Soft tissue facial profile analysis of adult Iraqis with different classes of malocclusion

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ABSTRACT

Background: Complete analysis of facial profile should also include an evaluation of soft tissue morphology.
Materials and Method:The sample consisted of 90 Iraqi adults (45 males and 45 females) aged 18-25 years from Baghdad city divided into 3 groups according to the ANB angle with 30 subjects in each group (15 males and 15 females) for class I, II and III. Lateral cephalometric radiograph was taken for each subject and 8 angular and 5 linear measurements were identified and determined, t-test, ANOVA and LSD test were used to compare between both genders and between different classes.
Results:Showed that females had greater angular measurements and smaller linear measurements with more lip prominence than males in all classes, there was more convex facial profile with more prominent forehead, more prominent tip of the nose with increased facial heights and more prominent lips in class II subjects than in class I and IIIsubjects.
Conclusion: There is wide variation in soft tissue facial profile among different classes of malocclusion and careful determination of the components of soft tissue facial profile is very important in the diagnosis and treatment planning.
Key wards: Soft tissue facial profile, malocclusion classes, profile analysis. (J Bagh Coll Dentistry 2013; 25(4):151-159).

INTRODUCTION

One of the primary goals of orthodontic treatment is to preserve and/or achieve optimal facial esthetics and balanced facial profile for any form of malocclusion.The harmonious soft tissue profile is one of the most important treatment goals in orthodontics and soft tissue profile analysis can provide valuable information in developing a meaningful concept of facial esthetic and harmony and supplemental tool for diagnosis and treatment planning[1]. Facial harmony is defined as orderly and pleasing arrangement of the facial parts in profile.Facial harmony in orthodontics is determined by the morphological relationships and proportions of the parts of the face that include the facial profile as a whole; the nose, the lips and the chin[2, 3].The soft tissue covering the face plays an important role in facial esthetics, speech and other physiological functions, moreover the force generated by the perioral soft tissue structure is known to be the most potent that can affect tooth position and malocclusion, therefore a good evaluation of soft tissue profile is very important in the standard diagnosis and treatment planningto ensure post treatment stabilityand success [4].

Successful evaluation of the facial balance and harmony include a study of the facial profile and the relationship of the nose, lips and chin; and after the clinical introduction of X-ray cephalometrics; lateral cephalometric radiograph has been used to study and evaluate the soft tissue profile including studies of the alteration that may occur as result of growth or effect of orthodontic treatment on the soft tissue profile [5], studies to predict and measure the changes associated with orthognathic surgery [6], studies dealing with facial forms to establish a base line data [7], [8] and studies that compare between the soft tissue profile of two or more populations or different ethnic groups [9, 10].

Relying on dentoskeletal analysis for treatment planning can sometimes lead to esthetic problems, especially when the orthodontist tries to predict soft tissue outcome using only hard tissue normal values. Many authors obtained soft tissue standards from subjects selected on basis of class I normal occlusion due to presence of strong interrelation between good facial esthetics and good occlusion [11]. However, good occlusion does not necessarily mean good facial balance [1]. The soft tissue analysis includes an appraisal of the adaptation of soft tissue to the bony profile with consideration to the size, shape and the posture of the parts of the face as seen on the lateral head film [2, 3]. It has been shown previously that a marked variation exists in the soft tissue covering the skeletodental framework, and the soft tissue vary in thickness over different parts of the facial skeleton, therefore the outline of the soft tissue profile does not correspond well with the underlying skeletal framework so that complete analysis of facial profile should also include an evaluation of soft tissue morphology [12].

As mentioned earlier most authors obtained soft tissue profile standards from subjects withclass I normal occlusion, therefore the present

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study was carried out to study and compare between the soft tissue profile analysis in Iraqi subjects with class I, II and III occlusion.

MATERIALS AND METHODS

Sample

Out of more than 200 subjects attending the orthodontic department at the college of dentistry, University of Baghdad; 90 subjects were selected that fit the following selection criteria:

1. All the subjects were Iraqi Arabs and were 18-25 years old.
2. They have complete set of permanent teeth regardless of the third molar with no severe crowding or spacing and no bimaxillary protrusion.
3. They have no facial asymmetry or malformation and no previous orthodontic or orthopedic treatment.

The subjects were divided into three groups as follows[13]:

1. Class I group (30 subjects; 15 males and 15 females) with class I molar relation and normal overjet and overbite (2-4 mm) and normal ANB angle (2-4º).
2. Class II group (30 subjects; 15 males and 15 females) with class II molar relation with increased overbite greater than 4 mm and ANB angle greater than 4º.
3. Class III group (30 subjects; 15 males and 15 females) with class III molar relation with overjet less than 2 mm and ANB less than 2º.

Method

After clinical examination a lateral cephalometric radiograph was taken for each subject with P M 2002 ProlinePlanmeca x-ray machine, all the images were imported into pentium 4 laptop for processing where all the measurements were done using AutoCAD software and cephalometric points and planes were determined and then angular and linear measurements were obtained (after correction of the magnification).

Cephalometric points[13, 14] (Figure 1)

Skeletal points

- *Nasion* (N): the most anterior point of frontonasal suture.
- *Orbitale* (Or): the lowest point of orbital shadow.
- *Porion* (Po): the most superior point of the external auditory meatus.
- *Pogonion* (Pog): the most anterior point of the bony chin.
- *subspinale* (Point A): deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla.
- *Menton* (Me): the most caudal point in the outline of the symphysis.
- *Gonion* (Go): at the intersection of the lines tangent to the posterior border of the ramus and the mandibular base.

Soft tissue points

- Skin nasion (n): the most concave point overlying the area of frontonasal suture.
- Pronasal (no): tip of the nose which is the most anterior point in the midsagittal plane.
- Subnasale (sn): where the nasal septum merges with the upper cutaneous lip in the midsagittal plane.
- Labralesuperius (Ls): the most anterior point on the margin of the upper membranous lip.
- Stomion (sto): the median point of oral embrasure when the lips are closed.
- Labraleinferius (Li): the most anterior point on the margin of the lower membranous lip.
- Soft tissue submentale (sm): the point of greatest concavity in the midline of lower lip.
- Soft tissue pogonion (pog): the most prominent point on soft tissue midsagittal plane.

Planes: (Figure 1)

- Skeletal Facial plane (N - Pog): line extending from Nasion to Pogonion.
- Frankfort Horizontal plane (FH): horizontal plane running between Porion and Orbitale.
- Mandibular plane (MP): line tangent to the lower border of the mandible

Angular measurement: (Figure 2)

- Angle of convexity (N-A-Pog): it expresses the protrusion of the maxillary part of the face to the total profile[13].
- Skeletal facial mandibular angle (sk-mp): the angle between the skeletal facial plane and mandibular plane, it was developed by [15].
- Nasofrontal angle: formed by a line tangent to the forehead from soft tissue nasion with the line tangent to the dorsum of the nose.
- Nasal angle: formed by a line tangent to the dorsum of the nose from soft tissue nasion with the line tangent to the lower border of the nose from soft tissue subnasale.
- Nasolabial angle: formed by a line tangent to the lower border of the nose from soft tissue subnasale with the line from labralesuperius to subnasale.

- Interlabial angle: it is the intersection angle at stomion of lines extending from labralesuperius and labraleinferius.
- Labiomental angle: it is the intersection angle at point (sm) of lines extending from labraleinferius and the tangent to the chin [16].
- Z-angle: formed by a line tangential to the soft tissue chin and to the most anterior part of either upper or lower lip which ever was most prominent to intersect the Frankfort Horizontal plane [17].

Linear measurements: (Figure 1)

A-Vertical: all the vertical variables were measured (in millimeters) perpendicular to the Frankfort Horizontal plane; the following measurements were done [13]:

- **Upper facial height (UFH):** distance between soft tissue nasion to subnasale point.
- **Lower facial height (LFH):** distance between subnasale point and soft tissue pogonion.
- **Total facial height (TFH):** distance between soft tissue nasion to soft tissue pogonion

B- Horizontal: the perpendicular measurements on Ricketts esthetic line ("E" line) from Ls and Li [2].

Statistical Analysis: was done using SPSS software version 15.

1. Descriptive statistics: means and standard deviations
2. Inferential statistics: independent sample t-test to compare between means for gender differences, ANOVA test followed by LSD test was used to compare between the means of the three groups.

The following levels of significance were used:

Non-significant	NS	$P > 0.05$
Significant	*	$0.05 \geq P > 0.01$
Highly significant	**	$0.01 \geq P > 0.001$
Very highly significant	***	$P \leq 0.001$

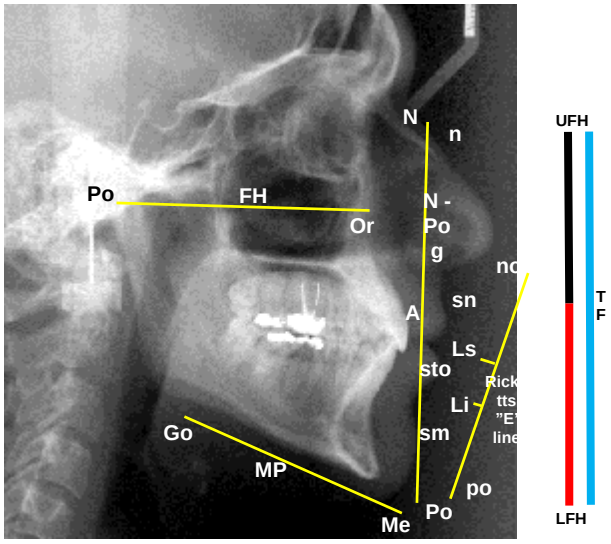

Figure 1: Cephalometric points, planes and linear measurements.

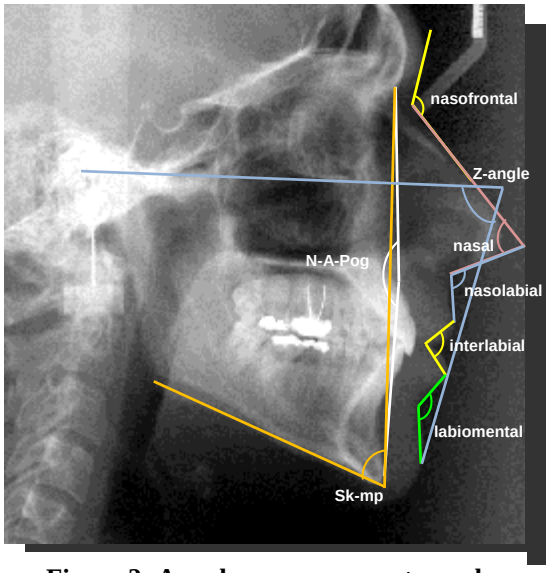

Figure 2: Angular measurements used.

RESULTS AND DISCUSSION

The descriptive statistics and gender differences between males and females for all the variables in class I, II and III are shown in table (1). Comparison between different classes in the study was done using ANOVA test followed by LSD test for the measurements that showed significant difference and the results are shown in table (2) for males and in table (3) for females.

Study of the soft tissue covering of the face plays an important role in facial esthetics and these soft tissues are affected by a variety of variables including skeletal relationship, soft tissue thickness and function [18]. Many studies for profile analysis were done in Iraq, however all their samples were having class I normal occlusion [19, 20] or comparison between class I and II [21], in this study a comparison was done among the soft tissue facial profile for class I, II and class III occlusion in a sample of Iraqi adults, therefore comparing the results with other studies may be difficult due to difference of the sample or difference in the variables measured.

The results for the variables in this study showed the following:

- ***N-A-Pog angle;*** there was non-significant difference between both genders for all the classes, however the mean values were higher in males than in females in class I sample which could be due to that males have more straight profiles than females [3, 13, 20-22], while it was higher in females in class II and III (Table 1). When comparing among different classes we found higher values in class III and lowest in class II sample with significant difference for males (Table 2) and females (Table 3) and this could be due to the difference in the position of the skeletal bases in the sagittal plane with the maxilla in more anterior position than the mandible in class II sample than in class I and III [13].
- ***sk-mp angle*** was higher in females than in males in class I subjects and this differ from other studies [19, 20], while it was higher in males than females with significant difference in class II and III subjects indicating that females have more facial tapering than males in these groups (Table 1). However there was significant difference among different classes for males and females with more facial tapering in class III males (Table 2) and females (Table 3) followed by other classes. This angle is greatly affected by the direction of mandibular rotation and further studies may be required to investigate the relation in different skeletal classes.
- ***Nasofrontal angle*** was higher in females than in males with significant difference for all the classes (Table 1), while it was higher in class III subjects and lowest in class II subjects for males (Table 2) and females (Table 3) with significant differences and these results are similar to those of [19, 21]. These results indicate that class III subjects have slightly more flattened forehead than that of class I and II subjects. This angle is highly related to the length of anterior cranial base and direction of facial growth and as the class II subjects have more anteriorly positioned maxillary base than the mandible so this may bring the nose into more prominent position in the face increasing the value of this angle, and this agree with [23].
- ***Nasal angle*** was higher in females than in males with significant difference for all the classes (Table 1), which means that females have more rounded tip of the nose than males and this could be due to the fact that males have more growth increment than females [21, 24], however the nasal angle was higher in class III subjects and lowest in class II subjects with significant difference for males (Table 2) and non-significant difference for females (Table 3) which means that class III subjects have more rounded and less prominent tip of the nose than other classes in the study while class II subjects have more prominent tip of the nose which give the face more convex appearance and this could be due to the more anterior position of the nasomaxillary complex in class II subjects while in class III subjects the more prominent mandible and chin and/or retruded maxilla make the face appear more flattened and concave [25].
- ***Nasolabial angle*** was higher in females than in maleswith significant difference for all the classes (Table 1), however there was higher values in class II males than class I and class III males with significant difference (Table 2), and higher in class I females than class II and class III females (Table 3). This angle is affected by the elevation of the nose tip and also the inclination of the upper incisors which could lead to difference in the values of the angle unrelated to the underlying skeletal pattern [18], our results differ from [21] who found no difference between class I and II sample.
- ***Interlabial angle*** was higher in females than in males in class I and class II subjects and higher in males in class III sample (Table 1), and these results are somewhat similar to the findings of other studies [19-21]. However it was higher in class III males than in class II and I maleswith significant difference (Table 2), and higher in class I females than class II and III with significant difference (Table 3). The value of this angle is greatly affected by the position and inclination of the incisor teeth (upper or lower) and/or the thickness of the lips [26] and further studies may be needed to study that effect.
- ***Labiomental angle*** was higher in females than males for all the classes with significant difference (Table 1). However it was higher in

class III subjects and lowest in class II subjects for males and females with significant difference (Table 2, 3), this could be caused by that the more anterior position of the mandible in class III subjects may cause flattening to the mentolabial sulcus while in class II subjects the more posterior position of the mandible may cause deepening of the mentolabial sulcus due to curling of the lower lip into forward position to contact the upper lip causing more acute angle [27]. Our results were higher than that of [19-22, 28] and similar to [8].

- ***Z-angle*** was higher in females than in males for all the classes although it was non-significant (Table 1). However it was higher in class III male sample and lowest in class II with significant difference (Table 2), while it was higher in class I females and lowest in class II (Table 3), this could be due to the fact that this angle is affected by the position of the lips and the chin in anterioposterior relation and as the mandible is in more anterior position in class III so the angle becomes more obtuse, while in class II relation the mandible is in more posterior pisition and the angle becomes more acute [17].Our results were higher than that of [21] and similar to [20, 22] and lower than [17].
- ***Facial Heights;*** the values were lower in females than in males with significant difference for all the classes(Table 1) and this is similar to other findings [3, 19-21, 29] and this could be because males have larger growth increment that continues for longer period than females, however when we compared between different classes we found that for both genders the values were higher in class II subjects than those of other classes (Table 2, 3); this could be as a result of the direction of growth of the nasomaxillary complex in class II sample could have some excess of growth in a forward and/or downward direction causing increase in the facial heights more than that of other classes [24].
- ***E-Ls and E-Li;***our results showed that females have more protrusion of the upper and lower lips in relation to the nose and chin than males in all the classes except upper lip in class I and lower lip in class III subjects, however there was non-significant difference for most of the readings (Table 1), this could be because males have larger measurements than females in general or males have longer lasting mandibular growth that could continue into adult life which may bring chin forward in relation to the nose [20, 24, 29, 30]. However there was more protrusion of the upper lip in class II males and females than that of class I and class III subjects with significant difference, and more retrusion of the upper lip in class III subjects than in other classes (Table 2, 3), while for the lower lip there was more protrusion in class II females than other classeswith significant difference, while for males the lower lip was more protruded in class III subjects than in class I and class II subjects, this could be due to the effect of the difference in the position of the tip of the nose and position of the chin in different classes and also the effect of the degree of the inclination of the incisors on lip protrusion which is greatly affected by the skeletal relation of the underlying dental bases resulting in different degrees of lip protrusion or retrusion in the upper or lower arch [13].

In ***summary*** we can say that:

- Females have higher values of almost all the angular measurements than males and this would give the face a smoother outline with more pleasant appearance than males.
- Facial heights were higher in males than in females in all the classes with higher values in class II sample than other classes.
- Females have more prominent upper and lower lips in almost all the classes than males especially in class II sample.
- Females have less prominent tip of the nose than males in all classes while males have more prominent tip of the nose in class II subjects than other classes.
- Males and females have similar skeletal facial profile in all classes of the study with more convex facial profile in class II subjects than class III and class I that showed straight facial profile.
- Class II subjects showed more prominent forehead than other classes.
- There is more facial tapering in males than in females in class II and class III subjects.
- The lips are more prominent than the chin in class II subjects than those of class I and III subjects.

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Table 1: Descriptive statistics and gender differences for class I, II and III

Variables	Class	Descriptive statistics				Genders Difference (d.f.=28)	
		Males (N=15)		Females (N=15)			
		Mean	S.D.	Mean	S.D.	t-test	P-value
N-A-Pog	Cl I	175.13	1.68	175.07	1.98	0.1	0.922 (NS)
	Cl II	167.73	2.15	168.8	1.82	-1.46	0.154 (NS)
	Cl III	175.13	1.85	176.2	2.01	-1.51	0.141(NS)
Sk-Mp	Cl I	66.73	1.75	67.73	1.71	-1.58	0.125 (NS)
	Cl II	68.67	1.91	63.53	1.81	7.55	0.000 **
	Cl III	64.93	2.02	61.87	1.92	4.26	0.000 **
Nasofrontal	Cl I	124.4	1.96	128	1.89	-5.13	0.000 **
	Cl II	120.73	1.94	126.2	1.57	-8.48	0.000 **
	Cl III	127.4	2.06	128.67	1.95	-1.73	0.095 (NS)
Nasal	Cl I	75.2	1.7	81	2.1	-8.31	0.000 **
	Cl II	70.87	1.85	80	1.85	-13.53	0.000 **
	Cl III	77.67	1.95	81.53	2.17	-5.14	0.000 **
Nasolabial	Cl I	102.6	2.16	112.4	1.99	-12.9	0.000 **
	Cl II	105.07	1.58	110.6	1.8	-8.94	0.000 **
	Cl III	98.27	1.94	100.6	2.03	-3.22	0.003 **
Interlabial	Cl I	98.27	2.25	110.87	1.81	-16.9	0.000 **
	Cl II	109.33	1.72	110.47	1.88	-1.72	0.096 (NS)
	Cl III	110.07	1.83	103.8	1.97	9.02	0.000 **
Labiomental	Cl I	129.4	1.8	131.8	2.04	-3.41	0.002 **
	Cl II	101	1.69	129.8	1.93	-43.42	0.000 **
	Cl III	131.53	1.88	139	2	-10.52	0.000 **
Z - angle	Cl I	76.8	1.97	79.53	1.68	-4.08	0.000 **
	Cl II	69.6	1.35	69.87	1.77	-0.46	0.646 (NS)
	Cl III	79	1.56	79.07	1.79	-0.11	0.914 (NS)
UFH	Cl I	56.39	1.92	55.89	1.97	0.7	0.488 (NS)
	Cl II	58.87	1.86	56.1	1.77	4.17	0.000 **
	Cl III	56.68	1.78	55.3	1.8	2.11	0.044 *
LFH	Cl I	55.94	1.99	48.95	1.9	9.84	0.000 **
	Cl II	60.87	1.99	56.57	1.77	6.24	0.000 **
	Cl III	54.85	1.99	52.84	1.85	2.85	0.008 **
TFH	Cl I	110.88	1.47	103.09	1.71	13.37	0.000 **
	Cl II	120.03	1.48	111.04	1.82	14.86	0.000 **
	Cl III	111.22	2.14	106.05	1.64	7.44	0.000 **
E line-Ls	Cl I	4.28	1.59	5.01	1.1	-1.47	0.152 (NS)
	Cl II	3.45	2.12	2.19	1.76	1.78	0.086 (NS)
	Cl III	5.21	1.9	5.04	1.22	0.3	0.763 (NS)
E line-Li	Cl I	2.88	1.65	2	1.94	1.34	0.192 (NS)
	Cl II	1.26	1.87	-0.06	1.09	2.35	0.026 *
	Cl III	0.49	2.09	0.63	1.27	-0.23	0.818 (NS)

S.D.: standard deviation, d.f.: degree of freedom

Table 2: Comparison between the measurements of class I, II and III for males using ANOVA test followed by LSD test

Variables	ANOVA for males Class I (N=15), Class II (N=15), Class III (N=15) Classes Difference (d.f.=44)		LSD test after ANOVA for males			
			Classes		Mean Difference	P-value
	F-test	P-value				
N-A-Pog	75.46	0.000 **	I	II	7.4	0.000 **
				III	0	1 (NS)
			II	III	-7.4	0.000 **
Sk-Mp	14.52	0.000 **	I	II	-1.93	0.008 **
				III	1.8	0.013 *
			II	III	3.73	0.000 **
Nasofrontal	42.28	0.000 **	I	II	3.67	0.000 **
				III	-3	0.000 **
			II	III	-6.67	0.000 **
Nasal	52.77	0.000 **	I	II	4.33	0.000 **
				III	-2.47	0.001 **
			II	III	-6.8	0.000 **
Nasolabial	48.65	0.000 **	I	II	-2.47	0.001 **
				III	4.33	0.000 **
			II	III	6.8	0.000 **
Interlabial	172.97	0.000 **	I	II	-11.07	0.000 **
				III	-11.8	0.000 **
			II	III	-0.73	0.308 (NS)
Labiomental	1352.63	0.000 **	I	II	28.4	0.000 **
				III	-2.13	0.002 **
			II	III	-30.53	0.000 **
Z - angle	133.59	0.000 **	I	II	7.2	0.000 **
				III	-2.2	0.001 **
			II	III	-9.4	0.000 **
UFH	8.03	0.001 **	I	II	-2.48	0.001 **
				III	-0.29	0.671 (NS)
			II	III	2.19	0.002 **
LFH	38.99	0.000 **	I	II	-4.93	0.000 **
				III	1.09	0.139 (NS)
			II	III	6.02	0.000 **
TFH	136.2	0.000 **	I	II	-9.15	0.000 **
				III	-0.34	0.587 (NS)
			II	III	8.81	0.000 **
E line-Ls	3.29	0.047 *	I	II	0.82	0.237 (NS)
				III	-0.94	0.180 (NS)
			II	III	-1.76	0.014 *
E line-Li	6.38	0.004 **	I	II	1.63	0.022 *
				III	2.4	0.001 **
			II	III	0.77	0.268 (NS)

N: number,d.f.: degree of freedom

Table 3: Comparison between the measurements of class I, II and III for females using ANOVA test followed by LSD test.

Variables	ANOVA for females Class I (N=15), Class II (N=15), Class III (N=15) Classes Difference (d.f.=44)		LSD test after ANOVA for females			
			Classes		Mean Difference	P-value
	F-test	P-value				
N-A-Pog	63.45	0.000 **	I	II	6.27	0.000 **
				III	-1.13	0.117 (NS)
			II	III	-7.4	0.000 **
Sk-Mp	41.6	0.000 **	I	II	4.2	0.000 **
				III	5.87	0.000 **
			II	III	1.67	0.016 *
Nasofrontal	7.45	0.002 **	I	II	1.8	0.009 **
				III	-0.67	0.319 (NS)
			II	III	-2.47	0.001 **
Nasal	2.17	0.127 (NS)	I	II	NS	NS
				III	NS	NS
			II	III	NS	NS
Nasolabial	160.33	0.000 **	I	II	1.8	0.015 *
				III	11.8	0.000 **
			II	III	10	0.000 **
Interlabial	66.24	0.000 **	I	II	0.4	0.565 (NS)
				III	7.07	0.000 **
			II	III	6.67	0.000 **
Labiomental	88.43	0.000 **	I	II	2	0.009 *
				III	-7.2	0.000 **
			II	III	-9.2	0.000 **
Z - angle	145.81	0.000 **	I	II	9.67	0.000 **
				III	-9.67	0.000 **
			II	III	-9.2	0.000 **
UFH	0.76	0.476 (NS)	I	II	NS	NS
				III	NS	NS
			II	III	NS	NS
LFH	64.02	0.000 **	I	II	-7.62	0.000 **
				III	-3.9	0.000 **
			II	III	3.72	0.000 **
TFH	81.14	0.000 **	I	II	-7.94	0.000 **
				III	-2.96	0.000 **
			II	III	4.98	0.000 **
E line-Ls	20.88	0.000 **	I	II	2.82	0.000 **
				III	-0.02	0.961 (NS)
			II	III	-2.85	0.000 **
E line-Li	7.52	0.002 **	I	II	2.06	0.000 **
				III	1.37	0.015 *
			II	III	-0.69	0.208 (NS)

N: number, d.f.: degree of freedom