Turkish Norms of McNamara's Cephalometric Analysis

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ABSTRACT

Objective: (1) To establish cephalometric standards for the Turkish adult population, (2) to compare Turkish norms with the published standards of McNamara norms, and (3) to compare the assessment of craniofacial structure by extracranial and intracranial reference lines.

Materials and Method: The main study sample consisted of 44 female and 29 male dental students aged between 19 and 29 years. All of the head films were taken in the natural head position, which was determined with 0.5-mm wire that was attached to a fluid level device to represent the true horizontal and a metal chain that was suspended in front of the cassette to check the true horizontal.

Results: For men, N perp A and Pg N perp were significantly greater ($p<0.001$) in the Turkish population, whereas SNA ($p<0.001$), CoGn ($p<0.001$), CoA ($p<0.001$), upper incisal A vertical ($p<0.05$), and lower incisor A pg ($p<0.05$) were significantly smaller. In women, N perp A and Pg N perp were significantly greater ($p<0.001$) in the Turkish population, whereas SNA ($p<0.01$), CoGn ($p<0.001$), and CoA ($p<0.01$) were significantly smaller. For both men and women, only the variables FH/GoMe and X1-X2/GoMe were compatible with each other ($p<0.001$).

Conclusion: The Anotolian Turkish sample has shorter midfacial (Co-A) and mandibular (Co-Gn) lengths and a more protrusive maxilla (N perp A) and mandible (Pg N perp). Extracranial reference lines are more reliable than intracranial reference lines because of interindividual variability. (*Turkish J Orthod* 2014;27:100–105)

KEY WORDS: McNamara analysis, Turkish cephalometric norms

INTRODUCTION

Harmonious facial esthetics and optimal functional occlusion have long been recognized as the most important goals of orthodontic treatment.[1,2] To accomplish these goals, a knowledge of normal craniofacial growth is essential.[1] Knowledge of the normal dentofacial pattern of adults in various ethnic groups is also important for clinical treatment planning.

The cephalometric evaluation of craniofacial morphology is one of the most significant tools in orthodontic diagnosis and treatment planning. It is well established that cephalometric standard values provide useful guidelines in orthodontic diagnosis. However, it is possibly incorrect to make rigid applications of these values since they represent population averages that may be inap-propriate as individual treatment goals. Furthermore, it has been suggested that an analysis is misused if it is applied to a patient of a different age or race.

Since the introduction of cephalometric radiography by Broadbent in 1931,[3] a number of different analyses have been devised. Among those analyses, McNamara's has been widely used in orthodontics because it is sensitive not only to the position of teeth within a given bone but also to the relationship of jaw elements and cranial base structures to one another.[4] McNamara's analysis method is useful when the values derived from the patient's head film is compared with the established norms for a similar ethnic group, age, and

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Figure 1. Radiograph taken in the natural head position. A 0.5-mm wire was adopted on the fluid level device to represent the true horizontal, and the vertical chain can be seen clearly.

gender. Because craniofacial features such as size, shape and form, and facial pattern will show variations in different genera, races, and subraces, normative data should be maintained for each racial group. Therefore, knowledge of normal dentofacial patterns of each ethnic group has much importance.

The purposes of this study were (1) to establish cephalometric standards for the Turkish adult population, (2) to compare Turkish norms with the published standards of McNamara norms, and (3)

to compare the assessment of craniofacial structure by extracranial and intracranial reference lines.

MATERIALS AND METHOD

A total of 73 lateral cephalometric radiographs of Turkish adults were used in the study. The radiographs were selected from the archive of Ankara University, Faculty of Dentistry, Department of Orthodontics. The main study sample consisted of randomly selected 44 female and 29 male dental students in the age range between 19 and 29 years. The inclusion criteria were Class I occlusions with minor or no crowding, normal growth and development, good facial symmetry determined clinically and radiographically, no previous orthodontic treatment, and no maxillofacial and plastic surgery.

Radiographic Technique

All of the head films were taken in the natural head position (NHP) as originally defined by Showfety et al.[5] Natural head postures of the subjects were determined with 0.5-mm wire that was attached to a fluid level device to represent the true horizontal and a metal chain that was suspended in front of the cassette to check the true horizontal (Fig. 1).[6] All radiographs were taken in a separate room by the same examiner.

Cephalometric Analysis

A total of 13 angular and linear variables were used in the study (Table 1; Fig. 2). Ten of the landmarks were used for the McNamara analysis,[4] whereas the other 3 variables were used for the comparison of extracranial and intracranial reference lines. The head films were traced manually and

Table 1. Landmarks and reference lines

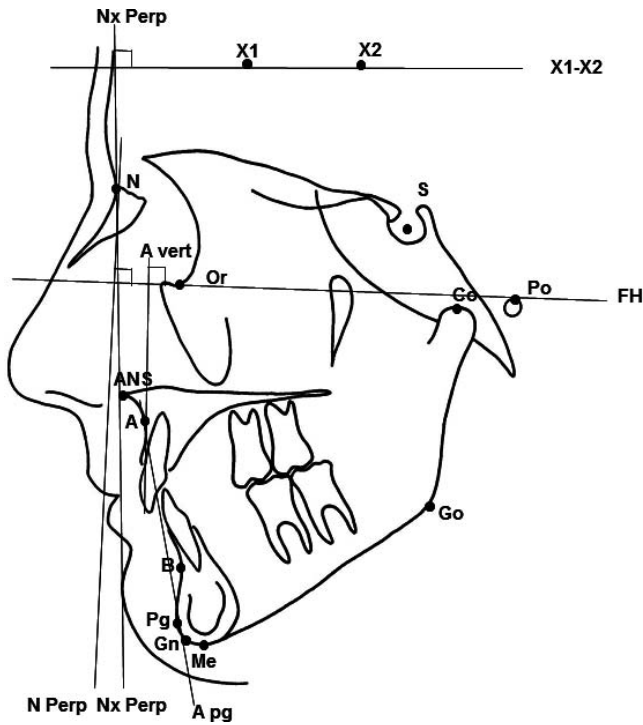|	
SNA	Angle between the lines SN and NA
N Perp A	Perpendicular distance between point A and N perp line
CoGn	Length between Co and Gn
CoA	Length between Co and point A
Maxillomandibular difference	Difference of the lengths CoGn and Co A
ANS Me	Length between ANS and Me
FH/GoMe	Angle between the lines FH and GoMe
Pg N Perp	Perpendicular distance between point A and N perp line
Upper incisal A vert	Perpendicular distance between the most anterior surface of upper incisor and A vertical line
Lower incisal A Pg	Perpendicular distance between facial surface of lower incisor and A to Pg line
A Nx Perp	Perpendicular distance between point A and Nx perp line
Pg Nx Perp	Perpendicular distance between pogonion and N perp line
X1-X2/GoMe	Angle between the lines X1-X2 and gonion menton

Figure 2. Cephalometric reference points and lines used in the study. (1) S: sella, N: nasion, (2) Or: orbita, (3) ANS: anterior nasal spine, (4) Pg: pogonion, (5) Gn: Gnathion, (6) Me: menton, (7) Go: gonion, (8) Po: porion, (9) Co: condylion, (10) X1: the most superior and anterior point on fluid level device, (11) X2: the most superior and posterior point on fluid level device, (12) FH: Frankfurt horizontal plane, line passing through Or and Po, (13) N perp: line passing from N perpendicular to FH, (14) A vert: line passing from A perpendicular to FH, (15) A-Pg: line passing through A and Pg, (16) X1-X2: true horizontal reference plane, line passing through X1 and X2, (17) Nx perp: line passing from nasion perpendicular to X1-X2 line.

digitized by the PORDIOS program by the same examiner.

Statistical Analysis

To assess Turkish norms of McNamara's cephalometric analysis, the mean value, standard deviation, and range of each of the 10 variables were calculated for both men and women separately. The resulting norms of the Turkish population and the norms of the Ann Arbor sample of McNamara were compared with a 1-sample t test.

For the evaluation of compatibility of extracranial and intracranial reference lines, 3 variables including the extracranial reference plane and 3 variables including the intracranial reference plane were compared with each other by correlation index statistics.

Error Study

Because the program (PORDIOS) automatically rejects the digitizing procedure if the 2 digitized points do not match, cephalometric landmarks were digitized twice simultaneously.

RESULTS

The results showed that 8 variables in men and 5 variables in women showed significant difference when compared with the Ann Arbor sample (Table 2). In men, N perp A and Pg N perp were significantly greater ($p<0.001$) in the Turkish population, whereas SNA ($p<0.001$), CoGn ($p<0.001$), CoA ($p<0.001$), upper incisal A vertical ($p<0.05$), and lower incisor A pg ($p<0.05$) were significantly smaller in the Turkish population. In women, N perp

Table 2. Turkish adult standards as compared with Ann Arbor sample standards using 1-sample t test[a]

	Male			
	McNamara Norm Mean ± SD	Turkish Norm Mean ± SD	Mean Difference	Significance
SNA	83.9 ± 3.2	81.69 ± 3.19	−2.21	***
N perp A	1.1 ± 2.7	3.05 ± 2.48	1.95	***
CoGn	134.3 ± 6.8	125.61 ± 5.99	−8.69	***
CoA	99.8 ± 6.0	93.46 ± 5.61	−6.34	***
Maxillomandibular difference	34.5 ± 4.0	32.15 ± 5.51	−2.35	*
ANS Me	74.6 ± 5.0	73.34 ± 7.42	−1.26	NS
FH/Go Me	21.3 ± 3.9	23.37 ± 7.95	2.07	NS
Pg N Perp	−0.3 ± 3.8	6.91 ± 5.24	7.21	***
Upper incisal A vert	5.3 ± 2.0	4.24 ± 2.09	−1.06	*
Lower incisal A Pg	2.3 ± 2.1	1.57 ± 1.45	−0.73	*

[a] NS, not significant.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

A and Pg N perp were significantly greater (*p*<0.001) in the Turkish population, whereas SNA (*p*<0.01), CoGn (*p*<0.001), and CoA (*p*<0.01) were significantly smaller.

For both male and female gender, only the variable FH/GoMe and X1-X2/GoMe were compatible with each other (*p*<0.001; Table 3).

DISCUSSION

This study focused on samples of untreated Anotalian Turkish subjects characterized as having normal occlusions and well-balanced faces. Most investigators have assessed craniofacial structures of different ethnic and racial groups and established norms for each group.[7–25] However, the evaluation of craniofacial structures by means of intracranial reference lines has been criticized for the following reasons:

1. Individual variations in the slope of intracranial reference lines may result in different interpretations of the craniofacial structure of subjects with similar profiles.[26–29]
2. Variations in the relationships between reference lines may result in different evaluations of facial skeletal patterns depending on the particular reference plane used.[29–32]
3. An evaluation of craniofacial structure by means of intracranial reference lines does not always reflect the clinical appearance of the individual subject.[27,28,32–34]

Because of these disadvantages, it has been argued that NHP and extracranial reference lines should be used for a logical assessment of craniofacial structure.[28,32,33] As we mentioned before, we used lateral cephalometric films of well-balanced Class I faces taken in the NHP with a fluid level device. According to our results, in both men and women, only the FH/GoMe parameter was compatible with the X1-X2/GoMe parameter. Therefore, we can conclude that extracranial reference lines are more reliable than intracranial reference lines because of interindividual variability.

Some studies have evaluated skeletal and soft-tissue cephalometric norms for Anatolian Turkish people.[35–39] According to Basciftci et al.,[35] most of the values for skeletal measurements in Anatolian Turkish adults were found to be similar to the ideal norms of Steiner.[35] Uysal et al.[38] found that the Turkish sample had a more retrognathic maxilla and mandible and a more vertical direction of facial development when compared with Saudi young adults. According to Kılıç et al.,[37] Anatolian Turkish adolescents, particularly girls, have smaller midfacial and mandibular lengths and longer and more retrusive faces than North American adolescents and adults.[36]

In our study, most of the skeletal parameters were significantly different from the Ann Arbor sample. In both men and women, SNA was significantly smaller, whereas N perp A and Pg N perp were significantly higher in the Turkish population. Co-A and Co-Gn were significantly smaller in both men and women in the Turkish population. However, ANS-Me and FH/Go Me did not differ between the 2 populations.

Our study sample was limited by number because of our limited NHP cephalometric films. Further investigations might highlight the cephalometric norms of the Turkish population.

Table 2. Extended

Female			
McNamara Norm Mean ± SD	Turkish Norm Mean ± SD	Mean Difference	Significance
82.4 ± 3.0	81.3 ± 3.10	−1.10	**
0.4 ± 2.3	2.94 ± 1.76	2.54	***
120.2 ± 5.3	117.45 ± 4.61	−2.75	***
91.0 ± 4.3	89.14 ± 4.40	−1.86	**
29.2 ± 3.3	28.31 ± 4.69	−0.89	NS
66.7 ± 4.1	68.08 ± 5.06	1.38	NS
22.7 ± 4.3	23.92 ± 5.00	1.22	NS
−1.8 ± 4.5	6.11 ± 4.46	7.91	***
5.4 ± 1.7	5.80 ± 1.92	0.40	NS
2.7 ± 1.7	2.81 ± 2.17	0.11	NS

Table 3. Correlation of extracranial and intracranial reference lines

	n	Correlation	Significance
Male			
N perp A–Nx perp A	28	−0.128	0.516
FH\GoMe–X1-X2/Go-Me	28	0.786	0.000
Pg N perp–Nx perp Pg	28	−0.294	0.128
Female			
N perp A–Nx perp A	44	0.265	0.083
FH\GoMe–X1-X2/Go-Me	44	0.647	0.000
Pg N perp–Nx perp Pg	44	−0.146	0.343

CONCLUSION

- The Anotolian Turkish sample has shorter midfacial (Co-A) and mandibular (Co-Gn) lengths and a more protrusive maxilla (N perp A) and mandible (Pg N perp).
- Extracranial reference lines are more reliable than intracranial reference lines because of interindividual variability.
- Along with clinical and radiographic examination, knowledge of normative cephalometric values for the Turkish population is important in clinical treatment planning.

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