

# Evaluation of the role of skull anthropometry for complete denture teeth selection: A cross-sectional study

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## Abstract

**Background:** Success of complete denture treatment lies in the ability to make it indiscernible from the natural. The selection of the six maxillary anterior teeth is of utmost importance as it contributes most to denture esthetics. Although various techniques and methods to determine the width of maxillary anterior teeth and its relation to various body measurements were done, the simple technique of using circumference of head has been less documented, specifically for Indian population.

**Aims and Objective:** The aim of this study was to determine whether a relationship exists between the widths of the upper six anterior teeth to head circumference and the objective was to decide whether head circumference can be used as a deciding criterion to select size of maxillary anterior teeth for Central Indian population.

**Materials and Methods:** This study was done on 300 people who included 135 males and 165 females. The circumference of head (A) and the combined width of the six anterior maxillary teeth (B) were measured and the ratio of A: B was determined.

**Results:** EPO Info software version 6 was used to derive the statistical analysis with unpaired Student's *t*-tests. In male students, the mean of the ratio between the head circumferences to the combined widths of the anterior maxillary teeth was 10.14:1. In female students, the mean of the ratio between the head circumferences to the widths of the anterior maxillary teeth was 10.09:1. The average circumference of head to mesiodistal width of six anterior teeth ratio was concluded to be 10.

**Conclusion:** Within the limitations of this study, the results suggest that head circumference divided by 10 can be used to select a teeth set with the resulting value as the combined mesiodistal width of six anterior teeth. This can be used as a starting point for determining the width of the anterior maxillary teeth for edentulous patients, which can be further confirmed with the esthetic appearance and with other facial measurements.

**Keywords:** Anterior maxillary teeth, head circumference, teeth selection

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## INTRODUCTION

Esthetics is a prime concern for patients seeking prosthetic treatment, and according to young, “it is apparent that beauty, harmony, naturalness, and individuality are major qualities” of esthetics.<sup>[1,2]</sup> Tooth loss is a severe emotional trauma to the patient which affects the functional as well as esthetic well-being.<sup>[3]</sup> The replacement of the lost natural tooth with artificial teeth which should impart the original natural look is a challenge for the dentist. Complete denture esthetics greatly depends on the ability to mimic natural dentition in the dentures. The size, color, shape, and overall arrangement of the teeth in the anterior maxillary zone are a prime determinant of denture esthetics.<sup>[3]</sup> Selection of teeth when an edentulous patient comes for prosthetic rehabilitation, due to the absence of a natural guide, becomes a challenge to the prosthodontist. However, there are little scientific data in the dental literature to use a guide for defining the proper size and shape of anterior teeth or determining normal relationships.<sup>[4]</sup> There have been various parameters that have been studied and used for determination of the size of the maxillary anterior teeth. “Berry’s biometric ratio method,”<sup>[5]</sup> in 1906, stated that the proportions of the upper central incisor tooth had a definite proportional ratio to face proportions. The tooth was one-sixteenth of the face width and one-twentieth the face length. “Anthropometric cephalic index method,” projected by Sears<sup>[6]</sup> in 1941, showed that width of the upper central incisor could be determined by dividing either the transverse circumference of the head by 13 or the bizygomatic width by 3.3. Nasal width was used as a guide by Boucher<sup>[3]</sup> and Hoffman *et al.*<sup>[7]</sup> referred to the nasal index as a guide to select the anterior teeth as it relates the interalar width to the space available for setting the anterior teeth.<sup>[8-10]</sup> Wehner *et al.*<sup>[11]</sup> suggested that the “parallel lines” extended from the lateral surface of the ala of the nose onto the labial surface of the upper occlusal rim could be used to give an estimation of the midline vertical axis of the upper canine teeth. Kern<sup>[12]</sup> found that most of the measurements of nasal width are equal to or within 0.5 mm of the measurements of the four maxillary anterior teeth. Inner canthal distance as a guide has been discussed in various studies,<sup>[13-16]</sup> and Abdullah,<sup>[17]</sup> in 2002, proposed a formula to calculate the width of the central incisor from the inner canthal distance as final central incisor width = inner canthal distance/2 × 0.618. Skull anthropometry can also be a primary starting point in selecting the mesiodistal width of the maxillary anterior teeth.<sup>[18]</sup> Although similar studies have been carried out in other parts in India, it can vary among different ethnic and cultural group of people.<sup>[15-17]</sup> Therefore, a need was felt to evaluate the validity of the cephalic proportion in

Central Indian population and whether circumference of head can be used as a determining factor for selection of maxillary anterior teeth. It would also prove the hypothesis that circumference of head can be related to the mesiodistal width of maxillary anterior teeth in the people residing in Nagpur.

## MATERIALS AND METHODS

This cross-sectional prospective study was carried out in the Department of Prosthodontics, VSPM Dental College and Research Centre, Nagpur, Maharashtra, India, after approval from the Institutional Ethical Committee. The sample size was derived from the statistician after the pilot study as 300. Therefore, 300 dental students, including 165 female and 135 male students, were selected using convenient random sampling method to participate in the study, and their written informed consent was taken. Inclusion criteria included sample population aged between 18 and 25 years with intact bilateral maxillary central incisor, Class 1 canine occlusion, fully erupted teeth with healthy state of gingiva and periodontium, caries free and nonattrited teeth, no related medical history, and willingness to participate in the study. Exclusion criteria consisted of patients with developmental abnormalities involving the face and head, Paget’s disease, hormonal abnormalities, fractured or restored maxillary anteriors with full crowns, microdontia of central incisor, and patients with diastema.

After recording the demographic information such as age and sex of each participant, various craniometric and odontometric measurements were obtained with the help of a nonstretchable measuring tape, a spreading caliper, and a sliding digital stainless steel Vernier caliper, as suggested in the previous studies.<sup>[13-16]</sup>

All measurements were done by the same two investigators following strict calibration and standardization protocol. The head measurement was done by a single investigator for all patients, the dental measurements were recorded by the second investigator for all the patients, and the exact measurements were noted. The techniques of recording of skull and dental measurements can be described as follows.

### Circumference of head (A)

Maximal fronto-occipital circumference was measured by placing a nonstretchable plastic tape (calibrated in millimeters) just on the occipital prominence and the supraorbital ridges while seating the patient in a relaxed state in an upright position and viewing the case laterally also to ensure proper placement of the tape [Figure 1]. In cases of females, the participants were asked to lift their



**Figure 1:** Measuring circumference of head

hair in occipital area and the tape was placed against the skin and not over the lumps of hair. This method was in accordance with the one used by Evreklioglu *et al.*<sup>[19]</sup>

**Combined mesiodistal width of six maxillary anterior teeth (B)**

The participants were seated comfortably on the dental chair in a relaxed state in an upright position with the head resting firmly against the headrest. The greatest mesiodistal crown width of the six permanent maxillary anterior teeth was measured between the anatomic contact points of the tooth interproximally with Vernier caliper placed incisally [Figure 2]. All the measurements repeated thrice to minimize the errors and obtained the average values. Later, all measurements were added to derive combined mesiodistal widths of all maxillary anteriors.<sup>[14]</sup> All the recorded measurements were calibrated in millimeters. Statistical comparisons were made between the recorded craniometric and odontometric measurements with respect to males and females.

**RESULTS**

Data were entered into a Microsoft Excel sheet and studied to obtain the ratio of mesiodistal width of maxillary anterior teeth and head circumference. The statistical analysis was done using EPO Info software version 6 IBM (Bangalore, India) and subjected to unpaired Student's *t*-test. The mean, standard deviation, standard error, and *P* values were calculated [Table 1]. The difference in mean circumference of head values in males and females was significantly different with the values for males being slightly higher [Graph 1]. The mean mesiodistal width of six anterior maxillary teeth in males and females did not show statistically significant difference; however, with males, the values were slightly higher than females [Graph 2]. In males, the mean of the ratio between the head circumferences to the combined widths of the anterior maxillary teeth was



**Figure 2:** Measuring mesiodistal width of each maxillary anterior tooth

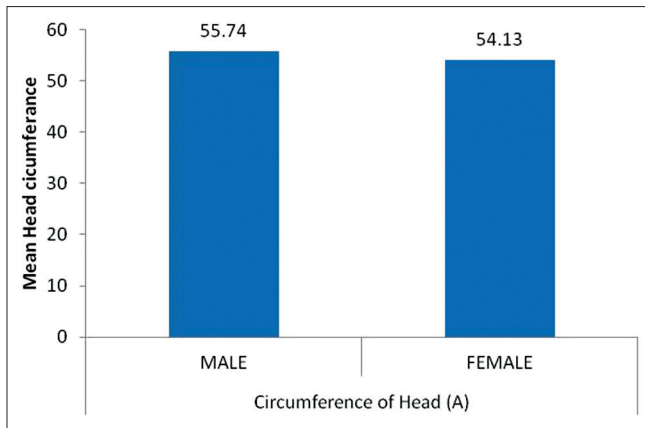
**Table 1: Group statistics**

	Gender	n	Mean	Std. deviation	Std. error mean	t-test	P
Circumference of head:A	Male	34	55.74	1.310	0.225	5.53	<0.001
	Female	66	54.13	1.403	0.173		
Width of six maxillary Anterior teeth:B	Male	34	5.215	0.3645	0.0625	0.690	0.492
	Female	66	5.156	0.4272	0.0526		
Ratio of A:B	Male	34	10.14	0.60156	0.10317	0.956	0.342
	Female	66	10.09	0.74610	0.09184		

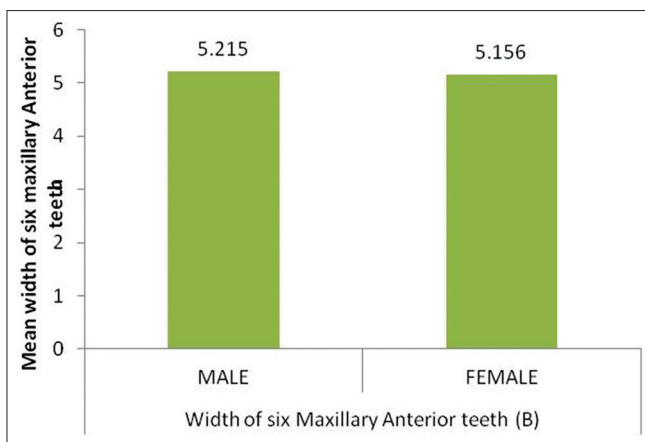
10.14:1, and in female, the mean of the ratio between the head circumferences to the widths of the anterior maxillary teeth was 10.09:1 [Graph 3], which can be rounded off to 10.

**DISCUSSION**

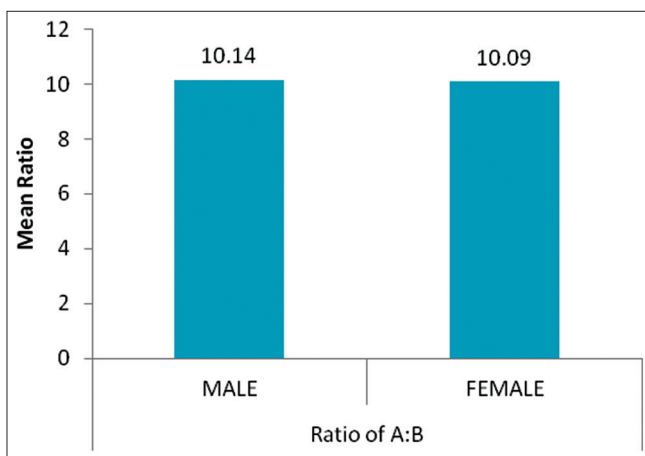
Esthetic variations in every individual lead to characteristic appearance as mentioned by Young.<sup>[1,2]</sup> The size, color, shape, and overall arrangement of the teeth in the anterior maxillary zone are a prime determinant of denture esthetics. The dentist is the only person who can accumulate, correlate, evaluate the biomechanical information, and assess the selection of anterior artificial teeth so that it will meet the individual esthetic and functional needs. Selection of teeth when an edentulous patient comes for prosthetic rehabilitation, due to the absence of a natural guide, becomes a challenge to the prosthodontist.<sup>[2,3]</sup> There have been various parameters that have been studied and used for determination of the size of the maxillary anterior teeth such as the interpupillary distance<sup>[7-10]</sup> and interalar width.<sup>[3,7,10,11]</sup> Various studies have been carried out in various parts of the world,<sup>[11,12]</sup> but study of circumference of head in determining the mesiodistal width of maxillary anterior teeth for Indian population has not been done. Anthropometric cephalic index method, projected by



**Graph 1:** Mean ratio of circumference of head in males and females



**Graph 2:** Mean width of six maxillary anterior teeth in males and females



**Graph 3:** Ratio of circumference of head:width of maxillary six anterior teeth

Sears<sup>[6]</sup> in 1941, is based on the fact that width of the upper central incisor could be determined by dividing the transverse circumference of the head by 13.

Most studies<sup>[19-21]</sup> have suggested that skull anthropometry can be a primary starting point in selecting the mesiodistal

width of the maxillary anterior teeth.<sup>[13,14]</sup> Most studies<sup>[15-17]</sup> done in this area also have been carried out to study the stature<sup>[22-25]</sup> and personality assessments based on anthropometric values. However, these do not include Asia and India even though they form largest population as compared to other ethnic groups; no measurements of tooth sizes have been made on the Central Indian population. Therefore, a need was felt to evaluate whether circumference of head can be related to the mesiodistal width of maxillary anterior teeth especially in the Central Indian population and to evaluate whether a difference exists between males and females. There has been some difference in the ratio of circumference of head and mesiodistal width of maxillary anterior teeth in studies done in foreign population.<sup>[3-5,10]</sup> In the present study, there was a statistically significant difference between the circumference of head measurements in the males and females ( $P < 0.001$ ). Previous studies<sup>[21-24]</sup> have reported a significant correlation between body height and head length, head width, as well as head circumference. Ilayperuma *et al.*<sup>[22]</sup> in their study of stature prediction reported that males were significantly greater in body height, cranial length, and width than females and reported a correlation between stature and cranial dimensions to be statistically significant ( $P < 0.05$ ). These variations could be ascribed to factors related to population differences as well as genetic factors. These observations are in agreement with Ukoha *et al.*,<sup>[23]</sup> who carried out a study on stature estimation from the head circumference, length, and width. In contrast, Jervas *et al.*<sup>[24]</sup> reported no significant gender difference in head length and head width. Shah *et al.*<sup>[13]</sup> reported that males were significantly greater in body heights, head length, and width than females ( $P < 0.05$ ). The observation regarding the combined mesiodistal width of maxillary anterior teeth in this present study in the males was slightly higher than in females though it was not statistically significant and is comparable to some previous studies.<sup>[19-21,26]</sup> The above concordance in the majority of the study confirms that the dimensions of body parts in males are higher than in females.<sup>[20-22]</sup> There was a strong correlation between the ratio of circumference of head and mesiodistal width of the six anterior teeth which was statistically significant which is in accordance with the study by Rahamatulla *et al.*<sup>[27]</sup>

## CONCLUSION

The present study establishes a significant correlation between the circumference of head and the width of maxillary six anterior teeth, and this can be used as a potential starting point in the selection of teeth for artificial dentures. The ratio of circumference of head to width of

maxillary anterior teeth may depend on the ethnicity and cultural diversity of the Indian population and before being put into clinical use should be evaluated for its significance in the population at hand and therefore also explains the variation that was found in this study when compared to studies done in other countries.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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