Lip Thickness with Tongue Space Area Assessment By Cephalometric Analysis for Iraqi Adult Sample with Class II Dental and Skeletal Pattern

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Abstract

Background: With different skeletal classes, there may be some variability among the lip thickness and tongue space area that could be the causative factor for skeletal malrelationship so that this study was aimed to determine the tongue and the available boundary space area with lip thickness and correlate them together in sample with class II skeletal pattern.

Methods: Seventy Iraqi adult subjects (32 males and 38 females) with cl II skeletal pattern who have increased over jet and ANB angle greater than four degrees. The cephalometric measurements include upper and lower lip thicknesses with height and length of tongue and position of tongue base and hyoid bone from the cervical line. The cephalograms were analyzed using AutoCAD program to measure demanded areas. **Results**: This study revealed that a significant gender difference was found between T-Area, V-TT, TH, V-FP, AH-CL, AH-FP, and upper and lower lip thickness in which higher mean value in males than females. The correlation between all the measured variables of present sample with SNA, SNB and ANB angles a non-significant difference was found except for V-CL which shows significant difference. Strong correlation was found among the T-Area with V-TT, TH, V-FP, AH-CL, AHFP, upper lip thickness and lower lip thickness.

Conclusions: In skeletal class II, the associated cranial base angles shows independent association from the boundary soft tissues so that these variations not always contribute to be the causative factor for skeletal disharmony.

Keywords: *class II, Cephalometric, lip thickness, tongue space.*

Introduction

Evaluation of soft tissue considered the integral part in diagnosis and treatment planning. As the tongue size influence the development of dentoalveolar structures (1), in class II skeletal relationships the small size of the tongue may influence the size of mandible or the positioning of dentoalveolar structures.

The skeletal mal-relationship in craniofacial growth and development may be caused and controlled by both genomic and epigenetic effects. According to Moss theory of growth, the soft tissues grow, and both bone and cartilage react (2,3). The airway form intraorally is influenced by the tongue form and size (4). The major part of upper airway is formed by the tongue which has both extrinsic and intrinsic muscles (5)(6).

Some previous studies have assessed the measurements of the tongue space area in skeletal class I and others measure the tongue size and airway space in patients with obstructive sleep apnea in various malocclusions (7,8,9). Other studies have assessed measurements of soft tissue norm as lip thickness in skeletal class I pattern (10,11,12). The aim of this study was to determine the tongue and the available boundary

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space area with lip thickness in patients with skeletal class II and correlate them together as by understanding these correlations among hard and soft tissues we can predict the final outcome and stability of orthodontic treatment.

Materials and Methods

The sample of this retrospective study was carried out at department of orthodontics/ college of dentistry/ Baghdad University, and included seventy Iraqi adult participants (32 males and 38 females) who seeking orthodontic treatment with an age range between 18-28 years to exclude the effect of growth [13]. A true lateral cephalogram were taken for each subject in this sample.

The sample were selected according to the following criteria:

14. Full permanent teeth except 3rd molars.

15. Class II skeletal relationship with increased over jet and ANB angle greater than four degrees.

16. Absence of cross bite.

17. No past orthodontic treatment.

18. Absence of acquired or congenital abnormalities to the face.

19. No history of nasal airway problems.

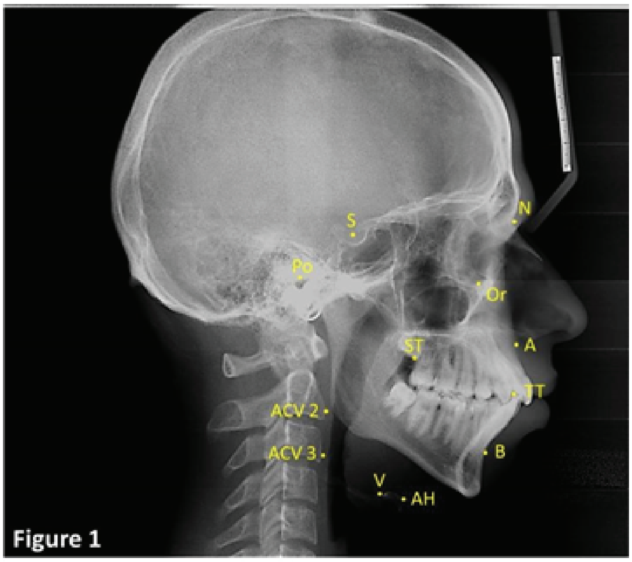
Each radiograph was taken with Frankfort horizontal parallel to the floor with the teeth in centric occlusion and the eyes straight look ahead.

The x-ray Machine used for this study was DIMAX3 Planmeca radiographic machine (digital x-ray unit system) and the digital cephalograms obtained were analyzed with AutoCAD 2015 in which the magnification of the images obtained was corrected by measuring the magnification factor of the cephalometric machine involving the nasal rod ruler graduation and then the measurements were gained.

The measurements of hard and soft tissues include evaluation of the tongue and boundary space region with lip thicknesses according to the landmarks, planes, linear and area measurements used in this study summarized in table 1 and described in figures 1,2 and 3.

Table 1: Cephalometric planes, Linear and area measurements.

Planes, lines and areas	Description
Frankfort plane (FP)	This plane extended from orbitale (Or) to porion (Po).
Cervical line (CL)	The line extension on second and third cervical vertebrae anteriorly.
V-TT	The line from the tongue tip to the tongue base (it represent the tongue length).
TH	Distance from ST point perpendicular to VTT. (it represent the tongue height).
V-FP	The line from V point perpendicular to FP.
V-CL	The line form V point to CL parallel to the FP.
AH-FP	The line from anterior tip of hyoid perpendicular to FP.
AH-CL	Line from anterior tip of hyoid to the cervical line parallel to FP.
Upper lip tissue thickness	The line measured between middle point at facial surface of upper central incisors to upper lip anterior.
Lower lip tissue thickness	The line measured between middle point at facial surface of lower central incisors to lower lip anterior.
Tongue area	This area formed by line passing through tip of the tongue, ST point and V point which include the tongue boundaries.



Point	Description
S	Sella
N	Nasion
A	Point A
B	Point B
Or	Point orbitale
Po	Point porion
TT	Tongue tip
ST	Superior tongue
V	Vallecula
AH	Anterior hyoid
ACV2	Anterior cervical line 2
ACV3	Anterior cervical line 3

Figures 1: Cephalometric landmarks involved in this study.

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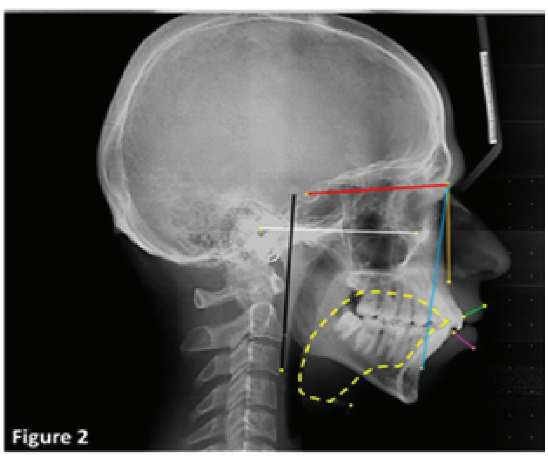
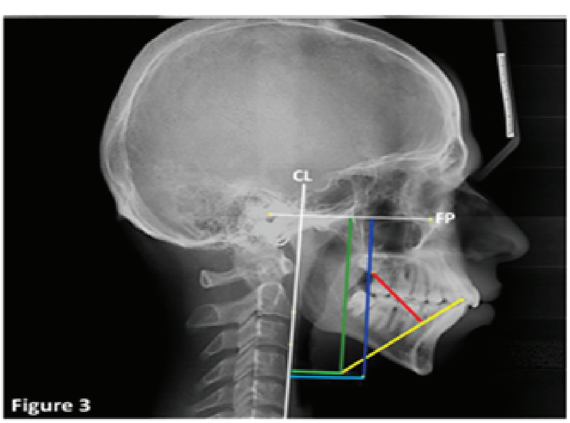


Color	Reference variable
White	Frankfort plane (FP)
Red	SN line
Orange	NA line
Blue	NB line

Figures 2: Cephalometric radiograph reveals the planes and tongue area used in this study



Green	Upper lip thickness
Violate	lower lip thickness
Black	Cervical line (CL)
Yellow	Tongue space area

Figures 3: Cephalometric radiograph showing linear measurements used in this study.

Color	Reference variable
Yellow	V-TT
Red	TH
Dark green	V-FP
Light green	V-CL
Dark blue	AH-FP
Light blue	AH-CL

Statistical Analysis

By the using of the Statistical Package for Social Sciences (SPSS) version 20, the 76 statistical analysis was done in which all data of sample were calculated.

The statistical analysis included:

1- Descriptive Statistics: including mean, standard deviation, minimum and maximum

values.

2- Inferential Statistics: including

• Independent sample t-test: for the genders difference comparison.

• Sig. (2-tailed) or P value.

• Pearson's Correlation Coefficient:

In order to quantify the strength of the association between angles, linear and area measurements; Pearson's correlation coefficients were used.

For the statistical evaluation of the results, the following levels of significance are used: $p\geq 0.05$ Non-significant (NS)

$0.05>p\geq 0.01$ * Significant (S)

Results

The descriptive statistics with gender difference of the present sample was described in table 2, in which a non-significant difference was found among SNA, SNB, ANB and V-CL. However, for the other variables the T-Area, V-TT, TH, V-FP, AH-CL, AH-FP, upper and lower lip thickness a significant difference was found between both genders in which higher mean was shown in males in all measured variables except for ANB angle.

Table 2: Gender difference of the present sample (Male N= 32 and Female N= 38).

Variable	Gender	N	Mean	Min	Max	SD	T-test	Sig. (2tailed)	Significance
SNA	M	32	83.281	78.0	91.0	2.9319	.760	.450	N.S
	F	38	82.71	71.0	87.0	3.29			
SNB	M	32	76.03	72.0	84.0	2.56	1.003	.319	N.S
	F	38	75.37	67.0	80.0	2.91			
ANB	M	32	7.25	1.0	10.0	1.81	-.188	.851	N.S
	F	38	7.34	1.0	11.0	2.21			
T-AREA (mm2)	M	32	2710.594	260.2531	2182.0	3145.0	6.193	.000	S
	F	38	2369.605	200.0941	2043.0	2726.0			

***Cont...* Table 2: Gender difference of the present sample (Male N= 32 and Female N= 38).**

V-TT (mm)	M	32	75.27	63.59	82.41	4.64	2.479	.016	S
	F	38	72.52	65.64	82.14	4.61			
TH	M	32	38.67	32.67	43.98	2.98	8.786	.000	S
	F	38	32.64	25.23	39.78	2.76			
V-FP	M	32	88.95	74.13	98.50	5.46	9.451	.000	S
	F	38	76.94	67.25	92.90	5.16			
V-CL	M	32	20.36	13.15	41.46	5.41	1.517	.134	N.S
	F	38	18.84	13.20	27.42	2.71			
AH-CL	M	32	33.84	24.58	41.58	3.54	4.387	.000	S
	F	38	30.37	23.93	38.86	3.08			
AH-FP	M	32	90.39	72.28	99.79	6.03	8.380	.000	S
	F	38	78.97	68.28	94.42	5.38			
Upper lip	M	32	12.48	9.49	15.35	1.20	4.954	.000	S
	F	38	10.95	8.67	15.53	1.36			
	M	32	13.60	10.73	15.49	1.19	4.227	.000	S
Lower lip	F	38	12.18	8.98	14.65	1.56			

The correlation between tongue area, upper and lower lip thickness and related linear measurements with the others was described in table 3 as the following:

• strong correlation was found among the **T-Area,** V-TT, TH, V-FP, AH-CL, AH107 FP, upper lip thickness and lower lip thickness.

• strong correlation was found among the ANB angle with SNA, SNB and V-CL. 109 **.** strong correlation was found among the **V-CL** with ANB, AH-CL, upper lip 110 thickness and lower lip thickness.

Table 3: Correlation between tongue area, upper and lower lip thickness and related linear measurements with the others. (N=70)

		TAREA (mm2.)	SNA	SNB	ANB	V-TT (mm.)	TH (mm.)	V-FP (mm.)	V-CL (mm.)	AHCL	AH-FP (mm.)	upper lip
SNA	**r**	.146										
	p	.229										
SNB	**r**	.129	.769**									
	p	.286	.000									
ANB	**r**	.049	.495**	- .174								
	p	.690	.000	.149								
V-TT (mm.)	**r**	.568**	.128	.004	.192							
	p	000	.291	.975	.111							
TH (mm.)	**r**	.735**	.057	.121	-.076	.248*						
	p	000	.637	.320	.534	.038						
V-FP (mm.)	**r**	.670**	-.013	.102	-.159	.466**	.763**					
	p	000	.913	.402	.189	.000	.000					
V-CL (mm.)	**r**	.194	-.069	.105	.249-*	-.056	.139	.154				
	p	.107	.571	.388	.038	.648	.251	.204				
AHCL	**r**	.534**	-.116	.001	-.179	.369**	.393**	.489**	.594**			
	p	000	.340	.996	.138	.002	.001	.000	.000			
AH-FP (mm.)	**r**	.667**	-.063	.044	-.156	.511**	.742**	.957**	.179	.515**		
	p	000	.606	.720	.197	.000	.000	.000	.139	.000		
upper lip	**r**	.354**	.044	.085	-.048	.158	.463**	.518**	.353**	.376**	.522**	
	P	003	.717	.483	.694	.190	.000	.000	.003	.001	.000	
lower lip	**R**	.450**	-.022	- .018	-.010	.345**	.445**	.573**	.326**	.381**	.576**	.361**

****. Correlation is significant at the 0.01 level (2-tailed).** 117 ***. Correlation is significant at the 0.05 level (2-tailed)**

Discussion

The Harmony of soft tissue profile in some conditions difficult to obtain which may be 121 due to soft tissue covering the teeth and bones is highly variable in their thickness. The 122 thickness and tension of facial soft tissues in addition to the imbalance of dental and

123 skeletal structures could lead to these variations among soft tissue profile [14]. Some 124 authors have suggested that the using of cephalograms is easier than the other methods 125 for airway patency measurement [15]. Parkkinen et al also confirm that the lateral 126 cephalogram is a reliable method for measuring the dimensions of the nasopharyngeal 127 and retropalatal areas [16,17].

128 In this study, the tongue space area for males and related linear measurements in class 129 II pattern showed higher mean values than females for most measured variables. A

130 significant gender difference was found among the T-Area, V-TT, TH, V-FP, AH-CL, 131 AH-FP,

which is in coincidence with class 1 sample (for the same ethnic population) 132 by other study [7].

133 For the lip thickness, a significant gender difference was found in which higher mean 134 values was in males than females for both upper and lower lips which agrees with class

1 sample (for the same ethnic population) by Al-Janabi MF and Kadhom Z [11] as described in table 4. The upper lip is thinner than the lower lip which differs from **class 1** sample by Al-Janabi MF and Kadhom Z who found thicker upper lips especially for females with the same age group. This may be related to the angulation of incisors in class 2 subjects as it is considered the most important determinants to the related soft tissues [6,18].

Tatjana Perović ans Zorica Blažej use Burstone lines to compare facial soft tissue thickness among class 2 skeletal pattern [19]; they presented that in class 2 skeletal relation the soft tissue thickness at the upper lip is thinner than the lower for both genders which agrees with class 2 sample of this study. However, the gender difference reveals a non-significant difference for class 2 skeletal pattern which disagrees with this study as it could be related to ethnic variation. Kristina Lopatienė et al reveal that the upper lip thickness in skeletal class 2 the females have higher mean value than males 148 [20]. The gender difference; however, reveal a non-significant difference among the class 149 2 subjects (tab. 5).

Table 4: comparative data of class II sample of present study with normative data (class I) of the same ethnic population by other studies.

Variable	Gender	present study (Cl II)	Kadhum MA (Cl I)	Al-Janabi MF and Kadhom Z (Cl I)
T-AREA (mm2)	M	2710.594	2551.67	-
	F	2369.605	2168.60	-
V-TT (mm)	M	75.27	76.08	-
	F	72.52	68.38	-
TH	M	38.67	33.46	-
	F	32.64	28.93	-
V-FP	M	88.95	80.52	-
	F	76.94	69.55	-
V-CL	M	20.36	19.98	-
	F	18.84	16.45	-
AH-CL	M	33.84	34.14	-
	F	30.37	27.14	-
AH-FP	M	90.39	87.32	-
	F	78.97	72.53	-
Upper lip	M	12.48	-	13.57
	F	10.95	-	12.29
Lower lip	M	13.60	-	14.26
	F	12.18	-	12.18

of the association between tongue area, upper and lower lip thickness and related linear measurements with the others was described in table 3 as the following:

- The strong correlation of the T-Area, V-TT, TH, V-FP, AH-CL, AH-FP with each other, this may be related to their representation to the tongue extensions as it lies within the same region.

By meaning of soft tissue area of the tongue influences the boundary hard tissues.

- The strong correlation among the AH-CL with T-Area, TH, V-TT, V-FP, V-CL and AH-FP could be explained by their regional relation with the tongue base in this region.

- The strong correlation among the V-CL with ANB, AH-CL, upper and lower lip thickness may be related to their association to the hard tissues skeletal bases.

- The strong correlation among the upper and lower lip thickness with each other as the lips usually follows the teeth and skeletal base at the associated region which is in agreement with Manal AShamlan and abdullah M Aldrees [21] who suggest that is due to variation in the upper incisors location with the alveolar bone on the dental base region and the sagittal inclination and position of the lower incisors.

- The strong correlation among the upper and lower lip thickness with T-Area, TH, VFP, V-CL, AH-CL and AH-FP suggest this relation due to the compensatory balance of hard tissue in skeletal class 2 between the tongue and associated inner structures from one side and the upper and lower lips from other side.

However, the correlation among SNA, SNB and ANB angles were strong among each other but weak correlation with the other variables. This suggests that these associated cranial base angles may have independent association from the boundary soft tissue area like the tongue. This could be due to variability of muscular activity and soft tissue tension to the nearby dentoskeletal structures.

Conclusion

The tongue space area with lip thickness and related linear measurements in skeletal class II pattern for males showed higher mean values than females for most measured variables and the associated cranial base angles shows independent association from the boundary soft tissue of tongue area and this may be related to variations of thickness and tonicity of facial muscles so that these variations may not always contribute to be the causative factor for skeletal disharmony.

Ethical Clearance: The research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq.

Conflict of Interest: The authors declare that they have no conflict of interest.

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