

Three-dimensional analysis of mandible in class one normal occlusion

Hussain A OBAIDI *
Afrah Kh AL-HAMDANY **

ABSTRACT

Most orthodontists and clinicians used to evaluate the patient's profile, clinically and radiologically. To obtain a correct diagnosis, most clinicians now realize the importance of an appraisal of the patient's facial esthetics from the frontal and lateral aspects.

The aim of the present study is to establish the cephalometric mandibular norms of Iraq adults (18-25 years) by means of linear and angular analysis of PA and LAT cephalometric radiographs. The sample is collected from the students of Mosul University and is consisted of 100 Iraqi adults (50 males and 50 females) aged (18-25 years) with class one normal occlusion.

LAT and PA cephalometric radiographs are taken for each subject. Twenty-seven cephalometric measurements (11 angular and 16 linear measurement).

Statistical analysis of data is done by using computerized statistical program Minitab. The angular measurements of the mandible showed that the females are significantly larger than males in the N.S.Ar, SN-MP, SN-Occ and B.Me-MP, where as the S.N.B., S.N.B., S.N.Pog and S.N.Id are significantly larger in the males, and the rest of the angular measurements show no significant difference between the two sexes. All the linear measurements of the mandible for males are significantly larger than the females.

Key words: Radiograph, cephalograph, frontal .

الخلاصة

معظم الاختصاصيين بتقويم الاسنان والسريريين اعتادوا على تقييم المرضى من جهة الجانب ، سريريا و شعاعيا . للتوصل الى فحص صحيح، معظم السريريين الآن يدركون أهمية تخمين المريض المتعلقة بالوجه من ناحيتي الامام (الجبهيّة) والجانب. هدف الدراسة الحالية هو إنشاء قياسات معيارية للفك السفلي للبالغين العراقيين باستخدام التحليلين الخطي و الزاوي للأشعة القياسية الامامية و الجانبية للرأس و إظهار أي علاقة بين البعد السهمي أو العمودي للبعد المستعرض الخاص بالفك السفلي. جمعت العينة من طلاب جامعة الموصل طبقا لمزايا معينة، وكانت متكونة من (١٠٠) بالغ عراقي (٥٠ ذكر و ٥٠ أنثى) تتراوح أعمارهم بين ١٨-٢٥ سنة كلهم مصنفون على انهم من الصنف الأول للإطباق الطبيعي.

*Husain Ahmed OBAIDI ; BDS, MSc : Assistant Prof.

** Afrah Khaz'al AL-HAMDANY; BDS, MSc: Assistant Lecturer.

Department of Pedodontics, Orthodontics, and Preventive Dentistry, College of Dentistry, University of Mosul, Mosul, IRAQ.

- أخذت أشعة قياسية جانبية وأمامية (جبهية) لكل شخص . وتم تحديد ٢٧ قياس (١١ زاوية و ١٦ مسافة) و ٧ نسب خاصة بالفك السفلي . وقد اجري التحليل الإحصائي للبيانات باستخدام الحاسب المبرمج إحصائيا وحسب نظام (minitab) ، وكانت النتائج كالآتي:
- أظهرت الإناث في العينة معدلات أكبر و بشكل ملحوظ من الذكور في القياسات الزاوية التالية: الزاوية السرجية (N.S.Ar) ، زاوية ميلان الفك (SN-MP) ، زاوية ميلان مستوى الإطباق (SN-Occ) و زاوية الارتفاق (B.Me-MP) . بينما كان معدل الزاوية (S.N.B) التي تمثل الموقع الأمامي - الخلفي للفك السفلي نسبة للقاعدة الجمجمية (القحفية) الأمامية و زاوية (S.N.Pog) والتي تمثل الموقع القاعدي للفك السفلي و زاوية (S.N.Id) التي ترمز للعلاقة بين الزائدة السنخية للفك السفلي و القاعدة الجمجمية (القحفية) الأمامية كان أعلى و بشكل ملحوظ في الذكور ، أما بقية الزوايا فأظهرت عدم وجود فروق واضحة بين الجنسين .
 - الذكور أظهرت معدلات أعلى و بشكل ملحوظ من الإناث في كل القياسات الخطية الخاصة بالفك السفلي .

INTRODUCTION AND REVIEW OF LITERATURE

Craniofacial morphology provides valuable data for determining genetic affinities and evolutionary adaptation of human population. Features such as dental arch morphology, shape, size, form, and facial pattern show variations in different genera, species, races and sub-races ⁽¹⁾ Mandibular morphology and position demonstrates great variation, even within ethnic groups ⁽²⁾.

Since the advent of radiographic cephalometry, along series of investigations have been conducted to determine the relation of craniofacial morphology to carious classes of dental malocclusions ⁽³⁾.

The frontal view of the face, and consequently the PA cephalograph, should be an integral part of facial evaluation, as man presents himself to the world face forward. Yet as of 1990, only 13.3% of practicing orthodontists have reported using frontal cephalometric radiographs as a regular record of their patients.

Many articles and atlases have been published on normative data related to facial structures that have been studied by means of lateral cephalometry. Few publications, however, in which the frontal radiography was used, are available for providing data concerning the transverse structures of the face ⁽⁴⁾.

Lateral (LAT) and postero-anterior (PA) radiographs are often used separately in cephalometric analysis. However, with few exceptions development of methods for integrating the two radiographic images to provide accurate three-dimensional models of the skull has not received the same attention as conventional two-dimensional cephalometry ⁽⁵⁾.

A number of authors used LAT and PA cephalographs separately to improve the decision of cephalometric analysis in the study or craniofacial treatment. However, there are very few population standards available for three-dimensional comparisons. The notable exceptions were the series of reports from Savara and associates at University of Oregon Child Study clinic who developed a method of obtaining three-dimensionally corrected distances from cephalograms and have applied it on a longitudinal basis to 103 boys and girls between 3 and 16 years of age ⁽⁶⁻⁸⁾.

In 1974, Ingerslev and Solow performed a three-dimensional study of the Danish population (20-30 years). For each subject LAT and PA cephalographs were taken to determine the sex difference in the craniofacial morphology for Danish Population. Christie (1977) established standards for Caucasian adults with nearly ideal occlusion using LAT and PA cephalographs, in addition to other orthodontic records, to produce a three-dimensional view of the craniofacial skeleton. Other authors performed three-dimensional cephalometric evaluation of craniofacial skeleton to identify specific dentoskeletal anomalies and to determine the effect of different orthodontic treatment⁽⁹⁻¹⁰⁾.

A number of authors and investigators described the relationships of various measurements within the craniofacial skeleton. Biggerstaff *et al.*,⁽¹¹⁾ for example described the comparative data base for diagnosing specific vertical dysplasia of 83 persons attended the University of Michigan over a period 6-16 years of age. They used ratio data to describe the anterior and posterior vertical relationships. Williams and Anderson⁽¹²⁾ analysed the craniofacial morphology of a series of children known to develop class III skeletal pattern; using ratios within the cephalometric measurements. Park *et al.*,⁽¹³⁾ investigated the sexual differences between Korean males and females (18 years old) and used the same ratios to analyse the vertical relations of craniofacial skeleton as described by Biggerstaff *et al.*,⁽¹¹⁾.

Scott⁽¹⁴⁾ investigated the relation between certain cranial and facial dimensions using the results of Young's study in 1916 which was carried out on 700 skulls (without mandibles) obtained from a Glasgow burial ground which was in use in 1840.

Savara *et al.*⁽⁶⁾ studied the relation of sagittal, vertical and transverse measurements of the mandible in their longitudinal study of 103 boys and girls (3-16 years) at University of Oregon Child Study Clinic and developed norms that provide valuable data over this age range.

Athanasίου *et al.*⁽⁴⁾, in their cross-sectional investigation, provided normative data of selected dentofacial PA cephalometric measures and described the patterns of transverse dentofacial structures of 588 Austrian school children (6-15 years old).

Cortella *et al.*,⁽¹⁵⁾ assessed the normal transverse relationship between both jaws in the Bolton-Brush population which consisted of 5000 persons many of whom had serial cephalometric records from early life of adulthood, the records LAT and PA cephalograms.

AIMS OF STUDY

1. To obtain data in three dimensions of the mandible in class 1 normal occlusion of Iraqi adults in Mosul City as measured by PA and LAT cephalometric radiographs to help in diagnosis treatment planning, and prognosis for the orthodontic and particularly orthognathic surgery.
2. To find the sexual differences in mandibular cephalometric measurements.

MATERIALS AND METHODS

Four colleges are randomly selected from the University of Mosul (College of Dentistry, College of Veterinary, College of Sciences and College of Arts). The sample of this study is collected from these colleges. (100) males and females of age ranging from (18-25) years are selected according to the following criteria:

1. Bilateral class I (normal occlusion), canine and molar relationships which is based on Angle classification with over bite and over jet ranging from (2-4) mm.
2. No apparent facial asymmetry.
3. No history of orthodontic treatment or maxillofacial surgery, orthopedic treatment, extensive dentistry.
4. No history of oral habit and no history of mouth breathing.

S. S. White cephalometer with a Wehmer Cephalostat (Model-W- 105 A) set at 90 KV and 15 mA power with 40-50 impulses is used. The double emulsion films used are [8x10 inch] produced by AGFA Gevart N. V. company, Belgium made.

Lateral cephalometric measurement of mandible include ten skeletal angles which are measured to the nearest half-degree. These angular measurements include: S.N.B angle, S.N. Pog, N.S. Ar (Saddle) angle, S.Ar.Go (articular) angle, Ar. Go-Me (gonial) angle, SN-MP angle, Occ-MP angle (Mandibular occlusal angle), SN-Occ angle, B. Me-MP (Symphysis angle) angle and SN-Id angle; and one dental angular measurement: LI-MP angle

And eight linear skeletal measurements are recorded to the nearest half millimeter including five sagittal linear skeletal measurements which are measured directly between two point include: S—N, Go-Me, Sym-De (symphysis depth), Ramus width and Cd-Gn; and three vertical linear skeletal measurements are measured directly between two points include: Ar-Go (ramus length), S-Go (posterior facial height) and N-Me (anterior facial height); and two vertical dental linear measurements are measured: LADH (mandibular anterior dental height) and LPDH (mandibular posterior dental height). The Postero-anterior cephalometric measurements of the mandible include four transverse linear skeletal measurements which are measured directly between two points. These include: Cd-Cd, Lp-Lp, Go-Go (Bi-gonial width) and AG-AG; and two transverse linear dental measurements, these are: Lm-Lm (mandibular inter-molar width) and Lc-Lc (mandibular inter-canine width). The data analysed by using Minitab system loaded on Pentium computer.

Statistical analysis included:

1. Descriptive statistics: Mean and standard deviation for all angular, linear and ratio measurements.
2. The significant differences of means between males and females are determined by using the t-student test at 0.05 level of significance.

RESULTS

Table (1) shows the mean and standard deviation for angular measurements of the total sample with comparison between males and females.

The results of this study indicate that males possessed higher values of the angles S.N.B, S.N. Pog, S.N.Id with significant difference between males and females, and higher S.Ar. Go, Occ. MP with non-significant sex difference at 0.05 level probability.

On the other hand females possess higher values of the angles N.S.Ar, SN.MP, SN.MP, SN-Occ, B. Me-MP with significant sex difference and higher Ar. Go. Me with non-significant sex difference at $P \leq 0.05$.

The females possess higher LI-MP value with non-significant sex difference at $P \leq 0.05$.

Table (1): Means and standard deviations for angular measurement of the total sample with comparison between males and females.

Variable	mean	SD	Sex**	mean	SD	t-value	Sig.*
SNB.	79.71	3.482	M. F.	80.98 78.44	3.352 3.158	3.90	S
SNPog	80.98	3.510	M. F.	82.51 79.45	3.165 3.179	4.82	S
NSAr	122.58	5.73	M. F.	121.12 124.04	6.13 4.93	-2.62	S
SarGo	145.39	7.74	M. F.	145.64 145.14	8.14 7.40	0.32	N.S
ArGoMe	120.5	6.18	M. F.	119.93 121.06	6.06 6.31	-0.91	N.S
SN-MP	29.255	5.626	M. F.	27.46 31.05	5.104 5.597	-3.35	S
Occ-MP	16.795	4.086	M. F.	17.03 16.56	4.058 4.142	0.57	N.S
SN-Occ	12.445	4.276	M. F.	10.44 14.45	3.717 3.863	-5.29	S
Bme-MP	81.27	5.779	M. F.	79.81 82.73	6.147 5.034	-2.6	S
SN-Id	82.175	3.581	M. F.	83.4 80.95	3.540 3.211	3.63	S
LI-MP	96.98	6.436	M. F.	96.77 97.19	6.788 6.125	-0.32	N.S

*N.S=not significant; S= significant at $P < 0.05$

**M=male (n=50); F=female (n=50).

-Variables were measured in degree.

Table (2) show the mean and standard deviations for the linear measurements of the total sample with comparison between males and females.

The results of this study indicate that males possessed higher values of all the skeletal and dental measurements with significant sex difference at $P \leq 0.05$.

Table (2): Means and standard deviations for linear measurement of the total sample with comparison between males and females.

Variable	Mean	SD	Sex**	Mean	SD	T-value	Sig.*
S-N	76.010	3.945	M F	78.32 73.70	3.459 2.929	7.21	S
Go-Me	78.83	5.609	M F	82.16 75.50	4.838 4.186	7.36	S
Pog-SL	15.75	2.191	M F	16.74 15.21	2.440 1.597	3.71	S
Ramus width	35.275	3.135	M F	36.49 34.06	3.517 2.113	4.19	S
Cd-Gn	125.71	7.66	M F	131.10 120.32	6.270 4.470	9.9	S
Ar-Go	55.27	6.067	M F	58.26 52.28	5.310 5.284	5.64	S
S-Go	90.040	7.649	M F	95.42 84.66	5.650 5.216	9.89	S
N-Me	129.07	7.46	M F	133.53 124.61	6.400 5.570	7.44	S
LADH	44.840	2.963	M F	46.80 42.88	3.059 2.455	7.07	S
LPDH	35.695	6.03	M F	37.30 34.09	2.852 2.048	6.43	S
Cd-Cd	108.24	6.07	M F	110.10 106.88	5.220 6.260	3.23	S
Lp-Lp	127.5	8.12	M F	130.28 124.71	6.520 4.010	5.14	S
Go-Go	103.96	6.042	M F	108.68 99.25	7.100 6.126	7.11	S
AG-AG	88.165	3.17	M F	91.03 85.30	5.612 5.052	5.37	S
Lm-Lm	27.71	2.18	M F	58.19 55.63	3.025 2.764	4.4	S
Lc-Lc	27.71	2.18	M F	28.36 27.06	1.935 2.235	3.11	S

*N.S=not significant; S= significant at $P<0.05$

**M=male (n=50); F=female (n=50).

-Variables were measured in degree.

DISCUSSION

In this study, a significant sex difference has been seen in angular measurements related to the anteroposterior position as expressed by S.N.B. This comes in agreement with Fonseca and Klein⁽¹⁶⁾ and Jacobson⁽¹⁷⁾. However, Goldman⁽¹⁸⁾, McNamara⁽¹⁹⁾, Shalhoub *et al.*⁽²⁰⁾, Park *et al.*⁽¹³⁾ and Al-Sayagh⁽²¹⁾ showed no significant difference in SNB angle between males and females. This difference in our study may be attributed to the criteria of the sample selection.

The S.N. Pog angle mean value shows a significant sex difference. This comes in contrast with Ingerslev and Solow's⁽²²⁾ found a non-significant difference for this angular measurements.

The Saddle angle N.S.Ar mean value shows a significant sex difference. This comes in contrast with Ingerslev and Solow's⁽²²⁾ and Al-Sayagh's⁽²¹⁾. The larger Saddle angle for males indicates that the cranial base angle falls under the influence of sex difference.

For the males S.Ar. Go mean value in the present study is higher than that showed by Al-Sayagh⁽²¹⁾. For females, the comparison of the articular angle in our study with other studies reveals a similar value to Al-Faituri⁽²³⁾ for Libyans but a higher value to that of Al-Sayagh⁽²¹⁾.

The gonial angle (Ar.Go.Me) mean value shows no significant sex difference. This comes in accordance with Ingerslev and Solow's⁽²²⁾, Flynn *et al.*'s⁽²⁴⁾ and Al-Abraham's⁽²⁵⁾.

The inclination of mandibular plane (MP) to (SN) plane in this study showed a significant difference with the females having the larger value indicating a more posterior inclination of (MP) in relation to (SN) plane. The result of this study comes in agreement with Park *et al.*,⁽¹³⁾ and Swierenga *et al.*,⁽²⁶⁾

The inclination of occlusal plane in relation to (MP) plane shows a non-significant sex difference and this comes in accordance with Ingerslev and Solow's⁽²²⁾.

For the SN-Occ angle, the result of this study reveals a significant sex difference. Park *et al.*,⁽¹³⁾ found a similar result.

The symphyseal angle (B.Me-MP) in this study is greater than that for females than for males with a significant sex difference with the males have a larger value.

For SN-Id angle, males in this study having a significantly large value than females which means that males have a more mandibular alveolar protrusion than females. In (1974) Ingerslev and Solow showed approximately similar mean values for both males and females.

The inclination of mandibular central incisor in relation to mandibular plane for males and females shows non-significant sex difference. The result of this study comes in accordance with Ingerslev and Solow⁽²²⁾, Connor and Moshiri⁽²⁷⁾, Swierenga *et al.*,⁽²⁶⁾ and Al-Sayagh⁽²¹⁾.

In this study there is a significant difference in all the linear measurements between the two sexes with the males having the larger value than females. This is consistent with the findings of previous studies (Christie,⁽²⁸⁾ Foo⁽²⁹⁾, El-Faituri,⁽²³⁾ Swierenga *et al.*,⁽²⁶⁾; Al-Abraham,⁽²⁵⁾ and Al-Sayagh,⁽²¹⁾).

CONCLUSIONS

- It is concluded that the angular measurements of the mandible are significantly larger in females than males for N.S.Ar, SN-MP, B.Me-MP and SN-Occ, whereas the S.N.B., S.N.Pog and S.N.Id are significantly larger in males. And the rest of the angular measurements show no significant difference between the two sexes.
- The linear measurements of the mandible are significantly larger in the males than in the females.

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