Original Article

Correlation of Mesiodistal width of Maxillary Central Incisor with Inner Canthal Distance using Decreasing Function of Golden Ratio

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ABSTRACT

Objective: To determine correlation between Mesiodistal width of Maxillary central incisor and golden ratio of inner canthal distance among dentate patients.

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Prosthodontics, Faryal Dental College, Sheikhupura from 1st October 2016 to 2nd October 2017.

Materials and Methods: Five hundred and fifty dentate Pakistani subjects with age ranging from 18 to 35 years, having no dental or facial deformations were analyzed. The central maxillary incisors were measured mesiodistally between the interproximal contact points and inner canthal distance by the help of veriner calipers. The width of the central incisor was predicted by multiplying the inner canthal distance with 0.618 (a decreasing function value of the golden ratio) and was then divided by 2.

Results: The statistically significant result (P-value<0.05) of this study proved that there is weak correlation between the observed mesiodistal width of central maxillary incisors and calculated central maxillary incisor width when the inner canthal distance was subjected to golden ratio.

Conclusion: The use of decreasing value of golden ratio of Inner Canthal Distance was not a reliable predictor to select maxillary central incisor width for edentulous patients.

Key Words: Esthetics, incisors, edentulous, inner canthal distance, golden ratio

INTRODUCTION

One of the primary objectives of prosthodontists is to achieve optimal esthetics without compromising function. Face is the most visible part of the body and smile plays a significant role in boosting self-confidence and self-esteem. The loss of anterior teeth often leads to a psychological trauma to the patient as it affects esthetics and thus self-esteem. Appropriate tooth selection and placement by using the art of dentogenics for creating an illusion of natural teeth has a positive effect on patient's self-esteem and quality of life.[1]

The recent development in computation techniques has led to more predictable and esthetically pleasing results. Towards this end, type and dimensions of the maxillary anterior teeth are necessary for both dental and facial esthetics. The central maxillary incisors due to its strategic dentolabial position in the arch makes them more noticeable when viewed from front. Schillingburg et al[2] showed that the combined width of maxillary central incisors, lateral incisors and canines accounted for 37%, 31% and 32% respectively.

On the basis of facial anthropology, different anthropometric measurements have been recommended to predict the mesiodistal width of the central maxillary incisors in edentulous patients. These include the intercomissural width[3], bizygomatic width[4-6], interalar width7 and interpupillary distance[8]. Likewise, inner (medial) canthal distance of the eyes has also been suggested as one of the anthropometric feature to predict the width of the central maxillary incisors[9, 10]. By the age of five years the inner canthal distance matures upto 93% [8]. Maturity of ICD is reached between eight and eleven years and no changes in measurements take place after the age of 16 years[4, 8]. Normally ICD varies from 28 to 35 mm[8]. No differences related to sex, race (black or white), or age have been reported making it a reliable anatomical dimension for selection of maxillary central incisor widh.[11]

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At the point when the extent or proportion of a smaller to larger part is the same as the proportion of the larger part to the whole, it is called as golden ratio or a Fibonacci series. On account of their vast significance in geometry and design and their manifestations in nature, these proportions are called as golden proportion or on the other hand golden ratio. The golden proportion is said to play an imperative part in the smile design theory. Some sections of the face have bee accounted for to show golden proportion.

In the literature, various investigators have tried to find out ratios between the different anthropometric parameters and central maxillary incisors width[10]. However, facial anthropometric parameters have not been assessed with golden ratio[12] to establish whether any working relationship exists with the central maxillary incisor width in our population. In golden ratio for any decreasing function, the number is multiplied by 0.618, and for any increasing function, it is multiplied by 1.618.[10]

The goal of this study is to find out whether a correlation exists between mean mesiodistal width of maxillary central incisor and inner canthal distance when ICD is multiplied to decreasing function of golden ratio and to evaluate its significance in predicting mesiodistal width of maxillary central incisor in edentate patients.

MATERIALS AND METHODS

This was a cross-sectional study conducted at department of Prosthodontics, Faryal Dental College, from 1st October 2016 to 2nd October 2017. The sample size was calculated using WHO sample size calculator. Taking mean =28.69 and standard deviation=1.784 of inner canthal distance[10] with 0.15 margin of error and 95% confidence level, the calculated sample size was 550 cases. The non-probability purposive sampling technique was used. All patients of age ranging from 18 to 30 years of either gender were included in the study. Subjects treated orthodontically, with missing maxillary anterior teeth, maxillary anterior teeth interproximal spacing and crowding, anterior teeth restored/ crown and bridge work done, caries or severe attrition in maxillary anterior teeth and congenital or acquired orofacial anomalies, orbital disease, facial trauma or facial surgery subjects were excluded from the study.

The mesiodistal width of maxillary central incisors were determined with Digital Vernier Callipers (Miltex Instrument Co, Viernheim, Germany) measuring to an accuracy of tenth of a millimeter. The interproximal contacts were used as reference points. The measurements were made with the pointed members of the gauge held parallel to the incisal edges and perpendicular to the facial surface of the tooth. Five readings were taken and then the averages of these value were recorded. The average width of a single maxillary central incisor (MCIW) was determine by adding the measurements of both the central maxillary incisors at the interproximal contact points and then dividing it by 2. The inner canthal distance was determined by supporting the subject's head in an upright position and setting the digital vernier caliper against the forehead and delicately contacting the angles of the medial palpebral crevices of the eyes. The average was calculated after measuring the distance between the angles of the medical canthus five times for each subject.

SPSS version 20 was used to analyze data. Mean and SD were calculated for quantitative variables. Frequency and Percentages were calculated for qualitative variables. Pearson's correlation coefficient was calculated. P-value ≤ 0.05 was taken as significant.

RESULTS

Five hundred and fifty subjects fulfilling the inclusion criteria were included in this study. The mean age was 24.68 ± 3.57 years. The mean of combined width of central incisors, mean mesiodistal width of maxillary central incisor, inner canthal distance & golden ratio of ICD were calculated as 17.12 ± 1.14 mm, 8.58 ± 0.47 mm, 31.35 ± 1.88 mm & 9.68 ± 0.58 mm (Table 1). Out of 550 patients, 374 (68%) of the patients included in the study were males and 176 (32%) were females (Fig 1).

The correlation between golden ratio of ICD and MCIW values for all subjects was 0.217. A positive correlation was found when for the golden ratio of inner canthal distance and MCIW variables from Pearson correlation coefficients (r) as presented in Figure 2. The relationship was not strong but significant (P<0.05).

The mean of MCIW and ICD values were recorded for descriptive statistics with respect to gender and age. Correlation was positive and significant (r =0.298 p=0.01) for males while correlation was positive but it is not significant (r= 0.075, p=0.32) for females. However weak positive correlation was also presented with respect to age groups. (Table 2)

Table No. 1. Descriptive statistics of quantitative variables

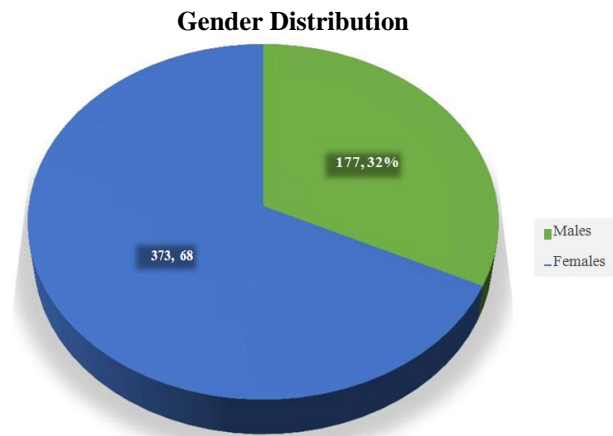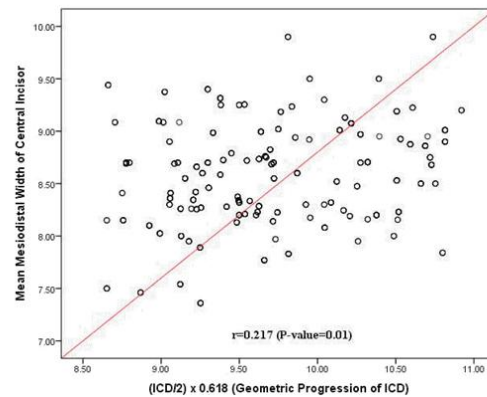| Variables	Mean±SD
Age	24.68±3.57
Combined width of central incisors	17.12±1.14
Mean mesiodistal width of maxillary central Incisors	8.58±0.47
Inner canthal distance	31.35±1.88
(ICD/2) x 0.618 (Golden ratio of ICD)	9.68±0.58

Figure 1: Frequency distribution of gender

Figure 2: Correlation between mean mesiodistal width of maxillary central incisor and golden ratio of inner canthal distance

Table No. 2. Correlation between mean mesiodistal width of central maxillary incisor and golden ratio with respect to gender and age

Variables	MCIW (Mean±SD)	Golden ratio of ICD (Mean±SD)	Correlation between MCIW and golden ratio of ICD (r)	P-value
Gender				
Male (n=373)	8.56±0.46	9.72±0.57	0.298	0.01
Female (n=177)	8.60±0.49	9.60±0.58	0.075	0.32
Age Groups				
18-25 years (n=357)	8.58±0.48	9.66±0.57	0.196	0.01
26-33 years (n=193)	8.57±0.45	9.73±0.59	0.264	0.01

DISCUSSION

In the present study, the mean mesiodistal width of the central incisors is in agreement with the findings of Scandrett et al[13] but is less than the values reported by Woodhead[14] and Cesario et al.[8] When the subjects were separated by gender, a higher mean mesiodistal width of central incisor was found for females than for males. Variation in the mesiodistal width of central incisors based on gender has also been reported by Al-Wazzan[9], Abdullah MA[10], Garn et al[15], Sanin and Savara[16]; and Lavelle[17], however all of these studies showed a higher mean central incisor width of males compared to that of females which the present study does not support. To some extent, the variations may be explained by differences in measuring techniques and in the ethnicities of the populations studied.

The mean inner canthal distance (ICD) of subjects in the present study was almost similar to Freihofer[18], but was less to the values reported by Abdullah et at[19] and Murphy and Laskin[20], and greater than the values reported by Laestadius et al[12]. There was a significant difference between the mean ICD measurements in relation to sex. The males had a significantly higher mean value of ICD

measurements than females. This finding is in accordance with the study carried out by Abdullah MA[10] & K.V. Arun Kumar et al[22]. However, the study carried out by Laestadius et al[21] showed no significant difference in the mean values of ICD when males was compared to females.

In earlier research, inner canthal distance has been studied to a lesser extent in relation to central incisor width. In present study, the correlation between inner canthal distance subjected to decreasing function of golden ratio and central incisor width was found to be weak. The weak relationship between inner canthal distance and central incisor width in males was significant (P<0.05), whereas in female no meaningful relationship was found between these distances (P>0.05). Moreover, the weak positive correlation was found between inner canthal distance and central incisor width with respect to change in age (P<0.05), suggesting that its increase is less age-dependent.

These finding is not in accordance with Abdullah MA[10], George and Bhat[23], Poonam et al.[24] who found that there was a relationship between inner canthal distance and central incisor width when subjecting it to geometric progression. This may be due to the ethnic variation between the populations.

CONCLUSION

Analysis of measurements of inner canthal distance and mesiodistal central incisor done on 550 subjects shows that mean central incisor width was significantly lower in males as compared to females whereas inner canthal distance was significantly lower for females than for males in our population. The results of our study suggests that inner canthal distance in terms of golden ratio may not be a dependable predictor for the selection of central maxillary incisor width for edentulous patients in our population.

Author's Contribution:

Concept & Design of Study:	Muhammad Saad Mateen Munshi
Drafting:	Khurram Nadeem and Fahd Mehtab-ud-Din
Data Analysis:	Khurram Nadeem and Fahd Mehtab-ud-Din
Revisiting Critically:	Muhammad Saad Mateen Munshi, Khurram Nadeem
Final Approval of version:	Muhammad Saad Mateen Munshi

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Wolfart S, Quaas AC, Freitag S, Kropp P, Gerber WD, Kern M. Subjective and Objective perception of upper incisors. J Oral Rehabil 2006;33:489-95.
2. Shillingburg HT, Kaplan MJ, Grace SC. Tooth dimensions–a comparative study. J Soth Calif Dent Assoc 1972; 40: 830-9.
3. Clapp GW. Selecting the forms and sizes in anterior teeth. In: Clapp GW, editor. Prosthetic articulation. 3rd ed. New York: The Dentists' Supply Co; 1914.p. 90-4.
4. Berry FH. Is the theory of temperaments the foundation of the study of prosthetic art? Dentists' Mag 1905;1: 405-11.
5. Williams JL. A new classification of human tooth form with special reference to a new system of artificial teeth. Dent Cansmos 1914; 56: 627-28.
6. House MM. Art – a fundamental in denture prosthesis. JADA 1937; 24: 406-22.
7. Sülün T, Ergin U, Tuncer N. The nose shape as a predictor of maxillary central and lateral incisor width. Quintessence Int 2005;36: 603-7.
8. Cesario VA Jr, Latta GH Jr. Relationship between the mesiodistal width of the maxillary central incisor and interpupillary distance. J Prosthet Dent 1984; 52: 641-3.
9. Al Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. J Prosthet Dent 2001; 86: 608-12.
10. Abdullah MA. Inner canthal distance and golden ratio as a predictor of maxillary central incisor width. J Prosthet Dent 2002; 88: 16-20.
11. Deogade SC, Mantri SS, Sumathi K, Rajoriya S. The relationship between innercanthal dimension and interalar width to the intercanine width of maxillary anterior teeth in central Indian population. J Ind Prosthodont Soc 2015; 15: 91-7.
12. Huntley HE. The divine proportion: a study in mathematical beauty. 1st ed. New York: Dover Publications; 1970.p. 22-9.
13. Scandrett FR, Kerber PE, Umrigar ZR. A clinical evaluation of techniques to determine the combined width of the maxillary anterior teeth and the maxillary central incisor. J Prosthet Dent 1982; 48: 15-22.
14. Woodhead CM. The mesiodistal diameter of permanent maxillary central incisor teeth and their prosthetic replacements. J Dent 1977;5: 93–8.
15. Garn SM, Lewis AB, Swindler DR, Kerewsky RS. Genetic control of sexual dimorphism in tooth size. J Dent Res 1967; 46: 963-72.
16. Sanin C, Savara BS. Permanent mesiodistal crown size. Am J Orthod. 1971; 59: 488-500.
17. Lavelle CL. Maxillary and mandibular tooth size in different racial groups and in different occlusal categories. Am J Orthod 1972;61: 29-37.
18. Freihofer HP. Inner intercanthal and interorbital distances. J Maxillofac Surg 1980; 8: 324-6.
19. Abdullah MA, Stipho HD, Talic YF, Khan N. The significance of inner canthal distance in prosthodontics. Saudi Dent J 1997;9: 36–9.
20. Murphy KW, Laskin DM. Intercanthal and interpupillary distance in the black population. Oral Surg Oral Med Oral Pathol 1990; 69: 676-80.
21. Laestadius ND, Aase JM, Smith DW. Normal inner canthal and outer orbital dimensions. J Pediatr 1969;74:465-8
22. Arun Kumar CKV, Gupta SH, Sandhu HS. Determination of mesiodistal width of maxillary anterior teeth using inner canthal distance. Med J Armed Forces Ind 2015;71: S376–81.
23. George S, Bhat V. Inner canthal distance and golden ratio as predictors of maxillary central incisor width in south Indian population. Ind J Dent Res 2010; 21: 491-5.
24. Poonam B, Satnam S, Arvinder Pal S, Ram Rathan G. Biometric relationship between inner canthal distance and golden ratio for the prediction of maxillary central incisor width. Ind J Dent Sci 2013; 5: 53-6.