Standards of Facial Esthetics: An Anthropometric Study

H. Jagadish Chandra · M. S. Ravi ·
S. M. Sharma · B. Rajendra Prasad

Received: 28 March 2010 / Accepted: 29 February 2012 / Published online: 28 June 2012
© Association of Oral and Maxillofacial Surgeons of India 2012

Abstract

Aim Anthropometry is an art and science used extensively for measuring the soft tissue proportions. While it is true that error is found in measurements of this kind, a great many trends of growth and development and therapy changes can be recorded with a significant degree of accuracy.

Objective Facial proportion varies among the different ethnic groups and today, most of the available studies are done on western population. Hence an Anthropometric study was conducted in the local population.

Materials and Methods The study was carried out with the aim of measuring the facial soft tissue proportion in the local population using anthropometry. Study was done using 100 subjects (50 males and 50 females) with Class I skeletal relationship and pleasing profile. Using standard anthropometric landmarks the various anthropometric measurements and facial proportional indices were determined (both horizontal and vertical) and were compared with that for North American Caucasians.

Results The statistical analysis revealed significant differences in the facial proportion between the two populations.

Keywords Facial proportions · Anthropometrics · Population study

Introduction

The concept of beauty has been periodically changing through ages and will continue to do so for the rest of the tenure of the human beings on earth. Eventhough tastes, fashion and standards of beauty change from time to time, there appears to be certain facial proportion and relationships that provide a basis for the diagnosis and planning for the improvement of facial form. A face is beautiful and shows harmonious features if the individual components are proportional. This is what is referred to as facial balance. A pleasant and harmonious face can be a great asset to ones social status and hence a therapist is held liable to shoulder the full responsibility of the overt alteration, desirable or undesirable, that may be produced because of aesthetic surgery. The term aesthetic maxillofacial surgery can be defined as a surgical practice that includes comprehensive evaluation, diagnosis and surgical treatment of the skeletal and soft tissue disharmonies of the maxillofacial region, in terms of beauty which provides happiness symbolized by beauty, morphologically and functionally.

Since it is impossible to quantify and attribute beauty, various linear and angular measurements for measuring facial proportions were thought of. Once the cephalometrics came into existence, more importance was given for the hard tissue relationship, and their correction. But soon it was realized that the correction of hard tissue alone does not bring about the desired results in many occasions. Soft tissue plays a major role in determining the final outcome of facial aesthetic surgical procedures [7].

Anthropometry is an art and science used extensively for measuring the soft tissue proportions. While it is true that error is found in measurements of this kind, a great many trends of growth & development and therapy changes can be recorded with a significant degree of accuracy [1]. It has

H. Jagadish Chandra (✉)
Oral & Maxillofacial Surgery, Yenepoya Dental
College & Hospital, Mangalore 575018, India
e-mail: jagadishmids@rediffmail.com

M. S. Ravi · S. M. Sharma · B. Rajendra Prasad
Oral & Maxillofacial Surgery, A.B. Shetty Memorial Institute of
Dental Sciences, Mangalore 575018, India

been shown that the reproducibility of rating of facial aesthetics is good and also opinions between panels were almost similar [2].

Facial proportion varies among the different ethnic groups and today, most of the available studies are done on western population. Hence an anthropometric study was conducted in the local population with the following aims and objective

1. To study the facial proportions of the local population
2. To establish the norms for facial aesthetics for the population
3. To correlate the findings with clinical application.
4. To compare the anthropometric measurements and facial proportions of the local population with that of the North American Caucasians.

Materials and Methods

The study was conducted using 100 adult subjects both male and female belonging to the age group of 18–25 years.

Criteria for selection of subjects

- Pleasing profile with competent lips.
- No history of prior surgical or orthodontic treatment.
- Class I occlusion with near normal dental arches.
- Normal overjet and overbite.
- Devoid of any obvious defect or deformity.
- Subjects originally belonging to local area.

A total of 100 subjects (50 males and 50 females) with skeletal class I relationship were selected for the study.

Cephalometric Analysis

Lateral cephalogram was traced and the following measurements were made to determine the skeletal relationships. All the measurements were made up to 0.5 degree and 0.5 mm accuracy. $\angle SNA$, $\angle SNB$, $\angle ANB$, Witt's appraisal were determined. Subjects with class 1 skeletal relationship selected.

Anthropometric Measurements

Direct anthropometric measurements were made keeping the head position parallel to the ground using magnetic level finder. Subjects were asked to sit in an upright relaxed position and made to look at a distant object. Measurements were performed according to classical methods of physical anthropology using standard instruments

Fig. 1 Standard instruments used for measuring width of the mouth, lip, length of the nose and naso-labial angle

Fig. 2 Standard instruments used for measuring height of the face, width of the head and mandibular arc

(Figs. 1, 2) described by Farkas L. G. Facial proportions were determined, which were clinically significant (Figs. 3, 4).

Various anthropometric landmarks used in the study:

1. Eurion (eu): most prominent lateral point on each side of the skull in the area of the parietal and temporal bones.
2. Zygion (zy): most lateral point of the zygomatic arch and is identified by trial measurement, not by anatomical relationship. It is identical to the bony zygion of the malar bones.
3. Gonion (go): most lateral point on the mandibular angle close to the bony gonion. It is identified by palpation. If the angle is flat or if there is rich soft tissue cover, determination of this point is very difficult.
4. Endocanthion (en): point at the inner commissure of the eye fissure. This soft endocanthion is located

Fig. 3 Sample measurement of width of the mouth

lateral to the bony landmark that is used in cephalometry.

5. Exocanthion (ex): point at the outer cornmissure of the eye fissure. The soft exocanthion is slightly medial to the bony exocanthion.
6. Alare (al): most lateral point on each alar contour.
7. chelion (ch): point located at each labial commissure.
8. Tragion (t): notch on the upper margin of the tragus.
9. Stomion (sto): imaginary point at the crossing of the vertical facial midline and horizontal labial fissure between gently closed lips, with teeth shut in the natural position.
10. Nasion (n): point in the midline of the nasal root and the nasofrontal suture. The slight ridge on which it is situated is felt by the observer's fingernail. This point is always above the line that connects the inner canthi. The soft nasion and the bony nasion are identical.
11. Subnasale (sn): mid point of the columella base at the apex of the angle where the lower border of the nasal septum and the upper lip meet. This point is not identical to the bony subnasion, or nasospinale (ns), which is the midpoint of the anterior margin of the apertura pyriformis at the base of the spina nasalis anterior.

Fig. 4 Sample measurement of height of the face

12. Gnathion (gn): lowest median landmark on the lower border of the mandible which is identified by palpation and is identical to the bony gnathion.
13. Labiale superius (ls): mid point of upper vermillion line.
14. Labiale inferius (li): mid point of lower vermillion line.

Individual charts were made for each subject. The obtained data were statistically analyzed using “*t*” test and the following observations and results were drawn (Tables 1, 2, 3, 4).

Results and Discussion

The study was undertaken to record the facial anthropometric measurement in group of 100 healthy subjects (50 male and 50 female) of age group of 18–25 years belonging to similar ethnic background.

It has been shown that hard tissue repositioning by surgical treatment will not result in concurrent linear movement of the soft tissue. Hence understanding soft tissue is must, irrespective of hard tissue deformity. This is not to undermine the importance of harmonious skeletal relationships, but harmonious skeletal relationship alone

Table 1 Mean and standard deviation of anthropometric measurements for local and North American Caucasian population (male)

Variable	Local population		North American Caucasians		T	P
	Mean	Standard deviation	Mean	Standard deviation		
Width of head	151.32	7.40	151.1	5.8	0.166	>0.05
Width of face	118.62	8.91	137.1	4.3	13.21	<0.001
Width of lower face	115.72	8.51	97.1	5.8	11.578	<0.001
Inter ocular diameter	33.16	2.71	32.9	2.7	0.53	>0.05
Binocular diameter	101.10	8.61	89.4	3.6	16.47	<0.001
Width of nose	37.00	2.75	34.7	2.6	4.291	<0.001
Width of mouth	50.14	4.55	53.3	3.3	3.709	<0.001
Maxillary arc	256.86	8.44	279.3	10.8	11.911	<0.001
Mandibular arc	284.04	10.03	304.1	13.2	10.756	<0.001
Morphological height of face	119.98	7.49	121.3	6.8	0.923	>0.05
Physiognomical height of upper face	78.40	8.93	74.0	4.2	3.153	<0.01
Height of lower face	54.54	11.24	71.9	6.0	9.634	0.00
Length of nose	56.82	3.81	53.0	3.5	5.221	0.00
Medial Vertical upper lip length	22.63	4.10	21.8	2.0	1.261	>0.05
Medial Vermilion height of upper lip	8.31	3.81	8.9	1.5	0.065	>0.05
Medial vermilion height of lower lip	11.27	2.09	10.4	1.9	2.08	<0.05
Naso-labial angle	99.04	7.82	98.9	8	0.089	>0.05

Table 2 Mean and standard deviation of anthropometric measurements for local and North American Caucasian population (female)

Variable	Local population		North American Caucasians		T	P
	Mean	Standard deviation	Mean	Standard deviation		
Width of head	152.68	5.79	144.4	144.4	7.923	<0.001
Width of face	112.38	9.06	129.9	5.3	11.35	<0.001
Width of lower face	113.84	8.62	91.1	5.9	15.396	<0.001
Inter ocular diameter	32.08	3.23	31.6	2.4	0.85	>0.05
Binocular diameter	99.12	13.33	86.8	4.0	6.26	<0.001
Width of nose	37.98	3.44	31.4	1.9	11.84	<0.001
Width of mouth	49.44	4.96	49.8	3.2	0.432	>0.05
Maxillary arc	256.70	22.96	267.5	11.3	8.542	<0.001
Mandibular arc	272.16	10.63	284.7	11.3	6.157	<0.001
Morphological height of face	119.95	7.47	111.8	5.2	6.255	<0.001
Physiognomical height of upper face	80.72	5.80	68.1	3.4	11.312	<0.001
Height of lower face	59.12	6.79	65.5	4.5	15.38	<0.001
Length of nose	58.58	5.31	48.9	2.6	8.357	<0.001
Medial Vertical upper lip length	22.92	2.75	19.6	2.4	1.357	>0.05
Medial Vermilion height of upper lip	7.80	2.21	3.4	1.3	1.655	>0.05
Medial vermilion height of lower lip	12.14	1.69	9.7	1.6	2.481	<0.05
Naso-labial angle	102.66	8.60	99.1	8.7	1.12	>0.05

without corresponding soft tissue drape will not achieve the desired proportional facial aesthetics. Hence hard tissue as well as soft tissue proportions are of paramount importance for the stability, function and aesthetics.

Anthropometric measurements that have important clinical applications and which are mostly affected by

surgical or orthodontic treatment were selected for the study. A total of 18 measurements (both horizontal and vertical) were determined using the method and instruments as described by Farkas L. G.

The data obtained were statistically analyzed using “*t*” test and mean and standard deviation were obtained to

Table 3 Mean and standard deviation of facial indices for local population and North American Caucasian population (male)

Variable	Local population		North American Caucasians	
	Mean	Standard deviation	Mean	Standard deviation
Facial	101.59	8.38	88.5	5.1
Mandible face width	98.17	10.72	70.8	3.8
Upper face	66.52	8.68	54.0	3.1
Mandible width face height	96.74	8.58	80.3	6.8
Mouth-face width	42.47	4.60	38.9	2.5
Lower face height	45.58	9.69	59.2	2.7
Inter canthal	32.95	2.63	36.8	1.8
Intercanthal nasal width	90.0	7.83	94.8	6.8
Nasal index	65.39	6.41	65.5	4.9
Nose face height	47.52	4.00	43.7	2.5
Upperlip height mouth width	45.50	9.56	40.9	3.9
Mouth- face width	42.47	4.60	38.9	3.2
Upperlip-nose height	40.06	8.56	41.1	3.1

Table 4 Mean and standard deviation of facial indices for local population and North American Caucasian population (female)

Variable	Local population		North American Caucasians	
	Mean	Standard deviation	Mean	Standard deviation
Facial	107.41	10.90	86.2	4.6
Mandible face width	101.78	9.23	70.1	4.2
Upper face	72.38	8.70	52.4	3.1
Mandible width face height	95.17	8.19	81.7	6.0
Mouth-face width	44.13	4.40	38.4	2.5
Lower face height	49.29	5.41	58.6	2.9
Inter canthal	33.93	14.56	36.4	1.5
Intercanthal nasal width	84.98	10.45	102.9	1.4
Nasal index	65.23	7.29	61.4	5.1
Nose face height	48.8	3.88	45.6	2.1
Upperlip height mouth width	47.01	8.64	39.4	2.7
Mouth- face width	44.13	4.40	39.5	2.5
Upperlip-nose height	39.38	5.50	39.5	3.4

establish the norms separately in males and females. An attempt has been made to correlate the findings with clinical application.

The mean values of the anthropometric measurements were compared with that of the North American Caucasian population (Tables 1, 2). It was observed that, width of the face, width of the lower face, bi-ocular diameter, width of the nose, width of the mouth, maxillary and mandibular arc, height of lower face, length of nose showed highly

significant variation both in males and females. Females also showed very highly significant variation in morphological height of the face, height of upper face and length of nose [3]. Significant variations were seen in height of lower lip between the two populations. Non-significant variation were seen in morphological height of the face for males, inter-ocular diameter, medial vertical upper lip length, medial vertical height of upper lip and naso-labial angle. These indicate that the overall facial dimensions are more in local population than Caucasian population [4] Proportional indices for the, local population were compared with that of the American Caucasians. It was seen that overall proportions were greater for the local Population. Very highly significant variation were observed in, facial, mandibular—face width, upper face, mandibular width—face height, mouth—face width, lower face—face height proportions. Upper lip—nose height, nasal index showed non-significant variation. Overall the facial features were more pronounced in the local population than North American Caucasians [6] (Tables 3, 4).

Hence it is very essential to understand the facial norms and proportion for various population so that the changes in soft tissue pattern that could result due to the surgical repositioning of the corresponding hard tissue counterpart should be taken into consideration, should be critically evaluated during the stage of treatment planning itself to avoid any disappointments and undesirable facial esthetics [5]. For example in case of maxillary vertical excess, as decided by cephalometric analysis, the treatment plan of impacting the maxilla upwards without giving due importance to the width of the nose and the naso-labial angle would result in disproportionate and non-harmonious changes which in turn will result in a poor facial aesthetics.

Similarly, in a case of maxillary excess and normal face height, surgical procedure to reduce the maxillary excess will finally result in reduction in facial height, which may not be accepted aesthetically.

In case of facial disfigurement such as cleft lip and palate or craniofacial syndromes (Treacher Collins syndrome, Aperts Syndrome, Achondroplasia etc.), these proportions can be used as references to achieve near normal values for establishing the facial harmony and structural balance.

Summary and Conclusion

The study was carried out with the aim of measuring the facial soft tissue proportion in the local population using anthropometry. Study was done using 100 subjects (50 males and 50 females) with Class I skeletal relationship and pleasing profile. Using standard anthropometric landmarks the various anthropometric measurements and facial

proportional indices were determined (both horizontal and vertical) and were compared with that for North American Caucasians. From the study the following conclusions were drawn.

- When compared between the two populations, the local population had a wider lower face while North American Caucasians showed wider mid face.
- Local population had overall greater values of proportional indices than North American Caucasian population.

3. Thomas CS, Nanda RS et al (1993) Perception of a balanced facial profile. *Am J Orthod* 104(2):180–187
4. Ferrario VF et al (1996) Facial three dimensional morphometry. *Am J Orthod Dentofacial Orthop* 109(1):86
5. William Arnett G et al (1999) Soft tissue cephalometric analysis, diagnosis and treatment planning of dentofacial deformity. *Am J Orthod Dentofacial Orthop* 116(3):239
6. Farkas LG, Cheung G (1979) Orbital measurements in the presence of epicanthi in healthy North American Caucasians. *Ophthalmologic* 179:309–315
7. Dunlevy HA, White RP et al (1987) Professional and lay judgment of facial esthetic changes following orthognathic surgery. *Int J Adult Orthod Orthognath Surg* 3:151–158

References

1. Gosman SD, Vineland DDS (1950) Anthropometric method of facial analysis in orthodontics. *Am J Orthod* 36:749
2. Bergman RT (1999) Cephalometric soft tissue facial analysis. *Am J Orthod* 116(4):373