



SOFT TISSUE PROFILE ANALYSIS AND ITS DIAGNOSTIC RELIABILITY IN PATIENTS WITH MALOCCLUSION”

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ABSTRACT

The soft tissue profile has an important role in the planning of the orthodontic treatment and differences are perceived in the variations of skeletal convexity, soft tissue, protrusion of the lips, and in the position of the incisors as well. Treatment planning procedures are based on hard and soft tissue measurements and some attempts are made to find out the characteristic values for hard and soft tissues by different types of malocclusion.

The object of the investigation was to determine the difference in the precision of measurements used in definition of thickness and height of the soft and hard tissues in subjects with Angle class II and class III by means of horizontal, vertical linear variables, angular variables on lateral cephalometric radiographs; and to determine the differences in the above-mentioned variables.

This investigation also involves checking the reliability and clinical significance of the parameters used here for diagnosis and treatment planning. Twenty-four lateral cephalometric radiographs of subjects from 9 to 26 years were selected for the investigation, out of which 15 with class II (13 girls and 2 boys) and 9 with class III (7 girls and 2 boys) by Angle.

Measurement of the thickness and height of the soft and hard tissues was performed by means of five horizontal parameters, four vertical parameters and six angular parameters. Values obtained were statistically analyzed by means of descriptive statistics and Student's t-test. Statistically significant variations were found among upper lip height, upper lip vermilion and the H angle. The large deviations revealed that these measurements showed a greater degree of individual variability and indicated that comparisons should be made with the range of normal values rather than with the means.

With the increasing demands of the patients due to the awareness and technological support, it is highly important to carry out detailed analysis of underlying soft and hard tissues before commencing the specific treatment plan.

KEYWORDS: malocclusion, soft tissue profile, Angle class II, Angle class III, cephalometric analysis.

INTRODUCTION

The different appearance of the profile is a result of a number of factors. One of the main factors in patient's facial appearance and the effect of treatment is influenced by sex and age of the patient, the type of treatment, the contour and tension of the lips, apart from the position of the teeth. Treatment planning procedures are based on hard tissue measurements and some attempts are made to find out a standard value for hard and soft tissues [Subtelny J., 1961; Merrifield L., 1966; Holdaway R., 1983; Nanda R. et al., 1990; Spyropoulos M., Halanzonitis D., 2001].

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Time and again the influence of orthodontic treatment on the circum-oral soft tissues is stressed upon. Today, it is generally accepted that orthodontic movement of teeth can change the appearance of the face. Many authors have highlighted the necessity of evaluating hard and soft tissues together: oral function, facial esthetics, and stability are important factors in orthodontic treatment [Subtelny J. 1961; Merrifield L., 1966; Mauchamp O., Sassouni V., 1973; Erbay E., Caniklioglu C., 2002].

The soft tissue profile has an important role in planning of the orthodontic treatment, and differences are perceived in the variations of skeletal convexity, soft tissue and protrusion of the lips, and also in the position of the lower incisors. Correction of malocclusion mainly effects changes in the appearance of the lower facial third. However,

the soft tissue, which covers the bone and the teeth can differ to such an extent that the dentoskeletal jaw relationship can be an inadequate guide for evaluation of facial disharmony. Changed relation between the hard tissues leads to redistribution of the soft tissues, so the treatment based only on skeletal standards can result in disharmonious facial proportions. In order to avoid greater errors, it is necessary to perform detailed analysis of the facial structures.

Today many methods for evaluation of facial changes and diversity are available, including anthropometry, photometry, computer imaging, and cephalometry. Skeletal norms are of assistance during determination of the type and prediction of treatment results, although the appearance of the soft tissue only partially depends on the support of the hard structures [Amjad A. et al., 2009]. In order to correctly predict the response of the soft tissue to the changed position of the hard tissue, it is important to understand the behavior of the soft tissue with regard to orthodontic and orthopedic changes, as well as to take into account its growth and development.

As the majority of dentofacial deformities, including changes arising from the effect of orthodontic treatment, which are most clearly reflected in the profile, the object of this investigation was to determine the precision of for measurements used in the definition of thickness and height of the soft tissue in subjects with Angle class II and class III by means of horizontal linear variables, vertical linear variables along with soft and hard tissue angular measurements on cephalometric radiographs.

Similar studies were done by sampling class I and class II skeletal pattern (age 14 to 18) and showed significant differences in the upper and lower lip lengths and as well as the relative protuberance of upper and lower lips compared to norm. [Subtelny J., 1961].

MATERIALS AND METHODS

Data were taken from the records of relevant lateral cephalometric radiographs of the Department of Pediatric Dentistry and Orthodontics of Yerevan State Medical University after MKhitar Heratsi. Twenty-four lateral cephalometric radiographs of subjects aged 9-26 years were selected and divided into two groups. The first group con-

sisted of 15 subjects with dental and skeletal class II (13 girls and 2 boys), and the second group consisted of subjects with class III (7 girls and 2 boys). Limitation of number for class III was due to fewer occurrences of the same problem.

Tracing paper was carefully fixed onto the radiograph, and the contours of the soft tissue profiles, *sella turcica*, frontal and nasal bone, orbit floor, *maxilla*, *mandible*, relation of the upper lower central incisor, the relation of the first lower molar and its antagonist were copied by pencil. The next step was the drawing in of cephalometric reference landmarks.

Blue and black coloured ballpoint marker was used to mark the anatomic soft and hard tissue landmarks. Lines (Figures 1-2), and angles (Figure 3) passing through them were measured with appropriate tools.

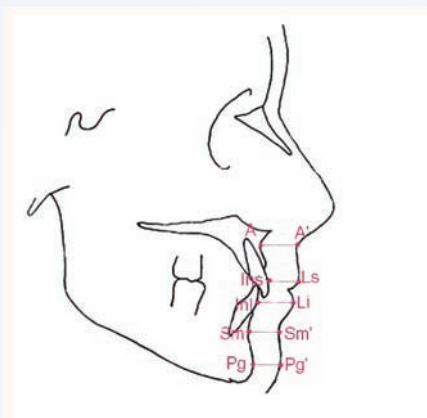


Figure 1. Horizontal linear measurements: landmarks used.

- **A'**: The landmark of the greatest concavity on the middle upper lip between the subnasale point and *labrale superius*.
- **A**: Subspinale - the deepest landmark of concavity of the frontal contour of the *processus alveolaris maxillae*.
- **Ls**: *Labrale superius* - the most anterior landmark of the upper lip.
- **Ins**: The landmark on the transition of the crown into the root of the upper middle incisor.
- **Li**: *Labrale inferius* - the most anterior landmark of the lower lip.
- **Inl**: The landmark on the transition of the crown into the root of the lower middle incisor.
- **Sm'**: *Supramentale* - the landmark of the greatest concavity in the middle of the lower lip between the *labrale inferius* point and the *pogonion* point.

- **Sm**: Supramentale - the deepest landmark of concavity of the frontal contour of the *processus alveolaris mandibulae*.
- **Pg pogonion** - the most anterior landmark of the soft tissue of the chin.
- **Pg' pogonion** - the most anterior landmark of the bony contour of the chin.

By joining each landmark on the soft tissue with the appropriate landmark on the hard tissue the following five horizontal lines were obtained:

- **A' - A**: Thickness of the upper lip in landmark A' ;
- **Ls - Ins**: Thickness of the upper lip in landmark Ls;
- **Li - Iml**: Thickness of the lower lip in landmark Li;
- **Sm' - Sm**: Thickness of the supramental tissue in landmark Sm' ;
- **Pg' - Pg**: Thickness of the soft tissue of the chin in landmark Pg'.



Figure 2. Vertical measurements: landmarks used.

Soft tissue landmarks used in vertical analysis of the facial profile:

sn - subnasale; ls - labiale superior; li- labiale inferior; st- stomion; gn- gnation; 1. upper lip height; 2. mandibular height; 3. upper lip vermillion; 4. lower lip vermillion.



Figure 3. Angular measurements: landmarks used.

1. Naso-labial angle: Cm-Sn-Ls.
2. Labio- mental angle: Li-Sm-Pg.
3. H angle: the angle between N-Pog line and H-line joining labrale superius and soft tissue pogonion (i.e. N Pog-Ls Pog).

Table 1.

Descriptive statistics for Class II.

CL II	N	Min.	Max.	Mean	S.D.
A'-A	15	13	17	14.7	1.63
Ls-Ins	15	8	18	13.93	2.63
Li-Iml	15	12	19	14.27	2.19
Sm'-Sm	15	9	14	10.87	1.5
Pg'-Pg	15	6	14	10.13	2.33
1	15	17	26	21.77	2.44
2	15	36	54	47.53	4.5
3	15	6	9	8.13	0.93
4	15	5	10	7.4	1.3
N-B	15	109	131	117	6.45
L-M	15	97	159	136.1	19.18
Z	15	61	88	71.4	7.53
H	15	10	21	14.33	3.52
I-NL	15	50	91	69	12.15
I-ML	15	64	111	87.93	10.84

Table 2.

Descriptive statistics for Class III.

CL III	N	Min.	Max.	Mean	S.D.
A'-A	9	12	18	15	1,94
Ls-Ins	9	12	18	14,33	1,8
Li-Iml	9	9	16	13	2,5
Sm'-Sm	9	7	15	10,33	2,29
Pg'-Pg	9	7	11	9,11	1,17
1	9	14	22	18,33	3,12
2	9	41	56	46,67	4,9
3	9	6	8	7,11	0,78
4	9	5	8	6,56	1,13
N-B	9	108	132	118,67	9,19
L-M	9	108	164	140,67	18,38
Z	9	63	81	74,44	5,88
H	9	6	13	8,44	2,35
I-NL	9	44	80	67	10,04
I-ML	9	82	102	92	7,47

4. Z angle: The inner angle between Frankfurt horizontal plane and profile line (i.e. tangent to Pog) and more prominent point on upper or lower lip.
5. Upper incisor to palatal plane: UI TO NL.
6. Lower incisor to mandibular plane: LI TO ML.

After the lines had been precisely drawn, distances in *mm* were measured with a caliper. The results obtained were classified according to Angle class and analyzed by statistical methods. Student's t-test was used for the analyzed variables to test the differences between the arithmetic means of the independent samples. Standard deviation was also used as the average deviation of measure-

TABLE 3

Difference between classes II and III

	Variables	Angle class	N	Mean	SD	t	p	Conf. inter. 95%	
								Inferior limit	Superior limit
Linear horizontal measurements mm	A'-A	cl II	15	14.7	1.63	-0.407	0.688	-1.829	1.229
		cl III	9	15	1.94				
	Ls-Ins	cl II	15	13.93	2.63	-0.402	0.692	-2.466	1.666
		cl III	9	14.33	1.8				
	Li-Im	cl II	15	14.27	2.19	1.305	0.205	-0.7478	3.288
		cl III	9	13	2.5				
	Sm'-Sm	cl II	15	10.87	1.5	0.701	0.491	-1.058	2.138
		cl III	9	10.33	2.29				
	Pg'-Pg	cl II	15	10.13	2.33	1.217	0.237	-0.7184	2.758
		cl III	9	9.11	1.17				
Linear vertical measurements mm	1	cl II	15	21.77	2.44	3.014	0.006*	1.073	5.807
		cl III	9	18.33	3.12				
	2	cl II	15	47.53	4.5	0.439	0.665	3.206	4.926
		cl III	9	46.67	4.9				
	3	cl II	15	8.13	0.93	2.754	0.012*	0.2519	1.788
		cl III	9	7.11	0.78				
	4	cl II	15	7.4	1.3	1.606	0.123	-0.2451	1.925
		cl III	9	6.56	1.13				
Angular measurements °	N-B	cl II	15	117	6.45	-0.524	0.606	-8.282	4.942
		cl III	9	118.7	9.19				
	L-M	cl II	15	136.1	19.18	-0.570	0.575	-21.06	11.98
		cl III	9	140.7	18.38				
	Z	cl II	15	71.4	7.53	-1.034	0.313	-9.139	3.059
		cl III	9	74.44	5.88				
	H	cl II	15	14.33	3.52	4.441	0.0*	3.14	8.64
		cl III	9	8.44	2.35				
	I-NL	cl II	15	69	12.15	0.415	0.682	-7.993	11.99
		cl III	9	67	10.04				
	I-ML	cl II	15	87.93	10.84	-0.990	0.333	-12.6	4.456
		cl III	9	92	7.47				

Notes: *Differences statistically significant, p < 0.05

ments from the arithmetic mean. Probability of $p < 0.05$ was taken as the degree of statistical significance. Consequently, $p < 5\%$ indicates statistically significant difference, which means that the result obtained was confirmed with 95% certainty [Schuurs A. et al., 1993]. Student's t-test was used to determine the differences among the variables used for various measurements.

RESULTS

Table 3 shows the measured data for analysis of soft tissue and hard tissue parameters in relation with malocclusion. Linear horizontal parameters like $A-A'$, $Ls-Ins$, $Li-Iml$, $Sm'-Sm$, and $Pg'-Pg$ did not show significant difference when compared between class II and class III. Greater variability was found in angular measurements except the H angle. Linear vertical measurement showed statistical significant differences in upper lip height and upper lip vermilion.

DISCUSSION

Though the changes in the soft tissues following the orthodontic treatment are still unclear [A quantitative method, 1959; Merrifield L., 1966], the analysis of soft and hard tissues in some way helps us to predict the changes that would follow the orthodontic tooth movements. The purpose of this investigation was to determine the differences in the precision of measurements in the definitions of soft and hard tissues in subjects with class II and class III by Angle.

The results obtained in the study showed the reliability of landmark location. The angular measurements used to compare the differences between class II and class III showed a greater standard deviation except the H angle. The large standard deviations revealed that these measurements showed a greater degree of individual variability and indicated that comparisons should be made with the range of normal values rather than with the means.

The mean values for the thickness of upper and lower lip did not show major statistical differences in comparing with class II and class III subjects. Similar findings were seen, when thickness of supra-mental and soft tissue chin was analyzed.

Linear vertical measurements showed significant statistical difference when upper lip height and

upper lip vermilion were compared. They showed the p values of 0.006 and 0.012, respectively.

Angular measurement showed statistical difference in H angle, where p value was 0.0 with the mean range of 14.33 and 8.44 degrees for class II and class III, respectively.

Naso-labial and labio-mental angles showed a greater degree of variation probably because of differences in skeletal malocclusions, gender and the age of group selected.

The upper incisor to palatal plane angle (UI to NL) and the lower incisor to mandibular plane angle (LI to ML) also showed greater degree of variation possibility because of the incisor position.

The Z angle showed a mean value of 71.4 and 74.44 degrees for class II and class III, respectively.

Further studies would be useful for further investigations.

CONCLUSION

On the basis of the results derived from this study, the following might be concluded

- There is a significant difference in comparing upper lip height and upper lip vermilion;
- There is a significant difference when the H-angle was compared among the subjects selected;
- Linear horizontal measurements did not show major difference in spite of having larger age variations;
- Angular measurements, except the Z-angle, showed a larger degree of variation. The large standard deviations revealed that these measurements showed a greater degree of individual variability and indicated that comparisons should be made with the range of normal values rather than with the means.

With the increasing demands of the patients, due to the awareness and technological support, it is highly important to carry out detailed analysis of underlying soft and hard tissues before commencing the specific treatment plan. This article is an attempt to evaluate the same problem. Further investigations will be required to support the necessity of soft and hard tissue detailing.

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