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Article *in* Indian Journal of Forensic Medicine & Toxicology · April 2021

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Cephalometric Assessment of Iraqi Sample from Basrah City for Orthodontic and Surgical Treatment Planning

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Abstract

Objectives: The aims of the present study were to establish the cephalometric norms for Iraqi sample from Basrah city and to study the sexual dimorphism.

Materials and Methods: Fifty dental students having normal occlusion were recruited and examined clinically then digital true lateral cephalometric X-rays were taken and analyzed using Smile stream software. Mean values and standard deviations were obtained and unpaired t-test was applied to assess the genders difference.

Results: Most of the skeleto-dental measurements lie within the normal range with almost proclined mandibular incisors and no significant gender differences.

Conclusions: Assessing the skeleto-dental relationships is far important to arrange accurate diagnosis and treatment planning for orthodontic and orthognathic cases.

Key words: *Orthodontics, orthognathic surgery, treatment planning.*

Introduction

The sagittal relation of maxilla to mandible is considered as the most important diagnostic criterion even prior to the introduction of Angle's classification of malocclusion at the beginning of previous century. To some degree, this relationship could be assessed by clinical examination, but more accurately it must be evaluated using lateral cephalometric radiograph [(1)].

Broadbent's [(2)] in 1931 introduced his cephalometer to the profession and made such films obtainable despite their primary use was for research and growth studies till the end 1940's. Between 1940 and 1993, a number of different analyses have been devised such as that of Downs [(3-5)], Steiner [(6-8)], Tweed [(9,10)], Ricketts [(11-13)], Wits [(14)], Jarabak and Fizzel [(15)], Burstone *et al.* [(16)], McNamara [(17)] and Arnett and Bergman [(18,19)].

Studies world-wide have remunerated attention to the ethnic factor and attempted to institute cephalometric values for different groups to help planning the right treatment for orthodontic and orthognathic cases [(20)].

In order to analyze dentofacial and craniofacial morphology accurately, a combination of various cephalometric parameters had been made and the majority of these analyses are relied on established norms derived statistically from population samples. Their prime exploit is to give resources for comparison an individual's dentofacial characteristics with a population average so as to recognize areas of considerable deviation, in addition to express the spatial relationship among different craniofacial structures' components [(21)].

In Iraq, many studies have been conducted to establish the cephalometric norms using different analyses and at different ages using sample from Baghdad and Mosul only [(22-30)], so this study aimed to establish the cephalometric norms for Iraqi sample from Basrah city and to verify the existence of sexual dimorphism.

Materials and Methods

Sample

The samples of this cross-sectional prospective cephalometric study included dental students at Basrah University collected between January and September 2020. The inclusion criteria for sample selection included the followings:

1. All were Iraqi Arab white from Basrah city.
2. The age ranged from 19-23 years old.
3. All have complete permanent dentition.
4. No history of previous orthodontic treatment, bad oral habits, facial trauma or craniofacial disorders.
5. All have Class I dental relationships (molars, canines, incisors) with normal overjet and overbite (2-4 mm).
6. Class I skeletal relationship verified clinically by the two fingers method.
7. No spacing/ crowding or it may minor of less than 3 mm.

Methods

After explaining the aims of study, about 200 students agreed to participate then examined clinically to ensure their fulfillment of the inclusion criteria, finally only 50 students (25 males and 25 females) were included. Digital lateral cephalometric radiographs were taken using PaX-i Insight™ machine (Vatech Co. Ltd., Gyeonggi-do, South Korea) with subjects' Frankfort plane parallel to the floor. These radiographs were analyzed after correcting the magnification using Smile stream software (USA). The following points, planes and measurements were determined [21,31]:

Cephalometric points

1. Point S (Sella): The midpoint of the hypophysial fossa.
2. Point N (Nasion): The most anterior point on the nasofrontal suture in the median plane.
3. Point Or (Orbitale): The lowest point on the inferior rim of the orbit.
4. Point Po (Porion): The most superiorly positioned point of the external auditory meatus.
5. Point ANS (Anterior Nasal Spine): It is the tip of the bony anterior nasal spine in the median plane.
6. Point PNS (Posterior Nasal Spine): This is a constructed radiological point, the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose. It marks the dorsal limit of the maxilla.
7. Point A (Subspinale): The deepest midline point on the premaxilla between the Anterior Nasal Spine and Prosthion.
8. Point B (Supramentale): The deepest midline point on the mandible between Infradentale and Pogonion.
9. Point Is (Incisor superius): The tip of the crown of the most anterior maxillary central incisor.
10. Point Ap 1 (Apicale 1): Root apex of the most anterior maxillary central incisor.
11. Point Ii (Incisor inferius): The tip of the crown of the most anterior mandibular central incisor.
12. Point Ap 1 (Apicale 1): Root apex of the most anterior mandibular central incisor.
13. Point Pog (Pognoion): The most anterior point on the symphysis of the mandible.
14. Point Gn (Gnathion): The midpoint between Pogonion and Menton points of the bony chin.
15. Point Me (Menton): The lowest point on the symphyseal shadow of the mandible.
16. Point Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and inferior border of the mandible.
17. AO: Point of intersection of the perpendicular line drawn from point A on to the functional occlusal plane.
18. BO: Point of intersection of the perpendicular line drawn from point B on to the functional occlusal

plane.

19. Point Sn' (subnasale): It is the point where the lower border of the nose meets the outer contour of the upper lip.

20. Point Pog' (soft tissue pogonion): It is the most prominent point on the soft tissue contour of the chin.

21. Point Pn (pronasale): The most prominent point of the nose.

22. Point Li (labrale inferius): It is the median point in the lower margin of the lower membranous lip.

23. Point Ls (labrale superius): It is the median point in the upper margin of the upper membranous lip.

Cephalometric planes

1. Sella-Nasion (S-N) plane: It is the anteroposterior extent of anterior cranial base.

2. Frankfort plane: A line passing through the points Porion and Orbitale.

3. N-A line: Formed by a line joining Nasion and point A.

4. N-B line: Formed by a line joining Nasion and point B.

5. Palatal plane (PP): A plane joining between anterior nasal spine and posterior nasal spine.

6. Mandibular plane (MP): Formed by a line joining Gonion and Menton.

7. A-Pog line: A line from point A to Pogonion.

8. Nasion perpendicular (NP) line: A vertical line drawn from Nasion perpendicular to Frankfort horizontal.

9. A vertical line: A vertical line drawn through point A parallel to the Nasion perpendicular.

10. Long axis of the upper incisor (U1): A line connecting Is and Ap 1.

11. Long axis of the lower incisor (L1): A line connecting Ii and Ap 1.

12. Functional occlusal plane: A line drawn through the region of the overlapping cusps of the first premolars and first molars.

13. Y-axis plane: A line extending between Gn and S.

14. E-line: A line extending from the tip of the nose to the soft tissue pogonion.

Cephalometric measurements

1. SNA: The angle between lines S-N and N-A. It represents the angular anteroposterior position of the maxilla to the cranial base.

2. N Per A: The perpendicular distance between Nasion perpendicular and point A. An anterior position of point A is a positive, and a posterior position is a negative value.

3. SNB: The angle between lines S-N and N-B. It represents the angular anteroposterior position of the mandible to the cranial base.

4. ANB: The angle between lines N-A and N-B. It represents the difference between SNA and SNB angles or it may be measured directly as the angle ANB.

5. Wits appraisal: The distance between AO and BO

6. N Per Pog: The perpendicular distance between Pogonion and Nasion perpendicular. An anterior position of Pogonion is a positive value and posterior position is negative value.

7. Y-axis angle: It is the angle between S-N and S-Gn planes anteriorly. It determines the position of the mandible relative to the cranial base.

8. FMA: The angle formed between the mandibular and Frankfort planes.

9. PP-MP: This defines the angle of inclination of the mandible to the maxillary base.

10. LAFH: The vertical distance between ANS and Me.

11. U1-A vertical: The perpendicular distance between the facial surface of the upper incisor and the point A- vertical plane.

12. U1-Apog: The perpendicular distance between the facial surface of the upper incisor and the point A-Pogonion plane.
13. U1-SN: The angle between long axis of upper incisor and S-N plane, posteriorly.
14. L1-Apog: The perpendicular distance between the facial surface of the lower incisor and the point A-Pogonion plane.
15. L1-NB: The perpendicular distance between the crown tip of the most proclined lower incisor and the NB plane.
16. L1-MP: The angle formed by the long axis of the most labial mandibular incisor to the mandibular plane, posteriorly.
17. U1-L1: The angle formed by the intersection of the lines representing the long axes of the most labial maxillary and mandibular incisors, posteriorly
18. Nasolabial angle (NLA): The angle defined by the columellar point-to-subnasale line intersecting with the subnasale to- labrale superior line.
19. Ls-E: The shortest (perpendicular) distance between Ls and E line.
20. Li-E: The shortest (perpendicular) distance between Li and E line.

Statistical Analysis

Data were analyzed using SPSS version 25 computer program. Means, standard deviations (SD) and independent samples t-test were obtained. Intra-class correlation coefficient test was used to test the intra- and inter-examiner reliabilities. The probability value was set at 5%.

Results

After good training on the software, 10 radiographs were measured by well-trained operator and the results were compared with professional radiologist to test the inter-examiner reliability. On the other hand, the same 10 radiographs were re-measured by the same operator after 2 weeks to verify the intra-examiner reliability. In both situations, the intra-class correlation coefficient test revealed excellent reliability (0.92 for inter- and 0.95 for intra- examiner reliability).

Table 1 showed the descriptive statistics and gender difference of all variables measured. Regarding the position of maxilla relative to the cranial base (SNA angle), there was no significant gender difference with nearly similar mean values. The position of the maxilla relative to N perpendicular showed significant gender difference with higher mean value in males.

Like the maxillary base, the position of the mandible, the difference between the maxillary and mandibular bases represented by ANB angle, Wits appraisal and the position of the chin relative to nasion perpendicular line did not show significant gender difference.

Regarding the vertical jaw relationship, the angular measurements represented by FMA, PP-MP and Y axis angles did not show any statistical gender difference in contrary to the lower facial height measurement that showed significant difference being higher in males.

Assessment of the position and inclination of the maxillary and mandibular incisors were performed using different angular and linear measurements. In general, no significant gender differences were reported in all measurements except the position of maxillary incisors to the A-Pog line and the position of mandibular incisor to the N-B line.

Nasolabial angle and the position of the upper and lower lips relative to the esthetic line showed non-significant gender differences too.

Table 1: Means ± SD and gender difference of different measurements

Measurements		Descriptive statistics				Gender difference	
	Males (N=25)		Females (N=25)				
	Mean	S.D.	Mean	S.D.	t-test	p-value	
Sagittal jaw relations	**SNA(º)**	82.050	2.336	82.376	3.814	-0.365	0.716
	N Per A (mm)	3.063	1.354	1.830	2.550	2.136	0.038
	SNB (º)	81.201	3.600	79.388	3.840	1.722	0.091
	N Per Pog (mm)	-1.296	2.856	-0.264	3.136	-1.218	0.229
	ANB (º)	3.638	0.749	3.232	1.119	1.507	0.138
	Wits (mm)	0.586	1.794	0.670	1.952	-0.158	0.875
Vertical jaw relations	**Y-axis (º)**	59.119	3.073	59.936	3.288	-0.908	0.369
	FMA (º)	23.813	3.754	23.560	4.640	0.212	0.833
	PP-MP (º)	26.502	3.273	27.870	4.365	-1.253	0.216
	LAFH (mm)	76.416	6.530	69.600	6.459	3.711	0.001
Dental relations	**U1-A vertical (mm)**	5.463	1.625	4.744	1.308	1.725	0.091
	U1-Apog (mm)	6.875	1.163	5.856	1.708	2.466	0.017
	U1-SN (º)	102.743	2.952	102.464	3.689	0.295	0.769
	L1-Apog (mm)	3.644	1.579	3.251	1.332	0.951	0.346
	L1-NB (mm)	5.812	1.432	4.833	1.814	2.118	0.039
	L1-MP (º)	96.872	4.834	97.232	5.671	-0.241	0.810
	U1-L1(º)	126.130	4.149	127.239	4.748	-0.880	0.383
Soft tissue relations	**Nasolabial angle (º)**	108.501	5.148	109.292	4.441	-0.582	0.564
	Ls-E line (mm)	-3.528	2.112	-3.344	2.042	-0.312	0.756
	Li-E line (mm)	-1.770	2.517	-0.896	2.497	-1.232	0.224

Discussion

Determination the normal values of cephalometric measurements becomes mandatory for each ethnic group and gender to get a prefect result. In this study, a group of dental students were selected carefully with specific criteria to study the skeleto-dental and soft tissue measurements relevant to the orthodontic and orthognathic cases.

To exclude the effect of growth, all of the participants were aged above 18 years old with normal dental relation and acceptable facial profile. Measurements from different analyses were taken to determine the cephalometric norms of the selected sample.

The first component evaluated was the position of the maxillary base relative to the cranial base represented by SNA angle and the position of point A relative to nasion perpendicular line of McNamara [17]. Regarding SNA angle, the mean value was slightly higher in females with no significant difference; additionally it was near to that of Steiner [6-8], McNamara [17] and other Iraqi studies [25-27]. On the other hand, the position of maxilla in relation to N perpendicular line indicated that males apparently had significant prognathic maxilla. This may be related to the position of point Nasion as reported by Al-Sahaf [22] where the position of point N is more anterior in males so reducing their SNA angle and increasing the distance between point A and Nasion perpendicular line.

Regarding the position of the mandible relative to the cranial base and N perpendicular line, the findings of SNB angle indicated that males had statistically insignificant protrusive mandible on contrary to the position of point pogonion relative to the N perpendicular line where females had protrusive chin; this can be supported by the finding of Kadhom and Al-Janabi [28] who found a more anterior position of point pogonion in females in comparison with males. The two measurements are different as Pogonion is the most anterior point of the chin and it may be differed according to its prominence that may be affected by the facial type and the genetic factor. Moreover, the position of point Nasion may vary between genders.

The vertical jaw relationships were assessed by three angles and one linear measurement. Basically in the literature, the linear measurements in males were reported to be significantly higher than females; this is in accordance with the finding of the present study, while the angular measurements (FMA, PP-MP and Y axis angles) showed non-significant differences and were near to the normal mean values reported in the previous studies [9,29].

Regarding the inclinations and positions of maxillary and mandibular incisors, these teeth were related to many planes. Concerning maxillary incisors position in relation to A-vertical line, it was comparable to that of McNamara [17] and appeared to be more protrusive than Downs [3,4] and Ricketts [11-13] with significantly higher mean values in males in relation to A-Pog line. On the other hand, the inclinations of these teeth were the same as reported by Jarabak and Fizzel [15]. The difference belongs to the point of measurement like the facial surface of the central incisors or the incisal edge and the posterior position of Pognion in males.

The mandibular incisors were related to A-Pog and N-B lines and the findings indicated that the results were comparable to that of Steiner [6-8] and Ricketts [11-13], moreover the mandibular incisors appeared to be proclined in relation to the mandibular plane and this makes the inter-incisal angle slightly lower than reported by Steiner [6-8]. Previous Iraqi studies found the same findings i.e. proclined mandibular incisors [25,29].

The naso-labial angle and lips position in relation to esthetic line of Ricketts determined the soft tissue relationships in the present study. In both genders, naso-labial angle was lie within the normal range of Burstone [16] and slightly protrusive lips that reported by Ricketts [11-13] but within the normal range.

Normal cephalometric values for Basrah population were determined for the first time and appeared to be near to that of Baghdadis and Mosulian people. Further studies are needed to establish the normal values at different ages and Negroid population in Basrah city.

Conclusions

Assessing the skeleto-dental relationships is far important to arrange accurate diagnosis and treatment planning for orthodontic and orthognathic cases.

Ethical Clearance: Approval for this study was taken from the scientific and ethical committees in the

College of Dentistry, Basrah University with reference no. 5 in January 2020. Ps The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq

Conflict of Interest: None

Funding: Self-funding

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