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SYRIAN NORMS OF MCNAMARA CEPHALOMETRIC ANALYSIS

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Abstract
McNamara's cephalometric analysis is one of the most suitable analyses for diagnosis, treatment planning and treatment evaluation. Yet, no study has, till now, detected the norms of this analysis in a Syrian population. The current study aims to establish cephalometric norms of McNamara's analysis for Syrians with normal occlusion and to compare these norms between males and females.
The study was conducted using lateral cephalometric radiographs of a sample comprised of 100 adolescents with normal, permanent occlusion. The results showed that there were statistically significant gender differences among Syrians for 11 out of 15 cephalometric variables. The comparison revealed statistically significant differences in most variables between Syrian males and females. Therefore, It would be preferable to use the specific Syrian norms.

Keywords: McNamara norms – lateral cephalometric radiograph – occlusion.

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LES NORMES SYRIENNES DE L'ANALYSE CÉPHALOMÉTRIQUE MCNAMARA

Résumé
L'analyse céphalométrique de McNamara est l'une des analyses les plus appropriées pour le diagnostic, la planification et l'évaluation du traitement. Pourtant, aucune étude n'a, jusqu'à présent, détecté les normes de cette analyse dans une population Syrienne. La présente étude vise à établir les normes céphalométriques de l'analyse de McNamara pour des Syriens et de comparer ces normes entre les hommes et les femmes.
L'étude a été réalisée à l'aide de radiographies céphalométriques latérales d'un échantillon composé de 100 adolescents avec occlusion permanente normale. Les résultats ont montré la présence de différences statistiquement significatives entre les deux sexes pour 11 variables céphalométriques de 15. Par conséquent, il serait préférable d'appliquer spécifiquement ces norms en étudiant la population syrienne.

Mots-clés: les normes McNamara - téléradiographie de profil –occlusion.

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Introduction

Following Broadbent [1] and Hofrath [2] development of a standard head imaging method in 1931, a large number of cephalometric analyses was developed. These analyses aimed to obtain norms for the samples used, which were often comprised of untreated specimens with "ideal occlusion" or "well balanced faces" with normal occlusion [3-8]. For many years, the aforementioned analyses formed important guidelines for diagnosis and treatment planning, given that these analyses can aid the orthodontist in specifying the changes that accompany growth as well as the changes resulting from orthodontic treatment [9].

All of the previous analyses were primarily interested in specifying the mean values and the acceptable, normal ranges for skeletal and dental variables. However, only some of these analyses assigned the appropriate importance to soft tissue [10-12].

Solow [13] mentioned that the greatest danger in cephalometric analyses is that they depend on certain craniofacial dimensions as individual values without being in accordance with other values. He thus highlighted the fundamental connection between vertical and horizontal cephalometric variables, introducing the concept or term known as "craniofacial pattern". This term states that although the individual cephalometric norms must be within a standard deviation from those

of the society, they can be still regarded as normal as long as these dimensions were in harmony with each other [13]. In cases with normal, balanced occlusion all, of the dental and facial components must be in agreement with each other [14].

McNamara's analysis is regarded as one of the most important of these analyses since it combines the anterior plane described by Burstone et al. [16] - (the plane passing through point Na and perpendicular to the Frankfort plane)- and a description of the length and relationship of the jaws characterized by Harvold [17]. This study is considered one of the most important studies that take into regard the fit between the craniofacial dimensions and the soft tissues. In addition, McNamara's study has been further developed given the increased need for a sensitive radiograph analysis for the dentition in relation to the skeletal base as well as the relation between the jaws and the cranial base. This approximation renders McNamara's analyses as most appropriate for the purposes of treatment planning and evaluation of results both for regular orthodontic patients as well as for patients with structural discrepancies, who are likely candidates for orthodontic surgery [15].

The problem with the majority of the current analyses is that they depend on the norms obtained from samples belonging to a specific ethnic group, namely Europeans and Americans. It may be inappropriate to apply the same norms to different ethnic groups, since ethnic differences have been proved in many previous studies [18-21].

The norms for McNamara's analysis were obtained from three sources: lateral cephalometric radiographs for individuals from whom the Bolton norms were extracted, a selected group of untreated individuals from the Burlington center for research and a third group of individuals from Michigan, Ann Arbor with good to ideal occlusion and dento-facial harmony [14].

Study sample	Sample size	Age (Mean)
Males	50	16.7±1.7
Females	50	16.4±2.1
Total	100	16.6±1.9

Table 1: Study sample characteristics.

Given the importance of McNamara's analysis, it has been noticed that no study has identified the norms for Syrians. Although previous researches were conducted with the aim of specifying the natural norms of the Syrian society, they have failed to cover all of the variables [22-23].

The present study aims to specify the Syrian norms for McNamara's analysis, by evaluating the variables on a sample of Syrians with normal occlusion, in addition to specifying the gender differences.

Materials and methods

The current study is an analytical sectional study. To determine the appropriate sample size, the Minitab software (Minitab Version 15, Minitab Inc., State College, PA, USA) was used with two-sample t-tests, a selected study power of 80 %, a significance level of 0.05, and a detected difference of 1.5°. The used standard deviation of 2.65° was based on a pilot study of 10 cases (five males and five females). The appropriate sample size was "50" radiographs in each group. The final sample was made up of 100 patients; its distribution is outlined in table 1.

The sample was chosen based on radiographs of patients with normal occlusion attending the college of dentistry at Al Ba'ath University.

The patients' age varied between 13.5-20 years; the permanent occlusion was complete except for the three molars.

The cephalometric radiographs specific to this study were obtained from the archive of the faculty of dentistry at Al Ba'ath University. All the radiographs were taken in normal head position and using the same X-ray device (PAX 400, Vatech Co, Haweseong, Korea).

Method of tracing

The markings and reference lines of McNamara's analyses are outlined in figure 1 and table 2.

The researcher drew all of the cephalometric radiographs and took all of the measurements by hand.

Measurement error

At least a month after the initial tracing and measurement taking, the above points were reallocated and retraced and the measurements were retaken for twenty cephalometric radiographs. These radiographs were randomly chosen from the whole sample. Following this, the results were recorded on separate charts and the mean measurement error (ME) was calculated using Dahlberg formula:

$ME = \sqrt{\sum d^2/2n}$

Where d: difference between the two measurements, n: number of double measurements.

It was observed that the measurement error for the different measurements did not exceed 0.4mm and 0.5 degrees.

Statistical anaylsis

All measured variables were entered into SPSS software (version 17.0, SPSS Inc., Chicago, Il, USA). Mean and standard deviation for the all variables were calculated. After ensuring the normal distribution of the variables,

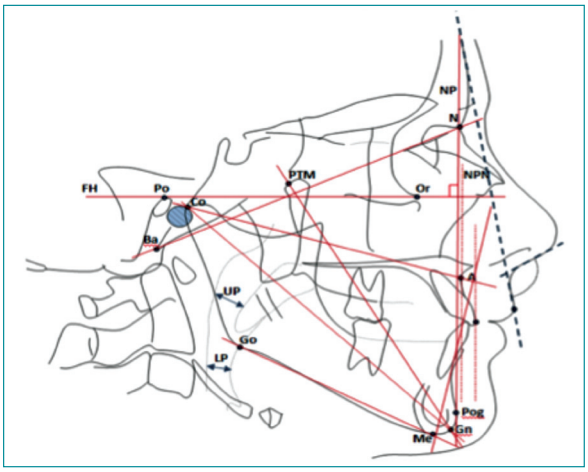

Fig. 1: Points, reference lines and measurements used in McNamara's analysis.

Reference lines	
FH	Line connecting point PO and Or
NP	Nasion perpendicular to Frankfort horizontal plane from point N
NPN	Nasion parallel to line NP, passing through point A
Facial plane	Line connecting the posterior ……
MP	Level of Mandible Go-Me
Measurements used in McNamara's Analysis	
Mandible to cranial base	
A-NP (mm)	Distance between point A and the line NP
SNA (degrees)	Angle formed between the anterior cranial base SN and line NA
Maxillomandibular differential	
Co-A (mm)	Midfacial length: distance between condylion and point A
Co-Gn (mm)	Mandibular length: distance between condylion and gnation anatomic
D (mm)	Difference between mandible length and midfacial length
ANS-Me (mm)	Height of lower anterior facial
MP-FH (degrees)	Mandibular plane angle with Frankfort horizontal plane
Facial axis angle (degrees)	Angle formed between the perpendicular on N-Ba and the facial plane
Maxilla to cranial base	
Pog-NP (mm)	Distance between point Pog and the line NP
Dentition	
Ui-A (mm)	Distance between front upper incisor point to the line NPN
Li-APog (mm)	Distance between front lower incisor point to the line A-pog
Airways	
UP (mm)	Width of upper pharynx
LP (mm)	Width of lower pharynx
Soft Tissue	
Nasiolabial angle (degrees)	Angle formed between upper lip and nasal base
Maxillary retrusion (degrees)	Angle formed between upper lip and the line NP

Table 2: Reference lines and measurements used in McNamara's analysis.

Examined variables	Mean	Lower limit	Upper limit
A-NP	-0.58±0.96	-0.39	1.54
SNA	80.58±1.63	78.14	83.01
Co-A	90.61±2.14	87.56	93.65
Co-Gn	113.98±1.98	110.86	117.09
D	23.38±2.16	20.98	25.77
ANS-Me	63.82±2.50	60.68	66.96
MP-FH	22.61±2.16	20.23	25.00
Facial axis angle	0.83±2.26	-1.44	3.09
Pog-NP	-4.41±2.09	-1.44	3.09
Ui-A	5.55±1.20	4.30	6.81
Li-APog	2.84±1.31	1.51	4.18
UP	17.32±1.36	15.79	18.85
LP	13.24±1.21	11.89	14.58
Nasiolabial Angle	97.76±1.69	95.09	100.43
Maxillary retrusion	11.29±0.84	10.34	12.24

Table 3: Descriptive statistics for the studied variables.

the 2-sample t-tests were carried out to compare between males and females.

Results

Mean and standard deviation of the studied variables are outlined in table 3.

The mean and standard deviation for the male and female groups were calculated separately.

Statistically significant differences were observed between males and females in eleven of the fifteen variables studied. These variables include: the distance between point A from the line NP (A-NP), the difference between the mandible and the midfacial length (D), the height of the lower anterior facial (ANS-Me), the mandibular plane angle with Frankfort horizontal plane (MP-FH), the facial axis angle, the distance between the point Pog from the line NP (Pog-NP), the distance between the front upper incisor point and the line NPN (Ui-NPN), the distance between the front lowermost incisor point from the line A-Pog (Li-APog), the upper pharynx (UP), the lower pharynx (LP) and the maxillary retrusion.

Discussion

The present study established the norms of McNamara's analysis for Syrians. In the published medical literature, no previous study addressed McNamara's analysis with all its variables as they apply to the Syrian society.

The study was designed as an analytical cross-sectional study. It included individuals from the Syrian society with normal occlusion and compared males to females.

An appropriate sample size, representative of the population, was chosen. Thus, the results of this study can be generalized on the entire Syrian society.

Dhalberg's formula revealed that the error in setting the point, tracing and measuring the variables did not exceed 0.4mm and 0.5 degrees. This verifies the reliability of these measurements and rules out occurrence of random errors.

The results of this research indicate that the mean norms for the Syrian sample were within the average mean norms of McNamara's analysis, with the presence of outliers. This agrees with Mahaini's study which indicated that the mean norms for the Syrian sample were within those of the "Orthognathic Face" [25].

Furthermore, the obtained results pointed to the existence of substantial differences between males and females in all of the variables examined. These differences can be noticed in eleven-eight line variables and three angular variables- out of the total fifteen

Variables examined	Male group	Female group	p-value	Significance
	Mean ± SD	Mean ±SD		
A-NP	-1.14 ± 1.28	-0.04 ± 1.34	<0.001	**
SNA	80.26 ± 2.72	80.87 ± 2.49	0.198	-
Co-A	90.76 ± 3.61	90.34 ± 3.72	0.211	-
Co-Gn	114.77 ± 4.65	113.16 ± 4.88	0.135	-
D	24.01 ± 3.77	22.72 ± 3.18	<0.001	**
ANS-Me	65.04 ± 4.82	62.57 ± 4.8	0.024	*
MP-FH	23.01 ± 4.48	22.19 ± 5.11	0.039	*
Facial axis angle	1.17 ± 3.34	0.46 ± 4.09	<0.001	**
Pog-NP	-4.72 ± 5.77	-4.12 ± 5.62	<0.001	**
Ui-A	5.82 ± 2.36	5.26 ± 2.52	<0.001	**
Li-APog	3.13 ± 2.28	2.53 ± 2.36	<0.001	**
UP	17.65 ± 3.11	16.96 ± 2.87	0.016	*
LP	13.44 ± 2.56	13.01 ± 2.25	0.046	*
Nasiolabial angle	98.36 ± 2.85	97.14 ± 2.21	0.173	-
Maxillary retrusion	9.02 ± 3.28	13.53 ± 3.85	<0.001	**

p≤0.05, **: p≤0.01, ***: p≤0.001
Table 4: Mean values and level of significant differences of the variables in males and females.

variables studied. The line variables were significantly larger for males than females.

No statistically significant differences existed between males and females for midfacial length and mandibular length. These results corroborate the findings of Wu et al. [26] on a sample of Caucasian, where they did not register any differences between males and females in these dimensions. However, for a sample of Chinese individuals, their study revealed that the midfacial length was significantly larger for males than females. Whereas, for the same sample, no statistically significant differences were noticed in the males mandibular length as compared to that of the females. The differences in findings can be attributed to ethnic/racial differences between the samples studied. The findings of this study are likewise in contrast to what Azzam [23] found upon examining a Syrian sample. He noticed that the lengths of both the maxilla and mandible were greater in males than females, although it ought to be mentioned that his measurement method of the lengths differed from that used in the present study.

Also, the mandible and maxilla were in a more retruded position in males versus females. This can be clearly seen from the relation between points A and Pog with the line NP. These results conform to those of Wu et al. [26] who found that for a sample of Chinese individuals, differences between the genders exist regarding the relation between the point Pog and the line NP which represents the mandibule's position. However, no such differences were noticed on a sample of Caucasians. As for the position of the maxilla, as represented by the relation between the point A and the line NP, Wu et al. [26] study did not register any differences between the genders in this dimension, for both the Chinese and Caucasian samples in contradiction to the findings of the present study. Furthermore, the findings of this study disagree with the findings of a study by Celebi et al. [27] which pointed to a greater mandibular protrusion for females than males for a sample of Turks. Once again such differences in findings could be attributed to disparities in measurement methods as well as ethnic/racial differences.

The lower anterior facial height was substantially greater for males as compared to females. These findings agree with those of Wu et al. [26] for both the Chinese and Caucasian samples, where they found that the lower anterior facial height was greater for males than females, irrespective of the race. These findings also agree with those of Azzam [23] on a Syrian sample.

Moreover, it was observed that both the upper and lower incisors were protruding substantially in males as compared to females. This is different

from what Wu et al. [26] found for both the Chinese and Caucasian samples, where they did not notice any statistically significant differences between genders. This could be a result of the racial differences between the samples examined.

Azzam's study [23] on a Syrian sample examined the distance between the incisors and the line A-Pog, but did not notice differences between genders. The discrepancy between the findings of our study and Azzam's [23] could be a result of the reference lines applied.

Although the present study did not record any statistically significant differences in the nasolabial angle between males and females, it however revealed that the maxillary protrusion angle was larger in females as compared to males. This signals the more vertical positioning of the upper labia in males in comparison to females in the Syrian sample.

The findings of this study agree with those of a study by Kandhasamy et al. [28], which found no statistically significant differences between males and females in a sample of Japanese. Yet the study pointed out that the nasolabial angle was larger, although not significantly, in males as compared to females. Unlike the findings of the current study, a study by Celebi et al. [27] on a sample of Turks, pointed to a greater protrusion in the upper labia and a smaller nasolabial angle in males relative to females. Once again the discrepancies in the findings can be explained by examining the differences in measurement methods as well as racial/ethnic differences.

In Azzam's [23] study of the Syrian sample, it was noted that the nasolabial angle was considerably larger in males than in females. However the study did not investigate the maxillary retrusion.

Conclusion

The norms generated by the present study can be applied on Syrian patients, as the findings therein represent the natural norms of the Syrian population.

The norms of McNamara's analysis can be applied on Syrian individuals, albeit with caution given that some of the mean values for the norms of the Syrian sample were on the outermost range-outliers- of McNamara's norms.

In addition, it is advisable to use gender-specific norms, since statistically significant differences exist between males and females for most of the variables examined.

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