

Golden proportion assessment between maxillary and mandibular teeth on Indian population

Naveen Gopi Chander^{1*}, MDS, DNB, Vaikunth Vijay Kumar², MDS, Vedantham Rangarajan³, MDS

¹Department of Prosthodontics, SRM Dental College, Ramapuram, Chennai, India, ²Department of Prosthodontics, Priyadarshini Dental College, Chennai, India, ³Department of Prosthodontics, Sri Venkateshwara Dental College, Chennai, India

PURPOSE. This study evaluated the existence of golden proportion between the widths of the maxillary and mandibular anterior teeth in Indian population. **MATERIALS AND METHODS.** The clinical tooth width measurements were recorded with the digital vernier calipers on 576 patients of both sexes in the age group of 21 - 30 years. Flexible ruler was used to determine the width of maxillary and mandibular anterior teeth on the patients by the same operator. The data obtained was statistically analyzed using paired student t-test ($\alpha=.05$). **RESULTS.** The golden proportion was not found between the width of the right central and lateral incisors in 53% of women and 47% of men. The results revealed the golden percentage was rather inconstant in terms of relative tooth width. **CONCLUSION.** The golden proportion is an inappropriate method to relate the successive widths of the maxillary anterior teeth in Indian population. [J Adv Prosthodont 2012;4:72-5]

KEY WORDS: Esthetic ratio; Golden proportion; Golden ratio

INTRODUCTION

The principles that make up esthetics are subtle.¹ Methodical analysis has revealed that principles can be applied to evaluate and alter dental esthetics with predictability.² Each principle can be considered, recognized, assessed and developed individually in esthetic management.³ Among the esthetic principles, the proportion can be predicted with a formula that defines the ratio of the component from one constituent to the next. The golden proportion (1.618 : 1.0) is a mathematically constant ratio that defines the dimensions between larger and a smaller length. This specific relation is unique, perfect, ideal, and desirable. It has been used from studying beauty to design esthetic restorations.^{4,5} It is also a valuable tool for the evaluation of symmetry, dominance, and proportion in the diagnosis of tooth arrangement and in the application of esthetic dental treatment.⁶ On the contrary, the researchers found that usage of the golden proportion is theoretical and its application is challenging.⁷⁻¹⁰ The studies have shown both the presence and the disapproval of golden proportion. The uncertainty of golden proportion in esthetic analysis and in smile design intended this study to evaluate the existence or presence of golden proportion in Indian population.

MATERIALS AND METHODS

The selected population was approved by a five member panel comprising of 2 restorative dentists, two patients and one resident for esthetics for standardization. The sample size for this study consisted of 576 volunteers, 305 females and 271 males, ranging in age from 21 to 30 years. A random population of acceptable esthetics was selected. The selection criteria required the subjects to have all of their natural anterior teeth with no history of orthodontic treatment, tooth size alteration, spacing and restorations. The volunteers were of Indian origin, their consent and ethical clearances were obtained from the institution ethical committee for the study. The teeth evaluated for maximum width on the incisal edge. Entire procedure was made simple as the patient restorations were evaluated in normal clinical situations rather than in complex environment. The flat end of digital caliper is used to measure the widths of the maxillary central, lateral and canine, mandibular central, lateral and canine. The width of maxillary and mandibular anterior teeth arch width was measured using a flexible ruler. The widths of the teeth were measured at the mesio-distal contact points of teeth (Fig. 1). Anterior teeth width was measured from distal contact point of 13 to distal contact point of 23 in maxilla and

Corresponding author: Naveen Gopi Chander
Department of Prosthodontics, SRM Dental College,
Ramapuram, Chennai, 600089, India
Tel. 91 98407 49441; e-mail, drgopichander@gmail.com
Received October 6, 2011 / Last Revision February 17, 2012 / Accepted February 20, 2012

© 2012 The Korean Academy of Prosthodontics
This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

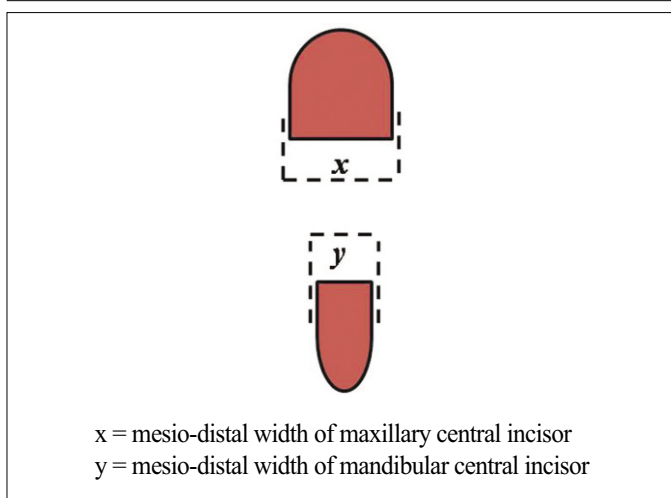


Fig. 1. Mesio-distal width of maxillary and mandibular central incisor.

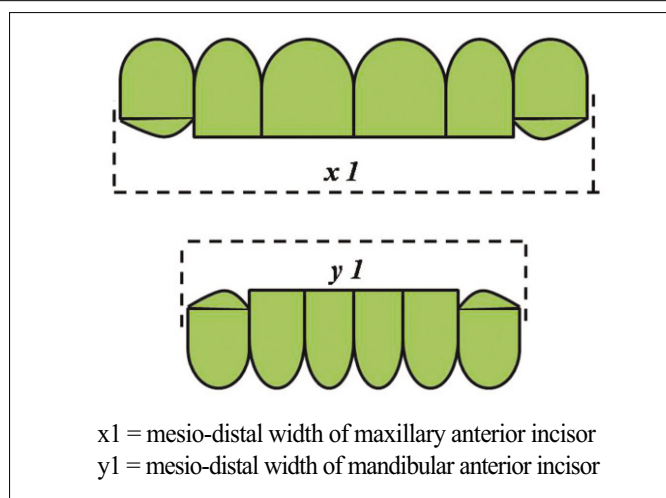


Fig. 2. Mesio-distal width of maxillary and mandibular anterior teeth.

distal contact point of 33 to distal contact point of 43 in mandibular teeth using flexible ruler (Fig. 2). Each measurement was made thrice by the same operator and the repetitive value was used for accuracy and calibration of results.

The golden proportion for each subject was assessed by multiplying the width of the larger component by 62% and compared the width of the smaller component for proportion to be analyzed. The width of central incisor was multiplied by 62% and compared with the width of the adjacent lateral incisor. Similarly the width of the lateral incisor, canine and the maxillary and mandibular teeth were evaluated for golden proportion. The measurements were recorded and statistically analyzed.

RESULTS

Data obtained were entered into Microsoft Excel sheet and analyzed statistically using SPSS statistical package version No. 10. Descriptive statistics were calculated for the frequency of participants having various ratios of golden proportions based on sex. Chi square analysis was used to find if there exists any association between sex and various ratios of golden proportions. Alpha error was set at 5%, and *P* value less than 0.05 was considered statistically significant.

The data revealed no statistical significance in the ratio of golden proportions based on gender. The data obtained from this study is summarized in Table 1. The mean ratio existed between maxillary and mandibular teeth ranged from 73% to 84%. The ratio of 1.2 and 1.3 were more common than 1.618 which is observed in 1% of the samples.

Table 1. Frequency and percentage of ratio in the study sample

Ratio	Males (%)	Females (%)	Total (%)
1.1	2 (0.9%)	3 (0.9%)	5 (1%)
1.2	118 (43.5%)	130 (42.4%)	248 (43%)
1.3	120 (44.3%)	123 (41.1%)	243 (42%)
1.4	27 (10%)	43 (14.1%)	70 (12%)
1.5	2 (0.9%)	3 (0.8%)	5 (1%)
1.6	2 (0.9%)	3 (0.8%)	5 (1%)

Chi square value = 2.88, *P* = 0.7 (Not significant)

DISCUSSION

The golden proportion (1.618 : 1.0) describes the ratio between the dimensions of a larger and a smaller length. Various researchers have opined for and against the use of this mathematic proportions in dentistry.¹⁻⁹ Levin⁴ observed the golden proportion between the width of central incisor, lateral incisor and the canine. George and Bhat¹¹ found that the golden proportion is reliable predictors for determining the width of the maxillary central incisors in the south Indian population. Preston¹² found 17% of his study samples had golden proportion between the width of the maxillary central and lateral incisors. Lombardi¹ recommended a repeated ratio concept in contrast to golden proportion. Mahshid *et al.*¹³ reported that the golden proportion did not exist between the widths of the maxillary anterior teeth and it was substantiated by Ward,¹⁴ Gillen *et al.*,¹⁵ Rosenstiel *et al.*¹⁶ The variation of thoughts among researchers¹⁷⁻²⁵ and lack of similar study on Indian population aimed this study to evaluate the existence of golden proportion between anterior teeth in the Indian population.

The results of the study indicated that golden proportion did not exist in majority of the Indian population. The ratio of 1.2 and 1.3 were more commonly observed in 43% and 42% of individuals than 1.618. The ratio of 1.5 and 1.6 were found in 5% and 1% of the study group evaluated. The 1.2 ratio which was commonly observed is substantiated by Rosensteil *et al.*¹⁶ Javaheri and Shahnavaz,²⁶ Jahanbin *et al.*,²⁷ Decker,²⁸ Sarver and Ackerman,²⁹ Marguardt,³⁰ Howells and Shaw,³¹ Amoric,³² Phillips *et al.*,³³ Wolfart *et al.*³⁴ consider golden proportion to be a superior aspect of esthetics but the proportion is more artistic, theoretical and impractical in nature. It is also inappropriate to anticipate for every patient to possess this precise relationship because human are individuals with unique facial and dental features. Being one of the microesthetics factors of esthetics it is not a major consideration whereas the other macroesthetic factors and principles play a significant role in determining esthetics.³⁵

The adherence to a particular proportion for all patients universally is impractical.²² The results of this study showed varied existence of specific ratio of 1.2 in 43% of study samples and 1.3 and 42% of samples. No major differences in proportion existed between the sexes and in the symmetry of maxillary and mandibular teeth. Findings of this study were substantiated by other investigations of de Castro *et al.*,³⁶ Ong *et al.*,³⁷ Wolfart *et al.*,³⁸ Shell and Woods³⁹ done on non-Indian population. The results of this study have inferred that golden proportion is negligible and not seen in majority of Indian population.

Unlike other studies^{8,11} the sample size selected for the study is superior but larger group is required to obtain definitive conclusions on Indian population which varies with cultural diversity. Though the width measurements were made to clinical precision there might be a 0.5 mm variation exist in the proximal contact area measurement which can be a binding limitation in this study. From the results obtained and within the limitations of the study the following were appraised. Ethnic differences should be considered for esthetics and proportion studies especially with Indian population which varies with cultural diversity. The golden proportion was not found between maxillary and mandibular anterior teeth in majority of Indian population and the ratio of 1.2 and 1.3 is more commonly seen in Indian population. There were no major changes seen in the proportions between sexes and symmetry of teeth in Indian population.

CONCLUSION

This study inferred that golden proportion between the widths of maxillary and mandibular teeth was not observed in the majority of Indian population.

REFERENCES

1. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 1973;29:358-82.
2. Ward DH. Proportional smile design using the recurring esthetic dental (red) proportion. *Dent Clin North Am* 2001;45:143-54.
3. Morley J, Eubank J. Macroesthetic elements of smile design. *J Am Dent Assoc* 2001;132:39-45.
4. Levin EI. Dental esthetics and the golden proportion. *J Prosthet Dent* 1978;40:244-52.
5. Snow SR. Esthetic smile analysis of maxillary anterior tooth width: the golden percentage. *J Esthet Dent* 1999;11:177-84.
6. Ricketts RM. The biologic significance of the divine proportion and Fibonacci series. *Am J Orthod* 1982;81:351-70.
7. Mizumoto Y, Deguchi T Sr, Fong KW. Assessment of facial golden proportions among young Japanese women. *Am J Orthod Dentofacial Orthop* 2009;136:168-74.
8. Murthy BV, Ramani N. Evaluation of natural smile: Golden proportion, RED or Golden percentage. *J Conserv Dent* 2008;11:16-21.
9. Bukhary SM, Gill DS, Tredwin CJ, Moles DR. The influence of varying maxillary lateral incisor dimensions on perceived smile aesthetics. *Br Dent J* 2007;203:687-93.
10. Ali Fayyad M, Jamani KD, Agrabawi J. Geometric and mathematical proportions and their relations to maxillary anterior teeth. *J Contemp Dent Pract* 2006;7:62-70.
11. George S, Bhat V. Inner canthal distance and golden proportion as predictors of maxillary central incisor width in south Indian population. *Indian J Dent Res* 2010;21:491-5.
12. Preston JD. The golden proportion revisited. *J Esthet Dent* 1993;5:247-51.
13. Mahshid M, Khoshvaghti A, Varshosaz M, Vallaei N. Evaluation of "golden proportion" in individuals with an esthetic smile. *J Esthet Restor Dent* 2004;16:185-92.
14. Ward DH. Proportional smile design using the recurring esthetic dental (red) proportion. *Dent Clin North Am* 2001;45:143-54.
15. Gillen RJ, Schwartz RS, Hilton TJ, Evans DB. An analysis of selected normative tooth proportions. *Int J Prosthodont* 1994;7:410-7.
16. Rosenstiel SF, Ward DH, Rashid RG. Dentists' preferences of anterior tooth proportion-a web-based study. *J Prosthodont* 2000;9:123-36.
17. Vegter F, Hage JJ. Clinical anthropometry and canons of the face in historical perspective. *Plast Reconstr Surg* 2000;106:1090-6.
18. Bell RA. The geometric theory of selection of artificial teeth: is it valid? *J Am Dent Assoc* 1978;97:637-40.
19. Latta GH Jr, Weaver JR, Conkin JE. The relationship between the width of the mouth, interalar width, bizygomatic width, and interpupillary distance in edentulous patients. *J Prosthet Dent* 1991;65:250-4.
20. Basting RT, da Trindade Rde C, Flório FM. Comparative study of smile analysis by subjective and computerized methods. *Oper Dent* 2006;31:652-9.
21. Al Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. *J Prosthet Dent* 2001;86:608-12.
22. Ahmad I. Geometric considerations in anterior dental aesthetics: restorative principles. *Pract Periodontics Aesthet Dent* 1998;10:813-22.
23. Koury ME, Epker BN. Maxillofacial esthetics: anthropometrics of the maxillofacial region. *J Oral Maxillofac Surg* 1992;50:806-20.
24. Scolozzi P, Momjian A, Courvoisier D. Dentofacial deformities treated according to a dentoskeletal analysis based on the divine proportion: are the resulting faces de facto "divinely" proportioned? *J Craniofac Surg* 2011;22:147-50.

25. Simon J. Using the golden proportion in aesthetic treatment: a case report. *Dent Today* 2004;23:82, 84.
26. Javaheri DS, Shahnavaz S. Utilizing the concept of the golden proportion. *Dent Today* 2002;21:96-101.
27. Jahanbin A, Basafa M, Alizadeh Y. Evaluation of the Divine Proportion in the facial profile of young females. *Indian J Dent Res* 2008;19:292-6.
28. Decker JD. The divine proportion. *Am J Orthod Dentofacial Orthop* 2004;126:19A-20A.
29. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: Part 2. Smile analysis and treatment strategies. *Am J Orthod Dentofacial Orthop* 2003;124:116-27.
30. Marquardt SR. Marquardt on the Golden Decagon and human facial beauty. Interview by Dr. Gottlieb. *J Clin Orthod* 2002;36:339-47.
31. Howells DJ, Shaw WC. The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. *Am J Orthod* 1985;88:402-8.
32. Amoric M. The golden number: applications to cranio-facial evaluation. *Funct Orthod* 1995;12:18-21, 24-5.
33. Phillips C, Trentini CJ, Douvartzidis N. The effect of treatment on facial attractiveness. *J Oral Maxillofac Surg* 1992;50:590-4.
34. Wolfart S, Thormann H, Freitag S, Kern M. Assessment of dental appearance following changes in incisor proportions. *Eur J Oral Sci* 2005;113:159-65.
35. Hasanreisoglu U, Berksun S, Aras K, Arslan I. An analysis of maxillary anterior teeth: facial and dental proportions. *J Prosthet Dent* 2005;94:530-8.
36. de Castro MV, Santos NC, Ricardo LH. Assessment of the "golden proportion" in agreeable smiles. *Quintessence Int* 2006;37:597-604.
37. Ong E, Brown RA, Richmond S. Peer assessment of dental attractiveness. *Am J Orthod Dentofacial Orthop* 2006;130:163-9.
38. 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.
39. Shell TL, Woods MG. Facial aesthetics and the divine proportion: a comparison of surgical and non-surgical class II treatment. *Aust Orthod J* 2004;20:51-63.