Assessment of facial golden proportions among central Indian population

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Abstract

Aim: This study aimed to identify and establish the facial and smile proportions in young adults and to compare the results with ideal or divine proportions, compare the proportions of males and females included in our study population and compare them with those established for Caucasian and Japanese populations. Materials and Methods: Two hundred participants (164 females, 36 males) with Angle's class I malocclusion (M.O), and well-balanced faces were selected and photographed in the frontal repose position. Analysis was done in Adobe Photoshop software. Statistical analysis was done using the Statistical Package for the Social Sciences version 17.0. (IBM Corporation Armonk, New York, United States). Results: Results suggested that females are more near to ideal ratios and males are more deviated from the ideal ratios. The proportions of males and females were not considerably different from each other. In Indian population, upper 3rd facial height (TR-LC) was increased and mid-face height (LC-LN) was decreased; in lower 3rd of the face, LN-CH was slightly increased in comparison to CH-ME. In facial widths, outer canthal width (LC-LC) was greater in the Indian population and mouth width (CH-CH) was normal. When compared with Indian population, Japanese participants had wider noses, outer canthal distance, and bitemporal width. Conclusion: It was concluded that significant difference was found between the proportions of the Indian population and ideal ratio. When Indian population was compared with Japanese and Caucasian populations, some parameters of facial proportions showed significant difference, which leads to the need for establishing standardized norms for various facial proportions in Indian population.

Key words: Caucasian population, golden ratio, Indian population, Japanese population

INTRODUCTION

Esthetics is the branch of philosophy which deals with the study of beauty, with ethics, logic, politics, and metaphysics. It has been said that beauty is in the eye of the beholder.[1] Throughout recorded history and even earlier, as evidenced by archaeological artifacts, human beings have been aware of and concerned about beauty and facial esthetics.[2]

Fibonacci da Pisa, in the twelfth century, proposed the divine proportions or the Golden ratio. The ratio between two esthetically proportionate parts is 1.618. This is known as the Fibonacci number.
Golden ratio constitutes an ideal that informs aesthetic assessment.\textsuperscript{[2-5]}

In the year 1982, Ricketts might have been the first orthodontist to apply it to the composition of facial hard and soft tissues. The “golden divider” is an instrument which may be used for morphologic analysis of the teeth, skeleton, and soft tissues of the face. It is based on the “Golden Section” also called the “Divine Proportion.”\textsuperscript{[6]} There is a certain quality of golden section which stimulates the views. This value has been called dynamic symmetry, which implies that it portrays an action and a continuum. This relation is based on the underlying laws of Mathematics.\textsuperscript{[1]}

Since the inception of Orthodontics as a specialty, orthodontists have been intrigued with measurements. When something is amenable to measurement, only then can it be regarded as scientific. The greatest trust in this direction evolved with the advent of Cephalometry and its application to clinical orthodontics. The ability to quantitate forms the basis of cephalometrics, in which the degree of disharmony can be measured.\textsuperscript{[2]}

Facial proportions are of interest in orthodontics and maxillofacial and plastic surgery.\textsuperscript{[2,6-8]} Hence, there is a need to review the facial proportions in central Indian population and compare this data with the golden proportion. It will help in establishing a standard for facial beauty and will significantly simplify the diagnosis and treatment of facial disharmonies and abnormalities.\textsuperscript{[9,10-12]}

MATERIALS AND METHODS

Source of data

This was a cross-sectional study. Two hundred participants (136 females and 64 males) aged approximately 18–25 years with a well-balanced face from various professional institutions in Bhopal district, Madhya Pradesh, a state in Central India, were selected after screening according to the below mentioned criteria for the study. Written consent from the institution was taken before proceeding with the study.

Inclusion criteria

Inclusion criteria were:
\begin{itemize}
\item Individuals with a pleasing smile and Angle’s class I relation.
\item No gross asymmetry of face.
\item Complete permanent dentition up to all the 2\textsuperscript{nd} molars present in the oral cavity.
\end{itemize}

Exclusion criteria

Exclusion criteria:
\begin{itemize}
\item History of orthodontic treatment or maxillofacial surgery.
\item History of restoration or prosthetic crowns in the anterior teeth.
\item History of periodontal surgery in the anterior arch.
\end{itemize}

Method of data collection

Complete enumeration of the individuals in the outpatient department of people’s college of dental sciences and research centre was done within a period of three months from January to March in 2011. Two hundred participants in this time period were selected on the basis of our inclusion and exclusion criteria. Clinical examinations were strictly done on the basis of inclusion and exclusion criteria. They were conducted entirely by four postgraduate students from the Department of Orthodontics, People College of Dental Sciences and Research College, Bhopal under the supervision of the head of the Department of Orthodontics. All the participants were subjected to detailed history taking, clinical examination, maxillary and mandibular impression, and photographs. Frontal repose photographs were taken of all the participants by positioning them in the natural head position, which was achieved by asking the patient to look at a distant object. Pictures were taken using a Nikon D-40 X SLR camera with umbrella flash lights. The camera was mounted on a tripod stand at a fixed distance of 10 inches from the participant. The Adobe Photoshop ruler software was used to obtain the measurements for the study.

Data recorded

The following data were recorded:
The following landmarks were used [Figures 1 and 2].

Statistical analysis

The data was compiled systematically. Statistical analysis was done using the Statistical Package for the Social Sciences SPSS version 17.0 (IBM Corporation Armonk, New York, United States) for determination of mean value for different proportions. Unpaired t-test was applied for comparison of means of our study population with:
\begin{itemize}
\item Ideal or divine proportion.
\item Males and females included in our study population.
\item Japanese female population.
\item Caucasian population.
\end{itemize}
RESULTS

Facial proportions in the photographs of 200 participants were analyzed [Table 1]. In local population, findings suggested that only TR-ME/LC-ME in both males and females is close to the ideal proportion; LN-ME/TR-LN and LN-CH/CH-ME in females is close to the ideal proportions and CH-ME/LC-CH alone in males showed less deviation from the ideal proportion.

On comparison of facial proportions in Indian males and females, findings suggested that out of 13 proportions, 3 proportions showed significantly deviation in males and females; 2 from vertical height (LN-ME/TR-LN, LC-LN/LN-ME) and 1 from horizontal width LC-LC/CH-CH).

On comparison of Indian population with Caucasian population, findings suggested that only 1 parameter (TS-TS/LC-LC) of horizontal width showed considerable deviation from Caucasian population.

On comparison of female population with Japanese population, out of 13 parameters, 5 proportions showed deviation from each other; 1 in vertical height

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**Table 1: Facial proportion at total facial proportion, height, and width dimensions**

<table>
<thead>
<tr>
<th>Component</th>
<th>Male (64)</th>
<th></th>
<th>Female (136)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (% respect to golden ratio)</td>
<td>SD</td>
<td>Mean (% respect to golden ratio)</td>
<td>SD</td>
</tr>
<tr>
<td>Facial proportion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR-LC:TR-ME</td>
<td>2.473 (152%)</td>
<td>0.145</td>
<td>2.453 (151%)</td>
<td>0.118</td>
</tr>
<tr>
<td>TR-ME:LN-ME</td>
<td>2.519 (155%)</td>
<td>0.165</td>
<td>2.607 (161%)</td>
<td>0.156</td>
</tr>
<tr>
<td>TR-ME:LC-CH</td>
<td>2.771 (171%)</td>
<td>0.112</td>
<td>2.763 (170%)</td>
<td>0.134</td>
</tr>
<tr>
<td>Vertical height</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR-ME:LC-ME</td>
<td>1.668 (103%)</td>
<td>0.066</td>
<td>1.691 (104%)</td>
<td>0.0566</td>
</tr>
<tr>
<td>TR-LC:LC-ME</td>
<td>1.485 (91%)</td>
<td>0.158</td>
<td>1.453 (89%)</td>
<td>0.116</td>
</tr>
<tr>
<td>LN-ME/TR-LN</td>
<td>1.491 (92%)</td>
<td>0.182</td>
<td>1.610 (99%)</td>
<td>0.148</td>
</tr>
<tr>
<td>LC-LN/LN-ME</td>
<td>2.055 (127%)</td>
<td>0.332</td>
<td>1.866 (115%)</td>
<td>0.244</td>
</tr>
<tr>
<td>CH-ME:LC-CH</td>
<td>1.539 (95%)</td>
<td>0.159</td>
<td>1.578 (97%)</td>
<td>0.165</td>
</tr>
<tr>
<td>LN-CH:CH-ME</td>
<td>1.450 (89%)</td>
<td>0.201</td>
<td>1.515 (93%)</td>
<td>0.218</td>
</tr>
<tr>
<td>LN-CH:LC-LN</td>
<td>1.216 (75%)</td>
<td>0.232</td>
<td>1.364 (84%)</td>
<td>0.209</td>
</tr>
<tr>
<td>Horizontal width</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LN-LN-CH-CH</td>
<td>1.287 (79%)</td>
<td>0.114</td>
<td>1.308 (80%)</td>
<td>0.0956</td>
</tr>
<tr>
<td>CH-CH-CL:LC</td>
<td>1.815 (112%)</td>
<td>0.145</td>
<td>1.308 (80%)</td>
<td>0.095</td>
</tr>
<tr>
<td>TS-TS:LC-LC</td>
<td>1.921 (75%)</td>
<td>0.127</td>
<td>1.206 (74%)</td>
<td>0.066</td>
</tr>
</tbody>
</table>

*Statistical analysis by one-factor student t-test significance level (S) P<0.05.
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(Tr-LC/LC-ME) all the horizontal widths (LN-LN/CH-CH, LC-LC/CH-CH, TS-TS/LC-LC) and 1 in total facial proportions (TR-LC/TR-ME).

**DISCUSSION**

Concept of facial esthetics and beauty originated along with the evolution of human beings and the extensive work of ancient pioneers such as Pythagoras, Leonardo da Vinci, Luca Pacioli for golden proportion and its significance in the explanation of beauty.

The present study was based on assumptions that how these proportions will affect or imply in our study population. Facial proportions of 200 participants were analyzed in this study on static frontal photographs.

Outcome of the present study revealed that facial height (TR-ME) in relation to the corner of the eye up to the chin (LC-ME) is similar to the golden ratio. In females, LN-ME/TR-LN (F: 99%) was close to the ideal proportion. Mizumoto et al. also found similar results in Japanese female population for these ratios. However, the present study suggested that females [LN-ME/TR-LN (99%)] are closer to ideal ratios; however, males [LN-ME/TR-LN (92%)] are more deviated from ideal ratios. Kawakami et al. reported that males show greater deviation from the ideal, however, in his study, parameter CH-ME/LC-CH showed deviation from the ideal ratio. However, in the present study parameter, CH-ME/LC-CH (M: 95%, F: 97%) showed ideal values. Deviations indicated a longer CH-ME than those seen in our population.

When our population was compared with Caucasians, findings suggested that, out of 10, 3 showed greater deviation in comparison [TS-TS/LC-LC (C: 94%, I: 74%) (LC-LC/CH-CH, C: 114%, I: 108%), LC-LN/LN-ME (C: 111%, I: 119%)].

When female population was compared to the Japanese female population, out of 13 proportions, 6 deviated from each other, 1 in vertical height (TR-LC/LC-ME, J: 98%, I: 89%) because TR-LC was increased in the Indian population and all the horizontal width proportions were showing deviation to Japanese female group.

In the present study, CH-CH was similar to the Japanese population, whereas there was difference in LN-LN and TS-TS, which suggests that Japanese have more width than the Indian population. Because the CH-CH width is common in Indian and Japanese population but LC-LC width is greater in Japanese population, Japanese population have wider outer intercanthal distance. For TS-TS/LC-LC, TS-TS width is greater in Japanese population suggesting the tendency of wider temporal area in comparison with Indian population. LC-LC width was also increased in Japanese population. Hence, Japanese population has the features of wider nose, outercanthal distance, and bitemporal width in comparison with Indian population.

Studies identifying the factors influencing the variations in facial morphology chiefly refer to the environmental conditions, socioeconomic status, and nutritional habits of the populations. Theories that, in hot and moist climates the nasal aperture becomes much wider, present in all African and Asian ethnic groups in both sexes, remains unproven. The great similarities between the north american white (NAW) and the European Caucasians, together with the stable characteristics of Asians and Africans maintained throughout their ethnic groups, can be explained only by inherited genetic factors – an explanation widely accepted by scientists.

**CONCLUSION**

It was concluded that there is a significant difference between proportions of Indian population and the ideal ratio. Furthermore, some parameters of facial proportions showed significant difference between Indian, Japanese, and Caucasian population, which leads to the need for establishing standardized norms for various facial proportions in Indian population. Although there was deviation from the golden proportion, the proportion between males and females in the study population did not have considerable difference from each other. Females are more near and males are more deviated from the ideal ratios. Further research is needed to establish more accurate proportions in the future. [As paradigm is shifted from hard to soft tissue and in diagnosis and treatment planning, soft tissue is definitely getting priority, and hence, these facial proportions will help in diagnosis and treatment planning].

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that
their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**