

Vertical Distance Between the Lingual Frenum and Incisal Edge of Mandibular Incisors: An Aid to Establish Mandibular Occlusal Plane

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ABSTRACT

Introduction: This study evaluated the reliability of measuring the distance between the anterior attachment of the lingual frenum and the incisal edges of the mandibular incisors, on casts, to be utilized as a preextraction record for determining the vertical position of the mandibular incisors in complete denture patients.

Materials and Methods: Two hundred and ten dentulous subjects within the age range of 18-25 years, exhibiting Class I dental relationships and without prior orthodontic treatment, were selected for this study. A mandibular cast was fabricated from irreversible hydrocolloid impression material in metal stock trays for each participant. All subjects were instructed to elevate their tongues during the impression-taking process. The vertical distance between the anterior attachment of the lingual frenum and the incisal edges of mandibular central incisors was measured on the casts using a digital vernier caliper. Means and standard deviations of the measurements were calculated and subjected to statistical analysis using SPSS 20.0 software.

Results: The distance between the anterior attachment of the lingual frenum and incisal edges of mandibular central incisors among the 210 subjects was $11.79\text{mm} \pm 1.36\text{ mm}$. In males it ranged from 9.11 to 14.62 mm with mean ($\pm\text{SD}$) $11.81 \pm 1.39\text{ mm}$ while in females it ranged from 9.25 to 14.36 mm with mean ($\pm\text{SD}$) $11.76 \pm 1.34\text{ mm}$.

Conclusion: The distance between the incisal edge of mandibular central incisor and the anterior attachment of lingual frenum may be used as a reliable land marks to determine occlusal vertical dimension.

Key words: Lingual frenal attachment; Mandibular incisors; Occlusal plane.

INTRODUCTION

The mouth is considered one of the focal points of the face, and it 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.¹

The restoration of natural and aesthetically pleasing lip support is a critical component of esthetic denture design. Researchers^{2,3} have emphasized the importance of placing artificial teeth in their natural anatomic position, taking into account the lips, cheeks, and tongue, in order to achieve a pleasing lip support. Therefore, possessing knowledge of the natural tooth position is a crucial initial step in determining the anterior tooth placement for the majority of complete denture patients.⁴ Accurate positioning of the anterior teeth is vital

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for the establishment of the vertical dimension, aesthetics, and phonetics, as well as incisal guidance.

The maxilla presents an incisive papilla, a dependable anatomic landmark for evaluating an edentulous patient's vertical relationship. Unfortunately, the mandible lacks a comparable stable landmark. However, the lingual frenum's anterior attachment lies midline on the lingual aspect of the mandibular central incisors, typically spanning a wider area.⁵

The study conducted by Cade⁶ revealed that the mandibular anterior teeth are more visible in various facial expressions than the maxillary anterior teeth. However, the majority of the literature concerning the placement of artificial anterior teeth focuses primarily on the positions of the maxillary teeth, with limited information available regarding the positions of the mandibular anterior teeth.

In the mandibular arch, the lingual frenum serves as a stable landmark that can be accurately recorded during function, as suggested by Majid Bissasu.⁷ This distinct fold of mucous membrane is formed beneath the undersurface of the tongue and is located lingual to the mandibular incisors in the midline, which makes it prominent and easily recordable. Consequently, the preextraction measurement from the anterior attachment of the lingual frenum (AALF) to the incisor edge of the lower incisor has been proposed as a means of establishing the occlusal plane for complete denture fabrication. This vertical distance is crucial for determining the mandibular occlusal plane and the vertical position of the mandibular incisors in complete denture patients.⁸

The objective of this research was to establish the vertical distance between the anterior attachment of the lingual frenum and the incisal edge of the mandibular central incisors in dentulous subjects. The primary goal is to

determine the average vertical distance along with the standard deviation, which can be useful in the construction of complete dentures.

METHOD AND MATERIALS

This study was conducted in the Department of Prosthodontics, School of Dental Sciences, and Chitwan Medical College. Total 210 dentulous patients of age group of 18-25 years was included in the study. Prior written informed consent was taken from all the subjects. One mandibular cast of each patient was prepared for each subject.

Subjects were selected based on the following criteria:

Inclusion criteria:

1. Presence of natural mandibular central incisors.
2. No previous history of orthodontic treatment.
3. No pathology affecting the mandibular dentition, tongue, surface texture and shape of teeth.
4. Subjects with Angle's class I molar relation.

Exclusion criteria:

1. Angle's class II and class III molar relationship.
2. Supra erupted lower incisors.
3. Fractured incisal edges.
4. Attrition of the incisal edge.
5. With any extracoronary restorations in mandibular incisors.
6. Patients with Ankyloglossia.

Materials and Tools

Following tools and materials were used in the study:

Impression Tray

Mouth Mirror

Mixing Bowl and Spatula

Cast Paralleling Device

Alginate impression materials (Zhermack Tropicalgin, Italy)

Dental Stone Type III (Kaldent, Kalabhai Karson Private Limited, Mumbai)

Dental Surveyor (Marathon Survey 103, US)

Digital Vernier Caliper (Berent digital vernier caliper 0-150 mm, BT 4059, Shanghai)

Method: Autoclaved perforated mandibular stock trays (fig. 1) covering all anatomical landmarks, including the second molar, were selected. The trays were adjusted for each patient, ensuring that the lingual flange of the tray was approximately 2-3 mm short of the movable tissues of the floor of the mouth. Overextended lingual flanges were shortened, and underextended flanges were extended with impression compound, as necessary.

An irreversible hydrocolloid impression (Zhermack Tropicalgin, Italy) of the mandibular arch was obtained using the selected stock tray. During the impression-making process, the patient was instructed to elevate the tongue and moisten the upper lip with the tip of the tongue. The loaded impression tray was stabilized in the mouth by placing the index and middle fingers in the molar and second premolar regions bilaterally, with the thumb positioned below the chin to prevent movement of the tray during the impression procedure. After the impression material had set, it was withdrawn with a sudden jerk and examined for any irregularities. Subsequently, the impression was thoroughly washed and disinfected. The cast was fabricated by pouring the impression with type III dental stone (Kaldent, Kalabhai Karson Private Limited, Mumbai). All casts were trimmed, and the base was poured using a base former.

Distance Measuring Method:

Point markings were made on the dentulous cast utilizing a sharp carbon marker. The first point was marked at the mesioincisal angle of

central incisors; the second point was marked on the anterior attachment of the lingual frenum. In cast where the mesioincisal angle of both mandibular central incisors was not at the same occlusal plane, the point marking was placed on the higher mesioincisal angle. The occlusal plane of all casts was oriented parallel to the horizontal plane using a cast paralleling device (fig. 2). For this purpose, the cast was secured on the cast holder of the dental surveyor (Marathon surveyor 103, US). The paralleling device, affixed to the surveying arm, was lowered and adjusted to establish contact with the plate at a minimum of three widely divergent points: one anteriorly and two posteriorly on both sides (fig. 3). This procedure ensures that measurements were obtained when the occlusal plane of the cast was parallel to the base of the surveyor. Once the cast was firmly secured in this position, the acrylic device was replaced with the analyzing rod. The surveying arm with the analyzing rod was lowered until the tip of the analyzing rod contacted the mark on the anterosuperior-most point on the lingual frenum (fig. 4). A horizontal mark was made with a sharp carbon marker on the vertical arm of the surveyor where it intersected the horizontal arm. Similarly, a second horizontal mark was made on the vertical arm of the surveyor where it intersected the horizontal arm when the tip of the analyzing rod contacted the mark on the mesioincisal angle of central incisors (fig.5). The distance between the two horizontal marks on the vertical arm of the surveyor was measured (fig. 6) using a Vernier caliper (Berent digital vernier caliper 0-150mm, BT 4059, Shanghai). The distance represents the vertical distance between the anterosuperior-most point on the lingual frenum and the mesioincisal edges of the mandibular central incisors. All values were tabulated and statistically analyzed using SPSS version 20.0.

RESULTS

Table 1 presents the measurements of the gap between the anterior attachment of the lingual frenum (AALF) and the mesioincisal edge of the mandibular central incisor (CI) for males, females, and the combined group. The overall AALF to CI distance for all subjects spanned from 9.11 to 14.62 mm, with an average ($\pm$ SD)

of 11.79 ± 1.36 mm. Male subjects exhibited a range of 9.11 to 14.62 mm, averaging 11.81 ± 1.39 mm, while female subjects showed a range of 9.25 to 14.36 mm, with a mean of 11.74 ± 1.34 mm. Statistical analysis revealed no significant difference in the average AALF to CI distance between genders (11.81 ± 1.39 vs. 11.76 ± 1.34 , $t = 0.229$; $p = 0.819$).

Table 1: Summarized distance between anterior attachment of lingual frenum (AALF) mesioincisal edge of mandibular central incisor (CI) of male and female subjects.

	Male	Female	Total	T-value	p-value
N	105	105	210	0.229	0.819
Minimum Distance	9.11	9.25	9.11		
Maximum Distance	14.62	14.36	14.62		
Mean	11.81	11.76	11.79		
SD	1.39	1.34	1.36		



Figure 1: Impression Tray

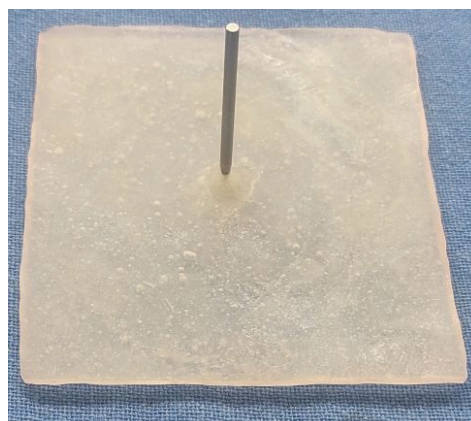


Figure 2: Cast Paralleling Device



Figure 3: Cast Mounted in the Surveyor



Figure 4: Analysing rod placed over the marking of anterior attachment of lingual frenum

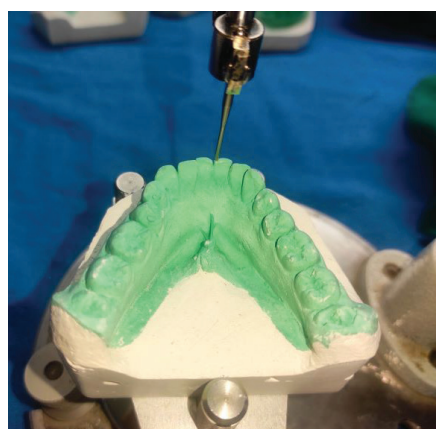


Figure 5: Analyzing rod placed over the marking at mesioincisal edge



Figure 6: Vertical distance measured between markings on vertical arm of survey

DISCUSSION

According to Frush and Fisher, achieving pleasing lip support for an edentulous patient involves the correct placement of the anterior teeth and their matrix to convey the most natural appearance, which can be regarded as an expression of the dentist's artistic talent. Boucher also holds the same viewpoint, while Payne proposed the concept of "setting the teeth where they grew."⁹

The vast majority of studies that focus on either the maxillary anterior teeth or their positioning concentrate on the anterioposterior placement of the maxillary central incisors.^{10,11} Researchers have found the incisive papilla to be a prominent and enduring feature that has been extensively studied.¹² However, there is a scarcity of information available on the positioning of mandibular anterior teeth, which has not been adequately explored thus far. According to Silverman S., during phonation, individuals typically reveal more of their mandibular anterior teeth than their maxillary anterior teeth.¹³

Vig and Brundo emphasized the significance of the maxillary and mandibular natural teeth's visibility. They posited that the mandibular arch played a more critical role than previously documented in the literature.¹⁴ Cade R. E. demonstrated that the mandibular anterior teeth significantly contribute to a patient's appearance.⁶ In various facial expressions, the mandibular anterior teeth were more conspicuous than the maxillary anterior teeth.^{6,9}

In the present study, the mandibular lingual frenum has been utilized as a landmark to assess its vertical relationship with the incisal edge of mandibular central incisors. While conclusive evidence exists for the incisive papilla as a stable landmark, no such mandibular landmark has been documented in the literature to date. A stable landmark is one that does not undergo

positional changes with the normal resorption pattern of edentulous maxillae and mandible. As the ridge resorbs, the crest approaches the ridge, whereas the frenal attachments do not undergo changes and, consequently, positional alteration. Therefore, this study proposes that due to its anatomical position and physiological function, the lingual frenum can be considered a stable landmark in the mandible.¹⁵

The armamentarium, specifically the cast paralleling device, is an occlusal plate that has been modified to function as an orientation device for casts. It is essential to orient the stone casts in a standardized manner during measurement to ensure that the results obtained can be applied when positioning artificial teeth in complete dentures. The distance measured represents the vertical distance between the anterior attachment of the lingual frenum and the mesioincisal edges of the mandibular central incisors.^{7,15} This method of measurement for calculating the distance has been employed by various researchers.^{7,15-17}

Previous research on this topic has been conducted across various ethnic groups. In a Syrian study involving 18 participants (9 males, 9 females), Bissasu⁷ found that the average distance between the mandibular central incisor's incisal margins and the lingual frenum's anterior attachment was 10.26 mm. A study in Iraq with 30 subjects (15 males, 15 females) by Rahman et al¹⁷ reported mean values of 10.7 mm for males and 10.9 mm for females. In Bangalore, India, Parimala and Prithviraj¹ examined 100 edentulous individuals and found a mean vertical distance of 12.3 mm between the lingual frenum's anterosuperior point and the mandibular central incisors' mesioincisal margins. Shah et al¹⁸ in a study of 318 participants, observed mean distances of 15.91 mm for males and 12.19 mm for females between the lingual frenum's anterior attachment and the mandibular central incisor's

incisal edge.

The current study, involving 210 participants, revealed mean distances ($\pm$ SD) of 11.81 ± 1.39 mm for males and 11.76 ± 1.34 mm for females between the lingual frenum's anterior attachment and the mandibular central incisors. As all subjects exhibited Angle's Class I molar relation, these findings are particularly relevant for edentulous patients with class I ridge relationships. The study's results indicate that the distance from the lingual frenum to the incisal edge varies across different populations, suggesting that ethnicity plays a role in this measurement.

CONCLUSION

This study demonstrated that the distance between the AALF and the mesio-incisal edges of mandibular central incisors can serve as a reliable landmark when the frenum is recorded during function. The overall range for vertical distance between the anterior attachment of the lingual frenum and mesio-incisal edge of mandibular central incisor was slightly more in males than in females.

These values will assist dental practitioners in assessing the conformation and position of artificial mandibular central incisors. Further research is necessary to determine the correct natural vertical position of mandibular anterior teeth during the arrangement of artificial teeth for complete denture fabrication.

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