

*Original Research***The Effect of Aging on Anatomical Landmarks in Both Sexes and its Relation to Occlusal Plane.**

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**Abstract:**

**Objectives:** To assess the relationship between intraoral and extraoral soft tissue landmarks, viz. retromolar pad, parotid papilla, ala-tragus line and interpupillary line with occlusal plane and to determine the consistency of these soft tissue landmarks with occlusal plane in both sexes and different age groups to establish the lost occlusal plane. **Materials and Methods:** A population of 200 dentulous subjects was divided into four age groups, each having 25 male and 25 female subjects. A custom made instrument, Occlusal plane analyzer was used to determine the relationship of occlusal plane with ala tragus line and interpupillary line using Digital Vernier Calipers. A metallic scale and a divider are used to measure the level of plane in relation to retromolar pad area and parotid papillae. All the statistical analysis was done using SPSS version 14. **Results:** Occlusal plane is found parallel to superior border of tragus in 62% females and middle border of tragus in 47% males. Interpupillary line is found parallel to occlusal plane in almost 100% subjects. In females' occlusal plane is found parallel to middle part of retromolar pad in 63% cases, while in males' it is found parallel to middle part of retromolar pad in 66% cases. The average distance of parotid papillae on both right and left side in females is 2.08 mm and 2.18 mm, while in males it is 2.10 mm and 2.24 mm on right and left sides respectively. Occlusal plane level in relation to retromolar pad showed significant changes with advancing age. **Conclusion:** To determine the posterior occlusal plane superior border of the tragus in females and middle border of tragus in males should be taken as guide line. Interpupillary line to determine anterior occlusal plane and parotid papillae to determine posterior occlusal plane can be used as landmark in both males and females and all age groups. Retromolar pad should not be taken as guide as it was not a consistent finding.

**Key words:** Occlusal Plane; Camper's Plane; Interpupillary Line; Occlusal Plane Analyser.

**Introduction:**

According to Glossary of Prosthodontic Terms (2005)<sup>1</sup> occlusal plane is "the average plane established by the incisal and occlusal surfaces of the teeth". It is not a plane but represents the planar mean of the curvatures of these surfaces. In complete denture construction, prosthodontist is responsible for restoring the natural esthetics of the patient and for developing an occlusion that is compatible with functional movements of the stomatognathic system and is one of the key factors in determining the prognosis of the treatment. In complete denture, the occlusal plane has variety of effects on cusp angle, treatment of occlusal disturbances, masticatory closing path and movements of the mandible, esthetics, phonetics and stability' therefore should be located in the same position in which it existed in natural dentition.<sup>2</sup>

Functionally, the inclination of the occlusal plane is one of the key factors governing occlusal balance and phonation. Esthetically, anterior occlusal plane takes on a fundamental rule to provide adequate support to upper lips by maintaining the philtrum and nasolabial grooves and ensures proper contact of upper and lower lip at the vermilion border.<sup>3</sup>

If occlusal plane is placed too high, tongue cannot rest on the lingual cusp of mandibular denture and prevent displacement. There is also a tendency for accumulation of food in buccal and lingual sulci. On the other hand if the occlusal plane is too low, it will lead to tongue and cheek bite. Ear lobes were introduced by Khalaf<sup>4</sup>, as an alternative landmark to guide in the orientation of occlusal plane as an alternative to interpupillary line. Supraorbital line may be used as a substitute for interpupillary line.

Numerous planes like Frankfort horizontal plane, Camper's plane, Palatal line, Occlusal line, Mandibular line, Interpupillary line, Hamular notch incisive papilla (H.I.P) etc. have been proposed by several authors to help define the level of occlusal plane. Many intraoral landmarks like commissures of the mouth, Incisive papilla, Parotid papilla<sup>5</sup>, Upper lip line<sup>6</sup>, height of retromolar pad, lateral borders of the tongue etc. have also been suggested.

Several principals have been postulated, example positioning of the occlusal plane on the line with the buccinators groove was recommended by Merkeley et al., and Shigli K et al,<sup>7</sup>(2005) found that mean value of buccinators groove was 0.94 mm below occlusal plane. Orientation of occlusal plane on the same level as the lateral border of tongue was also found as a consistent finding.

Boucher defined Camper's line as an imaginary line that runs from the inferior border of the ala of the nose to the superior border of the tragus of the ear. In some surveys occlusal plane was found parallel to line drawn from ala of nose to midpoint of tragus while in some inferior border of tragus was suggested as posterior point of Camper's line orientation.

The location of occlusal plane in complete denture fabrication is very variable and subjective, depending upon the uncertainty of reference landmarks and individual judgment. Therefore, reliability of various reference landmarks as a clinical guideline for establishing occlusal plane needs to be tested.<sup>8</sup> With ageing, tooth surface loss and attrition can be seen in male and female patients that lead to continued eruption of teeth and change in occlusal plane level. Therefore, need was felt to evaluate and find relationship between occlusal plane changes and ageing in the different age groups of dentulous male and female population.<sup>9</sup>

## Materials and Methods

A custom made device occlusal plane analyzer (Figure 1) was used together with other

instruments like Digital Vernier Calipers (Figure 2), metallic scale, surgical marking pencil, diagnostic instruments.

**Occlusal plane analyzer** (Figure 1): Occlusal plane analyzer was custom-made using a Fox Plane (Dr. Frank Fox Dentsply/York division, York, PA) and four long screws 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 occlusal plane relator arm. It serves 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 metal key was also provided with the instrument. A metallic scale or vernier calipers can be used to check the distance between the two arrowheads on two parallel plates.



Fig 1: Occlusal plane analyser and metal key



Fig 2: Digital vernier caliper

**Sample size:** The sample size decided comprised of 200 dentulous subjects, having 25 male and 25 female subjects in each age group. The four age groups selected are as following: Group 1:- 17-21yrs, Group 2:- 22-31yrs, Group 3:- 32-41yrs and Group 4:- 42-51yrs.

**Inclusion criteria:** Subjects had no history of orthodontic treatment, any facial trauma or surgery causing asymmetry of the eyes, all healthy permanent teeth were present in normal arch form and alignment, be no gross dental restorations that may alter the plane, and no apparent defect, deformity or asymmetry of the face.

### Methodology:

**Step 1: Parallelism of occlusal plane to Camper's line** (Figure 3): Subjects were seated in an upright position on a dental chair looking forward. The occlusal plane analyzer was placed in patient's mouth and held in position by the subject biting over it. Turns were given to the metal collars of the two screws supporting the side metal plates, thus opening the plate and were raised until it coincides with ala of nose. The distance between the arrowheads on the two plates was measured using the digital vernier calipers. Same distance between the two plates on both sides indicated parallel opening. The posterior end was then checked if it coincides with superior, middle or inferior point of tragus on both the sides. The process was repeated for the other side of the subject.



*Fig 3 (a &b): Relationship of occlusal plane with ala-tragus line. (Occlusal plane is parallel to line drawn from inferior border of ala of nose to superior border of tragus on right and left sides respectively).*

**Step 2: Parallelism of occlusal plane to interpupillary line** (Figure 4): This was checked using the similar above mentioned posture of patient and instrument. The frontal metal plate was made parallel to interpupillary line. Finally the parallelism with frontal connecting arm of the fox plane is checked, by measuring the distance between the two plates using digital vernier calipers. Same distance between both indicates parallelism.



*Fig 4: Relationship of occlusal plane with interpupillary line.*

**Step 3: Relationship of occlusal plane with Retromolar pad** (Figure 5): Using a surgical marking pencil, retromolar pad area of the subject was divided into three equal zones. The stainless steel scale is 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 recorded. The process was repeated for the other side of the arch.



Fig 5: Relationship of occlusal plane with retromolar pad.



Fig 6: Relationship of occlusal plane with parotid papilla.

**Step 4: Relationship of occlusal plane with Parotid papilla** (Figure 6): Relation of parotid papilla was determined by making the subject sit upright, lightly retracting the cheeks with mouth of the subject half open. The molar cusp coinciding with the papilla is recorded and the distance from it was measured using divider and vernier calipers. The procedure

was done for both right and left sides of the subject.

**Results:**

All the analysis was done using SPSS version 14. A p-value of <0.05 was considered statistically significant. Comparison of landmarks was done using Chi-square test between male and females and with different age groups. Distance of parotid papilla was compared using independent sample t test.

In females occlusal plane was found parallel to inferior border of tragus in 10% cases, middle border of tragus in 28% cases, and superior border of tragus in 62% cases. In males occlusal plane was parallel to inferior border of tragus in 18% cases, to middle border of tragus in 47% cases, and superior border of tragus in 35% cases. This shows that in females superior border coincides most while in males middle border of tragus (Table 1). Interpupillary line was found parallel to occlusal plane in almost 100% subjects and could be taken as a consistent landmark (Table 2).

Table 1: Incidence (%) of male and female having superior, middle and inferior border of tragus as a landmark parallel to occlusal plane.

		Sex				p-value
		Female		Male		
		N	%	N	%	
OP_CL	I	10	10%	18	18%	<0.001; Sig
	M	28	28%	47	47%	
	S	62	62%	35	35%	

Chi square test

Table 2: Incidence of parallelism with interpupillary line.

		Sex				p-value
		Female		Male		
		N	%	N	%	
OP_IP	N	0	0.0%	2	2%	0.497; NS
	Y	100	100%	98	98%	

Chi square test

In females occlusal plane was found parallel to middle part of retromolar pad in 63% cases, while to superior part in 37% cases. In males it was found parallel to middle part retromolar pad in 66% cases while to superior part in 34% cases, although the differences were not found to be significant (Table 3).

The average distance of parotid papillae on both right and left side in females was 2.08 mm and 2.18 mm, while in males it was 2.10 mm and 2.24 mm on right and left sides respectively. Relationship of parotid papilla with molars in both sexes is insignificant, neither did it show any age changes (Table 4).

Table 3: Relationship of occlusal plane with retromolar pad in all age groups.

		Age group								p-value
		1		2		3		4		
		N	%	N	%	N	%	N	%	
OP_RP	M	2	52	2	58	3	66	4	82	0.011; Sig
	S	2	48	2	42	1	34	9	18	
		6	%	9	%	3	%	1	%	
		4	%	1	%	7	%		%	

Table 4: Average distance of parotid papillae on both right and left side in both sexes.

	Sex				p-value
	Female		Male		
	Mean	SD	Mean	SD	
RIGHT	2.08	0.62	2.10	0.61	0.818; NS
LEFT	2.18	0.62	2.24	0.62	0.533; NS

Independent sample t test

Occlusal plane level in relation to retromolar pad showed significant changes with advancing age (Table 3). The level showed a shift from superior to middle half of the pad area. The probable cause for the same are assumed to be age changes in teeth anatomy, like attrition, erosion, abfraction, supraeruption etc.

**Discussion:**

One of the chief aims 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. Tremendous interest in this area and lack of complete knowledge, has initiated numerous concepts. Anteriorly, occlusal plane mainly helps in achieving esthetics and phonetics while posteriorly, it forms a milling surface. Thus, incorrect record of the occlusal plane will hamper esthetics, phonetics, and mastication. It may also affect the stability of the complete denture and ultimately result in alveolar bone resorption. Functionally, inclination of occlusal plane is one of the key factors governing occlusal balance. Thus it could be said that arranging teeth in correct plane is pivotal.<sup>9</sup>

According to GPT-8, Ala-tragus line is 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. The occlusal plane is at an angle of approximately 10 degrees relative to the Frankfort horizontal plane, when viewed in the mid-sagittal plane. Although ala-tragus line is the most commonly used and only extraoral landmark used to establish posterior occlusal plane, still remains controversial because of the disagreement on the exact position of reference of tragus. Posterior occlusal plane is analyzed in dentulous subjects using occlusal plane analyzer. The distance between the arrowheads on the two plates is measured using the digital Vernier calipers. Same distance between the two plates on both sides will indicate parallel opening. The posterior end is then checked if it coincides with superior, middle or inferior point of tragus on both the sides.<sup>10</sup>

It is found that in females posterior plane is more frequently parallel to superior border of tragus (62%), followed by middle and inferior border. While in males it is more frequently parallel to middle border (47%) followed by superior and inferior border respectively. The results are statistically significant, hence the

study concludes that tragus border (superior, middle, inferior) to be taken into consideration differs in sexes. No universal point can be taken for all the edentulous patients for determining the posterior occlusal plane. No significant age changes were appreciated.<sup>11</sup>

In the present study, few subjects showed occlusal plane parallel to line running from ala of nose to a point 10-15 mm above superior border of tragus. This observation may be assumed to be anatomical variation. It is not statistically or clinically significant therefore cannot be applied to the general population. Further studies on larger population must be conducted to know its significance,<sup>11</sup>

Parallelism of interpupillary line is taken into consideration in the study and is checked using the similar above mentioned posture of patient and instrument. Almost 100% subjects showed parallelism of anterior occlusal plane with interpupillary line, without any significant changes in different age groups. Hence, this landmark could be used universally as concluded by this study.<sup>12</sup>

The retromolar pad, also called piriformis papilla, is a mucosal elevation located in the retromolar area covering the retromolar triangle. In the posterior area, the main intraoral reference described corresponds to the retromolar pad. Although it is found out that orientation upon retromolar pad could place the occlusal plane a little too low posteriorly from the natural occlusal plane. It is seen in this study that in both the sexes middle border is found to be more consistent finding, although the differences were not found to be significant. When compared in different age groups, the incidence of occlusal plane coinciding with middle half increased (from 52%-82%) with simultaneous decreased incidence with superior border (48%-18%) and the differences are found to be significant. From these results it could be concluded that as age advances, due to attrition, abrasion and/or erosion there is lowering of the mandibular occlusal plane.<sup>13</sup>

Position of parotid papilla varies in relation to camper's line in different individuals and

varies on right and left sides in same individual. It is found that its position varied between first and second maxillary molars, from mesiobuccal to distobuccal cusps. Distance from the cusp tip also showed variations between subjects and within the right and left sides of the same subject (ranging from 1 to 4 mm). It is found more distant on left side as compared to right.<sup>14</sup>The variation of parotid papilla location in relation to occlusal plane may be attributed to anatomical factors, as it varies considerably from one person to another. In some people it may have a prominent elevation or it may be just a slight indentation. It must be realized that the accuracy of measurements is limited by the ability of the investigator to visualize the position of maxillary buccal cusps in a relaxed state of buccal mucosa. A variation of 0.5 mm is predicted. Flexibility of buccal mucosa also differs from person to person. Due to these reasons it is taken as an adjunct intraoral landmark for determining occlusal plane level.<sup>15</sup>

**Conclusion:** In this study 200 dentulous subjects of both sexes and different age groups were studied. Camper's plane showed variations in sexes. Superior border in females and middle border in males were found to be a more constant finding respectively. No age related changes could be seen within the groups. Interpupillary line was found to be parallel to occlusal plane in almost all the cases. Occlusal plane was found to be in level of middle and superior half of retromolar pad area with plane shifting toward middle half in higher age groups. Age related changes were significant in occlusal plane level intraorally. This may be attributed to occlusal surface wear (attrition), or other physiologic factors that may contribute to wear and supra-eruption of teeth with age. Parotid papilla varied from average 2-3 mm above the first and second molars, with differences on right and left sides in same individual. However, because of the variability and difficulty in the location of soft tissue landmarks, parotid papilla can only be taken as an adjunct and not an accurate determinant of the occlusal plane.

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