

# Assessment of Mesiodistal Angulation of Maxillary Lateral Incisors: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Idealistic prosthodontic treatment goals differ for different ethnic groups around the world. Dentogenic concept provides a quality of treatment and a more natural, harmonious and pleasing prosthesis as desired by patients. Providing natural and satisfactory aesthetics is especially important for anterior tooth prosthesis. Various degrees of crown angulation, have significant effect on attractiveness of smile.

**Aim:** To study the degree of mesiodistal angulation of maxillary right and left lateral incisors in both genders of different age groups, to guide in the arrangement of teeth fulfilling the fundamentals by providing a functionally and aesthetically satisfactory denture.

**Materials and Methods:** This cross-sectional study was conducted in Department of Prosthodontics at College of Dental Sciences, Davangere, Karnataka, India, from June 2012 to May 2015. A total of 500 patients with normal maxillomandibular relationship (250 males and 250 females) were included in the study and were divided into three age groups i.e, group A (21-30 years), group B (31-40 years), group C (41-50 years). Clinical examination of

patients was performed and dental casts of these patients were studied. A custom-made positioning jig was used to measure the mesiodistal angulations of maxillary right and left lateral incisors. The results were obtained by statistical analysis using paired-t test, One-way Analysis of Variance (ANOVA) and Tukey's Post-Hoc tests.

**Results:** The mean value for mesiodistal angulation of maxillary right and left lateral incisors in males was found to be  $6.648 \pm 0.9889$  and  $6.704 \pm 1.0042$  degrees, respectively. The mean value for mesiodistal angulation of maxillary right and left lateral incisors in females, was found to be  $6.592 \pm 0.8296$  and  $6.580 \pm 0.8381$  degrees, respectively.

**Conclusion:** The mesiodistal angulation of maxillary lateral incisors was comparatively greater in males than in females and the variation in the angulation was slightly more for maxillary left lateral incisors. The values for mesiodistal angulations of maxillary lateral incisors can serve, as guidelines for the arrangement of teeth and help in achieving desired aesthetics, provide adequate lip support and restore required functions.

**Keywords:** Aesthetics, Crown, Dentogenic, Denture, Personality

## INTRODUCTION

Once the natural dentition is lost, there is need for prosthetic replacement of missing teeth that greatly improves the masticatory efficiency as well as facial aesthetics. Dental aesthetics is an important and salient factor contributing towards facial aesthetics. Anterior teeth are anatomically positioned in the aesthetics zone and are first to be seen when an individual speaks, smiles, laughs or eats. Dental aesthetics is defined as the application of the principles of aesthetics to the natural or artificial teeth and restorations [1].

Providing natural and satisfactory aesthetics is especially important for anterior tooth prosthesis. Various degrees of crown angulation have significant effect on attractiveness of smile. The term 'crown angulation' refers to angulation (or tip) of the long axis of the crown [2]. In an untreated ideal occlusion, all natural teeth are arranged at an angle to the occlusal plane and each has an optimum angulation and inclination to best perform its individual and collective functions as well as provide aesthetics [3].

Dentogenic concept put forth by Frush and Fischer in 1956, emphasises on three factors which reflect aesthetics in dentures. It provides an approach to aesthetics in prosthodontics that, enables the clinician to create a restoration in harmony with the patient's objective personality. This concept considers age, personality and sex to restore the dentition for each patient and thus, maintains patient's unique individuality that has been missing in prosthesis [4].

The present study was designed to determine the Mesio Distal (MD) angulation of maxillary Lateral Incisors (LI) as a part of the dentition, depending upon gender and age of the adult patients visiting a

dental Institution in Karnataka, in order to learn its significance in the arrangement of artificial teeth and understanding its significant contribution to dentofacial aesthetics.

## MATERIALS AND METHODS

This cross-sectional study was conducted in Department of Prosthodontics at College of Dental Sciences, Davangere, Karnataka, India, from June 2012 to May 2015. Patients with complete set of permanent dentition, who fulfilled the inclusion criteria were selected for the study. The study group comprised of 500 adult patients (250 males and 250 females) belonging to the age group from 21-50 years. The study group was divided into three age groups [Table/Fig-1].

Groups	Age (years)	Male	Female	Total
A	21-30	85	85	170
B	31-40	82	82	164
C	41-50	83	83	166
Total		250	250	500

[Table/Fig-1]: Age distribution of patients.

Patients were included in the study based on inclusion and exclusion criteria mentioned below:

### Inclusion criteria:

- Class I canine-molar relations
- Normal overjet-overbite
- Well-aligned arches (no spacing, rotation, crowding)

- Full complement of permanent dentition
- Caries free

#### **Exclusion criteria:**

- Presence of supernumerary teeth
- History of orthodontic/periodontal/endodontic treatment
- History of trauma to anterior region
- Periodontally compromised dentition

**Description of custom-made jig:** A custom-made positioning jig was used [Table/Fig-2], following a modification of Mestriner MA et al., [5] and Kannabiran P et al., [6] design. This jig was used to measure the angulation and inclination of maxillary lateral incisors in all study casts. This instrument maintained the position of the mounted maxillary cast as oriented in Hanau wide-vue articulator. It had a Perspex platform on to which the mounted cast was attached using a screw beneath the platform. A vertical arm extended from one end of the platform to which a horizontal arm was attached and screws that allow right and left movements of the horizontal arm and also by which the height of the horizontal arm was adjusted. A standard 180 degrees plastic protractor which measures to the accuracy of 0.5 degrees was attached to the horizontal arm of jig. An immovable pointer (pointer A) was attached to a screw in the middle of the protractor extending to the entire length of the protractor, slightly above to the platform. This pointer rested against the long axis of the maxillary central incisor on the cast. Pointer A coinciding 90 degrees on the protractor represents the plane perpendicular to the Frankfort Horizontal Plane (FHP). Pointer B (movable sideways) was also attached to the metal screw in the middle of the protractor. This pointer rested on long axis of the maxillary lateral incisor on the cast and angulation readings, were read on the protractor.



[Table/Fig-2]: Custom made jig with Perspex platform and mounted metal protractor.

#### **Study Procedure**

Impressions of both arches were made using irreversible hydrocolloid and casts were poured in dental stone. Facebow record using polyvinyl siloxane bite registration material was transferred to Hanau Springbow articulator. Casts were mounted on the articulator in Maximum Inter-cuspal Position (MCP). The mounted maxillary cast was removed from the articulator. A point was marked on the deepest portion of the cervical margin on the labial surface and on the highest point on the incisal edge of the maxillary lateral incisor on the mounted cast. Then the MD width of the lateral incisor was measured with a digital vernier calliper (aerospace 0-150 mm, 0.01 mm resolution) and the midpoint was marked on the labial surface [Table/Fig-3]. These points were joined using a lead pencil, dividing the labial surface of the maxillary lateral incisor into two halves. This long axis marked was the Facial Axis of the Clinical Crown (FACC).

The mounted maxillary cast was then mounted on the Perspex platform of the custom-made jig [Table/Fig-2]. The height of the



[Table/Fig-3]: Mesiodistal width of maxillary lateral incisor measured using digital vernier calliper.

horizontal arm of the jig was so adjusted that, the labial surface of the maxillary central incisor was in front of the fixed pointer A and the maxillary lateral incisor was in front of the movable pointer B. Then, the middle long axis, marked by lead pencil, on the labial surface of maxillary central incisor was coincided with the pointer A and that of the maxillary lateral incisor was coincided with the pointer B above the platform. The reading was noted on the graduated metal scale of the protractor, where the other end of pointer B extended [Table/Fig-4].



[Table/Fig-4]: Mesiodistal angulation measured on the mounted maxillary cast by the pointers on the jig.

#### **Evaluation criteria:**

- Determination of MD angulation of maxillary right and left lateral incisors in males.
- Determination of MD angulation of maxillary right and left lateral incisors in females.
- Comparison of MD angulation of maxillary right and left lateral incisors in males as well as females.
- Comparison of MD angulation of maxillary right and left lateral incisors in male and female population belonging to same age group.

#### **STATISTICAL ANALYSIS**

The data obtained was statistical analysed using Paired t-test, one-way Analysis of Variance (ANOVA) using Statistical Package for the Social Sciences (SPSS) software. A p-value <0.05 was considered significant.

## RESULTS

The mean age of participants were  $41.6 \pm 1.22$  years. The mean value for MD angulation of Maxillary Right Lateral Incisor (MRLI) and Maxillary Left Lateral Incisor (MLLI) in males was found to be  $6.648 \pm 0.9889$  and  $6.704 \pm 1.0042$  degrees, and in females it was found to be  $6.592 \pm 0.8296$  and  $6.580 \pm 0.8381$  degrees, respectively. While comparing the MD angulation of MRLI as well as MLLI in males and females, no statistically significant difference existed [Table/Fig-5].

Gender	Mean MD angulation (in degree)		p-value (Paired t-test)
	Maxillary right lateral incisor	Maxillary left lateral incisor	
Males	$6.648 \pm 0.9889$	$6.704 \pm 1.0042$	0.934
Females	$6.592 \pm 0.8296$	$6.580 \pm 0.8381$	0.876
p-value	0.493	0.135	

**[Table/Fig-5]:** Comparison of MD angulation of maxillary right and left lateral incisors in males and females.  
p-value <0.05 was considered as statistically significant

In group A (21-30 years), the mean value of the MD angulation of MRLI and MLLI was  $7.100 \pm 1.11$  and  $7.441 \pm 1.05$  degrees and  $6.56 \pm 0.87$  and  $6.54 \pm 0.88$  degrees in females, respectively. In group B (31-40 years), it was found to be  $6.354 \pm 0.91$  and  $6.30 \pm 0.81$  degrees in males,  $6.73 \pm 0.88$  and  $6.60 \pm 0.86$  degrees in females, respectively. In group C (41-50 years), it was found to be  $6.476 \pm 0.73$  and  $6.34 \pm 0.65$  degrees in males and  $6.48 \pm 0.70$  and  $6.59 \pm 0.78$  degrees in females, respectively [Table/Fig-6].

Group	Males (in degrees)		Females (in degrees)	
	Right	Left	Right	Left
A	$7.100 \pm 1.11$	$7.441 \pm 1.05$	$6.56 \pm 0.87$	$6.54 \pm 0.88$
B	$6.354 \pm 0.91$	$6.30 \pm 0.81$	$6.73 \pm 0.88$	$6.60 \pm 0.86$
C	$6.476 \pm 0.73$	$6.34 \pm 0.65$	$6.48 \pm 0.70$	$6.59 \pm 0.78$
Test	F-value=15.354; p-value <0.001	F-value=47.784; p-value <0.001	F-value=2.08; p-value=0.127	F-value=0.104; p-value=0.9

**[Table/Fig-6]:** Comparison of MD angulation of maxillary right and left LI in males and females among the three age groups.

Test applied: One-way ANOVA  
p-value <0.05 was considered as statistically significant

In males, there was statistically highly significant difference in the MD angulations between group A and group B (p-value <0.0001); and between group A and group C (p-value <0.0001). But, no statistically significant difference in the MD angulations between group B and group C (p-value <0.9) with highest value of MD angulations seen in group A followed by group C and then group B. In females, there was no statistically significant difference in the MD angulations between group A, B and C with highest value found in group A followed by group C and then group B [Table/Fig-7].

Groups	Male	Female
A and B	p-value <0.0001	p-value=0.127
A and C	p-value <0.0001	p-value=0.127
B and C	p-value=0.9	p-value=0.9

**[Table/Fig-7]:** Significance of difference in MD angulation of maxillary lateral incisors in males and females among the three age groups.

Test applied: one-way ANOVA  
p-value <0.05 was considered as statistically significant

## DISCUSSION

Denture aesthetics is defined as the cosmetic effect produced by a dental prosthesis which affects the beauty, attractiveness, character and dignity of the individual [1]. Pound stated that the first principle of aesthetics is replacing the teeth in the natural positions from which they came [7]. Boucher CO, also stated that the teeth must be placed in exactly the same position as the natural teeth which they are to replace [8]. Hence, the position of teeth in prosthesis is utmost important for achieving natural aesthetics and proper functioning.

Placing anterior teeth in harmony with functional activity involve placing the teeth in an anteroposterior and mediolateral position in harmony with the action of lips and the tongue. Rotation of lateral incisors, however, will either harden or soften the dental composition. Right and left lateral incisors should have asymmetric long axis and they should be so positioned that, atleast a portion is seen when the patient speaks normally (speaking line determination) [9].

In choosing the tooth, the first consideration was the selection of a mold typically feminine and sculptured for a rounded body outline. In refining the basic ‘feminine’ mold to correspond in appearance to an extremely soft, pleasant personality, depth grinding of the mesiolabial angle is done, and the incisal edges of the central and lateral incisors are rounded to produce a softer appearance. The lateral incisors, with their masculine surface anatomy, are square and the mesial surfaces are rotated inward. The positioning of the six anterior teeth in the male patient results in the creation of an upward sweep of incisal edges of the central and lateral incisors. This is called the ‘smiling line’. In the denture base, more vigorous surface anatomy is also employed for a man than for a woman [10].

Andrews LF, studied angulations and inclinations of the long axis of untreated ideal occlusions and described six keys for the arrangement and occlusion of teeth [2]. According to him, crown angulation refers to angulation (or tip) of the long axis of the crown, not to angulation of the long axis of the entire tooth. Among the six keys to normal occlusion, key II-crown angulation (mesiodistal tip), the gingival portion of the long axis of all crowns was more distal than the incisal portion. The angle between the long axis of the crown (as viewed from the labial or buccal surface) and a line bearing 90 degrees from the occlusal plane is the degree of the crown tip [2]. He also stated that angulation of maxillary crowns averaged 9 degrees and inclination averaged 3 degrees for the lateral incisors [11]. Ursi W et al., stated that proper axial inclinations are necessary for distribution of occlusal forces with closed contact point [12]. The values of MD angulation of maxillary lateral incisors obtained in this study (6.5-6.7 degrees) were nearly similar to those suggested by Jordan RD et al., (7 degrees) [13]. Different authors have reported the importance of angulation of maxillary lateral incisors for aesthetics [Table/Fig-8] [6,11,13,14].

Study	Inference of the study
Kannabiran P et al., 2012 [6]	Objective of the study was to determine the need for finishing bends to attain optimal results in Dravidian patients. Conclusion was MD angulations of maxillary lateral incisor $-7.63 \pm 4.92^\circ$
Andrews LF, [11]	Angulation of maxillary crowns averaged $9^\circ$ and inclination averaged $3^\circ$ for the lateral incisors.
Jordan RE et al., [13]	MD angulation of maxillary lateral incisor was lateral incisor $-7^\circ$ .
Derek S, [14]	Proximal long axis of maxillary lateral incisors should be about $12^\circ$ from the vertical with its neck slightly nearer the alveolar ridge than the central incisor
Present study	To determine the mesiodistal angulation of maxillary lateral incisors as a part of the dentition to learn its significance in the arrangement of artificial teeth and understanding its significant contribution to dentofacial aesthetics. The mesiodistal angulation of maxillary lateral incisors was comparatively greater in males than in females especially in the age group of 21-30 years. The variation in the angulation was slightly more for maxillary left lateral incisors.

**[Table/Fig-8]:** Review of literature highlighting the importance of angulation of maxillary lateral incisors [6,11,13,14].

## Limitation(s)

Small sample size was the major limitation of the present study. The study can be also be considered for a larger population, hence, this can have further scope for research.

## CONCLUSION(S)

The mesiodistal angulation of maxillary lateral incisors was comparatively greater in males than in females, especially, in the age

group of 21-30 years. The variation in the angulation was slightly more for maxillary left lateral incisors. These values of mesiodistal angulation of maxillary lateral incisors can serve as guidelines in the arrangement of teeth during fabrication of complete or partial dentures, so as to keep the aesthetics natural looking and abide by the principles of teeth arrangement.

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