

# Evaluation of the Pharyngeal Size in Skeletal Class I and Class II Subjects Diseases

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## ABSTRACT

**Aims:** The aims of the study were to measure different variables of pharynx in class I and class II skeletal relation, clarify the effect of gender on the pharyngeal measurements and to find the effect of different classes (class I and class II) on the pharyngeal measurements. **Materials and Methods:** The samples consisted of cephalometric films of 40 subjects, 20 males (10 class I and 10 class II) and 20 females (10 class I and 10 class II). These films were traced and ten linear measurements of the pharynx. **Results:** No significant difference were noticed between males and females in class I participants except in Ba-PNS (sagittal depth of the bony nasopharynx), PNS-ppw (the sagittal depth of the pharynx along the line ANS - PNS) and hy-MP (millimeter distance from hyoid to the mandibular plane), where males showed a significantly higher value; while males showed a significantly higher value in Ba - ad<sub>2</sub> (sagittal depth of the nasopharyngeal airway along line S - Ba) and hy-apw<sub>2</sub> (millimeter distance from hyoid to ap<sub>2</sub>) in class II. **Conclusions:** No significant differences were noticed between males and females in class I and class II skeletal relation in most of the measured variables and also no significant differences were noticed in the same gender neither in class I nor in class II.

**Key words:** Pharyngeal size, class I, class II.

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## INTRODUCTION

The pharynx is a tube - shaped structure formed by muscles and membranes. It is located behind the nasal and oral cavities and the larynx, and extends from the cranial base to the level of the sixth cervical vertebra and the lower border of the coronoid cartilage. Its length is approximately 12-14 cm. The pharynx can be anatomically divided into three parts: nasopharynx, oropharynx and laryngopharynx<sup>(1,2)</sup>.

The nasopharynx is a cone-like space that extends three dimensionally downward from the most dorsal contact point on the body of the sphenoid (hormion) to the level of the hard palate and the foramen magnum. The nasopharynx is situated behind the nasal cavity and communicated with the posterior aperatus of the nose<sup>(3)</sup>.

The oropharynx opening into the oral cavity by an isthmus extends from the second cervical vertebra to the fourth cervical vertebra, while the laryngopharynx joins the oropharynx at the level of the pharyngoepiglottic fold and the hyoid at the level

of the 6<sup>th</sup> cervical vertebra<sup>(4)</sup>.

Because of the close relationship between the pharynx and dentofacial structures, a mutual interaction is expected to occur between the pharyngeal structures and the dentofacial pattern and therefore justifies the orthodontic interest<sup>(5)</sup>.

The nasopharynx and the oropharynx have significant locations and functions; because both of them form a part of the unit in which respiration, mastication, deglutition, olfaction and speech is carried out<sup>(6)</sup>.

The growth of the pharynx occurs in three directions: sagittal growth, transverse growth and vertical growth. So the shape and size of the pharynx can be defined in terms of depth and height in the median sagittal plane and width in the frontal plane<sup>(7)</sup>.

King,<sup>(8)</sup> Handelman and Osborne<sup>(9)</sup>, and Tourne<sup>(10)</sup> have reported the nasopharyngeal depth is formed at the early ages of life and then it usually remains the same. It has been stated however, that the width and height increments of the na-

sopharynx continue until adulthood<sup>(8-10)</sup>.

The pharyngeal morphology is not immutably established during childhood and adolescence but changes through adult life, the tendency toward a longer and thicker soft palate and narrower oropharynx during adulthood which can explain the increase in the prevalence of obstructive sleep apnea and related disorders in later life<sup>(11)</sup>.

The aims of the study were to measure the different variables of pharynx in class I and class II skeletal relation, to find the effect of gender on the pharyngeal measurements and to find the effect of different classes (class I and class II) on pharyngeal measurements.

## MATERIALS AND METHODS

Lateral cephalometric radiographs of 40 subjects (20 males and 20 females) with the age ranging between 19 and 23 years old were taken using standardized head position using S.S white cephalometric machine with a vohmer cephalostate (Model W.105A, Germany). The participants fulfilled the following criteria:

1. Class I and class II occlusion (molar relation)<sup>(12, 13)</sup>.
2. No previous orthodontic problem.
3. Overbite (2 – 4 mm).
4. No scar tissue, burn and wound in the neck region.
5. No breathing problem or deglutition disorders.

The radiographs were divided into two groups in accordance to the ANB angle:

- Class I skeletal relation: included 20 participants (10 males and 10 females) whom ANB angle ranged  $2 \pm 2$  degree with facial convexity (N.A.Pog =  $174^\circ - 176^\circ$ )<sup>(12, 13)</sup>.
- Class II skeletal relation: included 20 participants (10 males and 10 females) whom ANB angle more than 4.5 degree with facial convexity (N.A.Pog =  $170^\circ - 172^\circ$ )<sup>(12, 13)</sup>.

The following landmarks were demarcated on the traces of the radiographs (Figure 1):

1. Sella point (S): Midpoint of the sella turcica<sup>(14)</sup>.
2. Basion (Ba): Lower most point of the

anterior margin of the foramen magnum<sup>(14)</sup>.

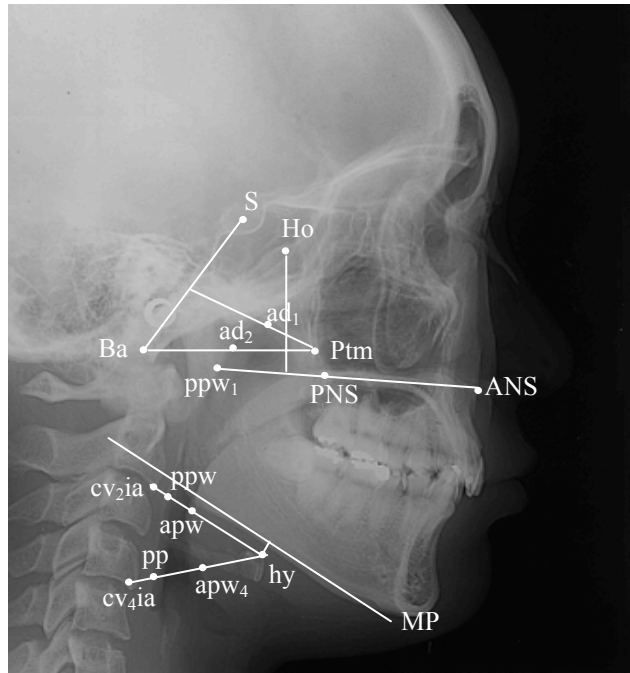
3. Homion (Ho): Most inferior point of the sphenooccipital synchondrosis<sup>(5)</sup>.
4. Pterygomaxillary fissure (Ptm): Most inferior point on average of right and left out line of the Pterygomaxillary fissure<sup>(5)</sup>.
5. ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba<sup>(5)</sup>.
6. ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S – Ba<sup>(5)</sup>.
7. ANS: Anterior nasal spine: tip of the anterior nasal spine<sup>(14)</sup>.
8. PNS: Posterior nasal spine: tip of the posterior nasal spine of the palatine bone in the hard palate<sup>(14)</sup>.
9. ppw: Posterior pharyngeal wall intersecting occlusal plane<sup>(5)</sup>.
10. ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS – PNS. apw<sub>2</sub>: anterior pharyngeal wall intersecting with cv<sub>2</sub>ai – hy<sup>(5)</sup>.
11. ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy<sup>(5)</sup>.
12. apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia – hy<sup>(5)</sup>.
13. ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy. hy: the most anterior and superior point of the hyoid bone<sup>(5)</sup>.
14. cv<sub>2</sub>ia: Most inferoanterior point of the body of second cervical vertebra<sup>(5)</sup>.
15. cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra<sup>(5)</sup>.

Ten linear measurements were determined (Figure 1);

1. Ba – ad<sub>1</sub>: Sagittal depth of the nasopharyngeal airway along line PNS–Ba.
2. Ba – ad<sub>2</sub>: Sagittal depth of the nasopharyngeal airway along line S – Ba.
3. Ba – PNS: Sagittal depth of the bony nasopharynx. Ptm – ad<sub>1</sub>: the millimeter distance from ptm to ad<sub>1</sub>.
4. Ptm – ad<sub>2</sub>: The millimeter distance from ptm to ad<sub>2</sub>.
5. PNS – ppw: The sagittal depth of the pharynx along the line ANS – PNS.
6. apw<sub>2</sub> – ppw<sub>2</sub>: Sagittal depth of the pharynx at the level of cv<sub>2</sub>ia.
7. hy – apw<sub>2</sub>: Millimeter distance from hyoid to apw<sub>2</sub>.
8. hy – apw<sub>4</sub>: Millimeter distance from

- hyoid to apw<sub>4</sub>.
9. hy – MP: Millimeter distance from hyoid to the mandibular plane.
  10. Ho ⊥ ANS – PNS: The height of the bony nasopharynx.
- Statistical analysis includes mean,

standard deviation and T – test were performed using SPSS system (software package for social science). The differences were tested for their significance at ( $p < 0.05$ ).



**Figure (1):** Cephalometric landmarks and linear measurements.

S: Sella point; Ba: Basion; Ho: Homion; Ptm: Pterygomaxillary fissure; ANS: Anterior nasal spine; PNS: Posterior nasal spine; MP: Mandibular plane; ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba; ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S–Ba; cv<sub>2</sub>ia: Most inferior point of the body of second cervical vertebra; cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra; hy: The most anterior and superior point of the hyoid bone; ppw: posterior pharyngeal wall; ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS–PNS; ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy; apw<sub>2</sub>: Anterior pharyngeal wall intersecting with cv<sub>2</sub>ia–hy; apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia– hy; ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy.

## RESULTS AND DISCUSSION

The selected samples did not have any breathing problem, this would implicate that the participants had a sufficient normal respiration.

No significant differences in the pharyngeal measurements were noticed between males and females with class I skeletal

relation in most of the measured variables. However, males demonstrated significantly larger values in Ba – PNS, PNS – ppw, hy – MP as shown in Table (1).

Males and females with class II skeletal relation showed no significant differences except for Ba – ad<sub>2</sub>, PNS – ppw and hy – apw<sub>2</sub> as shown in Table (2).

Table (1): Descriptive statistics of males and females samples with class I skeletal relation.

Variables	Gender	Mean	Maximum	Minimum	SD	T – test	Sig.
Ba – ad <sub>1</sub>	Male	21.2	30	16	3.10	0.06	N.S
	Female	21.3	26	15	4.21		
Ba – ad <sub>2</sub>	Male	35.15	45	30.5	5.77	– 0.05	N.S
	Female	34.10	40	30	3.32		
Ba – PNS	Male	49.7	59	46	3.3	– 4.04	S
	Female	44.35	46.5	38	2.58		
Ptm – ad <sub>1</sub>	Male	30.7	39	26	4.35	– 1.74	N.S
	Female	27.55	36	23	3.72		
Ptm – ad <sub>2</sub>	Male	25.8	37.5	16	2.3	– 0.76	N.S
	Female	23.5	33	15	1.9		
PNS – ppw	Male	29.35	40	20	3.83	– 2.88	S
	Female	24.9	28.5	21	3.03		
apw <sub>2</sub> – ppw <sub>2</sub>	Male	12.25	17	10	1.1	– 0.09	N.S
	Female	10.9	13	6	1.0		
apw <sub>4</sub> – ppw <sub>4</sub>	Male	17.25	23	10	4.64	– 1.29	N.S
	Female	14.75	23	6	3.36		
hy – apw <sub>2</sub>	Male	29.7	39	20	8.0	– 1.8	N.S
	Female	23.9	38	17	6.31		
hy – apw <sub>4</sub>	Male	24.0	29	18	3.98	– 1.63	N.S
	Female	20.6	30	16	5.25		
hy – MP	Male	15	19	12	4.47	– 2.11	S
	Female	10.6	18	5	4.86		
Ho–ANS–PNS	Male	25.55	37	22	3.16	1.74	N.S
	Female	22.2	31	16	5.2		

Variables are measured in millimeters; SD: Standard deviation; S: Significant; NS: Not significant; S: Sella point; Ba: Basion; Ho: Homion; Ptm: Pterygomaxillary fissure; ANS: Anterior nasal spine; PNS: Posterior nasal spine; MP: Mandibular plane; ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba; ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S–Ba; cv<sub>2</sub>ia: Most inferior point of the body of second cervical vertebra; cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra; hy: The most anterior and superior point of the hyoid bone; ppw: posterior pharyngeal wall; ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS–PNS; ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy; apw<sub>2</sub>: Anterior pharyngeal wall intersecting with cv<sub>2</sub>ia–hy; apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia– hy; ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy.

Table (2): Descriptive statistics of males and females samples with class II skeletal relation.

Variables	Gender	Mean	Maximum	Minimum	SD	T – test	Sig.
Ba – ad <sub>1</sub>	Male	36.2	35	19	4.8	– 1.49	N.S
	Female	32.4	32	10	6.45		
Ba – ad <sub>2</sub>	Male	51.2	46	30	5.73	– 2.21	S
	Female	45.3	46	28	6.16		
Ba – PNS	Male	27	62	46	7.26	– 0.02	N.S
	Female	26.35	60	40	7.31		
Ptm – ad <sub>1</sub>	Male	17.5	35	14	1.8	1.52	N.S
	Female	21.85	35.5	14	2.2		
Ptm – ad <sub>2</sub>	Male	31.4	35	14	6.17	– 1.87	N.S
	Female	27.05	32	13	3.98		
PNS – ppw	Male	13.4	37.5	20	2.17	– 2.88	N.S
	Female	9.7	33	21	3.43		
apw <sub>2</sub> – ppw <sub>2</sub>	Male	16.95	18	11	0.89	– 0.14	N.S
	Female	16.75	16	6	1.1		
apw <sub>4</sub> – ppw <sub>4</sub>	Male	9.21	21	12.5	9.21	– 0.47	N.S
	Female	8.34	28	13	6.34		
hy – apw <sub>2</sub>	Male	13.3	45	17	5.7	– 2.77	S
	Female	11.3	35	16	4.28		
hy – apw <sub>4</sub>	Male	22.2	33	19	5.16	1.52	N.S
	Female	21.1	28	13	7.55		
hy – MP	Male	13.3	20.5	10	5.29	– 0.93	N.S
	Female	11.3	17	6.5	4.27		
Ho–ANS–PNS	Male	31	43	23.5	5.25	– 1.34	N.S
	Female	29.6	38	20	3.03		

Variables are measured in millimeters; SD: Standard deviation; S: Significant; NS: Not significant; S: Sella point; Ba: Basion; Ho: Homion; Ptm: Pterygomaxillary fissure; ANS: Anterior nasal spine; PNS: Posterior nasal spine; MP: Mandibular plane; ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba; ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S–Ba; cv<sub>2</sub>ia: Most inferior point of the body of second cervical vertebra; cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra; hy: The most anterior and superior point of the hyoid bone; ppw: posterior pharyngeal wall; ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS–PNS; ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy; apw<sub>2</sub>: Anterior pharyngeal wall intersecting with cv<sub>2</sub>ia–hy; apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia– hy; ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy.

Our findings disagree with that of Handelman and Osborne<sup>(9)</sup>, Solow *et al.*,<sup>(15)</sup> and Linder – Aronson and Leighton<sup>(16)</sup> who found no effect of the gender on the pharyngeal measurements, which could be attributed to different age groups. However, our finding agrees with that of Sosa *et al.*<sup>(17)</sup> and Jean *et al.*,<sup>(18)</sup> who found a significant difference in the nasopharyngeal area in the latter and in Ba – PNS in the former between males and females. Although Cyelan and Oktay<sup>(5)</sup> denote the effect of gender on the pharyngeal measurements, they found a significant difference between males and females in hy –

apw<sub>2</sub>.

Concerning the effect of ANB on the pharyngeal measurements, no significant differences were seen between class I and class II skeletal relation in both males and females (Table 3 and 4). This study finding comes in agreement with that of Sosa *et al.*,<sup>(17)</sup> who found no statistical significant relationship between the pharyngeal measurements and the ANB angle in both genders and considered that the nasopharyngeal area appeared to be invariant to the differences of malocclusion types in terms of both actual and relative dimensions, similarly, Cyelan and Oklay<sup>(5)</sup>, Solow *et*

*al.*,<sup>(15)</sup> Wenzel *et al.*,<sup>(19)</sup> and Mergan and Jacobs<sup>(20)</sup> could find no relationship between pharyngeal measurements regarding the anteroposterior jaw relationship.

However, the total sample showed a statistically higher value in class I in both

Ba – PNS and apw<sub>2</sub> – ppw<sub>2</sub> and also in the measurements concerning the position of the hyoid bone hy – apw<sub>2</sub>, hy – apw<sub>4</sub> and hy – MP which indicates a more posterior position of the hyoid bone in total class II subjects (Table 5).

Table (3): Descriptive statistics of males with class I and class II skeletal relation.

Variables	Class	Mean	Maximum	Minimum	SD	T – test	Sig.
Ba – ad <sub>1</sub>	I	21.2	30	16	4.21	– 0.47	N.S
	II	22.2	35	19	5.16		
Ba – ad <sub>2</sub>	I	35.15	45	30.5	5.77	– 0.61	N.S
	II	36.6	46	30	4.86		
Ba – PNS	I	50.6	59	48	4.43	– 0.26	N.S
	II	51.2	62	46.5	5.73		
Ptm – ad <sub>1</sub>	I	31.5	39	26	5.08	1.6	N.S
	II	27	35	14.5	7.29		
Ptm – ad <sub>2</sub>	I	25.8	37.5	16.5	7.38	0.81	N.S
	II	25.5	35	14	5.7		
PNS – ppw	I	29.35	40	26.1	3.83	0.89	N.S
	II	31.4	37.5	20.1	6.17		
apw <sub>2</sub> – ppw <sub>2</sub>	I	12.25	17	10.5	3.36	– 0.91	N.S
	II	13.4	18	11	2.17		
apw <sub>4</sub> – ppw <sub>4</sub>	I	17.25	23	10	3.99	0.2	N.S
	II	16.95	21	12.5	2.67		
hy – apw <sub>2</sub>	I	29.7	39	20	8	0.67	N.S
	II	33.3	45	17	9.21		
hy – apw <sub>4</sub>	I	24	29	18	3.98	– 0.5	N.S
	II	24.1	33	19.5	5.7		
hy – MP	I	15	19	12	4.47	0.78	N.S
	II	13	20	10	5.29		
Ho–ANS–PNS	I	29	37.5	22	3.16	0.54	N.S
	II	31.5	43	23.5	5.25		

Variables are measured in millimeters; SD: Standard deviation; S: Significant; NS: Not significant; S: Sella point; Ba: Basion; Ho: Homion; Ptm: Pterygomaxillary fissure; ANS: Anterior nasal spine; PNS: Posterior nasal spine; MP: Mandibular plane; ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba; ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S–Ba; cv<sub>2</sub>ia: Most inferior point of the body of second cervical vertebra; cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra; hy: The most anterior and superior point of the hyoid bone; ppw: posterior pharyngeal wall; ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS–PNS; ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy; apw<sub>2</sub>: Anterior pharyngeal wall intersecting with cv<sub>2</sub>ia–hy; apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia– hy; ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy.

Table (4): Descriptive statistics of females with class I and class II skeletal relation.

Variables	Class	Mean	Maximum	Minimum	SD	T – test	Sig.
Ba – ad <sub>1</sub>	I	21.3	26.5	15.3	3.1	0.08	N.S
	II	21.1	32.5	10.1	7.55		
Ba – ad <sub>2</sub>	I	34.1	40.0	30.0	3.22	0.9	N.S
	II	31.8	46.0	28.0	7.33		
Ba – PNS	I	44.35	46.5	38.0	2.58	– 0.45	N.S
	II	45.3	60.0	40.5	6.18		
Ptm – ad <sub>1</sub>	I	27.55	36.0	23.0	3.72	0.46	N.S
	II	26.35	35.5	14.0	7.31		
Ptm – ad <sub>2</sub>	I	23.5	33.5	15.3	6.14	0.56	N.S
	II	21.85	32.0	13.0	7.06		
PNS – ppw	I	24.9	28.5	21.3	3.03	– 1.36	N.S
	II	27.05	33.0	21.0	3.98		
apw <sub>2</sub> – ppw <sub>2</sub>	I	10.9	13.5	6.5	3.31	0.8	N.S
	II	9.7	16.0	6.0	3.43		
apw <sub>4</sub> – ppw <sub>4</sub>	I	14.75	23.5	6.0	3.64	– 1.08	N.S
	II	16.75	28.0	13.5	3.58		
hy – apw <sub>2</sub>	I	23.9	38.4	17.0	6.31	0.12	N.S
	II	23.55	35.0	16.5	6.34		
hy – apw <sub>4</sub>	I	20.6	30.1	16.5	5.25	0.82	N.S
	II	18.85	28.0	13.0	4.28		
hy – MP	I	11.3	18.0	5.0	4.62	0.0	N.S
	II	11.3	17.0	6.0	4.27		
Ho–ANS–PNS	I	25.55	31.5	16.0	5.20	0.5	N.S
	II	24.6	28.0	20.5	3.03		

Variables are measured in millimeters; SD: Standard deviation; S: Significant; NS: Not significant; S: Sella point; Ba: Basion; Ho: Homion; Ptm: Pterygomaxillary fissure; ANS: Anterior nasal spine; PNS: Posterior nasal spine; MP: Mandibular plane; ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba; ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S–Ba; cv<sub>2</sub>ia: Most inferior point of the body of second cervical vertebra; cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra; hy: The most anterior and superior point of the hyoid bone; ppw: posterior pharyngeal wall; ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS–PNS; ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy; apw<sub>2</sub>: Anterior pharyngeal wall intersecting with cv<sub>2</sub>ia–hy; apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia– hy; ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy.

Table (5): Descriptive statistics of total sample with class I and class II skeletal relation.

Variables	Class	Mean	Maximum	Minimum	SD	T – test	Sig.
Ba – ad <sub>1</sub>	I	21.7	34	15	4.61	0.31	N.S
	II	21.2	35	10	5.62		
Ba – ad <sub>2</sub>	I	35.88	46	36	5.25	1.69	N.S
	II	32.95	46	28	5.66		
Ba – PNS	I	50.9	59	38	4.99	3.99	S
	II	44.30	62	43	4.64		
Ptm – ad <sub>1</sub>	I	29.25	39	23	6.54	1.19	N.S
	II	26.95	35	14	5.68		
Ptm – ad <sub>2</sub>	I	21.65	37.5	15	7.7	0.46	N.S
	II	22.67	32	11.5	6.49		
PNS – ppw	I	30.37	40	20.5	5.11	0.15	N.S
	II	25.98	37.5	20	3.61		
apw <sub>2</sub> – ppw <sub>2</sub>	I	12.83	17	6.5	2.82	2.58	S
	II	10.3	18	6.5	3.34		
apw <sub>4</sub> – ppw <sub>4</sub>	I	17.10	23	6.0	3.31	1.14	N.S
	II	15.75	21	12.5	4.17		
hy – apw <sub>2</sub>	I	31.0	39	17	1.9	3.1	S
	II	23.73	45	16	1.4		
hy – apw <sub>4</sub>	I	24.55	30	16	4.82	3.19	S
	II	19.73	33	13	4.75		
hy – MP	I	14.15	19	5	4.85	1.96	S
	II	11.3	20	6	4.33		
Ho–ANS–PNS	I	26.6	31	16	6.18	0.92	N.S
	II	28.08	43	20	4.17		

Variables are measured in millimeters; SD: Standard deviation; S: Significant; NS: Not significant; S: Sella point; Ba: Basion; Ho: Homion; Ptm: Pterygomaxillary fissure; ANS: Anterior nasal spine; PNS: Posterior nasal spine; MP: Mandibular plane; ad<sub>1</sub>: Point of intersection of posterior pharyngeal wall at the line from Ptm to Ba; ad<sub>2</sub>: Point of intersection of posterior pharyngeal wall and line from Ptm as perpendicular to S–Ba; cv<sub>2</sub>ia: Most inferior point of the body of second cervical vertebra; cv<sub>4</sub>ia: Most inferoanterior point of the body of fourth cervical vertebra; hy: The most anterior and superior point of the hyoid bone; ppw: posterior pharyngeal wall; ppw<sub>1</sub>: Posterior pharyngeal wall intersecting with ANS–PNS; ppw<sub>2</sub>: Posterior pharyngeal wall intersection with cv<sub>2</sub>ia and hy; apw<sub>2</sub>: Anterior pharyngeal wall intersecting with cv<sub>2</sub>ia–hy; apw<sub>4</sub>: Anterior pharyngeal wall along line intersection cv<sub>4</sub>ia– hy; ppw<sub>4</sub>: Posterior pharyngeal wall intersection with cv<sub>4</sub>ia and hy.

## CONCLUSIONS

No significant differences were noticed between males and females in class I participants except in Ba – PNS, PNS – ppw and hy – MP where males showed a significantly higher value; while in class II the only significant difference noticed were in Ba – ad<sub>2</sub> and hy – apw<sub>2</sub> with higher values for males. No significant differences were seen neither in females between class I and class II nor in males. However, total sample showed a more posterior hyoid bone position in class II.

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