

Age differences for Class I open bite malocclusion among adolescence (Lateral cephalometric study)

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ABSTRACT

The purpose of this study is to determine the age differences for open bite malocclusion concerning facial skeletal and dentoalveolar height.

The study was carried out on a sample of 50 students (24 males and 26 females) aged 12–15 years with Class I occlusion selected according to certain criteria among the students of secondary schools in the center of Mosul City. The sample was divided into two age groups: 12–13 years old, and 14–15 years old.

Lateral cephalometric radiograph was taken for each subject. Twenty one cephalometric measurements (nine angular and twelve linear) and five ratios had been determined. The data were statistically analyzed using Statistical Package for Social Sciences.

The results revealed that males showed significant increase in total posterior facial height, upper posterior facial height and ramus height with increasing age, while females showed increase of upper anterior dental height and decrease the ratio between upper posterior dental height and upper anterior dental height with increasing age.

Concerning angles, females approved significant increase of the angle formed by the intersection between occlusal plane and palatal plane (OP–PP), while males showed a slight decrease of the angle of palatal plane inclination in relation to anterior cranial base (SN–PP angle) with increasing age.

Key Words: Facial skeletal, dentoalveolar height, open bite.

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INTRODUCTION

The use of cephalometric measures that express the relations between craniofacial structure and occlusion is an accepted component of orthodontic diagnosis and orthognathic surgery. In 1964, Schudy⁽¹⁾ stated that vertical dimension is the most important dimension to the clinical orthodontist and the vertical dysplasias are in separately related to both open and closed bites. Anterior open bite has been defined as that condition where upper incisor crowns fail to overlap the incisal third of the lower incisor crowns when the mandible is brought into full occlusion.⁽²⁾

During the transition from the mixed to the permanent dentitions, large areas in the canine and premolar may be non-functional because of loose deciduous teeth or non-erupted teeth. Consequently, the individual must transfer a greater amount of his/her chewing function to the anterior area. This increased function may have a beneficial effect on the over bite and open bite. Studies by Isaacson and Speidel⁽³⁾ have shown an increased over bite at this age, followed later by a decrease in over bite as the permanent teeth complete their eruption. This may explain why simple and compound open bites seem to recur at

much higher prevalence at the ages of 13 to 15 years in almost all categories.

Age and sex appear to be variables that can affect or at least are related to open bite. Simple open bite prevalence decreased markedly between 7 to 9 years old groups and 10 to 12 years old. At later ages, simple open bite appears to increase slightly. One possible explanation for the high prevalence of open bite from canine to canine at age 7 to 9 is the incomplete eruption of the incisors.⁽³⁾

Isaacson *et al.*⁽⁴⁾ studied the prevalence of tongue thrust in 405 first-, sixth- and twelfth- grade Caucasian students, using the morphologic entity of open bite as his diagnostic criterion for tongue thrust. He observed a decreasing prevalence of open bite with increasing age.

Malocclusions are considered largely as symptoms of a dysplastic facial development. Changes in the structure of the bite with advancing age also may be considered largely as symptomatic and indicative of a change in the proportion between the various parts of the facial skeleton and the base of the skull.⁽⁵⁾

The aim of the current study is to determine the age differences for open bite malocclusion concerning facial skeletal and dentoalveolar height.

MATERIALS AND METHODS

The sample size of this study comprised 50 students, 24 males and 26 females. Their ages were ranged between 12–15 years old and were selected from examination of 3315 students in Mosul City.

The criteria of sample selection included:

1. Full set of permanent teeth in both jaws (excluding third molars).
2. Class I anterior open bite malocclusion smaller than or equal to –1 mm.
3. Normal healthy individuals with no gross facial deformity.
4. No history of orthodontic treatment or maxillofacial surgery or extensive dentistry.
5. All subjects are Iraqi in origin. Their parents and grand parents were born in the center of Mosul City.

Each person was seated on ordinary

chair, and was asked information about name, age and origin. History of facial trauma, orthodontic treatment and medical history were taken. All subjects were clinically examined in their schools, then the selected students were re-examined to check their fulfillment of the required sample selection.

Cephalometric Landmarks

A. Skeletal Landmarks (Figure 1)

- **Point S (Sella):** The midpoint of the hypophysial fossa.⁽⁵⁾
- **Point N (Nasion):** The most anterior point of the nasofrontal suture in the median plane.⁽⁵⁾
- **Point Ar (Articulare):** The point of intersection of the posterior margin of the ascending ramus and the outer margin of the cranial base.⁽⁵⁾
- **Point Go (Gonion):** A constructed point, the intersection of line tangent to the posterior margin of the ascending ramus and the mandibular base.⁽⁵⁾
- **Point Me (Menton):** The lowest point in the symphyseal shadow of the mandible is seen on the lateral cephalogram.⁽⁵⁾
- **Point ANS (Anterior Nasal Spine):** The anterior tip of the sharp bony process of the maxilla at the lower margin of the anterior nasal opening.⁽⁵⁾
- **Point PNS (Posterior Nasal Spine):** The posterior spine of the palatal bone constituting the hard palate coincides with the lowest point of the pterygomaxillary fissure.⁽⁵⁾

B. Dental Landmarks (Figure 1)

- **Point Is (Incisor Superius):** Tip of the crown of the most anterior maxillary central incisor.⁽⁶⁾
- **Point Ii (Incisor Inferius):** Tip of the crown of the most anterior mandibular central incisor.⁽⁶⁾
- **Point UMT (Upper Molar Tip):** The tip of the mesiobuccal cusp of the maxillary first molar.⁽⁶⁾
- **Point LMT (Lower Molar Tip):** The tip of the mesiobuccal cusp of the mandibular first molar.⁽⁶⁾

Cephalometric Planes (Figure 2)

- **SN Plane:** A plane joining the nasion point and the center of the sella turcica.⁽⁶⁾

- **Palatal Plane (PP):** A plane joining the anterior nasal spine and the posterior nasal spine.⁽⁷⁾
- **Occlusal Plane (OP):** A line joining the midpoint of the overlap of the mesiobuccal cusps of the upper and lower first molars

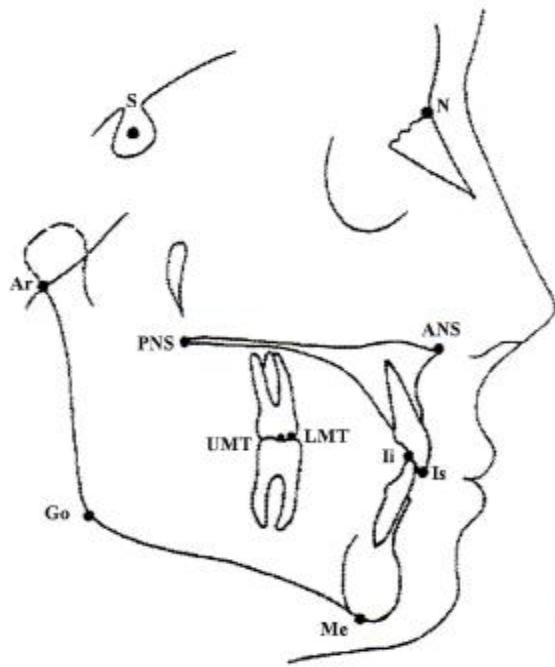


Figure (1): Skeletal and dental landmarks⁽¹⁶⁾

S: Sella; N: Nasion; Ar: Articulare; Go: Gonion; Me: Menton; Is: Incisor superior; Ii: Incisor inferior; ANS: Anterior nasal spine; PNS: Posterior nasal spine; UMT: Upper molar tip; LMT: Lower molar tip.

Regarding measurement techniques, the cephalometric landmarks and planes were recorded from the tracing of the radiographs to obtain the following measurements:

Linear Measurements (7 Skeletal and 5 Dental Linear Measurements) (Figure 3)

A. Skeletal Linear Measurements

- **TAFH–Total Anterior Facial Height (N–Me):** The vertical distance from nasion to menton.⁽⁹⁾
- **UAFH–Upper Anterior Facial Height (N–ANS):** The vertical distance from nasion to anterior nasal spine.⁽⁹⁾
- **LAFH–Lower Anterior Facial Height**

with the point bisecting the overbite of the incisors.⁽⁸⁾

- **Mandibular Plane (MP):** Formed by a line tangent to the lower border of the mandible, which extends from gonion to menton.⁽⁸⁾

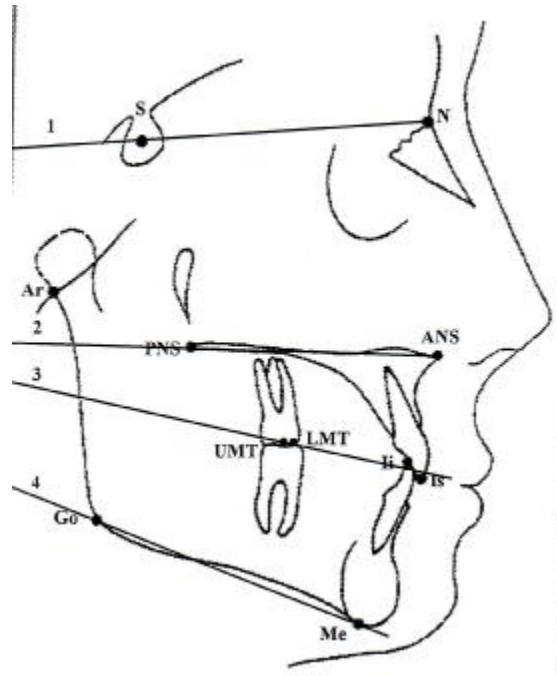


Figure (2): Cephalometric planes⁽¹⁶⁾

S: Sella; N: Nasion; Ar: Articulare; Go: Gonion; Me: Menton; Is: Incisor superior; Ii: Incisor inferior; ANS: Anterior nasal spine; PNS: Posterior nasal spine; UMT: Upper molar tip; LMT: Lower molar tip.

1: SN plane; 2: Palatal plane; 3: Occlusal plane; 4: Mandibular plane.

(ANS–Me): The vertical distance from anterior nasal spine to menton.⁽⁹⁾

- **TPFH–Total Posterior Facial Height (S–Go):** It is the vertical distance from the center of sella turcica to gonion.⁽⁹⁾
- **UPFH–Upper Posterior Facial Height:** It is the perpendicular line from point S to palatal plane.⁽¹⁰⁾
- **LPFH–Lower Posterior Facial Height:** It is the perpendicular line from the point gonion to the palatal plane.⁽¹⁰⁾
- **RH–Ramus Height (Ar–Go):** The distance from point Ar to point Go.⁽¹¹⁾

B. Dental Linear Measurements

- **Overbite:** It is measured in millimeters

as the distance between perpendicular lines projected into the nasion–menton line from the maxillary and mandibular incisal tips.⁽¹¹⁾ The overbite being smaller than or equal to –1 mm.

- **UADH (Upper Anterior Dental Height):** The perpendicular distance from upper incisor edge (UIE) projected at a right angle to the palatal plane.⁽⁹⁾
- **UPDH (Upper Posterior Dental Height):** The perpendicular distance from the mesiobuccal cusp of the upper first molar to the palatal plane.⁽¹¹⁾
- **LADH (Lower Anterior Dental Height):** The perpendicular distance from mandibular central incisor edge (LIE) projected at a right angle to the mandibular plane.⁽⁹⁾
- **LPDH (Lower Posterior Dental Height):** The perpendicular distance from the mesiobuccal cusp of the lower first molar

to the mandibular plane.⁽¹²⁾

Ratios (3 Skeletal and 2 Dental Ratios):

A. Skeletal Ratios

- **TPFH/TAFH:** It is the ratio between the total posterior facial height and total anterior facial height.⁽¹¹⁾
- **LAFH/TAFH:** It is the ratio between the lower anterior facial height and total anterior facial height.⁽³⁾
- **UAFH/TAFH:** It is the ratio between the upper anterior facial height and total anterior facial height.⁽¹³⁾

B. Dental Ratios

- **UPDH/UADH:** It is the ratio between the upper posterior dental height and upper anterior dental height.⁽¹⁴⁾
- **LPDH/LADH:** It is the ratio between the lower posterior dental height and lower anterior dental height.⁽¹⁴⁾

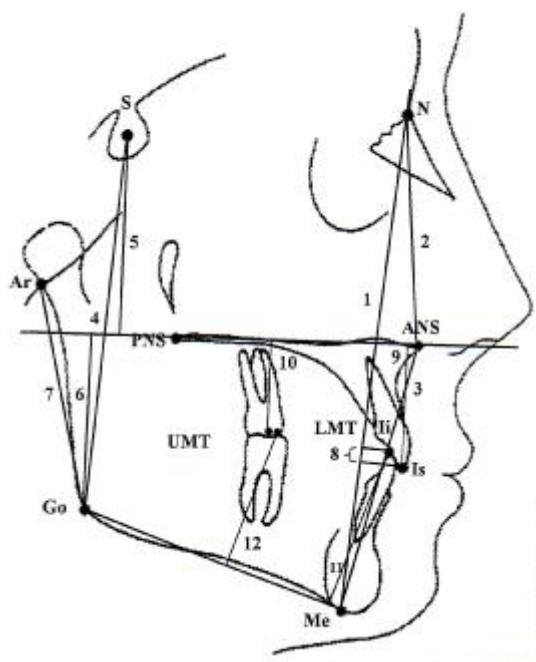


Figure (3): Skeletal and dental linear measurements⁽¹⁶⁾

S: Sella; N: Nasion; Ar: Articulare; Go: Gonion; Me: Menton; Is: Incisor superius; Ii: Incisor inferius; ANS: Anterior nasal spine; PNS: Posterior nasal spine; UMT: Upper molar tip; LMT: Lower molar tip.
 1: Total anterior facial height; 2: Upper anterior facial height; 3: Lower anterior facial height; 4: Total posterior facial height; 5: Upper posterior facial height; 6: Lower posterior facial height; 7: Ramus height; 8: Overbite; 9: Upper anterior dental height; 10: Upper posterior dental height; 11: Lower anterior dental height; 12: Lower posterior dental height.

Angular Measurements (9 Angles) (Figure 4)

- **SN–MP:** It represents the inclination of the mandible to the anterior cranial base.^(9, 14)
- **PP–MP (Palatomandibular Plane Angle):** The angle of inclination of the mandibular to the maxillary base.⁽¹¹⁾
- **OP–MP Angle (Mandibular Occlusal Angle):** This angle is formed between occlusal and mandibular planes.⁽³⁾
- **SN–PP Angle:** The angle of palatal plane inclination in relation to anterior cranial base.⁽¹⁵⁾
- **OP–PP Angle:** The angle which is formed by the intersection between occlusal plane and palatal plane.⁽¹⁶⁾
- **Ar.Go.Me (Gonial Angle):** The angle between the posterior border of the ramus (Ar–Go) and lower border of the mandible or mandibular plane (Go–Me).^(9, 15)
- **S.Ar.Go (Articular Angle):** The angle between the posterior border of ramus and posterolateral cranial base.⁽¹⁶⁾
- **N.S.Ar (Saddle Angle):** The angle between the anterior and posterior cranial base.⁽¹⁶⁾
- **Sum of Posterior Angles (Gonial+ Articular+ Saddle Angles):** The summation of gonial, articular and saddle angles.⁽¹⁶⁾

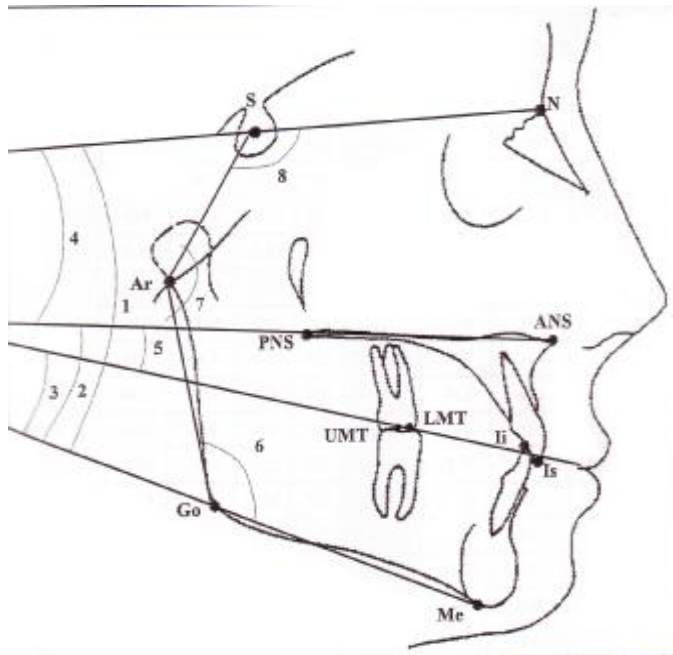


Figure (4): Angular measurements⁽¹⁶⁾

S: Sella; N: Nasion; Ar: Articulare; Go: Gonion; Me: Menton; Is: Incisor superior; Ii: Incisor inferior; ANS: Anterior nasal spine; PNS: Posterior nasal spine; UMT: Upper molar tip; LMT: Lower molar tip; MP: Mandibular plane; PP: Palatal plane; OP: Occlusal plane.
 1:SN–MP; 2: Palatomandibular plane angle; 3: Mandibular occlusal angle; 4: SN–PP; 5: OP–PP; 6: Gonial angle; 7: Articular angle; 8: Saddle angle.

The sample was divided into two age groups, 12–13 and 14–15 years old.

The data were analyzed using Statistical Package for Social Sciences (SPSS) to obtain minimum, maximum, means and standard deviations of overbite for total sample and both males and females, in addition to the means and standard deviations for the two age groups. Comparison between the two age groups for whole measurements (line-ar, angular and ratios) were determined by using Student's t-test at 5% level of significance.

RESULTS

Table (1) presented the minimum, maximum, means and standard deviations of overbite for males, females and total sample.

Table (2) showed means and standard deviations for linear measurements (dental and skeletal) of the males, females and total sample with comparison between two age groups. Males showed significant increase in TPFH with age. Also, males and total sample showed significant increase of UPFH and RH with age. The UADH showed significant increase with age in female subject only.

Table (1): Means and standard deviations of overbite for males, females and total sample

Sex	No.	Minimum	Maximum	Mean (mm)	±SD	Age Group	No.	Mean (mm)	± SD
Males	24	-1	-5	-2.41	1.28	12-13	12	-2.25	1.339
						14-15	12	-2.58	1.34
Females	26	-1	-6	-2.30	1.18	12-13	12	-2.41	1.379
						14-15	14	-2.21	1.032
Total	50	-1	-6	-2.36	1.78	12-13	24	-2.33	1.33
						14-15	26	-2.38	2.14

SD: Standard deviation.

Table (2): Means and standard deviations for linear measurements (dental and skeletal) of the males, females and total sample with comparison between two age groups

Variable	Sex	12-13 Years		14-15 Years		t-value	p-value
		Mean (mm)	± SD	Mean (mm)	± SD		
TAFH	Males	128.50	8.86	132.37	7.83	-1.13	0.26
	Females	126.66	6.77	128.00	7.21	-0.48	0.63
	Total	127.58	7.76	130.01	7.68	-1.11	0.27
UAFH	Males	55.70	5.97	56.83	2.79	-0.59	0.56
	Females	56.12	3.37	55.53	3.83	0.41	0.68
	Total	55.91	4.75	56.13	3.39	-0.18	0.85
LAFH	Males	74.87	5.24	77.12	7.04	-0.89	0.38
	Females	72.62	4.47	74.39	4.87	-0.95	0.34
	Total	73.75	4.90	75.65	5.98	-1.22	0.22
TPFH	Males	79.91	4.89	84.33	5.24	-2.13	0.04*
	Females	79.91	5.16	80.50	3.66	-0.33	0.74
	Total	79.91	4.92	82.26	4.78	-1.71	0.09
UPFH	Males	44.50	3.50	48.75	4.27	-2.66	0.01*
	Females	45.37	3.28	45.89	1.86	-0.50	0.61
	Total	44.93	3.35	47.21	3.45	-2.35	0.02*
LPFH	Males	34.25	2.65	34.62	3.49	-0.29	0.77
	Females	33.70	4.78	33.85	3.16	-0.09	0.92
	Total	33.97	3.79	34.21	3.27	-0.23	0.81
RH	Males	45.70	3.03	49.50	3.92	-2.65	0.01*
	Females	46.16	4.17	47.53	4.80	-0.76	0.45
	Total	45.93	3.56	48.44	4.44	-2.18	0.03*
PP1	Males	30.83	3.94	30.87	3.45	-0.02	0.97
	Females	27.62	3.01	30.03	2.87	-2.08	0.04*
	Total	29.22	3.80	30.42	3.11	-1.21	0.22
PP6	Males	24.33	3.17	25.58	3.06	-0.98	0.33
	Females	24.00	2.55	24.35	2.82	-0.33	0.74
	Total	24.16	2.82	24.92	2.94	-0.92	0.36
MP1	Males	44.58	3.26	46.16	4.35	-1.01	0.32
	Females	43.25	1.60	43.10	2.22	0.18	0.85
	Total	43.91	2.60	44.51	3.64	-0.66	0.50
MP6	Males	34.29	2.81	35.75	2.88	-1.25	0.22
	Females	32.58	1.89	33.71	2.16	-1.40	0.17
	Total	33.43	2.50	34.65	2.67	-1.65	0.10

TAFH: Total anterior facial height; UAFH: Upper anterior facial height; LAFH: Lower anterior facial height; TPFH: Total posterior facial height; UPFH: Upper posterior facial height; LPFH: Lower posterior facial height; RH: Ramus height; PP: Palatal plane; MP: Mandibular plane; SD: Standard deviation; * Significant difference ($p \leq 0.05$).

Males [n= 12 (12-13); n= 12 (14-15)]; Females [n= 12 (12-13); n= 14 (14-15)]; Total [n= 24 (12-13); n= 26 (14-15)].

Table (3) indicated means and standard deviations for ratios of the males, females and total sample with comparison between two age groups. The UPDH/UADH ratio decreased significantly with age in females.

rd deviations for angular measurements of the males, females and total sample with comparison between two age groups. Females showed significant increase of OP-PP angle with age, while males showed a slight decrease of SN-PP with increasing age.

Table (4) revealed means and stand-

Table (3): Means and standard deviations for ratios of the males, females and total sample with comparison between two age groups

Variable	Sex	12-13 Years		14-15 Years		t-value	p-value
		Mean	± SD	Mean	± SD		
TPFH/ TAFH	Males	0.6226	3.23×10 ⁻²	0.6373	3.70×10 ⁻²	-1.03	0.31
	Females	0.6308	2.81×10 ⁻²	0.6304	4.77×10 ⁻²	0.03	0.97
	Total	0.6267	2.99×10 ⁻²	0.6336	4.24×10 ⁻²	-0.65	0.51
LAFH/ TAFH	Males	0.5826	1.85×10 ⁻²	0.5813	2.30×10 ⁻²	0.14	0.88
	Females	0.5731	1.79×10 ⁻²	0.5809	1.88×10 ⁻²	-1.07	0.29
	Total	0.5778	1.84×10 ⁻²	0.5811	2.04×10 ⁻²	-0.58	0.56
UAFH/ TAFH	Males	0.4323	2.22×10 ⁻²	0.4296	2.05×10 ⁻²	0.31	0.75
	Females	0.4428	1.50×10 ⁻²	0.4334	1.53×10 ⁻²	0.55	0.13
	Total	0.4375	1.93×10 ⁻²	0.4317	1.76×10 ⁻²	1.12	0.26
UPDH/ UADH	Males	0.7923	8.20×10 ⁻²	0.8286	5.26×10 ⁻²	-1.29	0.21
	Females	0.8733	0.102	0.8097	4.10×10 ⁻²	2.13	0.04*
	Total	0.8328	9.99×10 ⁻²	0.8184	4.67×10 ⁻²	0.65	0.51
LPDH/ LADH	Males	0.7698	5.26×10 ⁻²	0.7759	4.79×10 ⁻²	-0.29	0.77
	Females	0.7534	4.53×10 ⁻²	0.7821	4.26×10 ⁻²	-1.66	0.10
	Total	0.7616	4.87×10 ⁻²	0.7793	4.43×10 ⁻²	-1.34	0.18

TAFH: Total anterior facial height; UAFH: Upper anterior facial height; LAFH: Lower anterior facial height; TPFH: Total posterior facial height; UPDH: Upper posterior dental height; UADH: Upper anterior dental height; LPDH: Lower posterior dental height; LADH: Lower anterior dental height; SD: Standard deviation; * Significant difference ($p \leq 0.05$).

Males [n= 12 (12-13); n= 12 (14-15)]; Females [n= 12 (12-13); n= 14 (14-15)]; Total [n= 24 (12-13); n= 26 (14-15)].

DISCUSSION

Linear Parameters

Regarding skeletal relationships, age difference inside linear skeletal measurements was not significant except at male inside TPFH which coincided with Cangialosi⁽¹⁵⁾ and at male and total sample inside UPFH and RH. This expressed that TPFH, UPFH and RH were more prone to be affected by growth (increased with age) and this coincided with Richardson⁽¹⁷⁾ for RH but not coincided with his results for TAFH and LAFH in which he showed that these measurements were significantly increase with age in total sample. Also, these findings were not similar with Karlsen⁽¹⁰⁾ concerning LAFH (increase with age). However, the results were in agreement with Nanda⁽¹⁸⁾ who showed that TPFH and RH were significantly increased with age in

males but it was in contract with his results concerning TAFH and LAFH in males.

For dental relationships, dentoalveolar height was not increased significantly between two age groups except UADH in females which came in agreement with Richardson⁽¹⁹⁾ in which the lack of vertical development in dentoalveolar height was cancelled by increasing height of the maxillary and mandibular basal areas as age advances.

Ratios

The UPDH/UADH ratio was decreased significantly with age in females group only which indicated that all other ratios were not affected significantly with age for both sexes and total sample. These findings agreed with Cangialosi.⁽¹⁵⁾

Table (4): Means and standard deviations for angular measurements of the males, females and total sample with comparison between two age groups

Variable	Sex	12-13 Years		14-15 Years		t-value	p-value
		Mean (°)	± SD	Mean (°)	± SD		
SN-MP	Males	39.91	4.83	37.75	4.98	1.08	0.29
	Females	37.50	4.46	38.64	6.07	-0.54	0.59
	Total	38.70	4.71	38.23	5.47	0.32	0.74
PP-MP	Males	31.08	3.91	31.04	4.43	0.02	0.98
	Females	28.75	4.57	30.32	4.19	-0.91	0.37
	Total	29.91	4.32	30.65	4.23	-0.60	0.54
OP-MP	Males	19.83	3.82	21.25	3.74	-0.91	0.36
	Females	21.66	4.31	20.14	4.04	0.92	0.36
	Total	20.75	4.09	20.65	3.87	0.08	0.93
SN-PP	Males	8.91	2.92	6.58	3.14	1.88	0.07
	Females	8.75	3.01	8.35	3.31	0.31	0.75
	Total	8.83	2.90	7.53	3.29	1.46	0.14
OP-PP	Males	11.20	4.33	9.83	1.58	1.03	0.31
	Females	7.00	2.37	10.21	1.79	-3.92	0.001*
	Total	9.10	4.03	10.03	1.67	-1.08	0.28
Go Angle	Males	132.62	5.25	130.29	6.09	1.00	0.32
	Females	128.54	3.99	127.32	7.26	0.51	0.60
	Total	130.58	5.01	128.69	6.78	1.11	0.27
Ar Angle	Males	143.12	10.37	145.66	7.61	-0.68	0.50
	Females	145.62	8.33	149.28	8.42	-1.11	0.27
	Total	144.37	9.29	147.61	8.11	-1.31	0.19
Saddle Angle	Males	125.00	6.23	122.91	5.10	0.89	0.38
	Females	123.83	7.48	122.42	7.04	0.49	0.62
	Total	124.41	6.76	122.65	6.10	0.96	0.33
Gonial+Articular +Saddle Angles	Males	400.75	4.37	398.87	5.13	0.96	0.34
	Females	398.00	4.55	399.03	6.55	-0.46	0.65
	Total	399.37	4.58	398.96	5.82	0.27	0.78

S: Sella; N: Nasion; MP: Mandibular plane; PP: Palatal plane; OP: Occlusal plane; Go: Gonion; Ar: Articular; SD: Standard deviation; * Significant difference ($p \leq 0.05$).

Males [n= 12 (12-13); n= 12 (14-15)]; Females [n= 12 (12-13); n= 14 (14-15)]; Total [n= 24 (12-13); n= 26 (14-15)].

Angular Parameters

The OP-PP angle significantly increased with age in females due to the change of inclination of occlusal plane with increasing age. The SN-MP and PP-MP angles increased with age in females and decreased in males but not in a significant degree. The SN-PP decreased with age for both sexes.

These results were in accordance with other studies.⁽²⁰⁻²²⁾ The Go angle on the other hand showed no significant difference between two age groups of both sexes although there were slight decrease with age which came in agreement with those of other studies^(15, 20, 21, 23) due to the compensation of slight increase of RH with age. The saddle angle also slightly decreased with

age. These results agreed with the findings of other studies.^(21, 24, 25)

CONCLUSION

Differences between the mean values of dentoskeletal measurements for corresponding two age groups were noticed. There was significant difference in TPFH, UPFH and RH between two age groups in males but not females, with greater values for the second age than that of the first age group as they show with age. Females showed increase of UADH and decrease the ratio between UPDH/UADH with increasing age. There was a significant increase of the OP-PP angle in females, while males showed a slight decrease of the SN-PP angle with increasing age.

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