# A Study of facial dimensions for the aesthetic replacement of maxillary anterior teeth

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## Abstract

An important element of prosthetic treatment for edentulous patient is the selection of appropriate sized anterior artificial teeth that will restore the natural harmony of dentofacial structure to achieve optimal aesthetics. The main objectives of this study were to determine the presence of proportional relationships among facial and anterior teeth measurements and to analyze the biometric ratios between facial and dental proportions in Myanmar population for anterior teeth selection. A total of 404 Myanmar subjects comprising male and female, age ranged from 18 to 25 years were studied. All facial measurements were made with face bow and digital caliper. Cast measurements were made with digital caliper having a precision of 0.01 mm. The mean values for facial dimensions were: Bizygomatic Width (BZW) = 140.24mm, Face Length (FL) = 187.75mm. The mean values for anterior teeth dimensions were: Incisor Width (IW) = 8.34mm, Anterior Six Teeth Width (ASW) = 53.88mm, Incisor Length (IL) = 10.14mm. From the results of this study the new biometric ratios between facial dimensions and teeth dimensions were: BZW:IW = 16.84, BZW:ASW = 2.6, FL:IL = 18.59. A positive significant correlation existed between facial and anterior teeth measurements (p=0.01). The regression formulae were: IW = 6.075 + (0.016 x BZW), ASW = 34.485 + (0.138 x BZW), IL = 7.133 + (0.016 x FL).The clinical significance of this study is the clinicians whose patients are of Myanmar origin who now have a biometric ratio and a formula method for determining the anterior teeth size for rehabilitating edentulous patients.

## Introduction

One of the most difficult aspects during the selection of maxillary anterior teeth for a removable prosthesis is determining the appropriate size of maxillary anterior teeth. Many attempts have been made to establish methods of estimating the size of these anterior teeth, and improving the aesthetic outcome. Aesthetics is a primary consideration for most patients seeking prosthodontic treatment. One of the major hurdles in clinical prosthodontics has been the selection and replacement of maxillary anterior teeth in the absence of pre-extraction records. With respect to the appearance of face, maxillary central incisors are popularly considered to be the key teeth when treating edentulous patients (Mavroskoufis, 1980). Poor aesthetics is a common reason in failure of maxillary complete dentures.

The selection of maxillary anterior teeth for complete dentures has long posed a problem in clinical practice, and a controversy about the best method to employ still exists. Several methods are of questionable validity, and many dentures have an obviously artificial appearance. As stated by Boucher (1970), the maxillary anterior teeth must be in proportion with the size of the face and head to achieve good aesthetics. Sharry (1974), Boucher (1970) and Pound (1962) all condemned the practice of selecting teeth based on measurements on the master cast. All agreed that size selection should

be based on facial measurements and proportions.

In Myanmar, there are no studies linking facial proportions with the size of anterior maxillary teeth that could be used as guide for determining/defining the maxillary anterior teeth dimensions. Therefore, the purpose of the present study is to determine the presence of proportional relationships among facial and anterior teeth measurements and to analyze the biometric ratios between facial and dental proportions in Myanmar population for anterior teeth selection.

## Material and Methods

18-25 years aged Myanmar subjects from Yangon and Mandalay were selected according to selection criteria. Sample size is 404.

### Inclusion Criteria

1. Myanmar subjects aged ranging from 18 to 25 years

2. All subjects have well aligned natural maxillary anterior teeth

### Exclusion Criteria

1. Apparent loss of tooth structure due to attrition, fracture, caries or restorations

2. Gingival or periodontal conditions or therapy that would undermine a healthy tissue to tooth relationship

3. Interdental spacing, crowding, rotation

4. Restored anterior teeth

5. History of Orthodontic treatment

6. Asymmetry of the face

7. Obvious problems that could disfigure or otherwise affect the face and dentition

All subjects were thoroughly explained about the study procedure and taken written consent to participate in this study. The study had been approved by the Ethics Committee of the University of Dental Medicine, Yangon.

## Natural tooth measurements

Irreversible hydrocolloid impression of the maxillary jaw was made (Aroma Fine Plus, GC Co., Japan) and the cast was poured in hard stone (Fuji Rock, Type IV Die stone, GC Co., E.U.). A small quantity of the mixed impression material was applied on the labial surfaces of the anterior teeth before the bulk of the tray was inserted into the mouth. The impression was disinfected with 0.5 % NaOCl solution for 10 minutes and immediately poured in stone using a vibrator and kept until completely set. Standard proportions, mixing temperature and time were used for both the impression material and the cast material. All impression procedures were performed according to the standardized methods used in the department. Measurements were made directly on the casts using a digital caliper (0.01mm precision).
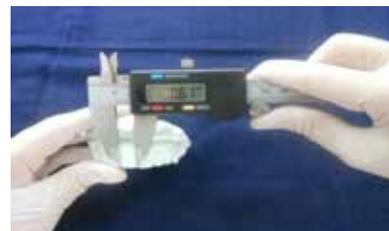


Figure 1. Measurement on study cast by digital caliper

Clinical crown width (IW) and height/length (IL) of the right maxillary central incisors were measured. Total width of anterior six teeth (ASW) was also measured on the cast using a transparent Mylar strip. The strip was placed over the labial surfaces of the maxillary anterior teeth from distal surfaces of left to right canine. Arc distance was marked with a 0.1 mm pointed tip permanent marker.



Figure 2. Measurement of ASW by Mylar strip

The strip was then kept on a flat white background, and the distance between the two marks was measured with a digital caliper.

**Facial measurements**

Facial measurements were taken with the subject seated in a dental chair, Frankfort plane parallel to the floor. Greatest bizygomatic width (BZW) of each subject was measured by using a face bow and millimeter ruler as suggested by Zarb et. al. (1990) and then accurate measurements were taken with the help of digital caliper.



Figure 3. Measurement of Facial Dimension by face bow and digital caliper

Facial length/height (FL) was also measured by digital caliper from the hairline to the lower edge of the mandible at rest. All the measurements were done for three times and average values were recorded. The recorded data was analyzed statistically.
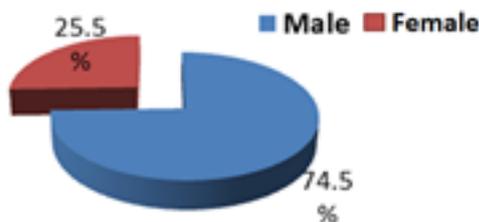
**Results**



Figure4 . Percent distribution of male and female

This figure shows the percent distribution of male and female subjects of this study. (Male = 74.50%, n = 301; Female = 25.50%, n = 103)

Table 1. Facial dimensions and anterior teeth dimensions of study subjects

| parameters | Male (mean±SD) | Female (mean±SD) | Total (mean±SD) |
|---|---|---|---|
| FL (mm) | 190.13±8.1 | 180.81±7.8 | 187.75±9.0 |
| IL(mm) | 10.26±0.6 | 9.8±0.7 | 10.14±0.7 |
| BZW (mm) | 141.73±5.9 | 135.89±5.3 | 140.24±6.3 |
| IW (mm) | 8.4±0.4 | 8.1±0.4 | 8.34±0.4 |
| ASW (mm) | 54.41±2.5 | 52.31±2.3 | 53.88±2.6 |

All four hundred and four Myanmar subjects' mean values of facial dimensions and anterior teeth dimensions were shown in Table 1. It shows the parameters of this study, facial length (FL), incisor length (IL), bizygomatic width (BZW), incisor width (IW) and anterior six teeth width (ASW) in millimeter.

Table 2. The biometric ratios between facial dimensions and teeth dimensions

| Ratio | Mean± SD | 95%CI | |
|---|---|---|---|
| | | Lower | Upper |
| BZW:IW | 16.84±1.0 | 16.7500 | 16.9488 |
| BZW:ASW | 2.60±0.1 | 2.5932 | 2.6211 |
| FL:IL | 18.59±1.4 | 18.4520 | 18.7386 |

Table 2 represents the analysis of biometric ratios between bizygomatic width and the width of right maxillary central incisor and the width of six maxillary anterior teeth, and also the biometric ratio between facial length and length of right maxillary central incisor.

Table 3. Linear regression analysis (BZW vs IW)

| | B | Std. Error | t | P |
|---|---|---|---|---|
| Constant | 6.075 | 0.468 | 12.991 | 0.000 |
| BZW (mm) | 0.016 | 0.003 | 4.8538 | 0.000 |

IW=6.075 + (0.016 x BZW), Dependent variable: (IW) Incisor width (mm),Predictors: (Constant), (BZW) bizygomatic width (mm)

Linear regression analysis shows that bizygomatic width (BZW) is significant predictor of the incisor width (IW) ($p < 0.001$).
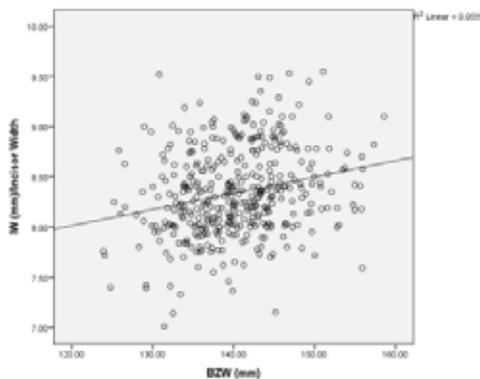
Figure 5. Linear regression analysis to evaluate the relationship between bizygomatic width (BZW) and incisor width (IW)

Scatter plot shows statistically significant positive correlation between incisor width (IW) and bizygomatic width (BZW) (r=0.235, r2=0.055, p<0.001). According to linear regression, correlation is not very strong.

Table 4. Linear regression analysis (BZW vs ASW)

|          | B      | Std. Error | t      | P     |
|----------|--------|------------|--------|-------|
| Constant | 34.485 | 2.731      | 12.628 | 0.000 |
| BZW (mm) | 0.138  | 0.019      | 7.111  | 0.000 |

ASW = 34.485 + (0.138 x BZW), Indicates p<0.001, Dependent variable: (ASW) anterior six teeth width (mm), Predictors: (Constant), (BZW) bizygomatic width (mm)

In this study, it is likely that the anterior six teeth width increase by 0.138 mm for every 1mm increase in bizygomatic width (BZW).
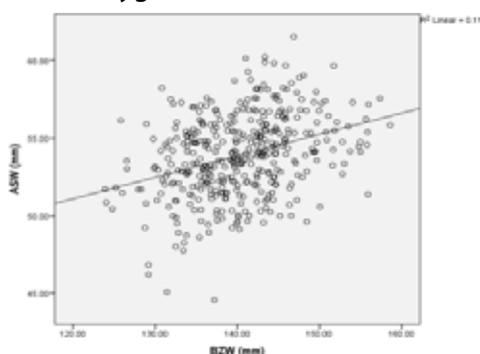


Figure 6. Linear regression analysis to evaluate the relationship between bizygomatic width (BZW) and anterior six teeth width (ASW)

Scatter plot shows the relationship between the values of anterior six teeth width (ASW) and bizygomatic width (BZW). (r=0.334, r2=0.112, p<0.001).

Table 5. Linear regression analysis (FL vs IL)

|          | B      | Std. Error | T     | P     |
|----------|--------|------------|-------|-------|
| Constant | 7.1333 | 0.746      | 9.557 | 0.000 |
| FL       | 0.016  | 0.004      | 4.038 | 0.000 |

IL=7.133 + (0.016 x FL), Indicates p<0.001, Dependent variable: (IL) incisor length (mm), Predictors: (Constant), (FL) face Length (mm)

Linear regression analysis shows that face length (FL) is significant predictor of the incisor length (IL) (p< 0.001).In this study, it is likely that the incisor length increase by 0.016 mm for every 1mm increase in bizygomatic width (BZW).
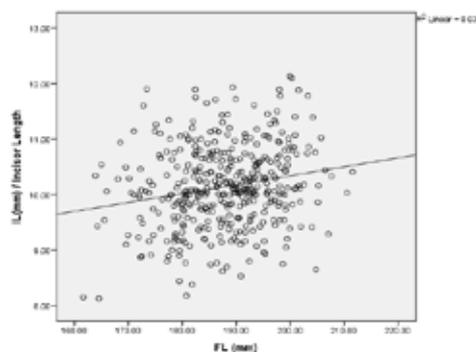


Figure 7. Linear regression analysis to evaluate the relationship between face length (FL) and incisor length (IL)

Scatter plot shows the relationship between the values of face length (FL) and incisor length (IL) (r=0.197, r2= 0.039, p<0.001).

**Discussion**

Decision on the selection of appropriate artificial teeth has to be based on proper dimensions, ratios and proportions. Since the position of maxillary anterior teeth has the strongest influence on aesthetics and only few guidelines exist for their ratios and proportions, it is reasonable to correlate and define the biometric ratios, average proportions and formulae in

intact dentition of Myanmar population.

## Central Incisor dimensions

The mean incisor width and length from this study is 8.34 mm and 10.14 mm, respectively. The mean values of this result are nearly the same with previous study (ThiriKyaw, 2008), which were 8.39mm for incisor width and 10.01mm for incisor length. Scandrett (1982) studied on Caucasians and found that the maxillary central incisor width for the right side to be 8.6 mm and for the left side to be 8.5mm. MacGregor (1989) also stated that the width of most natural maxillary central incisor is over 8.5 mm and any tooth less than 8 mm is rare. Therefore, Caucasian central incisor teeth were larger than that of Myanmar.

## Facial Dimensions

Bizygomatic width for Caucasians was 136.5 mm as described by Scandrett (1982). Al Wazzan (1995) studied on the Saudi patients and found that the mean bizygomatic width was 128.38 mm. According to Farkas (2005), in North American Whites (NAW) young adult population, bizygomatic width is 133.5 mm and face length is 180 mm. Therefore, Myanmar people have larger facial dimensions than that of Caucasians.

## Biometric Ratios

In the study of Lucas (2012) the measurements of mid-pupillary distance and bizygomatic width of the face were compared to the width of the maxillary central incisors and found that only the bizygomatic width technique showed values similar to the real width of the maxillary anterior teeth. Al-El-Sheikh (1998) studied on the relationship of the bizygomatic width, central incisor width and the width of the maxillary anterior teeth in Saudi population. The results showed that 1:16 ratio does not exist in Saudi population and the width of maxillary anterior teeth can be estimated through the bizygomatic width and the multiplying factor of 2.2 for both females and males. Praveen (2008)

also studied on the relevance of Pound's Formula to Indian Population. The study was conducted among 240 students in a dental school representing the different ethnic groups of India selected for anthropometric study. According to this study, Pound's formula is not applicable to Indian population. The new formula derived from the measured values is Intercanine width= Bizygomatic / 2.4 and Width of the central incisor = Bizygomatic width / 14.6. Oshagh (2009) studied on the relation between craniofacial dimensions and teeth size and stated that proportions of bizygomatic widths to upper centrals were 14.9 on right side and 14.7 on left side. According to the present study, the new biometric ratio derived from the measured values is Intercanine width= Bizygomatic width/ 2.6 and Width of the central incisor = Bizygomatic width / 16.9.It might be due to the smaller teeth size and/or larger face size of Myanmar people than those of other populations.

## Relationship between facial and anterior teeth dimensions

When the bizygomatic width was plotted against anterior six teeth width, a fairly strong correlation coefficient of 0.334 was exhibited. A weaker but highly correlation coefficient of 0.235 was observed when the bizygomatic width plotted against the central incisor width. A linear regression analysis was used to formulate a general equation to predict the central incisor width, central incisor length and anterior six teeth width measurement successfully. The resulted linear formulae can be used to estimate the central incisor width, central incisor length and anterior six teeth width from the face dimension. In this study, width and length of the anterior teeth might be estimated from the following regression equations: width of maxillary central incisor IW = 6.075 + (0.016 x Bizygomatic width); anterior six teeth width ASW = 34.485 + (0.138 x Bizygomatic width); length of maxillary central incisor IL = 7.133 + (0.016 x Face Length). This method produced consistent and more

objective results when compared to visual assessment or visual matching which are more subjective and depend on personal experience and taste rather than actual metric principles. Moreover, the use of regression formulae may aid in the selection of artificial teeth for complete dentures, especially for relatively inexperienced clinicians.

## Conclusion

From the results of this study, the following conclusions might be drawn:

(1) The new biometric ratios are; 1:16.84 for maxillary central incisor width with bizygomatic width, 1:2.6 for maxillary anterior six teeth width with bizygomatic width and 1:18.59 for maxillary central incisor length and face length. These can be used as a guide for the selection of the sizes of artificial teeth in Myanmar population.

(2) The following regression formulae may also be used as aids in the selection of the sizes of artificial anterior teeth for Myanmar edentulous patients. Width of maxillary central incisor IW = 6.075 + (0.016 x Bizygomatic width); Anterior six teeth width ASW = 34.485 + (0.138 x Bizygomatic width); Length of maxillary central incisor IL = 7.133 + (0.016 x Face Length).

The main benefits of this study are the clinicians whose patients are of Myanmar origin who now have a biometric ratio and a formula method of determining the anterior teeth size for rehabilitating edentulous patients.

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