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Original Article

Evaluation of craniofacial proportions: A pilot study

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ABSTRACT

Background: Regarding the need for determining the cephalometric norms for each population and the advantages of proportional analyses, we evaluated the variables of McNamara and Schwartz analyses and their relation in a pilot study on 6-17 years old Iranian students and provided formulas, which show these relations.

Materials and Methods: In this descriptive-analytical study, a tatal of cephalometric radiographs from the archive documents of Orthodontic Department of Isfahan Dental School was selected and traced. The variables of McNamara and Schwartz analyses were investigated. The data were analyzed by *t*-test and linear regression and Spearman correlation coefficient tests using SPSS 12 software, and the significance was set at 0.05. Then, a formula was suggested for predicting the relation between the jaws, cranium and face.

Results: The variables measured in this study were significantly different between the genders ($P < 0.05$), except for Co-Gn ($P = 0.055$), and they were higher in boys. All variables significantly increased ($P < 0.05$) with age from 6 to 17 years. The formulas presented in this study can be used for calculating the amount of PNS-AP_{max}, Go-AP_{man} and the Co-Gn, anterior nasal spine-menton in the Iranian population.

Conclusion: Within the limitation of this study, the formula presented in this study might be considered to predict the relation between jaw dimensions and cranial base and facial dimensions in the Iranian population.

Key Words: Analysis, cephalometry, orthodontics

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INTRODUCTION

Overcoming the psychosocial problems of unfavorable teeth and jaw appearance is a major cause for orthodontic treatment, and facial esthetics should be considered in clinical examination. However, esthetics has a subjective nature and instead facial proportion should be evaluated. In other words, finding the disharmony is an important goal in orthodontic diagnosis and treatment planning.[1]

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Cephalometry, alongside clinical examinations, is a useful method for evaluating the coordination of cranium, face and teeth and the geometric relation of these parts. Cephalometric analyses are very important in assessing treatment outcomes and also can be used for understanding the craniofacial features of different ethnic populations.[2]

Researchers have suggested the use of analyses that assess the varieties of each person's facial structure and evaluate their correlations. In these analyses, each individual has its own norms.[3,4] Several studies have shown that cephalometric norms differ between various age, sex and ethnic groups.[5,6] Therefore, it is logical to obtain cephalometric norms for each population.[2,7-10]

Regarding the need for determining the cephalometric norms for each population and the advantages of proportional analyses, we evaluated the variables of McNamara and Schwartz analyses and the irrelationin 6-17-year-old Iranian students and provided formulas,which show these relations.

MATERIALS AND METHODS

In this descriptive-analytical study, archive documents of Orthodontic Department of Isfahan Dental School were used. This study was approved by the Ethics and Research Committee of the School of Dentistry, Isfahan University of Medical Sciences. A total of 235 cephalometric radiographs of children, aged between 6 and 17 years, who had no history of orthodontic treatment and also based on 13 following criteria categorized as normal occlusion, was selected:

1. Symmetric face
2. The dentition must be complete regarding age (missing primary teeth were accepted if the space was maintained)
3. All teeth should have normal forms, size and position.
4. Class I (CLI) molar relation in permanent dentition/CL I or end to end molar relation in mixed dentition/flush terminal plane relation in second primary molars
5. CLI can in erelations
6. Normal overbite (maximum 3 mm) and normal over jet (maximum 2 mm)
7. Minimal or no space between teeth
8. Minimal or no rotations
9. No present crowding
10. No posterior cross bite
11. Nopreviousorthodontictreatment
12. No previous orthodontic surgery
13. No congenital deformities

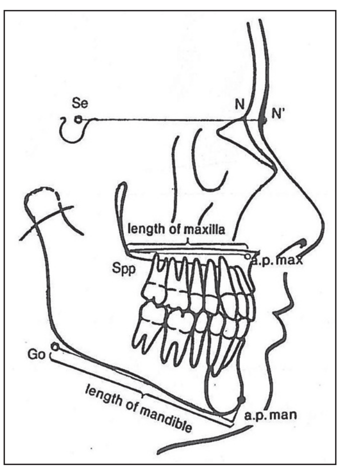

Figure 1: The cephalometric landmark and definitions (Schwarz[11]). Se: Sella (he center of sella turcica); N: Nasion (the most anterior limit of suture nasofortnal); Go: Gonion (the most outward point on the angle formed by the ramus and body of the mandible on its posterior, inferior aspect); Spp: Posterior nasal spine (the apex of the posterior nasal spine); AP_{man} (an anterior index for determining mandibular length, a perpendicular line from pogonion to the mandibular plane); AP_{max} (ananterior index for determining maxillary length, a perpendicular line from A point to palatal plane); N': Soft tissue nasion (the deepest point on the midline of forehead and nose).

Cephalometric method

The selected cephalograms were traced using Dentaurum acetate paper (Dentaurum, Germany), and the variables were measured using a cephalometric protractor (3M Unitek Corporation, Monrovia, California, USA). The measured cephalometric landmarks are presented in Figures 1 and 2.

Statistical analysis

The data were analyzed by *t*-test, linear regression and Spearman correlation coefficient tests using SPSS 12 software (SPSS Inc., Chicago, IL, USA). The significance was set at 0.05. Afterward, we offered formulas that can predict the relation between the jaws, cranium and face.

RESULTS

The data obtained from 6 to 17 years old Iranian students are shown in Table 1.

The results showed that except for the Co-Gn (P = 0.055), all other landmarks were significantly different between the genders ($P < 0.05$).

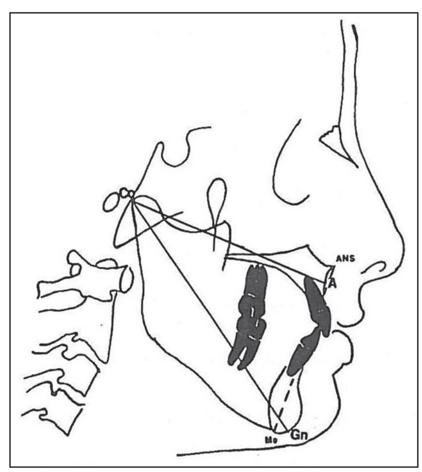

Figure 2: The cephalometric landmarks and definitions (McNamara[12]). ANS: Anterior nasal spine (the apex of the ANS); A: Subspinale (the most posterior point on the concave anterior point on the outline of the mandibular condyle); Me: Menton (the lower most point on the shadow of the mandibular symphysis).

There was a significant relation between the variables and age in which all increased by age [Table 1].

There was a relation between the effective midfacial length (Co-A), effective mandibular length (Co-Gn) and the anterior-lower facial height (anterior nasal spine-menton [ANS-Me]). There was also a relation between the anterior cranial base length (Se-N), maxillary base length ($PNS\text{-}AP_{max}$) and mandibular base length ($Go\text{-}AP_{man}$). The linear relation between the mentioned variables was achieved by linear regression analysis. The linear relation between the variables is "Y = α + ßX", which "Y" is the dependent variable and "X" is the independent variable. Table 2 shows calculating the amount of $PNS\text{-}AP_{max}$, $Go\text{-}AP_{man}$ (from the Schwartz[11] analysis) and the Co-Gn, ANS-Me (from the McNamara[12] analysis) using the formula.

Table 3 shows the relation between the effective length of maxilla, effective length of mandible and the lower facial height.

Table 4 shows the relation between maxillary base length, mandibular base length and Se-N.

Table 1: Mean amount of the evaluated variables regarding gender and the correlation coefficient between age and measured landmarks

Variable	Mean (mm)	SD	P	CC between age and measured landmarks
ANS-Me				0.6718*
Female	63.59	3.44	0.03	
Male	65.21	4.91		
Co-A				0.6878*
Female	87.36	3.04	0.005	
Male	89.37	4.41		
Co-Gn				0.8079*
Female	112.08	4.66	0.055	
Male	114.5	6.28		
Se-N				0.4115*
Female	70.2	2.73	0.000	
Male	72.71	3.77		
$PNS\text{-}AP_{max}$				0.708*
Female	42.51	2.77	0.004	
Male	48.66	2.91		
$Go\text{-}AP_{man}$				0.5218*
Female	74.48	3.6	0.029	
Male	76.28	4.42		

[a]SD: Standard deviation; ANS-Me: Anterior nasal spine-menton; Co-A: Condylion-subspinale; Co-Gn: Condylion-gnathion; Se-N: Sella-nasion; PNS-APmax: Posterior nasal spine-anterior index of maxillary length; $PNS\text{-}AP_{man}$: Posterior nasal spine-anterior index of mandibular length. [b]CC: Correlation coefficient. *All correlation coefficients showed significant relationship with age.

Table 2: The specific formula for evaluated variables

Variable	Formula for calculating the variable
$X_{Co\text{-}Gn}$	$(X_{Co\text{-}A}\times1.427)-12.81$
$X_{ANS\text{-}Me}$	$(X_{Co\text{-}A}\times0.573)+1.6748$
$X_{PNS\text{-}APmax}$	$(X_{Se\text{-}N}\times0.435)+16.937$
$X_{Go\text{-}APman}$	$(X_{Se\text{-}N}\times0.94)+8.264$

Co-Gn: Condylion — gnathion; ANS-Me: Anterior nasal spine — menton; $PNS\text{-}AP_{max}$: Posterior nasal spine — anterior index of maxillary length; $Go\text{-}AP_{man}$: Gonion - anterior index of mandibular length; Co-A: Condylion-subspinale; Se-N: Sellanasion.

DISCUSSION

The *t*-test was used to evaluate the differences between the genders. The results showed that except for the effective length of mandible (Co-Gn), every other variable was significantly higher in boys [Table 1]. Our study agrees with the study of Wu *et al.*,[13] which measured the normal amounts of McNamara analysis in 12-year-old Chinese students. Their study showed that Co-Gn had no significant difference between genders. Hajighadimi *et al.*[8] carried out the Steiner analysis on 67 Iranian children. Their study showed that there were significant differences between boys and girls regarding dental parameters, but no difference was observed when evaluating the skeletal parameters. Sadeghian *et al.*[10] compared the ANB, ß-angle, and the wits index between 6 and 17 years old Iranian boys and girls and reported no significant difference. But the μ-angle was significantly different between the genders in the same population.[14]

The spearman correlation coefficient was used to evaluate the relation of the variables with age. The analysis showed that there was a positive correlation with age that shows that the variables increase significantly from 6 to 17 years of age. This is logical due to the growth process in this range of age. Chalipa *et al.*[2] showed that there were significant changes in the location of cephalometric landmarks in 8-14-year-old Iranian girls in different age groups. Sadeghian and Samani[15] carried out a study on 96 Iranian students aged between 8 and 17 years and showed that there was a significant relation between age and dental arch width.

The linear parameters from the McNamar aanalysis[12] (Co-A, Co-Gn, ANS-Me) were measured in this study. Comparing the mean of parameters measured in this study with McNamara norms showed that lower anterior facial height (LAFH) is slightly greater in Iranian population, but the difference was not significant. Other parameters measured in this study were significantly lower than McNamara norms.

Table 3: Relation between midfacial length, mandibular length and LAFH in 6-17-year-old Iranian students

Midfacial length (mm) (Co-A)	Mandibular length (mm) (Co-Gn)	LAFH (mm) (ANS-Me)
75	94.22	59.72
76	95.64	60.3
77	97.07	60.87
78	98.5	61.44
79	99.92	62.02
80	101.35	62.59
81	102.78	63.19
82	104.2	63.73
83	105.63	64.3
84	107.06	64.88
85	108.49	65.45
86	109.91	66.03
87	111.34	66.6
88	112.77	67.17
89	114.19	67.75
90	115.62	658.32
91	117.05	68.98
92	118.74	69.46
93	119.9	70.04
94	121.33	70.61
95	122.76	71.18
96	124.18	71.76
97	125.6	72.33
98	127.04	72.9
99	128.46	73.48
100	129.89	74.05
101	131.32	74.64
102	132.74	75.19
103	134.17	75.77
104	135.6	76.34

LAFH: Lower anterior facial height; ANS-Me: Anterior nasal spine-menton; Co-Gn: Condylion-gnathion; Co-A: Condylion — subspinale.

Regarding the results it can be concluded that the LAFH to midfacial length and LAFH to mandibular length ratios is relatively greater in Iranian population compared to McNamara's norms.

McNamara's study doesn't consider dimorphic differences. In this study, the variables measured from McNamara's study were significantly different between the genders, except for Co-Gn. Although the differences were statistically significant, the numbers were clinically insignificant and therefore a single table can be used for both genders [Table 3].

Maxillary base length, mandibular base length and Se-N were evaluated from Schwartz's analysis.[11] Comparing the present study with Schwartz's analysis shows that there is a significant difference between the mean maxillary and mandibular base lengths, and these parameters are larger in our study. Schwartz uses a single table for both genders. The mean maxillary and mandibular base lengths were close in the present study, and therefore we also used a single table [Table 4].

Table 4: Relation between maxillary base length, mandibular base length and anterior cranial base length in 6-17-year-old Iranian students

Anterior cranial base length (mm)	Maxillary base length (mm)	Mandibular base length (mm)
Se-N	PNS-AP_{max}	Go-AP_{man}
63	44.34	67.49
64	44.78	68.42
65	45.21	69.36
66	45.65	70.3
67	46.08	71.24
68	46.52	72.18
69	46.95	73.12
70	47.39	74.06
71	47.82	75
72	48.26	75.94
73	48.69	76.88
74	49.13	77.82
75	49.56	78.76
76	50	79.7
77	50.43	80.64
78	50.87	81.58
79	51.3	82.52
80	51.74	83.46
81	52.17	84.4
82	52.61	85.34
82.5	52.83	85.81

Se-N: Sella-Nasion; PNS-APmax: Posterior nasal spine — anterior index of maxillary length; Go-AP_{man}: Gonion - Anterior index of mandibular length.

CONCLUSION

Within the limitation of this study, the formula presented in this study might be considered to predict the relation between jaw dimensions and cranial base and facial dimensions in the Iranian population.

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