

**Anthropometric Analysis of Anterior Maxillary Teeth Using Digital Photography-An Institution Based Cross-Sectional Study**<sup>1</sup>Dr. N. Sangeetha Meena, MDS, Department of prosthodontics TNGDC, Chennai<sup>2</sup>Dr. A. Meenakshi, MDS, Professor and guide, Department of prosthodontics TNGDC, Chennai<sup>3</sup>Dr. Guguloth Amani, Post graduate student, Department of prosthodontics TNGDC, Chennai**Corresponding Author:** Dr. Guguloth Amani, Post graduate student, Department of prosthodontics TNGDC, Chennai**Citation of this Article:** Dr. N. Sangeetha Meena, Dr. A. Meenakshi, Dr. Guguloth Amani, “Anthropometric Analysis of Anterior Maxillary Teeth Using Digital Photography-An Institution Based Cross-Sectional Study”, IJDSIR- December - 2020, Vol. – 3, Issue - 6, P. No. 333–343.**Copyright:** © 2020, Dr. Guguloth Amani, et al. This is an open access journal and article distributed under the terms of the creative commons attribution noncommercial License. Which allows others to remix, tweak, and build upon the work non commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.**Type of Publication:** Original Research Article**Conflicts of Interest:** Nil**Introduction**

Smile is a facial expression for positive emotions such as happiness (or) enjoyment. Most studies have shown that people are more concerned about missing anterior teeth and their replacement than about posterior teeth, as esthetics seems to be of greater importance than function of the teeth<sup>1</sup>. The ideal dimension for the anterior teeth is a difficult task accomplish due to the individuality of each person.

Fisher and Frush introduced Dentogenics concept which has made the selection of teeth more appropriate; with respect to sex, personality and age of the patient<sup>2</sup>. Several authors have suggested the use of mathematical or geometrical models to try to solve this issue to get an ideal and harmonious proportion of maxillary anterior teeth to improvise the rehabilitation and restorative procedures<sup>3</sup>. Lambordi was the first to suggest the application of golden proportion in dentistry. It was applied by classical mathematicians such as Euclid and Pythagoras in search

of divine harmony and balance<sup>4</sup>. In 1999, Snow suggested the golden percentage. He proposed the golden percentage, the proportional width of each tooth must be canine 10%, lateral 15% and central 25% of the total width across the anterior segment, to achieve an esthetically pleasing smile<sup>5</sup>. In 2001, Ward proposed RED proportion, in which the ratio between two adjacent teeth when observed in a frontal perspective should remain distally constant compared to golden proportion which is 62%, the RED proportion value ranges from 60% to 80%. The greater the height of central incisor, the smaller the ratio used should be and vice versa<sup>6</sup>.

Digital imaging<sup>7</sup> has become a mainstream in the dental practice, and advances in computer technology have provided the dental professional with new tools that allow digitizing, measuring, displaying, and manipulating facial images. Lot of studies on maxillary anterior teeth proportions have been studied in different populations in various countries but limited studies have been conducted

in south Indian population on the esthetic anterior teeth proportions. Therefore the purpose of this study was to study the anterior maxillary teeth proportions of the south Indian population and see if any of the existent anthropometric proportions can be applied to the oral rehabilitation of this population with the aid of digital photographs and computer analysis.

### Objectives

- To evaluate golden proportion in maxillary anterior teeth in individuals with natural dentition.
- To evaluate golden percentage in maxillary anterior teeth in individuals with natural dentition.
- To evaluate RED proportion in maxillary anterior teeth in individuals with natural dentition
- To evaluate W/L ratio in maxillary central incisors in individuals with natural dentition

To see if ethnic differences should be taken into consideration in order to establish objectively quantifiable width ratio between maxillary anterior teeth.

### Materials and Methods

A total of 100 dentulous subjects comprised of 50 males and 50 females with age ranging from 18 and 25 years were chosen for the study.

Data was collected using photographic technique with the help of a digital camera (Nikon D700) a frontal photograph was taken from each individual with an esthetic smile<sup>8</sup>. A standardized photographic collections was established under the following conditions, a lip retractor to have a complete view of the anterior maxillary area as well as the respected gingiva, a periodontal probe as a reference to calibrate the image processing software, the orthopantomograph head support and laser beam were used as a reference to keep the patient always at the same distance (60cm) and to assure that the Frankfort plane was parallel to the ground. The cephalostat of a panoramic

### Results

radiographic device is used to position the head in upright position while taking photographs. The center of the lens of camera should coincident with the participant's midline. The software (Adobe photoshop CS 3.0) has been used to measure the following:

**Golden proportion**<sup>9,10</sup> – Central incisor width x 62% compared with adjacent Lateral incisor width. Lateral incisor width x 62% compared with that of Central incisor width.(**FIGURE 1**)

**RED proportion**<sup>11</sup> – Dividing the width of each lateral incisor by the width of the adjacent central incisor and multiply the resulting number by 100. In the same way, the width of each canine was divided by the width of adjacent lateral incisor and the resulting number was multiplied by 100.(**FIGURE 2**)

**Golden percentage**<sup>5</sup> - The width of each central incisor or lateral incisor or canine was divided by the total width of all six maxillary anterior teeth and the resulting value is multiplied by 100. The six maxillary anterior teeth are said to be in golden percentage, if the values from canine to canine were 10, 15, 25, 25, 15, and 10%.(**FIGURE 3**)

The variables defined were analysed in SPSS by descriptive statistics and the quantitative data obtained was assessed for neutrality using Shapiowilks test and was found to be parametric in distribution. Comparison between widths and heights of all the six anterior maxillary teeth based on gender was carried out using independent sample t- test. Golden proportion presence in male and female subjects was assessed using chi-square test. Presence of golden percentage and RED proportion were also assessed. P value <0.05 was considered as significant in the study. To describe about the data, descriptive statistics, mean and standard deviation (S.D) were used.

Table1: Differences between Male and Female Anterior Maxillary Teeth Width

Tooth	13	12	11	21	22	23
Male	5.25	6.73	9.5	9.6	6.8	5.9
Female	5.2	3.65	9.2	9.2	6.7	5.78
P Value 0.831	0.831	0.260	0.001	0.000	0.502	0.502

Table 2: Differences between Male and Female Anterior Maxillary Teeth Height

Tooth	13	12	11	21	22	23
Male	9.51	8.78	10.19	10.12	8.81	9.39
Female	9.07	8.42	9.69	9.7	8.36	8.95
P value	0.000	0.000	0.000	0.000	0.000	0.000

Table 3 : Inter Group Comparison of the Presence and Absence of Golden Proportion in Rt. Lateral Incisor

			Golden proportion		Total
			Not in golden proportion	In golden proportion	
Groups	Male	Count	34	16	50
		% within groups	68.0%	32.0 %	100.0%
		% within golden proportion presence LIR	54.2%	43.2 %	50.0%
	Female	Count	29	21	50
		% within groups	58.0%	42%	100.0%
		% within golden proportion presence LIR	46.0%	56.8%	50.0%
	Total	Count	63	37	100
		% within groups	63.0%	37.0%	100.0%
		% within golden proportion presence LIR	100.0%	100.0%	100.0%

Table 4: Inter Group Comparison of the Presence and Absence of Golden Proportion in Lt. Lateral Incisor

			Golden proportion		Total
			Presence LIL		
			Not in golden proportion	In golden proportion	
Groups	Male	Count	44	6	50
		% within groups	88.0%	12.0 %	100.0%
		% within golden proportion presence LIL	51.2%	42.9 %	50.0%
	Female	Count	42	8	50
		% within groups	84.0%	16.0%	100.0%
		% within golden proportion presence LIL	48.8%	57.1%	50.0%
Total	Count	86	14.	100	
	% within groups	86.0%	14.0%	100.0%	
	% within golden proportion presence LIL	100.0%	100.0%	100.0%	

Table 5: Inter Group Comparison of the Presence and Absence of Golden Proportion in Rt. Canine

			Golden proportion		Total
			Presence rt.canine		
			Not in golden proportion	In golden proportion	
Groups	Male	Count	16	34	50
		% within groups	32.0%	68.0 %	100.0%
		% within golden proportion presence rt.canine	51.2%	49.2 %	50.0%
	Female	Count	15	35	50
		% within groups	30.0%	70.0%	100.0%
		% within golden proportion	46.4%	50.7%	50.0%

		presence rt.canine			
Total		Count	31	69	100
		% within groups	31.0%	69.0%	100.0%
		% within golden proportion presence rt.canine	100.0%	100.0%	100.0%

Table-6: Inter Group Comparison of the Presence and Absence of Golden Proportion in Lt. Canine

			Golden proportion		Total
			Presence left canine		
			Not in golden proportion	In golden proportion	
Groups	Male	Count	28	22	50
		% within groups	56.0%	44.0%	100.0%
		% within golden proportion presence left canine	58.3%	42.3%	50.0%
	Female	Count	20	30	50
		% within groups	40.0%	60.0%	100.0%
		% within golden proportion presence left canine	41.8%	57.7%	50.0%
Total		Count	48	52	100
		% within groups	48.0%	52.0%	100.0%
		% within golden proportion presence left canine	100.0%	100.0%	100.0%

Table 7: Red proportion relation between central incisor, lateral incisor and canine

		N	Mean	Std. deviation	Std. Error	Minimum	Maximum
RED Proportion  LI / CI  Left side	M	50	71.43	6.07	0.8589	60.5	83.5
	F	50	73.2	8.10	1.1466	62.6	83.8
	T	100	72.31	0.7183	7.1838	57.66	97.80
RED Proportion  C / LI  Left side	M	50	87.5	10.76	1.5218	73.6	95.6
	F	50	86.5	12.6	1.7831	74.3	94.5
	T	100	87	1.1672	11.67	72.18	98
RED Proportion  LI / CI  Right side	M	50	70.2	7.217	1.0206	55.4	81.8
	F	50	71.11	8.076	1.1422	63.6	81.8
	T	100	70.65	0.7633	7.633	55.36	96.09
RED Proportion  C / LI  Right side	M	50	78.7	8.16	1.1549	70.5	98.4
	F	50	80.49	9.67	1.3682	70.6	98.8
	T	100	79.58	0.8949	8.949	70.56	98.9

Table 8: The Mean value and standard deviation of the Golden Percentage for Male subjects

	Gender	N samples	Minimum	Maximum	Mean	Standard deviation
Rt Canine	Male	50	10.9	13.5	11.9	0.0891
Rt Lateral	Male	50	13.3	17.2	15.2	0.1821
Rt Central	Male	50	20.7	23.2	21.8	0.0837
Lt Central	Male	50	19.2	23.2	21.8	0.1271
Lt Lateral	Male	50	13.3	17.5	15.5	0.1273
Lt Canine	Male	50	11.8	15	13.5	0.1682

Table 9: The Mean value and standard deviation of the Golden Percentage for Female subjects

	Gender	N Samples	Minimum	Maximum	Mean	StandardDeviation
Rt Canine	Female	50	11.2	13.5	12.2	0.1179
Rt Lateral	Female	50	12.4	17.3	15.3	0.1873
Rt Central	Female	50	20.8	23	21.6	0.1252
Lt Central	Female	50	23	23.2	21.5	0.1464
Lt Lateral	Female	50	13.2	17.8	15.7	0.1723
Lt Canine	Female	50	11.7	15	13.5	0.1706

Table 10: The mean values, standard deviation, standard error of w/l ratios of rt and lt. central and lateral incisors

Groups	N	Mean	Std. Deviation	Std. Error Mean
CI-Right Male	50	94.3070	5.78484	.81810
Female	50	95.2745	4.20072	.59407
CI-Left Male	50	94.9038	5.80105	.82039
Female	50	94.7758	3.87442	.54793
LI-Right Male	50	76.8549	8.94453	1.26495
Female	50	77.9292	9.61485	1.35974
LI-Left Male	50	77.8334	7.66574	1.08410
Female	50	80.7955	9.52687	1.34730

**Interpretation of Results**

**Table-1** shows the mean value for the widths of right and left central incisors, lateral incisors, canines for both male and female subjects. From the above values we infer that the widths of all the six anterior maxillary teeth are greater in males than the female subjects. The right and left central incisors show

statistically significant differences between two genders ( $p < 0.05$ ).

**Table 2** shows the mean value of the heights anterior teeth for both male and female subjects. From the above values we infer that the heights of all the six anterior maxillary teeth are greater in male subjects when compared to the females. All the six anterior

maxillary teeth show statistically significant differences between the two genders ( $p < 0.05$ ).

**Table 3** shows the presence and absence of golden proportion in Rt lateral incisor. Out of 50 male subjects, golden proportion is not seen in 34 male subjects (68%) and only 16 male subjects (32%) show presence of golden proportion. Out of 50 female subjects, golden proportion is not found in 29 female subjects, (58%) and only 21 (42%) female subjects show presence of golden proportion in the Rt lateral incisor

**Table 4** shows the presence and absence of golden proportion in Lt lateral incisor. Out of male subjects, golden proportion is not seen in 44 male subjects (88%) and only 6 male subjects (12%) show presence of golden proportion. Out of 50 female subjects, golden proportion is not found in 42 female subjects, (84%) and only 8 (16%) female subjects show presence of golden proportion in the Lt lateral incisor.

**Table 5** shows the presence and absence of golden proportion in Rt canine. Out of male subjects, golden proportion is not seen in 16 male subjects (32%) and only 34 male subjects (68%) show presence of golden proportion. Out of 50 female subjects, golden proportion is not found in 15 female subjects, (30%) and only 35 (70%) female subjects show presence of golden proportion in the Rt canine.

**Table 6** shows the presence and absence of golden proportion in Lt canine. Out of male subjects, golden proportion is not seen in 28 male subjects (56%) and only 22 male subjects (44%) show presence of golden proportion. Out of 50 female subjects, golden proportion is not found in 20 female subjects, (40%) and only 30 (60%) female subjects show presence of golden proportion in the Lt canine.

From the above tables, we infer that though the golden proportion values are statistically insignificant, i.e.  $P > 0.05$ ; P value for LIR-0.408; LIL-0.774; CR-1.000; CL-0.161, golden proportion seems to be present in more number of female subjects than male subjects.

**Table 7** shows the mean values, maximum and minimum values, standard deviation of the RED proportion for both male and female subjects. The mean values of RED proportion between Lt central incisor and Lt lateral incisor in male and female subjects are  $(71.43 \pm 6.07)$  % and  $(73.2 \pm 8.10)$  % respectively. The mean values of RED proportion between Lt lateral incisor and Lt canine in male and female subjects are  $(87.5 \pm 10.76)$  % and  $(86.5 \pm 12.6)$  % respectively. The mean values of RED proportion between Rt central incisor and Rt lateral incisor in male and female subjects are  $(70.2 \pm 7.217)$  % and  $(71.11 \pm 8.076)$  % respectively. The mean values of RED proportion between Rt lateral incisor and Rt canine in male and female subjects are  $(78.7 \pm 8.16)$  % and  $(80.49 \pm 9.67)$  % respectively.

**Table 8** shows the mean values, maximum and minimum values and the standard deviation of the golden percentage for male subjects. The mean values of right central incisor and left central incisor are  $(21.8 \pm 0.0837)$  % and  $(21.8 \pm 0.1271)$  % respectively. The mean values of right lateral incisor and left lateral incisor are  $(15.2 \pm 0.182)$  % and  $(15.5 \pm 0.1273)$  % respectively. The mean values of right canine and left canine are  $(11.9 \pm 0.0891)$  % and  $(13.5 \pm 0.1682)$  %. The maximum values for Rt central incisor, Rt lateral incisor, Rt canine are 23.2%, 17.2%, 13.5% respectively. The maximum values for Lt central incisor, Lt lateral incisor, Lt canine are 23.5%, 17.5%, 15% respectively. The minimum values for Rt central incisor, Rt lateral incisor,

Rt.canine are 20.7%, 13.3%, 10.9% respectively. The minimum values for Lt central incisor, Lt lateral incisor, Lt canine are 19.2%, 13.3%, 11.8% respectively.

**Table 9** shows the mean values, maximum and minimum values and the standard deviation of the golden percentage for female subjects. The mean values of right central incisor and left central incisor are  $(21.6 \pm 0.1252)$  % and  $(21.5 \pm 0.1464)$  % respectively. The mean values of right lateral incisor and left lateral incisor are  $(15.3 \pm 0.1873)$  % and  $(15.7 \pm 0.1723)$  % respectively. The mean values of right canine and left canine are  $(12.2 \pm 0.1179)$  % and  $(13.5 \pm 0.1706)$  %. The maximum values for Rt. central incisor, Rt. lateral incisor, Rt. canine are 23%, 17.3%, 13.5% respectively. The maximum values for Lt. central incisor, Lt lateral incisor, Lt canine are 23.2%, 17.8%, 15% respectively. The minimum values for Rt. central incisor, Rt. lateral incisor, Rt. canine are 20.8%, 12.4%, 11.2% respectively. The minimum values for Lt central incisor, Lt lateral incisor, Lt canine are 23%, 13.2%, 11.7% respectively.

**Table 10** shows the mean, standard deviation and standard error of the W/L ratios of right and left central incisors, lateral incisors in both male and female subjects. The W/L ratios of Rt. central incisors in male and female subjects are 94.3 and 95.2% respectively. The W/L ratios for Lt central incisors for male and female subjects are 94.9 and 94.7% respectively. The right lateral incisors show 76.8 and 77.9% for male and female subjects respectively. The left lateral incisors show 77.8 and 80.7% for male and female subjects respectively.

### Discussion

There are several measurements, especially facial measurements used for the selection of maxillary anterior teeth which include bizygomatic width, interpupillary distance, intercanthal distance, mouth width and nose width<sup>12</sup>. Anyhow, Zaltarc et al suggested that the use of

facial measurements for selection of anterior denture teeth was generally inaccurate. He advised that the teeth should be selected according to the patient's appearance taking into account both dental and overall facial esthetics<sup>13</sup>. Ward D.H and Berry F.A stated that facial types play important role in the selection of artificial teeth<sup>14</sup>. Young stated that the variations in every individual lead to characteristic appearance. Most studies which were conducted in this area don't include Asia and India even though they form largest population as compared to other ethnic groups<sup>15</sup>

From this study it was observed that:

- The golden proportion was found to exist only in 14-69 % of subjects, least being the left lateral incisor and highest being right canine between perceived maxillary anterior teeth in natural dentition.
- The proportions between the widths of the maxillary anterior teeth were not constant as proposed by the Golden Proportion and the RED Proportion.
- The values observed were closer to the Golden Percentage Central incisor represented 22%, lateral incisor 15%, canine 13% of the width of six maxillary anterior teeth from front.
- Considering gender, there was a statistically significant difference. Male patients had teeth with larger dimensions than females.

### Figures



Figure 1: Golden Proportion



Figure 2: RED



Figure 3: Golden Percentage

### Conclusion

Within the limitations of this clinical study and the results of this study it can be concluded that

- Males have significantly larger tooth size than females
- The width and height variables of this sample are consistent with the averages obtained by other authors
- The theory of golden percentage was more applicable to the subjects of this study
- Golden proportion can be applied in the rehabilitation of maxillary anterior teeth if small changes are made in the values proposed.
- Gender has no statistically significant effect when the golden proportion, the golden percentage, and the RED were applied.
- In order to establish objectively quantifiable width ratio between maxillary anterior teeth, ethnic differences should be taken into consideration. This will also help determine exactly what percentages are truly golden.

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#### **Abbreviations**

RED - Recurring Esthetic Dental Proportion

W/L – width /length

Rt – right

Lt – left

LIL – lateral incisor left

LIR-lateral incisor right

CI –central incisor

LI- lateral incisor