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ORIGINAL ARTICLE

Correlation between Facial Soft Tissues and Vertical Facial Pattern in 12-16 Years Old Untreated Patients

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ABSTRACT

Background: Soft tissue paradigm shift has accentuated significance of soft tissue variables in diagnosis & treatment planning.
Aim: To find a correlation between facial soft tissues and underlying vertical facial patterns in young untreated patients.
Methods: The lateral cephalograms of 170 young individuals were divided into three equal groups, i.e., long, average, and short face, in accordance with the vertical facial patterns. This was done using a cross-sectional research design. Upper and lower lip lengths and extent of lip protrusion were measured for each individual. Non-probability consecutive sampling was done. The relationship between face soft tissue and the vertical facial pattern was examined using the Pearson Correlation test and less than 0.05 p-value was held statistically significant.
Result: Significant correlation between upper and lower lip lengths and vertical facial form was found. Similarly significant positive correlation between protrusion of upper and lower lips and vertical facial pattern was found.
Conclusion: Cephalometric analyses suggest the vertical dimensions of facial soft tissues conform to the vertical skeletal patterns. The long facial patterns have increased lip lengths and procumbent lips.
MeSH words: Cephalometric analysis, Cross-sectional study, Vertical facial pattern, Lip length

INTRODUCTION

Esthetic and proportionate profile is the main concern of most of the patients undergoing orthodontic treatment. In past skeletal and dental relationships were considered plan determining factors but after the paradigm shift towards importance of soft tissue profile, the treatment planning cannot be done without considering the effect on soft tissues.

Sassouni[2] was first one to classify facial forms into short, average and long faces in accordance with the vertical skeletal measurements in field of orthodontics. Soft tissue cannot be improved or planned without taking into account underlying vertical skeletal pattern[3]. If the soft tissue fails to follow underlying vertical pattern, the results will be unsatisfactory and unstable. Therefore both the skeletal pattern and soft tissue profile should be considered to plan the orthodontic treatment. The concept of 'rule facial thirds' was introduced by Leonardo Da Vinci[4] which aided to make the ideal vertical proportions an objective phenomenon.

Most of the studies conducted before have recorded the changes in facial soft tissues resulted by changes in skeletal proportions following orthodontic treatment. Only few studies have been done on correlation of facial soft tissue proportions and cephalometric parameters between different groups[5,6]. Tatjanal'erovic et al[7] (2018) studied "Male and Female Characteristics of Facial Soft Tissue Thickness in Different Orthodontic Malocclusions" examined by cephalometry. Sayagh NM et al[5] Studied analysis of soft tissue facial contours in various vertical growth trends. Waqar Jeelani et al[3] studied facial soft tissue analysis amid various vertical facial patterns and concluded that short facial pattern is associated with lesser display of incisors, acute nasolabial angle and recumbent upper and lower lips while long face patients are related with increased incisal show, protrusive upper and lower lips and obtuse nasolabial angles.

This study aims to find the correlation between skeletal vertical pattern and facial soft tissues in growing patients. These results may also aid in planning orthodontic treatment in accordance with underlying vertical characteristics while facilitating to predict a specific soft tissue prognosis for each pattern[6].

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METHADOLOGY

This cross sectional study was conducted in the Department of Orthodontics, The University of Child Health Sciences and Children's Hospital, Lahore. Sample size of 170 patients was calculated by taking 5% alpha-error 10% beta-error. Non-probability consecutive sampling technique was utilized with the inclusion criteria of : patients with no prior orthodontic or prosthodontic treatment , age range of 12 to 16 years, no previous trauma and surgery of facial region, normal sagittal measurement (ANB= 0-4) with crowding or any other orthodontic complaint. The exclusion criteria was; Syndromic patients, cleft lip and palate patients and subjects having bimaxillary protrusion as it can alter the soft tissue profile.

After approval from ethical committee, 170 patients who satisfied the inclusion criteria were involved in the research. After obtaining informed consent, all basic information (age, address and contact number) of each individual was noted. Then lateral cephalometric radiographs of the patients were taken by the radiologist. The measures observed to warrant a high degree of precision in obtaining cephalograms were; head fixed so that the sagittal plane lied at the right angle to the pathway of the x-rays, the Frankfort Horizontal Plane (FHP) was held parallel to the horizontal plane, teeth interposed in centric occlusion and lips postured in unstrained manner. Patients were allocated into three groups based on the following standards:

- Short face: patients having LAFH to TAFH ratio < 55%
- Average face: patients having LAFH to TAFH ratio 2:56% and 2:58%
- Long face: Subjects having LAFH to TAFH ratio >59%

Following observations were made on lateral cephalometric radiograph.

- Total anterior facial height / lower anterior facial height
- Soft Tissue measurements:
- Upper lip height/length and Lower lip height/length
- Upper lip protrusion and Lower lip protrusion

To eliminate bias and errors associated with radiographic tracings and measurements, all radiograph tracings and measurements were done by the same observer. The collected data was analyzed by the standard statistical methods by SPSS 25 software program. Arithmetic mean and standard deviations were recorded for every quantitative variable including age, upper lip

length, lower lip length, protrusion of upper lip, protrusion of lower lip. Gender & vertical facial pattern (short, average, long face) percentage (qualitative variable). Data as stratified according to vertical facial pattern, age and gender. Pearson Correlation test was utilized to check the correlation among facial soft tissues and vertical facial pattern. A p-value of less than 0.05 was held statistically significant.

RESULT

In this recent research, from 170 patients, the minimum age was calculated as 12 years and maximum age was 16 years with mean + standard deviation 14 + 1.406 years. The minimum value of upper lip height was 16.49 and maximum was 26.65 with mean + standard deviation 22.15 + 2.25. The minimum value of Lower lip height was 32.40 and maximum was 52.31 with mean + standard deviation 41.59 + 4.10. The minimum value of protrusion of upper lip was -5.94 and maximum was 2.92 with mean + standard deviation -2.39 + 2.11. The minimum value of protrusion of lower lip was -4.65 and maximum was 5.79 with mean + standard deviation -0.74 + 2.65 (Table 1). There were 98(57.60%) male patients and 72(42.40%) female patients. Short Face was present in 55 (32.4%) patients, Average Face was present in 59(34.7%) and Long Face was present in 56(32.9%) (Table 2).

Pearson correlation showed short facial pattern is significantly correlated with upper and lower lip height having p-value = 0.001, but average facial pattern is not significantly correlated with upper and lower lip height having p-value = 0.636 and long facial pattern is also significantly correlated with upper and lower lip height having p-value = 0.013 (Table 3).

Pearson correlation showed short facial pattern is not significantly correlated with protrusion of lower and upper lip having p-value= 0.087, average facial pattern is not significantly correlated with protrusion of lower and upper lip having p-value = 0.824 but long facial pattern is significantly correlated with protrusion of lower and upper lip having p-value = 0.047 (Table 4).

Pearson Correlation was significant between vertical facial patterns and upper lip height regarding < 15 years age group while it was insignificant between vertical facial patterns and upper lip height regarding ≥ 15 years age group having p-value = 0. 072 and 0.560 respectively (Table 5).

Correlation was not significant between vertical facial patterns and lower lip height regarding both age groups (Table 6).

Pearson Correlation was significant between vertical facial patterns and protrusion of upper lip regarding < 15 years age group while it was significant between vertical facial patterns and protrusion of upper lip regarding ≥ 15 years age group having p-value = 0.972and 0.017 respectively (Table 7). Correlation was not significant between vertical facial patterns protrusion of lower lip regarding both age groups (Table 8).

Table 1: Descriptive Statistics (n= 170)

	Min.	Max.	Mean	St. deviation
Age	12	16	14	1.406
Upper lip height	16.49	26.65	22.15	2.25
Lower lip height	32.40	52.31	41.59	4.10
Procumbency of upper lip	-5.94	2.92	-2.39	2.11
Procumbency of lower lip	-4.65	5.79	-0.74	2.65

Table 2. Distribution of vertical facial patterns

Vertical facial patterns	Frequency	Percentage
Short Face	55	32.4
Average Face	59	34.7
Long Face	56	32.9
Total	170	100.0

Table 3. Correlation between upper lip height and lower lip height regarding the stratification of vertical facial patterns

Vertical facial patterns		Upper lip height	Lower lip height
Short face			
Upper lip height	Pearson Correlation	1	0.593**
	Sig. (2-tailed)		0.001
	N	55	55
Lower lip height	Pearson Correlation	0.593**	1
	Sig. (2-tailed)	0.001	
	N	55	55
Average Face			
Upper lip height	Pearson Correlation	1	0.063
	Sig. (2-tailed)		0.636
	N	59	59
Lower lip height	Pearson Correlation	0.063	1
	Sig. (2-tailed)	0.636	
	N	59	59
Long face			
Upper lip height	Pearson Correlation	1	0.330*
	Sig. (2-tailed)		0.013
	N	56	56
Lower lip height	Pearson Correlation	0.330*	1
	Sig. (2-tailed)	0.013	
	N	56	56
**. Correlation found significant at the 0.01 level (2-tailed).			
*Correlation found significant at the 0.05 level (2-tailed).			

Table 4. Correlation between procumbency of upper lip and procumbency of lower lip regarding the stratification of vertical facial patterns

Vertical facial patterns			procumbency of upper lip	procumbency of lower lip
Short Face Average Face	Procumbency of upper lip Procumbency of lower lip	Pearson Correlation	1	0.087
		Sig. (2-tailed)		0.529
		N	55	55
	Procumbency of upper lip Procumbency of lower lip	Pearson Correlation	0.087	1
		Sig. (2-tailed)	0.529	
		N	55	55
		Pearson Correlation	1	0.027 0.842
		Sig. (2-tailed)	59	59
		N	-0.027	1
		Pearson Correlation	2 59	
		Sig. (2-tailed)		59
		N		
Long Face	Procumbency of upper lip Procumbency of lower lip	Pearson Correlation	1	0.231
		Sig. (2-tailed)		0.047
		N	56	56
		Pearson Correlation	0.231	1
		Sig. (2-tailed)	0.047	
		N	56	56

Table 5: Correlation among vertical facial patterns upper lip height with respect to age

Age group			Vertical facial patterns	Upper lip height
< 15 years	Vertical facial patterns	Pearson Correlation	1	0.182
		Sig. (2-tailed)		0.072
		N	99	99
	Upper lip height	Pearson Correlation	0.182	1
		Sig. (2-tailed)	0.072	
		N	99	99
≥ 15 years	Vertical facial patterns	Pearson Correlation	1	-0.070
		Sig. (2-tailed)		0.560
		N	71	71
	Upper lip height	Pearson Correlation	-0.070	1
		Sig. (2-tailed)	0.560	
		N	71	71

Table 6: Correlation among vertical facial patterns and lower lip height with respect to age

Age group			vertical facial patterns	lower lip height
< 15 years	Vertical facial patterns	Pearson Correlation	1	-0.061
		Sig. (2-tailed)		0.551
		N	99	99
	Lower lip height	Pearson Correlation	-0.061	1
		Sig. (2-tailed)	0.551	
		N	99	99
≥ 15 years	Vertical facial patterns	Pearson Correlation	1	0.157
		Sig. (2-tailed)		0.191
		N	71	71
	Lower lip height	Pearson Correlation	0.157	1
		Sig. (2-tailed)	0.191	
		N	71	71

Table 7: Correlation among vertical facial patterns and procumbency of upper lip with respect to age

Age group			Vertical facial patterns	Procumbency of upper lip
< 15 years	Vertical facial patterns	Pearson Correlation	1	0.004
		Sig. (2-tailed)		0.972
		N	99	99
	Procumbency of upper lip	Pearson Correlation	0.004	1
		Sig. (2-tailed)	0.972	
		N	99	99
≥ 15 years	Vertical facial patterns	Pearson Correlation	1	0.017
		Sig. (2-tailed)		0.888
		N	71	71
	Procumbency of upper lip	Pearson Correlation	0.017	1
		Sig. (2-tailed)	0.888	
		N	71	71

Table 8: Correlation among vertical facial patterns and procumbency of lower lip with respect to age

Age group			Vertical facial patterns	Procumbency of lower lip
< 15 years	Vertical facial patterns	Pearson Correlation	1	0.038
		Sig. (2-tailed)		0.709
		N	99	99
	Procumbency of lower lip	Pearson Correlation	0.038	1
		Sig. (2-tailed)	0.709	
		N	99	99
≥ 15 years	Vertical facial patterns	Pearson Correlation	1	0.121
		Sig. (2-tailed)		0.316
		N	71	71
	Procumbency of lower lip	Pearson Correlation	0.121	1
		Sig. (2-tailed)	0.316	
		N	71	71

DISCUSSION

The objective of the current research was to determine the correlation in facial soft tissue measurements and vertical facial patterns in 12-16 years old untreated patients. An imperative factor to be reflected in orthodontic treatment planning is the vertical growth pattern which should be designed to serve the morphologic characteristics of long and short facial types[8,9] including how facial soft tissues adapt to the aberrant vertical skeletal pattern[10]. The primary finding of our research is that underlying skeletal vertical pattern affects the vertical development of soft tissues. Therefore this should be kept in mind while diagnosis and treatment planning.

Cephalometric measurements for upper lip length was taken from subnasale to the commissure of the upper and lower lip; and from commissure of the upper and lower lip to the point on soft tissue chin parallel to menton was taken for lower lip length. According to this study long faces are associated with longer upper and lower lips and increased display of incisors, while these values are considerably decreased in subjects with short facial dimensions. So, there is a positive correlation between underlying

vertical skeletal pattern and lip heights. This could be predictive for young patients and should be kept in mind while diagnosis and treatment planning.

The extent of protrusion of upper lip was assessed using Esthetic E plane. The most anterior part on the vermilion of the upper lip i.e. labrale superius was marked and its respective position to the E plane was measured on a millimeter scale. A positive sign allocated when the lip point was located anterior to E plane and a negative sign when the lip position was posterior to the E plane. The protrusion of lower lip was similarly recorded using esthetic plane (E plane). The anterior most points on the vermilion border of lower lip i.e. labrale inferius was marked and its position with respect to E plane was measured on a millimeter scale. A positive sign was given when the lip point was anterior to E plane and a negative sign for when the lip position was posterior to the E plane. Protruded lips that teeth must be removed in order to address malocclusion and create a balanced facial profile[11]. This recent research shows that the protrusive lips are present in subjects with long vertical pattern. However, values for protrusion of upper and lower lips are more consistent with the esthetic E plane as these directly relate the postero-anterior position of lips to nose and chin. Additionally, protrusive lips gives more esthetic and youthful appearance and are found more frequently in young, growing children and females [12,13]. Over retraction of teeth can result in flattening of lip profile thus having negative effect on facial esthetics. These factors should also be kept in mind in making a treatment plan especially in patients with short facial height and adult patients.

Subjects having ANB=0-4 were only included in an effort to minimize the effect of sagittal relationship. Inclinations of maxillary and mandibular incisors can influence the lip profile although this confounding factor was unmanageable in this study [11]. Nonetheless patients with bimaxillary proclination were not included in order to minimize this factor. More studies should be conducted with more parameters (e.g. total nasal height, nasolabial angle etc.) on this topic to enhance the knowledge and skill.

Results of our study were in correlation with the previous studies done in adult patients. Although there are few studies conducted on this topic. We conducted the study in young growing patients so that benefits from growing age can be gained in treatment planning by modifying the growth in favor of ideal esthetics. Early diagnosis and orthodontic intervention by growth modification etc. can modify the soft tissue profile, improving the self-esteem, psychological well-being and quality of life of patients. Also early intervention can save patients from future compromised plans and invasive procedures like orthognathic surgery or camouflage surgeries.

CONCLUSION

vertical proportions of facial soft tissues of the population still undergoing growth changes, also follow the underlying vertical skeletal pattern. The long facial pattern have increased lip heights and procumbent lips. Whereas, short facial pattern is associated with decreased lip heights and recumbent lips.

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