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Evaluation of Facial Soft Tissue Profile in 6-15 Years Old Children with Normal Occlusion in Isfahan

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Abstract: The aim of this study was to evaluate the soft tissue profile changes during growth in a group of Isfahanian children, using the Holdaway analysis and determining the sexual dimorphism in studied group. In this descriptive-analysis study, 143 lateral cephalograms from a group of 6-15 years old Isfahanian children were evaluated and the changes were determined by Holdaway soft tissue analysis. The samples had cl 1 occlusion, no crowding or rotation of teeth, normal growth and development, normal skeletal profile and without earlier orthodontic treatment. All radiographs were analyzed by the Holdaway analysis. Data was analyzed using the t-test, Kolmograv Smirnov, ANOVA and Duncan tests. Indices that increased significantly with growth were: soft tissue facial angle, nose prominence, basic upper lip thickness, soft tissue chin thickness ($p<0.05$). Superior sulcus depth had no significant change with age ($p = 0.5$) and all other indices decreased significantly with age ($p<0.05$). Some indices were significantly different between two genders: nose prominence, basic upper lip thickness, soft tissue chin thickness, H-angle, sub-nasal to H-line ($p<0.05$). When comparing the 14-15 years age group with the Holdaway norms most indices were in the normal range except: skeletal profile convexity, H-angle, basic upper lip thickness and soft tissue chin thickness which were significantly higher than Holdaway norms ($p<0.05$). The results suggest that facial convexity decrease with age. Nose prominence and basic upper lip thickness increases in both sexes especially in males. Isfahanian 14-15 years old children had more convex profiles and thicker base upper lips compared to Holdaway norms.

Key words: Soft tissue profile, cephalometrics, holdaway norms, convex, lip

INTRODUCTION

The importance of facial appearance and smile esthetics in psychosocial ramifications for promoting social well-being and quality of life cannot be denied (Graber *et al*., 2011). Facial appearance is the major basis for interaction with the society (Sforza *et al*., 2008). Recently, improving the patients quality of life has received more attention than the other aspects of health, therefore orthodontists and other dental specialists have shifted their emphasis from function and occlusion to the patients appearance (Graber *et al*., 2011). Angle reported the importance of soft tissue and facial esthetics in 1907 and said that soft tissues are important in facial harmony (Angle, 1907). Holdaway also reported that systems which only use hard tissue measurements or reference lines can lead to disappointly results (Holdaway, 1983). Proffit stated that modern orthodontics needs a shiftaway from Angle's paradigm to soft tissue paradigm which considers facial esthetics (Proffit *et al*., 2013). Soft tissue paradigm offers the best possible adaptation for facial and perioral soft tissues (Thomas *et al*., 2012). Soft tissue determine the final facial contours which change with growth or orthodontic treatment (Wisth, 2007).

Several studies have evaluated the soft and hard tissue changes related to growth (Angle, 1899; Burstone, 1958; Subtelny, 1961; Subtelny and Rochester, 1959). Any tooth or skeletal structure evaluation should be accompaind by the assessment of the position and growth potential of nose, lips and chin soft tissues. It has been said that orthodontic treatment only affects the position of the lips but the growth process affects the general soft tissue including nose, lips and chin (Hoffelder *et al*., 2007). The orthodontist should be aware that the amount and direction of growth affects the facial structures (Vahdettin and Altug, 2012).

Holdaway soft tissue analysis (Holdaway, 1983) has been accepted widely in clinic and research both in

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orthodontics and orthognathic surgery and it is one of the complete soft tissue analysis and includes both linear and angular measurements.

Hwang *et al.* (2002) evaluated the facial differences in ethnic groups and concluded that the dentofacial relations between racial and ethnic groups are different therefore each should be treated according to their own features (Basciftci *et al*., 2004). It is important to introduce standards for each population to achieve a favorable facial harmony (Argyropolous and Sassoni, 1989). Few studies have been carried out to determine the cephalometric soft tissue norms in Iranian children whilst there is an increase in the Iranian population which seek orthodontic therapy or orthognathic surgery. Hajighadimi *et al.* (1981) evaluated the craniofacial features of 67 Iranian children (35 girls and 32 boys) using the Tweed and Steiner analysis. They reported that Iranian children have a more convex profile compared to the Tweed and Steiner norms. Taki *et al.* (2009) evaluated Persian adults with normal occlusions and balanced faces. They reported that Persian adults have higher skeletal convexity, chin soft tissue thickness and upper lip base thickness compared to the Holdaway standards.

The orthodontist should be aware of soft tissue profile changes during growth and have a clear image of maturational features of facial soft tissues. Soft tissue profiles are affected by ethnic properties therefore cephalometric norms of different populations should be determined. Studies which determine the soft tissue changes and cephalometric norms of Iranian adolescents have clinical significant.

MATERIALS AND METHODS

This observational, descriptive-analytic study was performed in the dental faculty of Isfahan University. The lateral cephalograms of 142 students (6-15 years old) was obtained from the orthodontic department archives. The radiograghs were divided into five groups: 6-7, 8-9, 10-11, 12-13 and 14-15 years. The criteria for sample selection was: cl I occlusion, no crowding or rotation of teeth, normal overbite and overjet, normal growth and development, balanced skeletal facial profile, no earlier orthodontic therapy or orthognathic surgery.

All lateral cephalograms were taken while the teeth were in CO and the lips had a light contact. Radiographic landmarks were traced on matte acetate papers by one performer. The Holdaway analysis was performed on each radiograph. The fallowing measurements were obtained (Fig. 1 and 2).

Soft tissue facial angle: The inferior-medial angle in the junction of the Frankfort plane with soft tissue Nasion-soft tissue suprapogonion.

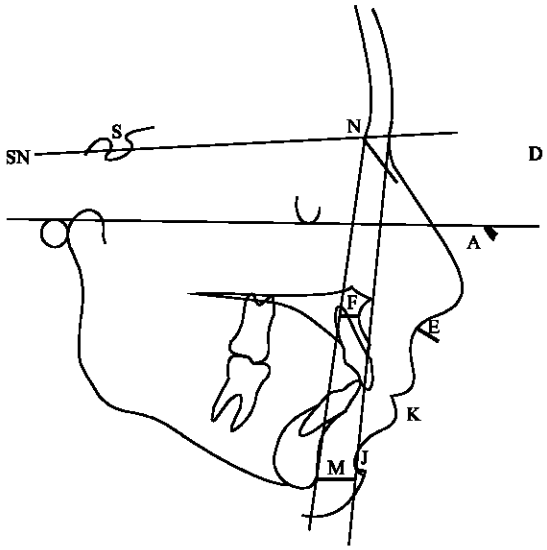

Fig. 1: Cephalometric measuerements of Holdaway analysis: A = Soft tissue facial angle; D = H-line; E = Soft tissue subnasal to H-line; F = Skeletal profile convexity; J = H-angle; k = Lower lip to H-line; M = Soft tissue chin thickness

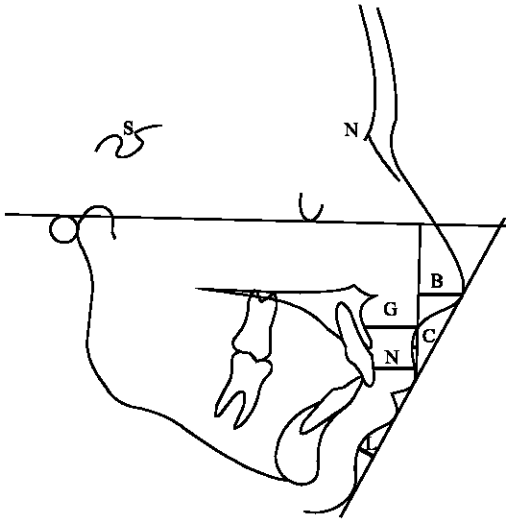

Fig. 2: Cephalometric measuerements of Holdaway analysis: B = Nose prominence; C = Superior sulcus depth; D = Basic upper lip thickness; H = upper lip thickness; L = Inferior sulcus to H-line

Superior sulcus depth: The distance between the upper lip sulcus from the vertical line from vermilion to the Frankfort plane.

Skeletal profile convexity: The distance from the A-point to the Nasion-Pogonion (facial line).

H (Harmony)-line: The line tangent on chin and upper lip.

H-angle: The angle between H-line and soft tissue facial line.

Nose prominence: The distance of nasal tip the perpendicular line to Frankfort and tangent to the upper lip vermilion.

Soft tissue subnasal to H-line (sub H-line): The distance from subnasal to H-line.

Basic upper lip thickness: The distance from a point 3 mm below the A-point to upper lip drape.

Upper lip thickness: The distance from the upper lip vermilion to the labial surface of the incisor.

Lower lip to H-line: The distance between the lower lip to H-line.

Inferior sulcus to H-line: The distance from the maximum convexity on the lower lip to H-line.

Soft tissue chin thickness: The distance between two vertical lines named the soft tissue facial plane and hard tissue facial plane in the supra pogonion level.

The aims of study:

- Evaluating the soft tissue changes of 6-15 years old children of Isfahan using the Holdaway analysis
- Comparing the 14-15 years group with standard Holdaway norms. The obtained data was analysed by t-test, Kolmograv Smirnov, ANOVA and Duncan tests

RESULTS AND DISCUSSION

This study showed that soft tissue facial angle, nose prominence, basic upper lip thickness, soft tissue chin thickness increased significantly with age ($p<0.05$) whilst H-angle, skeletal profile convexity, soft tissue subnasal to H-line and lower lip to H-line decreases significantly with age ($p<0.05$) and the superior sulcus depth does not change significantly with age ($p = 0.5$) (Table 1 and 2). These measurements were different between genders:

H-angle: There was a significant difference between genders in the 11-12 years old section ($p<0.05$) which the girls had a smaller angle compared to boys that shows the mandible growth earlier in female. The angle was equal in 14-15 years age section which shows the later growth spurt in boys.

Basic upper lip thickness: This index was higher in boys in all ages but only in the 14-15 years age section the difference was significant ($p<0.05$).

Table 1: Descriptive statistics of cephalometric measurements of soft tissue indexes and comparing than in studied age groups in Isfahanian boys

	6-7 years		8-9 years		10-11 years		12-13 years		14-15 years		
Measurements	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p-value
Soft tissue facial angle	86.15	3.07	88.76	2.02	89.66	2.93	86.77	2.85	90.96	2.68	**
Superior sulcus depth	3.60	1.56	3.68	1.35	3.37	1.12	4.05	1.46	3.04	1.21	NS
Skeletal profile convexity	4.56	1.26	2.67	1.85	1.96	1.87	2.04	3.28	1.05	2.16	**
H-angle	23.76	2.17	22.60	3.14	22.90	2.82	19.03	4.69	16.80	3.65	**
Nose prominence	14.01	1.33	14.25	1.78	14.10	1.71	16.46	1.65	18.81	2.61	*
Soft tissue subnasal to H-line	8.94	2.21	8.54	1.78	7.98	1.44	7.91	1.81	6.05	2.35	*
Basic upper lip thickness	12.50	0.80	13.96	1.82	15.29	1.15	15.67	1.57	18.01	1.49	**
Lower lip to H-line	3.03	1.61	3.26	1.44	2.87	0.95	3.20	2.15	1.00	1.24	**
Inferior sulcus to H-line	2.20	0.60	2.59	0.93	2.70	0.93	4.24	1.25	6.02	1.45	**
Soft tissue chin thickness	9.72	1.17	10.84	1.58	11.38	1.51	11.88	1.76	13.48	1.68	**

Table 2: Descriptive statistics of cephalometric measurements of soft tissue indexes and comparing than in studied age groups in Isfahanian girls

	6-7 years		8-9 years		10-11 years		12-13 years		14-15 years		
Measurements	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p-value
Soft tissue facial angle	88.03	3.07	87.98	2.23	88.98	2.42	90.80	3.23	90.94	3.31	*
Superior sulcus depth	3.50	1.56	3.13	1.21	3.01	1.17	3.35	1.09	3.66	1.19	NS
Skeletal profile convexity	4.88	1.26	3.50	1.59	2.37	2.45	2.61	2.18	2.20	2.56	*
H-angle	24.78	2.17	21.24	2.95	18.57	3.91	18.75	2.60	16.90	4.34	**
Nose prominence	12.28	1.33	14.83	1.44	16.37	1.74	17.05	1.97	18.26	2.67	**
Soft tissue subnasal to H-line	8.62	2.21	7.39	1.87	6.36	1.89	6.48	1.60	6.52	2.55	*
Basic upper lip thickness	12.72	1.08	13.26	1.49	14.86	1.38	15.17	1.98	15.46	0.84	**
Lower lip to H-line	2.30	1.03	2.74	1.13	1.85	1.50	1.95	1.16	1.73	1.30	NS
Inferior sulcus to H-line	2.20	0.50	2.28	0.72	3.91	1.69	4.57	1.10	5.14	1.04	**
Soft tissue chin thickness	11.70	1.10	10.42	1.11	12.23	1.43	11.50	1.57	12.73	1.17	**

*<0.05, **<0.001, NS: Not Significant, SD: Standard Deviation

Table 3: Comparison of mean and standard deviation of soft tissue measurements in 14-15 years old Isfahanian adolescents with Holdaway norms

	Isfahanian adolescent		Holdaway norms		
Measurments	Mean	SD	Mean	Range	Difference
Soft tissue facial angle	90.72	2.99	91	84-98	-0.28
Superior sulcus depth	3.32	1.20	3	1-4	0.32
Skeletal profile convexity	1.62	2.36	0	$$	1.62*
H-angle	16.85	3.99	10	7-14	6.85*
Nose prominence	18.53	2.64	19#	14-24	-0.47
Soft tissue subnasal to H-line	6.28	2.45	5	3-7	1.28
Basic upper lip thickness	16.73	1.16	15	$$	1.73*
Lower lip to H-line	1.36	1.27	0	-1-2	1.36
Inferior sulcus to H-line	5.58	1.24	5	$$	0.58
Soft tissue chin thickness	13.10	0.42	11#	10-12	2.10*

#Mean calculated as midpoint of the range when not provided by original researchers, $$ Range not provided by original researcher, *Different outside the range of Holdaway norms

Nose prominence: This index was significantly higher in boys in the 6-7 years age section ($p<0.05$) but the faster nose growth in girls leads to a significantly higher index in the 10-11 years age section in girls. In the 14-15 years age section the index was higher in boys but the difference was not significant ($p = 0.75$).

Soft tissue chin thickness: The index was significantly lower in boys in the 6-7 years age section ($p<0.05$). The index increased in both genders especially in boys and it becomes higher than girls in the 14-15 years age section but the difference was not significant ($p = 0.18$).

The Holdaway analysis has been obtained from adult measurements, therefore the last age section (14-15 years) was compared with Holdaway norms (Table 3). Most indices in Iranians were in the normal range except: skeletal profile convexity, H-angle, basic upper lip thickness and soft tissue chin thickness which were significantly higher than Holdaway norms ($p<0.05$).

Orthodontists should be aware of maturational soft tissue changes. Any changes in nose, chin and lips affect the facial profile and they could be a critical factor in predicting the stability of orthodontic treatment (Prahl-Andersen *et al*., 1995). Orthodontists are usually the first specialists which evaluate the esthetical problems in growing children therefore they should have a clear vision of maturational features of facial soft tissue. Orthodontic treatment can prolong the facial youth or accelerate the aging process. Soft tissue profile is also affected by other factors such as ethnic factors. Facial features should be evaluated in different ethnic groups (Celebi *et al*., 2013) and the orthodontists should recognize this ethnic factors in their diagnosis and treatment planning (Scavone *et al*., 2006).

In the study, soft tissue facial angle increased significantly with age in boys and girls ($p<0.05$) which agrees with the results of Schugg *et al*. (1985), Zylinski *et al*. (1992) and Saglam and Gazilerli (2001).

The results showed that superior sulcus depth was equal between both genders without a significant difference ($p = 0.5$). Genecow *et al*. (1990) reported an increase in superior sulcus depth with age. Saglam and Gazilerli (2001) evaluated the maturational changes on 42 boys and girls with normal occlusion and reported that this index increased with age and there was no significant difference between genders.

In the study, skeletal profile convexity and H-angle significantly decreased with age ($p<0.05$). These indices were significantly higher than Holdaway norms in the most mature groups which shows that Iranian adolescents have a more convex profile compared to American whites. Holdaway (1983) stated that there is a direct relation between H-angle and skeletal convexity, when skeletal convexity decreases, soft tissue convexity also decreases. Bishara *et al*. (1984) reported that H-angle decreases significantly in girls between 10 and 15 years and in boys between 15 and 25 years. Nose prominence increased significantly with age in our study which is similar to the studies by Wisth (2007), Hoffelder *et al*. (2007), Schugg *et al*. (1985) and Saglam and Gazilerli (2001). The nose was more prominent in boys in all ages. Earlier studies in Iranian population (Taki *et al*., 2009; Ahangar Atashi and Kachooei, 2008) also, confirmed that males had more prominent nose compared to females. Other studies which have confirmedthe results include: Thomas *et al*. (2012), Basciftci *et al*. (2004), Saglam and Gazilerli (2001), Anderson *et al*. (1973), Nanda *et al*. (1990) and Al Barakati and Bindayel (2012). Soft tissue sub-nasal to H-angle and lower lip to H-line decreased significantly with age ($p<0.05$) while there was no significant difference between boys and girls. Saglam and Gazilerli (2001) obtained similar results.

Inferior sulcus to H-line decreased significantly with age but in the studies of Saglam and Gazilerli (2001) and Lew *et al*. (1992), this index increased with age.

Earlier studies support the increase in basic upper lip thickness and upper lip thickness with age (Zylinski *et al*., 1992; Genecow *et al*., 1990; Nanda *et al*., 1990; Mauchamp and Sassoni, 1973). Wisth (2007), evaluated 4-10 years old children, Hoffelder *et al*. (2007), studid a population of 6-16 years old individuals and Hamamci *et al*. (2010), carried out a study on 30 Turks with cl 1 occlusion and average ages of 8.8, 12.8 and 17.8 all these studies reported that upper lip thickness increased with age. On the contrary, Mink (1990) and Forsberg and Odenrick (1979) reported that lips draw back with age.

The other index which increased significantly with age in both genders was soft tissue chin thickness this increase was more in boys. Nanda *et al.* (1990) evaluated 40 individuals between 7 and 18 years and reported that soft tissue chin thickness increased 2.1 mm in boys and 2 mm in girls. This index also increased in the studies of Wisth (2007), Genecow *et al.* (1990), Mauchamp and Sassoni (1973) and Hamamci *et al.* (2010). Various studies have supported the more increase of soft tissue chin thickness in males (Basciftci *et al.*, 2004; Taki *et al.*, 2009; Saglam and Gazilerli, 2001; Ahangar *et al.*, 2008; Flynn *et al.*, 1989).

In the study, Iranian adolescents had higher soft tissue chin thickness and basic upper lip thickness compared to Holdaway norms. Turkish (Basciftci *et al.*, 2004), Iraqi (Abdul-Qadir *et al.*, 2008) and Japanese female populations (Ioi *et al.*, 2007) had thicker soft tissue chin compared to Holdaway norms. Any increase in this index can compensate a retruded chin and lead to facial harmony. Al-Gunaid *et al.* (2007) reported that Yemeni males had a thicker upper lip base compared to Holdaway norms.

CONCLUSION

Soft tissue facial angle, nose prominence, basic upper lip thickness, soft tissue chin thickness increased significantly with growth ($p<0.05$) whilst facial convexity decreased significantly ($p<0.05$). These indices were significantly different between genders: nose prominence, basic upper lip thickness, soft tissue chin thickness, H-angle, sub-nasal to H-line. Comparing the 14-15 years old Iranian adolescents with the Holdaway norms revealed that these indices were higher than norms: Skeletal profile convexity, H-angle, basic upper lip thickness and soft tissue chin thickness ($p<0.05$) which shows that Iranian adolescents have a more convex profile and more prominent chin and lip compared to Americans.

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