Maxillary central incisor dimensions and its association with lower anterior facial height

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ABSTRACT

Background & Objectives: Maxillary anteriors are the major teeth displayed during the smile and have a dominant role in the dentofacial appearance. As the dimensions of incisors vary with various facial dimensions, this study aimed to find out the ratio of width to height of the maxillary central incisor and correlate it with the lower anterior facial height. **Materials & Methods:** One hundred participants (50 male and 50 female) were enrolled in this study. The width-height ratio of maxillary central incisor was calculated by measurements made in the photographs with Image J software. Lower anterior facial height was measured as the distance between subnasale and lower border of the chin with the help of digital vernier caliper. Correlation between width-height ratio and lower anterior facial height was done with Pearson's correlation. **Results:** The width height ratio of maxillary central incisor was found to be 0.86 for male and 0.89 for female. This ratio was statistically insignificant when compared between gender and sides. There was negligible correlation between this ratio and lower anterior facial height. **Conclusion:** Mean Width-height ratio of maxillary central incisor obtained from this study would serve as a guide in esthetic enhancement of the maxillary anterior dentition.
Key words: Esthetics, Lower anterior facial height, Maxillary central incisor, Proportion, Width-Height ratio

INTRODUCTION

With increasing public awareness of esthetics, dental professionals are findings ways to improve the appearance of the teeth which in turn add beauty to the face. Maxillary anteriors are the teeth mostly displayed during the smile and play an important role in the overall facial esthetics and influence the social attractiveness.[1] Besides their alignment; the shape, size, colour and symmetry of the maxillary anteriors are important considerations to the clinician.[2] As maxillary central incisors occupy 50% of the apparent dimension of all the anteriors, it has dominant effect in the smile esthetics.[3]

The width height ratio of maxillary incisors has been widely studied to harmonize it with the smile. It is believed to play a vital role in the esthetic outcome of the maxillary anterior teeth. As mesiodistal dimension is relatively stable, width-height ratio of a tooth often serves as a guide in restoration of reduced crown height due to trauma or attrition. Hence, this ratio is quite important for restorative planning, prosthetic replacement, esthetic gingival surgical procedure, and during finishing stage of orthodontic treatment. In search for an ideal ratio, several authors proposed various ratios- 0.72,[4] 0.76,[5] 0.78,[4, 6] 0.79,[7] 0.80,[8] 0.85,[9] 0.85 - 0.86,[10] 0.89-0.91.[11]

Many studies had correlated the dimensions of maxillary incisors with the inter-pupillary distance, inter-canthal distance, inter-alar distance, intercommisural width, and bizygomatic width.[12] Less emphasis has been given in the vertical dimension of face when correlating it with the dimensions of central incisor. This study aimed to find out the ratio of width to height of the maxillary central incisor in a Nepalese sample and correlate it with the lower anterior facial height.

MATERIALS AND METHODS

Ethical clearance to undertake this research has been obtained from NHRC (Nepal Health Research Council). A sample of 100 (50 males and 50 females) participants were enrolled in this study. The inclusion criteria were Class I molar relation,

class I canine relation with well aligned maxillary central incisors, no midline diastema, no gingival recession, no gingival inflammation and no attrition of the incisal edge as seen clinically. They were excluded if they had undergone prior orthodontic or restorative therapy involving maxillary central incisor. Informed consent was obtained from all the participants prior to the enrollment.

Lower anterior facial height was measured as the distance between subnasion and the lowermost border of the soft tissue chin. It was measured with a digital caliper with patient seated upright in the chair with jaw in relaxed position. Each participant was asked to recline in the dental chair and intra-oral frontal photograph was taken with cheeks retracted with the help of photographic retractor by single investigator (RG). A Nikon D 5100 DSLR camera was used with the lens of the camera perpendicular to the labial surface of the maxillary central incisors taking care of the rotation of patient's head.[13]

After the photographs were taken, they were uploaded in the computer and the dimensions of the teeth measured with the software ImageJ 1.49 (freely available at http://imagej.nih.gov/ij/). Calibration was not important as only the ratio of the dimensions of the central incisor was taken into consideration. All the data were entered in Excel 2013 and statistical analysis was done with SPSS version 20. All the measurements were made by a single investigator (RG).

Measurements of lower anterior facial height and dimensions of maxillary central incisors were repeated in randomly selected 25 samples at least two weeks from the first measurements. Descriptive statistics were calculated for all measurements along with 95% confidence interval. Gender differences were compared with independent t-test. Correlation analysis was done to find the correlation between the width– height ratio of maxillary central incisor and the lower anterior facial height.

RESULTS

This study included 100 samples with 50 males and 50 females. The mean age was 22.23 ± 1.99 years. Kolmogorov-Smirnov and Shapiro-Wilk tests were done to check the distribution of lower anterior facial height and width-height ratio of maxillary central incisors. The p values were above 0.05 indicating the normal distribution of these variables. Twenty-five samples were randomly selected and

the lower anterior facial height as well as width-height ratio was re-measured. Intra-class correlation coefficient was found to be 0.92 and 0.98 for width-height ratio and lower anterior facial height respectively showing excellent reliability.

Mean WH ratio of maxillary central incisor was 0.87 and 0.88 for right and left side respectively. Paired t-test showed no statistically significant difference in the width-height ratio of maxillary central incisor between right and left side (Table 1). Hence, average of right and left sides were derived for further comparisons.
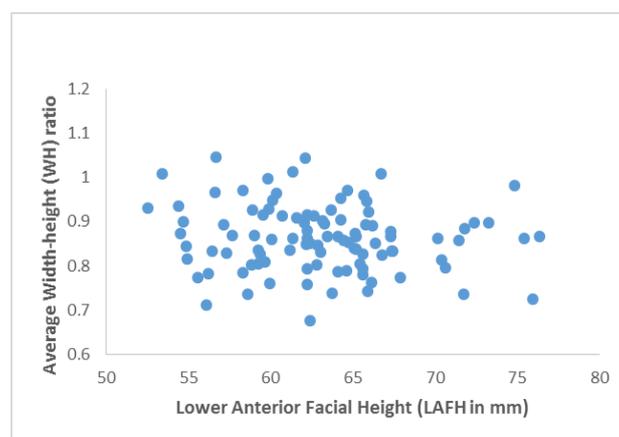

Figure 1. Scatter plot demonstrating the relationship between LAFH and WH ratio.

Mean WH ratio of maxillary central incisor was found to be 0.86 for male and 0.89 for female which is statistically insignificant difference when compared with independent sample t-test (Table 2 and 3).

Mean LAFH was 65.66 ± 4.70 mm and 60.25 ± 3.92 mm for male and female respectively showing significantly more LAFH in male than female (Table 2). The relationship between LAFH and WH ratio was evaluated with scatterplot (Figure 1). LAFH showed negligible correlation (Pearson's coefficient of -0.15) with WH ratio and there was not sufficient evidence (p= 0.142) to suggest this correlation as well.

DISCUSSION

This study aimed to find out the width-height ratio of maxillary central incisor and its association with lower anterior facial height. The size of maxillary central incisor has been extensively studied in extracted teeth,[4, 6] study models,[14-17] clinically [18] as

Table 1. Paired t-test for the difference between WH ratio of right and left side.

Teeth	Mean	SD	SE	95% CI		t	df	Sig. (2-tailed)
				Lower	Upper			
(11-21)	-0.007	0.044	0.004	-0.016	0.002	-1.586	99	0.116

11: Maxillary right central incisor   SD: Standard Deviation

21: Maxillary left central incisor   SE: Standard Error of mean

CI: Confidence Interval

Table 2. Descriptive statistics for lower anterior facial height and WH ratio

	Male				Female				Total			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
LAFH	65.66	4.70	56.20	76.34	60.25	3.92	52.52	70.62	62.95	5.10	52.52	76.34
WH ratio	0.86	0.07	0.67	1.00	0.89	0.08	0.70	1.06	0.87	0.08	0.67	1.06

LAFH: Lower anterior facial height   WH ratio: Width-height ratio of maxillary central incisor

SD: Standard deviation   Min: Minimum

Max: Maximum

Table 3. T-test for the difference between WH ratio between male and female.

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Male-female WH ratio	-1.850	98	0.067	-0.028	0.015	-0.059	0.002

Table 4: Comparison of WH ratio of maxillary central incisor in various population.

SN	Author	Population	Male	Female	Mean MF
1	Olsson et al[5]	Swedish	---	---	0.76
2	Magne et al[6]	White	---	---	0.78
3	Sandeep et al[7]	South Indians	0.80	0.79	0.79
4	Sterrett et al[10]	Georgians	0.85	0.86	---
5	Hasanreisoglu et al[11]	Turkish	0.89	0.91	---
6	Tsukiyama et al[4]	Asian (Japanese)	---	---	0.72
		White (Swedish)	---	---	0.78
7	Radia et al[18]	British	0.84	0.85	0.85
8	Gyawali and Singh (this study)	Nepalese	0.86	0.89	0.87

well as photographically.[4] Also its dimensions have been correlated with the various facial landmarks guiding clinicians for esthetic planning of the anterior dentition.

The mean WH ratio in this study was found to be 0.86 and 0.89 for male and female respectively. The ratio was higher as compared to the study done by Olsson et al,[5] Magne et al,[6] Sandeep et al,[7] Radia et al,[18] Tsukiyama et al,[4] whereas it is comparable with the study done by Sterrett et al,[10] and Hasanreisoglu et al[11] (Table 4).

Maxillary anterior teeth size varies among races and

the gender differences is also noted as well.[19, 20] Males tend to have wider and longer maxillary anteriors as compared to female.[10, 11, 21, 22] This study compared the width-height ratio of maxillary central incisor, not the absolute value. The crown width-height ratio is considered as the most stable reference with less variation between the races and the genders.[10, 14, 19] This study also showed no statistically significant difference when WH ratio was compared between male and female using t-test. Similar result was obtained when the WH ratio of maxillay central incisor was compared between sexes by Shahid et al[14] in Pakistani sample, Sah et al[16] in Central Chinese, Sterrett et al[10] in Georgians, and Sandeep et al[7] in South Indians. However, few studies discovered statistically significant difference in WH ratio of maxillary central incisor between male and female.[17, 23]

The incisal edge of the incisors gradually show attrition with increasing age, as a result of which the clinical crown height decreases but the width is relatively stable. Knowing the ratio would guide the clinician to restore the vertical height if the width is preserved. Ideal ratio should be derived from unworn dentition as the width-height ratio significantly changes when it is measured in attrited dentition.[4] This study excluded samples with significant attrition of incisal edge. Further, age of the sample was limited to 25 years which is comparable with the age range of similar reported studies.[7, 14]

This study found negligible correlation between width-height ratio of maxillary central incisor and the lower anterior facial height. The shape and size of the incisors have been found to correlate with the various facial dimensions in the literature. Ratio of the width of the maxillary central incisor to bizygomatic width was found to be 1:16 by Berry,[24] to interpupillary line as 1:6.93 by Al-Kaisy et al,[12] 1:6.5 to 1:7 by Cesario et al,[25] 1:7.7 for male and 1:7.5 for female by Hasanreisoglu et al[11]; to the intercanthal distance by 0.618:226 , 0.267:1.[27] Also, regression equations have been derived for the estimation of the width of central incisor taking various facial measurements.[28]

Similarly, investigating into the vertical dimension, Radia et al[18] proposed the ratio of the height of the central incisor to the total facial height (trichion to menton) to be 1:18 and, to the facial height (nasion to menton) as 1:12 but only as initial guide. They further warned the deliberate application of any such ratios as strong relationship could not be verified between maxillary central incisor proportion and facial proportion. Furtado et al[29] found that none of the horizontal or vertical measurements of the face could predict the dimensions of maxillary central incisor crown.

CONCLUSION

- Mean Width-height ratio of maxillary central incisor was found to be 0.86 for male and 0.89 for female.
- No statistically significant difference in width-height ratio of maxillary central incisor when compared between sides and gender.
- Negligible correlation exists between width-height ratio of maxillary central incisor and the lower anterior facial height.
- This ratio would serve as a guide in esthetic enhancement of the maxillary anterior dentition, however psychosomatic norms of each individual should also be given priority.

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