Original Article

Comparison of Downs analysis amongst Nepalese ethnic groups - Brahmins, Hindu Newars and Buddhist Newars

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Abstract

Introduction:

The cephalometric norms are specific to individual ethnic groups and knowledge of normative data of particular ethnic group will lead to better treatment results.

Objectives:

The objective of the study was to compare the three ethnic groups of Nepal; Brahmins, Hindu Newars and Buddhist Newars. The study also attempts to establish cephalometric norms in these Nepalese ethnic groups. Further comparisons were done with the norms available for Nepalese population and Caucasians.

Methodology:

Total 90 lateral cephalogram of three different ethnic groups of Nepal namely Brahmins, Hindu Newars and Buddhist Newars were studied for Downs analysis. The samples were between 18 to 32 years of age with Angle Class I dental relationship with minimal crowding (3-4 mm of crowding) and balanced pleasing facial profile on clinical observation. Cases that have undergone orthodontic treatment or have undergone extraction of teeth excluding third molars were not included.

Results:

Hindu Newars had more straight skeletal profile with increased facial angle (88.38°) and decreased angle of convexity (1.70°). There were significant differences between three Nepalese ethnic groups and to norms of overall Nepalese population and Caucasians. The Brahmins had significantly decreased facial angle (86.57°) as compared to Caucasians (87.8°, $P<0.05$). The angle of convexity was more in Brahmins (3.33°) and Buddhist Newars (2.95°) than in Caucasians (0°).

Conclusion:

The Brahmins had convex profile as compared to Hindu Newars and Buddhist Newars. Hindu Newars had straighter profile than Brahmins and Buddhist Newars. The Buddhist Newars had relatively vertical growth pattern than others. All three ethnic groups had protrusive dental component and horizontal growth pattern than Caucasians.

Key words:

Cephalometric analysis, Downs analysis, ethnic specificity

Introduction:

Cephalometric analysis has been routinely used to determine the relationships of the dentofacial complex. The cephalometric norms vary widely between different ethnic groups and are specific for individual ethnic groups, which have been supported by studies. Nepal is inhabited by diverse ethnic groups. Nepal's 2001 census enumerated 102 castes and ethnic groups. Till now we have been considering the cephalometric norms of Caucasians and overall norms of Nepalese population to treat Nepalese patients.Comparing the cephalometric readings of a patient from particular ethnic group with the norms of Caucasians and overall norms of Nepalese population, the diagnosis

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will not be precise as the cephalometric readings vary for different ethnic groups, which affects the treatment outcome. As there are no norms established for different ethnic groups of Nepal, it will be very useful if we could establish cephalometric norms for individual ethnic groups and compare with each other to see the differences. The established norms can be used in the cephalometric diagnosis of specific ethnic groups separately to obtain a correct diagnosis and to have a proper treatment outcome.

This study attempted to establish cephalometric norms for Nepalese ethnic groups namely Brahmins and Newars and compare with each other. The Newars - based on the religion - can be classified as Hindu Newars and Buddhist Newars. Majority of the Hindu Newars are Indo-Aryan origin and majority of Buddhist Newars are Mongoloid origin.Considering the differences in craniofacial pattern amongst the Indo- Aryans and Mongoloids, this study tried to see the differences in craniofacial pattern in Hindu Newars and Buddhist Newars.

This study holds the importance because no such studies have been done in the Nepalese population. It is aimed to achieve cephalometric norms for Brahmins, Hindu Newars and Buddhist Newars and find differences among them.

Materials and Methods

This was a Hospital based prospective cross-sectional study conducted at five different centers at Nepal. The centers were National Academy of Medical Sciences (NAMS), Bir hospital; Peoples Dental College and Hospital, Kantipur Dental College and Hospital , Kathmandu Model Hospital and Gandaki Medical College. Ethical clearance was obtained from institutional review board of NAMS. Permissions were taken from the committee of all the four institutions. Written informed consents were taken from all the participants. Total of 1200 samples were screened and 150 samples meeting the selection criteria were selected. Out of 150 samples 15 radiographs were discarded because of poor quality radiographs. From the 135 radiographs final samples consisting of 90 with 30 Brahmins; 30 Hindu Newars and 30 Buddhist Newars were randomly selected on lottery basis.

Three different ethnic groups of Nepal- Brahmins, Hindu Newars and Buddhist Newars were included. The ethnic classification was based upon as described by Prasad SR, Harka G, Bahadur BD, Rajbhandari L and Newar de davu, Newari Samaj 2005.The inclusion criteria were (1) Age between 18 to 32 years, (2) Angle Class I dental relationship with no spacing and minimal crowding (3-4 mm), (3) Balanced pleasing facial profile on clinical observation which was verified by second observer (Orthodontic faculty), (4) No history of orthodontic treatment, (5) Full set of permanent teeth with third molars either erupted or erupting or missing.

Lateral cephalogram were made from Rotograph plus, model MR05. The focus film distance is 1.65 meter and focus patient distance is 1.5 meter; output maximum is 85 kvp with 10 mA and total filtration is 2.5 mmAleq. Each subject was positioned in the cephalostat with the head oriented to the Frankfort horizontal plane and the teeth in centric occlusion with the lips in repose. The samples were made to wear lead apron during radiography. The cephalometric radiographs were traced by hand onto tracing sheets over an illuminated viewing box by using a standard technique. All radiographs were traced by the author on an average of 3 tracing per day to reduce errors due to fatigue. The landmark localization was rechecked by faculty of orthodontics. The linear measurements were measured with vernier caliper Mitutoya SER No. 60325791 (Japan) with 0.02mm accuracy and angular measurement with 0.5 degree accuracy. The linear and angular measurements were averaged to obtain a mean and standard deviation.

Skeletal cephalometric norms were obtained for Downs analysis.The data were entered in SPSS (Statistical package for social science) program version 16 (SPSS Inc, Chicago, Ill). The inter-ethnic group comparisons were done by one sample t- test and one way ANOVA followed by post hoc Bonferroni test wherever appropriate. The comparison for age distribution was done with independent t- test. The distribution of sex was done by Chi-squared test. The P values were calculated under the predetermined level of significance (0.05) and CI (Confidence Interval) of 95%. Twenty lateral cephalogram were re-traced by the same investigator after three months and Dahlberg's formula were utilized to assess intra-examiner error. Sm = $\mathbf{OS}d^2/2n$, where Sm is the method error, d is the difference between the first and the second measurements and n is the number of lateral cephalometric radiographs measured for the second time.

Table I. Inter-ethnic group comparison for variation in Sex

Ethnic group	Sex	Observed N	P value
Brahmins	Male	18	.273
	Female	12	
	Total	30	
Hindu Newars	Male	11	.144
	Female	19	
	Total	30	
Buddhist Newars	Male	13	.465
	Female	17	
	Total	30	

*P<0.5 Significant

Table II. Inter-ethnic group comparison for Downs analysis

Variables	Ethnic groups	Mean ± SEM
Facial angle (°)	B	86.57 ± 0.49 b
	H N	88.38 ± 0.59 a
	B N	87.98 ± 0.43
Angle of convexity(°)	B	3.73 ± 1.03
	H N	1.70 ± 0.83
	B N	2.95 ± 0.68
AB to NPOg (mm)	B	-6.02 ± 0.61
	H N	-4.62 ± 0.56
	B N	-5.05 ± 0.39
MP(°)	B	22.10 ± 0.73
	H N	21.98 ± 1.07
	B N	23.08 ± 0.56
Y-axis(°)	B	59.87 ± 0.64
	H N	58.98 ± 0.74
	B N	58.67 ± 0.44
OP(°)	B	7.72 ± 0.66
	H N	6.95 ± 0.70
	B N	7.77 ± 0.61
1 to 1(°)	B	124.62 ± 1.99
	H N	129.07 ± 1.99
	B N	128.32 ± 1.22
L 1 to OP(°)	B	25.93 ± 1.20 b,c
	H N	21.05 ± 1.44 a
	B N	21.43 ± 1.03a
L 1 to MP(°)	B	10.37 ± 1.10 b,c
	H N	5.13 ± 1.42 a
	B N	5.20 ± 0.95 a
U 1 to APog (mm)	B	6.15 ± 0.48
	H N	5.00 ± 0.42
	B N	4.92 ± 0.31

B-Brahmins, HN-Hindu Newars, BN-Buddhist Newars, P Values: a <0.05 with B, b<0.05 with HN, c<0.05 with BN. df = 2-87. Data were analyzed by one-way ANOVA followed by Bonferroni, 95% Confidence Interval

Table III. Comparison of Brahmins, Hindu Newars and Buddhist Newars with Nepalese for Downs analysis

Variables	Ethnic groups	Mean ± SD	P Value
Facial angle (°)	B	86.58 ± 2.73	.000*
	H N	88.38 ± 3.27	.017*
	B N	87.98 ± 2.38	.000*
	N	89.90	
Angle of convexity (°)	B	3.73 ± 5.65	.544
	H N	1.70 ± 4.56	.103
	B N	2.95 ± 3.71	.827
	N	3.10	
AB to N Pog (°)	B	-6.02 ± 3.36	.108
	H N	-4.62 ± 3.04	.496
	B N	-5.05 ± 2.16	.900
	N	-5	
MP (°)	B	22.10 ± 3.99	.142
	H N	21.98 ± 5.86	.265
	B N	23.08 ± 3.07	.836
	N	23.20	
Y-axis (°)	B	59.87 ± 3.51	.057
	H N	58.98 ± 4.08	.611
	B N	58.67 ± 2.44	.882
	N	58.60	
OP (°)	B	7.72 ± 3.62	.358
	H N	6.95 ± 3.84	.832
	B N	7.77 ± 3.33	.282
	N	7.10	
Inter-incisal angle (°)	B	124.62±10.91	.003*
	H N	129.07 ± 10.94	.317
	B N	128.32 ± 6.69	.030*
	N	131.10	
Lower incisor to OP (°)	B	25.93 ± 6.59	.000*
	H N	21.05 ± 7.90	.473
	B N	21.43 ± 5.19	.173
	N	20	
Lower incisor to MP (°)	B	10.37 ± 6.05	.000*
	H N	5.13 ± 7.77	.431
	B N	5.20 ± 5.19	.216
	N	4	
Upper incisor to A Pog (mm)	B	6.15 ± 2.62	.086
	H N	5.00 ± 2.33	.486
	B N	4.92 ± 1.69	.223
	N	5.30	

B-Brahmins, HN-Hindu Newars, BN-Buddhist Newars, N-Nepalese
**P<0.05 Significant*

Table IV. Comparison of Brahmins, Hindu Newars and Buddhist Newars with Caucasians for Downs analysis

Variables	Ethnic groups	Mean ± SD	P Value
Facial angle (°)	B	86.57 ± 2.73	.019*
	H N	88.38 ± 3.27	.337
	B N	87.98 ± 2.38	.676
	C	87.8	
Angle of convexity (°)	B	3.73 ± 5.65	.001*
	H N	1.70 ± 4.56	.050
	B N	2.95 ± 2.95	.000*
	C	0	
AB to N Pog (°)	B	-6.02 ± 3.36	.057
	H N	-4.62 ± 3.04	.744
	B N	-5.05 ± 2.16	.531
	C	-4.8	
MP (°)	B	22.10 ± 3.99	.79
	H N	21.98 ± 5.86	.94
	B N	23.08 ± 3.07	.04*
	C	21.90	
Y-axis (°)	B	59.87 ± 3.50	.472
	H N	58.98 ± 4.08	.580
	B N	58.67 ± 2.44	.110
	C	59.40	
OP (°)	B	7.72 ± 3.62	.023*
	H N	6.95 ± 3.84	.002*
	B N	7.77 ± 3.33	.017*
	C	9.30	
Inter-incisal angle (°)	B	124.62 ± 10.91	.000*
	H N	129.07 ± 10.94	.004*
	B N	128.32 ± 6.69	.000*
	C	135.4	
Lower incisor to OP (°)	B	25.93 ± 6.59	.000*
	H N	21.05 ± 7.90	.000*
	B N	21.43 ± 5.62	.000*
	C	14.50	
Lower incisor to MP (°)	B	10.37 ± 6.05	.000*
	H N	5.13 ± 7.77	.013*
	B N	5.20 ± 5.20	.000*
	C	1.40	
Upper incisor to A Pog (mm)	B	6.15 ± 2.62	.000*
	H N	5.00 ± 2.33	.000*
	B N	4.92 ± 1.69	.000*
	C	2.70	

B-Brahmins, HN-Hindu Newars, BN-Buddhist Newars, C-Caucasians
**P<0.05 Significant*

Results

Dahlberg's error varied between 0.31° to 0.52° for angular measurement and between 0.26 mm to 0.47mm for linear measurements which suggested no significant errors associated with radiographic measurements. The mean age of Brahmins was 23.90 ± 4.66 years; Hindu Newars was 22.37 ± 4.21 years and Buddhist Newars was 24.10 ±4.43 years. The age and sex distribution amongst the three ethnic groups were comparable (Table I). The means, standard deviations, and statistical differences for linear and angular measurements amongst different ethnic groups are presented in Table II. The comparisons with over all Nepalese and Caucasians are presented in Table III and IV respectively.

Discussion

The inter-ethnic comparison amongst the three ethnic groups showed that the Brahmins had significantly decreased facial angle (86.57°) than Hindu Newars (88.38°, Table II). This suggested that the Hindu Newars had prognathic mandible while Brahmins had retrognathic mandible. The Buddhist Newars had relatively higher mandibular plane angle (23.08°). Downs had suggested that, both retrusive and protrusive face can exhibit high mandibular plane angle but mostly a protrusive chin is associated with a lower mandibular plane angle and a retrusive chin with a higher mandibular plane angle. It could be suggested that with increase in facial angle the mandibular plane angle decreases as can be compared with the Hindu Newars. The Brahmins had significant increase in lower incisor to occlusal plane angulation (25.93°) as compared to Hindu Newars (21.05°) and Buddhist Newars (21.43°), suggestive of proclined lower incisors in Brahmins. The Brahmins had significantly increased lower incisor to mandibular plane angle (10.37°) as compared to Hindu Newars (5.13°) and Buddhist Newars (5.20°); suggestive that Hindu Newars and Buddhist Newars had relatively more upright mandibular incisor. All the three ethnic groups in the study showed significantly decreased facial angle than that of Nepalese population (Table III)[12]. The previous study for Nepalese population was not ethnic specific; ethnic consideration was not done in sample selection, which could have contributed to the difference in the result. The Brahmins and Buddhist Newars showed more protrusive dental pattern as compared to the average Nepalese population as suggested by interincisal angle which is 124.62° and 128° respectively. The Brahmins showed increased lower incisor proclination as compared to overall Nepalese norms as indicated by lower incisor to occlusal plane 25.93° and lower incisor to mandibular plane 10.37°.

While comparing with Caucasians, Brahmins had significantly decreased facial angle (P=0.019). The facial angle of Buddhist Newars (87.98°) was comparable with that of Caucasians (87.8°). All the three Nepalese ethnic groups had greater facial angle than Chinese (77.5°).The angle of convexity was increased with Brahmins (3.33°) and Buddhist Newars (2.95°) as compared to Caucasians (0°) (Table IV). The decreased facial angle and increased angle of convexity in Brahmins suggest that they have convex profile. On contrary the profile of Hindu Newars was straighter because of increased facial angle and decreased angle of convexity. In a study done in Koreans there was also marked difference in the skeletal patterns between Koreans and Caucasians with larger angle of convexity. The mandibular plane angle was significantly higher for Buddhist Newars (23.08°) as compared to Caucasians (21.90°; Table IV). The cant of occlusal plane significantly decreased in all three ethnic groups as compared to Caucasians (Table IV). The inter-incisal angle was significantly decreased (P=0.004) in three ethnic groups as compared to Caucasians (Table IV). The lower incisor to occlusal plane and lower incisor to mandibular plane angulation was significantly increased for all the three ethnic groups as compared to Caucasians suggestive of increased axial inclination of lower incisors. The Brahmins had more proclined lower incisors as compared to Chinese and Japanese population. The upper incisor to A-Pog plane was significantly increased for all the three ethnic groups as compared to Caucasians (Table IV). This is in unison with Downs's statement that there is correlation in the position of the upper incisor to the angle of convexity[10]. The higher the angle of convexity, farther the position of the maxillary incisor edge to A-Pog plane. In our study too with increase in angle of convexity there was increase in upper incisor to A-Pog plane.

Conclusion

- The Brahmins had convex profile with decreased facial angle and increased angle of convexity than Hindu Newars and Buddhist Newars.
- Hindu Newars had straighter profile than Brahmins and Buddhist Newars.
- All three ethnic groups had protrusive dental component and horizontal growth pattern than

Caucasians.

- The Buddhist Newars had relatively vertical growth pattern than Brahmins and Hindu Newars.
- The three ethnic groups showed differences as compared to Caucasians.
- We assume that the norms established in this study can be used while diagnosing and treating Brahmins, Hindu Newars and Buddhist Newars.

Limitations and Recommendations:

The ideal occlusion and pleasing profile were selected on clinical observation it would have been better if it was supplemented with study models and profile photographs. Further studies to include other ethnic groups of Nepal are recommended with larger sample size.

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