

Evaluation of dimensional (width-to-length) ratio for the aesthetic replacement of maxillary anterior teeth

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Abstract

An important element of prosthetic treatment for edentulous patient is selecting the size of anterior artificial teeth that will restore the natural harmony of dentofacial structure. Although various guidelines for anterior teeth selection have been examined in a number of studies, most of them were intended for white subjects. The purpose of this study was to determine the dimensional (width-to-length) ratio of maxillary central incisor teeth in Myanmar population as an aesthetic guide for selection of maxillary anterior teeth. A total of 404 subjects comprising male and female were studied. Their age ranged from 18 to 25 years with the mean age of 22 years. Cast measurements were made with digital caliper having a resolution of 0.01 mm. The mean values for anterior teeth dimensions were: Incisor Width (IW) = 8.34mm and Incisor Length (IL) = 10.14mm. From the results of this study the new guideline of dimensional ratio is 82.50 for Myanmar population and positive significant correlation existed between width and length of anterior teeth measurements ($p=0.01$). The regression formula was: $IL = 2.545 + (0.911 \times IW)$. The clinical significance of this study is the clinicians whose patients are of Myanmar

origin will have a guideline ratio and a formula method for determining the anterior teeth size for rehabilitating edentulous patients.

Introduction

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 [1]. Poor aesthetics is a drawback of maxillary complete denture success.

Aesthetics and harmony of the human body have been for ages sources of research and inspiration for scientists, artists and also in dentist. Lombardi (1973) was the first to suggest the application of the golden proportion in dentistry [2]. Leven (1978) created grids in the golden proportion, which relate the width of the space occupied by central incisors and half the total width of the smile [3]. Several authors have presented guidelines regarding anterior aesthetics in order to achieve excellent aesthetics. One of the most important guidelines

is the golden ratio (width-to-length ratio). The ideal golden ratio has been determined to be 0.75 to 0.80 mm, (Lombardi, 1973). Lee (1964) stated that an essential pleasing characteristic of a tooth should be that its length is greater than its width [4]. One of the unpleasant changes which occur in the natural teeth is the excessive wearing of the incisal third, thereby decreasing the length of the teeth. The alterations to the length of teeth are frequently inevitable during the adjustments needed to produce satisfactory occlusion and articulations. Therefore, every effort should be made to maintain the correct width-to-length ratio particularly of the central incisor teeth. The relationship of width-to-length of a tooth is important because, if two teeth are of the same width and different lengths, the longer tooth will appear to be narrower (Lombardi, 1973).

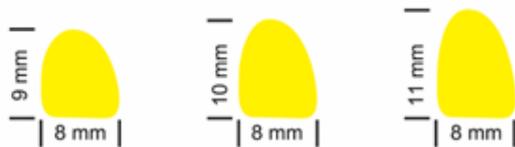


Figure 1. A. Wide tooth > 0.8 , B. Normal tooth (ratio $0.75 - 0.8$), C. Narrow tooth < 0.75

Several investigations have been conducted to examine tooth dimension and proportion. However, most of these studies were conducted in white populations. The purpose of this study was to investigate the dimensional (width-to-length) ratio in Myanmar population for maxillary anterior teeth selection.

Materials 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. Natural-borne 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

All subjects were thoroughly explained about the study procedure and taken consent to participate in this study.

Study Procedure

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 (0.01 mm precision).



Figure 2. Measurement on study cast by digital caliper

Clinical crown width (IW) and height/length (IL) of the right maxillary central incisors were measured. All the measurements were performed three times by the same author and the average values were recorded. The recorded data was analyzed statistically.

Results

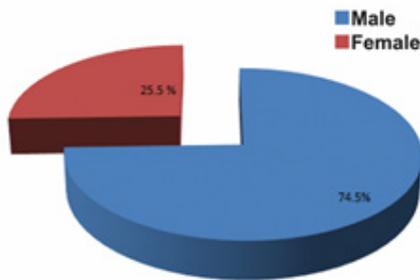


Figure 3. Percent distribution of male and female

Figure 3 represents the percent distribution of male and female subjects in this study. (Male = 74.50%, n = 301), (Female = 25.50%, n = 103)

All four hundred and four Myanmar subjects' mean values of anterior teeth dimensions were shown in Table 1.

parameters	Male (mean±SD)	Female (mean±SD)	Total (mean±SD)
IL(mm)	10.26±0.6	9.8±0.7	10.14±0.7
IW (mm)	8.4±0.4	8.1±0.4	8.34±0.4

Table 1. Anterior teeth dimensions of study subjects

Table 2 represents the percent of width-to-length ratios of incisor teeth. The mean value is 82.5009 percent.

Percent of width to length		Statistic
Mean		82.5009
95% Confidence Interval for Mean	Lower Bound	81.9966
	Upper Bound	83.0051
Std. Deviation		5.15610
Minimum		69.08
Maximum		98.35

Table 2. Analysis of Incisor Width-to-Length ratios

Figure 4 shows percent of width-to-length ratio. 36% of the 145 subjects were within 81% to 85%. The majority of the patients (86%) fell within 76% to 95% and the mean value is 82.50%.

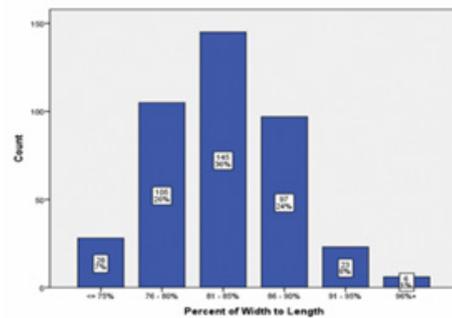


Figure 4. Analysis of width to length ratio of right maxillary central incisor

Scatter plot shows the relationship between the values of Incisor width (IW) and Incisor length (IL) ($r=0.541$, $r^2=0.293$, $p=0.000$). The regression formula was: $IL = 2.545 + (0.911 \times IW)$.

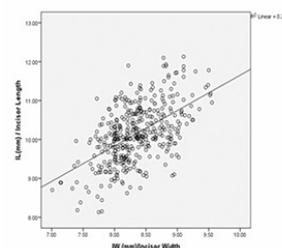


Figure 5. Linear regression analysis to evaluate the relationship between Incisor width (IW) and incisor length (IL)

Discussion

Proportion is the certain ratio between parts, and proportional means a proper correlation of parts among themselves. Tsukiyama (2010) stated that the comparison of crown width-to-length ratios in Asian and White subjects revealed a significant difference in all maxillary anterior teeth including premolars [5]. This result suggests that racial difference should be considered in the prosthodontic and restorative treatment of the maxillary anterior area.

In this study, the widest mesio-distal portion and longest apical-coronal portion of each maxillary anterior tooth were measured on the dental casts, and the width-to-length ratios (W/R %) were calculated. The mean incisor width is 8.34mm and length is 10.14mm, which were nearly the same with our previous study [6].

In Scandrett (1982), Maxillary central incisor width for right side is 8.6mm in Caucasians [7]. In 1980, Mavroskoufis studied on London dental students, the mean value for the mesiodistal crown width to be 8.90mm for the right side of central incisor [11]. In Myanmar population, the mean central incisor width is ranged from 7.01 to 9.55mm with a mean of 8.34mm. So, Caucasians' central incisor teeth were larger than Myanmar's.

The crown width-to-length ratio was accepted to be the most stable reference, as it showed minimal variations between the genders. Gillen et. al. (1994) also suggested that the width-to-length ratios of maxillary anterior teeth were not affected by gender, either in white or black populations [8].

Since the 1990s, crown width-to-length ratio has been considered the most important and valuable factor for achieving an esthetic outcome in the maxillary anterior

dentition. While changes in tooth length can occur as a result of aging process, tooth width generally remains constant. Tooth length can be calculated with the following equation: $L = W / \text{tooth proportion } \%$, where the mean tooth proportion ratio for Myanmar population is 82.50.

In the study of Zlataric (2007) in Croatia, the mean value of central incisor width-to-length ratio (W/R %) was 82.89% which is very similar with this study population [9]. In a study by Brisman (1980), a width-to-length ratio of 75% was preferred when a variety of tooth shapes were assessed by dental students and patients [10]. It was also stated that the maxillary anterior teeth, especially the central incisors, should have a width-to-length ratio of approximately 80% to achieve the best appearance. However, Hasanreisoglu (2005) found that a significant difference was observed when the mean value of the width-to-height ratio of central incisor was compared with the proportion of 80% in both genders [11].

Wolfart (2006) also showed that width-to-length ratio of upper central incisor is 0.82. So, 82% width-to-length ratio was perceived as the most attractive for normal central incisor although there is variability in the responses [12]. There is a definite trend towards the extremes of very long or very short teeth being less attractive. Wolfart (2006), Sterret (1999) and Magne (2003) also suggested the proportion according to the attractiveness judged by dental professionals and patients. They proposed that central incisor's width-to-length ratio should be up to 85% [12, 13, 14]. Copper (2012) also stated that the ideal length can be calculated by multiplying the known width by $1/0.82$ [15].

In this study, the width to length ratios of the central incisors exceeded the proportion

of 80% suggested as ideal for an attractive appearance in Myanmar population. It was also found that approximately 36% of the 145 subjects were within 81% to 85%. The majority of the patients (86%) fell within 76% to 95% and the mean value is 82.50%.

Again, ratios ranging from 69% to 98% were recorded, compared to ratios ranging from 76% to 86% noted in the dental literature. That is, the width-to-length ratio of the maxillary central incisor was found to be greater than those suggested in previous studies, which might be attributed to differences in racial characteristics.

Moreover, it appears that the maxillary anterior teeth of the Myanmar population group studied display a more square form due to the teeth having shorter length than those of other populations.

In addition, the proportions obtained in this study could be helpful in clinical practice, as well as in the dental artificial teeth mould manufacturing.

Conclusion

From the results of this study, proportionate anterior teeth size can be calculated with the following ratio and equation:

- $L = W / \text{tooth proportion } \%$, where the mean tooth proportion ratio for Myanmar population is 82.50.
- Incisor Length $IL = 2.545 + (0.911 \times \text{Incisor Width } IW)$

The main beneficiary of this study is the clinicians whose patients are of Myanmar origin will have width-to-length ratio and a formula method for determining the anterior teeth size for rehabilitating edentulous patients.

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