

Downs cephalometric norms for Iraqi adolescents in Mosul City

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ABSTRACT

The purpose of this study is to develop cephalometric standards for Iraqi adolescents in Mosul City, using Downs' analysis, and to compare them with those of white Americans.

The lateral cephalometric radiographs (108) Iraqi adolescents (57 males and 51 females) with age range was (12) to (15) years (with a mean of 13.7 years) were carried out. The subjects were chosen on the bases of having class I normal occlusion and well-balanced faces.

Measurements were taken for all dento-skeletal variables in Downs' analysis. Norms were established for the Iraqi sample and the comparison between both sexes was carried out. No significant difference was demonstrated between males and

Females. When the measurements of this study were compared with Downs' original data for white Americans, the Iraqi adolescents showed a highly significant greater values of facial convexity angle, mandibular plane angle, Y-axis angle, occlusal plane angle, lower incisors inclination to the occlusal plane and to the mandibular plane and the distance of upper incisors to Apog line. The interincisal angle and facial angle were significantly higher in Downs' original standards than the present study.

Key words: Cephalometric standards, Downs' Analysis, normal occlusion, balanced face.

الخلاصة

هدف هذه الدراسة هو إنشاء قياسات معيارية براس للعراقيين في العمر المراهقة في مدينة الموصل باستخدام تحاليل داونز وكذلك مقارنة النتائج مع القياسات المعيارية للأمريكيين البيض. شملت الدراسة (١٠٨) مراهق (٥٧ ذكر و٥١ أنثى) تراوحت أعمارهم ما بين (١٢) و(١٥) سنة وبمعدل عمري قدره (١٣,٧) سنة. أن اختيار أفراد العينة كان مستندا على أساس تحلي الشخص بصحة جيدة وامتلاكه الصنف الأول من علاقة Angle بين الطواحن والأنياب وان لا يزيد تزامم الأسنان عن (٣) ملم وكذلك امتلاكه لمنظر جانبي مستقيم الفكين. تم اخذ أشعة قياسية لكل شخص أجريت عليها تحاليل داونز. أجريت القياسات يدويا وحلت النتائج باستخدام البرنامج SPSS وكانت النتائج كالآتي :

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-تم إحراز قيم معدلي مع انحرافها المعياري للقياسات السنية و الهيكلية لتحليل داونز لكل من الذكور والإناث وكذلك العينة الكلية.
-لم يظهر أي فرق معنوي للقياسات بين الذكور والإناث.
-عند المقارنة مع قياسات داونز الأصلية للأمريكيين البيض، أظهرت النتائج امتلاك المراهقين من العراقيين لقيم أكبر وبفرق معنوي لكل من الزاوية الوجيهية، زاوية التحذب، زاوية مستوى الفك السفلي، محور نمو الوجه، زاوية مستوى الأطباق، زاوية ميل القواطع السفلية مع مستوى الأطباق، وكذلك المسافة الخطية بين حافة القواطع الأمامية العلوية والخط المستقيم الواصل بين النقطتين (A و Pog).
-بالنسبة للقواطع العلوية والسفلية أظهرت النتائج أنها أكثر بروزا وبفرق معنوي عند العراقيين منها عن الأمريكان.

INTRODUCTION

Cephalometric studies of different ethnic groups have found that normal measurements of one group should not be considered normal for other racial groups. Different racial groups must be treated according to their own individual characteristics ⁽¹⁾.

Uesato *et al.* ⁽²⁾ showed that the denture bases of the Japanese and Japanese - Americans were positioned slightly more posterior in relation to the cranial bases than those of the Caucasians. The ANB angle of (3) degrees indicated that the Japanese skeletal pattern tends to be more in class II category than in the Caucasian pattern. The relationship of the maxillary central incisor to the line NA was virtually identical with that of the Caucasian. The mandibular central incisor was slightly more procumbent than that of the Caucasian.

Aboul-Azm and Fahmy ⁽³⁾ found those Egyptian adults when compared to white American adults had a greater bimaxillary protrusion and a more acute interincisal angle.

Hajighadimi *et al.* ⁽⁴⁾ found that the skeletal pattern of the Iranian children was more retrusive than that of American Caucasian. Iranian group had a straighter bony profile. The mandibular plane angle and the occlusal plane angle were higher and The dental pattern of the Iranian sample was more procumbent in the Iranian group than the Steiner's norms.

Jung ⁽⁵⁾ noted that the Chinese exhibits a relatively more prognathic lower face - maxilla and mandible and class II tendency than Caucasian.

Bishara and Fernandez ⁽⁶⁾ showed that The SNB and SNPog angles were significantly larger for the North Mexican girls, indicating a relatively more protrusive mandible than the adolescent Iowa female.

Pereira *et al.* ⁽⁷⁾ found that the anteroposterior relations of the mandible and maxilla (ANB angle) of the Sambaquis were slightly more divergent than the reference norms applied to modern Caucasoid population.

Park *et al.* ⁽⁸⁾ found that Koreans have a similar skeletal pattern, slightly larger facial convexity, a more protrusive and labially inclined maxillary and mandibular incisors than Caucasians.

Bishara *et al.* ⁽⁹⁾ found that Egyptian have a tendency toward bimaxillary dental protrusion and a decreased overbite as compared with Iowa boys. Egyptian girls have a relatively more convex profile and a tendency toward mandibular protrusion.

Munandar and Snow⁽¹⁰⁾ found that Deutro-Malay Indonesians were significantly different from Caucasians, Chinese-Malays, and North-Indians for skeletal measures of the angle of convexity and Y axis and for dental variables of interincisal angle and upper incisors to A-Pog.

Miyajima *et al.*⁽¹¹⁾ found that the facial axis angle was more vertical in Japanese subjects than European-American ancestry, indicating a more downward direction of facial development. Japanese were also more protrusive dentally.

The purpose of this study is to establish cephalometric norms for Iraqi adolescents in Mosul City by means of Downs' analysis⁽¹²⁻¹⁴⁾ and comparing the data to Downs' original standards for white American.

MATERIALS AND METHODS

The sample consists of (108) students, (57) males and (51) females in Mosul City. Age range of the sample was (12) to (15) years with a mean of (13.7) years.

Criteria of Sample Selection

Certain criteria were used in the selection of subjects, they are:

- (1) Full complement of permanent dentition in both jaws (except for the third molars).
- (2) Class I molar and canine relationships, which are based on Angle Classification.
- (3) No or mild crowding (less than three millimeters).
- (4) Normal overjet and overbite (ranging from 2-4 mm).
- (5) No apparent dental or skeletal discrepancies and asymmetries.
- (6) No history of facial trauma, orthodontic treatment, extensive restorative dentistry and orthognathic or maxillofacial surgery.
- (7) Good health with no systemic disease.
- (8) No TMJ problems.
- (9) No history of parafunctional oral habits or mouth breathing.
- (10) The subjects were of Iraqi origin with their parents and grandparents were born in the center of Mosul City.

One hundred thirty six subjects met these criteria in the preliminary examination and were asked to report to the College of Dentistry, Mosul University for further examination and for taking cephalometric radiographs. Of these (136) subjects, (18) chose not to participate in the study, and after taking cephalometric radiographs, (10) subjects were excluded because of poorly exposed and / or developed cephalograms, non-occluding teeth and inability to locate the anatomical landmarks accurately on the radiograph. The data of (108) persons were included in the study (57 male and 51 female).

Cephalometric Analysis

Downs' analysis⁽¹²⁻¹⁴⁾ was used for tracing the lateral head film for the subjects. Each subject was traced by one investigator and checked for accuracy by another. Measures of dento-skeletal form were calculated by computer and tabulated by gender into skeletal and dental relationships.

Cephalometric Landmarks

Skeletal Landmarks (figure 1)

1. **Point S (Sella):** mid point of the hypophyseal fossa (sella turcica).
2. **Point N (Nasion):** the most anterior point of the frontonasal suture in the median plane.
3. **Point P (Porion):** the most superior point of the external auditory meatus.
4. **Point Or (Orbitale):** the lower most point on the inferior or bony margin of the orbit.
5. **Point Gn (Gnathion):** the most outward everted point on the profile curvature of the symphysis of the mandible.
6. **Point Go (Gonion):** the most outward and everted point on the angle formed by the junction of the ramus and body of the mandible on its posterioinferior aspect.
7. **Point Pog (Pognoion):** the most anterior point on the symphysis of the mandible.
8. **Point A (Subspinale):** an arbitrary measure point taken at the innermost curvature from the anterior nasal spine to the crest of the maxillary alveolar process.
9. **Point B (Supramentale):** An arbitrary measure point on the anterior profile curvature from the mandibular anthropometric landmark pogonion (Pog) to the crest of the alveolar process.
10. **Point Me (Menton):** Most inferior point on the symphysis of the mandible.

Dental Landmarks

1. **Point U1 (incisor superius):** Incisal tip of the crown of the most anterior maxillary central incisor.
2. **Point L1 (incisor inferius):** Incisal tip of crown of the most anterior mandibular central incisor.

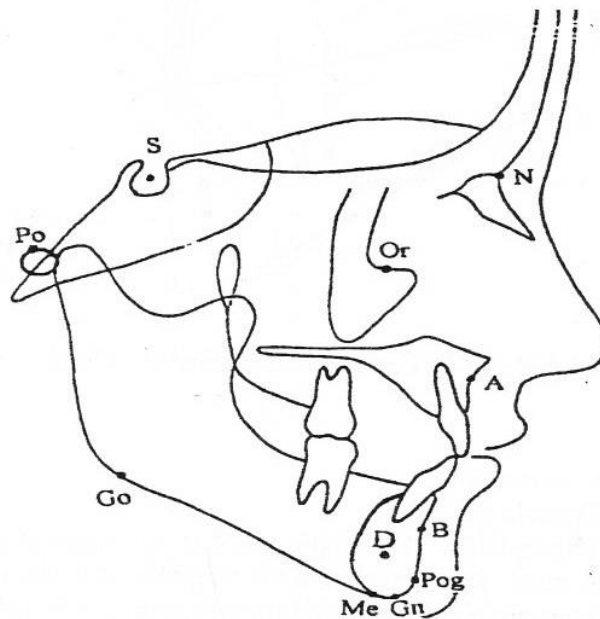


Figure (1): Cephalometric landmarks

Cephalometric Lines and Planes (figure 2)

1. **Frankfort Horizontal Plane (FH):** This facial plane connects the lowest point of orbit (Orbitale) and the superior point of the external auditory meatus (porion), machine porion.
2. **Occlusal Plane (OP):** This denture plane bisects the posterior occlusion of the permanent molars and premolars and extends anteriorly. In an ideal situation, the occlusal plane also bisects the occlusion of the incisor teeth.
3. **Mandibular Plane (MP):** A line between gonion (Go) and gnathion (Gn) (Steiner). In Downs' analysis the mandibular plan is measured between gonion (Go) and Menton (Me).
4. **Facial Plane (N-Pog):** A line from the anterior point of the frontonasal suture (N) to the most anterior point of the mandible (Pog).
5. **Incisal Axes:** The long axes of the maxillary and mandibular central incisors.
6. **Dental base limit (AB):** A line drawn through points A & B.

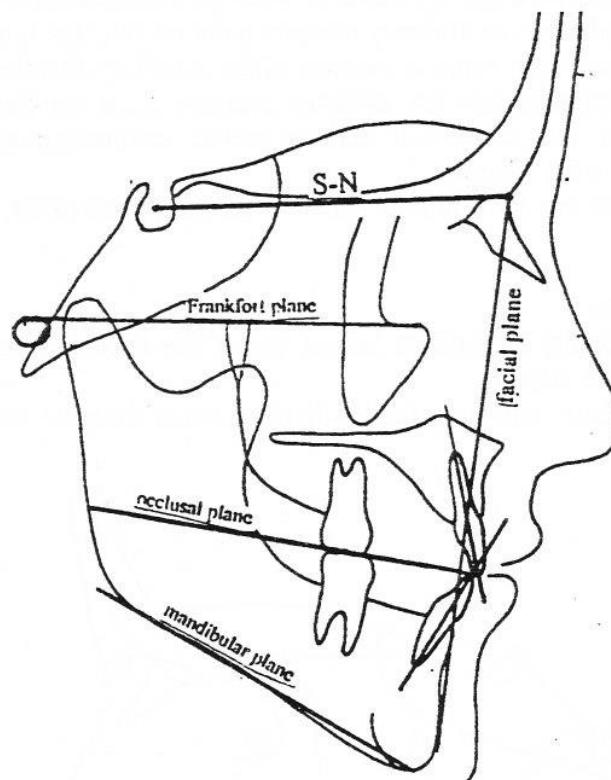


Figure (2): Cephalometric planes and lines

Cephalometric measurements

Downs' Skeletal Criteria (figure 3)

1. **Facial Angle (Npog-FH):** This angle gives an indication of the anteroposterior position of the most anterior point of the mandible. It is the inside inferior angle formed by the intersection of the Frankfort horizontal and facial plane.
2. **Angle of Convexity (N-A-Pog):** This angle reveals the convexity or (concavity) of the skeletal profile. It is formed by the intersection of a line from nasion (N) to Point (A) with a line from point (A) to Pogonion (Pog).

3. **A-B Plane Angle (A-B to NPog):** This angle reveals the maxillo-mandibular relationship of the apical bases relative to the facial line.
4. **Mandibular Plane Angle (MP to FH):** It is intersection between mandibular plane (Go-Me) and the Frankfort horizontal plane (FH).
5. **Y-Axis Angle (S-Gn to FH):** This angle is often called growth axis angle. It is formed by the intersection of a line from sella turcica (S) to Gnathion (Gn) with Frankfort horizontal plane (FH).

1. Facial angle (FH-NPog)
2. Angle of convexity (NA-Pog)
3. AB plane angle (AB-NPog)
4. Mandibular plane angle (FH-MP)
5. Y axis angle (FH-SGn)

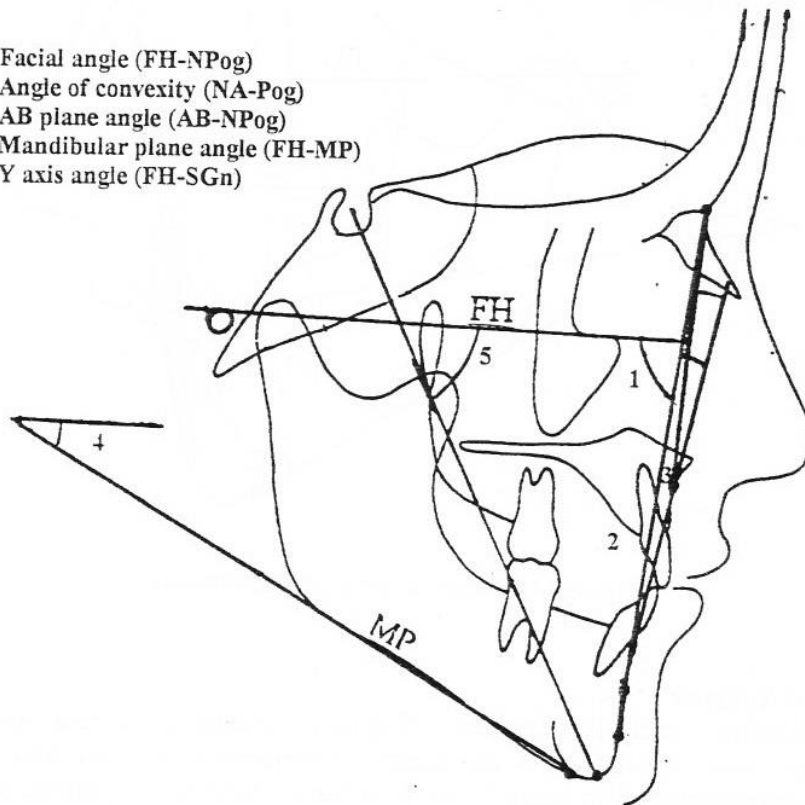


Figure (3): Down's skeletal measurements

Downs' Dental Criteria (figure 4)

1. **Occlusal Plane Angle (OP to FH):** this measurement indicates the angulation of the plane of occlusion relative to the Frankfort plane.
2. **Interincisal Angle (U1-L1):** This angle related the angular position of the long axis of the upper and lower central incisors to each other.
3. **Lower Incisor to Occlusal Plane (L1-OP):** This angle indicates the inclination of the lower central incisor relative to the occlusal plane.
4. **Lower Incisor to Mandibular Plane (L1-MP):** This angle reveals the inclination of the lower central incisor relative to the mandibular plane.

5. **Upper Incisor to A-Pog Line (U1 to APog):** This is only linear measurement in Downs' analysis. It gives an indication of the antero-posterior position of the incisal edge of the upper incisor relative to the A-Pog line.

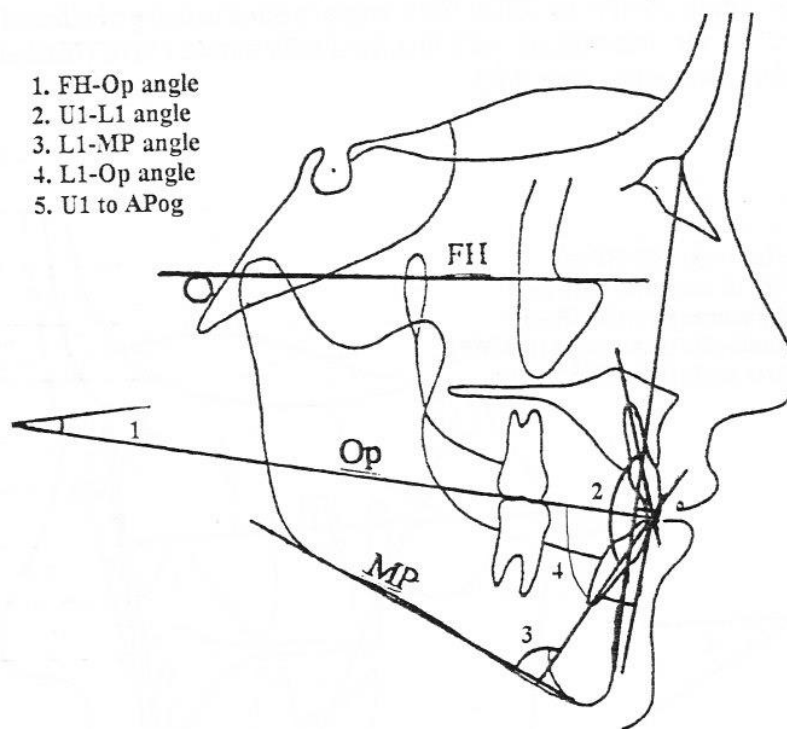


Figure (4): Down's dental measurements

Statistical Analysis

Standard descriptive statistics (minimum, maximum, means, and standard deviations) were calculated for the sample. Comparison between Iraqi males and females was established by using F-test. Comparison between the sample and Downs' original standards for white Americans was conducted by means of *t*-test.

RESULTS

Table (1) presents the minimum, maximum, means and standard deviations of the dento-skeletal measurements for the Iraqi adolescents in Mosul City.

Table (2) shows that the sex differences were small and no statistical significance was noted in the skeletal and dental measurements.

In table (3), The Iraqi subjects show greater values than the White Americans population in the following measurements: Angle of convexity (N-A-Pog), mandibular plane angle (FH-GoMe), growth axis angle (FH-SGn), occlusal plane angle (FH-OP), lower incisor to occlusal plane (L1-OP), lower incisor to mandibular plane (L1-MP) and upper incisor to A-pog line (U1 to Apog). The Iraqi adolescents show lower values of interincisal angle (L1-U1) and facial angle (FH-Npog) as compared to the White Americans sample of Downs'. These differences are highly significant ($p < 0.01$).

Table (1): Descriptive statistics: minimum, maximum, mean and standard deviation for Iraqi adolescents using Downs' skeletal and dental analyses

Variables*	Minimum	Maximum	Mean	SD**
Skeletal Measurements				
FH-Npog	75.0	92.0	84.84	3.54
N-A-Pog	-10.0	13.0	2.79	4.16
AB-NPog	-10.0	1.0	-3.81	2.51
MPA(FH-GoMe)	20.0	39.0	28.0	4.51
FH-SGn	55.0	69.5	62.50	3.37
Dental Measurements				
FH-OP	4.0	18.5	11.56	3.34
U1-L1	111.0	136.0	122.66	5.64
L1-OP	16.0	35.0	24.88	5.01
L1-MP	85.0	108.0	98.03	5.66
U1 to APog (mm)	1.5	12.0	7.43	2.21

* Measurements in degree except U1 to APog in millimeters

** SD: Standard deviation

DISCUSSION

Most Iraqi cephalometric standards are developed for adults^(15,16,17). Their standards may be of value for orthognathic surgery. Cephalometric standards for adolescent Iraqi males and females are urgently needed, because most persons requiring orthodontic treatment are in this age range. These standards will be of value in the diagnosis, treatment planning and treatment of dentofacial anomalies in Iraqi adolescents.

Skeletal Relationships

This study showed no significant differences in all skeletal measurements for Downs' analysis between males and females of Iraqi adolescents. However, the males revealed slightly larger mean values of N-A-Pog, FH-SGn and AB-NPog angles than those of females, indicating that the Iraqi boys have a more convex profile and a more downward growth of the mandible than those of Iraqi females. Females showed a greater mean value than males for facial angle indicating a more anterior position of female's mandible related to cranium when compared to males (table 2).

When the mean values of the sample of the present study were compared to the mean values of the white Americans, the results showed a significant difference for all measurements of Downs' analysis, except AB-plane angle (table 3).

The mean value of facial angle (FH-NPog) showed a lower value than that of White Americans. This indicates a posterior position of the mandible in relation to the cranium when compared with an average of (87.7°) of Downs' group. The mean value of the angle of convexity (N-APog) was (+2.79°) in comparison to zero of Downs.

This difference indicates that the maxillary part of the face was protrusive in Iraqi adolescents in comparison to Caucasians (White American's sample). The mean value of mandibular plane angle (FH-GoMe) was larger in Iraqi sample, indicating that Iraqi adolescents had high steepness of the mandibular base. The value of Y-axis angle (FH-SGn) was higher in Iraqi sample (62.5°) in comparison with (59.4°) of White Americans. This demonstrates that Iraqi adolescents had a more retrusive mandible, relative to cranium, as compared to White Americans.

Table (2): Comparison between Iraqi males and females using Downs' variables

Variables*	Sex	Min.	Max.	Mean	SD**	F-value	Sig.
Skeletal Measurements							
FH-Npog	M	75.0	92.0	84.37	3.39	2.186	NS***
	F	78.0	92.0	85.37	3.67		
N-A-Pog	M	-10.0	13.0	2.98	4.87	0.253	NS
	F	-5.0	8.0	2.58	3.21		
AB-Npog	M	-10.0	1.0	-3.92	2.80	0.234	NS
	F	-10.0	0.0	-3.69	2.16		
MPA-(FH-GoMe)	M	20.0	37.5	27.83	4.62	0.163	NS
	F	20.5	39.0	28.19	4.42		
FH-SGn	M	56.0	69.5	62.87	2.95	1.482	NS
	F	55.0	69.0	62.08	3.78		
Dental Measurements							
FH-OP	M	5.0	18.5	11.88	3.15	1.123	NS
	F	4.0	18.0	11.20	3.53		
U1-L1	M	112.0	136.0	123.10	5.93	1.804	NS
	F	111.0	134.0	122.17	5.31		
L1-OP	M	16.0	35.0	24.66	5.12	0.240	NS
	F	16.5	35.0	25.14	4.93		
L1-MP	M	86.0	107.0	97.84	5.41	0.135	NS
	F	85.0	108.0	98.25	5.98		
U1 to APog mm	M	1.5	12.0	7.47	2.43	0.056	NS
	F	4.0	11.0	7.37	1.98		

* Measurements in degrees, except for U1 to APog in millimeter

** SD: Standard deviation

*** NS: Not significant at $p \leq 0.05$

Table (3): Comparison between Downs' standards for Iraqi adolescents and Downs' original standards for white Americans

Variables*	Downs' standards (n = 20)			Iraqi standards (n = 108)			t-value	Sig.
	Range	Mean	SD	Range	Mean	SD		
Skeletal Measurements								
FH-NPog	82-95	87.5	3.57	75-92	84.84	3.54	3.08	S**
N-A-Pog	-8.5-10	0	5.09	-10-13	2.79	4.16	2.66	S**
AB-NPog	-9-0	-4.6	3.67	-10-1.0	-3.81	2.51	1.2	NS
MPA	17-28	21.9	3.24	20-39	28	4.51	5.77	S**
FH-SGn	53-66	59.4	3.82	55-69.5	62.5	3.37	3.70	S**
Dental Measurements								
FH-OP	1.5-14	9.3	3.83	4-18.5	11.56	3.34	2.72	S**
U1-L1	130-150.5	135.4	5.76	111-135	122.66	5.64	9.25	S**
L1-OP	3.5-20	14.5	3.42	16-35	24.88	5.01	8.88	S**
L1-MP	81.5-97	91.7	3.78	85-108	98.03	5.66	5.03	S**
U1 to APog mm	-1-5	1.7	3.05	1.5-12	7.43	2.21	9.99	S**

* Measurements in degrees except for U1 to APog in millimeters.

**Highly significant at $p \leq 0.01$, S = significant, NS = not significant
SD = standard deviation

Dental Relationships

This study showed no significant differences in all dental measurements between Iraqi males and females adolescents for Downs' analysis.

As illustrated in table (3), the result of statistical comparison between combined dental measurements for Iraqi adolescents and white Americans, offered by Downs, showed significant differences at ($p \leq 0.01$) for all measurements.

The cant of the occlusal plane of the present study was (11.56°), which is greater than the mean value established by Downs on White Americans. This indicate that Iraqi adolescent had steeper occlusal plane in comparison to White Americans. The mean inter-incisal angle U1-L1 was larger in White Americans & smaller in Iraqi adolescents. This indicates that the Iraqi adolescents had more protrusive upper and lower incisors than the White Americans did. The angle of lower incisor to occlusal plane (L1-OP) was smaller in White Americans & larger in Iraqi sample. This result

showed a more positive relation of the lower incisors to the occlusal plane when compared with White Americans. The lower incisor inclination to the mandibular plane (L-MP) was larger in Iraqi sample when compared with that of White Americans. This indicates that the lower incisor was more protrusive in Iraqi adolescents when compared to White American's sample. The distance of upper incisor to subspinale-pogonion plane (U1 to APog) was larger in the Iraqi sample and smaller in the White Americans. This indicates that the upper incisor was more protrusive in Iraqi adolescents as compared to White Americans.

CONCLUSION

Dentoskeletal measurements showed no significant difference between Iraqi males and females. Comparisons with Downs' original data for white-Americans revealed that Iraqi adolescents are characterized by more backward and downward position of the mandible and steeper mandibular plane when compared to white American subjects. Also the dental pattern of Iraqi adolescents was more protrusive than that of white American subjects. The results of this study support other investigations that a single standard of dento-skeletal relationships is not appropriate for application to different racial and ethnic groups.

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