ORIGINAL ARTICLE

Soft-tissue characteristics of Class II division 2 malocclusion in North Indian adult population: A comparative study

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ABSTRACT

Aims and Objectives: To evaluate and compare the soft-tissue characteristics associated with Angle's Class-I normal occlusion and Angle's Class-II division-2 malocclusion in North Indian adult population. **Materials and Methods:** Lateral cephalograms of 70 orthodontically untreated adult subjects, 40 were having normal occlusion (Group-A) with good facial profile (20 males - mean age 22.89 years and 20 females - mean age 21.27 years) and 30 subjects with Angle's Class-II division-2 malocclusion (Group-B) (15 males - mean age 22.50 years and 15 females - mean age 20.25 years) were analyzed. All the cephalograms were taken in natural head position, traced manually and 16 linear and 6 angular soft tissue parameters were measured which were derived from the Steiner, Ricketts, Burstone and Holdaway soft-tissue analyses. All the values were compared using Student's *t*-test with a level of significance at $P < 0{\cdot}05$. **Results:** Group-B males had significantly higher mean values for lip-line, soft-tissue thickness at labialis inferior ($P < 0.05$), and total facial contour angle ($P < 0.01$), whereas, Group-A males had significantly higher values for lower lip-chin length ($P < 0.001$), lower face height, soft-tissue chin-thickness ($P < 0.01$) and nasomental angle ($P < 0.05$). Group-B females had significantly higher values for lip-line ($P < 0.05$), soft-tissue thickness at labialis superior ($P < 0.01$), at labialis inferior and mandibular sulcus contour angle ($P < 0.05$) whereas, Group-A females had significantly higher values for upper lip length, lower lip-chin length ($P < 0.01$), lower face height ($P < 0.001$), nose length and lower lip to Sn-Pg' ($P < 0.05$). There was an apparent sexual dimorphism was found in soft tissue pattern of both the groups. **Conclusions:** Angle's Class-II division-2 malocclusion subjects have decreased lower lip-chin length and lower face height, while they have an increase lip-line, soft-tissue thickness at labrale superius, soft-tissue thickness at labrale inferius, total facial contour angle and mandibular sulcus contour angle.

Key words: Class-I normal occlusion, Class-II division-2 malocclusion, North Indian adult population, soft tissue

Introduction

Class-II malocclusion is most common type of malocclusion characterized by distal relation of lower dental arches to the upper and is divided into Class-II division-1 and Class-II division-2 malocclusion. These malocclusions may present a variety of skeletal, dental and soft-tissue configurations.[1,2] Among this Class-II division-2 malocclusion is rare and characterised by retroclined maxillary permanent incisors and its relationship to labial soft-tissue has been implicated as the principal etiological factor in the development and relapse of Class-II division-2 malocclusion.[3-8]

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After the introduction of cephalometric radiography in 1931 by Broadbent[9] and Hoffrath, many authors such as Steiner,[10] Down,[11] Broadbent[9] and associates, Ricketts,[12] Viken,[13] etc., have developed hard tissue cephalometric analysis and corresponding norms which provide useful guidelines for diagnosis and treatment planning.

It was found that the soft-tissues of the patient did not respond as expected to give a pleasing profile instead they exhibited high variability in their response to treatment based on hard tissue goals. Hence, it was found that the hard tissue

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measurements can deviate considerably from the facial form the patient expresses with the soft-tissues.[14,15] Soft-tissue variables such as lip thickness, soft-tissue chin-thickness, etc., can give results contrary to the hard tissue readings as in the case of a soft-tissue camouflage and one can find that the lips maybe more protrusive or retrusive than indicated by dentoskeletal measurements because of lips that are either excessively thick or thin.[16] Hence, evaluation of the patient's soft-tissue profile is one of the most important components of Orthodontic Diagnosis and Treatment planning.

Various authors have developed soft-tissue cephalometric analysis to interpret the diagnostic information relating to the soft-tissue facial profile.[10,12,14-17] As there is variability in the craniofacial morphology and nature of soft-tissue profile among different populations and ethnic groups, norms which are based on one population cannot always be applied to the other racial groups.[12,13,18] Keeping in mind the present study was conducted with the purpose of evaluating the soft-tissue pattern of North Indian population in normal occlusion, Angle's Class-II division-2 malocclusions and comparing them with each other.

Materials and Methods

Lateral cephalograms of 70 orthodontically untreated North Indian adult subjects (subjects, their parents and grandparents were native of North India and both the parents were of the same ethnical origin), 40 were having normal occlusion with good facial profile (Group-A) and 30 subjects with Angle's Class-II division-2 malocclusion (Group-B) were analyzed. Each group was further divided into male and female subgroups [Table 1].

Selection Criteria for the Class-I Normal Occlusion Sample

1. Pleasing soft-tissue profile.
2. Bilateral Angle's Class-I molar relationship in centric occlusion with normal overjet and overbite.
3. Well aligned maxillary and mandibular arches with < 2 mm crowding or spacing.
4. No congenitally missing teeth, congenital anomalies or facial asymmetry present.
5. No missing teeth (except 3rd molar).

Table 1: Age distribution of subjects in different groups

Group-A (normal occlusion) (*n* = 40)		Group-B (Class-II division-2) (*n* = 30)	
Subgroups	**Mean ± SD**	**Subgroups**	**Mean ± SD**
Male (*n*=20)	22.89±0.78	Male (*n*=15)	22.50±2.24
Female (*n*=20)	21.27±1.79	Female (*n*=15)	20.25±1.67

SD: Standard deviation

Selection Criteria for the Class-II Division-2 Sample

1. Bilateral Angle's Class-II molar relationship, with retroclined maxillary incisor teeth (at least of the two central incisors).
2. ANB angle >4°.
3. No congenitally missing teeth, congenital anomalies or facial asymmetry present.
4. No missing teeth (except 3rd molar).

Methods

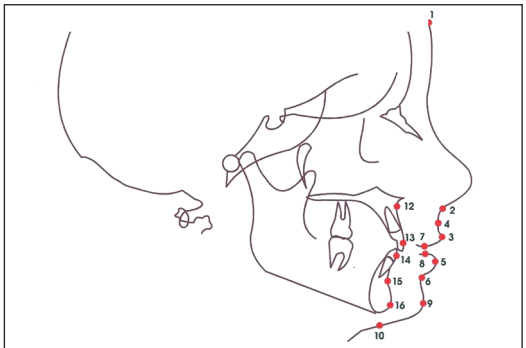
All cephalograms obtained from the department were taken by properly positioning the subjects on a Universal Counterbalancing type of cephalostat with the Frankfort Horizontal plane parallel to the floor, lips were relaxed and teeth in centric occlusion. Cephalograms should have good definition of hard- and soft-tissue structures. After placing registration points on the cephalograms, all the cephalograms were traced on acetate tracing sheets manually. The linear and angular measurements were made to the nearest 0.5 mm and 0.5° respectively with the help of millimeter ruler and protractor.

Methods of Analysis

Method of evaluation and comparison of soft-tissue variables for males and females in Group-A and Group-B are shown in Figures 1-6.

Statistics

Descriptive data that include mean, standard deviation and range values were calculated for each group. 95% confidence interval (limits) was provided for Group-A and Group-B. Between groups were compared by using Student *t*-test. *P* value less than 0.05 were considered to be statistically significant. Reliability of measurement was tested by doing double determinations of 10 cephalograms



Soft tissue points: 1. Glabella (G`), 2. Subnasale (Sn), 3. Labrale superius (Ls), 4. Superior labial sulcus (Ss), 5. Labrale inferius (Li), 6. Inferior labial sulcus (Si), 7.Stomion superius (Stms), 8. Stomion inferior (Stmi), 9. Pogonion (Pg`), 10. Gnathion (Gn`),
Hard tissue points:11. Glabella (G), 12. Subspinale (S), 13. Incision superius (Is), 14. Incision inferius (Ii), 15. Supramentale (Sm), 16. Pogonion (Pg)

Figure 1: Cephalometric points and landmarks used in the study

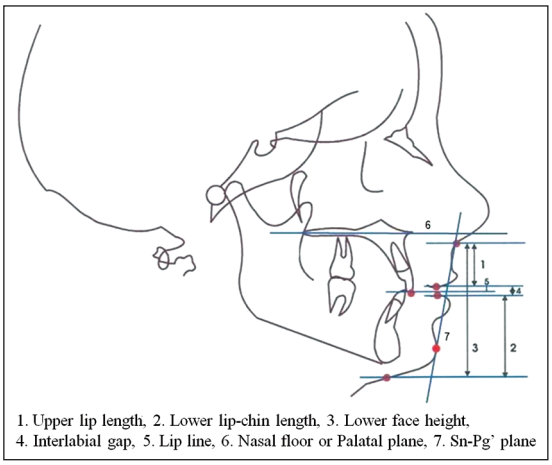


Figure 2: Reference planes and vertical measurements

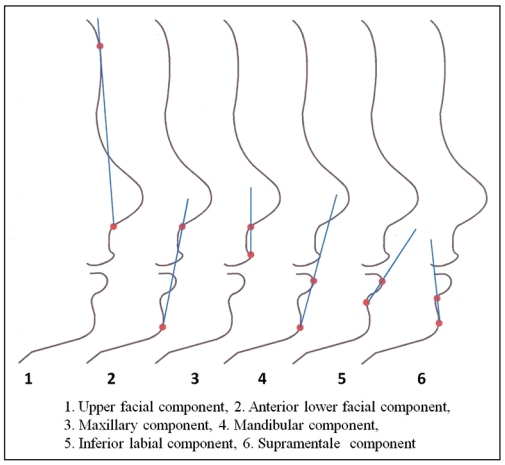


Figure 3: Profile components (line segments)

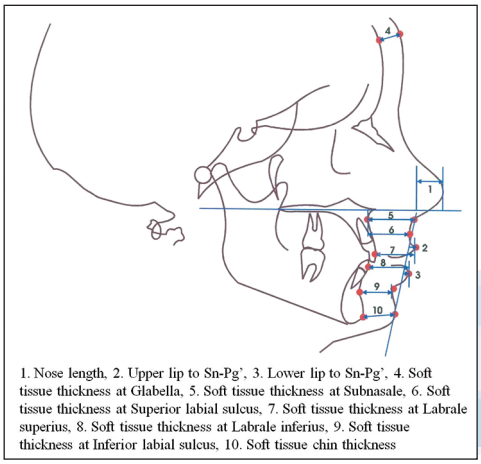


Figure 4: Horizontal linear measurements

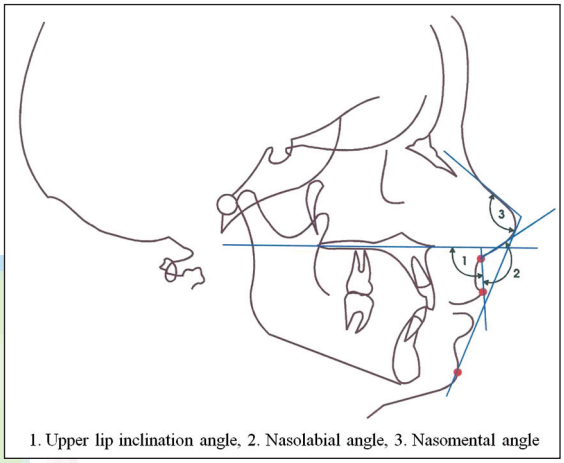


Figure 5: Angular measurements

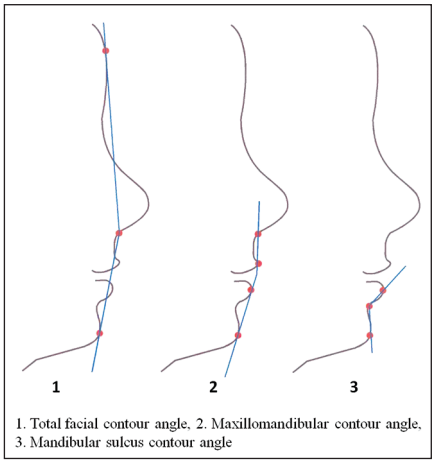


Figure 6: Contour angles

randomly selected at 15 days interval from the collected sample by the same operator. The comparison was drawn between 1st and 2nd determinations by Student's *t*-test. There was insignificant difference between 1st and 2nd measurements [Table 2].

Results

When mean values of soft-tissue variables of Group-A males and females were compared [Table 3] lower lip-chin length, lower face height, lip length ratio, soft-tissue thickness at superior labial sulcus, soft-tissue thickness at labialis superior, soft-tissue chin-thickness, nasomental angle and mandibular sulcus contour angle were found significantly lower whereas the lip-line and total facial contour angle were found significantly higher in females. When Group-B males and females were compared [Table 4] soft-tissue thickness at subnasale, at superior labial sulcus, at labialis inferior were found significantly higher in male.

On comparison of Group-A and B males [Table 5] lower lip-chin length, lower face height, soft tissue chin-thickness and nasomental angle was significantly higher for Group-A males, whereas lip-line, soft-tissue thickness at labialis inferior and total facial contour angle was higher for Group-B males. Comparing the Group-A and B females [Table 6] upper lip length, lower lip-chin length,

Table 2: Reliability analysis of cephalometric variables at two different time intervals

Variables	Ist reading (n = 10) (mean ± SD)	IInd reading (n = 10) (mean ± SD)	t	P
Linear measurements				
Upper lip length	22.42±1.34	22.30±1.42	0.19	0.85
Lower lip-chin length	49.10±4.29	49.20±4.11	0.05	0.96
Lower face height	71.80±4.60	71.70±4.50	0.05	0.96
Inter labial gap	3.60±1.42	3.65±1.72	0.08	0.94
Lip-line	4.40±2.40	4.45±2.48	0.05	0.96
Lip length ratio	1.80±0.42	1.85±0.48	0.25	0.80
Nose length	12.30±2.16	12.25±2.17	0.06	0.95
Upper lip to Sn-Pg'	8.15±1.72	8.20±1.80	0.06	0.95
Lower lip to Sn-Pg'	5.70±2.10	5.80±2.18	0.10	0.92
Soft-tissue thickness at glabella	5.30±0.86	5.35±0.80	0.13	0.90
Soft-tissue thickness at subnasale	16.40±1.97	16.45±1.82	0.06	0.95
Soft-tissue thickness at superior labial sulcus	13.70±1.70	13.60±1.84	0.13	0.90
Soft-tissue thickness at labialis superior	13.40±1.91	13.45±1.70	0.06	0.95
Soft-tissue thickness at labialis inferior	14.80±2.40	14.70±2.15	0.09	0.94
Soft-tissue thickness at inferior labial sulcus	11.60±1.95	11.65±1.90	0.06	0.95
Soft-tissue chin-thickness	12.05±1.78	12.10±1.92	0.06	0.95
Angular measurements				
Upper lip inclination angle	102.65±20.40	102.24±18.48	0.05	0.96
Nasolabial angle	98.94±13.59	98.65±12.60	0.05	0.96
Naso-mental angle	118.80±4.80	119.10±5.90	0.12	0.90
Total facial contour angle	23.16±4.38	23.24±4.34	0.04	0.97
Maxillo-mandibular contour angle	48.70±12.90	48.60±12.80	0.02	0.98
Mandibular sulcus contour angle	78.20±17.99	78.60±18.98	0.05	0.95

*P < 0.05, **P < 0.01, ***P < 0.001, SD: Standard deviation

Table 3: Mean and SD values of soft-tissue variables in Group-A (normal occlusion) and its comparison in male and female

Variables	Subgroup male (n = 20) mean ± SD	Subgroup female (n = 20) mean ± SD	t	P
Linear measurements				
Upper lip length	22.89±1.41	22.14±1.07	1.35	0.20
Lower lip-chin length	48.94±3.41	43.95±2.94	3.52	P<0.01**
Lower face height	71.83±4.64	66.73±4.57	2.47	P<0.05*
Inter labial gap	0.00±0.00	0.00±0.00	0	P=1
Lip-line	1.83±1.06	3.23±0.90	3.20	P<0.01**
Lip length ratio	2.14±0.09	1.99±0.17	2.38	P<0.05*
Nose length	15.33±2.02	14.18±1.85	1.33	0.20
Upper lip to Sn-Pg'	4.56±1.78	4.55±1.33	0.01	0.99
Lower lip to Sn-Pg'	3.06±1.86	4.18±1.66	1.42	0.15
Soft-tissue thickness at glabella	5.89±0.89	5.45±0.91	1.09	0.30
Soft-tissue thickness at subnasale	17.17±3.43	15.91±1.70	1.07	0.30
Soft-tissue thickness at superior labial sulcus	14.33±2.44	12.73±0.93	2.11	P<0.05*
Soft-tissue thickness at labialis superior	14.61±1.78	12.14±1.38	3.50	P<0.01**
Soft-tissue thickness at labialis inferior	14.56±1.84	13.59±1.45	1.32	0.20
Soft-tissue thickness at inferior labial sulcus	11.67±0.97	11.05±1.21	1.24	0.25
Soft-tissue chin-thickness	13.94±1.67	11.82±1.27	3.23	P<0.01**
Angular measurements				
Upper lip inclination angle	96.78±14.45	101.86±7.20	1.02	P=0.3
Nasolabial angle	95.17±11.82	99.14±10.12	0.81	0.45
Naso-mental angle	128.89±6.25	120.91±3.85	3.51	P<0.05*
Total facial contour angle	10.44±5.16	14.77±4.11	2.11	P<0.05*
Maxillo-mandibular contour angle	24.94±10.39	29.68±7.40	1.19	0.20
Mandibular sulcus contour angle	69.11±12.06	53.14±16.02	2.47	P<0.05*

*P < 0.05, **P < 0.01, ***P < 0.001, SD: Standard deviation

Table 4: Mean and SD values of soft-tissue variables in Group-B (Class-II division-2 malocclusion) and its comparison in male and female

Variables	Subgroup male (*n* = 15) mean ± SD	Subgroup female (*n* = 15) mean ± SD	*t*	*P*
Linear measurements				
Upper lip length	20.86±2.95	19.77±1.94	0.99	0.40
Lower lip-chin length	41.43±3.86	40.04±2.84	0.92	0.40
Lower face height	62.50±6.05	59.88±3.22	1.28	0.20
Inter labial gap	0.29±0.76	0.08±0.28	0.91	0.40
Lip-line	3.79±1.93	4.31±1.51	0.67	0.50
Lip length ratio	2.01±0.23	2.05±0.26	0.34	0.75
Nose length	13.43±1.90	12.42±1.47	1.32	0.20
Upper lip to Sn-Pg'	4.50±1.12	7.35±8.51	0.87	0.40
Lower lip to Sn-Pg'	2.71±0.99	2.12±2.45	0.60	0.55
Soft-tissue thickness at glabella	5.34±0.63	4.92±0.53	1.58	0.15
Soft-tissue thickness at subnasale	16.57±2.17	14.58±1.58	2.36	*P*<0.05*
Soft-tissue thickness at superior labial sulcus	13.43±1.02	12.00±1.12	2.80	*P*<0.05*
Soft-tissue thickness at labialis superior	16.07±1.74	14.23±2.03	2.03	0.08
Soft-tissue thickness at labialis inferior	17.14±2.54	15.00±1.76	2.22	*P*<0.05*
Soft-tissue thickness at inferior labial sulcus	11.43±1.84	10.38±0.82	1.78	*P*=0.10
Soft-tissue chin-thickness	12.71±2.38	11.04±2.19	1.58	0.15
Angular measurements				
Upper lip inclination angle	96.43±10.61	98.77±12.99	0.41	0.65
Nasolabial angle	104.57±15.22	104.70±12.99	0.03	0.99
Naso-mental angle	122.64±3.90	122.38±3.52	0.15	0.90
Total facial contour angle	18.86±5.83	17.69±5.45	0.45	0.65
Maxillo-mandibular contour angle	27.36±10.22	27.15±13.57	0.03	0.99
Mandibular sulcus contour angle	73.21±15.36	67.42±11.93	0.94	0.40

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$, SD: Standard deviation

Table 5: Comparison of soft-tissue variables in Group-A (normal occlusion) versus Group-B (Class-II division-2 malocclusion) in male

Variables	Group-A (normal occlusion) subgroup male (*n* = 20) mean ± SD	Group-B (Class-II, division-2) subgroup male (*n* = 15) mean ± SD	*t*	*P*
Linear measurements				
Upper lip length	22.89±1.41	20.86±2.95	1.83	0.08
Lower lip-chin length	48.94±3.41	41.43±3.86	4.13	*P*<0.001***
Lower face height	71.83±4.64	62.50±6.05	3.50	*P*<0.01**
Inter labial gap	0.00±0.00	0.29±0.76	1.16	0.20
Lip-line	1.83±1.06	3.79±1.93	2.60	*P*<0.05*
Lip length ratio	2.14±0.09	2.01±0.23	1.56	0.15
Nose length	15.33±2.02	13.43±1.90	1.91	*P*=0.07
Upper lip to Sn-Pg'	4.56±1.78	4.50±1.12	0.08	0.99
Lower lip to Sn-Pg'	3.06±1.86	2.71±0.99	0.45	0.65
Soft-tissue thickness at glabella	5.89±0.89	5.34±0.63	1.38	0.20
Soft-tissue thickness at subnasale	17.11±3.43	16.57±2.17	0.36	0.70
Soft-tissue thickness at superior labial sulcus	14.33±2.44	13.43±1.02	0.91	0.31
Soft-tissue thickness at labialis superior	14.61±1.78	16.07±1.74	1.64	0.15
Soft-tissue thickness at labialis inferior	14.56±1.84	17.14±2.54	2.34	*P*<0.05*
Soft-tissue thickness at inferior labial sulcus	11.67±0.97	11.43±1.89	0.34	0.70
Soft-tissue chin-thickness	13.94±1.67	12.71±2.38	3.73	*P*<0.01**
Angular measurements				
Upper lip inclination angle	96.78±14.45	96.43±10.61	0.05	0.99
Nasolabial angle	95.17±11.82	104.57±15.22	1.39	0.20
Naso-mental angle	128.89±6.25	122.64±3.90	2.31	*P*<0.05*
Total facial contour angle	10.44±5.16	18.86±5.83	3.06	*P*<0.01**
Maxillo-mandibular contour angle	24.94±10.39	27.36±10.22	0.47	0.60
Mandibular sulcus contour angle	69.11±12.06	73.21±15..36	0.60	0.50

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$, SD: Standard deviation

Table 6: Comparison of soft-tissue variables in Group-A (normal occlusion) versus Group-B (Class-II division-2 malocclusion) in female

Variables	Group-A (normal occlusion) subgroup female (*n* = 20) mean ± SD	Group-B (Class-II, division-2) subgroup female (*n* = 15) mean ± SD	*t*	*P*
Linear measurements				
Upper lip length	22.14±1.07	19.77±1.94	3.60	*P*<0.01**
Lower lip-chin length	43.95±2.94	40.04±2.84	3.30	*P*<0.01**
Lower face height	66.73±4.57	59.88±3.22	4.30	*P*<0.001***
Inter labial gap	0.00±0.00	0.08±0.28	0.94	0.35
Lip-line	3.23±0.90	4.31±1.51	2.08	*P*<0.05*
Lip length ratio	1.99±0.17	2.05±0.26	0.13	0.90
Nose length	14.18±1.85	12.42±1.47	.60	*P*<0.05*
Upper lip to Sn-Pg'	4.55±1.33	7.35±8.51	1.08	0.30
Lower lip to Sn-Pg'	4.18±1.66	2.12±2.45	2.36	*P*<0.05*
Soft-tissue thickness at glabella	5.45±0.91	4.92±0.53	1.78	0.10
Soft-tissue thickness at subnasale	15.91±1.70	14.58±1.58	1.98	0.08
Soft-tissue thickness at superior labial sulcus	12.73±0.93	12.00±1.12	1.72	0.10
Soft-tissue thickness at labialis superior	12.14±1.38	14.23±2.03	2.89	*P*<0.01**
Soft-tissue thickness at labialis inferior	13.59±1.45	15.00±1.76	2.12	*P*<0.05*
Soft-tissue thickness at inferior labial sulcus	11.05±1.21	10.38±0.82	1.61	0.15
Soft-tissue chin-thickness	11.82±1.27	11.04±2.19	1.04	0.30
Angular measurements				
Upper lip inclination angle	101.86±7.20	98.77±12.99	0.70	0.45
Nasolabial angle	99.14±10.12	104.76±12.99	1.17	0.25
Naso-mental angle	120.91±3.85	122.38±3.52	0.98	0.35
Total facial contour angle	14.77±4.11	17.69±5.45	1.46	0.15
Maxillo-mandibular contour angle	29.68±7.40	27.15±13.57	0.55	0.60
Mandibular sulcus contour angle	53.14±16.02	67.42±11.93	2.50	*P*<0.05*

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$, SD: Standard deviation

lower face height, nose length and lower lip to Sn-Pg' was significantly higher for Group-A females, whereas Group-B females had significantly higher values for lip-line, soft-tissue thickness at labialis superior, at labialis inferior and mandibular sulcus contour angle.

Discussion

Superimposed upon a dentoskeletal framework lies a variable soft-tissue mass comprising of connective tissue and muscles. Variation in this soft-tissue veneer can be an important factor in case analysis, as it influences-facial form and esthetics, and muscle balance of the orbicularis oris complex and hence the stability of the anterior dental segment.[19] Subtelny,[17] Burstone[19] and Bowker and Meredith[20] have recommended that the analysis of the soft-tissue should be taken into consideration for the proper evaluation of the underlying skeletal discrepancy because of individual differences in soft-tissue thickness, although this variability has no relationship to the configuration of the hard tissues. Investigators such as Merrifield,[21] Ricketts,[22] Burstone *et al*.,[23] and Holdaway[14] have developed numerous soft-tissue analyses to interpret the diagnostic information that the lateral cephalogram provides.

Since malocclusion, tooth stability and facial esthetics are influenced by the total mass, positions in space and general activity of soft-tissue structures and lip posture, the orthodontists are vitally concerned with soft-tissue morphology in various malocclusions. Hence, this study was conducted to evaluate the soft-tissue pattern of Class-II division-2 malocclusion and to compare it with normal occlusion sample.

The oriented lateral head cephalogram was used in the present study because it is approximately life size and a given position need not be held for a long period of time by the patients, contain other vital skeletal information which many orthodontists employ, record is permanent and the measurement can be repeated by the investigator, since both hard- and soft-tissue landmarks can be visualized, measurements relating them can be developed and records can be studied at the leisure of the investigator Burstone.[24] The horizontal linear measurements were measured parallel to palatal plane and vertical linear measurements were measured perpendicular to palatal plane. Sn-Pg' plane was used for evaluation of relative protrusion or retrusion of lips. Palatal plane was selected as the plane of reference because it remains relatively stable throughout growth[25] and it approaches a horizontal

position in erect posture thereby aids the visualization of profile components in space. Profile components (line segments) were taken for forming contour angles, which represent the intricate morphology of the integumental profile Burstone.[24]

When Group-A male and female were compared, it was found that the mean values of almost all the vertical and horizontal linear measurements were higher in males as compared to females. These sex difference were also noted by Burstone[19] and Arnett *et al*.[26] Alessandra and Barnett[27] also reported that soft-tissue measurement of the upper lip, superior sulcus, inferior sulcus and chin integuments to be significantly thicker in male than in female. Lower lip-chin length and lip length ratio were significantly higher in males when compared to females in present study, similar finding has been previously reported by Burstone,[28] Farkas and Kolar[29] and Powell and Humphreys.[30] The lip-line was found significantly lower in male when compared to female, this difference may be due to variation in upper lip length which was shorter in female. The labialis superior was found higher in male as compared to female, this finding is supported by Burstone[19] and Merrifield.[21] Soft-tissue chin-thickness was also significant higher in males, same finding was reported by Burstone.[19] The variable lower face height was significantly higher in male, similar finding was supported by Farkas and Kolar.[29] Nasomental angle and mandibular sulcus contour angle were found higher in males whereas, total facial contour angle was found higher in females. This may be due greater soft tissue chin-thickness in males.

When mean values of soft tissue variables in Group-B males and females were compared, it was found that most of the vertical and horizontal linear measurements were higher in males as compared to female as in Group-A subjects. Soft-tissue thickness at subnasale, at superior labial sulcus and at labialis inferior was found significantly higher in males. Literature is scant to support this finding.

When mean values of soft-tissue variables in Group-B were compared to Group-A in male, lower lip-chin length and lower face height was significantly lower in Group-B males. This finding could be due to decreased lower facial height and a more horizontal growth pattern in Class-II division-2 malocclusion group. Soft-tissue chin-thickness significantly lower in Group-B males which could be due to hypertrophied muscles in chin area. Total facial contour angle was higher and nasomental angle was found significantly lower in Group-B males, which could be due to distally locked mandible in Class-II division-2 malocclusions. The lip-line was significantly higher in Group-B males, this may be due to retroclination of upper central incisors teeth in Class-II division-2 malocclusion. The soft-tissue thickness at labrale inferius was significantly higher in Group-B, which may be explained on the basis that perioral muscles are more developed in Class-II division-2 malocclusions.

Mean values of soft tissue variables in Group-B is compared to Group-A females, lower face height and lower lip-chin length was significantly lower in Group-B females. This was due to the fact that in Class-II division-2 the growth pattern is more horizontal and lower facial height is less as compared to normal occlusion. Upper lip length was significantly lower in Group-B males as compared to Group-A females. The lip-line was significantly higher in Group-B males, this finding may be explained by the fact that maxillary incisors are supraerupted in Class-II division-2 malocclusion. The soft-tissue thickness at labialis superior and at labialis inferior was significantly higher in Group-B females. This finding may be attributed to increased development of musculature in orofacial region in Class-II division-2 cases. Lower lip to Sn-Pg′ was significantly lower in Group-B females, which may be explained on the basis that hypertrophied bands of muscles cross the midline in the lower sublabial region, which affects the Sn-Pg′ plane and hence lower lip to Sn-Pg′.

Conclusion

Following conclusions were drawn from this study:

1. Angle's Class-II division-2 malocclusion subjects have decreased lower lip-chin length and lower face height, while they have an increase lip-line, soft-tissue thickness at labrale superius, soft-tissue thickness at labrale inferius, total facial contour angle and mandibular sulcus contour angle.
2. An apparent sexual dimorphism was present in soft-tissue pattern of Angle's Class-II division-2 malocclusion.

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