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Integumental lips' height and separation in different Angle's classes of malocclusions

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ABSTRACT

Aims: To reveal the possible soft tissue difference in the upper and lower lip heights, separations and coverage of lower lip to upper incisors in different Angle's classes of malocclusion, to determine any difference in the mean between males and females for each variable and to find any correlation among the variables. **Materials and Methods:** Nightly nigh students (52 males, 47 females), 20–23 years of age that was randomly selected from the college of dentistry, University of Mosul.The overall sample was classified depending on Angle's classification of malocclusion into four groups (Class I, II.1, II.2 and III). For each group, four facial soft tissue variables were measured directly using electronic digital viernier caliper. **Results**: A major findings that emerged from the research is that the Class I subjects possessed higher values of upper lip length followed by Class II then Class III, this difference is significant between Class I,III and II,III and non significant between I,II. Where as Class III subjects possessed non significant higher values of lower lip length followed by Class II then Class I. The lip separation value is non significantly higher in Class II subjects followed by Class III then Class I. While Class III subjects possessed non significant higher values of lower lip to incisor superior followed Class I then Class II. **Conclusions:** For each specific Angle's class of malocclusion, a specific facial soft tissue parameters. The upper lip length is greater in Class I subjects. Class III subjects have the greater lower lip length. The inter–labial gap is larger in Class II subjects.While the coverage of the lower lip to incisor superior is greater in Class III subjects. Most of the variables are higher in males than females. Complex correlations among the studied variables are found that varied between weak to high positive or negative with varying degree of significance.

Key words: Anthropometry, Integument, Malocclusion , Soft tissue.

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INTRODUCTION

Anthropometry literally means "measurement of humans". Historically, the term anthropometry was applied to human measurement more generally, including the study of skeletons, and particularly skulls, of earlier populations, Bishara *et al*.,[1] define Anthropometry as the most basic method of analyzing dimensional changes of the soft tissues of the face with direct measurements.

The earliest studies of human form can be traced to the beginnings of anthropometry in ancient Egypy and Greece. Anthropometry can be performed on either living or dried subject specimen.[2]

Al–T'aani[3] stated that Helman (1927,1935,1939) adopted physical anthropometry to orthodontic research.

A number of methods have been used to evaluate the facial esthetic including anthropometry[4–9], cephalometry[4,10–16], photogrammetry [1,13], and computer imaging.[17,18]

Arnett and Bergman[19] mentioned that, the most important point in proper analysis of facial esthetics is the use of a clinical format. Examination should not be based on static laboratory X–ray film and photographic representation of the patient alone.

Some authors[20,21] discussed lip assessment for proportionality, interlabial gap, lower face height, upper lip length, and lower lip length. Powell and Humphreys[22] stressed that, esthetically, the relative length of the upper lip and its relationship with the incisal edge is an important consideration in a patient's mouth, i.e. in reposing and smiling.

Several Iraqi soft tissue studies have been conducted; measuring different facial

soft tissue parameters including upper and lower lips; whether direct soft tissue study as Nasir[5] and Ra'uf [6] ,or indirect soft tissue cephalometric studies as Al–T'aani[3] and Agha[12], Yousef [13] and Mahmood[14]; in their cephalometric sudies establish the normative value of facial soft tissue for young Iraqi adults in Mosul and Baghdad cities. On the other hand, Fakhri[10] in his cephalometric study determined upper and lower lip height, lip separation and coverage of lower lip to upper incisors for 9–13 years Iraqi children in Baghdad city.

This study is designed to Evaluate the upper and lower lip heights, separations and coverage of lower lip to upper incisors for the studied sample in Class I, II.1, II.2 and III malocclusion in young adult students of college of dentistry, University of Mosul, and to determine any difference in the mean between males and females for each variable in different Angle's classes of malocclusion, then to find any correlation among the variables.

MATERIALS AND METHODS

The sample consisted of 99 students (52 males, 47females) that were randomly selected from the college of dentistry, University of Mosul. The subjects were randomly selected healthy subjects, 20–23 years of age and with the permanent dentition completely erupted (except for wisdom teeth). The subjects had no congenital anomalies and no significant facial, dental asymmetries. None of them had undergone orthodontic treatment or, orthognathic surgery.

According to Angle's classification of malocclusion [23] .the overall sample is divided into: Table (1).

1. Class I: total(T) =53, males(M) =31, females(F) =22
2. Class II.1: T =24, M =9, F =15
3. Class II.2: T =4, M =0, F =4
4. Class III: T =18, M =12, F =6

Table (1): Frequency distribution of different Angle's classes of malocclusions in overall sample for males and females.

Malocclusion's class frequency	Percentage	Sex	Percentage%
Class I=53	31.31% 22.22%	M=31 F=22	53.53%
Class II.1=24	9.09% 15.15%	M=9 F=15	24.24%
Class II.2=4	0.0% 4.04%	M=0 F=4	4.04%
Class III=18	12.12% 6.06%	M=12 F=6	18.18%
overall =99	100%	99	100%

M: Males; F: Females.

Each subject was seated on an ordinary chair, asked information about name, age, medical and dental history. The use of a dental chair is usually not convenient for this because it was difficult for the examiner to face the subject directly and should not be reclined or resting on headrest, the mandible approximate centric relation position with the teeth lightly touching and the lips relaxed.[24]

Clinical extra and intra oral assessment had been made; the points were marked on the skin before measurement using water–soluble marker. Each subject was assessed in relaxed lip position, since different types of malocclusions were examined, according to Arnett and Bergman [20,25], which who said that "closed lip position may be useful when no facial deformity exists, but in the case of facial deformity, the closed lip posture is not accurate in terms of diagnosis and treatment planning".

The relaxed lip position is obtained while the patient is in centric relation by the following method:

1. Ask the patient to relax.
2. Stroke the lips gently.
3. Take multiple measurements on differ-

ent occasions.

4. Use casual observation while the patient is unaware of being observed.

All measurements were measured directly on the subject's face and taken under standardized conditions keeping Frankfort plane parallel to floor.

The electronic digital viernier caliper, Lezaco Art (2771,0–150 mm, 0–6 in, 0.01–mm accuracy, China), was used to measure all vertical measurements in millimeters.

To make landmark determination as consistent as possible, a given landmark was identified for each subject at one sitting. Each was then checked by another investigator. In order to minimize measurement error, all linear measurements were performed by two investigators working independently. Intra–investigator and inter–investigator measurement error was predetermined at 0.5 mm.

The following landmarks were defined. (Figure.)

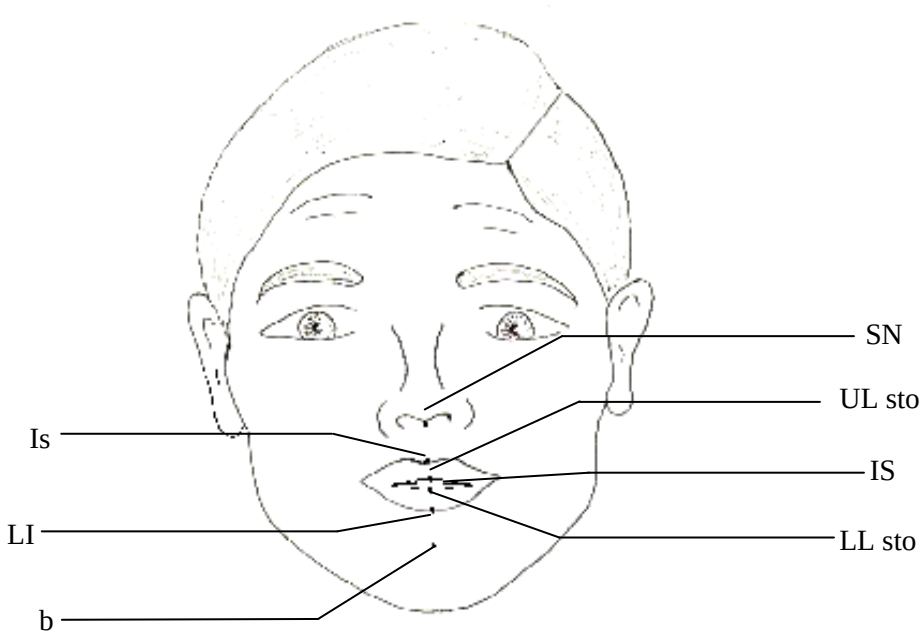

Figure: Soft tissue landmarks

- Subnasale (sn): The point at which the columella merges with the upper cutaneous lip.[2,24, 26]
- Labrale superius (ls): The point at which the upper lip tissue merges with vermilion tissue. [2,26, 27]
- Upper lip stomion (UL sto): the lower most point of the upper lip in the midline.[11,28]
- Lower lip stomion (LL sto): the upper most point of the lower lip in the midline.[28]
- Labrale inferius (li): The point at which the lower lip tissue merges with vermilion tissue.[2,27,29]
- Soft tissue b–point (b): The point of greatest concavity in the midline of the lower lip between lower vermilion border and soft tissue pogonion.[2,27,28]
- Incisor superius (IS): incisor tip of the most anterior maxillary central incisor.[11]

Soft tissue measurements

1. Medial vertical height of the upper lip (upper lip length) (UL): measured from upper lip stomion (UL sto) to subnasale (sn) point. [2,21,28]
2. Medial vertical height of the lower lip (lower lip length) (LL): measured from lower lip stomion (LL sto) to soft tissue (b) point.[2,24,28]
3. Lips separation (LS) (The interlabial gap): is the vertical midline opening between the relaxed upper and lower lips with the mandible in rest position.[11,23, 30]

4. Lower lip to incisor superior (LL–IS): the vertical distance between lower lip stomion (LL sto) &incisor superius (IS). A positive measurement was recorded when the lower lip covered the upper incisor & negative in the opposite condition.[11]

Descriptive statistics (mean, and standard deviation) were calculated for all variables in overall sample, males, females, and different Angle's classes. T–student test was used to show the possible differences in means of soft tissue variables between males and females, (intra–group). Analysis of variance (ANOVA) were used in an attempt to look for possible differences in means of soft tissue variables among Class I,II.1,II.2 and III(inter–group)–significant at P≤ (0.05). Correlation coefficient was carried out among all the variables for overall sample, males, and females in Class I, II.1,II.2 &III separately. The "r" value was described as significant at $P \leq 0.05$, and highly significant at $P \leq 0.005$.

RESULTS

The results of this study indicate that, in overall sample, males possessed higher values of UL, LL and LL–IS with non–significant difference between males and females, while females had higher non–significant LS value than males(Table 2).

Table (2): Descreptive statistics for soft tissue variables in overall sample for males and females.

Variable	overall=99	Males=52	Females=47	t–value	Significant
	mean ±SD	mean ±SD	mean ±SD		
UL	19.361±3.404	20.214±3.170	18.217±3.405	0.033	Not significant
LL	18.196±3.588	19.500±3.878	16.444±2.187	0.054	Not significant
LS	3.393±2.092	3.314±2.282	3.5±1.827	0.017	Not significant
LL–IS	2.797±1.283	2.830±1.304	2.752±1.269	0.009	Not significant

SD: Standard deviation; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.

In Class I subjects, a non significant sex difference has been seen in soft tissue variables with males possessing higher values of UL, LL& LL–IS, while females had higher significant LS value than males (Table 3).

Table (3): Descreptive statistics for soft tissue variables in Class I subjects for males and females.

Variable	Class I	Males=31	Females=22	t–value	Significant
	Mean ±SD	Mean ±SD	Mean ±SD		
UL	20.730±3.069	23.757±2.999	18.914±2.845	0.0	Not significant
LL	17.712±3.679	19.281±3.785	15.501±2.071	1.290	Not significant
LS	2.972±1.833	2.864±1.441	3.048±2.087	3.084	Significant
LL–IS	2.520±0.935	2.585±1.034	2.428±0.790	0.752	Not significant

SD: Standard deviation; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.

For Class II.1 subjects, a non significant sex difference has been seen in soft tissue variables with males possessing higher values of UL, LS& LL–IS, whereas males having higher significant LL value than females (Table 4).

Table (4): Descreptive statistics for soft tissue variables in Class II.1 subjects for males and females.

Variable	Class II.1	Males=9	Females=15	t–value	Significant
	Mean ±SD	Mean ±SD	Mean ±SD		
UL	19.186±4.034	20.004±3.069	18.033±3.454	1.703	Not significant
LL	18.674±3.493	21.369±3.864	17.057±2.021	1.968	Significant
LS	4.333±2.244	4.833±2.979	4.033±1.716	1.475	Not significant
LL–IS	2.384±1.021	2.634±1.429	2.233±0.693	0.355	Not significant

SD: Standard deviation; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.

While Class II.2 subjects, the comparison between two sexes is not real since in this study, no male subject has Class II.2 malocclusion and the total Class II.2 subjects representing females only (Table 5).

Table (5): Descreptive statistics for soft tissue variables in Class II.2 subjects for males and females.

Variable	Class II.2	Males=0	Females=4	t–value	Significant
	Mean ±SD	Mean ±SD	Mean ±SD		
UL	20.182±5.155	0	20.182±5.155	6.935	Significant **
LL	18.217±0.931	0	18.217±0.931	17.533	Significant **
LS	3.575±5.568	0	3.575±5.568	3.541	Significant **
LL–IS	2.491±2.750	0	2.491±2.750	2.818	Significant **

SD: Standard deviation; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.
**Comparison is not real because the mean value in males=0.

On the other hand, in Class III subjects, a non significant sex difference has been seen in soft tissue variables with males possessed higher values of UL, LL and LL–IS, while females having higher significant LS value than males (Table 6).

Table (6): Descreptive statistics for soft tissue variables in Class III subjects for males and females.

Variable	Class III N=4	Males N=12	Females N=6	t–value	Significant
	Mean±SD	Mean±SD	Mean±SD		
UL	18.187±3.133	18.580±1.835	17.140±5.413	0.381	Not significant
LL	19.017±3.287	19.538±3.707	17.627±0.972	–0.271	Not significant
LS	3.432±2.222	3.094±1.943	4.333±2.840	0.421	Not significant
LL–IS	3.247±1.577	2.893±0.961	4.193±2.489	–0.403	Not significant

N: Number of samples; SD: Standard deviation; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.

The major findings that emerged from the results was that Class I subjects possess higher values of UL followed by Class II then Class III, this difference is significant between Class I, III and Class II,III but not significant between Class I,II (Table7). Where as Class III subjects possess higher non significant values of LL followed by

Class II then Class I. The LS value is non significant higher in Class II subjects followed by Class III then Class I. While the Class III subjects posse non significant higher values of LL–IS followed by Class I then Class II.

Table (7): Results of analysis of variance, comparison of the soft tissue variable between Class I,II and III subjects.

Variable	overall	Class I	Class II	Class III	Significant
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	
UL	19.361±3.404	20.730±3.069	19.186±4.034	18.187±3.133	Significant **
LL	18.196±3.588	17.712±3.679	18.674±3.493	19.017±3.287	Not significant
LS	3.393±2.092	2.972±1.833	4.333±2.244	3.432±2.222	Not significant
LL–IS	2.797±1.283	2.520±0.935	2.384±1.021	3.247±1.577	Not significant

SD: Standard deviation; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.
** Significant difference between class I, III and II, III and a non significant difference between I, II.

Generally, the correlation coefficient is carried out among all the variables for overall sample, males and females in Class I, II and III separately. Some of them show a positive correlation, while others show a negative one. The "r" value was described as significant at P≤ 0.05, and highly significant at P≤ 0.005 (Tables 8–12).

The correlation coefficient among soft tissue variables for overall sample, males and females is described in Table (8). A high significant positive correlation (for males and overall sample) is seen between UL and LL, LS and UL (in males), LL and LS (in overall sample) and a significant positive correlation is seen between UL and LL (for females), LL–IS and UL (in males), and LS and LL–IS, LS and UL (in overall sample).

Table (8): Correlations of soft tissue variables in overall sample for males and females.

Variable	Sex	UL	LL	LS	LL–IS
UL	T		0.573**	0.230*	
	M		0.634**	0.396**	
	F		0.336*	0.232*	0.309*
LL	T	0.573**		0.443**	
	M	0.634**			
	F	0.336*			
LS	T	0.230*	0.443**		0.237*
	M	0.396**			
	F	0.232*			
LL–IS	T			0.237*	
	M				
	F	0.309*			

T: Total; M: Males; F: Females; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.
*significant at P≤0.05. ** highly significant at P≤0.005.

While Table (9) showed the correlation coefficient among soft tissue variables in Class I malocclusion. A high significant positive correlation (for total sample and females) was seen between UL and LL, and a significant positive correlation between LS and LL (for total sample and females).

Table (9): Correlations of soft tissue variables in Class I subjects for males and females.

Variable	Sex	UL	LL	LS	LL–IS
UL	T		0.694**		
	M		0.776**		
	F				
LL	T	0.694**		0.323*	
	M	0.776**			
	F			0.392*	
LS	T		0.323*		
	M				
	F		0.392*		
LL–IS	T				
	M				
	F				

T: Total; M: Males; F: Females; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.

*significant at P≤0.05. ** highly significant at P≤0.005.

In Class II.1 malocclusion, the correlation coefficient among soft tissue variables reveals a high significant positive correlation (for total sample) between UL and LL, LS and LL (for total sample and males) and a significant positive correlation between UL with LL and LS (for females) with LL–IS (Table 10).

Table (10): Correlations of soft tissue variables in Class II.1 subjects for males and females.

Variable	Sex	UL	LL	LS	LL–IS
UL	T		0.694**		0.419*
	M		0.704*	0.789*	
	F				
LL	T	0.694**		0.583**	
	M	0.704*		0.812**	
	F				
LS	T		0.583**		
	M	0.789*	0.812**		
	F				0.636*
LL–IS	T	0.419*			
	M				
	F			0.636*	

T: Total; M: Males; F: Females; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.

*significant at P≤0.05. ** highly significant at P≤0.005.

Table (11) revealed that the correlateon coefficient among soft tissue variables in Class II.2 malocclusion, a high significant positive correlation (for total sample and females) was seen between UL and LL.

Table (11): Correlations of soft tissue variables in Class II.2 for males and females.

Variable	Sex	UL	LL	LS	LL–IS
UL	T		0.694**		
	M				
	F		0.694**		
LL	T	0.694**			
	M				
	F	0.694**			
LS	T				
	M				
	F				
LL–IS	T				
	M				
	F				

T: Total; M: Males; F: Females; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.
*significant at P≤0.05. ** highly significant at P≤0.005.

In Class III malocclusion, the correlation coefficient among soft tissue variables shows a high significant positive correlation (for females) between LL with LS and LS with LL–IS. A significant positive correlation is seen between UL with LS (for males), UL with LL–IS (for total) and LS with LL (in total) (Table 12).

Table (12): Correlations of soft tissue variables in Class III subjects for males and females.

Variable	Sex	UL	LL	LS	LL–IS
UL	T				0.507*
	M			0.607*	
	F				
LL	T			0.45*	
	M				
	F			0.998**	0.984**
LS	T		0.45*		
	M	0.607*			
	F		0.998**		0.973**
LL–IS	T	0.507*			
	M				
	F		0.984**	0.973**	

T: Total; M: Males; F: Females; UL: Upper lip length; LL: Lower lip length; LS: Lip separation; LL-IS: Lower lip to incisor superior.
*significant at P≤0.05. ** highly significant at P≤0.005.

DISCUSSION

Peck *et al.*,[30] mentioned that the soft tissues more closely determine therapeutic modifiability. Thus, analysis of the soft tissues is the critical step in orthodontic decision making and this can only be accomplished through physical examination of the patient.

The present study ,using relaxed lip position, represents a panorama of different Angle's classes of malocclusions that is reflected upon the overlying soft tissue integument. While most of early direct soft tissue studies examined the person in the closed lip position these studies dealed with well–balanced or ideal faces. Therefore, reliable norms for relaxed lip position may be lacking for comparing and discussing.

Generally, the mean values for soft tissue variables in overall sample were found in Table (2). The mean UL in this study was slightly less than that of Burstone [20] and Wolford [31].

The LS mean value for overall sample was 2.092mm that come in accordance with Powell and Humpherys [22] who mentioned that the ideal inter labial gap in physiologic rest position is lightly touching up to 3mm. Burstone [20] found it to be 1.8 $\pm$1.2mm, while Lehman [32] found it to be 2$\pm$2mm.

The mean value of LL–IS for overall sample was 1.283mm that comes in agreement with Powell and Humpherys[22] who said that "esthetically ,the relative length of the upper lip and its relationship with incisal edge is an important consideration in a patient's mouth,this measurement establishes the lip line. In repose 2mm of the maxillary incisal edges should show".

For Class I subjects, as shown in Table (3), the mean value of UL in this study approached that Ra'uf [6] in different facial types for total, females and males. Arnett and Bergman[25] found UL to be 19–22mm; But less than Subtenly [33] who found UL to be 25 mm for both sexes and Burstone [20] who found it to be 20.10 mm in females and 23.80 mm in males, Farkas *et al*., [4] found it to be 19.60 mm in females and 21.70 mm in males.

LS value in Class I subjects is within the range of Legan who found it to be 2$\pm$2mm, and Arnett and Bergman [25] (1–5) mm.

In analyzing the results, Table (3–6) we found that Class I subject possesse higher values of UL followed by Class II.2 then Class II.1 subjects, Class III subjects possesse the least value. This result agreed with Rakosi [34] who mentioned that Class II.1 have shorter upper lip than that of Class I subjects. Rasheed and Gaib [35] in their comparative study between Class I and II.1 malocclusion found that class I male subjects possessed higher non significant value for UL and LL, on the contrary, class II.1 female subjects possess higher significant value for UL and LL, however, they used different landmarks to measure UL and LL.

In this study Class III subjects possess higher value of LL followed by Class II.1, Class II.2 subjects, Class I subjects possess the least value. This result agreed with Rakosi [34] who mentioned that the lower lip in Class III subjects is longer than that of Class I subjects, Ra'uf [6] and, Arnett and Bergman [25] they mentioned that increased lower one–third height, and subsequently lower lip, is frequently found with vertical maxillary excess and Class III malocclusions (lack of interdigitation opens vertical height). Decreased lower one–third height is associated with vertical maxillary deficiency and mandibular retrusion deep bites. While anatomic short lower lip is sometimes associated with Class II malocclusion.

The LS value was higher in Class II.1, Class II.2 subjects followed by Class III, while Class I subjects have the least value. According to Arnett and Bergman [25] Increases in interlabial gap are seen with anatomic short upper lip, vertical maxillary excess, and mandibular protrusion with open bite secondary to cusp interferences. Decreased interlabial gap was found with vertical maxillary deficiency, anatomically long upper lip (natural change with aging, especially in males), and mandibular retrusion with deep bite.

The mean value of LL–IS was higher in Class III subjects followed by Class I, Class II.2 and lastly Class II.1 subjects. Arnett and Bergman [25] mentioned that conditions of disharmony of LL–IS are produced by four variables:

1. Increased or decreased anatomic lower lip length (infrequently).
2. Increased or decreased maxillary skeletal length (frequently).
3. Thick lower lips expose less incisor than thin upper lips, all other factors being equal.
4. The angle of view changes the amount of incisor visible to the viewer.

The three variables that contribute to

the angle of view are (1) the patient's height, (2) the observer's height, and (3) the distance from the facial surface of the lower lip to the incisive edge (increased lip thickness reveals less relative tooth exposure).

Development and growth of face are influenced by sexual as well as genetic factors. Sex difference is not significant during childhood, but becomes so with development of other secondary characteristic.[36]

On the basis of the results and back to Tables (2–7) for overall sample, Class I,II.1, and III, a non significant sex difference has been seen for UL with males possessing higher value at 0.05level of probability. Al–T'aani [3] stated that Helman found that the UL show significant difference between two sexes. Ra'uf [6] found in Class I subjects, in sequare and tapered faces, males were having significant higher UL than females, while in oval face a non significant difference were found in UL with the males having larger value. Nasir [5] concluded that all facial measurements of young Iraqi adult males including UL were significantly higher than those of females.

For LL a non–significant sex difference has been seen with males possessing higher value at 0.05level of probability in total sample, Class I, and III.While Class II.1, males possess significant higher value than females. According to Al–T'aani[3] , Helman found that LL show non–significant difference between two sexes. Nasir[5] found LL were higher than those of females. While Ra'uf[6] , found in Class I subjects, in all facial types, males having significant higher LL than females.

Also for LL–IS a non–significant sex difference has been seen with males possessed higher value at 0.05 level of probability in overall sample, Class I, II.1and III. This may be attributed to high variability due to influence and interaction of several factors as length of LL, length of skeletal maxilla and length of crown of upper incisor or may be due to compensatory growth mechanism of overlying soft tissues that tend to hide the underlying skeletal discrepancy.

For LS a non significant sex difference has been seen with females possess higher value at 0.05level of probability in overall sample, Class II.1 and III. While Class I, females possessed significant higher value than males. This comes in agreement with Arnett and Bergman [25], who found in Class I subject, females show a larger LS within the normal range.

While Class II.2 subjects, the comparison between two sexes was not real since in this study, no male subject has Class II.2 and the total Class II.2 representing females only (Table 5).

The most obviously noticed correlation was UL with LL, in overall sample, a high significant positive correlation (for overall sample, males and females) is seen between UL and LL. In Class I malocclusion, a high significant positive correlation (for total and females) is seen between UL and LL. In Class II.1 malocclusion, a high significant positive correlateon (for total sample) was seen between UL and LL, and a significant positive correlation between UL and LL for females. According to AL–T'aani [3], Helman found that UL has high significant correlateion with LL in both sexes.

Regarding UL with LS, in overall sample, a high significant positive correlation is seen between UL&LS in males, and a significant positive correlation is seen between UL & LS in overall sample. This come in contrast with Arnett and Bergman [25], who mentioned that increases in LS are seen with anatomic short upper lip, vertical maxillary excess, and mandibular protrusion with open bite secondary to cusp interference. Decreased LS was found with vertical maxillary deficiency, anatomically long upper lip. However, this result may be attributed to individual variation of the over all sample before dividing it into subgroups. According to Proffit [37] variability in growth arises in several ways, from normal variation, from influences outside the normal experience, and from the timing effects. Variation in timing arises because the same event happens for different individuals at different times or, viewed differently, the biologic clocks of different individuals are set differently.

For UL with LL–IS, in overall sample, a significant positive correlation was

seen between UL and LL–IS in males. In Class III malocclusion. A significant positive correlation was seen between UL and LL–IS for total. This result may be contributed to the previously mentioned significantly positive correlation between UL and LL, since LL–IS is related to LL.

Concerning LL with LS, in overall sample a high significant positive correlation LL and LS. In Class II.1 malocclusion, a high significant positive correlation LL & LS for total sample and females.

In Class III malocclusion, a high significant positive correlation (for females) was seen between LL with LS. A significant positive correlation is seen between LL with LS in total. Arnett and Bergman [25], mentioned that increased lower one–third height, and subsequently lower lip, is frequently found with vertical maxillaary excess and Class III malocclusions (lack of interdigitation opens vertical height).

Correlation of LL with LL–IS, in Class III malocclusion, reveals a high significant positive correlation for females. This means as LL increased will decrease upper incisor exposure, this is in accordance to Arnett and Bergman.[25]

CONCLUSIONS

For each specific Angle's class of malocclusion , a specific facial soft tissue parameters. The upper lip length is greater in Class I subjects. The lower lip length is greater in Class III subjects. The inter–labial gap is greater in Class II subjects. The coverage of the lower lip to incicor superior is greater in Class III subjects. Most of the variables are higher in males than females. Complex correlations are found among the studied variables that varied between weak to high positive or negative with varying degree of significance.

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