Original Article

Anthropometric Facial Measurements of Bangladeshi Young Males using Neoclassical Facial Canons as criteria

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Abstract

Background: *To evaluate different types of facial forms of Bangladeshi young males by using neoclassical facial canons.*

Method: *This cross-sectional observational study was conducted at the Department of Orthodontics & Dentofacial Orthopeadics of Dental College Hospital, Dhaka. A total number of 100 male participants were selected among students and doctors of Dhaka Dental College Hospital according to inclusion and exclusion criteria. After identification of particular anatomical landmarks on a participant the values of different variables related to six neoclassical facial canons were measured through anthropometric method.*

Result: *In vertical proportion canon, nose length was the smallest variable than forehead height, lower face height and ear length. In horizontal proportion canon, naso-orbital proportion was found valid in 17%, orbital proportion was valid in 40%, naso-auoral canon showed validity in 15%, naso-facial proportion was found valid in14% in male.*

Conclusion: *The conclusion that can be drawn from this study is that the six neoclassical facial canons are unlikely to be applicable for Bangladeshi young adult male. Neoclassical facial canons serve as standard on which anthropometric measurements are counted. If the use of these canons is to be continued, they need to be adjusted through the application of contemporary anthropometric method. The result of the study supports the idea that a single standard of craniofacial esthetics cannot be applicable to all racial and ethnic groups or one subgroup to another even in the same race.*

Keywords: *Anthropometric measurement, Facial proportion, Neoclassical facial canon.*

Introduction

The objectives of orthodontic treatment are to achieve facial balance through stabilization of dentition and production of pleasing facial and dental aesthetics. It is important to identify and define the characteristics of a pleasing well-balanced face, as well as those of a functional occlusion. It is difficult to determine the standard of beauty, because of the tremendous variations among people occupying different racial groups.

Human face is the most striking marker of relationship between each other. Face conveys important perceptible information related to individual traits such as personal identity, gender, age, and ethnic origin.

The head is the part of human body which shows the least change. As it has a higher bony tissue content, its growth is much slower from the birth. Also, due to its structure, it contains lots of fixed points. This feature has attracted the attention in each era and many scientific and artistic studies have come out as a consequence.[1]

The first recorded set of facial proportional tenets was introduced by the Greeks. Polycleitus (450-420B.C.) was among the first to use artwork to portray the "ideal" facial proportions. Aristotle (384-322 B.C.) later recorded his subjective impressions of what specific measurements represented the "ideal" facial proportions. Marcus Vitruvius Pollio (31B.C.-14 A.D.) later wrote about the dimensions that were deemed the aesthetic ideal by the ancient Greeks. The European Renaissance artists, most notably Leonardo da Vinci (1452-1519 A.D.) would later take the concepts of the Greeks and developed them into a system known as the "neoclassical canons".[2] Roman architect Vitruvius (25 B.C.) divided the face into three equal parts vertically. His famous facial trisection is recommended in modern texts and used by orthodontists and orthognathic surgeons today, i.e.2000 years later.[3]

Canons are rules or formulae or law of simple proportions to describe the "ideal "form of the human body.[4] and based on the assumption certain fixed ratio existed between different parameters of a harmonious face.[5] These canons are regarded as precursors of the present anthropometric facial proportion indices and remain as the foundation on which modern facial analysis is based.[6]

The hallmark technique anthropometry is the scientific description of the physical characteristics of human body.[7] According to Onis and Haicht (1996, p 650) anthropometry is the single most portable, universally applicable, inexpensive, non-invasive method available to assess the proportions, size and composition of the human body.

Prior to the advent of cephalometric radiography, dentist and orthodontists often used anthropometric measurements (i. e. measurements made directly during clinical examination) to establish facial proportions, it is better to make facial measurements clinically rather than cephalometric analysis,

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because soft tissue proportions, as seen clinically, determine facial appearance.[8]

Anthropometric variables differ in different parts of the world and are influenced by age, sex, ethnicity and geographical distribution.[9]

Populations differ in their character, size, growth, and shape. Distributions between races by geographical location, historical origins, culture and language were usually subsumed into three major racial groups that is Asiatic (or Mongoloid), Black (or Negroid) and White (or Caucasian). Such classification into three groups provided each group with its own characteristics, which in general serve to distinguish one from others. Morphological and anthropological findings indicate not only does each racial group have its own standards but within the same race, each subgroup has its own standards. It is assumed unreasonable to apply the standards of one racial group to another.[10]

Because of racial characteristics specific proportional standards are required for various ethnic groups. In order to provide relevant information to improve facial aesthesis of a specific ethnic group comprehensive up to date data of soft tissue measurements are needed which are useful for orthodontists, plastic, reconstructive and maxillofacial surgeons for their treatment planning.

Facial analysis on different ethnic groups including those of Farkas on North American Caucasian and Singapore Chinese,[11] T. Le's on Vietnamese and Thais,[11] Porter and Oslon's on African American[12] have indicated that proportional standards of one racial group cannot be regarded or accepted as normal for another racial group. The anthropometric facial analyses of Rakhain population of Bangladesh were done by Iqbal M[13] to obtain a standard of soft tissue measurements of Rakhain population of Bangladesh. Meanwhile, up to present, no studies have been conducted related to the facial proportions of Bangladeshi young adults using neoclassical facial canons with an aim of clinical application of the findings.

The neoclassical canons of facial proportions were developed in Europe based on the expected features of aesthetically beautiful face. These canons were developed for Caucasoid population concentrating on beauty. Different population groups vary genetically, geographically in their craniofacial features. So, a single standard of anthropometric variables is not appropriate for all racial and ethnic groups.[14] A standard set arbitrarily for Caucasoid people is unlikely to be suitable for the Bangladeshi people.

There is no anthropometric data related to facial proportion of Bangladeshi young adult male available in the literature.

The present study, therefore, is expected to make a contribution in setting a standard of normative craniofacial anthropometric values related to six neoclassical facial canons of the adult Bangladeshi males. The results are compared to the Rakhain male of Bangladesh. It would also test the validity of six neoclassical canons of facial proportions on the population likely to be useful in the fields of Orthodontics, Plastic and Reconstructive surgery, genetic counseling for diagnosis and treatment planning.

Materials and Methods

A total number of 100 male participants of 18 – 30 years age group were selected among Bangladeshi students and doctors of Dhaka Dental College and Hospital with acceptable occlusion, no history of craniofacial trauma and surgery and no history of orthodontic treatment. Standard anthropometric methods were used for taking the measurements.

The materials and tools for examination includes digital sliding caliper, spreading caliper, written consent form, data collection sheet, black eye pencil.

All of the measurements were taken according to the method described by Koler and Salter (1997, pp 70-203).[3]

The participant was asked to sit relaxed on a chair. Soft tissue and bony landmarks are located through inspection and palpation and marked on the skin with a black eye pencil.

Nine linear projective measurements were taken from each subject.

Three section facial profiles were measured from trichion to nasion, nasion to subnasale and to gnathion. Nasoaural proportion was measured from nasion to subnasale and superaurale to subaurale. For orbitonasal proportion intercanthal distance and the distance between nasal ala to ala was measured. For orbital proportion, intercanthal distance and left eye fissure distance was measured. For naso-oral proportion, chelion to chelion distance was measured. For naso-facial proportion, zygion to zygion distance was measured.

All the measurements were taken with digital sliding caliper except zygion to zygion measurement which was measured with spreading caliper. All the measurements were taken twice to avoid measurement errors and were recorded in the data collection sheet. The final value that was used in the study was the average of the two obtained values. A facial canon was considered valid if the difference between the stated proportion and actual measurement was not more than 1mm.

Anthropometric landmarks used in this study were as follows

Trichion (tr): Mid point of the hair line.

Nasion (n): Mid point of frontonasal suture.

Subnasale (sn): Junction between lower border of nasal septum and the Cutaneous portion of the upper lip in the midline.

Gnathion (gn): Lowest point of lower border of the chin in the midline.

Endocanthion (en): Inner corner of the eye fissure where eyelids meet.

Exocanthion (ex): Outer corner of the eye fissure where

eyelids meet.
Cheilion (ch): Outer corner of the mouth where the outer edges of the upper and lower vermilions meet.
Zygion (zy): Most lateral point of the zygomatic arch.
Superaurale (sa): Highest point of the free margin of the ear.
Subaurale (sba): Lowest point of the earlobe.

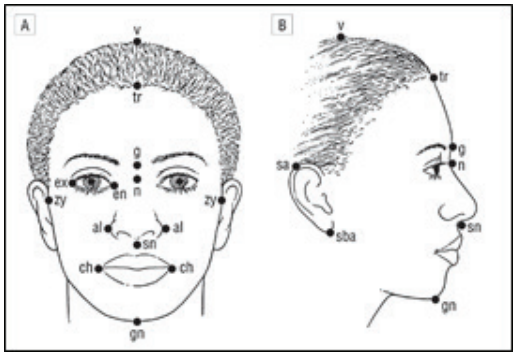
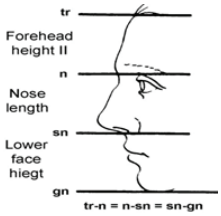


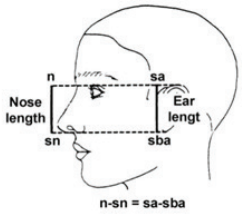
Figure 1 Anthropometric landmarks of head and face used in this study
(A) Frontal (B) Lateral views of head and face
(Source-Porter and Olson, 2001, P-2)[12]

Table 1 Formulae for neoclassical facial proportion canons used in this study

Canon	Description	Measurement
Three -section facial profile	The combined forehead -face height is divided into three equal parts.	tr-n = n-sn = sn -gn
Nasoaural proportion	The height of the nose equals the ear.	n-sn=sa -sba
Orbito-nasal proportion	The intercanthal distance equals the width of the soft nose.	en-en=al -al
Orbital proportion	The intercanthal distance equals the length of the right or left eye fissure.	en-en=en -ex
Naso -oral proportion	The width of the mouth equals 1.5 times the width of the soft nose.	ch-ch=(al-al) X1.5
Naso -facial proportion	The width of the soft nose equals one –quarter the width of the face.	al-al=(zy-zy)X0.25

Table 1 Formulae for neoclassical facial proportion canons (tr: Trichion, n: Nasion, sn: Subnasale, gn: Gnathion, sa: Subaurale,
sba: Superaurale, en: Endocanthion, al: Alare, ex: Exocanthion, ch: Chelion, zy: Zygion)





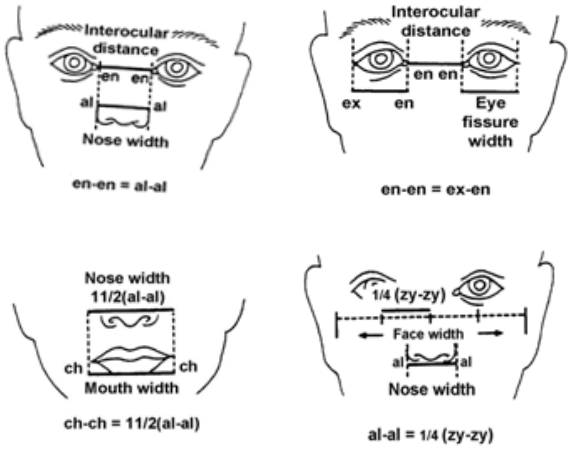


Figure 2 Six neoclassical facial proportion canon used in this study
(A) Three section facial profile canon (B) Nasoaural canon
(C) Orbitonasal canon (D) Orbital canon (E) Naso-oral canon
(F) Naso-facial canon.
(Source-Farkas and Munro, 1987, P-58-61)[7]

Results

This cross-sectional observational study was conducted among 100 male participants aged between 18-30 years. A simplified data collection sheet was used to collect the data.
The data were analyzed through SPSS software. The level of P value < 0.005 was considered significant.

Table: 2 Values of the variables related to two vertical neoclassical canons of facial proportions of Bangladeshi adult male.

canon	variable s related to particular canon	Values (mm) Range	Mean±SD	Significance of difference
Three -section facial profile	Forehead height (tr-n)	56.37 -81.07	69.24±5.9	p=0.001*
	Nose length (n-sn)	42.16 -56.50	50.06±2.2	
	Forehead height (tr-n)	56.37 -81.07	69.24±5.9	p=0.001*
	Lower face height (sn-gn)	52.26 -77.00	65.60±5.4	
Naso -aural proportion	Nose length (n-sn)	42.16 -56.50	50.06±2.2	p=0.001*
	Lower face height (sn-gn)	52.26 -77.00	65.60±5.4	
	Nose length (n-sn)	42.16 -56.50	50.06±2.2	p=0.001*
	Ear length(left) (Sa -sba)	50.00 -75.48	60.45±4.4	

(tr=trichion, n= nasion, gn=gnathion, sn=subnasale, sa= superaurale, sba=Subaurale) *From paired t test. P≤0.05 was considered as significant.

Table 3: Values of the variables related to four horizontal neoclassical Canons of facial proportions in Bangladeshi adult male

Intercanthal distance(en-en)	27.95-38.49	32.48±2.1	p=0.001*	
canon	variables related to particular canon		Values (mm)	Significance of difference
Orbitonasal proportion	Nose width (al-al)	33.24-43.88	36.74±4.2	
	Intercanthal distance(en-en)	27.95-38.49	32.48±2.1	p=0.010*
Orbital proportion	Left eye fissure length (ex-en)	28.25-37.17	32.74±2.0	
	Mouth width (ch-ch)	40.28-60.25	49.56±4.1	p=0.001*
Naso-oral proportion	Nose width x1.5 (al-al)	60.33-65.82	45.11±4.2	
	Nose width (al-al)	33.24-43.88	36.74±4.2	p=0.001*
Naso-facial proportion	Face width (zy zy) x.25	27.57-40.00	33.27±4.3	

en: endocanthion, al: alare, ex: exocanthion, ch: chelion, zy: zygion

*From paired t test.

P≤ 0.05 was considered as significant.

Table 4: Frequencies of validity and types of variations of two vertical neo classical canons of facial proportion of Bangladeshi adult male

		Frequency(male)
Valid canon	Variation	N-100
Three-section facial profile		
tr-n=n-gn=sn-gn	------	0%
	tr-n=sn-gn	19%
	tr-n>sn-gn	70%
	tr-n<sn-gn	11%
	tr-n=n-sn	0%
	tr-n>n-sn	100%
	tr-n<n-sn	0%
	n-sn=sn-gn	0%
	n-sn>sn-gn	0%
	n-sn<sn-gn	100%
Naso-aural proportion		
n-sn=sa-sba	-------	0%
	n-sn>sa-sba	10%
	n-sn<sa-sba	90%

tr: trichion; n: nasion; sn: subnasale; sa: superaurale sba: subaurale gn: gnathion

Table 5: Frequencies of validity and types of variations of two vertical neo classical canons of facial proportion of Bangladeshi adult male

		Frequency(male)
Valid canon	Variation	N-100
Orbito-nasal proportion		
en-en=al-al	---------	17%
	en-en>al-al	0%
	en-en<al-al	83%
Orbital proportion		
en-en=en-ex	----------	40%
	en-en>en-ex	30%
	en-en<en-ex	30%
Naso-oral proportion		
ch-ch=(al-al)X 1.5	---------	15%
	ch-ch>(al-al)x1.5	8%
	ch-ch<(al-al)x1.5	77%
Naso-facial proportion		
al-al=(zy-zy)x 0.25	----------	14%
	al-al>(zy-zy)x0.25	61%
	al-al<(zy-zy)x0.25	25%

en: endocanthion, al: alare, ex: exocanthion, ch: chelion, zy: Zygion

Table 6: Comparison of mean values of anthropometric facial measurements of Bangladeshi male and other male population group

Anthropometric Measurements	Bangladeshi male Present study	Bangladeshi Rakhain male[13]	North American White male[11]
Fore head *height* (tr-n)	*69,24*	*63.08*	*70.1*
Nose length (n-sn)	*50.06*	*49.24*	*53.0*
Lower face height (sn-gn)	65.60	60.24	71.9
Ear length (sa-sba)	60.45	62.35	62.4
Intercanthal distance (en-en)	32.48	33.19	32.9
Eye fissure width (en-ex)	32.74	30.04	31.2
Nose width (al-al)	36.74	41.16	34.7
Mouth width (ch-ch)	49.56	49.85	53.3
Face width (zy-zy)	133.11	139.15	128.5

tr: trichion; n: nasion; sn: subnasale; sa: superaurale sba: subaurale; gn: gnathion, en: endocanthion, al: alare; ex: exocanthion; ch: chelion; zy: zygion

Discussion

According to Tessier "harmony and disharmony does not lie within angles, distances, lines surfaces, or volumes. They arise from proportion.[15] Different types of orthodontic treatment can alter the facial balance and soft tissue contours of the face. Some of these procedures include dentofacial orthopedics with functional appliances, extraction or non-extraction treatment and orthognathic surgery.[16]

The sophisticated planning of orthodontic treatment demands determination of exact proportions between various areas of the head and face.

There is no previous study has reported on facial proportion of Bangladeshi young adults at Dhaka Dental College Hospital. So, the result of this study is expected to be useful in orthodontics and dentofacial orthognathic surgical reposition in the treatment of the patient with dentofacial deformities.

In the result chapter, table 1 shows the variables related to two vertical facial proportion and table 2 shows four horizontal facial proportion in Bangladeshi adult male. In three-section facial profile canon, nose length is the smallest variable. In naso-aural proportion canon, ear length is larger than nose length. In orbito-nasal proportion canon, nose width is larger than intercanthal distance. In orbital canon, mean value of intercanthal distance and eye fissure width is almost equal.

In naso-oral proportion canon, mouth width is smaller than 1.5 time's nose width.

In naso-facial proportion canon, mean value of nose width is larger than.25 time's zygomatic width.

Similar study has been conducted at the Department of Anatomy of BSMMU by Iqbal M.[13] on Bangladeshi adult Rakhain male. Table 6 compares this study with present study; we find Bangladeshi male has larger forehead height, nose length, lower face height and eye fissure width, smaller ear length, intercanthal distance and nose width and face width than that of Rakhain male. The mouth width is appearing to be similar to those of this study.

The three-section facial profile canon is not valid in any of the Rakhain male. Most frequent variation (97%) is forehead height is larger than nose length. 2% of male participants show validity of naso-aural canon. Most frequent variation (98%) is nose length is shorter than ear length. The only two canons that are found to be valid in a sizable proportion of Rakhain males (33%)is the orbital proportion canon The most frequent variation (95%) for orbito-nasal proportion canon was intercanthal width is smaller than nose width and for orbital canon; intercanthal distance is smaller than eye fissure width (62%). Mouth width is greater than 1.5 times nose width is found 99% in males. Nose width greater than.25 times face width is found 94% in males.

Table 4 and table 5 shows the validity and variation of six canons of facial proportions and show 0% validity of three section facial profile canon. The most frequent variation is forehead height is larger than nose length as similar to the findings of the Rakhain population. Most frequent variation (100%) is nose length is shorter than ear length. The three canons that are found to be valid in a sizable proportion in Bangladeshi young adults. These are orbito-nasal proportion canon (17%), orbital canon (40%), naso-oral proportion canon (15%) and naso-facial proportion canon (14%).

The most frequent variation in orbito-nasal proportion is nose width is larger than intercanthal width (83%); in orbital proportion eye fissure width is more than intercanthal distance (30%); in naso-oral proportion 1.5 nose width is larger than mouth width (77%); in naso-facial proportion nose width is larger than .25 zygomatic width (61%).

Le T, Farkas LG, Ngim RCK, Levin LS and Forrest CR[6] had taken nine projective measurements to determine morphometric differences of the face among young adult Chinese, Vietnamese and Thais and to assess the validity of six neoclassical facial canons in these populations. They also compared findings of Asian ethnic group with North American Caucasians. The most significant difference between these two groups was that the Asian group had significantly smaller mouth width, greater intercanthal width, shorter palpebral fissure, much wider noses. Neoclassical facial proportion canons were found valid in a markedly smaller percentage in Asian subjects (range -1.1 -21.7%) than in North American Caucasians (range -16.7-21.7%).

Farkas et al[11] identified the factors influencing the variations in facial morphology refer chiefly to the environmental condition, socioeconomic status and nutritional habits of the population along with racial variation and presented nine anthropometric measurements of North American Whites. It is evident from table 6 that the fore head height, intercanthal distance and eye fissure width in both sexes of the North American Whites are appearing to be quite similar to those of Bangladeshi adults. Bangladeshi males have larger nose width and face width than that of North American Whites males. Other variables are larger in North American Whites than in Bangladeshi adults.

Sahu, Paresh RnDr of Sambalpure University, Orissa, India[17] addressed some anthropometric variables of males and females of that state. The results of the female variables appear to be similar to present study except nose length and face width which is larger in Bangladeshi young females. The findings of six variables of male were almost similar to Bangladeshi males. The forehead height, nose length and lower face height are larger in Bangladeshi adult males.

Different population groups vary genetically, geographically in

their craniofacial features which in general serve to distinguish one from others or one subgroup to another even in the same race. So, a single standard of anthropometric variables is not appropriate for all racial and ethnic groups. A standard set arbitrarily for Caucasoid people or Rakhain people is unlikely to be suitable for the Bangladeshi people.

Conclusion

The result of the present study is useful in standardizing the craniofacial variables of Bangladeshi young males and females. The six neoclassical canons of facial proportions addressed in this study are unlikely to be applicable for Bangladeshi young adults. However, variations of these canons serve as criteria for measurement of craniofacial variables of Bangladeshi young adults. Standard deviation from the canons based on actual measurements of the same parts of the face can be compared among ethnic groups and may have clinical implications in the diagnosis and treatment planning of orthodontics, orthognathic surgery and maxillofacial surgery, plastic, reconstructive and cosmetic surgery of Bangladeshi young patients.

There are differences between some anthropometric measurements of Bangladeshi adults and Rakhain adults due to intra-ethnic variability. So, it is essential to develop detailed craniofacial standards for different populations and subpopulations even in different community, to look for inter-community and intra-community similarities and dissimilarities. It is unreasonable to apply a single standard of facial esthetics to all racial and ethnic groups or one subgroup to another in the same race.

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