragus line. Landa^[2] in 1947 said that the occlusal plane is parallel to line drawn from the alae of nose to the middle point of the tragus while Arthur O. Rahn and Charles M. Heartwell (1986)^[7] said the occlusal plane should coincide with Camper's line (superior border of the tragus). On the other hand, F. Rostamkhani, A. Sahafian and H. Kermani (2005)^[8] conducted a cephalometric study and concluded that the inferior border of the tragus can be suggested as the posterior point for ala-tragus line orientation. Various authors like J. E. Scott (1952)^[9] described an instrument "the bite plane leveler, Nikzad S. Javid (1974)^[10] suggested the use of "J-plane", Kazanoglu & John W. Unger (1992)^[11] described "Camper's plane indicator" and Urbano, Santana-Penin & Maria J. Mora (1998)^[12] described a U-shaped device for analyzing the level of ala-tragus line. In 1993, Vincent Kokich^[13] said for good esthetics the occlusal plane should be parallel to interpupillary plane while Jeff Morley and Jimmy Eubank (2001)^[14] said the creation of an incisal plane perpendicular to the facial midline produces a reliable and repeatable position that does not depend on the interpupillary line.

Jack Piermatti (2006)^[15] said the occlusal plane should terminate at the upper level of the retromolar pad while Arthur O. Rahn and Charles M. Heartwell (1986)^[7] said posterior height should not exceed half the height of the retromolar pad. On the other hand, K. Shigli, B.R. Chetal and J. Jabade (2005)^[16] found the lower one-third of the retromolar pad consistent with the mandibular occlusal plane while Robert L. Engelmeier (1996)^[17] said in the sagittal view the occlusal plane is determined by the incisal edges of maxillary central incisors and the approximate juncture of the upper and middle thirds of the retromolar pad.

K. Shigli, B.R. Chetal and J. Jabade (2005)^[16] found that the mean value of all readings of buccinator groove was 0.94 mm below the mandibular occlusal plane and is a reliable intraoral landmark for occlusal plane determination.

It is evident that the various concepts reported in literature allow variation in the location of occlusal plane. Hence a need was felt to evaluate the relationship between the occlusal plane, extraoral and intraoral landmarks.

Aims and Objectives

To assess relationships between intraoral and, extraoral soft tissue landmarks, *Viz.* Retroretromolar pad, buccinator groove, ala-tragus line and interpupillary line, with occlusal plane

To determine consistency of soft tissue landmarks with occlusal plane in both sexes and check for any variation

To evaluate the significance of soft tissue landmarks in establishing lost occlusal plane

MATERIAL AND METHODS

Selection Criteria

The study was conducted on 100 dentulous subjects (50 males and 50 females)

- Age group = 17 - 21 yrs
- No history of
- orthodontic treatment
- facial trauma or surgery causing asymmetry of the eyes
- no gingival or periodontal conditions or therapy that would undermine a healthy tooth-to-tissue relationship.
- All healthy permanent teeth were present in normal arch form and alignment with
- no interdental spacing or crowding present.
- teeth were not grossly abraded or attrited
- no gross dental restorations that might alter the plane
- no evidence of gingival alteration or dental irregularities
- Absence of any apparent defect, deformity or asymmetry of the face

Instruments Used

1. Occlusal Plane Analyzer [Figure 1]

This instrument was custom made to check for parallelism of ala-tragus line to the occlusal plane and occlusal plane to interpupillary line.

A FOX PLANE (Dr. Frank Fox (Dentsply /York division, York, PA) was taken. Four long screws were attached at the four ends of occlusal plane relator arm, care was taken to place these screws parallel to each other. Three metal plates (two in oblique direction and one in horizontal) were then attached to these screws. Two plates (oblique) were made parallel to the occlusal plane relator arm. It served to analyze the parallelism of occlusal plane with ala-tragus line. The third plate (horizontal) was parallel to the frontal connecting arm which could relate the occlusal plane to interpupillary line. A mark was made on both the sides of all the plates. The corresponding mark, which was in a straight line to the mark on the plate, was placed on the

arms of the fox plane. These marks helped determine parallelism of the plates by measuring the distance between the plates.

A metal key was also provided with the instrument to open the metal collars and help move the plates up and down.

2. Digital Vernier Callipers:

Digital Vernier calipers, with an accuracy of .001mm, were used to check the distance between the two arrowheads on two parallel plates.

3. Buccinator Groove Relator: [Figure 2]

It was custom made to compare the level of the buccinator groove (linea alba buccalis) with the occlusal plane. A vertical impression plate with rounded ends was attached on either side of the bite fork. The ends of these plates were rounded to avoid any possible injury to the soft tissues. Small holes were made on the vertical plates to help for the retention of the impression material.

4. Level Analyzer: [Figure 3]

An u-shaped plate was made to check the level of buccinator groove with the occlusal plane on the impression taken. While fabricating, care was taken to make sure both the prongs of the U were at the same level and parallel to each other.

5. Metallic Scale:

A thin 6" stainless steel scale was used to relate the occlusal plane to the retromolar pad.

Procedure

STEP - 1: Parallelism of Occlusal Plane to Campers Line:

Subjects are seated in an upright position on a dental chair so that they looked forward at the horizon. Using a surgical marking pencil, three points are marked on the tragus of the subject according to its location i.e. superior, middle and inferior. The occlusal plane analyzer is placed in the subject's mouth and held in position by the subject biting over it. The plate is raised until it coincided with ala of the nose. [Figure 4]

The distance between the arrowheads on the two plates is then measured using the digital vernier calipers. Same distance between the two plates on both sides indicated parallel opening. [Figure 5]

The posterior end is then checked whether to see if it coincided with the superior, middle or inferior point of the tragus. The procedure was repeated for both the sides.

STEP - 2: Parallelism of Occlusal Plane to Interpupillary Line:

The parallelism of occlusal plane with interpupillary line is checked using the same instrument. With the subject seated in the upright position, the occlusal plane analyzer is placed in the subject's mouth and held in position by the subject biting over it. The frontal metal plate is then made parallel to the interpupillary line. Finally, the parallelism is checked with the frontal connecting arm of the fox plane, by measuring the distance between the two plates using digital vernier calipers. Same distance between both the ends indicated parallelism. [Figure 5]

STEP - 3: Level of Occlusal Plane with Linea Alba Buccalis

For the buccinator groove, the buccinator groove relator and level analyzer are used. An irreversible hydrocolloid impression material (alginate - Zelgan 2002.Dentsply) is used to make the impression of the buccinator groove. An indelible pencil is used to mark the groove in the subject's mouth [Figure 6]. For the impression, alginate material is placed on the vertical impression plates. It is made certain that the distal aspects of the buccal vestibules on both sides are filled. The subject is then asked to pucker his/her lips as in sucking with the lips slightly separated, but without the loss of contact of teeth with the bite plate. This helps transfer the mark to the impression. The impression is then removed from the mouth, washed with water and excess trimmed.

The level analyzer is then used to check for the level of the groove in relation to the occlusal plane. One of the prongs of the plate is kept on the top side of the bite plate (depicting maxillary occlusal plane) such that the second prong extends on the other side of the vertical plate, carrying the vestibular impression [Figure 7]. The coincidence/non-coincidence of the groove to the occlusal plane is then noted. Similar procedure is followed for the other side also.

STEP - 4: Relationship of Occlusal Plane with Retromolar Pad

Using a surgical marking pencil, the retromolar pad area of the subject is divided into three equal zones. The stainless steel scale is then slid posteriorly over the cusps of the mandibular posterior teeth ensuring its contact with the tip of the cuspid on one side of the mandibular arch to make contact with the retromolar pad. The zone of contact i.e. the superior one-third, middle one-third or the junction of superior or middle one-third of the retromolar pad, is then recorded [Figure 8]. The process is repeated on the other side of the arch.

Statistical analysis was carried out using: CHI - SQUARE TEST. The level of significance adopted was 5%.

RESULTS

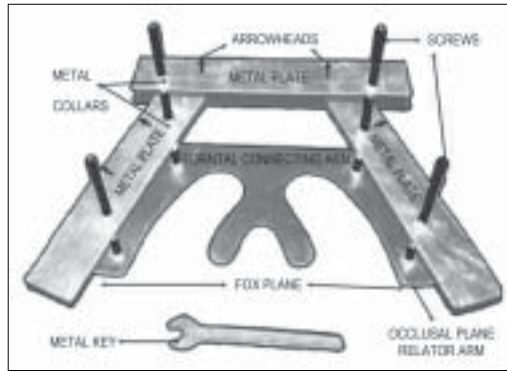


Figure 1: Occlusal plane analyzer

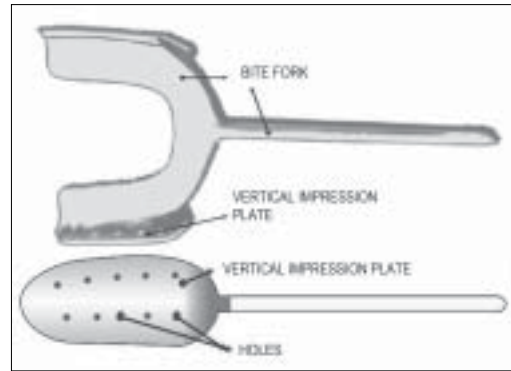


Figure 2: Buccinator groove relator



Figure 3: Level Analyzer



Figure 4: Parallelism of Occlusal Plane to Camper's Line



Figure 5: Checking Difference with Digital Vernier Calipers



Figure 6: Level of Occlusal Plane with Linea Alba Buccalis



Figure 7: Checking level of Linea Alba Buccalis using Level analyzer



Figure 8: Relationship of occlusal plane with retromolar pad

Occlusal Plane and Camper's Line

The occlusal plane analyzer was used [Table 1]; a variation of posterior reference point of Camper's line in males and females was also observed. It was seen that 72% of males had middle point as posterior reference point while 80% of females had superior point as the posterior reference point showing parallelism to the occlusal plane

Occlusal Plane and Interpupillary Line

The same instrument was used to analyze parallelism of the occlusal plane with the interpupillary line. Despite various claims only 13% subjects showed occlusal plane parallel to the interpupillary line. Not much difference was observed between the two sexes [Table 2], 92% of males and 82% of females showed canting

Occlusal Plane and Buccinator Groove

The buccinator groove relator was used to relate the occlusal plane with the level of buccinator groove. The level analyzer was used to analyze the level; 70% males and 66% females have the groove at the same level of the occlusal plane. So the buccinator groove can be used as a reliable [Table 3] landmark for orientation of occlusal plane.

Occlusal Plane and Retromolar Pad

A metallic scale was passed along the cusp tip from cuspid to mandibular II / III molar and extended posteriorly to check for the relationship between occlusal plane and retromolar pad. Insignificant difference between the males and females was observed as 76% of males and 78% of females with occlusal plane at the level of the middle third of the retromolar pad area [Table 4].

Comparing the right and left side

Variation of occlusal plane relationship with the ala-tragus plane, buccinator groove and retromolar pad area was observed on the right and left side. The retromolar pad area showed maximum number of variations followed by buccinator groove; least in relating the ala-tragus line to occlusal plane. This indicates that ala-tragus plane is a reliable [Table 5] landmark for orienting the occlusal plane. Intraorally, buccinator groove is the best available landmark.

DISCUSSION

The orientation of the occlusal plane lost in patients rendered edentulous should be relocated if complete dentures are to be esthetic and function satisfactorily. The orientation of the occlusal plane forms the basis for teeth arrangement conducive to satisfactory esthetics and proper function.

Table 1: Parallelism of occlusal plane with camper's line

Camper's Line (Ala of T=the nose to)	Males (%)	Females (%)	Total (%)
Superior point of tragus	24	80	52
Middle point of tragus	72	20	46
Inferior point of tragus	4	0	2

Table 2: Parallelism of occlusal plane with Inter-pupillary line

Inter-Pupillary Line	Males (%)	Females (%)	Total (%)
Parallel to occlusal plane	8	18	13
Not parallel to occlusal plane	92	82	87

Table 3: Relationship between level of buccinator groove and occlusal plane

Buccinator groove (At the level)	Males (%)	Females (%)	Total (%)
same as that of the occlusal plane	70	66	68
Superior to the occlusal plane	30	32	31
Inferior to the occlusal plane	0	2	1

Table 4: Relationship between occlusal plane and retromolar pad area

Retro-molar pad (Occlusal plane at the level of)	Males (%)	Females (%)	Total (%)
Superior 1/3 rd	8	8	8
Middle 1/3 rd	76	78	77
Junction of superior and middle 1/3 rd	16	14	15

Table 5: Variation of occlusal plane relationship with ala-tragus plane, buccinator groove and retromolar pad area as observed on right and left side

	Males (%)	Females (%)	Total (%)
Camper's line	20	28	24
Buccinator groove	32	26	29
Retromolar pad	30	38	34

Anteriorly, occlusal plane mainly helps in achieving esthetics and phonetics while posteriorly, it forms a milling surface. Thus, incorrect record of the occlusal plane would hamper esthetics, phonetics, and mastication. It may also affect the stability of a complete denture and ultimately result in alveolar bone resorption.

Functionally, inclination of the occlusal plane is one of the key factors governing occlusal balance. Movement of the mouth during chewing shows a harmonious relationship between the tongue, the mandibular posterior teeth, and the buccinator muscle; incorrect location of occlusal plane, results in malfunctions.

Thus it can be said that for the success of complete denture prosthesis, arranging the teeth in correct plane

of occlusion is pivotal. Changes in the plane of occlusion modify the physical and functional relationship of the oral musculature leading to an alteration in function, comfort and also the esthetic value. Considering the importance of the accurate establishment of the location and the effect of the inclination of the established occlusal plane on function, esthetics and speech, a method to conform it to the occlusal plane that existed in the natural teeth seems necessary. Hence, this study was conducted to examine the significance of various soft tissue landmarks as a guide to establish the original occlusal plane as was present in the patient's natural dentition and determine the consistency of soft tissue landmarks with the occlusal plane in both sexes and check for any variation.

SUMMARY AND CONCLUSIONS

On the basis of the results obtained, the following conclusions can be drawn:

In maximum number of subjects, the occlusal plane was found parallel to Camper's plane with the anterior reference point as the ala of the nose and posterior reference point as the superior point of tragus.

The posterior reference point of Camper's plane showing parallelism with occlusal plane varies in males and females. In males, it is the middle point of tragus and in females the superior point of tragus.

The occlusal plane is not always parallel to the

interpupillary line. Slight canting was observed.

The buccinator groove is found to be at the level of the occlusal plane in most of the subjects; independent of sex of the subject. Hence, it can be considered the most stable intra-oral landmark for orienting the occlusal plane.

Majority of the subjects showed the occlusal plane at the level of middle third of the retromolar pad area. However, due to high percentage of variation between the right and left side it cannot be considered a reliable landmark for orienting the occlusal plane.

The results of this study indicate that no single method was accurate in determining the occlusal plane. However, using more than one of these parameters along with a judicious clinical judgment, we can be very close to the ideal occlusal plane level for an edentulous patient.

It must be constantly borne in mind that the occlusal plane is determined by the dynamics of function and not by any particular static relationship. It is also advisable that occlusal plane should be selected on the basis of anatomical landmarks, esthetics, phonation, comfort and function.

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