McNamara's Cephalometric Analysis of Adult Brahmins of Kathmandu

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ABSTRACT

Introduction: Appropriate comparison of an individual's craniofacial structure can be made when evaluated relative to his/her comparable peer group. However, McNamara's Caucasian norms are being used for adult Brahmins cephalometric analysis.

Objective: To determine cephalometric norms using McNamara's analysis in adult Brahmins of Kathmandu and to compare the values within the group and with Caucasians.

Materials & Method: Screening of 850 individuals aged 18-27 years was performed. Inclusion criteria were Angle's Class I molar and canine relation with normal overjet and overbite, symmetric face with acceptable profile, without craniofacial abnormalities, orthodontic/surgical treatment in the past and without proximal caries or prosthesis. Lateral digital cephalometric radiographs of 41 selected adult Brahmins of Kathmandu (23 males and 18 females) were manually traced. Comparative test was conducted within adult Brahmins of Kathmandu and with Caucasian group at significance level $p \leq 0.05$.

Result: Adult male Brahmins of Kathmandu were found to have larger craniofacial measurements: Effective Mandibular Length ($p \leq 0.001$), Maxillo-mandibular Differential ($p \leq 0.05$) and Lower Anterior Facial Height ($p \leq 0.01$) than adult female Brahmins of Kathmandu. Adult Brahmins were found to have smaller craniofacial measurements compared to Caucasians.

Conclusion: Gender and ethnic diversity must be considered during orthodontic diagnosis and treatment planning for an individual.

Key words: Brahmin, cephalometric analysis, McNamara analysis,

INTRODUCTION

Standardized radiographic technique by Broadbent and Hofrath in 1931[1] permitted precise vertical and sagittal measuring of craniofacial structures. Since then different analysis such as Downs,[2] Steiner,[3] McNamara[4] systems evolved in different ethnic groups.

The uniqueness of McNamara Analysis (1984) is that; it expresses jaw size as well as its position in reference to N perpendicular. This gives the facial skeletal profile picture making the analysis easily communicable. Acknowledging its simplicity this analysis system was used in analyzing craniofacial structure of different ethnic groups (Japanese,[5] Turkish,[6] Saudis,[7] Chinese[8]). In addition, it also stated gender diversity beside ethnic diversity.

Cephalometric studies using other analysis system have been performed earlier on Nepalese Population.[9] Largest groups of Kathmandu's population being Newars, Brahmins and Chhetris, norms of these groups needs to be established for appropriate comparison. Hence this study aimed to establish norms for adult Brahmins of Kathmandu using McNamara analysis.

MATERIALS AND METHOD

Ethical approval was obtained from the Institutional Review Board (IRB). Convenience sampling was performed among college students of different locations in Kathmandu, conforming to exclusion and inclusion criteria. Informed and signed consent were taken from the participants who were selected.

Radiographic Technique

Radiographs were taken in natural head position[10] with right side facing the cassette. This position was fixed with the forehead clamp positioned at Nasion. Parallel position of Mid Saggital Plane of the subject with the sensor was fixed by positioning ear rods in ear holes. The central beam of the x-ray tube passed through the ear rod and

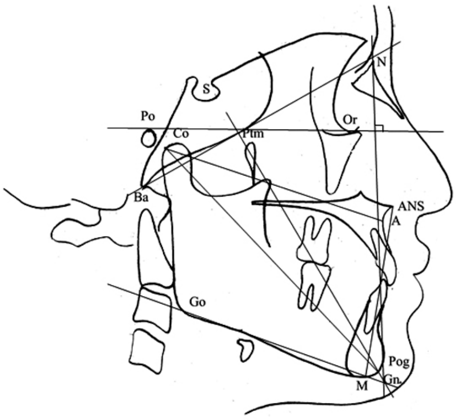

Figure 1: Cephalometric Landmarks and Planes

Table 1: Description of Landmarks

Anterior nasal spine (ANS)	Spinous process of the maxilla forming the most anterior projection of the floor of the nasal cavity.
Pogonion (Pog)	Most prominent point on the anterior aspect of symphysis of mandible.
Anatomical Gnathion (Gn)	The most anteroinferior aspect of the mandibular symphysis
Menton (Me)	The most inferior point on the symphysis of the mandible.
Gonion (Go)	Most posterior inferior point on ramus of the mandible.
Porion (Po)	Superior aspect of external auditory meatus.
Orbital (Or)	Lowest point on the inferior bony margin of the orbit. The point used is halfway between the right and left orbital.
Pterygomandibular Fissure (PTM)	Posterior superior aspect of Pterygomaxillary Fissure.
Cephalometric Gnathion (cGn)	Intersection of Facial Plane and Mandibular Plane.

external auditory meatus, perpendicular to the cassette. In this position the subject was exposed with maximum intercuspation and lips in light contact. The subject was asked to stand still during exposure until the beep sound stops. Digital Sordex Cranex Excel Ceph 71 Kvp, 6 mA was exposed for 1.2 seconds by the operator standing behind the lead loaded door to reduce cumulative lethal effect.[11] The distance from the source to the Mid Sagittal Plane was 134 cm and the distance from Mid Sagittal Plane to x-ray film was 18 cm. Linear measurements had 13% enlargement.

Cephalometric Method

The lateral cephalograms of two comparison groups were traced in random in order to prevent the researcher-bias.

Since Error in cephalometry is due to lack of reproducibility of landmarks rather than the difference in measurements; landmarks were relocated for their validity and average of the two was taken in case of differences. Intra-observer variation in identifying and locating anatomical landmarks during tracing and measurements assessed by using paired t-test showed no statistically significant intra examiner error.[12]

Lateral radiographic cephalograms were traced and measured. Table 1 presents the cephalometric Landmarks required for McNamara analysis with its description. Figure 1 presents their localization.

Magnification factor

Measurements obtained were made comparable with the magnification factor of the reference sample in the following manner:

Y = X* Magnification factor of McNamara sample / magnification factor of present study

Y = Adjusted measurement

X = Raw measurement[13,14]

Statistical Analysis

Descriptive statistics were derived from the quantitative data using SPSS (Statistical Package for Social Science). Then the data were presented in tables and t-test was performed at the level of significance .05.

RESULT

The characteristic and frequency of quantitative data of eleven different variables of craniofacial structures showed normal distribution approximately in frequency distribution graphs. Statistically significant age differences between the sample groups were not observed as shown in Table 2.

Comparison of adult Brahmin males and females is expressed in Table 3. Adult Brahmin males had significantly larger Effective Mandibular Length ($p \leq 0.001$), Maxillomandibular Differential ($p \leq 0.05$) and Lower Anterior Facial Height ($p \leq 0.01$) than adult Brahmin females.

Table 2: Demographic data of adult Brahmins of Kathmandu

Gender	Number	Age in years			
		Minimum	Maximum	Mean	SD
Male	23	18	27	21.04	2.61948
Female	18	18	27	20.17	2.38253

Table 3: Comparison of adult male and female Brahmins of Kathmandu

Variables	Minimum		Maximum		Mean		SD		*p-Value*
	Male	Female	Male	Female	Male	Female	Male	Female	
Maxillary Skeletal Position									
SNA°	75.00	75.00	87.00	90.00	81.78	82.39	3.38	3.74	0.595
Co-point A mm	79.33	75.50	93.66	88.88	85.23	82.57	3.43	3.25	0.15
Point A to Na-P mm	-6.69	-5.73	4.78	7.65	-0.62	0.90	2.98	3.27	0.132
Mandibular Skeletal Position									
Pog to Na-P mm	-13.38	-9.56	10.51	4.78	-3.12	-1.86	5.55	4.07	0.408
Co-Gn mm	103.22	98.44	119.47	113.73	110.04	104.92	4.26	4.49	0.001***
Inter Maxillary									
MXMD-DF mm	19.12	15.29	34.41	32.5	24.81	22.35	3.71	3.88	0.048*
Vertical Skeletal Components									
FA-A°	-6.00	-7.00	6.00	4.00	0.52	-0.72	3.31	2.61	0.186
ANS-Menton mm	54.48	51.61	75.5	66.9	63.81	59.15	5.12	4.01	0.002**
Md-P °	17.00	18.00	34.00	30.00	23.09	23.11	5.74	3.16	0.986
Maxillary Dentoalveolar Position									
UI-A mm	2.87	0.96	9.56	9.56	5.76	5.65	1.79	2.13	0.873
Mandibular Dentoalveolar Position									
Li-A Pog mm	0.00	0.00	12.42	6.69	3.91	3.16	2.61	2.12	0.452

** p ≤ 0.05; ** p ≤ 0.01; *** p ≤ 0.001* *NS – Not Significant*

Comparison of adult males and female Brahmin and Caucasian were expressed in Table 4 and 5. Adult Brahmins had greater Effective Maxillary length, Effective Mandibular Length, Maxillomandibular Differential and Lower Anterior Facial Height than Caucasians at significance level *p*≤0.001.

Comparison of adult male Brahmin and Caucasian also presented with posteriorly positioned maxilla and mandible at significance level p≤0.05 and anteriorly positioned lower incisors at significance level p≤0.01.

Table 4: Comparison of cephalometric means between male Brahmins and Caucasians

Variables	Caucasian		Brahmin		Mean Difference	*p-Value*
	Mean	SD	Mean	SD		
Maxillary Skeletal Position						
SNA°	83.90	3.20	81.78	3.38	2.12	0.0186*
Co-point A mm	99.80	6.00	85.23	3.43	14.57	0.000***
Point A to Na-P mm	1.10	2.70	-0.62	2.98	1.72	0.0275*
Mandibular Skeletal Position						
Pog to Na-P mm	-0.30	3.80	-3.12	5.55	2.82	0.0357*
Co-Gn mm	134.30	6.80	110.04	4.26	24.26	0.000***
Inter Maxillary						
MXMD-DF mm	34.50	4.00	24.81	3.71	9.69	0.000***
Vertical Skeletal Components						
FA-A°	0.50	3.50	0.52	3.31	-0.02	0.9841
ANS-Menton mm	74.60	5.00	63.81	5.12	10.79	0.000***
Md-P °	21.30	3.90	23.09	5.74	-1.79	0.1919
Maxillary Dentoalveolar Position						
UI-A mm	5.30	2.00	5.76	1.79	-0.46	0.3562
Mandibular Dentoalveolar Position						
Li-A Pog mm	2.30	2.10	3.91	2.61	-1.61	0.0148**

** p ≤ 0.05; ** p ≤ 0.01; *** p ≤ 0.001*

Table 5: Comparison of cephalometric means between female Brahmins and Caucasians

Variables	Caucasian		Brahmin		Mean Difference	*p-Value*
	Mean	SD	Mean	SD		
Maxillary Skeletal Position						
SNA°	82.40	3.00	82.39	3.74	0.01	0.992
Co-point A mm	91.00	4.30	82.57	3.25	8.43	0.000***
Point A to Na-P mm	0.40	2.30	0.90	3.27	-0.50	0.5634
Mandibular Skeletal Position						
Pog to Na-P mm	-1.80	4.50	-1.86	4.07	0.06	0.9761
Co-Gn mm	120.20	5.30	104.92	4.49	15.28	0.000***
Inter Maxillary						
MXMD-DF mm	29.20	3.30	22.35	3.88	6.85	0.000***
Vertical Skeletal Components						
FA-A°	0.20	3.20	-0.72	2.61	0.92	0.3866
ANS-Menton mm	66.70	4.10	59.15	4.01	7.55	0.000***
Md-P °	22.70	4.30	23.11	3.16	-0.41	0.7347
Maxillary Dentoalveolar Position						
UI-A mm	5.40	1.70	5.65	2.13	-0.25	0.6395
Mandibular Dentoalveolar Position						
Li-A Pog mm	2.70	1.70	3.16	2.12	-0.46	0.4673

*$p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$ NS – Not Significant*

DISCUSSION

Sample selection of previous studies were based on occlusal evaluation/facial esthetic or both as in the present study.[4, 5, 8, 15]

Frankfort horizontal plane is one of the Reference Plane of this study. Since machine Porion deviates from anatomic Porion by 10 mm, anatomic Porion was used in this study.[16]

Sexual dimorphism was observed in previous studies when male and female subjects within Chinese,[17] Mexican Americans,[18] and Japanese[19] were compared. Significant gender difference observed within the adult Brahmin groups of Kathmandu indicated sexual dimorphism. So further comparisons of Brahmins with other ethnic groups required separate comparison for male and female groups.

Radiographic magnification error is the possible problem encountered in this analysis system due to greater linear distances of the parameters used. Hence, for accuracy, measurements of this study were made comparable with the radiographic magnification of the reference sample (changed from 13% to 8%).[13, 14]

Maxillary length in adult male Brahmins of Kathmandu (85.23 mm) were greater than female Brahmins of Kathmandu (82.57 mm) but it was positioned more posteriorly in reference to Nasion perpendicular plane in male Brahmins of Kathmandu (-0.62 mm) and more anteriorly placed in female Brahmins of Kathmandu (0.90 mm). Mandibular Length was significantly greater in male Brahmins of Kathmandu subjects, however chin prominence was lesser in males as indicated by Pogonion to Nasion Perpendicular (-3.12 mm in males, -1.86 mm in females).

Lower Anterior Facial Height was significantly greater in male subjects (63.81 mm in males, 59.19 mm in females) with similar steepness of Mandibular Plane (23.01 mm males, 23.11 mm females) which could be influenced by greater Ramal Height in male Brahmins of Kathmandu as compared to females.[20] Facial axis angle was negative in female Brahmins of Kathmandu (-0.72°) indicating narrower antero-posterior dimension of face compared to male Brahmins of Kathmandu (0.52°).

Upper and Lower Anterior Dentition was also more anteriorly positioned in male Brahmins of Kathmandu compared to females. However, these findings were not statistically significant.

Maxillary Length of male adult Brahmins of Kathmandu was significantly smaller (85.23 mm) compared to Caucasian males (99.80 mm) and it was more posteriorly positioned as signified by SNA Angle (81.78, 83.90 degrees) and Point A to Nasion Perpendicular (-0.62, 1.10 mm) respectively. Mandibular Length was also significantly smaller (110.02, 134.30 mm) and posteriorly positioned as signified by Pogonion to Nasion Perpendicular (-3.12, -0.30 mm). Maxillomandibular Differential was 24.81 mm for adult male Brahmins of Kathmandu, 34.50 mm for male Caucasians. Lower Anterior Facial Height was significantly smaller as measured by parameter ANS to M (63.81, 74.60 mm). Mandibular anterior dentition was significantly anteriorly positioned 3.91 mm in adult male Brahmins of Kathmandu than male Caucasians 2.30 mm.

Adult female Brahmins of Kathmandu, compared to female Caucasians (Table 5) presented with smaller maxilla (82.57, 91.00 mm), significantly smaller mandible (104.92, 120.20

mm), recessive chin in reference to Nasion Perpendicular (-1.86, -1.80 mm), significantly smaller Lower Anterior Facial Height (59.15, 66.70 mm), steeper mandibular plane (23.11, 22.70 degrees) and anteriorly positioned Upper and lower anterior teeth compared to female Caucasians (5.65 mm upper 3.16 mm lower and 5.40 mm upper and 2.70 mm lower).

Lower Anterior Facial Height was considered to have strong hereditary and weak environmental influence.[21] This study also revealed significant difference in Lower Anterior Facial Height when adult male and female Brahmins of Kathmandu and Caucasian were compared.

Posteriorly positioned lower jaw in male and female adult Brahmins of Kathmandu in reference to Nasion Perpendicular was compensated by significantly anteriorly positioned lower anterior teeth, showing natural dental compensation.[22]

CONCLUSION

This study shows that gender and ethnic diversity must be considered during orthodontic diagnosis and treatment planning for an individual. Furthermore following conclusions were drawn:

1. Jaw size and its position: Maxillary Length, Mandibular Length, Point A to N Perpendicular, Point B to Nasion Perpendicular; Linear and angular vertical components: LFH, MP angle, Facial Axis Angle; Dentoalveolar position has been determined for adult male and female Brahmin of Kathmandu.
2. Adult Brahmins craniofacial structure is different than Caucacians hence mean and standard deviation of adult Brahmins obtained in this study helps in diagnosing and formulating treatment plan for adult Brahmins.
3. Gender diversity exists within adult Brahmins of Kathmandu group indicating need for separate comparison for male and female.
4. Since the study revealed differences in craniofacial structure of adult Brahmins and Caucasians, we recommend future study of craniofacial structure for other ethnic groups separately for multiethnic Nepalese population.

OJN

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