

## The effect of basicranial flexure on facial divergence of Iraqi adults (18–25 years) in Mosul City

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### ABSTRACT

The present study was carried out to detect the possible effect of cranial base angulation on facial divergence in a sample of young Iraqi adults in Mosul City, to investigate the pattern of facial divergence of the sample and to reveal the sex difference in facial divergence.

Sixty-four Iraqi adults (18–25 years), (32) males and (32) females, were collected according to certain criteria. Lateral cephalometric radiograph was taken for each subject. Eighteen variables were recorded and analyzed using SPSS system loaded on Pentium II computer.

The results indicated that: 1) Flexure of basicranium has a detectable effect on facial divergence; 2) The most frequent facial pattern is posterior divergent with convex profile; and 3) There is a significant sex difference in facial divergence.

*Key Words:* Basicranium, facial divergence, cephalogram, facial convexity.

### الخلاصة

أجريت الدراسة الحالية لتحديد التأثير المحتمل لانحناء قاعدة الجمجمة على التباعد الوجهي في عينة مكونة من البالغين العراقيين في مدينة الموصل وللتقصي عن نموذج التباعد الوجهي لهذه العينة، ولإظهار أي اختلافات في التباعد الوجهي لكلا الجنسين.

كانت العينة مكونة من (64) بالغ عراقي (18-25 سنة)، (32) ذكر و (32) أنثى، جمعت العينة وفقاً لمزايا معينة. أخذت أشعة قياسية رأسية جانبية لكل شخص. وسجل (18) متغير وتم تحليل النتائج باستخدام نظام (SPSS) الإحصائي المحمّل على جهاز كومبيوتر (Pentium II).

أظهرت النتائج أن: (1) انحناء قاعدة الجمجمة له تأثير ملحوظ على التباعد الوجهي، (2) النموذج السائد للوجه هو الوجه ذو التباعد الخلفي والمحدّب من الجانب، و (3) كانت هناك اختلافات معنوية بين الجنسين فيما يخص تباعد الوجه.

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## INTRODUCTION

The face is man's most unique social feature, even more so than his name<sup>(1)</sup>. Faces vary from one to another and for many different reasons<sup>(2)</sup>.

There are significant racial differences in facial divergence, and those reasonable degrees of both posterior and anterior divergences are compatible with good facial proportions and good dental occlusion<sup>(3)</sup>.

The growth of facial or cranial parts relates specifically to the other cranial and facial parts. For normal occlusion and facial harmony, all bones must grow in correct<sup>(4)</sup>. The basicranium is generally considered to be the most stable of all portions of the craniofacial skeleton and the least affected by external influences<sup>(5)</sup>.

The cranial base is relatively stable during growth compared with calvaria and face, providing some basis against which the growth of the latter skull elements can be compared. During embryonic and early foetal periods, the cranial base becomes flexed in the area between the pituitary fossa and the spheno-occipital junction; so that the developing face becomes tucked in under the cranium<sup>(6)</sup>.

Previous studies demonstrated that facial forms and types of malocclusion have underlying morphology predisposed by basicranial configuration. The floor of the cranium is a developmental template from which the growing naso-maxillary complex and mandible are suspended. The proportions of the cranial floor establish a corresponding pattern for the facial composite as well as positions of facial components<sup>(5,7)</sup>.

Enlow's philosophy<sup>(5,8)</sup> is that there is an important association between the configuration of the cranial base and face type. Rakosi<sup>(9)</sup> reported that Durer in the 16<sup>th</sup> century had shown the contrast between a convex and concave profile or a broad and a narrow face. Many authors<sup>(10-13)</sup> observed three categories: Convex, straight and concave profiles. There are two major considerations which are responsible for the convex, straight or concave profile line, the position of the maxilla antero-posteriorly in the face (with reference to the cranium) and the relation of the mandible to the maxilla<sup>(14)</sup>.

According to Thomas and Ronald<sup>(1)</sup>, one of the successful classifications of the profile is based on the relationship of the face to its cranial base. A straight face is one in which the anterior limits of the cranial base (point N), the maxilla (point A), and the mandible (point Pog) lie in a vertical plane. If the maxilla and mandible lie posterior to such a vertical plane, the face is said to be posteriorly divergent. If the maxilla and mandible lie anterior to the vertical plane, the face is said to be anteriorly divergent. When the anterior limits of the cranium, maxilla and mandible lie in the same plane, whether that plane is vertical, or posteriorly or anteriorly divergent, the face is said to be orthognathic; i.e. "the jaws are in a line". If the teeth are forward or protracted in relationship to the face, the face is considered to be convex. If the teeth are retracted in relationship to the face, the face is concave. If the mandible is forward or protracted in relationship to the maxilla, the face is considered to be concave.

The facial divergence also has been described by Graber and Swain<sup>(3)</sup>, by taking the mandible a guide to facial divergence. They reported that, if the mandible is positioned posteriorly, as indicated by facial angle less than (90) degrees, the face is posteriorly divergent; while if the mandible is anteriorly positioned and the facial angle is greater than (90) degrees, the face is anteriorly divergent.

Proffit<sup>(15)</sup> reported that divergence of the face is term coined by the eminent orthodontist-anthropologist Milo Helman and is influenced by the patient's racial and ethnic background.

### Aims of the Study

- ◆ To detect the possible effect of cranial base angulation on facial divergence in a sample of young Iraqi adults in Mosul City.
- ◆ To investigate the pattern of facial divergence of young Iraqi adults.
- ◆ To reveal the sex difference in facial divergence of the sample.

## MATERIALS AND METHODS

### The Sample

The study was carried out on (64) young Iraqi adults (32 males and 32 females) students aged (18–25) years from Mosul University. They were collected according to the following criteria:

- 1) Full set of permanent teeth in both jaws excluding third molars.
- 2) Bi-lateral class I canine and molar relationships.
- 3) Overjet and overbite ranging (2–4) mm.
- 4) No dental discrepancy.
- 5) No apparent facial asymmetry.
- 6) No history of orthopaedic, orthodontic treatment or maxillo-facial surgery.
- 7) All subjects are Iraqi in origin and born in Mosul City.

### The Supplies

The S.S White Cephalometer with a Whemer Cephalostat (Model-W-105 A) set at (90) kV and (15) mA power with (40–50) impulses together with (8–10) inches cassette of non-grid Whemer type with a pair of highly sensitive intensifying screen is used for taking lateral cephalometric radiograph.

### The Method

A lateral cephalometric radiograph is taken for each subject in the position of maximum intercuspation and the lips relaxed keeping Frankfort Horizontal Plane parallel to the floor<sup>(16)</sup>. The distance between the source of radiation, mid-sagittal plane of patient and the film cassette is kept fixed.

### Tracing Procedures

All the radiographs are traced in a darkroom. Tracing is done manually including the external and internal contour of the cranium, the outline of pituitary fossa, naso-maxillary complex and mandible.

### The Cephalometric Landmarks (Figure 1)

The following landmarks are used in this study as described Downs<sup>(10)</sup>, Steiner<sup>(12)</sup>, Ricketts<sup>(17, 18)</sup> and Rakosi<sup>(9)</sup>.

- ★ **Point S (sella):** the midpoint of the hypophysial fossa.
- ★ **Point N (nasion):** the most anterior point of the naso-frontal suture in median plane.
- ★ **Point N' (soft tissue nasion):** corresponding to point nasion on soft tissue.
- ★ **Point Ba (basion):** the lowest point on the anterior margin of the foramen magnum in the median plane.
- ★ **Point A (subspinale):** deepest midline point on pre-maxilla between anterior nasal spine and prosthion.
- ★ **Point B (supramentale):** most posterior point in concavity between infradentale and pogonion.

- ★ **Point Pr (prosthion):** alveolar rim of maxilla, the inferior most anterior point on the alveolar process in the median plane between maxillary  $\underline{1|1}$
- ★ **Point Id (infradentale):** alveolar rim of the mandible, the highest most anterior point on the alveolar process in the median plane between the mandibular  $\underline{1|1}$
- ★ **Point ANS (anterior nasal spine):** tip of anterior nasal spine.
- ★ **Point PNS (posterior nasal spine):** tip of posterior spine of palatine bone in hard palate.
- ★ **Point Pog (pogonion):** most anterior point in contour of chin.
- ★ **Point Gn (gnathion):** most inferior and anterior point in contour of chin.
- ★ **Point Me (menton):** most inferior point in contour of chin.
- ★ **Point Go (gonion):** a constructed point, the intersection of line tangents to the posterior margin of ascending ramus and the mandibular base.
- ★ **Point Po (porion):** the most superior point on the periphery of external acoustic meatus.
- ★ **Point Or (orbitale):** lowest point on lower margin of bony orbit.

#### The Cephalometric Planes

- ★ **SN Plane:** is formed by line joining point S and point N<sup>(12)</sup>.
- ★ **FH (Frankfort horizontal plane):** is formed by line joining point Po and point Or<sup>(10)</sup>.
- ★ **PP (palatal plane):** is formed by line joining point ANS and point PNS<sup>(12)</sup>.
- ★ **MP (mandibular plane):** is formed by line joining point Go and point Me<sup>(12)</sup>.

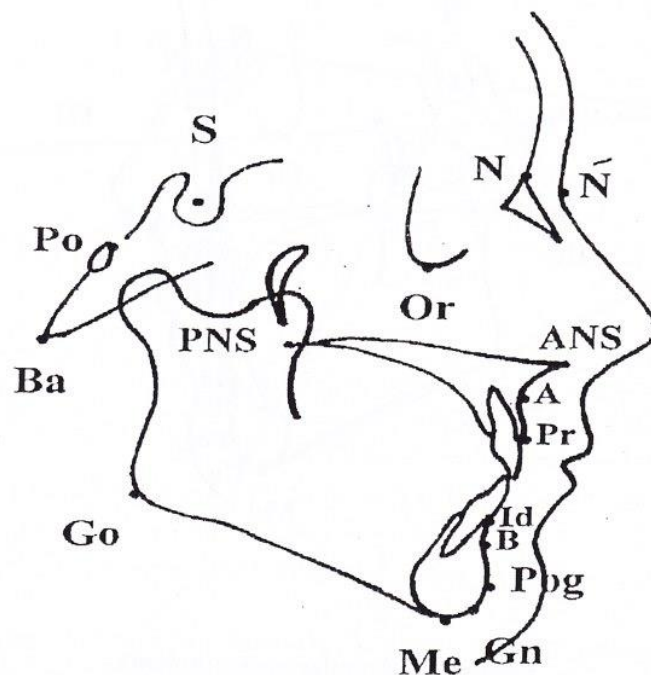


Figure (1): Cephalometric landmarks

## The Cephalometric Measurements

### I – Angular Measurements (Figure 2)

All the angular measurements are measured to nearest half degree.

- ⊗ **N.S.Ba:** angle of cranial base, between the anterior and posterior cranial bases <sup>(5)</sup>.
- ⊗ **S.N.A:** indicates the antero-posterior position of maxilla in relation to anterior cranial base <sup>(12)</sup>.
- ⊗ **S.N.B:** indicates the antero-posterior position of mandible in relation to anterior cranial base <sup>(12)</sup>.
- ⊗ **A.N.B:** indicates the amount of skeletal jaw discrepancy <sup>(12)</sup>.
- ⊗ **S.N.Pr:** indicates the relationship of alveolar process of maxilla to anterior cranial base <sup>(9)</sup>.
- ⊗ **S.N.Id:** indicates the relationship of alveolar process of mandible to anterior cranial base <sup>(9)</sup>.
- ⊗ **S.N.Pog:** indicates the basal position of the mandible in relation to anterior cranial base <sup>(9)</sup>.
- ⊗ **J Angle** (after A. M. Schwarz): the angle of inclination of maxilla between perpendicular from point  $\dot{N}$  to FHP and the palatal plane <sup>(9)</sup>.
- ⊗ **SN-MP:** represents the inclination of mandible to anterior cranial base <sup>(12)</sup>.
- ⊗ **N.S.G (Y-axis):** represents the pattern of mandibular growth <sup>(10)</sup>.
- ⊗ **N.A.Pog:** represents the angle of convexity of facial profile <sup>(19)</sup>.

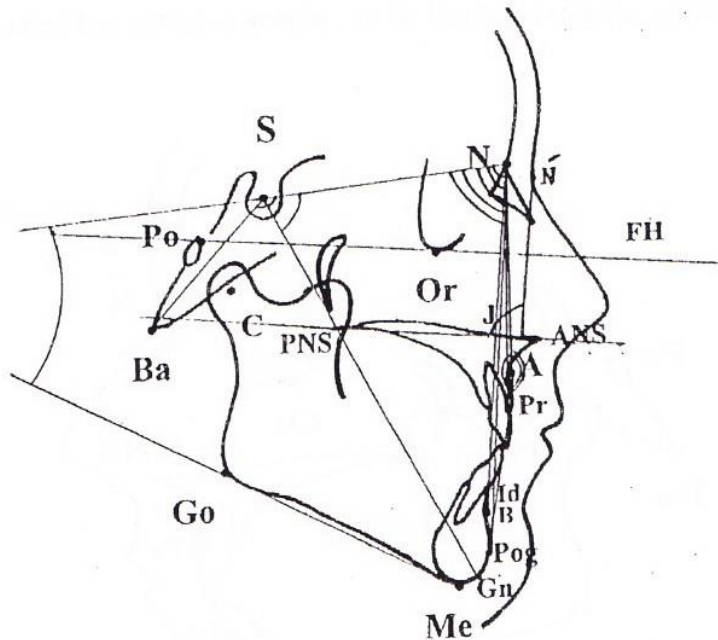


Figure (2): Angular measurements.

## II – Linear Measurements (Figure 3)

These are measured to nearest half millimeter.

- ✿ N-Ba: effective length of cranial base measured from point N to point Ba<sup>(10)</sup>.
- ✿ S-N: represents the length of anterior cranial base<sup>(10)</sup>.
- ✿ S-Ba: represents the length of posterior cranial base<sup>(10)</sup>.
- ✿ AFH (N-Me): anterior facial height, a vertical distance between point N and point Me<sup>(4)</sup>.
- ✿ PFH (S-Go): posterior facial height, a vertical distance between point S and point Go<sup>(4)</sup>.

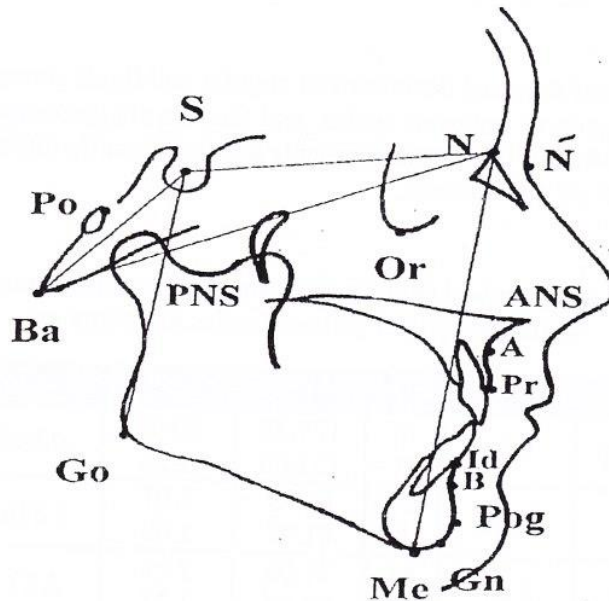


Figure (3): Linear measurements

### Assessment of Facial Divergence

Frankfort horizontal plane has proven adequate for facial typing<sup>(10)</sup>, a perpendicular line is drawn from point N to FH plane.

The facial divergence and facial convexity are classified according to Thomas and Ronald method<sup>(1)</sup>, as described previously, so the face is either orthognathic, anterior divergent, posterior divergent, orthognathic with maxillary protrusion or retrusion, orthognathic with mandibular retrusion or protrusion; and the facial convexity is either straight, convex or concave.

### Calibration Procedure

The validity of landmarks, linear and angular measurements is assessed using intra- and inter- examiner calibration by repeating all tracing procedure and measurements of (8) randomly selected radiographs from the sample with lapse of (2) weeks to exclude the memory bias.

Matching pairs t-test is used; the results indicated no significant difference between the first and second readings at level of ( $p \leq 0.05$ ).

### Analysis of Data

SPSS system loaded on Pentium II computer was used to analyse the data. Statistical analyses include:

1. Descriptive statistics (mean and SD) for all variables.
2. t-test and chi-square test to investigate the sex difference of means between males and females at (0.05) level of significance.
3. Simple Correlation Coefficient (r-value) for all variables for males, females and total sample.

The level of probability is considered significant at ( $p \leq 0.05$ ) and highly significant at ( $p \leq 0.01$ ).

### RESULTS

The mean and standard deviations of angular and linear measurements for total sample with comparison between males and females are presented in tables (1) and (2), respectively. Most of these measurements are significantly differ between the two sexes at (0.05) level of significance.

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

Variable	Mean	SD	Sex	Mean	SD	t-value	Significance
N.S.Ba	130.22	8.26	M	129.38	10.48	-0.815	N.S
			F	131.06	5.22		
S.N.A	82.41	3.09	M	82.89	3.07	1.236	N.S
			F	81.94	3.09		
S.N.B	79.84	3.47	M	81.02	3.21	2.87	S
			F	78.66	3.37		
A.N.B	2.5	2.15	M	1.84	2.04	-2.54	S
			F	3.16	2.09		
S.N.Pr	85.56	3.45	M	85.91	3.54	0.794	N.S
			F	85.22	3.39		
S.N.Id	82.39	3.68	M	83.44	3.67	2.327	S
			F	81.34	3.43		
S.N.Pog	81.1	3.56	M	82.7	3.01	4.01	S
			F	79.5	3.37		
J	84.48	3.37	M	85.31	3.48	2.01	S
			F	83.66	3.1		
SN-MP	29.36	5.99	M	26.44	5.24	-4.44	S
			F	32.28	5.29		
N.S.Gu	67.2	3.67	M	66.31	3.86	-1.987	S
			F	68.09	3.29		
N.A.Pog	184	5.72	M	182.34	5.82	-2.413	S
			F	185.67	5.2		

M = Male (n = 32), F = Female (n = 32).

S = Significant, N.S = Non Significant at  $p \leq 0.05$

- Variables were measured in degrees.

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

Variable	Mean	SD	Sex	Mean	SD	t-value	Significance
N-Ba	110.73	7.88	M	115.58	6.67	6.23	S
			F	105.87	5.76		
S-N	76.23	4.29	M	78.94	3.56	6.47	S
			F	73.53	3.11		
S-Ba	49.03	3.57	M	51.53	2.31	7.84	S
			F	46.53	2.77		
AFH	128.7	7.15	M	132.14	7.01	4.36	S
			F	125.26	5.52		
PFH	89.36	7.94	M	95.19	6.09	8.65	S
			F	83.53	4.58		

M = Male (n = 32), F = Female (n = 32).

S = Significant, N.S = Non Significant at  $p \leq 0.05$

- Variables were measured in millimeters.

Table (3) showed the percentage and chi-square test of facial divergence for total sample with comparison between the two sexes. The most frequent facial divergence pattern is the posteriorly divergent face (60.9%), followed by anteriorly divergent (17.2%) then orthognathic (10.9%) and orthognathic with mandibular retrusion (10.9%). All these patterns are significantly differ between the two sexes.

Table (3): Percentage and chi-square test of facial divergence for total sample with comparison between males and females

Facial Divergence	Percentage	Sex	Percentage	Chi-square Test	Significance
Posterior Divergent	60.9	M	71.9	15.358	S
		F	50		
Orthognathic	10.9	M	6.3	2.857	S
		F	15.6		
Orthognathic with Mandibular Retrusion	10.9	M	3.1	3.265	S
		F	18.8		
Anterior Divergent	17.2	M	18.8	4.192	S
		F	15.6		

M = Males (n = 32); F = Females (n = 32).

S = Significant.

- d.f = 9.



Table (4) represents the percentage and chi-square test for facial convexity of total sample with comparison between males and females. The most frequent pattern of facial convexity is convex profile (57.8%), followed by straight profile (23.4%) and the least is concave profile (18.8%). All these patterns of facial convexity are significantly differ between the two sexes.

Table (4): Percentage and chi-square test of facial convexity for total sample with comparison between males and females

Facial Convexity	Percentage	Sex	Percentage	Chi-square Test	Significance
Convex	57.8	M	43.8	14.76	S
		F	71.9		
Straight	23.4	M	21.9	5.749	S
		F	25		
Concave	18.8	M	34.4	6.009	S
		F	3.1		

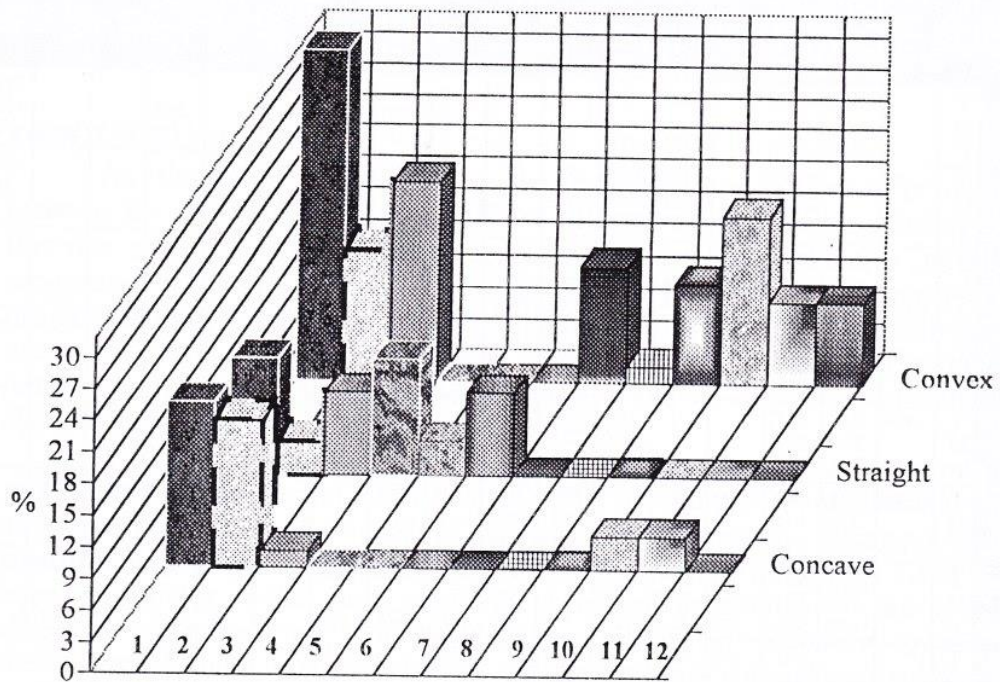
M = Males (n = 32); F = Females (n = 32).

S = Significant.

- d.f = 4.

Figure (4) demonstrated a histogram showing the comparison of percentage between males and females for different facial convexities in relation to their facial divergence. It was found that (31.25%) of convex profile faces are posteriorly divergent, (15.63%) are anteriorly divergent, and (10.94%) are orthognathic with mandibular retrusion; whereas (10.94%) of straight faces are posteriorly divergent and (10.94%) are orthognathic faces. Of concave faces, (15.63%) are posteriorly divergent and (3.13%) are anteriorly divergent.

Table (5) represents pearson correlation coefficient of cephalometric measurements of total sample with comparison between males and females.



- 1 ■ Posterior Divergent (Total)
- 2 ■ Posterior Divergent (Males)
- 3 ■ Posterior Divergent (Females)
- 4 ■ Orthognathic (Total)
- 5 ■ Orthognathic (Males)
- 6 ■ Orthognathic (Females)
- 7 ■ Orthognathic with Mandibular Retrusion (Total)
- 8 ■ Orthognathic with Mandibular Retrusion (Males)
- 9 ■ Orthognathic with Mandibular Retrusion (Females)
- 10 ■ Anterior Divergent (Total)
- 11 ■ Anterior Divergent (Males)
- 12 ■ Anterior Divergent (Females)

Figure (4): The comparison of the percentage between males and females for different facial convexities in relation to their facial divergence

Table (5): Pearson Correlation Coefficient of cephalometric measurements of total sample with comparison between males and females

Variable	Sex	NSBa	SNA	SNB	ANB	SNPr	SNId	SNPog	J	SN-MP	NSGn	NAPog	NBa	SN	SBa	AFH	PFH	Facial Divergence	Facial Convexity
NSBa	T		<i>-.365</i>			<i>-.275</i>	<b>-.286</b>				<i>.639</i>		<i>.445</i>					<b>.221</b>	
	M										<i>.724</i>		<i>.432</i>		<i>.357</i>			<b>.203</b>	
	F		<i>-.512</i>	<i>-.377</i>		<i>-.435</i>	<i>-.435</i>				<i>.495</i>		<i>.458</i>		<i>-.450</i>		<i>-.447</i>	<b>.240</b>	
SNA	T	<i>-.365</i>		<i>.766</i>		<i>.933</i>	<i>.829</i>	<i>.672</i>			<i>-.359</i>	<i>.330</i>						<b>.258</b>	<i>.296</i>
	M			<i>.791</i>		<i>.945</i>	<i>.852</i>	<i>.679</i>			<i>-.394</i>	<i>.394</i>						<b>.408</b>	<i>.416</i>
	F		<i>-.512</i>	<i>.746</i>		<i>.923</i>	<i>.971</i>	<i>.688</i>		<b>-.383</b>	<b>-.445</b>	<b>.402</b>					<i>.430</i>	<b>.377</b>	
SNB	T		<i>.766</i>		<i>-.455</i>	<i>.735</i>	<i>.962</i>	<i>.957</i>	<i>.461</i>	<i>-.499</i>	<i>-.511</i>				<i>.325</i>		<i>.458</i>		
	M		<i>.791</i>		<b>-.383</b>	<i>.874</i>	<i>.952</i>	<i>.950</i>	<i>.396</i>	<i>-.739</i>	<i>-.716</i>						<i>.653</i>		
	F		<b>-.337</b>	<i>.746</i>	<i>-.399</i>	<i>.627</i>	<i>.971</i>	<i>.965</i>	<b>.434</b>	<i>-.739</i>	<i>-.716</i>						<i>.653</i>		
ANB	T			<i>-.455</i>			<b>-.311</b>	<i>-.520</i>	<i>-.390</i>	<i>.512</i>	<b>.286</b>						<i>-.393</i>	<b>.267</b>	<i>.728</i>
	M			<b>-.383</b>				<i>-.469</i>									<i>.762</i>		
	F			<b>-.399</b>				<i>-.432</i>	<i>-.505</i>	<i>.531</i>	<i>.456</i>						<i>.649</i>		
SNPr	T	<i>-.275</i>	<i>.933</i>	<i>.735</i>			<i>.797</i>	<i>.630</i>	<b>.275</b>		<b>-.312</b>								
	M		<i>.945</i>	<i>.874</i>			<i>.904</i>	<i>.777</i>	<b>.445</b>										
	F		<b>-.435</b>	<i>.923</i>	<i>.627</i>		<i>.695</i>	<i>.553</i>			<b>-.401</b>	<i>.437</i>							<i>.377</i>
SNId	T	<b>-.286</b>	<i>.829</i>	<i>.962</i>	<b>-.311</b>	<i>.797</i>		<i>.903</i>	<i>.452</i>	<i>-.372</i>	<i>-.458</i>				<i>.275</i>		<i>.358</i>		
	M		<i>.852</i>	<i>.952</i>		<i>.904</i>		<i>.894</i>	<b>.382</b>								<i>.630</i>		
	F		<b>-.435</b>	<i>.806</i>	<i>.971</i>	<i>.695</i>		<i>.924</i>	<b>.446</b>	<i>-.626</i>	<i>-.641</i>						<i>.630</i>		
SNPog	T		<i>.672</i>	<i>.957</i>	<i>-.520</i>	<i>.630</i>	<i>.903</i>		<i>.437</i>	<i>-.602</i>	<i>-.532</i>	<i>-.356</i>			<i>.381</i>		<i>.544</i>		<i>-.337</i>
	M		<i>.676</i>	<i>.950</i>	<i>-.469</i>	<i>.777</i>	<i>.894</i>		<b>.365</b>								<i>.637</i>		
	F		<i>.688</i>	<i>.965</i>	<b>-.432</b>	<i>.553</i>	<i>.924</i>		<b>.393</b>	<i>-.747</i>	<i>-.723</i>						<i>.637</i>		
J	T			<i>.461</i>	<i>-.390</i>	<b>.275</b>	<i>.452</i>	<i>.437</i>		<b>-.272</b>		<i>-.410</i>			<i>.249</i>		<i>.347</i>		
	M			<i>.396</i>		<i>.455</i>	<b>.382</b>	<b>.365</b>									<i>.509</i>		<i>-.407</i>
	F			<b>.434</b>	<i>-.505</i>		<b>.466</b>	<b>.393</b>			<b>-.366</b>	<i>-.487</i>					<i>.509</i>		<i>-.407</i>
SN-MP	T			<i>-.499</i>	<i>.512</i>		<i>-.372</i>	<i>-.602</i>	<b>-.272</b>		<i>.586</i>	<i>.513</i>	<i>-.361</i>	<i>-.423</i>	<i>-.424</i>		<i>-.703</i>		<i>.545</i>
	M										<i>.866</i>	<i>.403</i>				<i>-.494</i>		<i>.566</i>	
	F	<b>.385</b>	<b>-.383</b>	<i>-.739</i>	<i>.531</i>		<i>-.626</i>	<i>-.747</i>				<i>.866</i>	<i>.403</i>			<i>-.706</i>			
NSGn	T	<i>.639</i>	<i>-.357</i>	<i>-.511</i>	<b>.286</b>	<b>-.312</b>	<i>-.458</i>	<i>-.532</i>		<i>.586</i>				<b>-.303</b>			<i>-.347</i>		
	M	<i>.724</i>													<i>.486</i>				
	F	<i>.495</i>	<b>-.445</b>	<i>-.716</i>	<i>.456</i>	<b>-.401</b>	<i>-.641</i>	<i>-.723</i>	<b>-.366</b>	<i>.866</i>						<i>.547</i>	<i>-.505</i>		
NAPog	T		<i>.330</i>		<i>.822</i>			<i>-.356</i>	<i>-.410</i>	<i>.513</i>							<i>-.355</i>	<b>.294</b>	<i>.827</i>
	M		<i>.394</i>		<i>.802</i>					<i>.481</i>								<i>.851</i>	
	F		<b>.402</b>		<i>.811</i>		<b>.437</b>			<b>-.487</b>	<b>.403</b>							<i>.774</i>	
NBa	T	<i>.445</i>								<i>-.361</i>				<i>.783</i>	<i>.642</i>	<i>.497</i>	<i>.577</i>		
	M	<i>.432</i>												<i>.731</i>	<b>.365</b>				
	F	<i>.458</i>												<i>.523</i>	<b>.381</b>				
SN	T									<i>-.423</i>	<b>-.303</b>			<i>.783</i>	<i>.508</i>	<i>.425</i>	<i>.591</i>		<i>-.276</i>
	M													<i>.731</i>		<i>.379</i>			
	F													<i>.523</i>		<i>.379</i>			
SBa	T			<i>.325</i>			<i>.275</i>		<i>.249</i>	<i>-.424</i>				<i>.642</i>	<i>.508</i>		<i>.527</i>	<i>.671</i>	<i>-.289</i>
	M							<i>.381</i>						<i>.365</i>		<i>.484</i>			
	F		<i>.357</i>											<b>.381</b>		<i>.454</i>			
AFH	T									<i>.506</i>			<i>.497</i>	<i>.425</i>	<i>.527</i>		<i>.531</i>		
	M									<i>.537</i>	<i>.547</i>			<i>.484</i>		<i>.396</i>			
	F																		
PFH	T			<i>.458</i>	<i>-.393</i>		<i>.358</i>	<i>.544</i>	<i>.347</i>	<i>-.703</i>	<i>-.347</i>	<i>-.355</i>	<i>.577</i>	<i>.591</i>	<i>.671</i>	<i>.531</i>			<i>-.461</i>
	M									<i>-.494</i>			<b>.379</b>		<b>.396</b>				
	F	<i>-.447</i>	<b>.430</b>	<i>.653</i>			<i>.630</i>	<i>.637</i>	<i>.509</i>	<i>-.706</i>	<i>-.505</i>			<i>.454</i>					
Facial Divergence	T	<b>.221</b>	<b>.258</b>		<b>.267</b>							<b>.294</b>							
	M	<b>.203</b>	<b>.408</b>																
	F	<b>.240</b>																	
Facial Convexity	T		<i>.296</i>		<i>.728</i>									<i>-.276</i>	<i>-.289</i>		<i>-.461</i>		
	M		<i>.416</i>		<i>.762</i>			<i>.377</i>		<i>.545</i>		<i>.827</i>							
	F		<i>.377</i>		<i>.649</i>	<i>.377</i>			<i>-.407</i>	<i>.556</i>		<i>.774</i>							

Italics numbers represent significant at  $p \leq 0.05$ ; Bold numbers represent highly significant at  $p \leq 0.01$   
M = Males (n = 32); F = Females (n = 32); T = Total.  
(-) = negative correlation.

Generally, the correlation coefficient is carried out among all the variables for males, females and total sample separately. Some of them show a positive correlation, while others show a negative one. The "r" value is described as significant at ( $p \leq 0.05$ ) and highly significant at ( $p \leq 0.01$ ).

## DISCUSSION

As shown in table (1), the angle of basicranium (NSBa) is nearly equal between the two sexes with no significant difference. This interesting finding means that this angle is not under influence of sex difference. This fact is true and come in accordance with Ricketts<sup>(20)</sup> who stated that because brain growth is completed early, the cranial base has been employed as reference from which facial growth has been measured true. Ingerslev and Solow<sup>(21)</sup>, and Enlow<sup>(5)</sup> who reported that the basicranium is generally considered the most stable of all portions of craniofacial skeleton and the least affected by external influences.

A significant sex difference is seen in the angular measurements related to antero-posterior position of the mandible (SNB), alveolar process of mandible (SNId) and basal position of mandible (SNPog). These angular measurements are significantly different with the males having larger value. It means that males having larger mandibles and/or more anteriorly positioned mandibles and this comes in agreement with Proffit<sup>(22)</sup> who stated that the males having a tendency toward more forward mandibular rotation, whereas the females showed a backward rotation. The antero-posterior positions of maxilla (SNA) and alveolar process of maxilla (SNPr) are non-significantly differing between the two sexes. However, (ANB) angle is significantly differ with the females having the larger value, meaning that females have a tendency toward more backward rotation. In other words, having more tendency toward convex profile than males.

Both the angles of inclination of maxillary base ( $\angle J$ ) and ( $\angle SN-MP$ ) inclination of mandible in relation to (SN) plane are significantly differ between the two sexes. The males having the larger (J) angle value. Rakosi<sup>(9)</sup> stated that a large (J) angle signifies ante-inclination, a small angle signifies retro-inclination of the lower face. While the females having larger (SN-MP) angle indicating a tendency for more posterior rotation of mandible and more tendency to convex profile than males. Karlson<sup>(23)</sup> stated that (SN-MP) is a fairly good indicator of the direction of mandibular rotation.

Also, (NSGn) angle is significantly larger in females than males supporting the previous results.

The angle of convexity of facial profile (NAPog) is also significantly differ with the females having the larger value indicating high tendency to convex profile in females than males.

Regarding the linear measurements, as found in table (2), all the measurements are significantly differ with the males having the larger value at (0.05) level of significance. The observed difference means that these measurements fall under influence of sex difference.

The pattern of distribution of facial divergence, as shown in table (3); the majority of the sample having posterior divergent faces with the males having a significantly higher percentage than females, followed by anterior divergent faces with the males also having significantly larger value; then followed by orthognathic face pattern with the females having significantly higher value. The orthognathic

profile with mandibular retrusion faces having the same percentage as orthognathic faces with the females also having the larger value.

So the pattern of facial divergence of the present young Iraqi adults approximates the pattern of Whites of northern European ancestry which tend to have a posteriorly divergent face and in contrast to American Indians and Africans which tend to have an anteriorly divergent face; eastern Europeans tend to have straight profile<sup>(15)</sup>.

Facial convexity of the sample is found in table (4). The majority of the sample having convex profile with the females having significantly larger percentage followed by straight profile with the females having significantly higher value than males and the least is concave profile with the males having significantly larger percentage than females.

Generally, the facial convexity of the present young Iraqi adults sample resembles the pattern of Asian faces (Chinese, Japanese) and the Australian aborigine<sup>(19)</sup>.

Figure (4) represents a histogram showing the comparison of the percentage between males and females for different facial convexity in relation to their facial divergence. (31.25%) of convex profile faces having posteriorly divergent faces, (15.63%) of convex profile faces having anteriorly divergent faces and (10.94%) of convex profile faces having orthognathic faces with mandibular retrusion; while (10.94%) of straight faces having posteriorly divergent faces and also (10.94%) of straight faces having orthognathic faces. Regarding the concave faces, (15.63%) of these faces having posteriorly divergent faces, while (1.56%) of these faces having anteriorly divergent faces.

Pearson correlation coefficient for different variables is shown in table (5). The cranial base angle (NSBa) is negatively and significantly correlated with (SNA) angle and negatively and highly significantly correlated with (SNPr) and (SNId). It means that as cranial base angle opens, it has a tendency to decrease the prognathism of the jaws. (NSBa) angle is positively and significantly correlated with (NSGn) which means that as the cranial base angle opens, it results in more mandibular retrusion, as this positions the glenoid fossa (and therefore the condyles) more posteriorly and results in more mandibular retrusion. This is in agreement with Coben<sup>(25)</sup> who stated that obtuse cranial base increases the depth of upper face and results in mandibular retrusion.

The cranial base angle is also significantly correlated with (NBa) and highly significantly correlated with facial divergence. This is an important finding and come in accordance with Thomas and Ronald<sup>(1)</sup> who stated that as the cranial base angle closes, it shortens the effective length of the cranial base (NBa). It also results in thrusting the face into a more anteriorly divergent posture. As the cranial base angle opens, it lengthens the cranial base and creates a more posteriorly divergent relationship face to cranium.

Facial divergence is highly significantly correlated with (SNA), (ANB) and with the angle of convexity of face (NAPog). It means that the more posteriorly divergent the face, associated with high (SNA), (ANB) and increase in face convexity.

The facial convexity is significantly correlated with (NAPog) angle, also positively correlated with (ANB) angle and (SN-MP) angle, and highly significantly correlated with (SNA) and negatively correlated with (PFH). This means that the more convex the profile, associated with increase in maxillary prognathism and posterior mandibular rotation.

(NAPog) angle of face convexity is significantly correlated with (SNA), (ANB) and facial convexity and negatively correlated with (SNPog). This means that as the maxillary prognathism increased or mandibular retrognathism associated with increase in facial convexity.

(NAPog) is negatively correlated with ( $\angle J$ ) and (PFH) and positively correlated with (SN-MP). It means that as face convexity increases, (J) angle reduced associated with retro-inclination of lower face which characterized with increased (SN-MP), increased (AFH) and reduced (PFH), and this come in agreement with Rakosi<sup>(9)</sup>.

## CONCLUSIONS

1. The basicranium angulation affect on facial divergence.
2. The most frequent facial pattern of young Iraqi adults in Mosul City is the posteriorly divergent face with convex profile.
3. There is significant sex difference in facial divergence between males and females.

## REFERENCES

1. Thomas JZ, Ronald ML. Annotated atlas of facial analysis. *Dent Clin North Am.* 1976; 20(4) Oct: 641-660.
2. Johnson EL. The Frankfort mandibular plane angle and the facial pattern. *Am J Orthod.* 1950; 36: 516-533.
3. Graber TM, Swain BF. *Orthodontics: Current Principles and Techniques.* CV Mosby Co. 1985; Pp: 66-67.
4. Biggerstaff RH, Allen RC, Tuncay OC, Berkowitz J. A vertical analysis of the human craniofacial complex. *Am J Orthod.* 1977; 72(4): 397-405.
5. Enlow DH. *Handbook of Facial Growth.* 3<sup>rd</sup> Edn. WB Saunders. Philadelphia. 1982.
6. Sperper GH. *Craniofacial Embryology.* 3<sup>rd</sup> Edn. Bristol. Wright. 1981; Pp: 82-86.
7. Bhat M, Enlow DH. Facial variations related to head form type. *Angle Orthod.* 1985; 55: 269.
8. Enlow DH, McNamara JA. The neurocranial basis for facial form and pattern. *Angle Orthod.* 1973; 43: 256-270.
9. Rakosi T. *An Atlas and Manual of Cephalometric Radiography.* 2<sup>nd</sup> Edn. Wolfe Medical Publication. Great Britain. 1982.
10. Downs WB. Variations in facial relationships: Their significance in treatment and progress. *Am J Orthod.* 1948; 34: 812-840.
11. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. *Angle Orthod.* 1952; 22: 142-145.
12. Steiner CC. Cephalometric for you and me. *Am J Orthod.* 1953; 39: 729.
13. Sassouni V. Classification of skeletal facial types. *Am J Orthod.* 1969; 55: 109-123.
14. Graber TM. *Orthodontics: Principles and Practice.* 3<sup>rd</sup> Edn. WB Saunders Co. 1988; Pp: 35-55.
15. Proffit WR. *Contemporary Orthodontics.* CV Mosby Co. 1993; Pp: 147-149.
16. Miles DA, Van ML, Razmus TF. *Basic Principles of Oral and Maxillofacial Radiology.* 1992; Pp: 137.