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Research Article

Esthetic Dental Proportions Assessment in Maxillary Anterior Dentition: An Analytical Cross-Sectional Study

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ABSTRACT

Introduction: The esthetic dental proportions are important in assessing the harmony and esthetic appeal of the anterior maxillary dentition. However, the applicability of commonly proposed mathematical proportions may vary between individuals and populations.

Objective: This clinical study assessed the prevalence and association and determined the ranges of esthetic dental proportions, which include the Golden proportion, Golden percentage, Golden standard, Chu's proportion, and Recurring Esthetic Dental Proportion in maxillary anterior dentition.

Materials and Methods: The study was an analytical cross-sectional study, and the number of research subjects was 420 respondents, consisting of 210 males and 210 females aged 18-30 years. Frontal photographs of the anterior maxilla were taken and analyzed digitally. The apparent tooth width and clinical crown length were measured between the canine teeth. The five esthetic dental proportions were determined and analyzed with SPSS version 25.

Results: The results showed that all five esthetic dental proportions differed. The highest prevalence was observed with the Golden Percentage, especially for the lateral incisors. Gender, age, and ethnicity were also found to be different. The findings showed that there was no single mathematical standard for anterior dental proportions, but rather that each individual had a different standard.

Conclusion: Esthetic dental proportions should be viewed as population-based values, and not fixed values. Evaluation of several proportional concepts can help with the planning of a specific anterior esthetic treatment plan.

Keywords: *Esthetic dental proportions; Golden Proportion; Golden Percentage; Golden Standard; Chu's Proportion; Recurring Esthetic Dental Proportion; Maxillary anterior teeth.*

INTRODUCTION

The anterior teeth of the maxilla play a significant role in the aesthetic appearance of the smile and harmony of the face, and this is why dental esthetics is a significant part of modern dentistry. They are wide, long, well-positioned, and relate to other teeth to create the smile. Therefore, esthetic dental proportions, especially the recurring esthetic dental proportion (RED proportion), are given much attention to assess the natural anterior dentition. RED proportion is the idea that there are consistent relationships between the apparent widths of successive anterior teeth, different from the traditional golden proportion. A systematic

review showed that there is great variability in the frequencies of esthetic dental proportions for natural maxillary anterior teeth, and that no one proportional relationship may be true for every person (1). Moreover, there is a discrepancy between subjective perceptions of dental attractiveness and objectively measured tooth proportions, which highlights the need to evaluate both dental dimensions and esthetic perception (2).

The dimensions of maxillary anterior teeth are variable by population, ethnicity, age, and individual. Anterior tooth dimensions and proportional relationships were found in a cross-sectional study of young Cambodians, highlighting the need for population-specific data when assessing dental esthetics (3). Anterior esthetics is also affected by gingival characteristics, as they are related to the relationship between the tooth crowns and the gingival contour, which affects the visual harmony of the smile. Therefore, digital photographic analysis has been employed to explore the golden proportion in addition to gingival aesthetic line classifications, which highlights that both dental and gingival parameters are to be taken into consideration while assessing esthetic parameters (4). The golden proportion has been used as a mathematical guideline to evaluate the apparent width of maxillary anterior teeth. But there is conflicting evidence of its occurrence in the natural dentition. Studies on maxillary anterior teeth have found that the golden proportion cannot be consistently found between the adjacent teeth, which means that the natural dental relationships are not necessarily in the theoretically ideal proportions (5).

This has also been observed as a difference between primary and permanent dentitions, suggesting that the type of dentition and developmental characteristics may influence the proposed golden relationships (6). The results indicate that the dimensions of natural teeth should be measured directly and not based on a predetermined mathematical ratio that is considered the ideal esthetic standard. Another important factor in the anterior esthetic assessment is the relationship between the facial and dental dimensions. Clinical studies have shown that facial measurements can help identify the correct width of maxillary anterior teeth, which is why dental proportions must be taken in the context of the entire face (7). Population-based studies have also examined the distribution of golden and recurring esthetic dental proportions and found variations in the distribution. These results suggest that esthetic dental relationships vary between populations and should be evaluated based on the population under study (8).

The golden proportion has also been called into doubt by evidence from other populations around the world. A systematic review of the prevalence of golden proportion relationships among natural anterior teeth in various populations revealed significant differences across populations, suggesting that the mathematical principle of golden proportions does not hold true for all natural dentitions globally (9). An observational study of dental students has also investigated the proportions of anterior teeth with regard to aesthetic perception, which has shown that there is not always a direct link between the number of teeth and their visual attractiveness (10). The results substantiate the importance of a realistic evaluation of dental dimensions and their association with the perception of esthetic harmony. Anterior dental proportions are of interest in the Pakistani population as the dimensions of the anterior dentition and esthetic requirements may differ among different populations. In Pakistan, research has revealed that dentists believe in the proportions and harmony of anterior teeth as an important factor in the assessment of an attractive smile (11).

Digital photographic anthropometric studies have also been done in the Pakistani population to determine the size of anterior maxillary teeth, which may be helpful in understanding the natural dental morphology and esthetic treatment planning (12). This kind of evidence illustrates the importance of taking measurements directly from the population being studied to assess dental proportions. The esthetic perception is not only dependent on the numerical ratios of the teeth. In the Turkish population, the relationship between dental ratios and aesthetic perception has been investigated, which shows the importance of assessing proportional relationships in a visual way (13). In the same way, esthetic risk assessment has pointed to the importance of considering multiple factors, including both anatomical and esthetic, in treatment planning for the anterior region, especially for implant-related rehabilitation (14). Therefore, the assessment of anterior dental proportions must be seen from a wider perspective that includes the dimensions of the teeth, the structures of the face, the nature of the gingival tissues, and the harmony of the smile.

When assessing the appropriate anterior tooth dimensions, facial measurements may be used as useful information. Relationships have been found

between maxillary anterior teeth and commonly measured facial characteristics to support the relevance of facial anatomy in esthetic treatment planning (15). Dental proportional assessment can also include discrepancies in tooth size between dental arches. Bolton analysis has shown that there are interethnic differences in tooth-size relationships, which also suggests that interethnic differences in dental size may be due to population characteristics (16). The results of this research suggest that the proportional standards obtained from one population may not be assumed to apply to another population. Another important parameter in anterior esthetics is the width-to-length ratio, which can significantly affect the smile appearance when the shape of the crown changes. The importance of this measurement in describing the natural anterior tooth morphology has been studied in young Gujarati individuals, specifically in terms of width-to-length ratios of the anterior teeth (17). Research on a North Indian population has also evaluated the dimensions of the anterior teeth for the presence of the golden proportion and found differences in the relationship of anterior teeth (18). Therefore, an analytical cross-sectional approach to the evaluation of maxillary anterior dental proportions may give clinically useful information regarding the dimensions of natural teeth, the relationships between them, and the use of the proposed esthetic standards in a certain population.

Objective: This clinical study aimed to evaluate the prevalence and association and to establish the ranges of esthetic dental proportions such as Golden proportion, Golden percentage, Golden standard, Chu's proportion, and Recurring Esthetic Dental Proportion (REDP) in the maxillary anterior dentition.

MATERIALS AND METHODS

Study Design: An analytical cross-sectional study was conducted.

Study Setting: This study was carried out in the Dental Outpatient Department of Dow University of Health Sciences. Institutional Review Board of Dow University of Health Sciences (IRB-1001/DUHS/Approval/2018/52) approved the study, and informed written consent was obtained from all participants.

Study Duration: The study period was 12 months.

Sample Size: There were 420 participants aged between 18 and 30 years, 210 of whom were males and 210 were females. The original sample size was 356 participants, but it was raised to 420 to increase the accuracy and decrease the margin of error.

Sample Technique: Convenience sampling (non-probability sampling) was employed. Participants who met the pre-defined inclusion and exclusion criteria were recruited until the sample size was achieved.

Inclusion criteria: Participants were included if they had full maxillary anterior dentition, no interdental spacing, rotation, or crowding beyond grade 1 orthodontic treatment needs, lacked periodontal or gingival problems affecting the tooth–tissue relationship, and had no previous orthodontic treatment history (18–30 years old).

Exclusion criteria: Those with gingival modifications or dental abnormalities involving the maxillary anterior teeth, evident loss of tooth structure (fracture, attrition, caries, or restorations), noticeable facial or dental conditions that could affect assessment, or crowns or bridges that affect tooth positioning were excluded.

METHODS

This is an analytical cross-sectional study, which involved 420 respondents, 210 male and 210 female, aged between 18 and 30 years. Standardized frontal photographs of the maxillary anterior teeth were taken with a DSLR camera with the participant sitting upright. The camera was placed at 12 o'clock, and the distance between the camera focal plane and the participant's inter-canine horizontal plane was kept constant at 50cm. A cheek retractor was used to obtain the retracted anterior-tooth view. Digital analysis of images was performed in Adobe Photoshop. The width of the maxillary anterior teeth (canine to canine) was measured using the Scale Tool software, and the length was measured from the gingival zenith to the incisal edge. The measurements were taken on a proforma, and the Golden Proportion, Golden Standard, Golden Percentage, Recurring Esthetic Dental Proportion, and Chu's Proportion were calculated. The obtained values were entered into SPSS version 25 for statistical analysis.

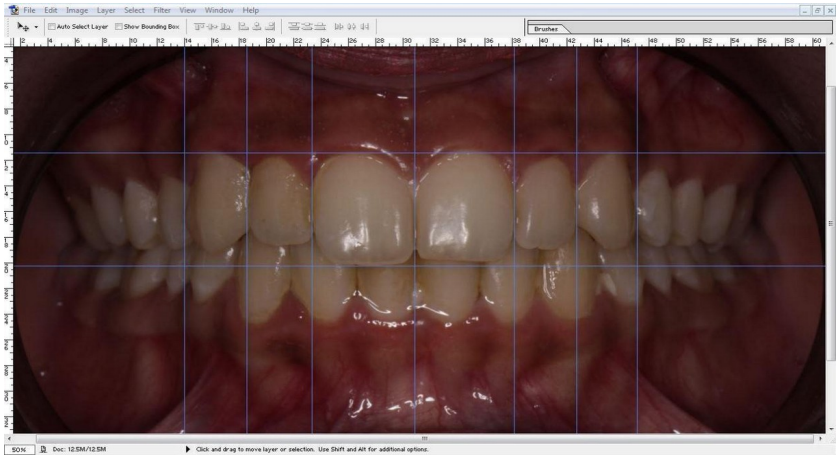


Figure 1. *Digital measurement of the maxillary anterior tooth dimensions using Adobe Photoshop, showing the measurement of tooth width and length.*



Figure 2. *Retracted frontal view of the maxillary anterior dentition obtained using a cheek retractor for standardized assessment of the anterior teeth.*



Figure 3. *Standardized photographic setup showing the participant in an upright position, with the camera mounted at the 12 o'clock position and a fixed 50-cm distance between the camera focal plane and the participant's inter-canine horizontal plane.*

RESULTS

A total of 420 participants were analysed, with 210 male and 210 female participants. The mean age was 22.97 ± 3.10 years (range 18–30 years); 153 participants (36.4%) were aged 18–21 years, 183 (43.6%) were aged 22–25 years, and 84 (20.0%) were aged 26–30 years. Most participants were Urdu speakers (n = 254), followed by Punjabi (n = 59), Sindhi (n = 49), Pathan (n = 30), and other ethnicities (n = 28). 95% confidence intervals were computed for the overall sample and subgroups. The esthetic dental proportions for the entire sample are summarized in Table 1. Both one-sample t-tests revealed significant differences

between Golden Proportion, Golden Standard, and Golden Percentage and their reference values (p = 0.001). The central-to-lateral incisor ratio (1.46 ± 0.14 right; 1.47 ± 0.14 left) fell below the 1.62 reference, whereas lateral-to-central (0.69, 0.68) and canine-to-lateral ratios (0.81, 0.80) exceeded 0.62.

The central incisors showed a percentage of 85.60% right and 84.46% left, which is above the 80% reference, whereas the lateral incisors and canines showed a percentage of 70.22% right and 68.56% left, which is below the 80% reference. The percentages of the right central incisor, lateral incisor, and canine were 22.40%, 15.43%, and 12.49%, respectively, compared to the references of 25%, 15%, and 10%, respectively. Throughout, the right and left values were very similar. The relative deviation of each proportion from its reference value is displayed in Figure 4.

Table 1. Esthetic dental proportions in the total sample compared with reference values (n = 420).

Proportion	Measurement	Mean ± SD	95% CI	Reference	p
Golden Proportion					
R central/lateral	Ratio	1.46 ± 0.14	1.44–1.47	1.62	0.001
L central/lateral	Ratio	1.47 ± 0.14	1.45–1.48	1.62	0.001
R canine/lateral	Ratio	0.81 ± 0.12	0.80–0.82	0.62	0.001
Golden Standard					
R central incisor	%	85.60 ± 7.64	84.86–86.33	80	0.001
R lateral incisor	%	70.22 ± 8.92	69.37–71.08	80	0.001
R canine	%	54.45 ± 9.13	53.58–55.33	80	0.001
Golden Percentage					
R central incisor	%	22.40 ± 1.03	22.31–22.50	25	0.001
R lateral incisor	%	15.43 ± 1.15	15.32–15.54	15	0.001
R canine	%	12.49 ± 1.47	12.35–12.63	10	0.001
Recurring Esthetic Dental proportion					
R lateral to central	%	69.06 ± 6.32	68.45–69.66	—	0.001*
R canine to lateral	%	81.58 ± 12.87	80.34–82.81	—	0.001*

*R = right; L = left. p values from one-sample t-tests against the reference value. *Paired t-test of distal RED ratios (right side).*

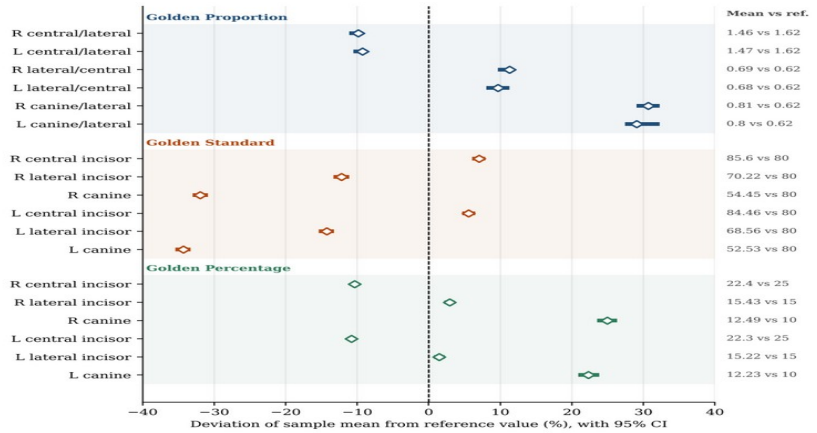


Figure 4. *Forest plot of the percentage deviation of each mean proportion from its reference value (dashed line = 0%), with 95% confidence intervals. Values on the right give the sample mean versus the reference.*

The most common proportion was the Golden Percentage of lateral incisors (around 32%-33% of the participants). Recurring esthetic dental proportion was not constant distally: the lateral-to-central ratio (69.06 ± 6.32% right; 68.49 ± 6.50% left) differed significantly from the canine-to-lateral ratio (81.58 ± 12.87%; 80.87 ± 13.97%; p = 0.001). The difference in proportions between the right lateral incisor and the measured width was 5.45 ± 0.52 mm versus 5.91 ± 0.51 mm (p = 0.001), and between the right canine and the measured width was 4.41 ± 0.57 mm versus 6.91 ± 0.51 mm (p = 0.001). Overall, the apparent width of the central incisor was narrower than the golden proportion, and no proportion was as ideal as the central incisors. Table 2 and Figure 5 show gender comparisons. The Golden Standard values for females were higher than those for males for all six teeth, as the right central incisor Golden Standard value was 87.46 ± 7.59% for females compared to 83.73 ± 7.25% for males, and the 95% confidence intervals for females and males did not overlap for any tooth. In contrast, males had higher canine-to-lateral RED ratios (83.60 ±

12.45% versus 79.55 ± 12.99% on the right) and higher Chu's values (right lateral 6.07 ± 0.51 versus 5.75 ± 0.46). The Golden Proportion and lateral-to-central RED ratios did not differ between the sexes, and their confidence intervals overlapped. Therefore, gender differences were specific to each parameter and greatest for the Golden Standard.

Table 2. Selected esthetic dental proportions according to gender (n = 210 per group).

Parameter	Unit	Male Mean ± SD	Female Mean ± SD	95% CI overlap
Golden Proportion, R central/lateral	Ratio	1.47 ± 0.14	1.45 ± 0.13	Yes
Golden Standard, R central incisor	%	83.73 ± 7.25	87.46 ± 7.59	No
Golden Standard, R lateral incisor	%	68.17 ± 8.33	72.27 ± 9.04	No
Golden Standard, R canine	%	52.87 ± 8.15	56.03 ± 9.78	No
Golden Percentage, R lateral incisor	%	15.27 ± 1.10	15.59 ± 1.18	Yes
RED, R lateral to central	%	68.63 ± 6.28	69.48 ± 6.34	Yes
RED, R canine to lateral	%	83.60 ± 12.45	79.55 ± 12.99	No
Chu's Proportion, R lateral	—	6.07 ± 0.51	5.75 ± 0.46	No
Chu's Proportion, R canine	—	7.07 ± 0.51	6.75 ± 0.46	No

R = right. 95% CI overlap indicates whether the male and female 95% confidence intervals for the mean overlap.

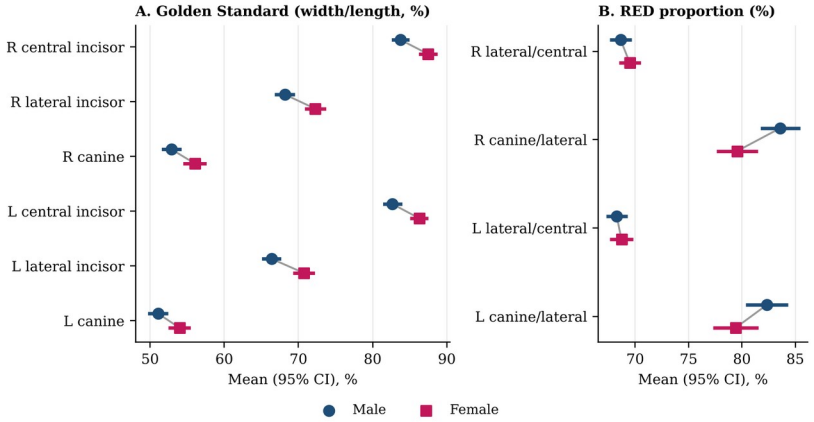


Figure 5. *Dumbbell plot of male (circles) and female (squares) means with 95% confidence intervals for (A) Golden Standard and (B) recurring esthetic dental (RED) proportion by tooth.*

DISCUSSION

Five esthetic dental proportions (Golden Proportion, Golden Standard, Golden Percentage, Recurring Esthetic Dental Proportion (RED), and Chu's Proportion) were evaluated in this study. The findings showed variation, not one uniform mathematical value. Variations were also found by tooth type, sex, age, and ethnicity. This is in line with the findings that there is significant variation in the esthetic dental proportions of recurrent dentition (1). It also facilitates research which suggests that the dental proportions measured may not align fully with people's notions of dental esthetics (2). The Golden Proportion had means of 1.46 for the central-to-lateral incisor ratio on the right and 1.47 on the left. This suggested that the ratio was not the same between the participants, as there was variation around the means. Ethnic differences were also noted with right central-to-lateral ratios of 1.42 for Pathan participants and 1.47 for Punjabi participants. The same kind of variation in tooth size and shape of the anterior teeth of the maxillae has been described in young Cambodians (3). Therefore, the results of the present study justify the consideration of Golden Proportion as a population characteristic and not as a universal one.

The values of the golden standard were highest for central incisors and gradually decreased for the lateral incisors and canines. The overall mean was around 85.60% in the right central incisor, with different ethnic groups having different values. This means that there is a difference in the appearance of the anterior tooth contribution. The importance of Golden Proportion and gingival aesthetic line classification (4) has also been highlighted in previous digital photographic studies. Therefore, it is important to take into account both the overall smile framework and gingival architecture when evaluating numerical tooth proportions. Golden Percentage showed a gradual shift towards canines from the central incisors. The values were found to be around 22%

for central incisors, approximately 15% for lateral incisors, and approximately 12% for canines. The highest occurrence of the Golden Percentage relationship was observed in the lateral incisors, especially on the left side. Previous studies have reported that the Golden Proportion is not consistently found in natural maxillary anterior teeth, suggesting that the actual measurements of the population should be evaluated instead of relying on the theoretical values (5). There have also been reports of differences between primary and permanent dentitions, suggesting that proportional relationships may differ depending on dentition type (6).

The lateral to central incisor relationships were about 69%, and the canine to lateral incisor relationships were 80-82% RED value. So, there was no single percentage that represented apparent tooth-width reduction. There was also some variation between age groups and ethnicities. The right lateral to central RED value was found to be around 68.15% for the Punjabi group and 71.06% for the Pathan group. Research in facio-dental has proven that facial measurements can help in determining the appropriate width of the maxillary anterior teeth (7). There have also been reports of Golden and RED proportions varying in population-based studies (8). The results show that the Golden Proportion, Golden Standard, Golden Percentage, RED, and Chu's Proportion cannot be used as interchangeable measurements, as they refer to different aspects of anterior tooth relationships. A systematic review of the global populations showed that there were significant differences in the prevalence of Golden Proportion, casting doubt on its universal applicability (9). A study of dental students also revealed that anterior tooth proportions as measured were related, but not exclusively determining, of perceived dental esthetics (10). The results of this study provide justification for the evaluation of several proportional systems.

The Pakistani context was significant as the study population consisted of different ethnic groups. In the past, smile aesthetics studies in Pakistan indicated that dentists found anterior tooth proportion and harmony to be crucial elements of an attractive smile (11). Standardized photography of a Pakistani population has also been shown to be a helpful tool in assessing anterior tooth dimensions (12). Consistent assessment was possible thanks to standardized frontal photography and digital measurements. The ethnic differences observed also suggest that a single reference value may not be suitable for the Pakistani population. The results must also be considered in terms of aesthetic perception. Studies in the Turkish population showed that there are relationships between dental ratios and aesthetic perception, and that numerical harmony does not always lead to a perception of attractiveness (13). Esthetic risk assessment has also focused on assessing several factors in anterior treatment planning, not relying on just one measurement (14). For this reason, the ranges indicated should be understood as clinical parameters and not as exact standards of what is attractive.

Evidence is provided to support individualized assessment, with evidence connecting maxillary anterior teeth with facial measurements. Studies have shown that there are correlations between anterior tooth dimensions and common facial measurements (15). However, dental dimensions have also been found to be different between ethnic groups, as indicated by Bolton analysis (16), further supporting the role of population characteristics on dental dimensions. These results highlight the importance of population-specific information. Lastly, anterior smile relations in width to length are significant. A study of young Gujarati people showed variation in the width-to-length ratios of the maxillary anterior teeth (17), and another North Indian study showed that there was population-specific variation in the dimensions of anterior teeth and in the Golden Proportion (18). In general, the present results suggest that esthetic dental proportions are more appropriately expressed as ranges than as universal values. Evaluating five proportional systems in the same population allows for a greater insight into the relationships between the maxilla and the anterior teeth, and can help the clinician to choose specific esthetic references for each patient.

CONCLUSION

The aim of this study was to evaluate the prevalence, association, and ranges of the five esthetic dental proportions (Golden Proportion, Golden Percentage, Golden Standard, Chu's Proportion, and Recurring Esthetic Dental Proportion) in the Maxillary Anterior Dentition. The results showed that these proportional relationships were quite different, revealing no consistent mathematical proportion for the natural maxillary anterior dentition. Golden Percentage had the highest prevalence observed with the observed parameters, especially when it came to lateral incisors. Anterior dental proportions also varied by gender, age, and ethnicity, which further substantiated the role of individual and population

factors on anterior dental proportions. The findings also showed that esthetic proportions cannot be viewed as set standards but rather as ranges. Therefore, assessment of multiple proportional concepts may provide a more comprehensive approach to evaluating anterior dental esthetics. The results of this study may help clinicians analyze a patient's smile, plan restorations, and choose suitable esthetic references for those who need maxillary anterior dental rehabilitation.

REFERENCES

1. Ahmed N, Khalid S, Vohra F, Halim MS, Al-Saleh S, Tulbah HI, Al-Qahtani AS, Abduljabbar T. Analysis of recurrent esthetic dental proportion of natural maxillary anterior teeth: A systematic review. The Journal of Prosthetic Dentistry. 2024 Feb 1;131(2):187-96.
2. Sharmila R, Jayaletchimi S, Tew IM, Beh YH. Self-perceived dental esthetics and the relationship to maxillary anterior tooth proportions among dental students. The Journal of Advanced Prosthodontics. 2025 Apr 25;17(2):83.
3. Tithphit A, Schneider B, Othman A, Phit V, Tith HY, von See C. Analysis of Maxillary Anterior Tooth Dimensions and Proportions in Young Cambodians: A Cross-Sectional Study. Oral. 2025 Dec 3;5(4):99.
4. AlMathami SA, Ismail AA, Sghaireen MG, Helal DA. Assessment of golden proportion and gingival aesthetic line classification in maxillary anterior teeth: A cross-sectional digital photographic analysis. Bioinformation. 2026 Apr 30;22(4):2496.
5. Tariq K, Khan MW, Mushtaq MA, Qaiser S, Ilyas S. ANALYSIS OF GOLDEN PROPORTION IN MAXILLARY ANTERIOR DENTITION. Pakistan Oral & Dental Journal. 2022 Jul 4;42(2):100-3.
6. Pursnani RA, Saxena A, Parihar A, Chauhan SP, Verma N, Pushparekha G. Comparing the Existence of Golden Proportion Using Maxillary Anterior Teeth Dimensions in Primary and Permanent Dentition: A Cross-sectional Study. International Journal of Clinical Pediatric Dentistry. 2024 Dec 19;17(11):1206.
7. Ahmed N, Halim MS, Ab-Ghani Z, Abbasi MS, Aslam A, Safdar J, Das G, Ahmed AR, Jamayet NB. The analysis of facio-dental proportions to determine the width of maxillary anterior teeth: a clinical study. Journal of Clinical Medicine. 2022 Dec 10;11(24):7340.
8. Srinivasulu C, Sujesh M, Rao DC, Rajanikanth AV, Ravishankar Y, Harilal G. PREVALENCE OF GOLDEN PROPORTION AND RECURRING ESTHETIC DENTAL PROPORTION IN TELANGANA POPULATION: A CROSS-SECTIONAL STUDY. Genetics and Molecular Research. 2026 Jul 7.
9. Ahmed N, Abbasi MS, Vohra F, Khalid S, Halim MS, Ab-Ghani Z, Alrabiah M, Al Ahdal K, Alhamdan MM, AlFaraz Y, Al-Aali KA. Assessment of golden proportion among natural maxillary anterior teeth of global population: a systematic review. Applied Sciences. 2022 Jun 17;12(12):6196.
10. Ganeiber T, Bugaighis I. Assessment of the Aesthetic Proportions of the Anterior Maxillary Teeth among Dental Libyan Students: An Observational Study. Libyan International Medical University Journal. 2024 Jul;9(02):081-6.
11. Jouhar R, Ahmed N, Ahmed MA, Faheemuddin M, Mosaddad SA, Heboyan A. Smile aesthetics in Pakistani population: dentist preferences and perceptions of anterior teeth proportion and harmony. BMC Oral Health. 2024 Mar 29;24(1):401.
12. Quraeshi S, Mehdi A, Kazmi SM. Anthropometric Analysis of Anterior Maxillary Teeth with Digital Photography-Study in a Pakistani Population. JPDA. 2025 Oct 1;34(04).
13. Önal E, Şahin Z, Ersöz E, Özer NE. The Relationship Between Dental Ratios and Aesthetic Perception in the Turkish Population. Sağlık Bilimleri Dergisi. 2025 Dec 12;34(3):499-506.
14. Shiggaon LB, MadhavMane V, Zadode AS, Bhavsar SC, Sharma M, Kerudi VV. Evaluation of “Esthetic Risk Assessment Analysis” for Dental Implant Patients: A Cross-sectional Study. Journal of the Scientific Society. 2025 Jul 1;52(3):260-5.
15. Alshamri HA, Al Moaleem MM, Al-Huthaifi BH, Al-Labani MA, Naseeb WR, Daghriri SM, Suhail IM, Hamzi WH, Abu Illah MJ, Thubab AY, Aljabali SA. Correlation between maxillary anterior teeth and common facial measurements. Clinical, cosmetic and investigational dentistry. 2023 Dec 31:289-300.
16. Abd Rahman AN, Othman SA, Marya A. Measuring tooth size discrepancies using Bolton analysis: a comparative cross-sectional study among major ethnicity in Malaysia. BMC oral health. 2023 Aug 2;23(1):534.
17. Dave BH, Mehta SP, Sutaria SP, Sutariya PV. Analysis of Width/Length Ratio in Maxillary Anterior Teeth Among Gujarati Young Individuals: A Cross-Sectional Study. Advances in Human Biology. 2023 May 1;13(Suppl 1):S59-64.
18. Handa A, Bhullar KK, Sandhu RM. An analysis of maxillary anterior teeth dimensions for the existence of golden proportion in the representative North Indian population. Journal of Conservative Dentistry and Endodontics. 2024 Feb 8;27(2):175.