

## “EVALUATE THE LINEAR RELATION BETWEEN ANTEROSUPERIOR MOST POINT ON THE LINGUAL FRENUM AND MANDIBULAR INTERCANINE LINE – AN EX-VIVO STUDY”

### Prosthodontics

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### ABSTRACT

**AIM:** To evaluate the linear relationship between lingual frenum to the cusp tip of mandibular intercanine line.

#### METHODOLOGY:

A total of 188 subjects of age between 18 to 25 years were selected randomly from the outpatient department as well as dental and medical undergraduates including 83 males and 105 females. One mandibular cast was prepared for each subject. Subjects were selected based on the inclusion and exclusion criteria. The linear distance between center point of the intercanine line and anterosuperior point on the lingual frenum was measured using travelling microscope

**RESULT:** On statistical analysis, it was found that there is a negative linear relation with Pearson correlation value as -0.049 that means the strength of association was medium.

**CONCLUSION:** Within the limits of this study, the following conclusion was drawn:

The distance between the most anterosuperior point on the lingual frenum and the antero-posterior positioning of the mandibular canines can be used as a reliable landmark when the frenum was recorded during function. But, as this study had its own limitations further studies are recommended.

### KEYWORDS

Linear Relation, Lingual Frenum, Mandibular Intercanine Line, Anterior Teeth Arrangement

#### INTRODUCTION:

Esthetics is a primary concern for patients seeking prosthodontic treatment. The restoration of natural and pleasing lip support is one of the prime requisites of an aesthetic denture. Researches states that to achieve a natural look, nature should be imitated by placing the artificial teeth in same position as occupied by the natural teeth.<sup>1,2</sup>

Knowledge of natural tooth position is a valuable starting point in establishing anterior tooth position for most of the complete denture patients.<sup>3</sup> Proper positioning of the anterior teeth is essential in determining the vertical dimension, aesthetics and phonetics and last but not least incisal guidance.<sup>4</sup> Some studies have shown that mandibular anterior teeth are displayed to a greater extent than the maxillary teeth in various facial expressions as person ages. But most literature related to positioning of artificial anterior teeth, emphasizes more on the position of maxillary teeth and little information is only available regarding positioning of mandibular anterior teeth.<sup>4,5</sup>

The incisive papilla is often used as an anatomic landmark in positioning of maxillary anterior central incisors, although shape of the papilla shows wide range of variation, the putative Centre of the papilla is commonly used as a point of reference. The horizontal relationship between the maxillary central incisors and position of incisive papilla is relatively constant.<sup>6,7,8,9</sup>

The anatomic landmark can be used for proper positioning of mandibular anterior teeth in their original position and to establish the level of lower occlusal plane in complete denture patients. The value aided in establishing the vertical dimension easier by making a pre-determined height of mandibular occlusal rim.<sup>4,1</sup>

In mandibular arch, lingual frenum seems to be a stable landmark which can be accurately recorded in function as proposed by Masjid Bissas.<sup>2,4</sup> It is showed that mandibular anterior teeth are displayed to a greater extent than the maxillary anterior teeth in various facial expressions as a person ages.<sup>5</sup>

There are various studies conducted for evaluating the relation of lingual frenum and mandibular central incisor,<sup>2,4,10,11</sup> but none of the studies have been carried out to evaluate the relationship between lingual frenum and Positioning of the mandibular canine.

Hence, the purpose of this study is to evaluating the relationship between lingual frenum to the cusp tip of mandibular intercanine line.

#### METHODOLOGY:

An Ex-vivo descriptive study was carried out in the Department of Prosthodontics including Crown and Bridge, Sri Siddhartha Dental College, Tumkur, "To evaluate the linear relationship between anterosuperior most point on the lingual frenum to the cusp tip of mandibular intercanine line".

Prior to starting of the study the research proposal was put forward to ethical committee of the institution and approval was obtained.

A total of 188 subjects of age between 18 to 25 years were selected randomly from the outpatient department as well as dental and medical undergraduates including 83 males and 105 females. One mandibular cast was prepared for each subject. Subjects were selected based on the following inclusion and exclusion criteria.

#### INCLUSION CRITERIA:

- 1) Class I dental relationship
- 2) Minimum or no incisal wear of the teeth
- 3) 18-25 years of age
- 4) Good oral hygiene
- 5) Completely erupted dentition, excluding 3rd molars
- 6) Canine should be upright in position
- 7) All anterior teeth should have contact point and orderly erupted
- 8) All six teeth, canine to canine must be present

#### EXCLUSION CRITERIA:

- 1) Previous orthodontic treatment
- 2) Pathology affecting dentition
- 3) Excessive attrition
- 4) Gross malalignment
- 5) Tongue tie
- 6) Subjects with any tooth size or shape deformity
- 7) Periodontally compromised dentition such as localized or generalized periodontitis, pathologic migration
- 8) Subjects with congenital and acquired orofacial deformities

Prior to impression, written informed consent was taken from all the subjects. Autoclaved perforated mandibular stock tray covering all anatomical landmarks including second molar were selected. The tray was adjusted for each subject so that lingual flange of tray was approximately 2-3mm short of movable tissues in the floor of the mouth. An alginate irreversible hydrocolloid impression material was mixed (Tropicalgin, Zhermack) as per the manufacturer's instructions and impression of mandibular arch was made using selected stock tray. During impression making the subject was instructed to elevate the tongue and moisten the upper lip with the tip of the tongue. Tray insertion trials were performed before making impression so as to train the subjects to correctly record lingual frenum [FIGURE 1].

#### Figures and Photographs:



**Figure 1: Trial - functional movement of tongue**

The loaded impression tray was held in the mouth by placing the index and middle fingers in first molar and second premolar areas bilaterally with thumb below the chin to prevent movement of tray during impression making [FIGURE 2].

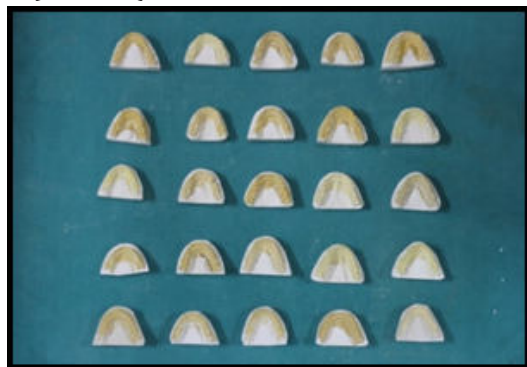


**Figure 2: Impression making**

Remove the impression with care after material was set. It was withdrawn with sudden jerk and examined for any errors.

#### PREPARATION OF CAST:

The impression was thoroughly washed and disinfected by immersing the impression in 3% sodium hypochlorite. And after disinfection, the impression was rinsed thoroughly with water to remove any remnants of the disinfectant, which may affect the surface of the cast when gypsum was poured. The cast was made by two pour techniques with Type III dental stone, and all the casts were trimmed distal to the second molar. After the material was set, cast will be recovered and base will be made with the help of a base former using Type II dental plaster [FIGURE 3].



**Figure 3: Prepared casts**

All the casts were marked M or F with an indexing label, which denotes the Male and Female.

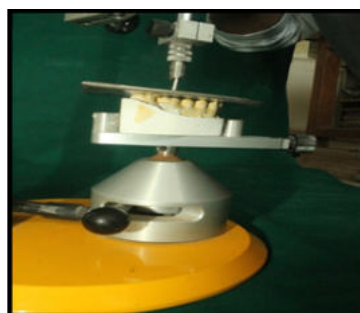
#### EVALUATION OF LINEAR DISTANCE:

Point markings were made on the dentulous cast by using sharp carbon marker tip. Points were marked on the anterosuperior most point on the lingual frenum and cusp tips of the canine teeth [FIGURE 4].



**Figure 4: Points on the anterosuperior most point on the lingual frenum and cusp tips of the canine teeth**

Then the distance between the cusp tips of right and left mandibular canine was measured by using Vernier caliper. Then the casts mounted on the cast holder of a surveyor with the occlusal plane in horizontal position. To achieve horizontal relationship, a device consisting of flat metal plate with central metal rod attached to its center at 90° was employed. When the central metal rod was fixed to the surveying arm of the surveyor, the metal plate will be parallel to the base of the surveyor. Once the cast was attached on the cast holder of the dental surveyor, a metal device fixed to the surveying arm lowered to establish contact with the teeth. The cast holder was tilted until the teeth established the contact with the metal plate in at least three widely divergent points, one anterior and two posterior 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 [FIGURE 5].



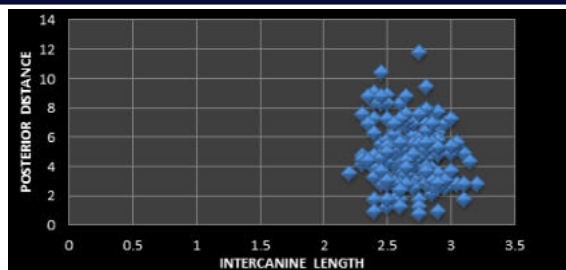
**Figure 5: Cast paralleling with custom made flat metal plate fixed to the surveyor**



**Figure 6: Intercanine line marking on cast**



**Figure 7: Linear distance measured using travelling microscope**



**Graph 1: Scattered diagram showing mean cusp tips of mandibular intercanine length and position of cusp tips of mandibular intercanine line to the anterosuperior most point on the lingual frenum:**

**Table 1: Pearson correlation showing mean cusp tips of mandibular intercanine length and position of cusp tips of mandibular intercanine line to the anterosuperior most point on the lingual frenum:**

|                     | Mean   | Standard deviation | Pearson correlation value | P value |
|---------------------|--------|--------------------|---------------------------|---------|
| Inter Canine Length | 2.6686 | 0.27774            | -0.049                    | 0.501   |
| Posterior distance  | 4.6756 | 1.96855            |                           |         |

A custom made flat edge of a ruler was attached across the dental arch from premolars to premolars with the front edge touching the cusp tips of both right and left canine.

Once the cast was firmly attached in this position, the metal device was replaced with the analyzing rod. Then analyzing rod was lowered until the tip of the analyzing rod made contact with flat edge ruler. Then, point marker was attached to the surveyor and intercanine point was marked on the dentulous cast. A line center & perpendicular to the ruler was dropped to mark center portion of the intercanine line [FIGURE 6].

The linear distance between center point of the intercanine line and anterosuperior point on the lingual frenum was measured using travelling microscope [FIGURE 7].

## RESULT:

The following methods of statistical analysis were used in the study. The data collected was entered in Microsoft Excel and statistical analysis was conducted using SPSS (Statistical package for social sciences) IBM version23.

Descriptive statistics included mean and standard deviation. Inferential statistics included Pearson's Correlation test. Pearson correlation coefficient value 'r' interpretation for linear relationship was based on d values ranged from -1 (strong negative relationship) to +1 (strong positive relationship). P value was set at 0.05 at 95% Confidence Interval.

The normality assumption was tested using Pearson Correlation test **Table 1.**

Table I & Graph I depict inter canine distance & linear relation of anterosuperior most point of the lingual frenum to the cusp tips of mandibular inter canine line. The mean inter canine distance was  $2.67 \pm 0.28$  cm. The cusp tips of mandibular intercanine line was observed to be always anterior to the anterosuperior most point of the lingual frenum but varied from 0.9 to 11.75 mm among the subjects observed. The mean distance being  $4.67 \pm 1.97$  mm.

On statistical analysis, it was found that there is a negative linear relation with Pearson correlation value as -0.049 that means the strength of association was medium.

## DISCUSSION:

For positioning of the anterior teeth on denture base in complete denture, the surface tissue affords clues that help locate the proper position of the anterior teeth. The first landmark of importance in the anterior region of the maxillary process is the incisive papilla.

Some studies suggested that a line drawn at right angles to the midline passing through the center of the incisive papilla passes through the

tips of the maxillary canines.<sup>6,7,8,12</sup> A line bisecting the incisive papilla that is perpendicular to the long axis of the cast can be used to establish the antero-posterior positions of the canines. By transcribing the position of the intercanine line on a well contoured occlusal rim, combined mesiodistal width of the six maxillary anterior teeth from midcanine can be determined. It provides both dentist and technicians with a better for location and placement of anterior teeth.<sup>6,8</sup>

Most literatures related to the positioning of anterior teeth emphasize more on the positioning of maxillary anterior teeth and little information is available regarding the positions of mandibular anterior teeth and it's 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.

In an effort to expand upon the information presently available, various researches was undertaken to explore the role played by the mandibular arch in variety of facial expressions. **Vig and Brundo** were the first group focused on the exposure of natural maxillary and mandibular teeth, which changes with aging in anterior tooth exposure. Literature suggests that the mandibular arch do play a significant role in constructing dentures, natural appearing and esthetically attractive. Not only do the data suggest a significant role of the mandibular anterior teeth, but the types of individual who are likely to display these teeth to greater extent in a variety of expressions were also noted.<sup>5</sup>

**Heartwell and Rahn** 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 upper lip to drop.<sup>13</sup> Referring to the above literatures, it was evident that the mandibular anterior teeth do play an important role in esthetics of complete denture.

In the mandibular arch, labial and lingual frenum can be considered as stable landmarks. As compared to labial frenum, the lingual frenum is a small muscle which attaches the tongue to the bone and 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.<sup>10,14,15</sup>

The tongue is that organ of the body which is constantly in use throughout life and therefore, in normal physiological conditions does not undergo disuse atrophy. As the ridge resorbs, the crests get closer to the ridge and not to the frenal attachments that undergo changes. Therefore in this study, due to its anatomical position and physiological functioning the lingual frenum was taken as a stable anatomical landmark in the mandible.<sup>4</sup>

Keeping this in mind, various studies were undertaken to establish a stable mandibular landmark to assess its vertical relationship with incisal edge of mandibular central incisors.

**Bissasu, Hanan A. Rahman et al, Parimal and Prithiviraj and Balasubramanian et al** in their studies indicate that the distance between the anterior attachment of the lingual frenum and incisal edges of the mandibular central incisors was reliable when the frenum was recorded during function. Because the position of the incisal edges of mandibular incisor was stable, the position of the anterior attachment of the lingual frenum can be considered relatively stable when the frenum was recorded during function and can be used to establish the level of lower occlusal and vertical positioning of mandibular anterior teeth in complete denture patients if no other pre-extraction records were available.<sup>2,10,11,16</sup>

There are various studies conducted for evaluating the relation of lingual frenum and mandibular central incisor,<sup>2,4,7,10,11,15</sup> but none of the studies have been carried out to evaluate the relationship between lingual frenum and mandibular canine.

Hence in the present study, lingual frenum was considered as a stable landmark to measure the liner relationship between the anterosuperior most point on the lingual frenum to the cusp tip of mandibular intercanine line.

In the present study, the last natural permanent tooth of the whole arch was second molar as it represents full eruption period.

Dentulous subjects with abnormal frenum conditions like tongue tie were not involved in the study as the anterior attachment of lingual frenum during impression making was recorded and it will be difficult for the patient to elevate the tongue and moisten the upper lip with the tip of the tongue in the tongue tie situations.

The tip of the canines was marked and flat edge of a ruler was laid across the dental arch with front edge touching the tips of mandibular canine. A line perpendicular to the ruler was dropped to mark its position in relation to the lingual frenum.

The armamentarium i.e. cast paralleling device was an occlusal plate which was modified to form an orientation device for cast. It is important to orient the stone casts in a standardized manner during measurement so that the results achieved can be applied when artificial teeth are being set in complete dentures.

The impression was taken with irreversible hydrocolloids in modified stock trays. A linear measurement between two objects in a three dimensions relationship imposes problems when the objects were not aligned on the same plane in three dimensions. To reduce this error, travelling microscope was used. The method of measurement used in this study for calculating the linear distance between the anterosuperior most point on lingual frenum and the cusp tips of mandibular canine line was in accordance with **Majid Bissasu, swati gupta et al, Rajendra et al, Philip Schiffman, Parimala and Prithviraj, Kaushik K Pandey et al**<sup>2,4,6,17,10</sup>

The result of this study revealed that, the mean inter canine distance was  $2.67 \pm 0.28$  cm and the cusp tips of mandibular intercanine line was observed to be always anterior to the anterosuperior most point on the lingual frenum. But in the present study the observations varied from 0.9 to 11.75mm among the subjects observed. This may be explained by the different factors, like tray selection, resistant of the tongue moment and/or did not strictly followed the instructions related to tongue movements during impressions for recording anterosuperior most point on lingual frenum, water powder ratio of the impression material in measuring techniques, the anatomical variations between the individuals is considerable.<sup>2</sup>

The mean distance was  $4.67 \pm 1.97$  mm & Pearson correlation showed there was a negative correlation on statistical analysis.

The mean value was 4.6947 mm in males and 4.6297 mm in females (Table & Graph III & IV). Although the mean distance was slightly less in females; there was no statistically significant difference between the genders was noted. (Graph IV)

As this study was first of its kind, there is no literature to compare the findings. This study showed that the distance between the most anterosuperior point on the lingual frenum and the antero-posterior positioning of the mandibular canines can be used as a reliable landmark when the frenum was recorded during function. But, as this study had its own limitations further studies are recommended.

The limitations of the present studies were limited sample size, improper distribution of genders. Hence, values obtained for average linear distance of  $4.67 \pm 1.97$  mm can't be universally generalized. At the same time all the observations showed the presence of cusp tips of mandibular intercanine line anterior to the anterosuperior most point on the lingual frenum can't be ruled out.

Applying the obtained values clinically in teeth arrangement and then comparing it with a conventional technique would result in better understanding of the result. The clinical relevance of this study lies in its application to complete denture construction. Instead of adhering rigidity to a rule, the dentist should use a combination of biometric guides, phonetics tests and denture space identification to reproduce the relationships established between natural teeth and the orofacial investing tissue. A dental technician, without the chance of seeing the patient, should make use of such anatomic landmarks in the construction of wax occlusal rims and during teeth selection and positioning the anterior teeth in arrangement, so that they approximate the final position of the artificial teeth. This will help reduce the clinician time of both the dentist and the patient. The dentist on receiving the wax rim and the trail should make adjustment according to the individual requirements of the patient. So, this study leaves a new path in the direction of standardizing the anterioposterior position

of the mandibular canine to the stable functional form of anterosuperior most point on the lingual frenum.

of anterosuperior most point on the lingual frenum.

## CONCLUSION:

**Within the limits of this study, the following conclusions were drawn:**

1. The mean distance between right and left cusp tip of mandibular intercanine line was  $2.67 \pm 0.28$  cm.
2. Intercanine line always passed anterior to the anterosuperior most point on the lingual frenum.
3. The cusp tip of mandibular intercanine line passed approximately 4.6756 mm Anterior to the anterosuperior most point on the lingual frenum
4. The distance between the most anterosuperior point on the lingual frenum and the antero-posterior positioning of the mandibular canines can be used as a reliable landmark when the frenum was recorded during function. But, as this study had its own limitations further studies are recommended.
5. The distance between the anterosuperior most point on the lingual frenum and the cusp tip of mandibular intercanine can be used as a pre-extraction record for determining the antero-posterior positioning of the mandibular canines.

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