



## An Innovative Method to Determine the Width of Maxillary Anterior Teeth with the Help of Measurements Obtained from the Master Cast

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### ABSTRACT

**Aim:** Analyse the correlation between the measurements made from the landmarks on the cast and the width of the anterior teeth in dentulous study subjects and assessed whether a similar correlation exists in edentulous condition .

**Materials and methods:** Measurements were made on the cast of dentulous and edentulous subjects. The measurements made were, from incisive papilla to the right hamular notch, from incisive papilla to left hamular notch and distance between two hamular notches. After measuring these distances, the predicted value was calculated by taking mean of these three distances. The actual value in both the groups was measured with a flexible ruler. The mean and standard deviation of both groups were calculated. Results were analyzed with correlation and regression analysis.

**Results:** The analysis showed that there was a positive correlation between actual and predicted values in both dentulous and edentulous group of study subjects (p-value <0.01) . As the actual value increased in both the groups, the predicted value also increased. So the actual value can be derived with the help of predicted value which will be useful in selecting the proper tooth mold size of the maxillary teeth for edentulous patients.

**Conclusion:** A positive correlation exists between the width of the maxillary teeth (actual value) and mean of the distance

(predicted value) between the right hamular notch and incisive papilla, left hamular notch and incisive papilla and interhamular distance in dentate subjects.

**Clinical significance:** The results obtained from the present study will be helpful for selecting the proper teeth mold size along with other teeth selection methods. Further studies are required to derive a more scientific and reliable method for anterior teeth selection.

**Keywords:** Hamular notch, Incisive papilla, Tooth mold size.

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### INTRODUCTION

In the field of Prosthodontics, one of the important considerations is the customization and fabrication of a denture which is aesthetically acceptable. It involves various clinical and laboratory procedures. The selection of teeth is prominent among them. If the teeth selection does not meet the expectations of the patient, it is very disappointing, especially for maxillary teeth.<sup>1</sup> Usually, the methods followed are Berry's biometric method, anthropometric cephalic index (ACI), dentogenic concept.<sup>2,3</sup>

Because of the occurrence of dynamic alterations with time, the accuracy of Berry's biometric method is doubtful, as its prime focus is on soft tissue landmarks. In the ACI, the circumference of the head is measured using measuring tape at the level of the forehead, but the rim of the head may vary due to the aging process. In Dentogenic concept very little or no attention is given to the size of upper anterior teeth.<sup>4</sup>

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Mesiodistal dimensions is an essential parameter for assessing anterior artificial teeth, because it width of these teeth is minimal, it will undoubtedly lead to failure of denture to mimic realism.<sup>4</sup> Use of landmarks which are less affected by factors such as aging, weight changes, and extraction of teeth will be more reliable compared to the above-mentioned methods. The landmarks incisive papilla and pterygomaxillary notch are considered to be stable a s compared to the other methods.<sup>1,5-7</sup> The present study involved the use of anatomical landmarks to derive a proportion which is helpful in the selection of maxillary teeth.

## AIMS AND OBJECTIVES

To determine the correlation between the maxillary anterior teeth width in dentulous subjects and the canine line to canine line measurements on occlusal rims of edentulous subjects with the mean of the distance between the right hamular notch and incisive papilla, left hamular notch and incisive papilla and interhamular distance in dentulous and edentulous subjects respectively.

## Selection Criteria for Subjects

The subject size for both dentulous and edentulous subjects was determined to be 100 for both dentulous and edentulous patients.

## Inclusion Criteria

- Dentulous study subjects were 17 to 25years old normal Class1 occlusion subjects,
- Edentulous subjects were of age group from 50 to 80 years,
- Both the sexes were included.

## Exclusion criteria

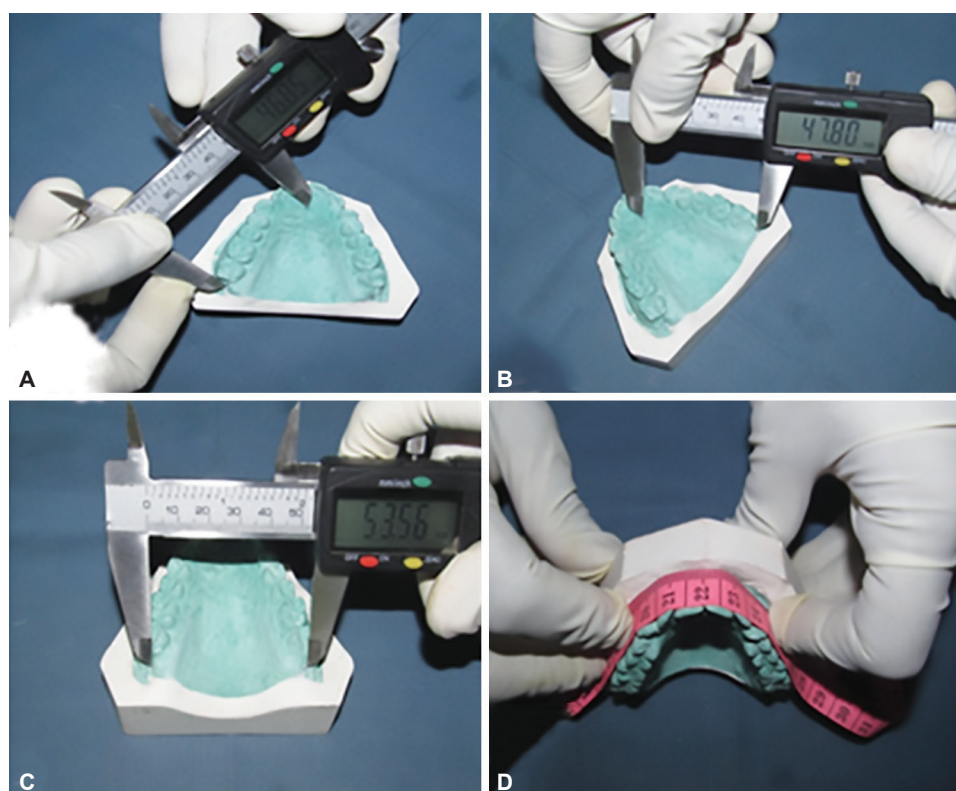
- Subjects with congenitally missing teeth,
- Subjects with temporomandibular deformities,
- Subjects with orthodontic intervention.

## MATERIALS AND METHODS

### For Dentulous Subjects

Maxillary impressions were made using the irreversible material. The casts were obtained using ADA type 3 dental stone. The cast was retrieved after the proper setting of dental stone. The damaged casts were not included in the study. The buccolingual center of the pterygomaxillary notch and incisive papilla were marked on the dental cast using graphite pencil. The distance between the incisive papilla and center of the pterygomaxillary notch of each side was measured using a digital caliper (Fig. 1 ).

The distance between right side buccolingual center of the pterygomaxillary notch and incisive papilla was



**Figs 1A to D:** Measurement of dimensions (A) Right side of the maxillary cast using caliper; (B) Left side of the maxillary cast using caliper; (C) Between the two ends of the maxillary cast using caliper; (D) Circumferential dimensions of the maxillary cast

termed as D1, whereas the distance between the left side of the buccolingual center of the pterygomaxillary notch and incisive papilla was termed as D2. The distance between two centers pterygomaxillary notch was measured and termed as D3; additionally, the mean of these three values was calculated as termed as ‘predicted value.’

To get the actual value flexible ruler was used. The flexible ruler was kept on the distal contact area of the canine to the distal contact area of the canine on the opposite side. The distance was termed s D4 (Fig. 1D ).

**For Edentulous Subjects**

Maxillary impressions were made using impression compound. The casts were poured using adenosine deaminase (ADA) Type 2 dental plaster. Special trays were fabricate d for each patient using pica tray material followed by border molding and final impression procedure. Casts were poured using ADA type 3 dental stone after proper beading and boxing.

Similar measurements were made on to the edentulous casts and were termed as E1 E2 and E3, additionally, mean of these three values were calculated and termed as “predicted value” (Fig. 2).

The temporary denture bases were fabricated using denture base materials; occlusal rimes were fabricated with modelling wax. The maxillary occlusal rims with

denture base were inserted into the patient’s mouth, and labial inclinations of occlusal rimes were modified for adequate lip support.

Determination of the midline of the face was done, followed by transferring it to the maxillary occlusal rim. Next step was the scribing of the canine lines on the occlusal rim’s labial surface, according to the commissure of the lip at rest. To get the “actual value” distance between these two lines were measured and termed as E4 (Figs 2, 3, and 4 ). These values obtained (actual and predicted value) in both the groups were statistically analyzed to determine the corre lation between these two values.

**RESULTS**

After calculating the predicted and actual values for dentulous and edentulous conditions, results were drawn with the help of the paired t-test, correlation, and regression analysis. In dentulous situation mean of the actual value was found to be  $52.00 \pm 2.91$  mm whereas in the edentulous condition it was  $47.05 \pm 3.12$  mm . The mean of the predicted value was  $52.00 \pm 3.38$ mm in dentulous condition and  $47.36 \pm 2.62$  mm in edentulous condition. The mean difference between these two values was 0.20 mm and 0.31 in a dentulous and edentulous group of study subjects . Pearson’s correlation coefficient was found out to be 0.56 for dentulous condition and 0.54



**Figs 2A to D:** Measurement (A) Lateral dimensions of a left side of the mandibular cast using caliper; (B) Lateral dimensions of a right side of the mandibular cast using caliper; (C) Dimensions of between the two ends of the mandibular cast using caliper; (D) Marking the commissure of the lips

for the edentulous condition, which states that the actual value and the predicted value were correlated (Table 1). The results showed that as the actual value increases the predicted value also increases for both the groups (Table 2). This states that there was a positive correlation between actual and predicted values (Graphs 1 and 2).

In dentulous condition, the regression coefficient was found out to be 0.49 and 0.65 for the edentulous condition. For both the study groups, for achieving the mesiodistal dimension of the anterior teeth, derivation of the regression prediction formula was done. For a dentulous group, the regression constant was found to

be 26.7 and 16.4 for the edentulous group. The formula obtained for the dentulous and edentulous group was  $AV = 26.7 + 0.49 (PV)$  and  $AV = 16.4 + 0.65 (PV)$  respectively. The standard error which can be expected was  $\pm 2.41$  mm for the dentulous group and  $\pm 2.63$  for edentulous group (Table 2).

In edentulous condition, the regression coefficient was found out to be 0.65. The regression prediction formula to get the mesiodistal dimension of anterior teeth was derived. The regression constant was found to be 16.4. The formula obtained was,  $AV = 16.4 + 0.6 (PV)$ . The standard error which can be expected was  $\pm 2.63$  mm.

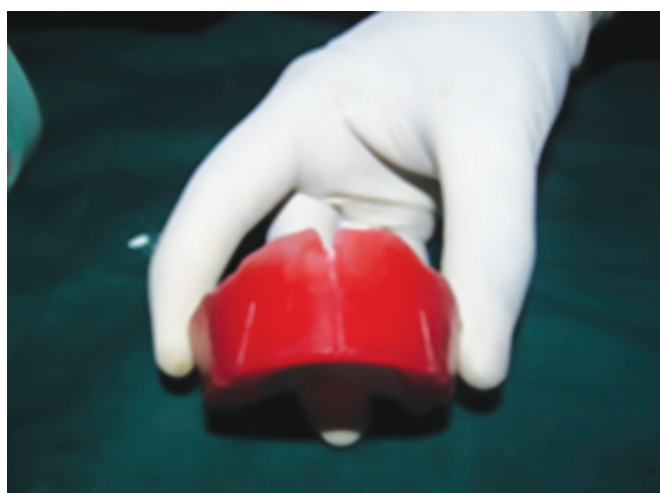


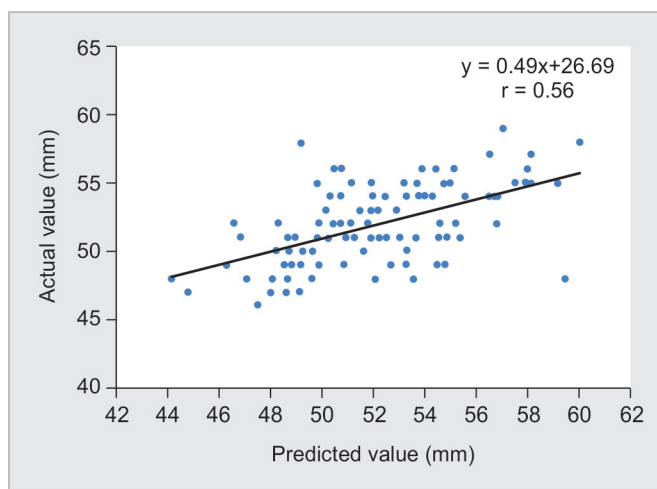
Fig 3: Transferring of the marking on the wax rims



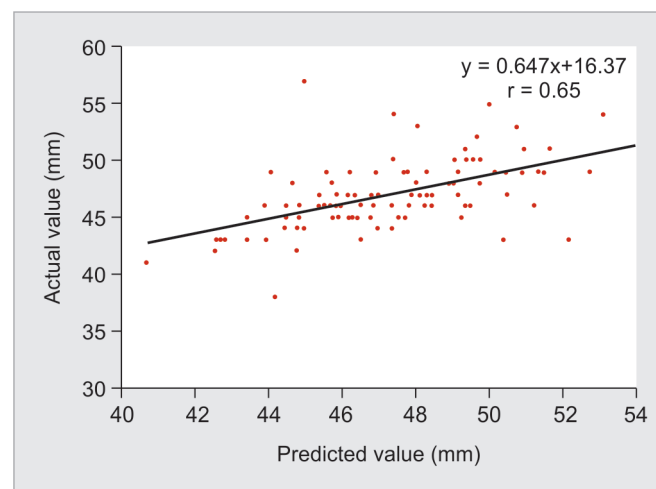
Fig 4: Measurement of circumferential dimension of the waxrim

Table 1: Correlation analysis between actual and predicted value

		Mean $\pm$ SD	Mean difference	T	p	Correlation Coefficient 'r' value	p-value
Dentulous condition	Actual value	52.00 $\pm$ 2.91					
	Predicted value	52.00 $\pm$ 3.38	0.2	0.66	0.51 NS	0.56	<0.001
Edentulous condition	Actual value	47.05 $\pm$ 3.12					
	Predicted value	47.36 $\pm$ 2.62	0.31	1.31	0.26 NS	0.54	<0.001



Graph 1: Comparison between the actual and predicted value in dentulous study subjects



Graph 2: Comparison between the actual and predicted value in edentulous study subjects

**Table 2:** Regression analysis between actual and predicted value

Group	Measurement	Correlation coefficient, 'r' value	Regression coefficient 'b' value	Regression prediction of AV	SE
Dentulous	Actual and predicted value	0.56	0.49	AV = 26.7 + 0.49 (PV)	± 2.41
Edentulous	Actual and predicted value	0.54	0.65	AV = 16.4 + 0.65 (PV)	± 2.63

## DISCUSSION

The selection of artificial teeth to replace the missing teeth is a relatively easy procedure when some of the natural teeth remain, however, for an edentulous individual with no preextraction records available, the choice of the mold and arrangement is problematic. The dentist must rely on clinical judgment together with the individual's esthetic preference for the teeth selection. However, the result can be disappointing if the expectations of the individual do not match to those of the dentist's selection.<sup>1,8</sup>

The size of the anterior teeth is selected during jaw relation procedure.

Following the adjustment of the wax occlusal rims as per the lip support and vertical dimensions of the occlusal rims, corresponding to the commissure of the mouth in the state of the rest, formulation of the marks showing the location of canine is done.<sup>9-12</sup> The distance between two marks is then measured around the curvature of the rim, and the measurement obtained determines the width of six anterior teeth. Significant discrepancies are created by following some of the proposed guidelines used for teeth selection based on the size, further leading to a great deal of confusion and errors.<sup>11</sup>

In a study to check the correlation between the bi-commissural width, sagittal cranial diameter, intrabuccal frenum distance, and maxillary teeth it was found that intercommisural width, interalar width, intrabuccal frenum distance, sagittal cranial diameter width of the philtrum, bi-zygomatic width are significantly correlated with the width of maxillary teeth.<sup>13</sup>

But philtrum width was found to be with the largest percentage of standard error, and there was difficulty in clinically obtaining the measurements. The intercommisural width had the greatest correlation with the maxillary anterior teeth. In the present study, verification of the biometric ratio, in between bitygomatic width and central incisor, of 16:1 was done. In the past literature, Young, House and Loop, Berry, and Wavrin had this ratio to be 16:1. These authors reported no standard deviation, correlation coefficient or confidence limits. The study did not find any statistically significant correlation of large magnitude between bitygomatic width and width of the central incisor. They concluded that the biometric ratio 16:1 has a little-predicted value for a given individual because the magnitude of the correlation was small.<sup>13</sup> Questions were raised by Vanderlei Luiz Gomes

et al. who doubted whether an average facial measurement would be appropriate to estimate the width of central incisor for a patient who is partially edentulous.<sup>3</sup> Similar conclusions were drawn by Kern et al. and Kini et al.<sup>14,15</sup>

Another facial structure investigated was the width of the nose, when measured in bone structure, the nasal width showed equal or nearly equal measurements to the width of four maxillary incisors in 93% of the skulls analyzed. However, when measured in soft tissue, the interalar width is not correlated to the width of the four maxillary incisors. Smith in 1975, found that neither the nasal width nor the interalar width correlates to the width of six upper anterior teeth.<sup>3</sup>

So in the present study, an attempt was made to determine the width of the maxillary anterior teeth using landmarks which can be easily identified on the cast. Two groups were made one of the dentate subjects and another of the edentulous subjects. Purpose of making two groups was to analyze the correlation between the measurements made from the landmarks and the width of the anterior teeth in a dentulous group of study subjects and to see whether a similar correlation exists in edentulous condition.

Pterygomaxillary notch and incisive papilla landmarks were used as reference point to make the measurements on the casts. Pterygomaxillary notch is a palpable notch formed by the junction of the maxilla and pterygoid hamulus of the sphenoid bone. The position of the pterygomaxillary notches do not appear to change with factors such as weight changes, aging, and extraction of teeth.<sup>1</sup>

The incisive papilla is a small pear-shaped eminence composed of a pad of fibrous connective tissue overlying bony exit of nasopalatine blood vessels, nerves. It is one of the most significant landmarks in locating maxillary central incisor position. Studies have stated that incisive papilla is a stable landmark that was observed by caliper measurement on pre-extraction and post resorption models.<sup>5</sup>

In a study conducted by Goncalves et al., the flexible ruler was used to measure the mesiodistal width of anterior.<sup>3</sup> Similarly for dentulous group of subjects in present study the actual value was measured using a flexible ruler on the maxillary cast from the distal contact area of one canine to distal contact area of the opposite canine.

In a study conducted by Baker, canine to canine control group measurements were made on the occlusal rim.

The maxillary occlusal rims were fabricated, and after initial fitting procedures the maxillary record base and occlusal rims were placed intraorally, and the labial inclination was modified for adequate lip support. The lines were scribed on the labial surface of the occlusal rim, corresponding to the commissure of the lips at rest. The canine-to-canine measurements, treated as control, were made using a flexible ruler.<sup>13</sup> Similarly, the actual value for an edentulous group of study subjects was measured in the present study.

In the present study distance between the pterygomaxillary notch and incisive papilla on both the sides and inter pterygomaxillary distance was calculated in both the groups to obtain the predicted value. The correlation and statistical regression analysis was used to determine the correlation between the actual and predicted values. The correlation analysis stated that there was a statistically significant correlation between actual and predicted value in both the groups of study subjects. Purpose of making two groups was to check the correlation between the actual and predicted value in the dentulous group and to see whether similar correlation exist in the edentulous condition. The result showed that the correlation which exists in case of dentulous subject's similar correlation exists in edentulous condition.

The regression analysis was carried out to check whether any formula or proportion can be derived to predict the mesiodistal dimension of anterior teeth. The formula was derived in both dentulous and edentulous condition this formula enables us to get the actual value in individual cases with the help of predicted value. A simple objective technique involving anatomical measurements would provide at least a starting point for tooth selection.

The limitations of the study are as follows:

- In the present study, the factor of gender was not considered.
- The influence of the arch form on the mesiodistal width of anterior in both dentulous and edentulous groups was not considered.
- The study does not include other ethnic population.

## CONCLUSION

There is a correlation between the width of the maxillary anterior teeth (actual value) and mean of the distance (predicted value) between the right hamular notch and incisive papilla, left hamular notch and incisive papilla and interhamular distance in dentate subjects.

There is a correlation between the canine line to canine line measurement (actual value) and mean of the distance (predicted value) between the right hamular notch and incisive papilla, left hamular notch and incisive papilla, and interhamular distance on edentulous master cast.

As the actual value increased, predicted value also increased in both the groups.

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