ORIGINAL ARTICLE

CEPHALOMETRIC NORMS FOR PAKISTANI SAMPLE FOR THE SKELETAL VARIABLES OF MCNAMARA ANALYSIS

[1]MASOOMA HAMEED
[2]AMJAD MAHMOOD
[3]ROZINA NAZIR

ABSTRACT

Objective of the study was to determine cephalometric skeletal norms for Pakistani sample according to McNamara analysis.

It was a cross-sectional study, conducted on the standardized lateral cephalometric radiographs of 28 males and 72 females. Subjects falling in the age range of 18 to 23 years, having skeletal Class I jaw relationship, normal vertical dimension and no history of orthodontic treatment were included in the study. Lateral cephalometric radiographs were traced and McNamara analysis was performed. Both the maxilla (-0.2±3.7mm) and mandible (-5.9±1.3mm) were positioned backward. The mean of effective mandibular length and Frankfort to mandibular plane angle were found to be 124±6.6mm and 25.0°±4.6° respectively. The mean values of cephalometric variables for Pakistani adults were significantly larger than the McNamara established norms. The current study results showed statistically significant differences in most cephalometric values of McNamara Analysis, between Pakistani adults and McNamara established norms. Pakistanis have distinct cephalometric values, therefore, for Pakistani Orthodontic and Orthognathic surgery patients it is advisable to use these as a standard in treatment planning.

Key Words: *Cephalometric norms; McNamara analysis; Orthognathic surgery.*

INTRODUCTION

Lateral cephalogram is one of the basic aids in diagnosis and treatment planning in orthodontics. Several cephalometric analyses have been introduced to diagnose and study the patients' malocclusion. McNamara analysis is one of the well-defined and specific analysis among them. This describes not only the position of teeth within bone but also the relationship of jaws with the cranial base.[1] This made McNamara's analysis a suitable tool for the diagnostic purposes for both regular orthodontic patients as well as for orthognathic surgery and growth modification patients. In this analysis James McNamara studied European-American population and developed norms for them.[2,3]

Genetics play an important role in determining the facial characteristics of individuals. Hence, the variation in facial characteristics and diversity in the size and shape of different facial attributes ask for establishing norms for each ethnic group separately. The norms made by McNamara for European-Americans differ from those established for other ethnic groups. However, these norms are in routine use since several years, which is not justified both ethically and scientifically as it may result in false diagnosis leading to faulty treatment plan. These ethnic variations in cephalometric norms have also been reported in many previous studies.[2,3]

Khan et al[4] conducted a study to establish norms according to Jaraback's analysis for Pakistani population and compared the mean of cephalometric values with Jaraback's norms. According to results, there were significant difference in mean values between Pakistani sample and Caucasians.

Shaikh et al[5] made cephalometric norms for esthetically pleasing Pakistani faces and compared them with established norms for Caucasians. The study results showed significant difference in the mean cephalometric values between Pakistani population and Caucasians.

Several studies[6-9] were conducted to establish cephalometric norms for Pakistani population. However, none of them established the norms for the McNamara analysis. Since, reliable norms for Pakistani subjects are not available yet; European-American norms are

[1] Masooma Hameed, Resident, BDS, FCPS II Resident (Orthodontics), Orthodontic Department, Margalla Institute of Health Sciences, Rawalpindi. **Author for Correspondence:** Dr Masooma Hameed, Rasheed General Store, New Ali Bahadur, Quetta Email: somatareen@yahoo.com
[2] Amjad Mahmood, Associate Professor, BDS, FDS, RCSEd (Orthodontics), Orthodontic Department, Margalla Institute of Health Sciences, Rawalpindi
[3] Rozina Nazir, Associate Professor, BDS, FDS, (Orthodontics), Orthodontic Department, Margalla Institute of Health Sciences, Rawalpindi

Received for Publication: December 10, 2017
Approved: December 27, 2017

being used for the assessment of orthodontic patient. This rationality stimulated the authors to conduct this study with an aim to determine the cephalometric skeletal norms for Pakistani sample using McNamara analysis.

METHODOLOGY

Current study was approved from Ethical Review Committee of Margalla Institute of Health Sciences, Rawalpindi (MIHS). Informed written consent was taken from the patients fulfilling the inclusion criteria. Total 540 patients' records were taken from the archive of orthodontics department of MIHS and analyzed, out of them 100 patients (28 males and 72 females) met the inclusion criteria. Patients falling in the age 18–23 years,4 skeletal Class I relationship (ANB angle 0-4o)10 with normal vertical skeletal dimension (SN-MP 25.5° ± 5.3°)[11] were included. Patients with history of orthodontic treatment, trauma, any syndrome and patients undergone orthognathic and plastic surgery were excluded from study. Lateral Cephalograms of the selected patients were taken and McNamara analysis was performed using lead pencil (Goldfish HB with 0.5mm lead thickness) on tracing sheets (sheet of transparent lead acetate paper measuring 8X10 inch and 0.003 inch thickness) and readings were noted. All statistical analyses were performed using SPSS 21.0. Descriptive statistics (mean and standard deviations) were calculated for all cephalometric variables. To estimate the error of method, 30 Cephalometric radiographs were randomly selected and were retraced and re-measured in an interval of one month by a colleague. Method errors were calculated by using Dahlberg's formula.[12] The t test was employed to compare the mean cephalometric values of Pakistani adults with McNamara established norms. The results of the test were considered significant at $p < 0.05$.

RESULTS

There were total 100 patients, 28% (n=28) males and 72% (n=72) females. Descriptive statistics (mean and standard deviations) were calculated for McNamara cephalometric variables. Method error for linear and angular measurements was calcu-

TABLE 1: CEPHALOMETRIC MEASUREMENTS USED IN MCNAMARA ANALYSIS

McNamara variables	Definitions[13]
Point A to Nasion perpendicular (Point A-NP)	A vertical line is constructed perpendicular to the Frankfort horizontal and extended inferiorly from the nasion. The perpendicular distance is measured from point A to the nasion perpendicular.
Pog to Nasion perpendicular (Pog-NP)	The perpendicular distance is measured from the pogonion to the nasion perpendicular.
Effective midface length (Co-point A)	Distance from condylion (Co) to point A.
Effective mandibular length (Co-Gn)	Distance from condylion (Co) to anatomic gnathion(Gn).
Maxillo-mandibular difference (Mx-Md differential)	Effective midface length minus effective mandibular length.
Lower anterior face height (Ans-Me)	A line is measured from the anterior nasal spine to the menton.
Frankfort to Mandibular plane angle (MP-FH)	The angle between the anatomic Frankfort plane and the mandibular plane, Gonion-Menton.

TABLE 2: COMPARISON BETWEEN CEPHALOMETRIC MEAN OF PAKISTANI ADULTS ND MCNAMARA NORMS

S. No.	Variables	Present Study		McNamara Norms		P value
		Mean	SD	Mean	SD	
1	Point A-NP (mm)	-0.2	±3.7	0.4	±2.3	0.06
2	Pog-NP (mm)	-5.9	±1.3	-1.8	±4.5	0.003*
3	Co-point A (mm)	98.2	±5.4	91	±4.3	0.001*
4	Co-Gn (mm)	4.9	±6.6	120.2	±5.3	.04*
5	Mx-Md differential (mm)	26.8	±3.7	29.2	±3.3	0.05*
6	ANS-Me (mm)	68.9	±4.8	66.7	±4.1	0.06
7	MP-FH (°)	25.0°	4.6°	22.7°	±4.3°	0.04*

p value showing * significant

TABLE 3: COMPARISON BETWEEN CEPHALOMETRIC MEAN OF PAKISTANI MALES AND MCNAMARA NORMS

S. No.	Variables	Pakistani Males		McNamara Norms for Males		P value
		Mean	SD	Mean	SD	
1	Point A-NP (mm)	-0.2	±5.0	1.1	±2.7	0.05*
2	Pog-NP (mm)	-6.1	±6.0	-0.3	±3.8	0.003*
3	Co-A (mm)	101.7	±4.7	99.8	±6.0	0.045*
4	Co-Gn (mm)	133.4	±5.2	134.3	±6.8	0.06
5	Mx-Md differential (mm)	31.8	±4.4	34.5	±4.0	0.06
6	ANS-Me (mm)	76.1	±4.5	74.6	±5.0	0.05*
7	MP-FH (°)	24.90	±5.70	21.30	±3.90	0.04*

p value showing * significant

TABLE 4: COMPARISON BETWEEN CEPHALOMETRIC MEAN OF PAKISTANI FEMALES AND MCNAMARA NORMS

S. No.	Variables	Pakistani Females		McNamara Norms for Females		P value
		Mean	SD	Mean	SD	
1	Point A-NP (mm)	-1.6	±4.0	0.75	±2.5	0.04*
2	Pog-NP (mm)	-6.7	±6.5	-1.05	±4.2	0.003*
3	Co-A (mm)	89.0	±6.41	95.40	±5.2	0.02*
4	Co-Gn (mm)	115.8	±7.1	127.25	±6.1	0.004*
5	Mx-Md differential (mm)	26.8	±5.8	31.85	±3.7	0.03*
6	ANS-Me (mm)	68.0	±6.3	70.65	±4.5	0.06
7	MP-FH (°)	25.19°	±5.4°	22.0°	±4.1°	0.05*

p value showing * significant

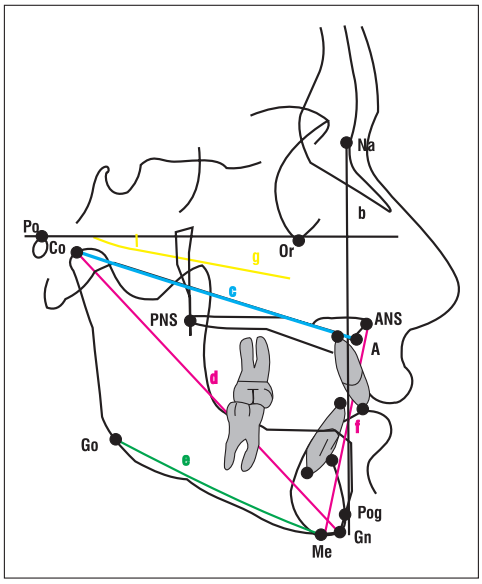

Fig 1: The cephalometric landmarks and planes used in McNamara analysis.[13] **Na** (Nasion), **Po** (Porion), **Or** (Orbitale), **A** (Subspinale), **ANS** (Anterior nasal spine), **Co** (Condylion), **Pog** (Pogonion), **Gn** (Gnathion), **Me** (Menton), **Go** (Gonion), **a** (Po-Or plane), **b** (Nasion perpendicular NP), **c** (Co-point A), **d** (Co-Gn), **e** (Go-Me), **f** (ANS-Me), **g** (FH-MP)

lated by using Dahlberg's formula. Method errors of cephalometric measurements was calculated to be less than 0.9 mm for linear measurements and 0.5° for the angular measurements which were insignificant.[14]

The mean cephalometric values of Pakistani adults and comparison with McNamara established norms are shown in Table 2. The maxilla Point (A-NP=-0.2±3.7mm) and mandible (Pog-NP=-5.9±1.3mm) were placed posterior to cranial base. The mean effective midface (Co-point A) and mandibular length (Co-Gn) were 98.2±5.4mm and 124±6.6mm respectively. The mean of lower anterior facial height (ANS-Me) and FH to mandible plane angle (MP-FH) were 68.9±4.8mm and 25.0° ±4.6° respectively.

The mean cephalometric values of Pakistani males and comparison with McNamara established norms are shown in Table 3. In Pakistani adult males, maxilla point (A-NP=-0.2±5.0mm) and mandible (Pog-NP=-6.1±6.0mm) were placed posterior to cranial base. The mean effective midface (Co-point A) and mandibular length (Co-Gn) in adult Pakistani males were 101.7 ±4.7mm and 133.4±5.2mm respectively. The mean of lower anterior facial height (ANS-Me) and FH to

mandibular plane angle (MP-FH) were 76.1.9±4.5mm and 24.9°±5.7° respectively.

The mean cephalometric values of Pakistani females and comparison with McNamara established norms are shown in Table 4. In Pakistani adult females, maxilla (A-NP=-1.6±4.0mm) and mandible (Pog-NP= -6.7±6.5mm) were placed posterior to cranial base. The mean effective midface (Co-point A) and mandibular length (Co-Gn) were 89.0 ±6.4mm and 115.8±7.1mm respectively. The mean of lower anterior facial height (ANS-Me) and FH to mandibular plane angle (MP-FH) were 68.1.9±6.3mm and 25.49°±5.7° respectively.

DISCUSSION

It has been observed that variables like racial origin, gender, age and face type contribute to facial variation. Skeletal and dental differences between racial groups were considerable. These differences play an important role in deriving objectives for achieving excellent orthodontic treatment results for any specific population.

Current study determined skeletal cephalometric norms for Pakistani sample according to McNamara analysis and compared the mean values with McNamara established norms. The study results were similar to Al Jasser and Garcia study results who found racial differences in their research, but they performed another analysis instead of McNamara analysis in their study.[15,16,17]

Aljame et al[18] found that adolescent Kuwaitis had reduced chin prominence and steeper mandibular plane angle that resulted in increased profile convexity. These findings showed similarities to the current study's results by observing reduced chin prominence but posteriorly placed pog was the contributing factor for reduced chin prominence in current Pakistani sample. Frankfort to mandibular plane angle was found to be normal in current study.

Al-Barakati and Talic[1] conducted a study, in which total 65 (36 males and 29 females) dental students of Saudi population were included to establish cephalometric norms according to McNamara analysis. They concluded that Saudi population had distinct facial features, convex profiles, increased lower facial height. Increased vertical dimension might explain tendency for backward mandibular growth rotation resulting in reduced chin prominence. While in current study reduced chin prominence was not due to increased facial height but due to backward position of pog from Nasion perpendicular. The mean of the cephalometric values were different from McNamara established norms but showed similarities to present study's results.

Miyajima and McNamara[2] compared 54 Japanese adults with 125 European-American adults. The Japanese adults were having smaller sagittal facial dimensions, larger vertical facial dimensions and bimaxillary protrusion with an acute nasolabial angle. The facial axis angle in Japanese explained downward direction of facial development. Their study result was in contrast to current study observation, which observed greater antero posterior facial dimensions and bimaxillary retrognathism. Current study included the patients with skeletal class I jaw relationship while Japanese adults were selected on the bases of ideal occlusion with well balanced faces in their study.

Park et al[19] described the skeletal pattern of Koreans and stated that they have a similar skeletal pattern as that of Caucasians, with slightly larger facial convexity and bimaxillary proclination. Hajighadimi[20] conducted a study and concluded that Iranians had more retrusive skeletal pattern, convex profiles, high mandibular plane angle and bimaxillary dental protrusion. These findings are in partial agreement with current study's findings.

Alam et al[21] established norms for Bangladeshi adults according to McNamara analysis and compared the mean cephalometric values with Caucasians norms. They stated that both the maxilla and mandible were positioned anterior to cranial base, which is in contrast to current study's results. Both the maxilla and mandible have a tendency to be positioned forward, but the mandible was more forward which gives a clinical impression of Class III skeletal pattern while current study observed tendency towards skeletal class II pattern with convex profile. Their study results showed dissimilarities from current study's findings, might be due to different study inclusion criteria which included only patients with Class I incisor relationship with satisfactory aesthetics.

The results of the current study established that the norms made for specific population should be used as standard for successful orthodontic treatment for that specific population and should not be used for other populations. Further studies are required with larger sample size to get more results that are significant.

CONCLUSION

When compared McNamara established norms with the current study, it was observed that Pakistani subjects displayed distinct facial features, greater convex profiles, reduced chin prominence and tendency towards Class II facial pattern. Therefore, Pakistanis have distinct cephalometric values, so for Pakistani Orthodontic and Orthognathic surgery patients it is advisable to use these as a standard in treatment planning.

REFERENCES

1 Al-Barakati SF, Talic NF. Cephalometric norms for Saudi sample using McNamara analysis. Saudi Dental J. 2007;19(3):139-45.

2 Miyajima K, McNamara JA, Kimura T, Murata S, Iizuka T. Craniofacial structure of Japanese and European-American adults with normal occlusions and well-balanced faces. Am J Orthod Dentofacial Orthop.1996. 31;110(4):431-38.

3 Mills JR. (1982). Principles and practice of orthodontics. London: Churchill Livingstone, Longman Group Ltd.

4 Khan T, Ahmed I, Erum E G. Cephalometric measurements of a Pakistani adult sample according to Jarabak's Analysis. J Pak Med Assoc: 1345;2013.

5 Shaikh AJ, Alvi AR. Comparison of cephalometric norms of esthetically pleasing faces. J Coll Physicians Surg Pak. 2009;19:754-58.

6 Burki S, Faisal M. In search of normal facial profile. Pak Oral Dental J 2000; 20: 165-74.

7 Hamid W, Asad S. Prevalence of skeletal components of malocclusion using composite cephalometric analysis. Pak Oral Dental J 2003; 23: 137-44.

8 Hamid W, Asad S. Vertical reference plane: used to asses cephalometric features of a Pakistani sample. Pak Oral Dental J 2005; 25: 193-200.

9 Zaib F, Israr J, Ijaz A. Photographic angular analysis of adult soft tissue facial profile. Pak Orthod J 2009; 1: 34-9.

10 Bokhari F, Asad S. Sagittal pattern and severity of skeletal discrepancy in class II Div I malocclusion. Pak Orthod J 2010;2:66-71.

11 Susan N. Al-Khateeb, Emad F. Al Maaitah, Elham S. Abu Alhaija, and Serene A. Badran. Mandibular symphysis morphology and dimensions in different anteroposterior jaw relationships. The Angle Orthod. 2014;84(2):304-09.

12 Galvão MCS, Sato JR, Coelho EC. Dahlberg formula – a novel approach for its evaluation. Dental Press J Orthod. 2012;17(1):115-24.

13 McNamara JA. A method of cephalometric evaluation. Am J Orthod Dentofacial Orthop. 1984; 86: 449-69.

14 Houston WJB. The analysis of error in orthodontic measurements. Am J Orthod Dentofacial Orthop. 1983;83: 382-90.

15 Al Jasser NM. Cephalometric evaluation of craniofacial variation in normal Saudi population according to Steiner analysis. Saudi Med J 2000; 21:746-50.

16 Al Jasser NM. Cephalometric evaluation for Saudi population using the Downs and Steiner analysis. J Contemp Dent Pract 2005; 6: 52-63.

17 Arcia CJ. Cephalometric evaluation of Mexican Americans using the Downs and Steiner analyses. Am J Orthod Dentofacial Orthop. 1975; 68:67-74.

18 Al-Jame B, Årtun J, Al-Azemi R, Al- Behbehani F, BuHamra S. Lateral cephalometric norms for adolescent Kuwaitis: Hard tissue measurements. Med Princ Pract 2006;15:91-97.

19 Park IC, Bowman D, Klapper L. A cephalometric study of of Korean adults. Am J Orthod Dentofacial Orthop.1989. 1;96(1): 54-59.

20 Hajighadimi M, Dougherty HL, Garakani F. Cephalometric evaluation of Iranian children and its comparison with Tweed's and Steiner's standards. Am J Orthod Dentofacial Orthop. 1981. 1;79(2):192-97.

21 Alam MK, Basri R, Purmal K, Sikder MA, Saifuddin M, Iida J. Cephalometric norm study in a Bangladeshi population using McNamara analysis. Int Med J. 2013;20(1):84-86.

CONTRIBUTIONS BY AUTHORS

1 Amjad Mahmood & Masooma Hameed:	Contribution to conception and design.
2 Rozina Nazir & Masooma Hameed:	Interpretation of data, drafting the article or revising it critically.
3 Masooma Hameed & Rozina Nazir:	Acquisition of data, analysis and interpretation of data
4 Amjad Mahmood & Rozina Nazir:	Final revsion and critical analysis.