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Vertical Proportion of Face in Bangladeshi Young Adult

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ABSTRACT

Introduction: Anthropometry is applied to obtain measurements of living subjects for identifying age, stature and various dimensions related to particular race or an individual. Balance in physical proportions is one the most important criteria for ideal esthetics. There are various facial heights like upper facial height (UFH), middle facial height (MFH) and lower facial height (LFH). Facial features including proportionate facial height play a vital role in esthetics.

Objectives: To evaluate the correlation among the various facial heights (UFH, MFH and LFH), the validity of vertical balance of face (upper facial height, middle facial height and lower facial height are equal) and variations in Bangladeshi adults.

Materials and methods: The study was a descriptive observational cross sectional study with 500 participants by convenient sampling aged 18-25 years of equal sex distribution. Each participant was made to sit on a wooden chair. The anthropometric landmarks, trichion (tri), glabella (g), subnasale (sn) and gnathion (gn), were marked on the participant's face with a dermographic pen. With the help of a digital vernier sliding calipers, the measurements were taken in millimeters and the participant was in centric relation when measuring the facial height. Chi square test was done for gender significance. Paired "T" and Pearson's correlation coefficient test were used for individual for combination of TFH to UFH, MFH and LFH to find out correlation among them. The criteria for statistical significance were set at $p< 0.05$ and CI 95%.

Results: In males TFH, LFH, MFH & UFH were 193.2 ± 9.5 mm, 69.6 ± 3.5 mm, 66.8 ± 3.0 mm, 61.6 ± 6.2 mm whereas in females 180.1 ± 7.9 mm, 62.7 ± 3.0 mm, 61.7 ± 2.4 mm, 55.8 ± 5.2 mm respectively. Chi square test denoted statistical significance revealing a "p" value of 0.0001 for gender significance. Paired "T" was used for individual intervals for combination of TFH to UFH, MFH & LFH and statistical significance was observed in combination of TFH to LFH,MFH &UFH with a "p" value of 0.0001 & 95 % CI. Moderate to strong statistical significant correlation was found TFH, LFH, MFH & UFH except in UFH for both males in Pearson's correlation coefficient test.

Conclusions: Our study doesn't match the facial proportions based on artistic norms, which is being practiced in clinical orthodontics till today. Lower facial height is usually a little greater than middle facial height which is in turn greater than upper facial height

Key words : **Facial Height, Lower Facial Height, Middle Facial Height, Upper Facial Height**

INTRODUCTION

Perceptions of attractiveness are universal or cross-cultural and inherited.[1] Anthropologist Symons defined beauty as "averageness", the average values of the features of face in a human population. A well balanced physical proportion is one of the most important criteria for ideal esthetics. Facial features including proportionate facial height play a vital role in esthetics.

Guidelines for the 'ideal' in facial attractiveness have been presented in a number of ways, namely: artistic, cephalometric and anthropometric. Prior to the advent of cephalometric radiography, dentists and orthodontists often used anthropometric measurements (i.e. measurements made directly on living subject during a clinical examination) to assist in establishing facial proportions.[2] Facial

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anthropometric studies have got vast implications in health-related fields and are useful for orthodontists, plastic surgeons, maxillofacial surgeons for their treatment plans, as well as for physical anthropologists and forensic facial reconstruction experts.[3]

Facial anthropometry[7] describes two types of face height, namely: Physiognomic facial height (trichion – gnathion) and Morphological face height (nasion – gnathion). Physiognomic face is divided into three parts, such as upper face (trichion – glabella), middle face (glabella – subnasale) lower face (subnasale – gnathion). Morphological face is divided into upper face (nasion – subnasale) and lower face (subnasale – gnathion).

Renaissance artists used classical Greek cannons, to establish simplistic rules defining the relationship among various parts of face. Vertical balance was believed to exist when upper face, middle face and lower face are approximately equal.[8] This trisection, the Virtuvious trisection had been cross-examined by Greek, Roman & Renaissance artists (e.g. Da Vinchi , Durer, Francesca and Pacioli, Cennini and others) and they contributed to an overall scheme of proportions that subsequently became the norm (based on the average) for use by artists, and subsequently (perhaps unknowingly) by surgeons and orthodontists[1]. But this vertical proportion has recently been brought into challenge after extensive work of Farkas during 1967-1984 on North Americans Caucasians. The Vitruvian trisection is perhaps not absolutely correct, as the upper, mid and lower face height is not found mathematically equal in Farkas study.[1]

The available anthropometric values related to this study are limited to Caucasians and there is a little data available for Asians. Moreover, there is no available standard data regarding facial height proportions in our country. So it is essential to address the scientific data to establish the various facial heights proportions among the Bangladeshi adult population. Reliable and comparable data is needed to evaluate the facial height proportions for orthodontics, dentofacial orthopedic, orthognatic surgery and reconstructive maxillofacial surgery.

The aim of the study is to evaluate the correlation among the various facial heights (UFH, MFH and LFH), the validity of vertical balance of face (upper facial height, middle facial height and lower facial height are equal) and variations in Bangladeshi adults.

MATERIALS AND METHODS

This study was a descriptive observational cross sectional study by convenient sampling, conducted among the 500 participants of Bangladeshi by birth with equal sex distribution aged 18-25 years. The source of the materials was the students of Dhaka Dental College, BSc Nursing and Para-medical students of Armed Forces Medical Institute, troops of Bangladesh Army and Airmen of Bangladesh Air Force at Dhaka Cantonment. Exclusion criteria was any cranio-facial abnormalities, growth-related disorders, genetic abnormalities, prolonged diseases such as congenital heart diseases, endocrine, renal and intestinal disorders, history of facial trauma, those belonging to intermingling communities (i.e. whose parents and grandparents had inter-caste marriages), history of previous orthodontic and craniofacial surgical treatment, gummy smile, deep bite, open bite and subjects with visible abnormality.

The landmarks of the study were defined as follows:

Trichion. It is the mid point of the hair line lies on sagittal plane.

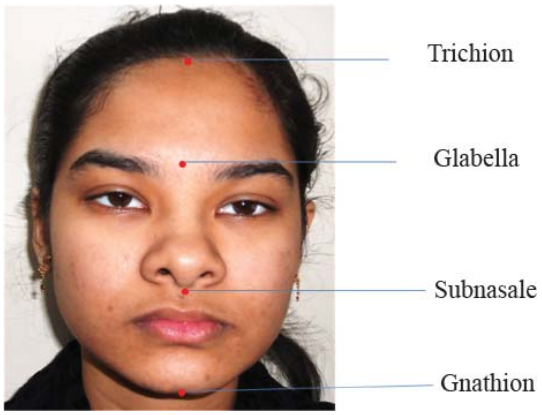
Glabella. The prominent point in the median sagittal plane between supraorbital ridge.

Subnasale. It is the junction between the lower border of the nasal septum, the partition which divides nostrils, and the cutaneous portion of the upper lip on the mid line.

Gnathion. The lowest point in the mid line on the lower border of the chin.

Each participant was made to sit on a wooden chair. The anthropometric landmarks the trichion(tri), glabella (g), subnasale (sn) and gnathion (gn), were marked on the participant's face with a dermographic pen. With the help of a digital vernier sliding calipers, the measurements were taken in millimetres and the participant was in centric relation when measuring the facial height. The measurements were recorded to the nearest 0.1 cm. A repeat measurement was taken for each participant. If the two measurements disagree by more than 0.1 cm, then a third measurement was taken. The participant's measured height was subsequently calculated as the mean of the two observations or the mean of the two closest measurements if a third was taken. When necessary to round the mean value to the nearest 0.1 cm, rounding was to the nearest even digit. Chi square test was done for gender significance. Paired "T" and Pearson's correlation coefficient test were used for individual for combination of TFH to UFH, MFH and LFH to find out correlation among them. The criteria for statistical significance were set at $p< 0.05$ and CI 95%.

Fig. 1 Anthropometric land marks on face



*UFH=Trichion to Glabella, MFH=Glabella to Subnasale, LFH=Subnasale to Gnathion.

Fig. 2
LFH =Sunasale to Gnathion

Fig.3
MFH= Glabella to Subnasale

Fig.4
UFH=Trichion to Glabella

RESULTS

Table 1. Distribution of various facials heights among male and female subjects

Subject	LFH(mm) (Mean±SD)	MFH(mm) (Mean±SD)	UFH(mm) (Mean±SD)	TFH(mm) (Mean±SD)
Male (n=250)	69.6±3.5	66.8±3.0	61.6±6.2	193.2±9.5
Female (n=250)	62.7±3.0	61.7±2.4	55.8±5.2	180.1±7.9

*LFH-Lower facial height, MFH-Middle facial height, UFH-Upper facial height, TFH-Total facial height

Table-1shows all the facial height parameters are more in male than that of female.

Table 2. Distribution of TFH compare with LFH, MFH and UFH by gender

Sex	TFH	(95%CI)	P-value
Male	198.2±9.5	197.0-199.4	0.0001*
Female	180.1±7.9	179.1-181.8	0.0001*
	LFH		
Male	69.6±3.5	69.1-70.0	0.0001*
Female	62.3±3.0	62.3-63.1	0.0001*
	MFH		
Male	66.8±3.0	66.4-67.2	0.0001*
Female	61.7±2.4	61.4-62.1	0.0001*
	UFH		
Male	61.6±6.1	60.9-62.4	0.0001*
Female	55.8±5.1	55.1-56.4	0.0001*

*using paired t-test

In the table 2, Paired "T" was used for individual intervals for combination of TFH to UFH, MFH and LFH and statistical significance was observed in combination of TFH to LFH, MFH &UFH with a "p" value of 0.0001 & 95 %.

Table 3. Pearson's correlation coefficient test

For Total	LFH	MFH	UFH	TFH
LFH	1.0000			
MFH	0.8494*	1.0000		
UFH	0.4204*	0.4601*	1.0000	
TFH	0.8539*	0.8559*	0.7973*	1.0000
For Male				
LFH	1.0000			
MFH	0.7424*	1.0000		
UFH	0.1548	0.2417*	1.0000	
TFH	0.7028*	0.7392*	0.7725*	1.0000
For female				
LFH	1.0000			
MFH	0.6626*	1.0000		
UFH	0.1313	0.2098*	1.0000	
TFH	0.6880*	0.6981*	0.7337*	1.0000

*p<0.05

Table 3 shows correlation with moderate to strong statistical significance among TFH, LFH, MFH and UFH

Table 4. Comparison of UFH, MFH and LFH among themselves by sex

	Male (n=250)		Female (n=250)	
	n	%	n	%
MFH Vs UFH				
MFH>UFH	190	75.7	210	83.7
MFH=UFH	44	17.5	32	12.7
MFH<UFH	16	6.8	8	3.6
MFH Vs LFH				
MFH>LFH	5	2.0	28	11.1
MFH=LFH	39	15.5	85	33.9
MFH<LFH	206	82.5	137	55.0
UFH Vs LFH				
UFH>LFH	9	3.6	9	3.6
UFH=LFH	9	3.6	8	7.2
UFH<LFH	232	92.8	223	89.2

Table 4 shows In the majority of samples LFH is usually greater than MFH which in turn greater than of UFH in both sexes.

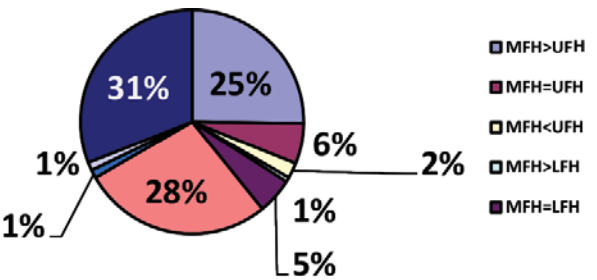


Fig:5 Distribution of comparison of UFH, MFH and LFH among themselves by male

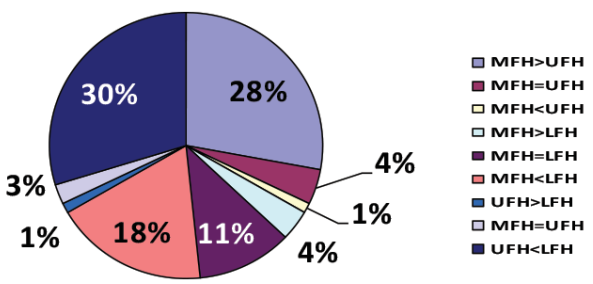


Fig.6 Distribution of comparison of UFH, MFH and LFH among themselves by female

In the fig. 5 and fig. 6 in majority of the samples LFH, MFH and UFH were rarely equal. LFH were usually greater than MFH and MFH were often greater than UFH.

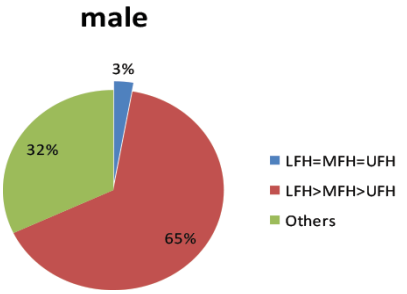


Fig 7 Comparisons of LFH, MFH and UFH in males

Only 3% cases of female samples show LFH=MFH=UFH. In majority of samples showed

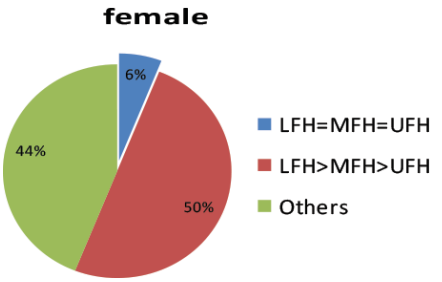


Fig .8 Comparisons of LFH, MFH and UFH in females

Only 6% cases of male samples showed LFH=MFH=UFH. Majority of samples showed LFH>MFH>UFH.

Table 5: Comparisons of LFH, MFH and UFH among females of Bangladesh, China & North American White[15]

	Bangladesh	China	North American White
MFH Vs UFH			
MFH>UFH	83.7	75.0	7.5
MFH=UFH	12.7	7.0	0.0
MFH<UFH	3.6	18.0	92.5
MFH Vs LFH			
MFH>LFH	11.1	46.0	32.0
MFH=LFH	33.9	14.0	0
MFH<LFH	55.0	40.0	68.0
UFH Vs LFH			
UFH>LFH	3.6	24.0	0
UFH=LFH	7.2	6.0	0
UFH<LFH	89.2	70.0	100

Middle third of the Chinese and Bangladeshi faces were taller than upper third, on average, while in the white opposite is true. The lower third of the white as well as Bangladeshi face were usually more prominent than middle third, whereas the Chinese faces were almost equally distributed between those with one or other being more prominent. In the Chinese faces the upper third was less prominent than lower third, which was same as white and Bangladeshi faces.

Table 6: Distribution of facial height proportion by sex

Sex	LFH	MFH	UFH
Male	35.1	33.7	31.1
Female	34.8	34.3	30.9
Total	34.9	34.0	31.0

*LFH proportion (LFH %) = LFHx100/TFH

*MFH proportion (MFH %) = MFHx100/TFH

*UFH proportion (UFH %) = UFHx100/TFH

Lower facial height is little greater than his or her mid-face height, which in turn greater than individual's upper face height.

Table 7: Comparison of various facial heights among Bangladeshi, Southern Chinese and North American white in female[15]

	BD	S. China	NAW
LFH	34.8	34.3	35.0
MFH	34.3	34.3	35.0
UFH	30.9	30.9	31.4

*BD-Bangladesh, S. China- Southern China, NAW- North American white

The relative proportions of horizontal thirds in Chinese, Caucasian's white and Bangladeshi women were not equal. The upper facial height was less prominent than middle and lower thirds, which were about equal in height in Chinese and Caucasian's white but lower facial height was greater than middle facial height in Bangladeshi women.

Table 8: Comparison of anthropometric values of total facial height and lower facial height among various nations & ethnic races[19]

Nationality	Male		Female	
	TFH(mm)-tri to gn (Mean)	LFH(mm)-sn-gn (Mean)	TFH(mm)-tri to gn (Mean)	LFH(mm)-sn-gn (Mean)
Bangladeshi	198.2	69.6	180.1	62.7
Gujarati	183.5	63.5	179.7	56.7
Japanese	191.4	69.4	182.8	62.8
Vietnamese	180.9	71.1	171.1	64.0
Thai	185.1	72.4	172.8	62.6
Chinese	187.3	72.8	176.2	66.4
North American white	187.5	71.9	172.5	65.5
Azerbaijan	185.1	69.0	175.4	63.6
Bulgarian	184.3	69.5	170.5	61.6
Czech	181.7	70.7	182.9	66.0
Croatian	180.1	66.0	172.6	60.7
Garman	182.2	67.9	170.9	63.3
Greek	178.7	65.8	173.8	63.3
Hungarian	181.3	64.2	169.4	56.7
Italian	186.0	71.4	171.4	64.4
Polish	181.9	68.1	172.1	60.5
Portuguese	190.7	69.6	177.4	62.8
Russian	184.4	64.5	174.4	61.4
Iranian	180.3	73.3	175.9	66.2
Turkish	186.5	65.9	179.2	59.1
Egyptian	176.9	64.1	161.4	57.8
Angolan	182.6	67.3	172.4	63.2
Afro-American	194.6	78.9	180.1	71.5
Zulu	188.6	72.2	179.1	65.4

DISCUSSION

This study was a descriptive observational cross sectional study conducted among the 500 participants at Dhaka city with equal sex distribution by convenient sampling, aged 18-25 years. The aim of the study is to evaluate the correlation among the various facial heights (UFH, MFH and LFH), the validity of vertical balance of face (upper facial height, middle facial height and lower facial height are equal) and variations in Bangladeshi adults and to find out gender significance & to compare with the similar studies.

A single standard facial aesthetics is not appropriate for all racial and ethnic groups and a normative data of facial measurements are essential for precise determination of the degree of variation from the normal.[12-20] Morphometric study for the craniofacial relations and variations in humans have long been used to differentiate in various racial groups in physical anthropology.[13] Moreover morphological characteristics are important factors to be considered in the diagnosis and treatment planning in orthodontics & dentofacial orthopaedics.[14] Whenever we examine a patient for orthodontic treatment, our prime concern would be only on the face.

Pearson's correlation coefficient test was done to find out the correlation among the variables. Moderate to strong statistical significant linear correlation was found among TFH, LFH, MFH and UFH. Paired "T" was used for individual intervals for combination of TFH to UFH, MFH and LFH. Statistical significance was observed TFH versus UFH, MFH and LFH in both sexes with p value 0.0001 and CI 95%.(Tables-3). On the other hand, in a similar study at Gujarat, India, Kulkarni N et al did not find significant correlation to TFH to UFH, MFH and LFH. The reason may be that we addressed very strictly the factors affecting the facial height while taking the measurements.[11]

Males were observed to have more TFH, UFH, MFH and LFH (table-1) than female. Perhaps it is due to genetic reason. As the value of UFH is unreasonably variable, it is not a reliable indicator to find out the correlation. The probable cause for this may be wide variations in hair line. These findings corroborate with the findings of Kulkarni N et al.[11]

Vertical facial proportions was first addressed by Virtuvious (25 BC)[1] where he showed that vertical facial thirds(UFH, MFH and LFH) were equal. Later on Renaissance artist Durer and Leonardo independently invented the three part facial canon similar to that of the Virtuvious tri-section, the difference was only in the landmark (nasion instead of glabella) separating the forehead and nose.[10,16] But in the various extensive studies done by Farkas et al.[1] heights of vertical facial thirds were rarely found equal in Caucasian's whites. Farkas et al[16] showed that the Vitruvious trisection was not absolutely correct, at least in the male whose lower face height was a little greater than his mid-face height, which in turn was greater than his upper face height in Caucasians. In our present study only 3% males & 6% females showed LFH=MFH=UFH and LFH› MFH›UFH 65% & 50% respectively (Fig. 7 & 8). Samples showed that LFH>MFH was 82.5% & 55%; MFH>UFH was 75.7% & 83.7% and LFH>UFH was 92.8% & 89.2% males & females respectively (Table-4 & Fig 5 and 6). We found facial height proportions 35.1%, 33.7% & 31.1% for LFH, MFH & UFH respectively for males and 34.8%, 34.3% & 30.9% for LFH, MFH & UFH respectively for females (Table-6). Our findings match to the findings of Farkas et al.[1,16]

A comparative study was made in females with the findings of present study & Sim et al[15] among Bangladeshi, Southern Chinese and the Caucasians of North American White. Middle third of the Chinese and Bangladeshi faces were taller than upper third, on average, while in the white opposite is true. The lower third of the white as well as Bangladeshi face were usually more prominent than middle third, whereas the Chinese faces were almost equally distributed between those with one or other being more prominent. In the Chinese faces the upper third was less prominent than lower third, which was the same as white and Bangladeshi faces (Table-.7).These dissimilarities may caused by ethnic, racial and genetic variations.

Comparison of facial height proportions among Bangladeshi, Southern Chinese and the Caucasians of North American White: Vertical facial proportions in the frontal & lateral view are best evaluated in the context of facial thirds, which the Renaissance artists noted were equal in height in well proportionate faces.[17] A comparative study of various facial heights among Bangladeshi, Southern Chinese and North American white in female[15] was done (Table-5). The relative proportions of horizontal thirds in the Chinese women were upper third in 31.4%, the middle third in 34.3%, and the lower third in 34.3% which were 31.9%, 35% & 35% respectively for Caucasians white women[15,18] The relative proportions of facial height in Bangladeshi women were 30.9%, 34.3% and 34.8%, for UFH, MFH & LFH respectively. These variations in the relative proportions were likely caused by ethnic & racial variations.

A comparative study[19] of total facial height (tri-gn) & lower facial height (sn-gn) was made (Table 8) among five Asian nations (Gujarati, Japanese, Vietnamese, Thai & Chinese), twelve nations of Caucasians (North American white, Azerbaijan, Bulgarian, Czech, Croatian, Garman, Portu-

guese, Russian, Greek, Hungarian, Italian & Polish), three Middle East nations (Iranian, Turkish & Egyptian) and three African ethnic groups(Angolans, Zulus & Afro-Americans) with our study. The values were identical to our study, as all values were within 02 (two) SDs except the lower facial height of Hungarian, Egyptian and Gujarati females which were significantly smaller than our study. The facial heights of Egyptian females were also significantly smaller than our study. These dissimilarities may be due to genetic, ethnic & racial diversifications.

CONCLUSION

Our study doesn't match the facial proportions based on artistic norms, which is being practiced in clinical orthodontics till today. Lower facial height is usually a little greater than middle facial height which is greater than upper facial height. So the virtuvias trisection is not valid in Bangladeshi population. The findings of this study may aid to establish Bangladeshi norms that will be useful in orthodontic diagnosis, treatment plan and to evaluate the treatment outcome.

REFERENCES

1. Edler R.J. Background consideratons to facial aesthetics. Journal of Orthodontics 2001; 28(2): 159-68.
2. Profit WR, Fields HW. Contemporary Orthodontics. 4th ed. St. Louis: Mosby; 2007: 177.
3. Baral P, Lobo S W, Menezes R G, Kanchan T, Krishan K, Bhattacharya S, Hiremath S S.An anthropometric study of facial height among four endogamous communities in the Sunsari district of Nepal. Singapore Med J 2010; 51(3): 211-15.
4. Shrestha O, Bhattacharya S, Jha N , Dhungel S, Jha, Shrestha S and Shrestha U. Cranio facial anthropometric measurments among Rai and Limbu community of Sunsari District, Nepal. Nepal Med Coll J 2009; 11(3): 183-185
5. Frowde H.M.A. The concise Oxford dictionary of current English. 3rd ed. Oxford Clarendon Press; 1912 : 382.
6. Ese Anibor, Dennis E. O. Eboh and Mabel O. Etetafia. A study of craniofacial parameters and total body height. Adv. Appl. Sci. Res 2011; 2(6):400-405
7. Kolar J.C., Salter E.M. Craniofacial anthropometry. Charles C Thomas. Publisher, ltd. Springfield, Illinois, USA; 1997: 102-04.
8. Farkas L.G., Munro I.R. Anthropometric Facial Proportions in Medicine. Charles C Thomas, Springfield, Illinois, USA; 1997: 87-8.
9. Matoula S, Pancherz H. Skeletofacial morphology of attractive and nonattractive faces. Angle Orthod 2006; 76(2): 204-10.
10. Farkas L.G., Munro I.R. Anthropometric Facial Proportions in Medicine. Charles C Thomas, Springfield, Illinois, USA; 1997: 3-12.
11. Kulkarni. N and Kohli. M Estimation and correlation of individual facial height and total body height. J. Int Oral Health 2011; 3(2): 38-42
12. Richardson ER. Racial differences in dimensional traits of the human face. Angle Orthod 1980;50:301-9.
13. Rizvi. H. M, Hossian M. Z, Tanee .K. Ethnical evaluation of Bangladeshi young adults in terms of morphologically-analyzed craniofacial skeleton. APOS Trends in Orthodontics.2013; 3:15-22.
14. De Freitas LM, Pinzan A, Janson G, et al. Facial height comparison in young white and black Brazilian subjects with normal occlusion. Am J Orthod Dentofacial Orthop 2007; 131: 706.
15. Sim RST, Smith JD, Chan ASY. Comparison of the aesthetic facial proportions of the Southern Chinese and white women. Arch Facial Plast Surg. 2000;2(2):113-20.
16. Farkas LG, Hreczko TA, Kolar JC, Mounro IR. Vertical and horizontal proportions of the face in the young adult of North American Caucasians: Plast and Reconstr Surg. 1995;75(3):328-38.
17. Profit WR, Fields HW. Contemporary Orthodontics. 4th ed. St. Louis: Mosby; 2007: 179-80.
18. Koury ME, Epker BN. Maxillofacial aesthetics: anthropometrics of the maxillofacial region. Journal of Oral and Maxillofacial Surgery.1992 ;50:806-20.
19. Farkas LG, Katic MJ, Forrest CR. International anthropometric study of facial morphology in various ethnic groups/races. J craniofac Surg.2005; 16(4):615- 46.
20. Miyajima K, McNamara J.A, Kimura T, Murata S, Iazuka T. Craniofacial structure of Japanese and European-American adult with normal occlusions and well balanced faces. Am J of Orthod Dentofacial Orthop1996;110:431-8.

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