

A Comparative Radiographic Evaluation of Occlusal Plane in Dentulous and Edentulous Subjects: A Clinical Study

Bishnupati Singh¹, Subhash Chandra², Kumar Sourabh³, Ajoy K Shahi⁴, Swati Sharma⁵, Sandeep Kumar⁶

ABSTRACT

Aim: The aim of this study is to establish a proportion between the inferior border of mandible and lower edge of the mental foramen and inferior border of mandible to occlusal plane for dentulous subjects and to evaluate the validity of this proportion in orienting the occlusal plane for edentulous subjects.

Materials and methods: The occlusal plane was evaluated in the selected 50 dentulous and edentulous subjects for its relation to the mental foramen and inferior border of the mandible. The orthopantograms obtained were traced with the markings and the measurements were tabulated under different headings. After measuring the distances, the proportion between the distances was determined. The mean proportions of dentulous, edentulous, male, and female subjects were evaluated. Then the proportion of male subjects was compared with that of female subjects and dentulous subjects with that of edentulous subjects. Comparison of proportion between the different groups was done by using unpaired *t* test. The mean and standard deviation (SD) were determined for each group separately and were compared within each group. From the calculated “*t*” value, “*p*” the probability for error was found out.

Results: In dentulous subjects, the proportion ranged from 1:3.53 to 1:4.40. The mean was 1:3.90. In edentulous subjects, the proportion ranged from 1:3.50 to 1:4.15. The mean was 1:3.84. On comparison, the difference between both the groups was 0.06. The difference was statistically insignificant ($p = 0.14$). In the comparison of dentulous male and female subjects, the difference obtained was 0.02. The difference was statistically insignificant ($p = 0.77$). The comparison of edentulous male and female subjects and the difference obtained was 0.03. The difference was statistically insignificant ($p = 0.51$).

Conclusion: The derived proportion of 1:4 between the inferior border of mandible and mental foramen and inferior border of mandible and occlusal plane in edentulous patients as measured on an orthopantogram may yield a plane of occlusion similar to that existing in the dentulous state.

Clinical significance: The above-drawn proportion between the inferior border of the mandible to the lower edge of the mental foramen and between the inferior border of the mandible and the occlusal plane in edentulous patients may yield a plane of occlusion which is oriented similar to that existing in the dentulous state. The proportions derived radiographically in this study can serve as a basis for future studies to establish the occlusal plane for edentulous subjects.

Keywords: Dentulous, Edentulous, Inferior border of mandible, Occlusal plane.

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INTRODUCTION

Complete denture prosthodontics is the dental specialty which places a number of important factors in the control of the operator during the fabrication of complete denture prosthesis. The orientation of occlusal plane is one amongst them and is crucial in terms of function and esthetics. Many authors have observed that the orientation of the occlusal plane may affect the denture function and that it is important to determine this orientation correctly in making comfortable dentures.¹ This, therefore, also includes the plane of occlusion. Studies have shown that the occlusal plane of artificial denture should be positioned at the same level as that in the natural dentition.²

It is evident from the literature that there is lack of consensus regarding the location of the occlusal plane in complete denture construction.³⁻⁵ Wical and Swoope in 1974 conducted a study to estimate the severity of the resorption of mandible in which the mental foramen and the lower border of the mandible were used as reference points.⁶ In panoramic radiographs, the constancy of their position irrespective of the duration of edentulousness and the amount of resorption attributed to the selection of these landmarks. The study concluded by establishing a ratio of 3:1 in the distance between the inferior border of the mandible to the

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crest of the residual ridge and the distance between inferior border of mandible and the lower edge of mental foramen in dentulous subjects to assess residual ridge resorption in edentulous patients. The Camper's plane was the first effort in modern dentistry to establish occlusal plane. It was based on scientific research and was made parallel to ala-tragal plane posteriorly.^{7,8}

It is well-established in the literature that these two reference points, namely inferior border of the mandible and the lower edge of the mental foramen are fairly constant in the position and proportion to each other. It is also that these anatomic landmarks bear a constant proportion to the distances between the inferior border of the mandible and the crest of the alveolar bone. The inferences drawn from Wical and Swoope study were utilized to carry out the present study. The aim of the present study was to establish a proportion between the inferior border of mandible and lower edge of the mental foramen and inferior border of mandible to occlusal plane for dentulous subjects and to evaluate the validity of this proportion in orienting the occlusal plane for edentulous subjects.

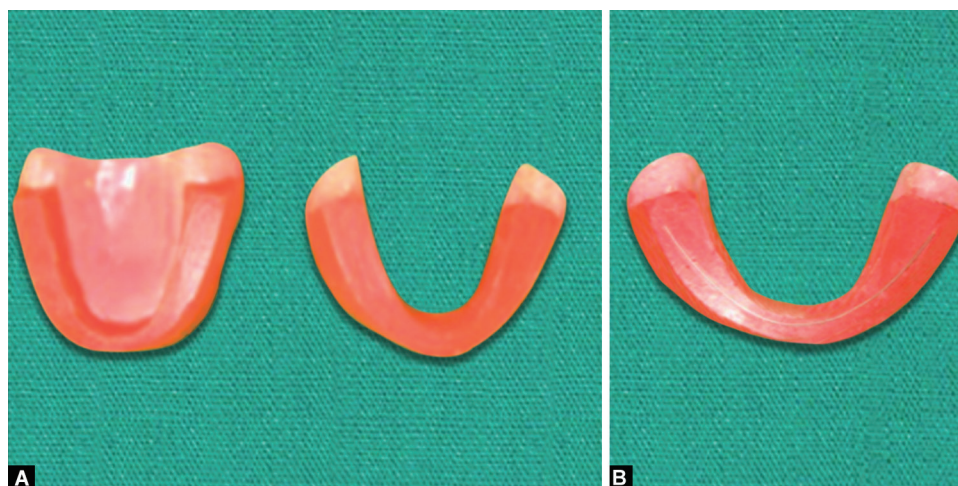
Also added to the aim were the following objectives:

- To verify radiographically the occlusal plane existing in natural dentition and establishing the proportion in the distances between the lower edge of mental foramen to the inferior border of mandible and inferior border of mandible to the occlusal plane in dentulous subjects using panoramic radiographs.
- To establish radiographically a proportion in the distances between lower edge of mental foramen to the inferior border of mandible and inferior border of mandible to the established occlusal plane in edentulous subjects using panoramic radiographs.
- To compare and correlate the proportions obtained from dentulous subjects with that obtained from edentulous subjects.

MATERIALS AND METHODS

In the present study, 50 dentulous and 50 edentulous subjects were selected from the outpatient department of Buddha Institute of Dental Sciences and Hospital, Patna, and ethical clearance for the same was obtained from the Institutional Ethical Committee. Equal numbers of male and female subjects were selected in both the dentulous and edentulous subjects. An informed consent was

obtained from the subjects regarding their participation in the study. Normal healthy, dentate subjects within the age group of 21–25 years were selected for the study. Mandibular premolars and first molars were present and mandibular molars were in angle's class I relationship. Although the occlusion in all subjects did not conform to the textbook ideal, all were considered acceptable. Normal healthy, completely edentulous patients within the age group of 50–70 years were selected for the study. Subjects did not have any systemic or debilitating disease and had acceptable neuromuscular control. Subjects did not have any temporomandibular joint disorders. Maxillary and mandibular final impressions were made and master casts were obtained in dental stone. Maxillary and mandibular occlusal rims were fabricated on the adapted temporary denture bases (Fig. 1A). With the completed upper occlusal rim placed in the patient's mouth, the physiologic rest position was determined. The lower occlusal rim was adjusted so that the amount of freeway space was 2–3 mm. The parallelism of the anterior occlusal plane with interpupillary line and posterior occlusal plane with the ala tragal line (ATL) was verified using fox plane (Fig. 2). The same procedure was followed for all the edentulous subjects included in this study. After the occlusal plane was established, a 23-gauge stainless steel (SS) wire was shaped to the form of lower occlusal rim. The wire was accurately adapted on the occlusal plane of the lower occlusal rim and was stabilized by the addition of a thin layer of wax (Fig. 1B). Due to the radiopacity of the SS wire, the occlusal plane could be easily demarcated and traced in the panoramic radiographs (Fig. 4B). The method followed in this study to obtain the panoramic radiographs for dentulous and edentulous subjects was based on the method followed by Wical and Swoope in their study. The radiographs were obtained following the user manual and instructions (Fig. 3). In dentulous subjects, the lower occlusal plane was considered at the cusp tip of the mandibular second premolar (Fig. 4A). The second premolar was selected as reference tooth based on the findings of a study conducted for the size, orientation, and positional relationship to the mandibular second premolar by Phillips et al. and the buccal cusp tip was chosen as a reference point to facilitate vertical linear measurements with maximum accuracy as suggested by Xie et al.^{9,10} The method of tracing the panoramic radiograph to outline the selected reference points and to obtain the distances between the selected reference points included in this study was based on the method followed by Wical and Swoope in their study.⁶ With the help of the "X-Ray Viewer," the three reorientation marks



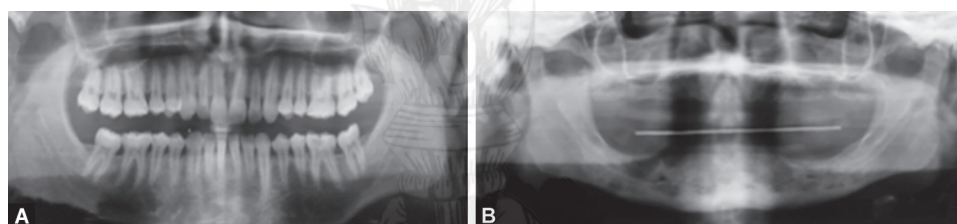
Figs 1A and B: (A) Fabricated occlusal rims for establishing the occlusal plane; (B) Stainless steel wire attached to the lower occlusal rim



Figs 2A to C: Maxillary occlusal plane checked for anterior visibility, labial fullness, and parallelism to the ala-tragus line and interpupillary line



Figs 3A and B: Obtaining panoramic radiograph of the edentulous and dentulous subjects



Figs 4A and B: Panoramic radiograph of the dentulous and edentulous subjects

and the main landmarks, namely the mandibular canal, the mental foramen, the inferior border of the mandible, and the occlusal plane depicted by the cusp tip of the mandibular second premolar were outlined on both right and left sides of the acetate paper using a HB-tipped pencil. Thus, the tracing of the dentulous panoramic radiograph was completed in this manner (Fig. 5). The same procedure for tracing the panoramic radiographs was followed for all of the selected 50 dentulous subjects. With the help of the "X-Ray Viewer," the three reorientation marks and the main landmarks, namely the mandibular canal, the mental foramen, the inferior border of the mandible, and the occlusal plane depicted by the Konark S.S. Dental wire were outlined on both right and left sides of the acetate paper using a HB-tipped pencil. Thus, the tracing of the edentulous panoramic radiograph was completed in this manner (Fig. 6).

The same procedure for tracing the panoramic radiographs was followed for all of the selected 50 edentulous subjects. The measurements of the reference points outlined in this study were done in accordance with the criteria followed by Wical and Swoope, Yosue and Brooks, and Guler et al. in their respective studies.^{6,11,12}

After obtaining the tracings of the panoramic radiographs of selected dentulous subjects included in this study on the acetate paper, the selected reference points were marked using HB-tipped pencil in the following manner:

- Point A: point on the inferior border of the mandible in line with the mental foramen.

- Point B: point on the lower edge of the mental foramen.
- Point C: point on the occlusal plane (cusp tip of the mandibular second premolar) in line with the mental foramen.
- The selected reference points, namely A, B, and C were joined by a straight line on the acetate paper to aid in the linear measurement of distances between the reference points. All measurements were in mm. The same procedure for outlining and measuring the distances between the reference points was followed on the right as well as on the left side of the panoramic radiographs. The above-mentioned procedure for the measurement of distances between the reference points was followed for all of the selected 50 dentulous subjects.

Procedure for Edentulous Subjects

- Point C': point on the occlusal plane (as depicted by the Konark SS wire attached to the mandibular occlusal rim) in line with the mental foramen. A' and B' represent similar points as in dentulous subjects. The above-mentioned procedure for the measurement of distances between the reference points was followed for all of the selected 50 edentulous subjects. The acetate paper with the outlined reference points of all the selected subjects (50 dentulous and 50 edentulous) were subjected to mathematical interpretation to arrive at a proportion between the reference points. The distances between AB, AC, A'B', and A'C' were

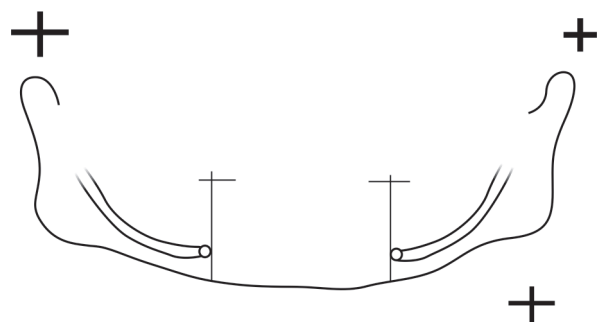


Fig. 5: Tracing of the dentulous panoramic radiograph

measured on both right and left sides of the selected dentulous and edentulous subjects. The right and left values were taken as average for all the measurements in one subject. The proportion for the distances between AB and AC was obtained. Similarly, the proportioning for the distances between A'B' and A'C' was obtained. Both the obtained proportions were compared. The same procedure was followed for all the 50 dentulous and 50 edentulous subjects selected for this study. The results obtained from this study were tabulated under various headings for statistical analysis and interpretation. To facilitate inter- and intragroup comparisons, necessary subdivisions were made.

Data analysis was done using SPSS v20. Descriptive statistical tests were performed. The comparison of mean proportion between dentulous and edentulous, and male and female subjects was done using independent sample *t* test. *p* value less than 0.05 was considered statistically significant.

RESULTS

An equal number of male and female subjects were selected in the dentulous and edentulous categories to investigate any sexual variation in the proportions obtained. The following results were drawn from the study, which compared the proportion in the distances between lower edge of mental foramen to the inferior border of the mandible and inferior border of mandible to the occlusal plane in dentulous and edentulous subjects. To avoid interexaminer error, only one investigator was responsible for performing all the measurements for all the subjects. After measuring the distances, the proportion between the distances was determined. The mean proportions of dentulous, edentulous, male, and female subjects were evaluated. Then the proportion of male subjects was compared with that of female subjects and dentulous subjects with that of edentulous subjects. Comparison of proportion between the different groups was done by using unpaired *t* test. The mean and SD were determined for each group separately and were compared within each group.

X_1 —mean proportion of one (dentulous /male/female) group.

X_2 —mean proportion of another (edentulous/male/female) group,

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\text{Std. error of difference (SE)}}$$

$$SE = \frac{SD}{\sqrt{n}}$$

From the calculated “*t*” value, “*p*”—probability for error was found out.

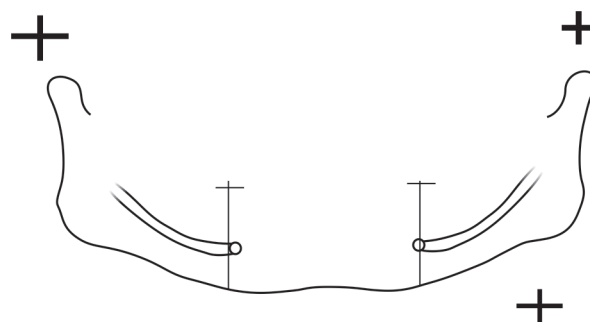


Fig. 6: Tracing of the edentulous panoramic radiograph

Table 1 shows the comparison of 50 dentulous and 50 edentulous subjects. In dentulous subjects, the proportion ranged from 1:3.53 to 1:4.40. The mean was 1:3.90. In edentulous subjects, the proportion ranged from 1:3.50 to 1:4.15. The mean was 1:3.84. On comparison, the difference between both the groups was 0.06. The difference was statistically insignificant ($p = 0.14$). Graphical representation of the same by bar chart is shown by Figure 7.

Table 2 shows the comparison of 25 dentulous and 25 edentulous male subjects. In dentulous male subjects, the proportion ranged from 1:3.53 to 1:4.40. The mean was 1:3.89. In edentulous male subjects, the proportion ranged from 1:3.50 to 1:4.15. The mean was 1:3.84. On comparison, the difference between both the groups was 0.05. The difference was statistically insignificant ($p = 0.24$). It also shows the comparison of 25 dentulous and 25 edentulous female subjects. In dentulous female subjects, the proportion ranged from 1:3.58 to 1:4.40. The mean was 1:3.91. In edentulous female subjects, the proportion ranged from 1:3.55 to 1:4.10. The mean was 1:3.87. On comparison, the difference between both the groups was 0.04. The difference was statistically insignificant ($p = 0.36$).

Table 3 shows the comparison of dentulous male and female subjects. There was no significant difference obtained in the comparison of mean proportion between male and female in both dentulous and edentulous subjects. (p value > 0.05).

Figure 8 shows the mean proportion between dentulous and edentulous with sex differentiation by the bar chart and the mean difference was statistically insignificant.

Figure 9 shows mean proportion between male and female subjects within dentulous and edentulous subjects by the bar chart and the mean difference was statistically insignificant.

DISCUSSION

Most prosthodontic textbooks advise that artificial teeth be placed in the positions previously occupied by the natural teeth.¹³ When natural teeth are to be replaced by artificial teeth, it is logical to arrange the artificial teeth in a position as close as possible to the one previously occupied.¹⁴ Although the mandibular plane may also be independent of the existence of the dentoalveolar structures, the mobile nature of the mandible renders the orientation of the mandibular plane infinitely variable in relation to craniofacial skeletal landmarks.¹⁵⁻¹⁷ Biting force during maximum clenching was observed to be the greatest when the occlusal plane was made parallel to the ala-tragus line and decreased when the occlusal plane was inclined about 5° anteriorly or about 5° posteriorly.¹ The use of preextraction records to achieve the plane of occlusion in edentulous patients has been advocated for many years, with many

Table 1: Comparison of the mean proportion between dentulous and edentulous subjects

Group	Number	Proportion				Significance of difference		
		Range	Mean	SD	SE	Difference	t value	p value
Dentulous	50	3.53–4.40	3.90	0.17	0.02	0.06	1.50	0.14
Edentulous	50	3.50–4.15	3.84	0.18	0.03			NS

SD, standard deviation; SE, standard error of difference; t value, unpaired t test; $p < 0.05$, S (significant); $p > 0.05$, NS (nonsignificant)

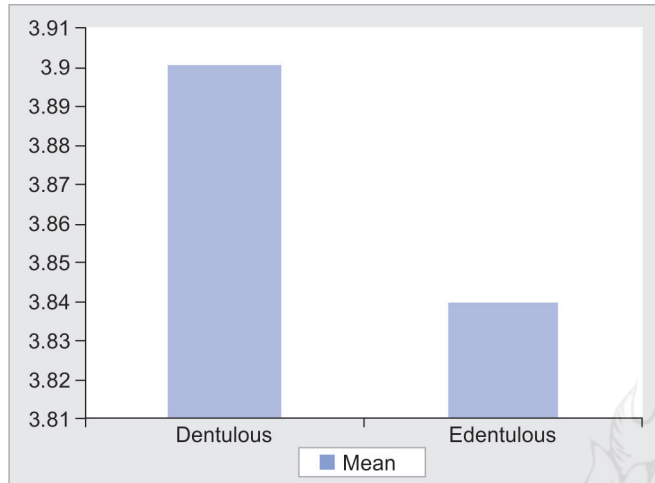


Fig. 7: Comparison of the mean proportion between dentulous and edentulous subjects (without sex differentiation)

methods proposed for making them. Among these methods are special gauges (e.g., Sorenson, Willis, and Dakometer), cardboard or wire profiles, measurements from photographs, measurement of the interfrenal distance, measurement of the closest speaking space, and use of a gauge-oriented on the palate to reproduce tooth position.^{18–24} In the absence of previous records, investigators have suggested various concepts or methods for the orientation of the occlusal plane based on morphologic studies on natural and artificial dentitions and also on clinical judgment.^{3,25,26} Out of all the proposed extraoral methods for orientation of the occlusal plane in edentulous patients, ATL continues to be the most widely used and well-documented guide for occlusal plane orientation.²⁷ Further, the several tragal references recommended in the literature are not always definable or recognizable.²⁸

Clapp in 1910 was the first to relate Camper's line/plane to occlusal plane.²⁹ These are the superior border, middle or tip, and the inferior margin or border of the tragus.^{19,21,30–34} It is not known whether these observations are personal preferences or those based on investigations; however, between the seven tragal references selected to orient ala-tragus plane to occlusal plane, parallelism was seen when the tragal reference was between superior border and the middle of the tragus (41.5%).³⁵ Spratley describes it as running from the center of the ala to the center of the tragus, whereas Ismail and Bowman define it as a line that passes from the ala of the nose to the center of the tragus of the external auditory meatus.^{3,4} Therefore, its validity as a reference point has been questioned.²⁸ It is also necessary to ascertain that the selected reference points are not affected by degenerative processes or surgical interference and could readily be identified on the face.³⁶ The profuse hair growth in tragus also renders it cumbersome to identify and mark the various tragal landmarks.³⁷

The use of cephalometrics in prosthodontics has been advocated for some time and its introduction into prosthetic treatment planning has become evident, and attempts have been made to establish cephalometric norms.¹⁵ Panoramic radiography is commonly used in large institutional practices as the sole method of screening edentulous and dentate patients.³⁸ Many reports have concluded that the radiographic screening of all edentulous patients is indicated because of the considerable percentage of positive radiographic findings.^{26,30,39–45} A slight misalignment of the head does not significantly affect the vertical measurements in the mandible or of the posterior maxilla if the reference lines are in the same vertical plane as the teeth.¹⁰ Tal and Moses compared the accuracy of panoramic radiography and computed tomography (CT) in the evaluation of depth of the mandible at recipient implant sites.⁴⁶

In light of the above, the present study was undertaken to investigate the role of panoramic radiography in assessing, evaluating, and comparing the occlusal plane in a selected group of dentulous and edentulous subjects of Indian origin. The lower edge of the mental foramen and the inferior border of the mandible were chosen as reference points for both test groups since it is known to remain constant in spite of increasing age or resorption of the alveolar process above the foramen.^{47–50} The bone below the foramen constitutes a predictable proportion of the total bone height in the majority of normal subjects and has been shown not to be significantly affected by resorption until extreme atrophy occurs, and its height might serve as the basis for estimating the original mandibular height in edentulous subjects.⁶ Clinically the lower edge of the mental foramen appears to be a more useful reference mark in panoramic radiographs.⁶

It has been stated that the most common location of the mental foramen was inferior to the crown of the second premolar and approximately 60% of the distance from the buccal cusp tip of that tooth to the inferior border of the mandible.⁹ And also in the natural dentition, the lower occlusal plane runs from the incisal edges of the lower anterior teeth through the tips of the cusps of the posterior teeth to a point approximately two-thirds of the height of the retromolar pad.⁵¹ According to Xie et al., vertical measurements should only be made using reference points and lines that are located anatomically directly above or below the point being measured, in the plane as the center of the image layer.¹⁰ Based on the above recommendations in the present study, the lower occlusal plane was considered at or closer to the lower second premolar in the dentulous subjects depending upon the location of the mental foramen.

Comparative studies on dry skulls have shown a close correlation with the radiographic location of the mental foramina.^{9,52–55} Guler et al. in a study on variation in the vertical height measurements in the edentulous maxilla and mandible had used proportions derived from dentulous subjects to arrive at the measurement

Table 2: Comparison of the mean proportion between dentulous and edentulous male and female subjects

Group	Number	Proportion				Significance of difference		
		Range	Mean	SD	SE	Difference	t value	p value
Dentulous	25	3.53–4.40	3.89	0.16	0.03	0.05	1.18	0.24
Edentulous	25	3.50–4.15	3.84	0.14	0.04			NS
Dentulous	25	3.58–4.40	3.91	0.18	0.04	0.04	0.91	0.36
Edentulous	25	3.55–4.10	3.87	0.14	0.03			NS

Table 3: Comparison of the mean proportion between dentulous and edentulous male and female subjects

Group	Number	Proportion				Significance of difference		
		Range	Mean	SD	SE	Difference	t value	p value
Male	25	3.53–4.40	3.89	0.14	0.03	0.02	0.30	0.77
Female	25	3.58–4.40	3.91	0.18	0.04			NS
Male	25	3.50–4.15	3.84	0.19	0.04	0.03	0.67	0.51
Female	25	3.55–4.10	3.87	0.14	0.03			NS

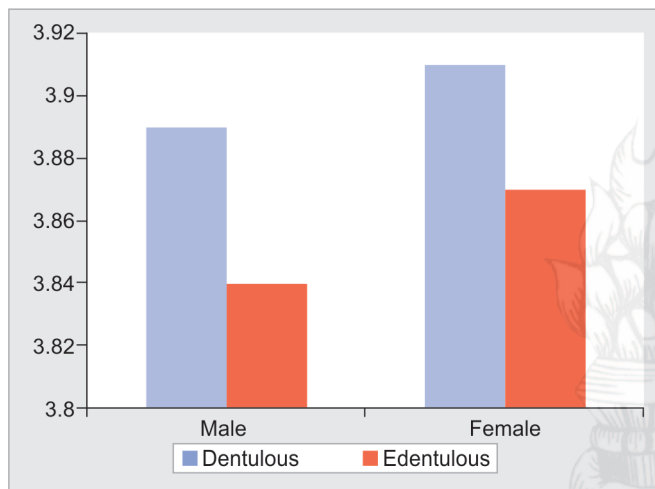


Fig. 8: Comparison of the mean proportion between dentulous and edentulous subjects (with sex differentiation)

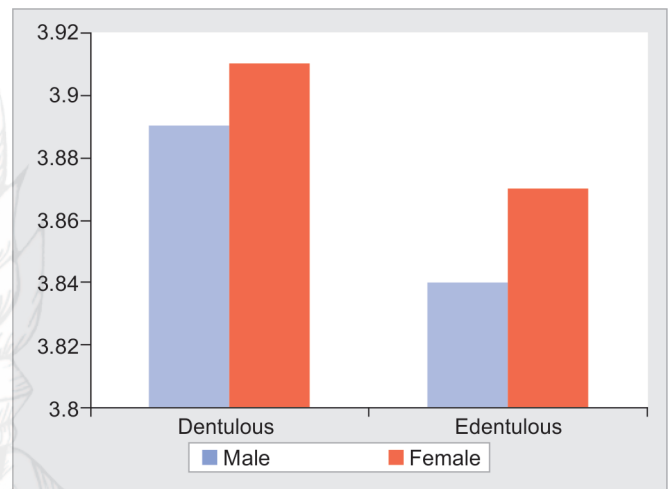


Fig. 9: Comparison of the mean proportion between male and female subjects within dentulous and edentulous subjects

sites in edentulous subjects using panoramic radiographs.¹² The measurements of various anatomic landmarks from the crest of the ridge were calculated, e.g., at the molar and premolar sites. To derive at the location of molar and premolar sites in edentulous patients, they used the proportions of the horizontal distances of these sites from the midline of dentulous patients. The authors were of the view that the measurement sites in the edentulous mandible could be determined with these proportions obtained from the dentate patients' radiograph, while the same panoramic machine was used in both groups, and no obvious distortion was observed in the images of the maxillas and mandibles.¹² They also stated that magnification factor was not necessary to correct the radiographic heights, because all radiographs were taken with the same panoramic apparatus.

On the basis of the above, present study used proportions derived separately for dentulous and edentulous subjects from their respective panoramic radiographs and were later correlated and comparisons were drawn. Hence, the obtained proportion between the inferior border of the mandible to the lower edge of the mental foramen and between the inferior border of the mandible to the dentulous occlusal plane can be convincingly used to predict the height of the occlusal plane in edentulous patients from the inferior border of the mandible, if a similar proportion existed for the edentulous subjects also.

The present study was an attempt to establish a proportion in the distances between the inferior border of mandible to lower edge of mental foramen (AB) and inferior border of mandible to occlusal plane (AC). These distances for dentulous and for edentulous subjects were determined by measuring them on traced panoramic radiographs.

A similar study was conducted by Wical and Swoope to establish a proportion in the distance between the total height of the mandible and the height of the lower edge of the mental foramen and upper edge of mental foramen to the inferior border of mandible.⁶ Similarly, in the present study using the inferior border of mandible, mental foramen, and occlusal plane as references, a proportion was established between the inferior border of mandible to the lower edge of the mental foramen and inferior border of mandible to the occlusal plane in dentulous and edentulous subjects. The mean proportion for dentulous subjects was 1:3.90. The overall mean proportion for edentulous subjects was 1:3.84. The mean proportions for male dentulous and male edentulous subjects were 1:3.89 and 1:3.84, respectively, which was statistically insignificant. The mean proportions for female dentulous and female edentulous subjects were 1:3.91 and 1:3.87, respectively, which was again statistically insignificant. On overall comparison between the dentulous and edentulous subjects, the difference calculated was also statistically insignificant.

In the present study although the lower border of the mandible was considered as a reference point and considering that the diameter of the mental foramen as reported by Phillips was about 3.5 mm in vertical aspect, the measurements in the present study were almost within the same range as reported in the earlier study. The inferior border of the foramen was usually 11.5–16.0 mm from the inferior border of the mandible.⁹ Measurements in the present study also fell within the same range.

Wical and Swoope in their study obtained a proportion of 1:2.90; they considered it approximately as 1:3 to measure the original height of the alveolar bone. In this study, a mean proportion of 1:3.90 and 1:3.84 was obtained in dentulous and edentulous subjects. This proportion can be approximately considered as 1:4. The findings of this study showed that the lower occlusal plane in edentulous subjects was almost at the same level with that of the dentulous subjects. Thus, the ratio of 1:4 can be used to establish the level of lower occlusal plane in edentulous subjects.

Also of special mention is the fact that the predictability of implant treatment has transformed treatment methodology for edentulous patients, be it an implant-supported overdenture or implant-supported fixed prostheses. The height of the occlusal plane from the crest of the ridge can be of special help in the selection of the implant superstructure and various components involved in such treatment procedures during treatment planning.

The present study had its own limitations and there is always a scope for future enhancement. In some instances, the mental foramen is not distinctly visible on the panoramic radiographs. Various reasons have been cited for its conspicuous absence in the literature; some amongst them include superimposition of tooth buds in mixed dentition radiographs, inability to distinguish from the trabecular pattern in complete dentition radiographs, thin mandibular bone in edentulous radiographs, and overly dark radiographs.⁵⁵

CONCLUSION

The following conclusions were drawn from the present clinical study, which evaluated and compared radiographically the proportion in the distances between the inferior border of the mandible to the lower edge of mental foramen and inferior border of mandible to the occlusal plane in dentulous and edentulous subjects:

- A proportion of 1:4 was established for the distances between the inferior border of the mandible to the lower edge of mental foramen and the inferior border of the mandible to the occlusal plane for all the 50 dentulous subjects included in this study.
- A similar proportion of 1:4 was established for the distances between the inferior border of mandible to the lower edge of the mental foramen and the inferior border of the mandible to the occlusal plane for all the 50 edentulous subjects included in this study.
- The mandibular occlusal plane derived for edentulous subjects yielded a plane of occlusion similar to that of dentulous subjects in this study.
- The derived proportion of 1:4 between the inferior border of mandible and mental foramen and inferior border of mandible and occlusal plane in edentulous patients as measured on an orthopantomogram may yield a plane of occlusion similar to that existing in the dentulous state.

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