

Comparative Evaluation of Golden Proportion and Recurring Esthetic Dental (RED) Proportion in Natural Dental Esthetics

Rezaul Kabir¹, Md Mujibur Rahman Howlader², Md Tarik Immam Hossain Molla³,
Must. Nur-E-Jannat⁴, Md Ashraf Ali⁵, and Mozammel Hossain^{6,*}

ABSTRACT

This study explores the differences between the distribution of Golden Proportion and Recurring Esthetic Dental (RED) Proportion in natural maxillary anterior teeth. Photographs of the subject's anterior teeth were taken from the frontal view. The width ratios of canine to lateral incisor and lateral incisor to central incisor were calculated. The existence of the Golden Proportion was considered when the width ratios between canine to lateral incisor or lateral incisor to central incisor were within the range of 0.55–0.66. To evaluate the existence of RED proportion in each subject, the width ratio of canine to lateral incisor was compared with the width ratio of lateral incisor to central incisor. The distribution of the Golden proportion was observed in 66.7% and the RED proportion was observed in 22.2% of the natural dentition of the study population. The existence of the Golden proportion was significantly higher than the existence of the RED proportion in well-aligned natural dentition in the study population ($P < 0.05$). Clinicians may choose the Golden proportion over the RED proportion during the maxillary anterior esthetic treatment procedure.

Keywords: Dental photography, Golden proportion, Natural dentition, Recurring Esthetic dental proportion.

Submitted: July 26, 2023

Published: November 10, 2023

 10.24018/ejdent.2023.4.6.296

¹Keraniganj Upazilla Health Complex, Bangladesh.

²Department of Conservative Dentistry & Endodontics, Bangabandhu Sheikh Mujib Medical University, Bangladesh.

³Dhaka Dental College, Bangladesh.

⁴Anabil Hospital, Bangladesh.

⁵Dental Unit, Sir Salimullah Medical College, Bangladesh.

⁶Department of Conservative Dentistry & Endodontics, Bangabandhu Sheikh Mujib Medical University, Bangladesh.

*Corresponding Author:

e-mail: mozammelresearch@gmail.com

1. INTRODUCTION

In cosmetic dentistry, it is crucial to achieve a pleasing proportion when restoring or replacing anterior maxillary teeth. Different proportions have been proposed to characterize the appropriate connection between maxillary anterior teeth in the quest to create beautiful restorations [1]–[3]. The Recurring Esthetic Dental (RED) and Golden proportions have frequently been proposed as the foundation of smile design theory [4]–[6].

Lombardi was the first to propose using the Golden ratio in dental practice. The golden proportion is roughly 1.61803:1 in ratio [7]. This idea states that the maxillary lateral incisor's width, when viewed from the front, should be approximately 62% of the maxillary central incisor's width. In a similar fashion, the breadth of the maxillary canine, when viewed from the front, should be approximately 62% of the width of the resultant lateral incisor according to Bhuvanewaram *et al.* [8]. Researchers found that by keeping this Golden ratio between the teeth in the

maxillary anterior section, we could produce an aesthetically acceptable repair and grin.

Golden proportion appears to be an ideal ratio for controlling dental esthetics, however many studies that looked into its occurrences and clinical consequences in natural dentition have referred to it as a theoretical ratio and questioned its applicability [9], [10]. As a result, Ward developed the Recurring Esthetic Dental (RED) proportion concept, which allowed practitioners to choose their own proportion as long as it was consistent and moved distally in the arch [11], [12].

In contrast to the Golden Proportion, which is constant at roughly 62%, the values of the Red Proportion are often between 60% and 80%. This gives us more freedom to adapt tooth characteristics to facial proportions [13]. The width of the central incisor is multiplied by the required RED proportion to arrive at the required width of the lateral incisor after the ideal size of the central incisor has been calculated. To match the intended canine frontal appearance, the lateral incisor width is also multiplied by

the same RED proportion. Nevertheless, the RED proportion, according to some experts, may not be the best way to relate the consecutive width of the maxillary anterior teeth in the natural dentition [14], [15].

For a few years, theories have been put out to produce harmony among the anterior teeth, such as the Golden proportion and the RED proportion based on the width ratio. Even though these hypotheses have not yet been thoroughly tested, they are among the most popular analytical tools for developing proportionate smiles. So, we must measure their distribution in people with natural, well-aligned dentitions and attractive smiles in order to support the use of the Golden and RED proportion to build esthetic anterior restoration. Therefore, it's crucial to determine whether these strategies may be employed as accepted approaches to building beautiful smiles or not, as well as whether these methodologies are well suited to develop appropriate harmony to the frontal teeth.

According to numerous research, the typical tooth size on which these proportionate ideas were founded varied depending on race, age, and sex. In order to establish a harmonious grin design for suitable treatment planning, it is required to compare the distribution of the Golden and RED proportions and their gender and age variation in the Bangladeshi population.

2. MATERIALS AND METHODS

Purposive sampling was used in this cross-sectional study, which had 108 participants total, including BSMMU staff members, postgraduate students, and patients. The subjects who participated in the study gave their consent, had a complete set of healthy well aligned natural teeth, and were excluded if they had any of the following: congenital defect in the maxillary anterior teeth, history of orthodontic or orthognathic treatment, and obvious asymmetry in the anterior region. A DSLR camera (CANON 700D) was used to capture a picture of each subject from the frontal perspective, as seen below: people sitting with their heads in their natural positions. The operating distance between the camera and the subject was set at 15 cm. The maxillary anterior teeth's visibility was improved by the application of cheek retractors. Throughout the investigation, photographs were taken by the same investigator alone under the same lighting conditions.

These images were transferred to a computer. One study measured the width (the distance between the most mesial and distal contact sites) of each canine, lateral incisor, and central incisor of the maxilla using a software named Digimzer (Fig. 1). People stand with their heads in their natural positions. The operating distance between the camera and the subject was set at 15 cm.

To get an accurate result, the investigator had to repeat each measurement and take a mean value. Sometimes, the measurement was repeated if it varied by more than 0.2 mm from the previous.

The width of each canine was divided by the width of the adjacent lateral incisor as seen from the front, and the width of each lateral incisor was divided by the width of the adjacent central incisor to determine whether the

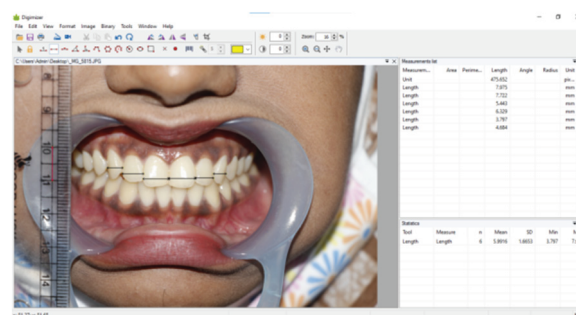


Fig. 1. Measurement of each tooth width using software named Digimzer.

Golden Proportion existed. The existence of the Golden proportion between two adjacent anterior teeth was taken into consideration when the ratio was in the range of 0.55 to 0.66. When the width ratios of three neighboring anterior teeth were consistent, the existence of the RED proportion was taken into consideration; a difference of 0.05 or less was regarded as acceptable for the ratio in the case of RED proportion.

The statistical package of social science (SPSS) version 25 (SPSS Inc. Chicago, USA) was used to analyze the collected data. Data was presented as a percentage proportion and a mean SD. To examine the differences between males and females and various age groups, the chi-square and paired t-tests were used. To compare the Golden and RED proportions, the Z test was used. The testing level of significance followed a 95% confident interval (p-value 0.05).

3. RESULTS

It was determined that 72 out of the 108 participants had the Golden proportion on at least one side. 66.7% of the population had the Golden proportion between their maxillary anterior teeth. On the other hand, 24 people out of 108 showed a RED proportion on at least one side. In 22.2% of the population, there was an incidence of the RED proportion between the maxillary anterior teeth. According to the Z-proportion test, there was a significant difference between the proportions of Golden and RED in the sample population. In the study population, the incidence of the Golden Proportion was noticeably higher than the RED Proportion (Tables I–V). For the distribution of the Golden and RED percentages, there was no discernible variation between the various age and sex groups ($P > 0.05$) (Tables I–V).

TABLE I: DISTRIBUTION OF GOLDEN PROPORTION WITHIN THE RANGE 0.55–0.66 IN MAXILLARY ANTERIOR TEETH ACCORDING TO SEX (n = 108)

Gender	n	Golder proportion		p-value
		Canine/Lateral	Lateral/Central	
Male	62	12 (9.7%)	50 (40.3%)	0.090
Female	46	3 (3.3%)	38 (41.3%)	
Total	108	15 (6.9%)	88 (40.7%)	

Note: Data were expressed as Frequency and percentage. p-value reached from Chi-square test.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

REFERENCES

- [1] Hasanreisoglu U, Berksun S, Aras K, Arslan I. An analysis of maxillary anterior teeth: facial and dental proportions. *J Prosthet Dent.* 2005;94(6):530–8.
- [2] Al-Marzok MI, Majeed KRA, Ibrahim IK. Evaluation of maxillary anterior teeth and their relation to the golden proportion in Malaysian population. *BMC Oral Health.* 2013;13(1):1–5.
- [3] Al Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. *J Prosthet Dent.* 2001;86(6):608–12.
- [4] Ahmed N, Khalid S, Vohra F, Halim MS, Al-Saleh S, Tulbah HI, et al. Analysis of recurrent esthetic dental proportion of natural maxillary anterior teeth: a systematic review [published online ahead of print, 2022 Mar 8]. *J Prosthet Dent.* 2022;S0022-3913(21)00708-3. <https://doi.org/10.1016/j.prosdent.2021.11.035>.
- [5] Ahmed N, Abbasi MS, Vohra F, Khalid S, Halim MS, Ab-Ghani Z, et al. Assessment of golden proportion among natural maxillary anterior teeth of global population: a systematic review. *Appl Sci.* 2022;12(12):6196.
- [6] Ahmed N, Halim MS, Khalid S, Ab Ghani Z, Jamayet NB. Evaluation of golden percentage in natural maxillary anterior teeth width: a systematic review. *J Prosthet Dent.* 2022;127(6):845–e1.
- [7] Lombardi RE. The principles of the visual perception and their clinical application to denture esthetics. *J Prosthet Dent.* 1973;29:358–82.
- [8] Bhuvaneswaram M. Principles of smile design. *J Conserv Dent.* 2010;13(4):225–32.
- [9] Bukhary SM, Gill DS, Tredwin CJ, Moles DR. The influence of varying maxillary lateral incisor dimensions on perceived smile aesthetics. *Brit Dent J.* 2007;203:687–93.
- [10] Markovics ER, János K, Biriş C, Cerghizan D, Horga C, Bögözi B, et al. Aesthetic principles of the upper front teeth: application of golden proportion (Levin) and golden percentage (Snow). *Acta Marisensis-Seria Medica.* 2013;59(1):25–7.
- [11] Ward DH. A study of dentists' preferred maxillary anterior tooth width proportion: comparing the recurring esthetic dental proportion to other mathematical and naturally occurring proportions. *J Esthet Restor Dent.* 2007 Dec;19(6):324–39.
- [12] Kalia R. An analysis of the aesthetic proportions of anterior maxillary teeth in a UK population. *Brit Dent J.* 2020 Mar 2020;228(6):449–55.
- [13] Sudhakar N, Vishwanath A. Smile esthetics. *J Med Dent Sci.* 2014;13(1):32–6.
- [14] Azimi M, Dinparvar M, Teimourian H, Farhadian M. Evaluating recurring esthetic dental proportion (RED) and Golden Proportion in natural dentition. *Avicenna J Dent Res.* Mar 2017;9(1):30267.
- [15] Shetty S, Pitti V, Babu CS, Kumar GS, Jnanadev KR. To evaluate the validity of recurring esthetic dental proportion in natural dentition. *J Conserv Dent.* 2011 Jul;14(3):314.
- [16] Mashid M, Khoshvaghti A, Varshousaz M, Vallaei N. Evaluation of Golden Proportion in individuals having esthetic smiles. *J Esthet Restor Dent.* 2004;16:185–92.
- [17] Preston JD. The golden proportion revisited. *J Esthet Restor Dent.* 1993 Nov;5(6):247–51.
- [18] Levin EI. Dental esthetics and the golden proportion. *J Prosthet Dent.* 1978 Sep 1;40(3):244–52.