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Original Research Article

Comparative evaluation of facial divine proportions in males and females with average growth pattern

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ABSTRACT

Background: Facial beauty of an individual depends on proportion and its relationship to various facial parts which varies in each individual. The values of measured proportion in beautiful faces are likely to approximate divine proportion and may show variation with ethinicity, sex, growth pattern. Hence, aim of the study was to evaluate and compare vertical and horizontal parameters of facial divine proportions in male and female subjects with average growth pattern.

Materials and Methods: 30 subjects (18-30 yrs age) with average growth pattern (based on cephalometric measurements FMA, Yaxis, GoGn-SN and facial axis angle) were divided into two groups as Group I (Male subjects, n=15) ; Group II (female subjects, n=15). Standardized frontal facial photographs of all the subjects were obtained. Nine vertical and four horizontal parameters were measured on all the facial photographs using IC Measure software and were used to evaluate horizontal and vertical facial proportions and then compared to divine proportions considering 1.618 as 100%.

Results: Horizontal and Vertical facial proportion in males were higher than females. Group I showed that three of seven vertical facial proportions were close to divine proportion (1.618) whereas only one vertical facial proportion in Group II were close to divine proportions. Horizontal facial proportions in both the groups deviated more from divine proportion (1.618).

Conclusion: There was difference between males and females for the vertical and horizontal facial proportions with values being larger in males. This should be considered as an accessory guideline in planning orthodontic or orthognathic treatment.

1. Introduction

Facial beauty of an individual depends on proportion and its relationship to various facial parts which varies in each individual. Facial balance is determined by its underlying skeleton and overlying soft tissue.[1]

It is obvious that human face changes during growth[2] and there is great difference between the craniofacial structure of an infant and adult. Thus, anatomic balance can be changed during growth as well as during orthodontic treatment, so there is importance of knowing ideal proportion in orthodontics treatment.

Values of measured proportion in beautiful faces are likely to approximate divine proportion or Golden proportion and is considered as an important factor in facial esthetics. It is also named as 'Golden Proportion' or 'Golden ratio' and denoted by symbol as 'Phi' ratio. This ratio can be expressed mathematically as 1.618:1 or 1:0.618.[3]

Due to evidence of facial morphological difference between male and females it can be assumed that there may also be some difference in their divine proportions, hence this study was planned to evaluate and compare the facial

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divine proportion in males and females with average growth pattern.

2. Materials and Methods

2.1. Inclusion criteria

1. Patients in the age range of 18-30 years to ensure complete growth of soft and hard tissues
2. Patient who had not undergone fixed orthodontic treatment.
3. Patients having apparently symmetrical faces.
4. No history of trauma to the dentofacial region.

2.2. Exclusion criteria

1. Patients with congenital defect in craniofacial region or syndromes.
2. Patients with any pathological involvement of the jaws.
3. Patients having horizontal or vertical growth pattern.

Lateral cephalogram of patients coming to our department was analysed for the type of growth pattern (average growth pattern) based on cephalometric parameters like FMA(23^0-25^0), Y-axis(53^0-60^0), GoGn-SN(28-32^0), Facial axis angles(90^0-95^0). The subjects with deviated values for different parameters were excluded.

The standardized frontal photographs of 30 selected subjects (males n=15, mean age 19.5, and females n=15, mean age 19.5) who met with the inclusion criteria were taken using digital camera with scale attached on backdrop for callibaration.

An updated version of the IC Measure Software version was used to analyse the photograph and to take measurements. For each photograph, the scale was set in IC Measure software, keeping the unit of length as centimeter. This enabled direct and highly accurate measurements of the photographs.

Following Landmarks were identified on IC measure software to evaluate vertical and horizontal facial proportions:[4] (Figure 1)

1. Trichion (TR) – the point at the top of forehead at the junction of the face(hairline) and skull fascia.
2. Lateral canthus of eye (LC)
3. Cheilion (CH) - the point at the corner of the mouth
4. Lateral rim of ala of nose (LN)
5. 5.Menton (M)- Point corresponding with soft tissue menton at the lower border of soft tissue chin.
6. LN- lateral rim of ala of nose
7. TS- point at the lateral border of temple at the level of the eye

The details of parameters and ratios as evaluated in the study are tabulated in Tables 1 and 2 and shown in Figure 2a & b.

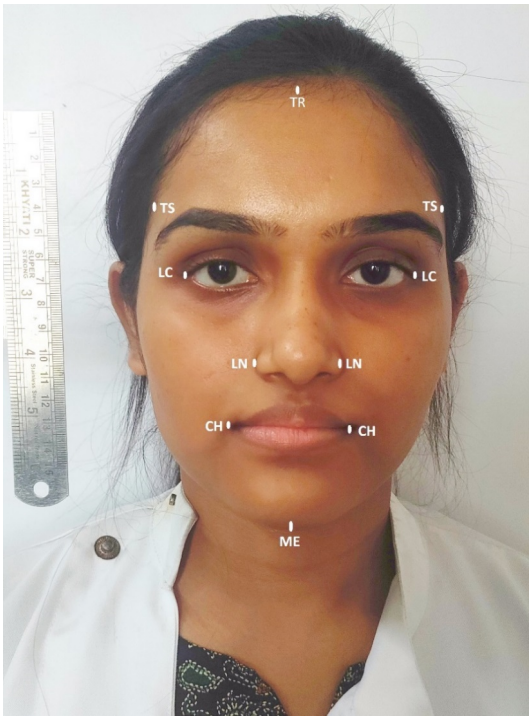

Figure 1: Landmarks used in the study to evaluate vertical and horizontal facial proportions

Table 1: Parameters to evaluate Vertical and Horizontal Facial Proportions

Parameters	Description
Vertical parameters	
TR-ME	Total facial height
LC-ME	Lower & mid anterior facial height
TR-LC	Upper two-third of face
TR-LN	Upper and mid facial height
LN-ME	Lower one third of face
LC-LN	Mid one-third of face
LN-CH	Lower one-third of mid facial height
CH-ME	Lower one-third of facial height
LC-CH	Lower one-third of anterior facial height
Horizontal Parameters	
TS (right)-TS (left)	Width of head
LC (right)- LC (Left)	Lateral width of eye at the lateral canthus
LN (right)- LN (left)	Width of nose
LC (right) – LC (Left)	Width of mouth

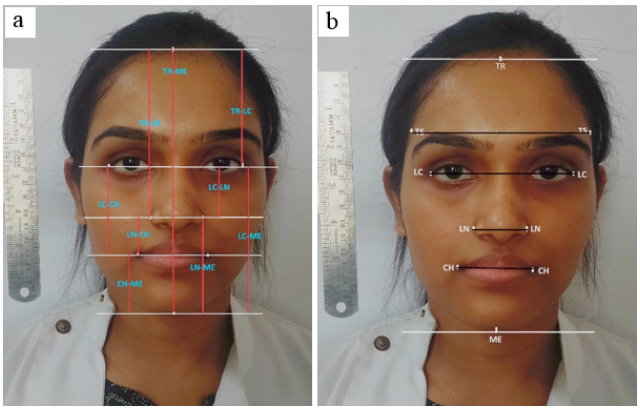

Figure 2: a: Parameters to evaluate vertical facial proportions; **b:** Parameters to evaluate horizontal facial proportions

These parameters were then used to evaluate ratio between them in horizontal and vertical plane (Table 2).

Table 2:

TR-ME:LC-ME-	The ratio between Total facial height Lower (TR-ME) and Lower and mid anterior facial height (LC-ME).
TR-LC:LC-ME-	The ratio between Upper anterior facial height and Lower and mid anterior facial height (LC-ME).
LN-ME:TR-LN-	The ratio between Lower anterior facial height (LN-ME) and Upper and mid anterior facial height (TR-LN).
LC-LN:LN-ME-	The ratio between Middle anterior facial height(LC- LN) and Lower anterior facial height (LN-ME).
CH-ME:LC-CH-	The ratio between Lower two-third of facial height (CH-ME) and Mid anterior facial height and upper one third of Lower anterior facial height (LC-CH).
LN-CH:LC-LN-	The ratio between Upper one third of Lower anterior facial height (LN-CH) and Middle anterior facial height (LC- LN)
LN-CH:CH-ME-	The ratio between Upper one third of Lower anterior facial height (LN-CH) and Lower two-third of facial height (CH-ME)
Horizontal ratios	
TS-TS: LC-LC	The ratio of distance between TS of right and left side to LC of right and left side.
LC-LC: CH-CH	The ratio of distance between LC of right and left side to CH of right and left side.
CH-CH : LN-LN	The ratio of distance between CH of right and left side to LN of right and left side

The data so obtained was tabulated and results were interpretated and compared with divine proportions considering 1.618 as 100%.

3. Results

howsdescriptive and comparative data of facial proportions (horizontal and vertical) obtained for both the groups. Ratios were compared to divine proportions of 1.618 that is taken as 100%.

For male and female ratios obtained were more closer to divine ratio in vertical planes (male- TR-ME:LC-ME (98.85%), LC-ME:TR-LC(97.02%), LC-CH:CH-ME(93.19%); females- TR- ME : LN-ME 107%), however, all horizontal proportions CH(r-l): LN(r-l), LC(r-l): CH(r-l), TS(r-l): LC(r-l) were found to be deviated from divine proportion in both the groups.

Sexual dimorphism was seen in facial proportions in present study with statistically significant difference for TR-ME:LC-ME (Females> males), LC-ME:TR-LC (males> females), TR-LN: LN-ME (Females> males), LN-ME:LC-LN (males> females), LC-CH:CH-ME (Females> males), LC-LN:LN-CH (Females> males).

On contrary, Sexual dimorphism was not seen for any of the ratios in horizontal plane.

4. Discussion

Ricketts was the first one to apply divine proportion to the composition of facial hard and soft tissue. He used these divine proportion a guide for planning orthognathic surgery after detailed examination of lateral, frontal cephalogram and photographs. He showed that for a beautiful face, proportion in face was related to golden ratio.[5]

Sexual dimorphism as noted in previous studies, was evaluated from result of present study. ratios of parameters of vertical and horizontal proportion were generally higher in males than females.

Peck & Peck[6] compared the facial dimension in males and females. He used the vertical skeleto-facial dimension and founds significant sexual dimorphism in the vertical lip - tooth jaw relationship, where in male sample showed 2.2mm of mean vertical maxillary increase over female sample. There was larger facial dimension in males compared to females, similar to the results of the present study.

Omotoso et al[7] showed that there was bisexual variation in upper and lower face height and concluded significant differences in mean morphological and total facial length amongst male and females. The morphological facial length (N-Gn), total facial length (Tr-Gn), facial width (Bizygomatic width), nasal width(right and left ala of nose) were significantly higher among males than females.

In comparison to vertical facial proportion, horizontal proportion were deviated more from divine proportion in both the groups in our study. Similar results were seen in previous studies as well.

Result in our study for facial vertical proportion analysis showed that in Group I facial structure which show golden relation to each other are TR-ME:LC-ME (total facial height

Table 3:

Facial Proportions	Comparision of various facial proportion between Group I(male) & GroupII(female)						
	Group I(Male)			Group II (Female)			
Vertical Proportions	Mean+-SD	std. error Mean	%value (considering 1.618=100%)	Mean+-SD	Std.Error Mean	%value (considering 1.618=100%)	P value
TR-ME:LC-ME	1.59±0.12	0.032	98.85	1.74 0.21	0.055	107.64	0.036
LC-ME:TR-LC	1.56 0.17	0.044	97.02	1.24 0.12	0.032	77.19	0.001
TR-LN:LN-ME	1.39 0.16	0.043	86.19	1.76 0.15	**0.04**	109.06	0.001
LN-ME:LC-LN	3.31 0.38	0.098	204.84	2.87 0.18	0.048	177.62	0.001
LC-CH:CH-ME	1.50 0.24	0.063	93.19	1.75 0.22	0.058	108.51	0.008
LC-LN:LN-CH	1.05 0.17	0.045	65.45	1.20 0.10	0.027	74.44	0.011
CH-ME:LN-CH	1.36 0.21	0.054	84.31	1.26 0.21	0.055	78.04	0.201
Horizontal Proportions							
CH-CH:LN-LN	1.27 0.10	0.026	78.49	1.27 0.10	0.026	78.69	0.933
LC-LC:CH-CH	1.81 0.08	0.021	111.93	1.89 0.14	0.038	117.08	0.069
TS-TS:LC-LC	1.23 0.15	0.04	76.23	1.25 0.06	0.017	77.68	0.597

is golden to lower and mid anterior facial height), LC-ME:TR-LC (lower and mid anterior facial height is golden to upper two-third of face), LC-CH:CH-ME (lower one-third of anterior facial height is golden to lower one-third of facial height) with respective percentages ages as 98.85%, 97.02%, and 93.19% respectively. In Group II (females) only TR-ME:LC-ME (total facial height is golden to lower and mid anterior facial height) but values were more than golden proportion (107%). On comparing Group I & Group II, golden ratio of total facial height: lower and mid anterior facial height (TR-ME:LC-ME) was higher than divine ratio for females (107.64%) and lesser in males (98.85%).

For LC-ME:TR-LC, both male and female had lesser values than divine ratio, with females having more deviation (77.19%) than males (97.02) and there difference was statistically significant.

For TR-LN: LN-ME, Golden ratio was higher than divine ratio for females (109.06%) and lesser in males (86.19%), there difference was statistically significant.

For LN-ME:LC-LN, both male and female had higher values than divine ratio, with males having more deviation (204.84%) than females (177.62) and there difference was statistically significant.

For golden ratio of LC-CH:CH-ME, female had higher values (108.51%) than divine ratio, with males having less deviation (93.19%)and there difference was statistically significant. For LC-LN:LN-CH, both male and female had lesser values than divine ratio, with females having more deviation (74.44%) than males (65.45%) and there difference was statistically significant.

For CH-ME:LN-CH both male and female had lesser values than divine ratio, with males having more deviation (84.31%) than females (78.04%) and there difference was statistically non-significant.

For the facial width proportion (horizontal) analysis in Group I and II of present study. It was seen that the value of LC-LC:CH-CH (lateral width of eye at the lateral canthus to width of mouth) was deviated more from divine proportion (111.3% and 117.08% respectively), whereas, CH-CH: LN-LN (width of mouth to width of nose) was 78.49% and 78.69% respectively and TS-TS:LC-LC (width of head to lateral width of eye at the lateral canthus) was 111.93% and 117.08% respectively and these ratios were smaller than divine proportion in both groups. However, none on comparison Group I & Group II both males females had lesser values than divine ration for CH-CH: LN-LN (Males- 78.49%; females-78.69%), and TS-TS:LC-LC (Males- 76.23%; females-77.68%), whereas LC-LC:CH-CH both males females had higher values than divine ratio (Males- 111.93%; females-117.68%).

Mizumoto et al[8] also found same result for horizontal facial proportion (TS-TS:LC-LC), that was 1.620 in Japanense women while in female subjects of our study it was 1.25. He found five of 7 measurements of vertical facial proportions (TR-ME:LC-ME, TR-LC:LC-ME, LC-ME: TR-LN, CH-ME:LC-CH, LN-CH:CH-ME) were close to golden proportion in females, whereas in our study only TR-ME:LN-ME were close to golden proportions in females.

Kawakami et al[9] evaluated ratios of various facial length to golden proportions in oriental populations and concluded that LC-ME:TR-ME (lower and mid anterior facial height is golden to total facial height), TR-LC:LC-ME(upper two-third of facial height is golden to upper mid one third of facial height), AL-ME:TR-AL (lower one-third of face is golden to upper and mid facial height), LC-AL:AL-ME (mid one-third of face is golden to lower one-third of face), whereas, CH-ME:LC-CH, AL-CH:CH-ME, and AL-CH-LC-AL showed deviation from golden ratio and deviation

was greater in males than females.

Ferrario et al[10] studied soft tissue facial asymmetry among white causcasian adults. The form of right and left hemifaces was assessed using soft tissue facial landmarks (trichion, nasion, pronasale, subnasale, B point, pogonion, eye lateral canthi, nasal alae, labial commissures, tragi, gonia) using infrared photogrammetry. The mean faces of both the group showed right side of face was larger than left side regardless of sex. We did not compare right and left side in study but horizontal facial proportions were more deviated from divine proportions.

We emphasize that facial analysis is essential in orthodontics and orthognathic planning, nevertheless, the evaluation of beauty seems to be mostly subjective and personal.[11]

Recent work that supports the lack of divine proportion between dental and facial structures also asserts that this ratio is an inappropriate way to link dentofacial dimensions with a natural look during hard and soft tissue rehabilitation.[12] However, the fact that phi can ease the identification of facial disharmonies by establishing a universal standard cannot be denied.[13] The importance of elucidating modern concepts of facial beauty is becoming increasingly understood.[14] Perhaps Ralph Waldo Emerson (known as the first Americanto champion the wisdom of ancient India) summed it up best when he said, 'If eyes were made for seeing, then beauty is its own excuse for being.'[15]

Other studies stated that sagittal malocclusions (skeletal) determined by the ANB angle had no effect on the subjects' frontal facial attractiveness. Thus, facial attractiveness is influenced by overlying soft tissue & underlying hard tissue morphology as well.[16]

Within the limitation of the present study, it can be stated few ratios of vertical and all the ratios of horizontal facial proportion were deviated from divine proportion. These ratios could be used in assessing soft tissue morphological characteristics of an individual. If closer to divine proportions, then it can be considered as good soft tissue morphology and it can influence our need of extractions in borderline cases. Thus, Facial proportion can be helpful in the assessment of facial beauty and attractiveness along with other factors.

Hence, the divine proportion should be used as an accessory guideline in orthodontic or ortho surgical treatment planning.

Further studies can be conducted on larger sample size, with different growth pattern and malocclusion types to evaluated variation in facial proportion from divine ratio.

5. Conclusion

The present study showed that:

1. In Vertical facial proportion, total facial heights (TR-ME) was golden to lower and mid-anterior facial heights (LC-ME), both in males and females.
2. Lower and mid anterior facial height (LC-ME) was golden to upper two-third of face (TR-LC), lower one-third of anterior facial height (LC-CH) was golden to lower one-third of facial height (CH-ME) in males only.
3. Horizontal facial proportion were deviated more from divine proportion in both males and females
4. Horizontal and Vertical parameters of facial proportion of males were larger than females
5. Sexual dimorphism was seen for vertical facial proportions TR-ME:LC-ME (Females> males), LC-ME:TR-LC (males> females), TR-LN: LN-ME (Females> males), LN-ME:LC-LN (males> females), LC-CH:CH-ME (Females> males), LC-LN:LN-CH (Females> males).
6. On contrary Sexual dimorphism was not seen for any of the ratios in horizontal plane.

6. Patient Consents

Had taken consent from patient for publishing his/her photo in journal.

7. Source of Funding

None.

8. Conflict of Interest

None.

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