

PREVALENCE OF GOLDEN PROPORTION AND RECURRING ESTHETIC DENTAL PROPORTION IN TELANGANA POPULATION: A CROSS - SECTIONAL STUDY

Dr. C. Srinivasulu¹, Dr. M. Sujesh², Dr. D. Chalapathi Rao³, Dr. A.V. Rajanikanth⁴, Dr. Y. Ravishankar⁵, Dr. G. Harilal⁶

¹Post Graduate Student, Department of Prosthodontics and Crown and Bridge, Mamata Dental College and Hospital, Khammam, Telangana, India

²Professor, Department of Prosthodontics and Crown and Bridge, Mamata Dental College and Hospital, Khammam, Telangana, India (Corresponding Author)

³Professor, Department of Prosthodontics and Crown and Bridge, Mamata Dental College and Hospital, Khammam, Telangana, India

⁴Professor, Department of Prosthodontics and Crown and Bridge, Mamata Dental College and Hospital, Khammam, Telangana, India

⁵Professor & Head, Department of Prosthodontics and Crown and Bridge, Mamata Dental College and Hospital, Khammam, Telangana, India

⁶Professor, Department of Prosthodontics and Crown and Bridge, Mamata Dental College and Hospital, Khammam, Telangana, India

Corresponding Author: Dr. M. Sujesh

ABSTRACT

Aim: The aim of this study was to assess the prevalence of golden proportion and recurring esthetic dental proportion in Telangana population.

Materials and Methods: This study was executed in the department of Prosthodontics wherein the volunteers aged between 18 and 25 years, were selected to participate in the study. Subjects were seated comfortably and instructed to assume the Natural Head Position and Photographs were taken following the American Academy of Cosmetic Dentistry (AACD) guidelines. All images were saved in JPEG format at 300 dpi resolution and imported into Adobe Photoshop CC for digital analysis. The mesiodistal width of each tooth was then calculated in pixels. The collected data were entered into a spreadsheet and subsequently analyzed using statistical software. To evaluate the Golden Proportion, the measured width of the central incisor was multiplied by 0.618 (61.8%) and compared with the width of the adjacent lateral incisor. All data was analysed for statistical evaluation to determine the prevalence and consistency of esthetic dental proportions.

Statistical Analysis and Results: Statistical Analysis was done with Statistical Package for Social Sciences [SPSS] for Windows. The measured mean width of the right and left central incisors was 7.94 ± 0.58 mm and 7.98 ± 0.57 mm respectively. Paired t-test analysis revealed no statistically significant difference. When seeing the prevalence of Golden Proportion, the mean ratio was $75.4 \pm 10.7\%$ on the right side and $74.3 \pm 9.5\%$ on the left side, with an overall combined mean of $74.9 \pm 10.1\%$. When seeing the RED Proportion, Chi-square test revealed that the proportion of ratios within the RED range was significantly higher than those outside the range ($p < 0.001$), indicating that RED proportion is more commonly observed in the study population. When seeing the gender comparison of the lateral/central incisor width ratio on the right side, the mean ratio among males was $76.2 \pm 11.3\%$, while among females it was $74.9 \pm 10.5\%$.

Conclusion: Authors concluded and expressed excellent bilateral symmetry in mesiodistal teeth dimensions, with no statistically significant differences between right and left sides. Gender-based comparison also revealed no significant variation in lateral-to-central incisor width ratios, indicating that anterior tooth proportions in the Telangana population were largely independent of side and gender.

KEYWORDS: Prevalence, Golden Proportion, Recurring Esthetic Dental RED Proportion, Telangana Population, Dental Esthetics, Prosthodontics, American Academy of Cosmetic Dentistry, Natural Head Position

INTRODUCTION

Dental esthetics, and smile was widely regarded as the most significant component of facial esthetics and contributes substantially to an individual's attractiveness and self-esteem.¹ The anterior region of the dentition holds particular significance due to its prominent visibility during function and expression. The morphology, position, proportion, and alignment of these teeth exert a profound influence on the perceived balance and harmony of the dentofacial complex. Consequently, the careful evaluation, selection, and restoration of this region constitute a cornerstone of esthetic dentistry and demand meticulous attention to geometric, proportional, and anatomical principles. Despite its conceptual appeal, the applicability of the golden proportion in natural human dentitions has been extensively debated. Investigations by Preston², Gillen³, and Snow⁴ questioned its universality, reporting inconsistent occurrences of golden proportion relationships in natural populations. These findings challenged the reliability of prescribing a fixed 62% ratio across all clinical situations and emphasized the necessity for more adaptable, individualized approaches to esthetic evaluation. Contemporary prosthodontics and esthetic dentistry, despite remarkable technological advancements such as digital workflows, computer-aided

design, and novel biomaterials, remain firmly reliant on the principles of dental esthetics rooted in mathematics and visual science. Achieving an optimal esthetic outcome transcends artistic intuition; it requires adherence to objective, reproducible, and scientifically validated criteria^{3,5}. Furthermore, recent anthropometric studies, emphasized considerable variations in anterior tooth dimensions and proportions across different populations and ethnic groups. These findings highlight the importance of developing population specific norms rather than relying exclusively on classical or Western derived ideals. Consequently, esthetic rehabilitation today necessitates a balanced integration of universal design principles with individualized clinical judgment, ensuring that outcomes achieve not only harmony and functionality but also cultural and anatomical relevance. This discrepancy suggested that universal application of fixed esthetic dental ratios may not be clinically reliable and instead demands population specific data.^{6,7,8,9,10,11} Cultural and anatomical diversity necessitate customized approaches in smile design. Moreover, no data exists for the Telangana population one with distinct ethnic and demographic features which creates a critical gap in the literature.¹⁰ Establishing normative data for anterior tooth proportions in this population was essential to improve treatment predictability, especially in prosthodontics and esthetic smile reconstruction. The present study therefore seeks to assess the prevalence and applicability of both the Golden and RED proportions in telangana region through validated methodologies, thereby contributing to the development of more personalized and effective smile design strategies.

Aim and Objectives

Aim

The aim of this study is to assess the prevalence of golden proportion and recurring esthetic dental proportion in Telangana population.

Objectives

- To determine the mesiodistal width of individual maxillary anterior teeth.
- To determine golden proportion in a representative sample of Telangana origin.
- To determine RED [Recurring Esthetic Dental] proportion in a representative sample of Telangana origin.
- To compare and determine whether the golden or red proportion is prominent in the representative sample of Telangana origin.

MATERIALS AND METHODS

This study was planned, abstracted and executed in the department of Prosthodontics of the institute. Ethical clearance was obtained from the Institutional Ethical Committee of Mamata dental college (Annexure I), in accordance with the Declaration of Helsinki for research involving human subjects. [MDC-KT-23203103001D] Then volunteers were selected based on a detailed screening process. Written informed consent was obtained from all participants prior to data collection. A total of 100 student volunteers from Mamata Dental College, aged between 18 and 25 years, were selected to participate in the study. The following Inclusion criteria were used for selection subjects with Angle's Class I molar relation, No history of orthodontic treatment, Absence of facial asymmetry, No prosthetic restorations, Presence of all maxillary anterior teeth with no spacing or crowding. The following Exclusion criteria were used for selection.^{7,8,9,10} Presence of incisal wear or interdental spacing, Restorations in any of the maxillary anterior teeth, Lip deformities or abnormalities, Missing anterior or posterior teeth, Evident loss of tooth structure, History of facial or dental trauma, Cleft lip/palate or other craniofacial anomalies. All images were captured in a controlled indoor photographic room designed to eliminate external light variability [fig 1]. A matte, non-reflective green background was mounted vertically to provide uniform contrast between the subject's facial structures and the background [fig 2]. Fig 3 is showing the Canon EOS 1500 DSLR Camera. Fig 4 is showing the FH Plane Parallel to Floor. Fig 5 is showing the Photographs according To AACD Specifications. Ambient light interference was eliminated by conducting photography under exclusively artificial illumination, thereby preventing fluctuations in colour temperature and exposure. Two studio soft box lights were positioned bilaterally at approximately 45° to the subject's mid-sagittal plane to provide uniform and shadow-free illumination. Uniform lighting is critical in proportional analysis studies, as shadow formation may artificially alter the perceived width of teeth, thereby affecting GP and RED ratio calculations. Standardized frontal images of each subject's natural smile were captured using a Canon EOS 1500D DSLR camera (Canon Inc., Tokyo, Japan), equipped with a 35–105 mm lens. Subjects were seated comfortably and instructed to assume the Natural Head Position (NHP) by looking straight ahead into a mirror, a method validated by Solow.²¹ Fig 6 is showing the Photos Analyzed Digitally In Adobe Software. The working distance between the camera and the subject was standardized at 30 cm.⁹ Photographs were taken following the American Academy of Cosmetic Dentistry (AACD) guidelines for smile documentation.¹² The specifications for 1:2 or 1:3 magnification retracted frontal views included: The upper and lower teeth should be slightly parted so the incisal edges are visible, Show as much gingiva as possible, Minimize the appearance of lips and retractors in the image, Teeth and adjacent tissue must be completely and clearly visible, The midline of the face should be used as the vertical midline of the image, The horizontal midline of the image should be the incisal plane of the upper teeth, perpendicular to the vertical midline, Focus on central and lateral incisors. Proper depth of field (high f-stop) will allow other visible teeth to be in focus, Tongue should be positioned away from the teeth to avoid distraction. The patients were positioned

in the natural head position. Digital camera was mounted on to a tripod and images were captured using a standardized camera canon 1500D with 35-105 mm focal length; with ISO sensitivity of 160 and shutter speed of All images were saved in JPEG format at 300 dpi resolution and imported into Adobe Photoshop CC for digital analysis. To minimize measurement errors, all image-based evaluations were repeated by the same examiner after a two week interval. The mesiodistal width of each tooth was then calculated in pixels. The collected data were entered into a spreadsheet (Microsoft Excel, Microsoft Corp., Redmond, WA) and subsequently analyzed using statistical software. To accurately convert pixel values from photographs into millimetres, a pixel to-millimetre ratio was calculated. This was achieved by dividing the actual (intraorally measured) mesiodistal width of the right maxillary central incisor (in mm) by its corresponding pixel width on the image.

Proportion Calculations

To evaluate the Golden Proportion, the measured width of the central incisor was multiplied by 0.618 (61.8%) and compared with the width of the adjacent lateral incisor. Similarly, the width of the lateral incisor was multiplied by 0.618 and compared to that of the canine.

The RED Proportion was determined using the following formula:

- Width of each lateral incisor ÷ Width of the adjacent central incisor × 100
- Width of each canine ÷ Width of the adjacent lateral incisor × 100

All measurements and proportion analyses were compiled for statistical evaluation to determine the prevalence and consistency of esthetic dental proportions within the study population.



Figure 1: Standardized Digital Photographic Set Up



Figure 2: Lighting Standardization



Figure 3: Canon EOS 1500 DSLR Camera



Figure 4: FH Plane Parallel to Floor



Figure 5: Photographs According To AACD Specifications

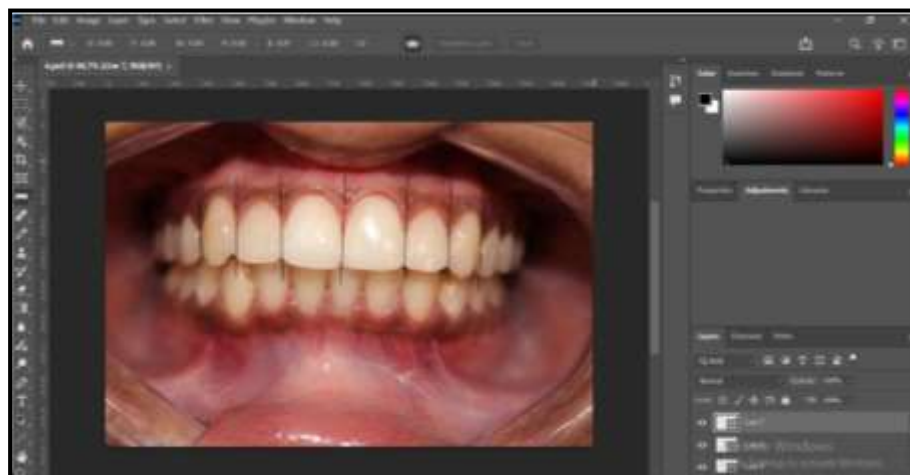


Figure 6: Photos Analyzed Digitally In Adobe Software

Statistical Analysis

Statistical Package for Social Sciences [SPSS] for Windows Version 22.0 Released 2013. Armonk, NY: IBM Corp., was used to perform statistical analyses. Level of significance was set at $p < 0.05$.

RESULTS

Table No.1 shows the summary of apparent mesiodistal dimensions of maxillary anterior teeth in the study population. The mean width of the right and left central incisors was 7.94 ± 0.58 mm and 7.98 ± 0.57 mm respectively. Paired t-test analysis revealed no statistically significant difference between right and left sides for central incisors ($p = 0.523$), lateral incisors ($p = 0.619$), and canines ($p = 0.975$), indicating excellent bilateral symmetry. Table No.2 shows the prevalence of Golden Proportion in the maxillary lateral/central incisor width ratio. The mean ratio was $75.4 \pm 10.7\%$ on the right side and $74.3 \pm 9.5\%$ on the left side, with an overall combined mean of $74.9 \pm 10.1\%$. Chi-square analysis demonstrated that the proportion of ratios within the Golden range was significantly lower compared to those outside the range ($p < 0.001$). Table No.3 shows the prevalence of RED Proportion in the maxillary lateral/central incisor width ratio. Chi-square test revealed that the proportion of ratios within the RED range was significantly higher than those outside the range ($p < 0.001$), indicating that RED proportion is more commonly observed in the study population. Table No.4 shows the comparison of Golden Proportion and RED Proportion categories among the 200 evaluated ratios. Overall, 70.5% of ratios were within the RED range. The Chi-square test showed a statistically significant difference among the distribution of categories ($p < 0.001$). Table No.5 shows the gender comparison of the lateral/central incisor width ratio on the right side. The mean ratio among males was $76.2 \pm 11.3\%$, while among females it was $74.9 \pm 10.5\%$. Independent t-test analysis revealed no statistically significant difference between males and females ($p = 0.567$), indicating that gender does not significantly influence the lateral/central incisor width ratio in the study population.

Table 1: Summary of apparent mesiodistal dimensions of maxillary anterior teeth in the study population (mm)

Tooth	Side	Mean (mm)	SD (mm)	Paired t-test p-value (Right vs Left)
Central Incisor	Right	7.94	0.58	0.523
	Left	7.98	0.57	
Lateral Incisor	Right	5.95	0.65	0.619
	Left	5.90	0.64	
Canine	Right	3.82	0.63	0.975
	Left	3.82	0.68	
All p-values > 0.05 → no statistically significant difference between right and left sides (excellent bilateral symmetry)				

Table 2: Prevalence of Golden Proportion (Lateral / Central incisor width ratio) Golden Proportion considered present when ratio is within 62% ($62\% \pm 5\%$)

Side	Mean Ratio (%)	SD (%)	Within 62% n (%)	Percentage (%)	p- value*
Right	75.4	10.7	20	20.0	< 0.001
Left	74.3	9.5	21	21.0	
Combined	74.9	10.1	41	20.5	
*p-value from Chi-square test comparing proportion of ratios within 62% vs outside this range					

Table 3: Prevalence of RED Proportion (Lateral / Central incisor width ratio)

Side	Mean Ratio (%)	SD (%)	Within 60–80% n (%)	Percentage (%)	p-value*
Right	75.4	10.7	67	67.0	< 0.001
Left	74.3	9.5	74	74.0	
Combined	74.9	10.1	141	70.5	
*p-value from Chi-square test comparing proportion of ratios within 60–80% vs outside this range					

Table 4: Comparison of Golden Proportion vs RED Proportion (n = 200 ratios)

Category	Frequency	Percentage (%)	p-value (Chi-square)
----------	-----------	----------------	----------------------

Golden only (62%)	5	2.5	< 0.001
Overlap: Golden & RED (60–67%)	36	18.0	
RED only (68–80%)	105	52.5	
Outside both ranges (<57% or >80%)	54	27.0	
Total within RED range (60–80%)	141	70.5	

Table 5: Gender comparison of lateral/central incisor width ratio (right side)

Gender	n	Mean Ratio (%)	SD (%)	p-value (independent t-test)
Male	38	76.2	11.3	0.567
Female	62	74.9	10.5	

Figures Interpretation

Figure No.1 shows the comparison of mean apparent mesiodistal widths of maxillary anterior teeth between the right and left sides. The graphical representation clearly illustrates minimal variation between right and left sides, which supports the non-significant p-values obtained from the paired t-test. Figure No.2 shows the prevalence of Golden Proportion (62%) in the maxillary lateral/central incisor width ratio. The bar graph demonstrates that only a small fraction of the evaluated ratios meet the Golden proportion criteria. Figure No.3 shows the prevalence of RED Proportion (60–80%) in the maxillary lateral/central incisor width ratio. The graphical representation highlights the predominance of RED proportion in the study population. Figure No.4 shows the distribution of maxillary lateral/central incisor width ratio categories. The majority of ratios (52.5%) fall within the RED-only range (68–80%), followed by 27% outside both ranges. A smaller proportion (18%) lies within the overlapping Golden and RED range (60–67%), and only 2.5% are exclusively within the Golden-only range (62%). Figure No.5 shows the gender comparison of the mean lateral/central incisor width ratio on the right side. The mean ratio among males (76.2%) is slightly higher than that of females (74.9%), but the graphical difference is minimal.

Figure 1: Comparison of Mean Apparent Mesiodistal Widths of Maxillary Anterior Teeth between Right and Left Sides

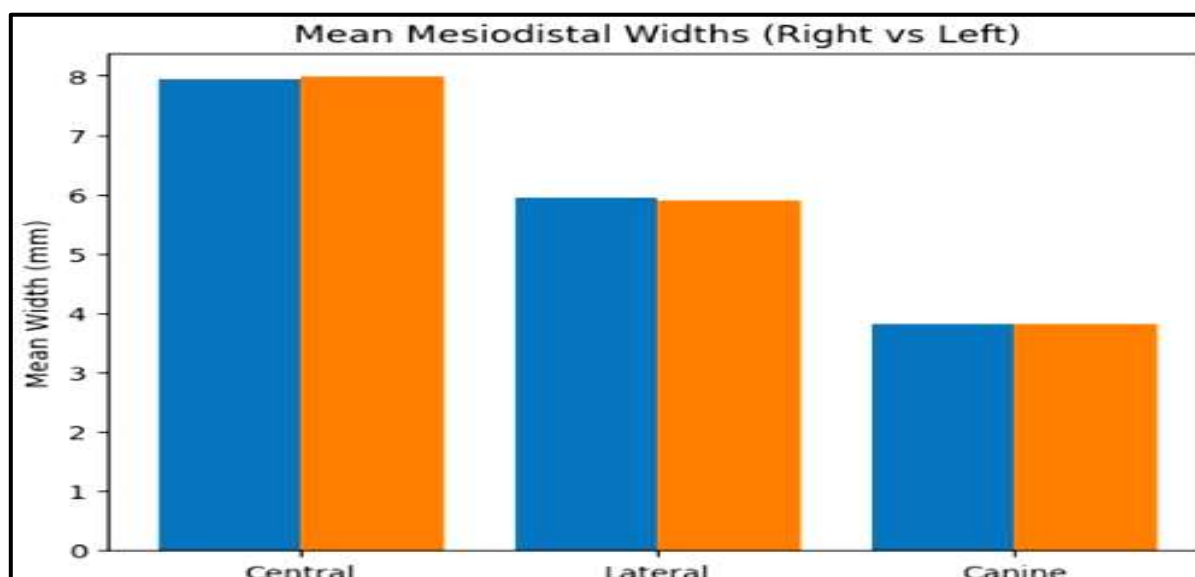


Figure 2: Prevalence of Golden Proportion (62%) in Maxillary Lateral/Central Incisor Width Ratio

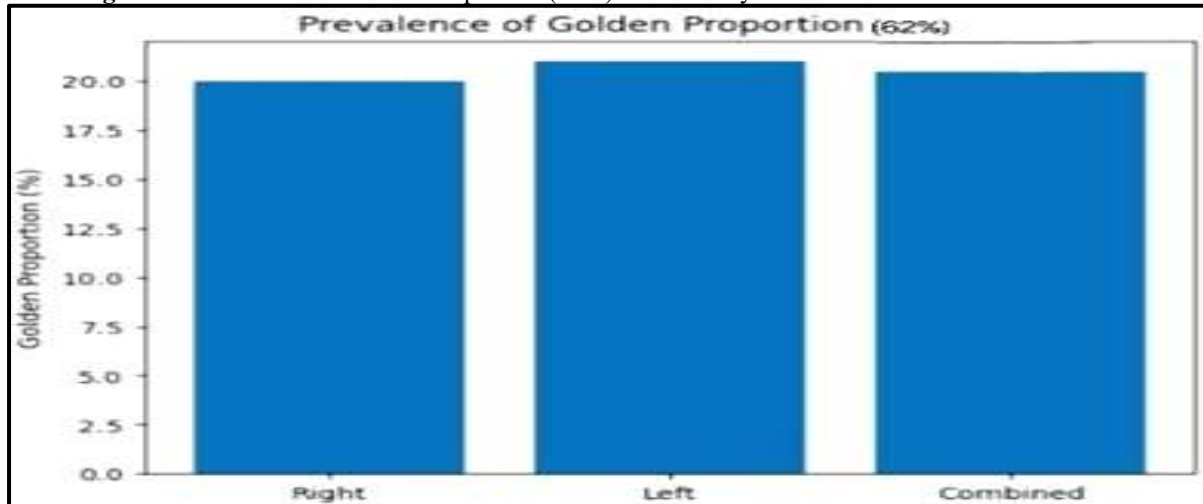


Figure 3: Prevalence of RED Proportion (60–80%) in Maxillary Lateral/Central Incisor Width Ratio

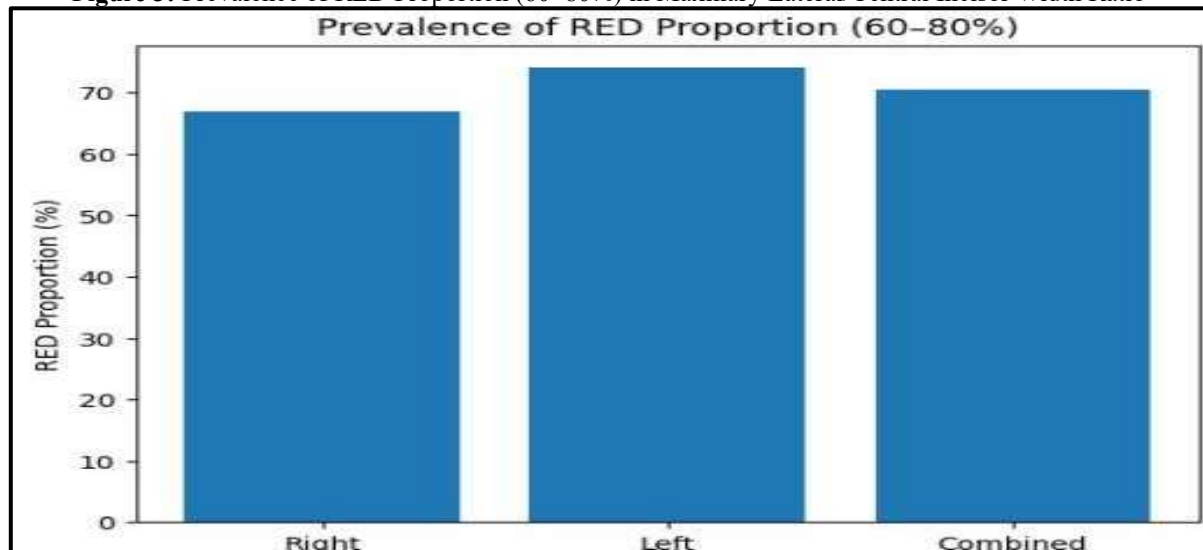


Figure 4: Distribution of Maxillary Lateral/Central Incisor Width Ratio Categories (Golden, RED, and Outside Range)

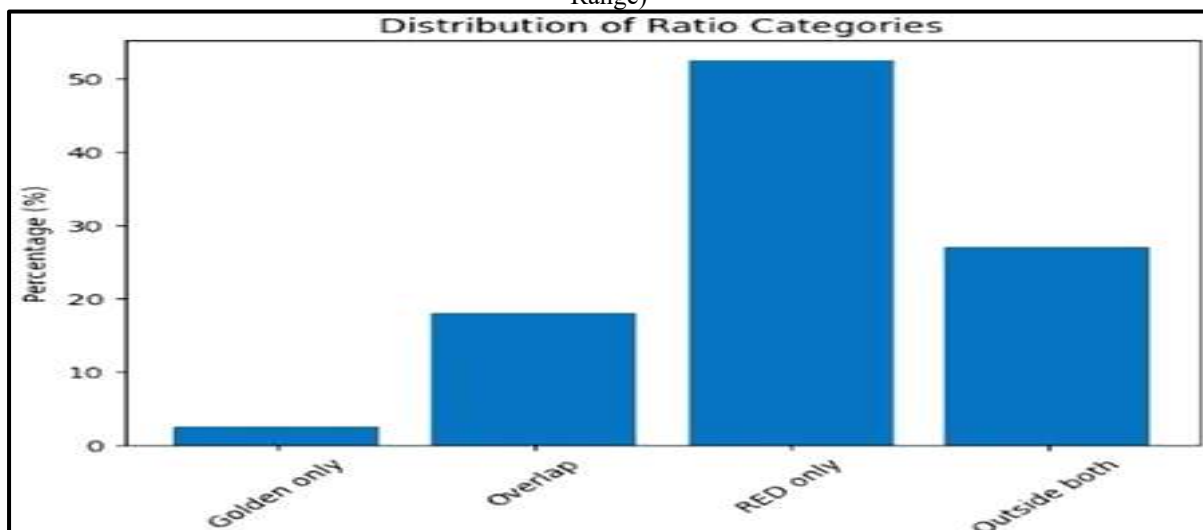
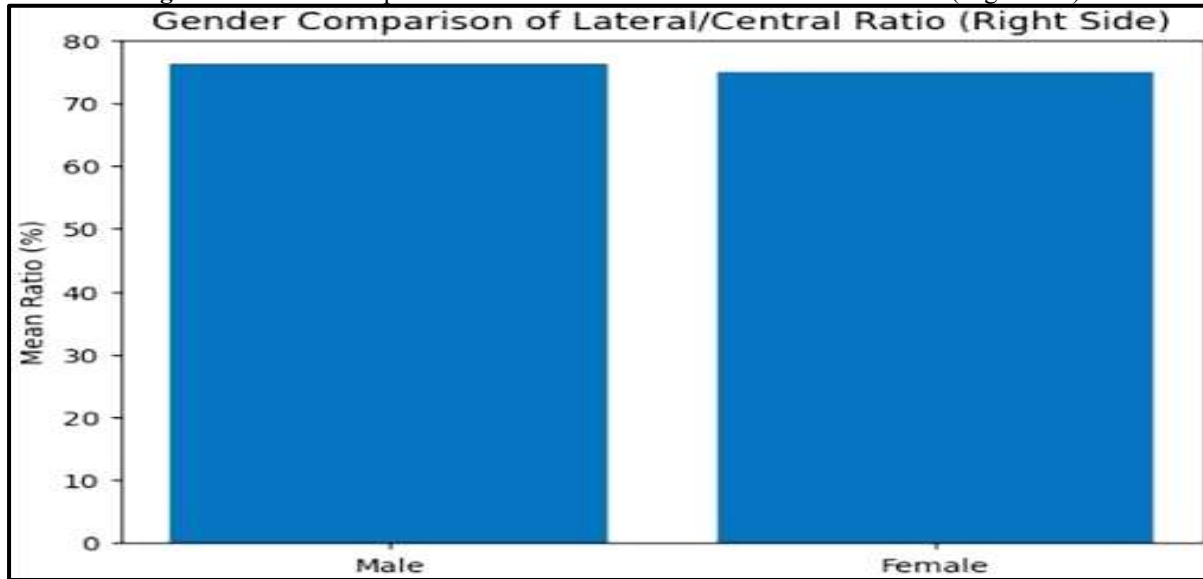


Figure 5: Gender Comparison of Mean Lateral/Central Incisor Width Ratio (Right Side)



DISCUSSION

Esthetics was a fundamental component of prosthodontic dentistry, with anterior tooth proportions playing a decisive role in smile harmony and facial perception.^{1,13} The Golden Proportion (1.618:1), introduced into dentistry by Lombardi¹ and subsequently formalized by Levin^{13,14} proposed that the visible width of the maxillary lateral incisor should be approximately 62% of the central incisor, and the canine 62% of the lateral incisor in frontal view. The present study strongly substantiated this biologic viewpoint. In the Telangana population aged 18–25 years, the mean lateral-to-central incisor ratio was $74.9\% \pm 10.1\%$, demonstrating a substantial and clinically meaningful deviation from the classical 62% Golden standard. Importantly, only 20.5% of the evaluated ratios fell within the Golden range (57–67%), and this difference were statistically highly significant ($p < 0.001$). The magnitude and consistency of this deviation indicated that the Golden Proportion was not the predominant natural pattern in this population. Rather than representing a universal biological constant, the 62% ratio appears to function more as a theoretical esthetic guideline than as a naturally occurring norm. The statistical findings of this study were not isolated observations but were in strong agreement with both international and Indian literature. Preston et al.² and Gillen et al.³ reported that the 62% ratio was rarely observed in natural dentition across diverse populations. Their analyses revealed that while some individuals might approximate Golden relationships, the majority exhibited broader proportional variability. Snow et al.¹⁵ proposed the Golden Percentage concept precisely because the Golden Proportion lacked consistent clinical representation, suggesting that visible tooth widths were better expressed as percentage distributions across the anterior segment rather than as fixed inter tooth ratios. Kawakami et al.¹⁶ attributed deviations from Golden standards to ethnic and population-specific craniofacial differences. Londono et al.¹⁷, through systematic review and meta-analysis, concluded that there was insufficient scientific evidence to support the universal biological presence of the Golden Proportion in natural dentition. Thus, the 20.5% prevalence observed in the present Telangana cohort aligned with high-level global evidence and strengthen the external validity and scientific credibility of the study findings. Indian investigations further conformed these observations. Sandeep et al.¹⁸ reported only 14% Golden prevalence among South Indians, reinforcing the limited applicability of the 62% rule within regional populations. Shah et al.¹⁹, Agrawal et al.²⁰, Mahajan et al.²¹, Murthy and Ramani²², Singh and Datta²³, and Meshramkar et al.²⁴ consistently documented limited adherence to the Golden Proportion in natural anterior dentition. Regional studies conducted in Kerala²⁵ Dakshina Kannada²⁶, and Maharashtra.²⁷ The present study demonstrated that 70.5% of ratios conformed to the RED proportion range, which was statistically highly significant ($p < 0.001$) and markedly greater than Golden adherence. Furthermore, 52.5% of ratios fell exclusively within the RED proportion only range, whereas only 2.5% were Golden proportion only. This distribution pattern was highly informative. It clearly indicates that the natural anterior dentition of the Telangana population followed a flexible proportional gradient rather than a rigid mathematical constant. Clinically, rigid application of the 62% Golden ratio might result in over narrowing of lateral incisors during restorative or prosthodontic procedures. Over-reduction in width could compromise tooth anatomy, emergence profile, and gingival contour harmony. In contrast, RED proportion allowed the clinician to maintain proportional consistency without sacrificing natural morphology. It provided a guiding framework rather than a restrictive formula. In esthetic rehabilitation, especially in veneer placement, composite build-ups, or full mouth rehabilitation, flexibility was essential to preserve individuality while achieving harmony. RED proportion therefore demonstrated greater clinical realism and biological plausibility. Despite these limitations, the present study provides statistically significant, biologically plausible, and literature-supported evidence that the Golden Proportion was not the predominant natural anterior tooth relationship in the Telangana population. In contrast,

the markedly higher prevalence of RED proportion demonstrated that flexible proportional reduction better reflects natural dentition. The evidence presented statistical distribution; comparative prevalence, biologic reasoning, and consistency with global and Indian literature collectively defended the conclusion that RED proportion was superior to Golden proportion as a representative framework for anterior tooth relationships in this population. A detailed statistical analysis was carried out using descriptive statistics, paired t-tests to check right and left symmetry, independent t-tests to compare males and females, and chi-square tests to determine prevalence. This provided a strong and reliable method for analyzing the data. Reporting the p-values added scientific strength and ensured that the results were interpreted objectively. The study also compared both Golden and RED proportions, which gave a wider clinical understanding. Since RED proportion showed a much higher prevalence, it proves that flexible proportional concepts are more practical and useful in smile design. Importantly, RED proportion does not go against esthetic principles; instead, it improves them. It moves away from following one fixed number and focuses more on natural variation and individual harmony. This approach matches modern evidence-based dentistry, respects differences among populations, and supports patient-centered smile design. Therefore, the findings of this study strongly support the need for population-specific esthetic standards and show that smile design should focus on natural biologic variation and flexible proportions rather than strictly following one universal mathematical ratio.

Limitations of the Study

Although our study is statistically adequate, larger multi-centre studies across different districts and socioeconomic groups would enhance external validity and provide more representative regional norms. Another limitation is the use of two-dimensional photographic analysis. While standardized protocols were followed, 2D images assess only apparent mesiodistal widths and do not fully capture three-dimensional morphology or arch curvature. Future studies incorporating three-dimensional digital scanning or stereo-photogrammetry would provide more precise spatial assessment. All measurements were performed by a single examiner to ensure consistency; however, formal intra-examiner reliability testing was not reported. Clinically, the low prevalence of Golden Proportion (20.5%) and significantly higher prevalence of RED Proportion (70.5%) indicate that strict adherence to the 62% Golden ratio may not reflect natural anterior tooth relationships in Telangana.

CONCLUSION

Within the limitations of this study, it was concluded that although the Golden Proportion remains an influential theoretical guideline in esthetic dentistry, it cannot be regarded as a universal biological norm. The RED Proportion appears to be more adaptable, clinically relevant, and representative of natural anterior teeth relationships in the Telangana population. Hence, esthetic treatment planning should be guided by population-specific data and flexible proportional concepts rather than rigid mathematical standard. Nonetheless, the authors anticipate some future studies and investigations those are crucial to increase the related understanding and transparency with confirmation of current perspectives and norms.

REFERENCES

1. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent.* 1973;29:358–82.
2. Preston JD. The golden proportion revisited. *J Esthet Dent.* 1993;5:247–51.
3. Gillen RJ, Schwartz RS, Hilton TJ, Evans DB. An analysis of selected normative tooth proportions. *Int J Prosthodont.* 1994;7:410–7.
4. Snow SR. Esthetic smile analysis of maxillary anterior tooth width: the golden percentage. *J Esthet Dent.* 1999;11:177–84.
5. Rosenstiel SF, Ward DH, Rashid RG. Dentists' preferences of anterior tooth proportion—a web-based study. *J Prosthodont.* 2000;9:123–36.
6. Mosomi MN, Maina SW, Osiro OA, Omondi BI. Evaluation of the Golden Proportion, Golden Percentage, and Recurring Esthetic Dental Proportion in Kenyans of African Descent. *Clin Exp Dent Res.* 2024;10(4).
7. Rokaya D, Kitisubkanchana J, Wonglamsam A, Santiwong P, Srithavaj T, Humagain M. Nepalese Esthetic Dental (NED) Proportion in Nepalese Population. *Kathmandu Univ Med J.* 2015;13(3):244–249.
8. Ibrahim M, Al-Marzok M, Majeed KRA, Ibrahim K. Evaluation of maxillary anterior teeth and their relation to golden proportion in Malaysian population. *BMC Oral Health.* 2013;13:9–11.
9. Forster A, Velez R, Antal M, Nagy K. Width ratios in the anterior maxillary region in a Hungarian population: Addition to the golden proportion debate. *J Prosthet Dent.* 2013;110(3):211–215
10. Naqash TA, Bali SK. Evaluation of golden proportion between maxillary anterior teeth in Kashmiri population. *Int J Clin Cases Investig.* 2014;5(2):3–7.
11. Baghiana G, Peter D, Manju V, Babu AS, Krishnan V. Relevance of Recurring Esthetic Dental (RED) proportion and golden proportion among patients attending a tertiary care center at Kochi, Kerala. *J Oral Biol Craniofac Res.* 2022;12(6):890–893
12. American Academy of Cosmetic Dentistry. A Guide to Accreditation Photography: Photographic Documentation and Evaluation in Cosmetic Dentistry. AACD; 2013.

13. Levin EI. Dental esthetics and the golden proportion. *J Prosthet Dent.* 1978;40:244–52.
14. Livio M. The golden ratio: The story of phi, the world's most astonishing number. *Crown*; 2008 Nov 12.
15. Snow SR. Esthetic smile analysis of maxillary anterior tooth width: the golden percentage. *J Esthet Dent.* 1999;11:177–84
16. Kawakami S, Tsukada S, Hayashi H, Takada Y, Koubayashi S. Golden proportion for maxillofacial surgery in Orientals. *Ann Plast Surg.* 1989;23(5):417–25
17. Londono J, Ghasemi S, Lawand G, Dashti M. Evaluation of the golden proportion in the natural dentition: A systematic review and meta-analysis. *J Prosthet Dent.* 2023;129(5):696–702
18. Sandeep N, Satwalekar P, Srinivas S, Reddy CS, Reddy GR, Reddy BA. An analysis of maxillary anterior teeth dimensions for the existence of golden proportion: clinical study. *J Int Oral Health.* 2015;7(9):18
19. Shah DS, Vaishnav K, Duseja S, Sheth RS. Evaluation of recurring esthetic dental proportion in natural mandibular anterior dentition. *Adv Hum Biol.* 2015;5(1):1–4
20. Agrawal VS, Kapoor S, Bhesania D, Shah C. Comparative photographic evaluation of various geometric and mathematical proportions of maxillary anterior teeth: A clinical study. *Indian J Dent Res.* 2016;27(1):32–6
21. Mahajan V, Nagpal A, Gupta R, Vaidya S, Jabeen F, Thakur K. Comparative evaluation of golden proportion, recurring esthetic dental proportion and golden percentage in Himachal demographic. *JAMMR.* 2019;29:1–7
22. Murthy BV, Ramani N. Evaluation of natural smile: Golden proportion, RED proportion, Golden percentage. *J Conserv Dent.* 2008;11:16–21
23. Singh R, Datta K. The golden proportion—God's building block for the world. *J Indian Prosthodont Soc.* 2008;8(1):6–9.
24. Meshramkar R, Patankar A, Lekha, Nadiger R. Prevalence of golden and red proportion in aesthetically pleasing smiles. *Eur J Prosthodont Rest Dent.* 2013;21(1):29–33
25. Baghiana G, Peter D, Manju V, Babu AS, Krishnan V. Relevance of Recurring Esthetic Dental (RED) proportion and golden proportion among patients attending a tertiary care center at Kochi, Kerala. *J Oral Biol Craniofac Res.* 2022;12(6):890–893
26. Verma A, Prasad DK. A Study to Evaluate the Prevalence of Golden Percentage and Recurring Esthetic Dental Proportion among Young Individuals in Dakshina Kannada. *J Health Allied Sci NU.* 2024;14:386–389
27. Prakash P, Bahri R. Prevalence of dental esthetic proportion and its correlation with dentogenics in Maharashtrian population—a cross-sectional study. *IP Ann Prosthodont Restor Dent.* 2022;8(03):150–61.