Cephalometric Study of the Dentofacial Complex of Bangladeshis according to Downs Analysis

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Abstract:

Introduction: The purpose of this study is to formulate cephalometric norms of the Bangladeshi population using Downs Analysis; and to evaluate whether significant cephalometric differences exist between Bangladeshi and Caucasian people.

Methods: The study was conducted for 91 Bangladeshi young adults (48 males and 43 females), aged 19–27 years, with esthetically pleasing and harmonious faces, Angle I molar relationship, with all permanent teeth present and no history of orthodontic treatment orofacial trauma. Lateral cephalograms taken of these subjects were used for a series of morphometric analysis.

Results: There was a significant difference between the genders on some values. Bangladeshi Female showed significantly larger facial angle more protrusive chin and angle of convexity which is more protrusive maxillary part than that of Males. While Bangladeshi male showed significantly greater Y-axis angle that means downward forward growth pattern, and steeper Cant of occlusal plane than that of females.

Statistically, several significant differences were noticeable in the results of the present study when compared with the norms suggested for a white Caucasian population by Downs. Bangladeshi's exhibit significantly smaller facial angle more retrusive mandible, significantly greater Y-axis angle more downward forward growth pattern and also significantly more protrusive anterior teeth than that of the Caucasian population.

Conclusion: These results have clinical implications in the diagnosis and treatment of adult Bangladeshis with dentofacial deformities.

Key Words: Cephalometric norms, Downs Analysis, Caucasian population, Bangladeshi young adults.

Introduction:

The use of cephalometric radiography in the study of growth, de-velopment of the face and in the clinical practice of orthodontics is well established. Clini-cally it is of value in growth prediction, diagnosis, treatment planning and prog-nosis.[1] Downs' analysis was not presented as the basis for a treatment goal rather it is a method for examining and quantifying the relationships of the skeletal components of the face. i.e. maxilla and mandible and its dentition, essentially the incisors. [2,3]

After the introduction of Downs' analysis several orthodontists investigated whether his mean skeleto-facial measurements of American Whites were applicable to other ethnic groups. Cotton, Takano and Wong[4] applied Downs' analysis respectively to American Negros, American Japanese, and American Chinese individuals. All came to the identical conclusion that the Downs mean values were not applicable to their respective groups.

Altemus[5] reported in his study on Negroes that the skeletal pattern of Negroes was almost identical, and the dental pattern was significantly protrusive when compared with standards of the Caucasian race given by Downs.

Kotak[6] applied Downs' analysis on Indian Gujrati girls and his readings showed that the mandible was more distally placed and the anterior teeth were in a protrusive relation when compared to Downs norms.

These conclusions stimulated the start of the present investigation. Therefore, the present study was concerned with an ethnic group for which little cephalometric information is available or the information available is error prone, the Bangladeshis. The purpose of this study was to formulate cephalometric norms for the Bangladeshis and compare these data with the norms established by Downs.[7]

Materials and Methods:

The material for this study consisted of standardized lateral head cephalograms of 91 Bangladeshi young

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adults (48 males and 43 females). The study was conducted in Shaheed Suhrawardy medical college dental unit department of Orthodontics and Dentofacial Orthopedics. The subjects were in the age range of 19–27 years. The following criteria were used for selection of subjects; healthy individual with normal growth and development, excellent facial harmony, full complement of fully erupted teeth (excluding third molars) in good occlusion, class I molar and canine relationship, acceptable overjet and overbite, no crowding, no rotations, no cross bite and a negative history of orthodontic treatment. A lateral head cephalogram was taken for each individual in a standard position with the teeth in centric position and with lips relaxed. These were taken on a Broadbent Bolton cephalometer (Siemens, Erlanger, Germany). All the landmarks, planes and angles used in the present study were according to the descriptions and definitions given by Downs.

To determine the error involved during the tracing of cephalograms, picking the landmarks, and taking the measurements, twenty-five cephalometric x-rays were retraced one month after the originals were done. The standard error calculated was found to be statistically insignificant.

Written informed consent was obtained from each subject before taking X ray. Ethical clearance for the study was reviewed and approved by Ethics Committee of Shaheed Suhrawardy medical college Ref: ShSMCH/Ethical/2021/02 dated:17/01/2021.

Results:
Table 1 and Tabel 2 shows the means of linear and angular measurements for Bangladeshi male and female young adults according to Downs analysis. On comparison between the male and female subjects [Tabel 3]. Bangladeshi Female showed significantly larger facial angle (with a confidence level of $P < 0.05$) which is more protrusive chin and angle of convexity which means more protrusive maxillary part than that of Males. While Bangladeshi male showed significantly greater Y-axis angle that means downward forward growth pattern, and steeper Cant of occlusal plane than that of females. no significant differences were found for all the other measurement between male and female subjects.

When Bangladeshi subjects were compared with Caucasians, most measurement items exhibited a significant difference from the means of the Caucasians excluding Angle of Convexity, A-B Plane to Facial Plane, Mandibular Plane Angle and Cant of occlusal plane that depicted no statistically significant differences between Bangladeshi and Caucasian subjects [Table 4]

Statistical analysis: - The descriptive statistics for Bangladesh sample were calculated using Microsoft Excel. P-Values were calculated using STATA

Figure 1shows Downs' analysis with the reference points identified. Figure 2 shows a clear difference in the polygonic-portrayal of Caucasian and Bangladeshi dentofacial patterns. However, the racial characteristics of Bangladeshis is more so in dental pattern. Figure 3 shows a polygon depicted by Alam Mk et al[8] for their study on Downs cephalometric norms of Bangladeshi young adults. This polygonic- portrayal appears to be quite different from that of the present study demands the study needs to be revised and explains the reason why the present study was justified.

Table-I

Skeletal and Dental Pattern of Bangladeshi Male according to Down's Analysis

Measurement(N=48)	Mean	SD	Range	
			Min	Max
Facial Angle	84.45	3.28	77.00	92.00
Angle of Convexity	0.23	5.46	-13.00	17.00
A-B Plane to Facial Plane	-3.58	3.30	-10.50	6.00
Mandibular Plane Angle	23.88	6.37	6.00	36.00
Y axis Angle	63.08	3.82	53.00	71.00
Cant of occlusal plane	11.21	4.08	3.00	19.00
Interincisal Angle	120.01	9.74	96	144.00
Mandibular Incisor to OP	23.89	7.40	9	43.5
Mandibular Incisor to MP	10.75	7.28	-2.00	31
Upper Incisor to A-Pog Plane(mm)	8.34	2.33	2	14.00

Table-II

Skeletal and Dental Pattern of Bangladeshi Female according to Down's Analysis

Measurement(N=43)	Mean	SD	Range	
			Min	Max
Facial Angle	86.99	2.69	78	90.5
Angle of Convexity	3.19	7.18	-10.50	17.00
A-B Plane to Facial Plane	-3.88	4.69	-12	6
Mandibular Plane Angle	23.28	5.24	14	36
Y axis Angle	60.70	3.49	54	69
Cant of occlusal plane	9.08	3.94	3	19
Interincisal Angle	118.19	8.49	105	134
Mandibular Incisor to OP	25.71	6.35	12	39
Mandibular Incisor to MP	10.60	6.51	-3	25
Upper Incisor to A-Pog plane(mm)	8.32	2.33	4	14

SD – Standard deviation

Table-III

Comparisons of the mean angular linear measurements between male and female Bangladeshi subjects according to Downs Analysis

Parameters	Male N=48				Female N=43				P-value
	Average	SD	95%CI		Average	SD	95%CI		
			Lower	Upper			Lower	Upper	
Facial Angle	84.45	3.28	83.50	85.40	86.99	2.69	86.16	87.82	0.001***
Angle of Convexity	0.23	5.46	-1.36	1.82	3.19	7.18	0.98	5.39	0.029*
A-B Plane to Facial Plane	-3.58	3.30	-4.54	-2.62	-3.88	4.69	-5.33	-2.44	0.723
Mandibular Plane Angle	23.88	6.37	22.03	25.72	23.28	5.24	21.67	24.89	0.627
Y axis Angle	63.08	3.82	61.97	64.19	60.70	3.49	59.62	61.77	0.003**
Cant of occlusal plane	11.21	4.08	10.02	12.39	9.08	3.94	7.87	10.30	0.013*
Interincisal Angle	120.01	9.74	117.18	122.84	118.19	8.49	115.57	120.80	0.347
Mandibular Incisor to OP	23.89	7.40	21.74	26.03	25.71	6.35	23.76	27.66	0.214
Mandibular Incisor to MP	10.75	7.28	8.64	12.86	10.60	6.51	8.60	12.61	0.918
Upper Incisor to A-Pog plane (mm)	8.34	2.33	7.67	9.02	8.32	2.33	7.61	9.04	0.968

Significance at level P<0.05*; SD – Standard deviation; 95%CI-95 percent confidence intervals of Downs cephalometric measurements

Table-IV

| Parameters | Downs CaucasianNorm (N=20)[7] | | | Bangladeshi norm total (N=91) | | | | | | | Significance |
| | Mean | SD | Range | Mean | SD | Range | | 95% CI | | Mean | P value |
						Min	Max	Lower	Upper	Difference	
Facial Angle	87.8	3.57	82 to 95	85.65	3.26	77.00	92.00	84.97	86.33	2.15	0.010*
Angle of Convexity	0	5.09	-8.52 to 10	1.63	6.47	-13.00	17.00	0.28	2.97	-1.63	0.293
A-B Plane to Facial Plane	-4.6	3.67	-9 to 0	-3.73	4.00	-12.00	6.00	-4.56	-2.89	-0.87	0.374
Mandibular Plane Angle	21.9	3.24	17 to 28	23.59	5.84	6.00	36.00	22.38	24.81	-1.69	0.214
Y axis Angle	59.4	3.82	53 to 66	61.96	3.84	53.00	71.00	61.16	62.76	-2.56	0.008**
Cant of occlusal plane	9.3	3.83	1.5 to 14	10.20	4.13	3.00	19.00	9.34	11.06	-0.90	0.374
Interincisal Angle	135.4	5.76	130 to 150.5	119.15	9.17	96.00	144.00	117.24	121.06	16.25	<0.001***
Mandibular Incisor to OP	14.5	3.48	3.5 to 20	24.75	6.94	9.00	43.50	23.30	26.19	-10.25	<0.001***
Mandibular Incisor to MP	1.4	3.78	-8.5 to 7	10.68	6.89	-3.00	31.00	9.25	12.12	-9.28	<0.001***
Upper Incisor to A-Pog plane (mm)	2.7	3.05	-1 to 5	8.33	2.31	2.00	14.00	7.66	9.00	-5.63	<0.001***

Significance at level P<0.05*; SD – Standard deviation; 95%CI-95 percent confidence intervals of Downs cephalometric measurements
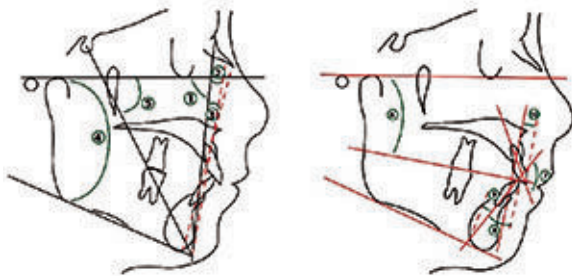

Figure 1: *Downs analysis with the reference points identified. 1. Facial plane. 2, Convexity. 3, A-B plane. 4, Mandibular plane. 5, Y axis. 6, Occlusal plane. 7, Interincial angle. 8, T to Occlusal plane. 9, T to mandibular plane. 10, to A-P plane.*
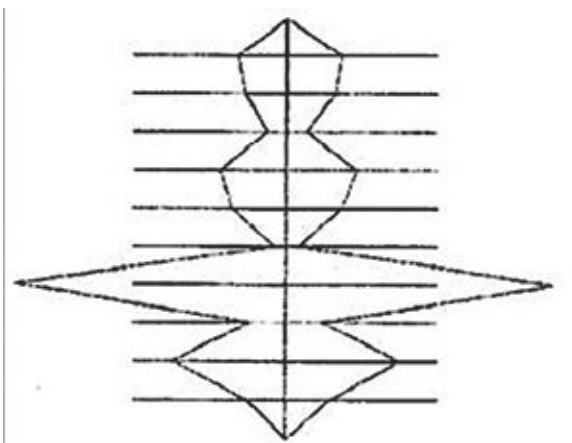

Figure 3: *polygon depicted by Alam Mk et al[8] for their study on Downs cephalometric norms for Bangladeshi young adults.*
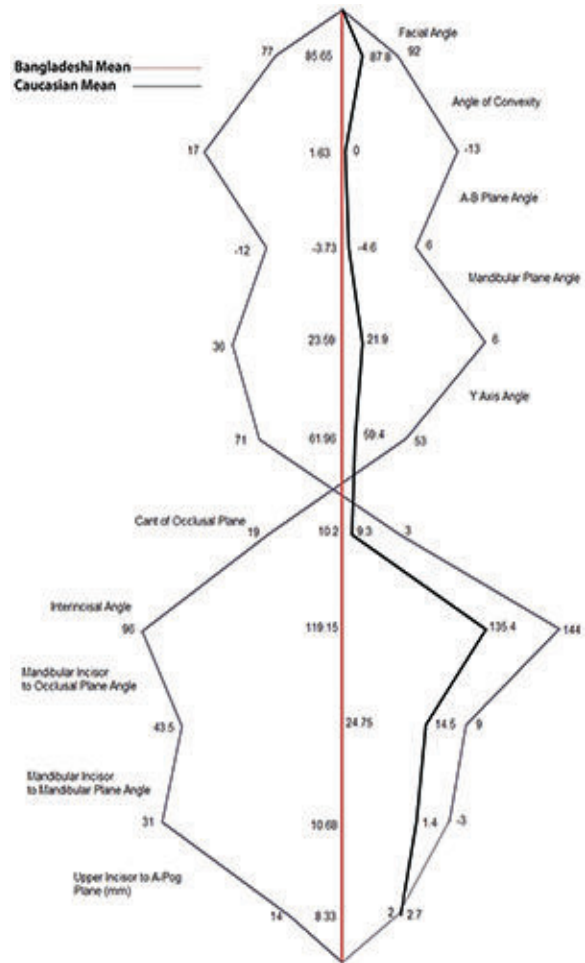

Figure 2: *Polygonic portrayal of Bangladeshi dentofacial patterns from Downs' analysis*

Observations and Discussion:

The findings of the present study are discussed under two headings, the first for skeletal pattern and the other for dental pattern. In each group the results of the present study are also compared with findings of

other investigators particularly those of Alam Mk et al[8] for their study deals with Downs cephalometric norms for Bangladeshi young adults which instead of simply expressing the facts have given birth to perplexity.

Skeletal:

Alam Mk et al,[8] in their study have found that the mean value of the Down's variable for Bangladeshi male were consistently larger than Bangladeshi female. Bangladeshi females were found to have significantly smaller facial angle (P < 0.001), Y-Axis angle (P < 0.001), Cant of occlusal plane (p < 001). mandibular plane angle (P < 05) and angle of convexity (p < 05). Other variables showed insignificant difference.

Where as in the findings of the present study Bangladeshi Female showed significantly larger (p < 001) facial angle more protrusive chin and angle of convexity (p<05) which means more protrusive maxillary part or midface than that of Males. However Bangladeshi male showed significantly greater Y-axis angle (p<05) that is downward forward/vertical growth pattern, and steeper (p<05) Cant of occlusal plane than that of females. Other variables showed insignificant difference.

Alam Mk et al[8] in their study have not performed a significance test to compare the differences between Downs standards and Bangladeshi norms. However, they have stated that Angle of convexity, A-B line, mandibular plane angle and inter incisal angle showed more variation compare to other variables. Angle of convexity and A-B line defines a person profile condition. Compared to the Caucasian mean values, Bangladeshi adults showed more straight profile. Mandibular position in relation to Frankfort horizontal plane can be determined by mandibular plane angle. The mean value of the mandibular plane angle in case of Bangladeshi adult is much larger than the Caucasian value which suggests growth of the mandible is favorably vertical. The long axis of upper and lower central incisor axis makes interincisal angle by which dental proclination Or retroclination can be determined. Caucasian value showed more proclined relationship compared to the Bangladeshi adult. This indicates that the Bangladeshi

adult have straight type facial pattern.

Yet the findings of the present study don't support these ideas. Rather Bangladeshis possess a facial skeleton which is close to Caucasians [figure 3, table 4] except Bangladeshi's exhibit significantly (p<05) smaller facial angle more retrusive mandible, significantly (p<05) greater Y-axis angle more downward forward or vertical growth pattern. The Bangladeshis female population also have a greater angle of convexity that is more protrusive maxillary part.

Dental:

No significant differences were found in the dental pattern of male and female Bangladeshis.

However, the dental pattern of Bangladeshis was significantly different (p<0.001) n all parameters when compared to Downs norms. They exhibit a decreased value of interincisal angle (119.15) and increased values of lower incisor mandibular plane (10.68) which is suggestive of proclined upper and lower incisors which contribute to their bidental facial profile. Increased linear distance of maxillary incisor A-Pog line (8.33mm) among them further contributes to superior protrusion.

Also, a hyperdivergent growth pattern with a retrusive mandible and slightly protrusive maxillary part contributes to the bidental protrusion. Hence Bangladeshis have a protrusive profile than that of the Caucasians this again goes against the findings of Alam Mk et al[8].

Downs' norms for Indians were investigated by Kotak[6], Ravi Nanda,[1] Sidhu[9], Valiathan (Indian Residents of Washington DC)[10], Kharbanda[11,12] and in several studies at the Lucknow University.[13]

It was observed that Indian faces possess racial characteristics more so in dental pattern. Bangladesh being a country of the Indian subcontinent share a similar racial pattern. The present study supports this idea.

Conclusion:

In view of the findings of the current study it is evident, even in the Bangladeshis with so-called well-balanced faces, have some fundamental variations in the craniofacial structure when compared with Downs norms. These should be established to serve in the diagnosis and treatment of the Bangladeshi patients.

The result of the present study also supports the view that a single standard of facial esthetics should not be applied to all racial groups.

Conflict of Interest

There is no conflict of interest regarding the research, authorship and publication of this article.

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