ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 2, Issue – 6, November - December - 2019, Page No. : 386 - 398

Aesthetic Indicator for Selection of Maxillary Anterior Teeth: a Study among the South Indian Population

[1]Dr. Surabhi Duggal, MDS, Lecturer, Department of Prosthodontics and Implantology, School of Dental Sciences, Sharda University, Greater Noida

[2]Dr. Shafath Ahmed, MDS, Professor, Department of Prosthodontics and Implantology, SRM Kattankulathur Dental College and Hospital, Chennai

[3]Dr. V. Vidyashree Nandini, MDS, DNB, Professor and Head of Department, Department of Prosthodontics and Implantology, SRM Kattankulathur Dental College and Hospital, Chennai

Corresponding Author: Dr. Surabhi Duggal, MDS, Lecturer, Department of Prosthodontics and Implantology, School of Dental Sciences, Sharda University, Greater Noida

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Purpose: To evaluate and arrive at a relationship for the width of a central incisor and the combined width of maxillary six anterior teeth derived from the five facial measurements; inner canthal distance (ICD), interpupillary distance (IPD), bizygomatic width (BZW), interalar distance (IAD) and intercommisural width (ICW) amongst the South Indian population. Also, to compare the golden proportion of the software with the result obtained from the study for a patient desiring replacement of upper front teeth.

Materials And Methods: The study included five South Indian states: Tamil Nadu (group 1), Kerala (group 2), Andhra Pradesh (group 3), Telangana (group 4) and Karnataka (group 5) involving hundred subjects' per group in whom facial measurements along with, measurements for width of central incisor and the combined width of maxillary anterior teeth were made with the help of a standardized digital frontal photograph of the subjects' face feeded into the "Planmeca Romexis smile design" software. Pearson's correlation coefficient was used and regression equations formulated.

Results: Significant correlation existed between BZW, ICW, IAD and maxillary anterior teeth (P=0.01) in groups 1, 4 and 5.

Conclusion: This study can be used to predict the width of maxillary six anteriors for individuals belonging to major South Indian states. The results (regression equation) obtained was compared with the 'golden proportion' template in the software to restore a patient with missing maxillary anterior teeth by superimposing the photograph feeded into the software and designing the smile according to the patient's satisfaction.

Keywords: Maxillary six anterior, south India, facial measurements, correlation, digital software

Introduction

Smile is one of the most important facial expressions. It is an indicator of beauty and is essential in conveying friendliness, agreement, and appreciation. Aesthetics is defined as, beauty and attractiveness that instill a sense of pleasure, whereas aesthetic frame of the face is that area where midlines, cants and parameters of smile are perceived and are sensitive to perception. Dental facial

aesthetics is the relation between face, lips, gums and teeth.

Pythagoras described the "golden" proportion as a proportion of two measurements in synchronization. It is used in dentistry, to compare the widths of central incisors, lateral incisors and canines.[1] Other guiding principles that help obtain an accurate proportion in a pleasant smile are the Recurring Esthetic Dental Proportion (RED), the SPA factor, M proportion by Methot and the Chu's aesthetic gauges.[3]

The perception of beauty might be influenced by culture, race, or ethnic concept. Therefore, while reviewing whether natural proportions exist, the ethnicity and region should be considered to decide their applicability when creating smiles in different parts of the globe.[2]

Technology has made communication with the patient's easier and their expectations and desires can be understood. Photography using intraoral cameras, and videos are an invaluable aid in perceiving possible treatment outcomes. They make it easy to judge the amount of tooth alteration required to obtain best results.[4,5]

In this study, we have adopted the "Planmeca Romexis Smile Design", it is a Digital Smile design software that helps us view and achieve better aesthetics. The dentist can decide whether cosmetic contouring alone or as an adjunctive treatment can improve the general appearance of the patient.[4]

The objective of this study was to evaluate and arrive at a relationship for the width of maxillary central incisor and the total width of maxillary anteriors from distal surface of one canine to another derived from the five facial measurements: interpupillary distance(IPD), innercanthal distance(ICD), bizygomatic width(BZW), interalar distance(IAD) and intercommisural width(ICW) for the population of South India belonging to: Tamil Nadu, Kerala, Andhra Pradesh, Telangana, Karnataka. Also to compare the results obtained with the 'golden proportion' template of the digital smile design software for a patient requiring restoration of maxillary anteriors.

Materials and Methods

500 subjects' in the age group of 21 to 40 years with ancestral background from the following states were enquired and selected, 100 from the state of Tamil Nadu (group 1), 100 from the state of Kerala (group 2), 100 from the state of Telangana (group 3), 100 from the state of Andhra Pradesh (group 4), and 100 from the state of Karnataka (group 5). Those who fulfilled the inclusion criteria of all six maxillary anterior teeth present without attrition and no previous orthodontic treatment or restorations and crowns in maxillary teeth were chosen. Subjects' with developmental anomalies, a history of orofacial surgery, orbital disease, prosthetic maxillary teeth and rotated or malformed, supernumerary teeth were exempted from the study.[11,17,18]

The subject was asked to sit on an adjustable stool, with head upright and looking straight forward. A digital camera (Canon EOS 200D, 24.2 MP resolution, 18-25m f/4-5.6 lens, Japan) set on a tripod of height 1280mm, captured full face photographs of subjects' smiling in a frontal view, revealing most of the maxillary anterior teeth (Fig. 1).[18] Two most prominent points on the zygomatic arch were manually marked on the subjects' faces and photographs clicked.[6] The distance between the camera lens on the tripod and the tip of each subject's nose was fixed at 150cm (Fig. 2).[12] A wooden board with two metric rulers at right angles were placed such that the subject's head was positioned at the junction of the two rulers (Fig. 1).[2,12,15] All images were captured by a single operator to avoid bias.[18] Images were transferred to a personal computer and then to the "Planmeca Romexis Smile Design" software (developed by "Planmeca Oy", a leading company originating from Finland) in which facial

measurements were made for each group along with the width of central incisor (CI) and the straight line width from distal surface of one canine to the other (CC) using an inbuilt scale calibrated to the metric ruler placed along the side of the subject.

Inner canthal distance (ICD) - measured using the scale, setting it at a point from a medial angle of the fissure of the right eye and extending the line to the medial angle of the fissure of the left eye (Fig. 3).[14]

Interpupillary distance (IPD) - recorded by starting and setting a point at the mid of pupil of the right eye and then extending this line to the mid of pupil of the left eye (Fig. 4).[9]

Interalar distance (IAD) - measured from a widest point of alae on either side of the nose (Fig. 4).[9,13,15]

Intercommissural width (ICW) - recorded while the subject was in a smiling state by measuring the distance from one angle of mouth to another (Fig. 4).[16,15]

Bizygomatic width (BZW) - distance between the two most prominent points marked manually on the zygoma of the subject's face, measured from the uploaded photograph (Fig. 3).[6]

Measurements to obtain the width of a central incisor and straight line distance from distal surface of one canine to another was also made similarly.[11] (Fig. 4, 3). The readings were noted in a tabular column along with the name, age, and origin of each subject.

The data were analyzed using the "Statistical Package for the Social Sciences" (SPSS for Windows v.20; SPSS Inc.). The variables follow a normal distribution, therefore to analyze the data parametric methods were applied. To compare the facial measurements with the width of central incisor and from canine to canine, Pearson's correlation test was applied and the significance level fixed at 5% ($P<0.05$).

Results

Descriptive analysis was done for all the five groups to determine whether the values obtained from the study were statistically significant, and a linear regression equation was formulated. Mean and standard deviation are presented in the form of graphs for groups 1, 2, 3, 4 and 5 (Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9).

Fig. 5 shows descriptive statistics for group 1. Mean and standard deviation of bizygomatic width is 99.84±26.91 mm, whereas mean and standard deviation of intercommissural width is 54.68±15.42 mm. The width of central incisors vary from 0.8 to 13.70 with a mean of 7.51±1.86 mm, while the width of anteriors from canine to canine range between 21.90 and 84.20 with the mean value being 39.37±12.84 mm.

The descriptive analysis (Fig. 6) signifies mean and standard deviation for group 2. It is the highest for bizygomatic width, 102.8±26.44 mm, ranging from 35.0 to 164.20. The mean width of central incisor is 7.27±1.74 mm whereas mean width of anteriors from canine to canine is 31.40±8.37 mm.

Fig. 7 depicts descriptive statistics for group 3. The interpupillary distance ranges from 32.60 to 126.40 with a mean value of 58.94±15.02 mm. Bizygomatic width ranges from 51.70 to 203.0 with mean and standard deviation of 96.69±26.41 mm. Intercommissural width ranges from 33.70 to a maximum of 133.90 with mean and standard deviation of 54.55±15.34 mm. The mean width value of a central incisor is 7.06±0.94, whereas for width of anteriors from canine to canine it is 31.66±4.01 mm.

Fig. 8 shows descriptive statistics for group 4. The mean and standard deviation for bizygomatic width is 97.09±29.11 mm. Values for intercommissural width range from a minimum of 3.0 to a maximum of 92.90 with a mean and standard deviation of 53.48±15.33 mm. The width of central incisor varies from 1.10 to 13.20 with

mean value of 7.61±2.35 mm. Mean width of anteriors from canine to canine is 33.07±12.79 mm.

Fig. 9 shows descriptive statistics for group 5. The values for bizygomatic width varies from 57.40 to 203.00 with mean and standard deviation 101.75±21.96 mm. Mean and standard deviation for intercommissural width is 56.56±13.75 mm. The mean width value of central incisor is 7.65±1.08 mm ranging from 5.20 to 11.70. The mean value of anteriors from canine to canine is 36.48±6.37 mm.

A linear regression equation was formulated for groups 1, 4 and 5 using the facial measurements to determine the width of central incisor and combined width of anteriors.

Regression equations for assessing the width of central incisor for groups 1, 4 and 5 are as follows:

For group 1 – width of central incisor = 5.427+ 0.021*BZW

For group 4 – width of central incisor = 3.314 + 0.080*ICW

Width of central incisor = 3.539 + 0.098*ICW − 0.29*IAD

For group 5 – width of central incisor = 6.137 + 0.015*BZW

Regression equations for assessing the width of anteriors from canine to canine for groups 1, 4 and 5 are as follows:

For group 1 – width of maxillary anteriors from canine to canine = −1.308 + 0.407 (BZW)

Another equation for the same group is,

Width of maxillary anteriors from canine to canine = −2.296 + 0.249*BZW+ 0.308*ICW

For group 4 – width of maxillary anteriors from canine to canine = 7.008 + 0.487*ICW;

For group 5 – width of maxillary anteriors from canine to canine = 30.528 + 0.190*ICD

For group 2 and 3, the regression models were non – significant.

The Pearson's correlation coefficient test for group 1 (table 1) depicts the correlation of facial measurements such as interpupillary distance, innercanthal distance, bizygomatic width, interalar distance and intercommissural width with the width of central incisor and the width of maxillary anteriors from canine to canine for group 1. Width of a central incisor as well as width of anteriors from canine to canine exhibits a positive and highly significant (P = 0.01) correlation to the interpupillary distance, the innercanthal distance, bizygomatic width, interalar distance and the intercommisssural width.

Table 2 shows a positive and highly significant correlation (P = 0.01) between the interpupillary distance, innercanthal distance, bizygomatic width, interalar distance, intercommissural width and the width of central incisor as well as the width of maxillary anteriors from canine to canine for group 4.

The results of Pearson's correlation coefficient test for group 5 (table 3) show a positive and highly significant correlation between the interpupillary distance, innercanthal distance, bizygomatic width, interalar distance, intercommisssural width and the width of central incisor, whereas between the width of maxillary anteriors from canine to canine and the facial measurements the correlation is positive and significant (P = 0.05).

Therefore, with the statistical analysis it can be inferred that a positive and highly significant correlation exists between BZW, ICW, IAD and the width of central incisor for subjects hailing from group 1, 4 and 5.

A negative and insignificant correlation was seen between the facial measurements and widths of central incisor and maxillary anteriors for the subjects of group 2 and 3.

Discussion

Facial aesthetics depends largely on the aesthetic appearance of maxillary anterior teeth. No definite

guidelines for group of maxillary anterior and facial measurements pertaining to the South Indian population exist, thus the sample for the present study was selected from five ethnic groups belonging to the major states: Tamil Nadu (group 1), Kerala (group 2), Telangana (group 3), Andhra Pradesh (group 4), and Karnataka (group 5) of South India. Young participants (20 to 40 years) were chosen and thus the measurements of anterior tooth widths were made.

This study was done to evaluate the presence if any relation exists between facial measurements and dimensions of maxillary anterior teeth. The data were subjected to statistical analysis. From the analysis, regression correlations were formulated with the help of correlation coefficients. Interpretation of regression equations was utilized to predict widths of upper central incisor as well as the width of six anterior teeth from one canine to another. Also, Pearson's correlation coefficient provided the p-value, which helped in analyzing the significance of the study.

In this study, higher correlation chances were seen when facial measurements such as BZW (bizygomatic width), ICW (intercommissural width), IAD (interalar distance) were compared to the width size of central incisor for groups 1, 4 and 5 whereas the BZW (bizygomatic width), ICW (intercommissural width) and ICD (inner canthal distance) were linked to the mesiodistal widths of six anterior teeth from canine to canine for groups 1, 4 and 5.

The IPD in our study demonstrated a mean of 60.03 mm for Group 1, 61.27 mm for group 2, 58.94 mm for group 3, 58.56 mm for group 4 and 59.70 mm for group 5. These values were in accordance to the study carried out by Cesario and Latta that described a mean of 59.16 mm in one hundred participants from the US army.[7]

The ICW in our study showed a mean value of 54.68 mm for subjects belonging to group 1, 57.02 mm for group 2, 54.55 mm for group 3. According to the study by Latta, Weaver, and Conkin a mean of 53.74 mm was obtained after evaluating edentulous subjects, with a significant difference in males.[9]

The ICD values obtained in our study demonstrated a mean of 32.12mm for group 1, 32.14 mm for group 2, 31.31 mm for subjects of group 3, 30.98 mm for group 4 and 31.38mm for group 5. Abdullah observed a mean of 28.30mm while Wazzan, mentioned a mean of 31.92mm, with a range from 25 to 39mm while measuring the facial section with modified Boley gauge.[10,19] The diverse values could be an outcome of the ethnic differences of the study sample analyzed. In our study, the maximum value (32.14mm) corresponded to group 2.

The BZW demonstrated in our study shows a highly significant (p=0.01) and positive correlation to the mesiodistal width of six maxillary anterior teeth from the distal surface of one canine to another and also correlated with the mesiodistal width of a single central incisor for the groups 1, 4 and 5 as calculated from the digital image. Scanderet, Keber, Umbrigar found that the bizygomatic width can serve as an interpreter for determination of central incisor width as well as the width of anterior from canine to canine.

The IAD in our study showed a highly significant (p=0.01) and positive correlation with the mesiodistal width of six anterior and width of a central incisor in the subject's originating from group 1 when measured on the image. This is similar to the study by Hoffmann, Boomberg, and Hatch who displayed a relation between the interalar distance and intercanine width.[8]

The IAD is significantly related to the width of the six anterior (p=0.05) as seen in the subjects of group 4 and highly significant to the width of a central incisor (p=0.01) for group 5. In the present study, a regression equation

was formulated that can be used in clinical situations applicable to individuals from Group 1.

The mean width of central incisor was found to be 7.51mm for group 1, 7.27mm for group 2, 7.06mm for group 3, 7.61mm for group 4 and 7.65mm for group 5. It can be estimated from the bizygomatic width for group 1 and 5, and from the intercommissural width and interalar distance for group 4.

A weak, negative and insignificant ($p>0.05$) correlation was seen between facial measurements and width of six anterior teeth and the width of maxillary central incisor for subjects' of group 2. For group 3, a negative correlation was seen between the interalar distance and the width of central incisor as well as between the intercommissural width and the central incisor width. The IPD, ICD and BZW exhibited a positive but insignificant correlation ($p>0.05$) to the central incisor width and the width of anterior from canine to canine.

The regression equations obtained are of clinical significance for groups 1, 4 and 5.

An example comparing the results obtained and the 'golden proportion' in the software is applied on a patient whose native origin was from group 1. He reported with a complaint of unpleasant smile due to missing upper front teeth and desired a replacement for the same. Images of the face and intraoral images of the patient were captured. These images were uploaded in the "Planmeca Romexis Smile Design" software and a template according to the Golden proportion was superimposed on the subject's photograph. The BZW and ICW were measured from the uploaded image (Fig. 10) and the width of central incisor, as well as the width of maxillary six anterior teeth from canine to canine, was calculated by applying the regression equation formulated for Group 1 from the study. Thus, the two images obtained: one from superimposition of the 'Golden Proportion' template of the software (Fig. 11) and second from the application and superimposition of the regression equation (Fig. 12) was shown to the patient and based on his satisfaction the final prosthesis will be fabricated.

The main clinical advantage of this study is the applicability of the regression equations obtained. It can be useful to help inexperienced clinicians rehabilitate their patients in the maxillary anterior region, presenting from the above - mentioned origins and also provides an insight of the esthetic result of the final prosthesis to the patients' satisfaction.

The limitations of the study are that the results and regression models applied did not specifically investigate the gender differences. Patients' with congenital anomalies, developmental facial defects like cleft lip, Down's syndrome, midline diastemas, an unaesthetic spacing of the teeth, orthodontic treatment is not indicated, Millers class II, III and IV patients who desire replacement by fixed prosthesis have not been included in the study. Errors in dimensions made during photography or while taking measurements of the photographs can also be considered a limitation of this study.

Further future research including population from other regional states of India can be evaluated and studied with similar parameters and a larger sample size. Hard tissue landmarks can also be taken into account for future studies. However, the results obtained from this study depict facial measurements as a reliable predictor to improve the overall aesthetic appearance of an individual for selection of missing teeth.

Conclusion

In the study conducted to find if a correlation exists between the facial measurements and the width of central incisor and total width of maxillary anteriors in the South Indian population, it can be concluded that;

The BZW, ICW and IAD showed the maximum correlation to the width of a central incisor for group 1, group 4 and group 5, whereas the BZW, ICW and ICD showed the highest correlation to the width of maxillary anteriors from canine to canine for group 1, group 4 and group 5. A negative and insignificant correlation (P>0.05) was seen between the width of central incisor and width of maxillary anteriors from canine to canine for group 2 and group 3.

Hence, the width of a central incisor and the total width of maxillary anterior from the distal surface of one canine to another can be predicted by incorporating the regression equations obtained from the study for each population.

References

1. Levin E. Dental esthetics and the golden proportion. J Prosthet Dent 1978; 40(3): 244–252.
2. Nida Al – Kaisy and Balkees TG. Selecting maxillary anterior tooth width by measuring certain facial dimensions in the Kurdish population. J Prosthet Dent 2015; 115(3): 329-334.
3. Bhuvaneswaran M. Principles of smile design. J Conserv Dent 2010; 13(4): 225-232.
4. Goldstein RE, Garber DA, Goldstein CE, Schwartz CG, Salama MA, Gribble AR, Adar P, Ginsberg LJ. Esthetic update: the changing esthetic dental practice. J Am Dent Assoc 1994; 125(11): 1447-1456.
5. McLaren EA, Garber DA, Figueira J. The Photoshop Smile Design Technique (Part I): Digital Dental Photography. Compend Contin Educ Dent 2013; 34(10): 772-779.
6. Scandrett F, Kerber P, Umrigar Z. A clinical evaluation of techniques to determine the combined width of the maxillary anterior teeth and the maxillary central incisor. J Prosthet Dent 1982; 48(1): 15-22.
7. Cesario VA, Latta GH. Relationship between the mesiodistal width of the maxillary central incisor and interpupillary distance. J Prosthet Dent 1984; 52(5): 641-643.
8. Hoffman W, Bomberg TJ, Hatch RA. Interalar width as a guide in denture tooth selection. J Prosthet Dent 1986; 55(2): 219-221.
9. Latta, Weaver, Conkin. The relationship between the width of the mouth, interalar width, bizygomatic width, and interpupillary distance in edentulous patients. J Prosthet Dent 1991; 65(2): 250-254.
10. Abdullah M. Inner canthal distance and geometric progression as a predictor of maxillary central incisor width. J Prosthet Dent 2002; 88(1): 16-20.
11. Gomes V, Goncalves L, Prado C, Junior I, Lucas B. Correlation between Facial Measurements and the Mesiodistal Width of the Maxillary Anterior Teeth. J Esthet Restor Dent 2006; 18(4): 196–205.
12. Mohd Isa Z, Tawfiq O, Mohd Noor N, Shamsudheen M and Rijain O. Regression methods to investigate the relationship between facial measurements and widths of the maxillary anterior teeth. J Prosthet Dent 2010; 103(3): 182-188.
13. Rai R. Correlation of nasal width to inter canine distance in various arch forms. J Indian Prosthodont Soc 2010; 10(2): 123-127.
14. George S, Bhat V. Inner canthal distance and golden proportion as predictors of maxillary central incisor width in south Indian population. Indian J Dent Res 2010; 21(4): 491-495.
15. Ellakwa A, McNamara K, Sandhu J, James K, Arora A, Klineberg I, El-Sheikh A, Martin FE. Quantifying the Selection of Maxillary Anterior Teeth Using Intraoral and Extraoral Anatomical Landmarks. J Contemp Dent Pract 2011; 12(6): 414-421.

16. P Mahesh, S Rao, Pavan KT, K Shalini. An In Vivo Clinical Study of Facial measurements for Anterior teeth selection. Annals and Essences of Dentistry 2012; IV(1): 1-6.
17. Lucas BL, Bernardino-Júnior R, Lopes-Júnior I, Gonçalves LC, Gomes VL. Comparison of three anthropometric techniques for tooth selection. Eur J Prosthodont Restor Dent 2012; 20(2): 67-70.
18. Kini A, Angadi G. Biometric ratio in estimating widths of maxillary anterior teeth derived after correlating anthropometric measurements with dental measurements. Gerodontology 2013; 30(2): 105-111.
19. Al Wazzan KA. The relationship between innercanthal dimension and the widths of maxillary anterior teeth. J Prosthet Dent 2001; 86(6): 608-612.

Legends Figure

Fig. 1: Subject's photograph while smiling

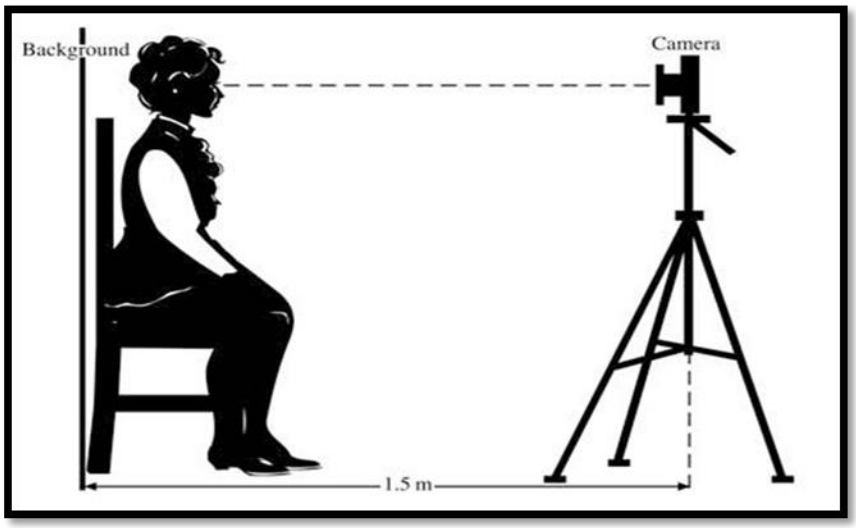

Fig. 2: Photographic arrangement of subject and camera

Fig. 3: Photographic measurements on the subject showing inner canthal distance (ICD), bizygomatic width (BZW) and width of anteriors from canine to canine

Fig. 4: Photographic measurements on the subject showing interpupillary distance (IPD), interalar distance (IAD), intercommissural width (ICW) and width of central incisor

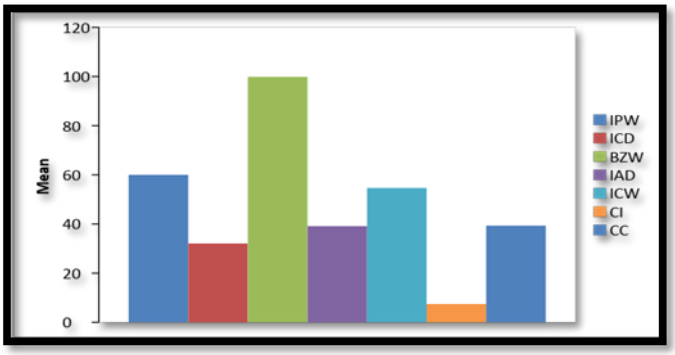

Fig. 5: Descriptive statistics for group 1

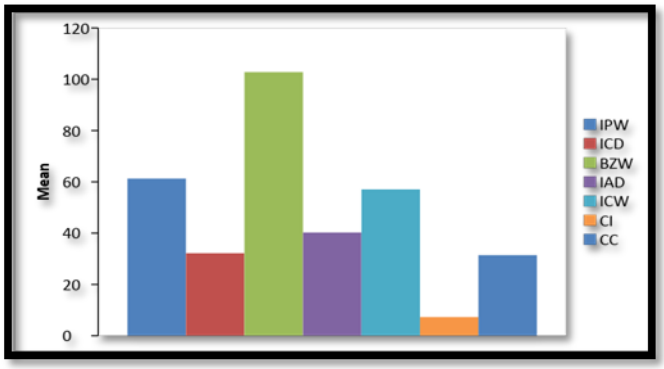

Fig. 6: Descriptive statistics for group 2

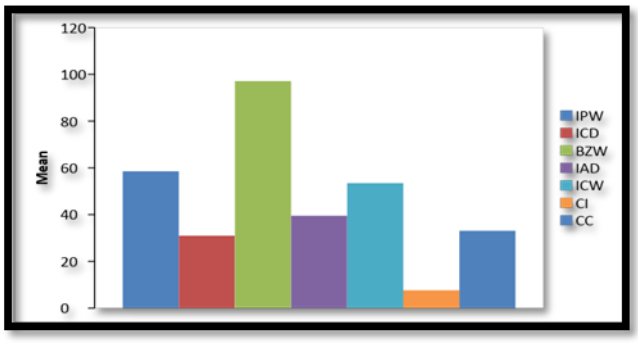

Fig. 7: Descriptive statistics for group 3

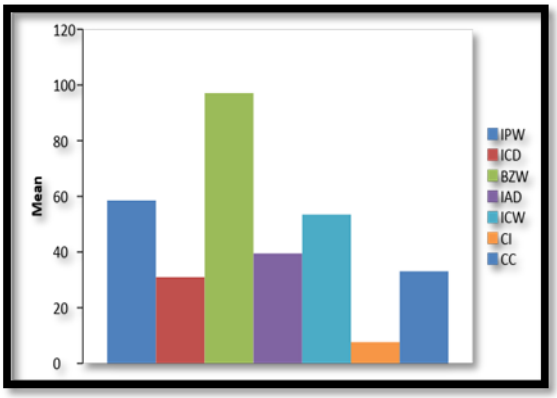

Fig 8: Descriptive statistics for group 4

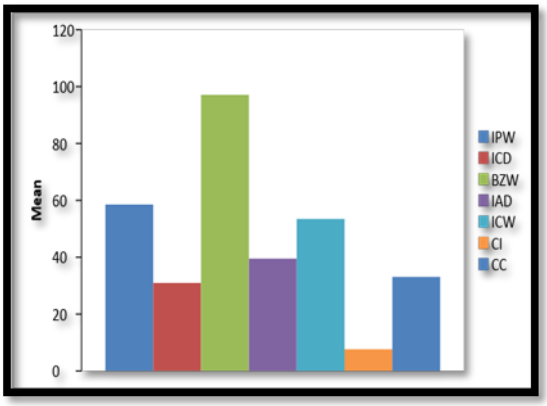

Fig. 9: Descriptive statistics for group 5

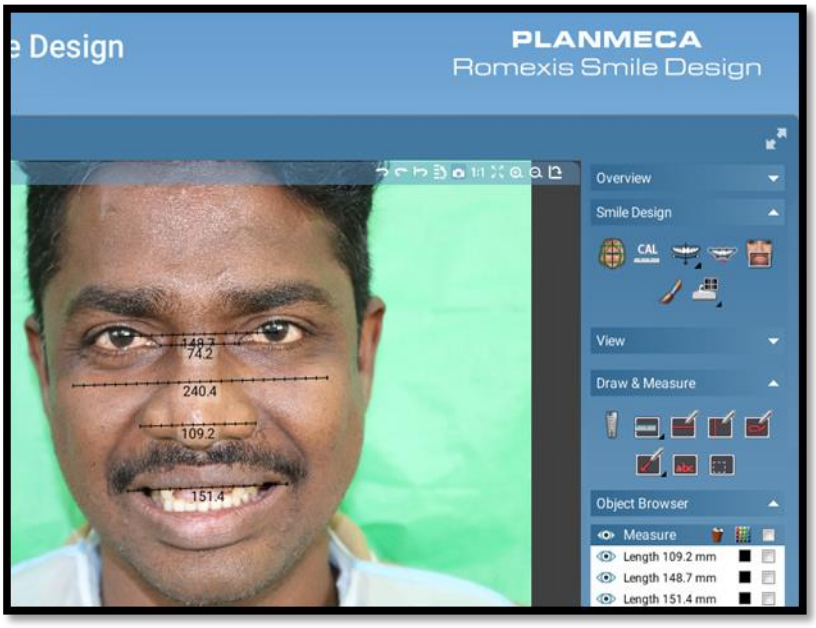

Fig. 10: Photographic measurements on the patient showing interpupillary distance (IPD), inner canthal distance (ICD), bizygomatic width (BZW), interalar distance (IAD) and intercommissural width (ICW)

Fig. 11: Superimposition of 'golden proportion' template on the patient's image

Fig. 12: Superimposition of 'regression equation' obtained from the study on the patient's image