

# ANALYSIS OF GOLDEN PROPORTION IN MAXILLARY ANTERIOR DENTITION

<sup>1</sup>KIRAN TARIQ, <sup>2</sup>MUHAMMAD WASEEM ULLAH KHAN, <sup>3</sup>MUHAMMAD ASIF MUSHTAQ,  
<sup>4</sup>SUMAYIA QAISER, <sup>5</sup>SAHAR ILYAS

## ABSTRACT

*The purpose of this study was to analyze the existence of golden proportion in clinical crowns of maxillary central incisors, lateral incisors and canines by using their perceived mesio-distal widths among patients of Punjab Dental Hospital, Lahore. A Descriptive Cross-Sectional study was conducted in outpatient department, Punjab Dental Hospital, Lahore from 6 March 2020 to 6-September-2020. Maxillary gypsum casts were obtained from 151 patients fulfilling the inclusion criteria. Standardized frontal photograph of each cast was recorded on a digital camera. Perceived mesio-distal widths of central incisors, lateral incisors and canines were determined by Adobe Photoshop version CS-6. Mean width ratio of lateral incisor/central incisor (LI/CI) and canine/lateral incisor (C/LI) of each side was calculated and compared with the Golden ratio (0.62). Chi-square test was applied to explore Golden proportion. For right side golden proportion for LI/CI was seen in 20(13.25%) patients and for C/LI golden proportion was seen in 5(3.31%) patients. For left side golden proportion for LI/CI was seen in 28(18.54%) patients and for C/LI golden proportion was seen in 5(3.31%) patients. Right and left side proportions were found symmetrical for LI/CI ratio (right: 0.72, left: 0.73) whereas for C/LI, it was asymmetrical (right:0.68, left: 0.80). The outcomes did not show sufficient gender variation to affect the golden proportion measurements. Results of this study revealed low frequency of golden proportion in clinical crowns of maxillary central incisor, lateral incisor and canine. LI/CI golden proportion was more common than C/LI golden proportion. The adapted golden proportion might not serve as a guideline to create well-balanced proportions in maxillary anterior teeth for our population.*

**Key words:** Analysis, Dentition, Maxilla], Esthetics.

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## INTRODUCTION

Golden Proportion is a constant mathematical ratio which is approximately equal to 1.618 : 1 and occur in the form of repeated patterns across the universe from DNA double helix to the spiral arms of the Milky Way.<sup>1,2</sup> As a standard of beauty it can be seen through human body, the face, the fingers and the teeth.<sup>3</sup> In esthetic dentistry, Golden proportion has been used to

determine proportions in facial shape, size, symmetry, soft tissue profile, lip morphology and ideal smiles.<sup>4,5</sup> Lombardi proposed that dental aesthetics are optimized if central incisor to lateral incisor width and lateral incisor to canine width are repeated in golden proportion when viewed from the front.<sup>6</sup> When converted to percentage proportion the smaller width is 62% the size of larger one. In this way, the perceived width of maxillary lateral incisor is 62% of the central incisor, and the perceived width of canine is 62% of the lateral incisor.<sup>7</sup>

Ker and colleagues found out that ideal perceived width of lateral incisor should be 72% of the perceived width of the central incisor, with a wide range of acceptability from 53% to 76%. Azam et al<sup>8,9,10</sup> in their study identified that golden proportion was found in 10% of the perceived lateral incisor to central incisor width ratio on both sides and 2% of the perceived canine to lateral incisor width ratio on the right side and 6% on the left side. In a study among Kurdish and Arab Population, golden proportion was found to exist between maxillary lateral incisor and central incisor (Kurdish:0.62, Arabs:0.63) but not between maxillary

<sup>1</sup> Dr Kiran Tariq, BDS, FCPS, Prosthodontics Ex PGR, Prosthodontics Department of Prosthodontics, de 'Montmorency College Of Dentistry, Lahore. Cell: 0322 6252308, Email: kirantariq1234@gmail.com

<sup>2</sup> Muhammad Waseem Ullah Khan, BDS FCPS Prosthodontics, Associate Professor, Prosthodontics, Dental Institute, Faisalabad Medical University, Faisalabad. Cell: 0333 4844930, Email: veritarian@gmail.com

<sup>3</sup> Muhammad Asif Mushtaq, BDS, EX PGR Prosthodontics, Ex PGR, Prosthodontics, de 'Montmorency College of Dentistry, Lahore. Cell: 0334 9844763. Email: dr.asif100@yahoo.com

<sup>4</sup> Sumayia Qaiser, BDS, FCPS, Prosthodontics, Department of Prosthodontics, de 'Montmorency College of Dentistry, Lahore. Cell: 0336 1492868. Email: dr\_sonia\_89@hotmail.com

<sup>5</sup> Sahar Ilyas, Ex PGR (Orth), de Montmorency College of Dentistry

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canine and lateral incisor (Kurdish: 0.69, Arabs: 0.73)<sup>10</sup>. However, a recent review and meta analysis on previous literature concluded that golden proportion in dentistry is just a myth. Previous studies have shown varying results among different ethnic groups and have questioned the universal application of golden proportion in dental esthetics; thus there is a need to reconsider this principle. The rationale of this study was to evaluate the existence of golden proportion in maxillary anterior teeth among patients presenting to a Tertiary Care Hospital in Lahore, Pakistan, which will help to explore the validity of using this proportion in restoration of anterior dentition in Pakistani population.

## METHODOLOGY

This descriptive Cross sectional Study was conducted in Out patient department of Punjab Dental Hospital, Lahore, from 6 March 2020 to 6 September 2020. A total of 151 patients were included in the study. Sample size was calculated using EPI calculator with a confidence level of 95% and a 5% margin of error. Inclusion Criteria of this study was any male or female patient aged 20-35 years visiting for dental treatment of posterior teeth, having fully erupted intact and well aligned permanent maxillary anterior teeth. Exclusion Criteria was any patient having malocclusion (anterior open bite/cross bite, intruded, extruded or rotated teeth), anterior teeth restorations or any fixed anterior dental prosthesis, history of orthodontic treatment or signs of tooth wear. Informed verbal consent was taken from a total of 151 patients (70 males, 81 females) fulfilling the inclusion criteria. Irreversible hydrocolloid impression of maxillary arch was made in stock tray and cast poured with type IV dental gypsum. The cast was placed on a graph paper with well-defined horizontal axis and

vertical axis. The cast was positioned such that the tips of both canines lie on horizontal axis and the cast midline, a line passing between central incisors, lies on vertical axis. Standardized frontal photographs of each cast were recorded on a digital camera (Canon 750D) with lens having focal length of 18-55mm. The camera lens was centered on the vertical line that extends along the midline of the cast from frontal view and perpendicular to the labial surfaces of central incisors. The distance between the camera lens and the cast was kept constant throughout at 25cm and the lens focal length was kept at 55mm for all photographs. Frontal photographs were taken for each cast. Photographs were transferred to a personal computer and perceived widths of central incisor, lateral incisor and canine was measured using Adobe Photoshop version CS-6 Figure 1. All measurements were made by one person, repeated thrice and mean value calculated. Ratio of lateral incisor/central incisor and canine/lateral incisor of each side was calculated and compared with golden ratio that is (0.62). The collected data was analyzed using SPSS 20. Chi square test taking P-value  $\leq 0.05$  as significant was applied.

## RESULTS

- Existence of Golden proportion between lateral incisor and central incisor and canine and lateral incisor is shown in table 1.
- Mean Right and left side Lateral incisor to Central incisor ratio (LI/CI) and its difference from golden proportion is shown in table 2.
- Mean Right and left side Canine to Lateral Incisor ratio (C/LI) and its difference from golden proportion is shown in table 3.

TABLE1: EXISTENCE OF GOLDEN PROPORTION IN STUDY SAMPLE.

Existence of Golden Proportion in No. of Participants			
		YES	NO
RIGHT SIDE	LI/CI	20 (13.25%)	131 (86.75%)
	C/LI	5 (3.31%)	146 (96.68%)
LEFT SIDE	LI/CI	28 (18.54%)	123 (81.45%)
	C/LI	5 (3.31%)	146 (96.68%)

TABLE 2: MEAN RIGHT AND LEFT SIDE LI/CI RATIOS AND DIFFERENCE FROM GOLDEN PROPORTION.

	Right side LI/CI	Difference from Golden Ratio	Left side LI/CI	Difference from Golden Ratio
Mean	0.72	-0.10	0.73	-0.10
SD	0.08	0.08	0.09	0.11
Minimum	0.54	-0.22	0.57	-0.30
Maximum	0.84	0.08	0.92	0.28

TABLE 3: MEAN RIGHT AND LEFT SIDE C/LI RATIOS AND DIFFERENCE FROM GOLDEN PROPORTION

	Right side C/LI	Difference from Golden Ratio	Left side C/LI	Difference from Golden Ratio
Mean	0.68	-0.10	0.80	-0.18
SD	0.04	0.16	0.08	0.10
Minimum	0.53	-0.78	0.62	-0.36
Maximum	0.77	0.09	0.98	0.11

TABLE 4: RIGHT AND LEFT SIDE GOLDEN PROPORTION BETWEEN LATERAL INCISOR AND CENTRAL INCISOR IN RELATIONSHIP TO GENDER

	Right Side Golden Proportion (LI/CI)		P Value	Left Side Golden Proportion (LI/CI)		P Value
	Yes	No		Yes	No	
Male	11 (15.71%)	59 (84.28%)	0.450	11 (15.71%)	59 (84.28%)	0.406
Female	9 (11.11%)	72 (88.88%)		17 (20.98%)	64 (79.01%)	

TABLE 5: RIGHT AND LEFT SIDE GOLDEN PROPORTION BETWEEN CANINE AND LATERAL INCISOR IN RELATIONSHIP TO GENDER

	Right Side Golden Proportion (C/LI)		P Value	Left Side Golden Proportion (C/LI)		P Value
	Yes	No		Yes	No	
Male	1 (1.42%)	69 (98.57%)	0.229	2 (2.85%)	68 (97.14%)	0.772
Female	4 (4.93%)	77 (95.06%)		3 (3.70%)	78 (96.29%)	

- Right and left side Golden proportion between Lateral incisor and Central incisor in relation to gender is shown in table 4.
- Right and left side Golden proportion between Canine and Lateral incisor in relation to gender is shown in table 5.

## DISCUSSION

Several authors have outlined a relationship between maxillary anterior teeth and mathematical proportions. These include golden proportion, golden percentage, and recurring esthetic dental (RED) proportion.<sup>12</sup> Lombardi<sup>6</sup> and Levin<sup>13</sup> were the first to introduce the idea of golden proportion in esthetic dentistry and to apply this ratio in the maxillary anterior sextant.

Preston<sup>14</sup> proposed that golden proportion lies in the range of 0.61 to 0.63, and the same range was contemplated in our study during evaluation of the data. In this study, for right side golden proportion between lateral and central incisor was seen in 20(13.25%) patients and for canine and lateral incisor golden proportion was seen in 5(3.31%) patients. For left side golden proportion for lateral and central incisor was seen in 28(18.54%) patients and for canine and lateral incisor golden proportion was seen in 5(3.31%) patients. These

results are similar to some previous studies. Maharanjan et al<sup>15</sup> in his study showed that golden proportion was found in 14.28% of the perceived lateral to central incisor width ratio and 12.69% of the perceived canine to lateral incisor width ratio. According to the results of a study from Bangladesh the golden proportion existed in 17% of the perceived width ratios of lateral incisor to central incisor and 4% of the width ratios of canine to lateral incisor in natural dentition.<sup>16</sup> Among Jordanian population, lateral incisor to central incisor width proportion existed in 22% of the study subjects and canine to lateral incisor width proportion in 11%.<sup>17</sup> Above studies show relatively lower percentage of subjects with golden proportion between canine and lateral incisor when compared to golden proportion between lateral incisor and central incisor.

Equal side proportions suggest that re-establishing Golden proportion symmetry is a pre requisite when dental restorations are planned in the esthetic region. Side difference in this study was found symmetrical for LI/CI ratio on both sides (right: 0.72, left: 0.73) [table 2] whereas for C/LI it was asymmetrical ( right :0.68, left: 0.80) [table 3]. Results for LI/CI ratio are consistent with a study, where right and left LI/CI ratio was also found symmetric in Arab population group (right 0.635, left 0.628) and contrasted with results of Kurdish population group which revealed significantly

larger LI/CI ratio on right side than left side (0.63 vs. 0.69,  $p=0.049$ ). For C/LI, both Kurdish and Arab groups had symmetry on right and left side as opposed to our study.<sup>10</sup>

Studies have shown that racial differences in a population should be considered when seeking to apply the concept of the golden proportion in maxillary anterior dentition.<sup>18,19</sup> In spite of the wide acceptance of golden proportion in restorative dentistry and its application in dentofacial aesthetics, the overwhelming literature disproves its use as the most relevant, constant proportion. However, it is important to consider that geometric proportions are only one aspect of interpreting anterior dental aesthetics and other factors such as facial form, lip profile, arch form, tooth shape, size, shade, midline, symmetry etc. Require consideration before finalizing an aesthetic treatment.<sup>20,21</sup>

Some limitations of the present study should be highlighted, measurements were performed only on the photographs with no measurements on the casts or directly in the subject's mouth, and a small sample size could have made the generalization of the results questionable.

Taking the results of present study and previous findings into consideration, further studies should be conducted on a large number of subjects with equal male to female ratio in different populations with other methods of evaluation so that the use of esthetic proportions in the restoration of anterior dentofacial esthetics could be defined more clearly. Different dentofacial specificities, ethnic background, cultural variations, individual's own perception, and the differences in the study sample of each population may also influence the results.

## CONCLUSION

Results of this study revealed low frequency of golden proportion in clinical crowns of maxillary central incisor, lateral incisor and canine. LI/CI golden proportion was more common than C/LI golden proportion. Golden proportion should be a range rather than a particular value. The adapted golden proportion might not serve as a guideline to create well-balanced proportions in maxillary anterior teeth for our population.

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## CONTRIBUTIONS BY AUTHORS

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|--|---|
| 1 Kiran Tariq:                             | Concept & design of study                           |
| 2 Kiran Tariq, Muhammad Waseem Ullah Khan: | Drafting  |
| 3 Muhammad Asif Mushtaq:                   | Data Analysis                                       |
| 4 Sumayia Qaiser, Sahar Ilyas:             | Revisiting critically and final approval of version |