

A Comparative Study of Mandibular Incisor Relation to the Lingual Frenum in Natural Dentition and in Complete Denture Wearers

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Abstract The determination of the occlusal vertical dimension and proper positioning of the anterior teeth are major factors in making complete dentures which will give optimum service. In this study, efforts were made to evaluate the reliability of measurement of vertical distance between the anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors in natural dentition among different age groups and in complete denture wearers. Three hundred dentulous subjects belonging to different age groups and hundred edentulous patients wearing complete dentures were selected. The dentulous group was divided into three groups, group I (20–40 years), group II (41–60 years), group III (61 years and above) and the edentulous subjects being group IV (40–60 years). Mandibular irreversible hydrocolloid impression (Alginate) was made using modified stock tray. In edentulous subjects impression was made with denture in position. The vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors was measured on the dentulous casts and casts of complete denture wearer using dental surveyor and the vernier calipers. The values were tabulated and statistically analysed. The mean vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors among dentulous subjects was 12.3 mm and among

complete denture wearers was found to be 13.2 mm. There was no significant variation in the mean vertical distance among dentulous subjects belonging to different age groups. At 5 % significance level, statistically there was a significant difference in the mean vertical distance between group I and group IV; group II and group IV.

Keywords Mandibular incisor relation · Lingual frenum · Natural dentition · Complete denture wearers

Introduction

The mouth is considered to be one of the focal points of the face, the smile plays a major role in how we perceive ourselves, as well as in the impressions we make on the people around us. The loss of teeth and their supporting structures primarily affects the lower third of the face and thus produces changes in facial appearance and expressions. The restoration of natural and pleasing lip support is one of the prime requisites of an esthetic denture. According to Frush and Fisher [1], pleasing lip support for edentulous patients is achieved by the correct placement of the anterior teeth and their matrix, with the burden being placed on the central incisors. Pound [2] states that to achieve a natural look, nature should be imitated by placing the artificial teeth in the same position as occupied by the natural teeth. Hence, the knowledge of natural tooth position would be valuable as a starting point in establishing anterior tooth position for every complete denture patient [3]. Placing teeth in these positions enhances phonetics, denture stability, and physiologic support for the lips, tongue and cheeks.

In the maxilla, incisive papilla is considered as a stable anatomical landmark and can be used for anteroposterior

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and vertical positioning of maxillary central incisors. Cade [4] showed that mandibular anterior teeth are displayed to a greater extent than the maxillary anterior teeth in various facial expressions. But most literature related to positioning of artificial anterior teeth emphasize more on the positions of maxillary teeth and little information is available regarding the positions of mandibular anterior teeth. In the mandibular arch labial and lingual frenum can be considered as stable anatomical anterior landmarks. Among these two landmarks, the lingual frenum seems to be more stable and can be accurately recorded. The lingual frenum is a thin sheet of tissue that attaches the centre of the ventral surface of the tongue to the floor of the mouth (Fig. 1). It is located lingual to the central incisors, in the midline, which is quite prominent and can be accurately recorded during function. In the edentulous condition, it attaches to the lingual aspect of the lower ridge in the midline (Fig. 2). This anatomical landmark can be used for proper positioning of lower anterior teeth in their original position and to establish the level of lower occlusal plane in complete denture patients.

Hence, this study was designed to evaluate the vertical distance between the anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors in natural dentition among different age groups and in complete denture wearers and its reliability in vertical positioning of mandibular anterior teeth in complete denture patients.

Materials and Methods

The present study was carried out in the Department of Prosthodontics at Government Dental College, Bangalore. The study involved edentulous subjects and complete denture wearers.



Fig. 1 Lingual frenum in dentulous individual

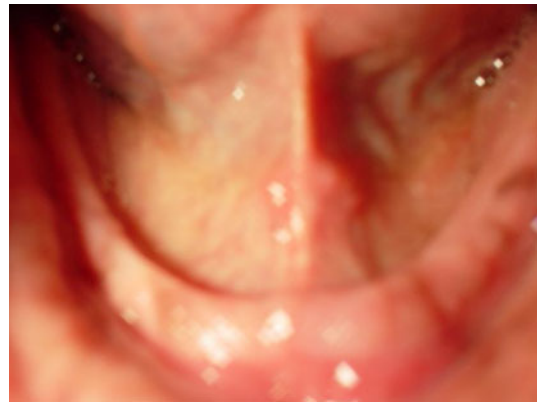


Fig. 2 Lingual frenum in edentulous individual

Dentulous Subjects

Depending upon the age, the dentulous subjects were divided into three groups. Each group consisted of hundred subjects,

- Group-I: 20–40 years of age
- Group-II: 41–60 years of age
- Group-III: 61 years and above

The Dentulous subjects were selected based on the following criteria:

- (a) Subjects with full complement of natural teeth (third molar is not taken into consideration).
- (b) Subjects with Angle's class I molar relation.
- (c) Upper and lower anterior teeth should be intact without any partial/full crowns.
- (d) Straight profile on visual examination.
- (e) No history of previous orthodontic/surgical treatment.
- (f) Good periodontal health.
- (g) Subjects without ankyloglossia.
- (h) Subjects without any parafunctional habits.
- (i) Subjects without supraerupted and mesially/distally inclined mandibular incisors.

Edentulous Subjects (Complete Denture Wearers)

Group IV consisted of 100 complete denture wearers aged between 40 and 60 years.

The Edentulous subjects were selected based on the following criteria:

- (a) Subjects should be successful complete denture wearer.
- (b) Denture should not be more than a year old.
- (c) Denture border extension should be adequate.
- (d) Subjects with class I ridge relation.

(e) Denture fabrication should be satisfactory regarding teeth arrangement and vertical dimension.

Materials

Following materials were used in the study:

- (1) Mandibular perforated dentulous metal stock tray
- (2) Irreversible hydrocolloid impression material (Alginate)
- (3) Dental surveyor (Jelenko surveyor)
- (4) Vernier calipers
- (5) Carbon marker
- (6) Cast paralleling device

Method

Following method was employed to measure vertical distance between the anterosuperior most point of the lingual frenum and mesioincisal edges of mandibular central incisors.

Mandibular cast was made for each subject. Autoclaved perforated mandibular stock tray covering all anatomical landmarks including second molar was selected. The tray was adjusted so that the lingual flanges of the tray was approximately 2–3 mm short of the movable tissues in the floor of the mouth. Over-extended lingual flanges were corrected by trimming using a metal trimmer (Fig. 3). In cases with short flange, it was corrected using impression compound (Fig. 4).

An irreversible hydrocolloid impression of mandibular arch was made using selected stock tray. During impression making the patient was instructed to elevate the tongue and moisten the upper lip with the tip of the tongue. The



Fig. 3 Over-extended lingual flange corrected by trimming using metal trimmer



Fig. 4 Short lingual flange corrected using impression compound

loaded impression tray was held in the mouth by placing the index and middle fingers in molar and second premolar regions bilaterally with the thumb below the chin to prevent movement of the tray during impression procedure. After the impression material was set, it was withdrawn with sudden jerk and examined for any irregularities. Subsequently, impression was thoroughly washed and disinfected (Figs. 5, 6). The cast was made by pouring the impression with the type III dental stone. All the casts were trimmed and base was poured using base former. In complete denture wearer impressions were made with dentures in position following the same procedure.

Measuring Method

Point markings were made on the dentulous cast by using sharp carbon marker tip, one in the mesioincisal angle of central incisors, second point was marked on the antero-superior most point on the lingual frenum (Figs. 7, 8). The casts were then attached on the cast holder of the dental



Fig. 5 Impression of dentulous subject

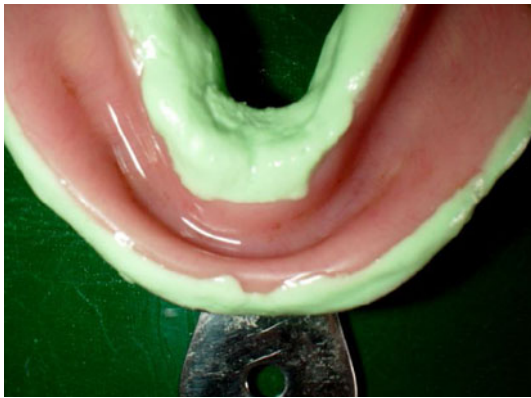


Fig. 6 Impression of edentulous subject with complete denture



Fig. 8 Pencil markings on the edentulous cast

surveyor. Subsequently the occlusal plane was made parallel to horizontal plane. To achieve this horizontal relationship, a device consisting of flat acrylic plate with central metal rod attached to its centre at 90° was employed (Fig. 9). When the central metal rod is fixed to the surveying arm of the surveyor, the acrylic plate will be parallel to the base of the surveyor. Once the cast is attached on the cast holder of the dental surveyor, the acrylic device fixed to the surveying arm was lowered to establish contact with the teeth (Fig. 10). The cast holder was tilted until the teeth established the contact with the acrylic plate in at least three widely divergent points one anteriorly and two posteriorly on both the sides. This ensures that measurements were made when the occlusal plane of the cast was parallel to the base of the surveyor.



Fig. 9 Cast paralleling device

Once the cast is firmly attached in this position, the acrylic device was replaced with the analyzing rod. The surveying arm with analyzing rod was lowered until the tip of the analyzing rod made contact with the mark on the anterosuperior most point on the lingual frenum (Fig. 11). A horizontal mark was made with a microtip pen on the vertical arm of the surveyor where it meets the horizontal

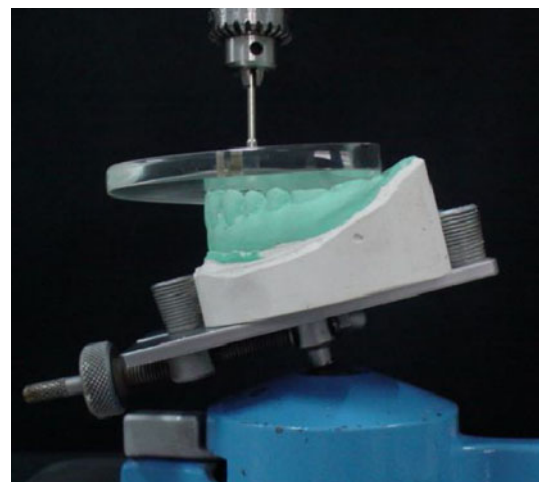


Fig. 10 Cast paralleling device used to orient the cast on the surveyor



Fig. 7 Pencil markings on the dentulous cast

arm (Fig. 13). Similarly, a second horizontal mark was made on the vertical arm of the surveyor where it meets the horizontal arm, when the tip of the analyzing rod is made to contact the mark on the mesioincisal edges of central incisors (Fig. 12). The distance between two horizontal marks on the vertical arm of the surveyor was measured

using vernier calipers (Fig. 14). The distance represents the vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors.

Same method was employed to measure the vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors in complete denture wearers. All the values were tabulated and statistically analyzed.

Results

The summary of the study is shown in (Table 1).

Among the dentulous groups, the variance is more in group III (age >61) when compared with the other groups. In relation to dentulous, the edentulous group has more variance.

The variance among the females in dentulous as well as edentulous groups was more compared to males.

In the two tailed test, at 5 % significance level, statistically there is no significant difference between the averages of groups I and II; groups I and III; groups II and III; groups III and IV (Table 2).

At 5 % significance level, statistically there is significant difference between the averages of groups I and IV; groups II and IV (Table 2).

At 5 % significance level, statistically there was no significant difference between the males and females within the groups (Table 3).

Discussion

Placing the artificial teeth so as to convey the most natural appearance may be regarded as an expression of the artistic



Fig. 11 Analyzing rod contacting the anterosuperior most point on the lingual frenum



Fig. 12 Analyzing rod contacting the mesioincisal edges of the central incisors

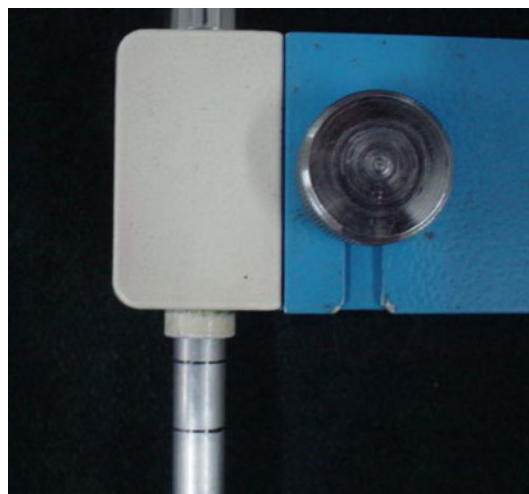


Fig. 13 Markings on the vertical arm of the surveyor

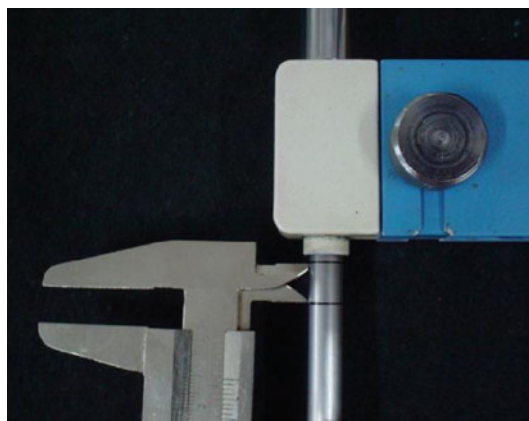


Fig. 14 Vernier callipers used measure the vertical distance

talent of the dentist. Nature's method of tooth placement and contour of tissues results in more esthetic appearance, more comfort and satisfaction to the patient [5]. The need

Table 1 Summary statistics

Subjects	Age group	Sex	Observations	Mean (mm)	SD	Min	Max	Coefficient of variation (%)
Dentulous	20–40 years	Female	44	11.9	1.6	9.1	15.6	14
		Male	56	12.3	1.5	8.4	15.9	12
	20–40 years total		100	12.1	1.6	8.4	15.9	13
	41–60 years	Female	43	12.1	2.0	8.5	16.8	17
		Male	57	12.5	1.5	9.1	15.9	12
	41–60 years total		100	12.4	1.7	8.5	16.8	14
61 years above	Female	44	12.4	1.7	9.2	16.9	14	
		Male	56	12.8	2.0	9.1	16.9	15
	61 years above total		100	12.6	1.9	9.1	16.9	15
Dentulous total			300	12.4	1.8	8.4	16.9	14
Edentulous	61 years above	Female	48	13.3	2.2	9.1	19.8	17
		Male	52	13.3	1.7	9.1	17.4	13
	61 years above total		100	13.3	2.0	9.1	19.8	15
Edentulous total			100	13.3	2.0	9.1	19.8	15

Table 2 Z-test between groups

Groups compared	P value	Test result
Group I and group II	0.329686938	Insignificant
Group I and group III	0.397388999	Insignificant
Group I and group IV	0.000000	Significant
Group II and group III	0.277946372	Insignificant
Group II and group IV	0.000371252	Significant
Group III and group IV	0.143446022	Insignificant

P < 0.05 significant; *P* > 0.05 Insignificant

Table 3 Z-test within Group (between genders)

Groups compared	P value	Test result
Group I	0.223598995	Insignificant
Group II	0.31437518	Insignificant
Group III	0.186026921	Insignificant
Group IV	0.964576919	Insignificant

to secure natural tooth position has been stated by Pound [8]. Boucher [9] has also stated, “The only correct position of a tooth is the one in which it was placed by nature”.

Many prosthodontists insist that artificial anterior teeth should be placed in position similar to those occupied by natural teeth. The surface anatomy of the oral tissues affords clues that helps to locate the proper position of the anterior teeth on the denture base [5]. Prosthodontists have long sought to find a constant anthropometric measurement within the face. He is confronted with an infinite variation of facial patterns and biometric measurements. However, there is no universally acceptable accurate method because

of wide variation in the physical characteristics of individual.

Most literatures related to the positioning of anterior teeth emphasize more on the positioning of maxillary anterior teeth [7]. Little information is available regarding the positions of mandibular anterior teeth and it is inadequately dealt with in the literature. Some authors apparently, feel that lower natural teeth are not readily visible and they play a minor role in denture esthetics.

However, Payne [10] and Silverman [11] showed that during phonation, people usually display more of the mandibular anterior teeth than the maxillary anterior teeth.

Cade [4], showed that mandibular anterior teeth do play an important role in patients appearance. The mandibular anterior teeth were displayed to a greater extent than the maxillary anterior teeth in various facial expression. An increase in the visibility of the mandibular anterior teeth was found in persons 40 years of age or older. Men displayed mandibular anterior teeth in facial expressions to a greater extent than women.

Heartwell and Rahn [6] have contended that the visibility of mandibular teeth increases with age. Increased visibility can result from loss of muscle tone which can allow the lower lip to sag and the upper lip to droop.

Referring to the above literatures, the mandibular anterior teeth do play a important role in esthetics of complete denture.

In the maxilla, the incisive papilla is considered as a stable anatomic landmark and can be used to determine the vertical dimension and proper positioning of maxillary anterior teeth. In the mandibular arch, labial and lingual frenum can be considered as stable anatomical landmarks.

As compared to labial frenum, the lingual frenum is more significant due to its prominent location in the midline, lingual to the mandibular central incisors and its unaltered position even after the extraction of lower anterior teeth. The lingual frenum is quite prominent during function and can be accurately recorded. Keeping in view the above points the lingual frenum can be considered as a stable reference landmark in an edentulous patient. This landmark can be employed to orient the incisal plane of lower central incisors and determine the lost occlusal vertical dimension.

The results of the study, indicated that, there was no statistical significant difference in the mean vertical distance between the anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors among dentulous subjects irrespective of sex and age. This suggests that there was no anatomic variation in the attachment of lingual frenum in males and females.

Statistical analysis showed, that statistically there was no significant difference in the mean vertical distance between the dentulous subjects belonging to different age groups. But statistically there was a significant difference in the mean vertical distance between group I and group IV; group II and group IV.

This suggests that mandibular anterior teeth of dentures were being set at higher level than in the natural dentition. The difference in the mean vertical distance between complete denture wearers and dentulous subjects was about 0.9 mm.

The study indicated that the distance between the anterosuperior most point on the lingual frenum and the mesioincisal edges of mandibular central incisors can be used as a reliable landmark when frenum is recorded during function. This distance can be measured on a pre-extraction dentulous casts as a record for determining the original vertical position of the mandibular central incisors. However, if pre-extraction record is not available, the average vertical distance of 12.3 mm can be used to establish the level of lower occlusal plane and arrangement of mandibular anterior teeth in the edentulous patients.

In this study, the following limitations are observed. While selecting the sample for the complete denture subjects in group IV, the variability in denture fabrication done by different operators was not considered. The subjects in this study being from a limited population, value obtained for the average vertical distance of 12.3 mm is not universally valid. Along with the average vertical distance between the anterosuperior most point on the lingual frenum and the mesioincisal edges of mandibular central incisors, other factors have to be considered while arranging the mandibular anterior teeth in complete denture.

Conclusion

Following conclusions are drawn from this study:

- (1) The lingual frenum irrespective of sex and age had a constant relation with the mesioincisal edges of mandibular central incisors. The mean vertical distance found among 20–40 years age group was 12.1 mm; 40–60 years age group was 12.4 mm and above 61 years age group was 12.6 mm.
- (2) In dentulous subjects the mean vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors was 12.3 mm.
- (3) In complete denture wearers the mean vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors was slightly higher, of about 0.9 mm which suggests that mandibular anterior teeth of artificial denture are being placed at higher level than in the natural dentition.
- (4) The vertical distance between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors is relatively stable when frenum is recorded during function. This measurement can be obtained from the dentulous cast before extraction and can be used as a pre-extraction record for determining the original vertical position of the mandibular anterior teeth.

If pre-extraction record is not available, various factors for positioning of mandibular anterior teeth in complete denture have to be considered. The average vertical distance of 12.3 mm between anterosuperior most point on the lingual frenum and mesioincisal edges of mandibular central incisors can be used to establish the level of lower occlusal plane and vertical positioning of mandibular anterior teeth in complete denture patients.

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