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Comparison of Facial Soft Tissue among Different Facial Patterns: A Cephalometric Study

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ABSTRACT

Introduction

With the advancement of the soft tissue paradigm, various soft tissue factors have been added to the orthodontic problem list for diagnosis and treatment planning. This study aimed to examine the dimensions of facial soft tissues alongside various cephalometric parameters in orthodontic patients.

Methods

This observational study was conducted at Department of Orthodontics and Dentofacial Orthopedics, Dental Clinical Sciences-1, TU Teaching Hospital. Three different groups based on the morphological patterns (brachyfacial, dolichofacial, and mesofacial) with soft tissue parameters of upper lip thickness (ULT), lower lip thickness (LLT), upper lip height (ULH), lower lip height (LLH), soft tissue chin thickness (SCT) were studied. X-rays selected for this study from 18-30 years old patients with no craniofacial deformities were selected. SPSS 21 was used for statistical analysis.

Results

The mean value of facial axis measurement (BaN.PtGn) was 90.02 ± 4.14^0. The mean values of ULT was 14.51±2.74 mm, LLT was 16.33±1.87 mm, ULH was 28.21±3.66 mm, LLH was 47.43±4.66 mm, and SCT was 14.70±2.54 mm. The BaN.PtGn, ULT, and SCT were significantly different among three facial types. Brachyfacial facial type had higher ULT than mesofacial and dolichofacial types whereas higher SCT than mesofacial types. The correlation between different soft tissue measurements showed weak to very weak strength association.

Conclusion

Brachyfacial facial types had higher upper lip thickness than mesofacial and dolichofacial types and higher soft chin thickness than mesofacial types. There was no difference among gender in brachyfacial types, whereas male predominance was seen in mesofacial and dolichofacial type.

Keywords
Cephalometry; facial pattern; soft tissue

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INTRODUCTION

The appearance of an attractive and pleasant face is significantly influenced by the harmonious relationship between various facial structures. Historical figures, such as the Greek sculptors who created the statues of Apollo Belvedere and Aphrodite of Melos, considered these proportions to be ideal. The concept of ideal vertical facial proportions became more defined with the introduction of the "rule of facial thirds" by Leonardo Da Vinci and the "divine proportions" theory established by Euclid.[1-3]

In orthodontics, Sassouni was a pioneer in categorizing facial shapes based on vertical measurements, classifying them into long, average, and short faces.[4] Achieving the optimal vertical facial profile is a primary goal in orthodontic treatment, as there is a strong correlation between vertical facial dimensions and ideal facial aesthetics. The soft tissue paradigm introduced several soft tissue factors into orthodontic considerations.[5] Discrepancies between the soft tissues of the face and the underlying vertical skeletal structure can lead to unfavorable aesthetic outcomes.[6-8]

In recent years, both patients and orthodontists have increasingly emphasized the importance of soft tissue outlines in determining facial aesthetics.[9-10] .There are relatively few studies that specifically compare cephalometric characteristics and soft tissue dimensions across different morphological groups.[11,12] Most existing research focuses on how soft tissues respond to changes brought about by orthodontic interventions.[13,14]

Therefore, this study aims to compare the soft tissue dimensions and various cephalometric parameters in orthodontic patients with brachyfacial, dolichofacial and mesofacial patterns.

METHODS

An observational cross-sectional study was carried out at the Institute of Medicine, Maharajgunj, Kathmandu. Ethical approval for the proposal was granted by the institutional ethical review committee (Reference no: 434(6-11)E^2 before the data collection. Sample size of minimum 20 in each group was derived based on reference article given by Feres et al. Sampling method used was convenient sampling. Each participant signed an informed consent to participate in the study. Lateral cephalogram, a routine radiograph needed for diagnosis and treatment of patients were used as samples to carry out this study. These radiographs were recorded using the standard techniques with the jaw kept in the centric relations, teeth maintained in occlusion, lips kept at relaxed posture with head fixed in natural head position. Patients aged 18-30 years were included in this study. Patients having previous orthodontic treatment and craniofacial deformities were excluded from the study. For data analysis, radiographs were categorized into three groups consisting 30 individuals in each group, based on patients' morphological patterns: brachyfacial, dolichofacial, and mesofacial. Facial axis (BaN.PtGn) with normal value of 90°[15] was set as criteria used to divide the sample into groups. 3° variation proposed by McNamara[16] was utilized to define the groups as mesofacials (facial axis equal to or above 87° and equal to or below 93°), dolichofacials: (facial axis above 93°), brachyfacials (facial axis below 87°). Soft tissue dimensions assessed were (Fig 1).Upper lip thickness (ULT): distance between the junction of the contour of the maxillary incisor and the pre-maxilla, and point UL, located in the anterior-most region of the upper lip contour. Upper lip height (ULH): distance between the palatal plane (ANS-PNS) and a parallel line going through Stu (located at the bottom of the contour of the upper lip). Lower lip thickness (LLT): distance between the junction of the contour of the lower incisor and the anterior contour of the chin, and point LL, located in the anterior-most contour of the lower lip. Lower lip height (LLH): distance between the mandibular plane and a parallel line going through Stl (located at the upper border of the contour of the lower lip). Soft chin thickness (SCT): shortest distance between Pog' and NB line.

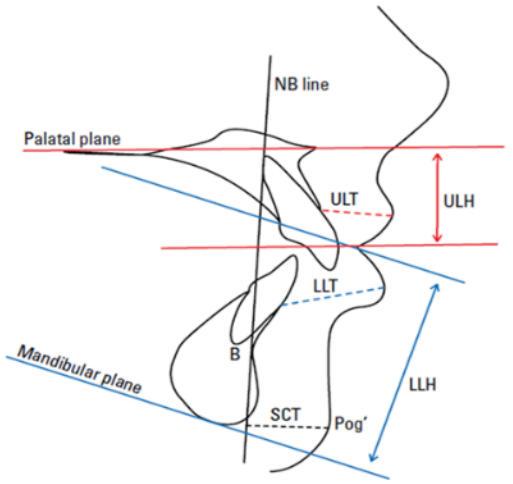

Figure 1. Measurement of soft tissue dimensions

Raw data were collected on Microsoft Excel (Ver. 2016) during the study. The means, standard deviations, medians, and quartiles for all parameters were calculated. ANOVA and post hoc tests were applied based on the normal distribution of samples. The Pearson Correlation Coefficient was utilized to assess the correlation between variables. IBM SPSS Statistics for Windows, Version 21.0 was used for statistical analysis. A p-value < 0.05 was considered statistically significant.

RESULTS

Sample comprised 66 radiographs divided into three groups each based on the morphological patterns as brachyfacial, dolichofacial, and mesofacial with 22 patients in each group. Among total sample, 55% (36) were females while 45% (30) were males. In dolichofacial pattern type females, 68.18% (15) which were more than males 31.81% (7) where as in mesofacial females were 45.45% (10) which was less than males 54.55% (12). In Brachyfacial equal number among genders were noted. (Figure 2). In this study, the mean age was 21.83±4.79 years with the youngest age of 18 years and the older age of 39 years. The mean value of facial axis measurement (BaNptGN) was 90.02 degrees ranging from 83 to 98 degrees. Similarly, under soft tissue measurement, the mean value of ULT, LLT, ULH, LLH, and SCT was 14.51±2.74 mm, 16.33±1.87 mm, 28.21±3.66 mm, 47.43±4.66 mm, and 14.70±2.54mm respectively. (Table 1)

The mean facial axis had greater values for Dolichofacial (94.66 degree) followed by mesofacial (90.05 degree) and then last Brachyfacial (85.36 degree). There was a statistical mean difference between the facial axis and morphological types($p<0.05$). Similarly, on further comparison, there were significant differences in the facial axis between mesofacial and brachyfacial, mesofacial and dolichofacial, and brachyfacial and dolichofacial respectively ($p<0.05$).(Table 2)

There was a statistical mean difference between ULT and morphological facial types($p<0.05$). On further comparison, mesofacial had smaller mean ULT (13.27±2.7) values than brachyfacial (16.07±2.48) with statistically significant difference($p<0.05$). Also, dolichofacial had smaller mean ULT (14.18±2.33) values than brachyfacial with a statistically significant difference($p<0.05$). However dolichofacial had a higher value than mesofacial with a statistically non-significant difference($p>0.05$).(Table 2)

The mean LLT values were lesser for dolichofacial facial types (15.96±1.96) when compared to mesofacial (16.46±2.28) and brachyfacial (16.59±1.29). There was no statistical mean difference between the LLT values for different morphological facial types. ($p>0.05$)(Table 2)

The mean ULH values were lesser for dolichofacial facial types (27.36±4.48) when compared to mesofacial (28.46+-2.81) and brachyfacial (28.80±3.51). There was no statistical mean difference between the ULH values for different morphological facial types. ($p>0.05$)(Table 2)

The mean LLH values were similar for dolichofacial facial types (47.30±4.69), mesofacial (47.64±5.40) and brachyfacial (47.36±4.01). There was no statistical mean difference between the LLH values for different morphological facial types. ($p>0.05$) (Table 2)

There was a statistical mean difference between SCT and morphological facial types.($p<0.05$) On further comparison, mesofacial had smaller mean SCT (14.00±3.02) values than brachyfacial (15.86±1.73) with a statistically significant difference.($p<0.05$) However, dolichofacial had smaller mean SCT (14.23±2.37) values than brachyfacial but higher SCT values for mesofacial with a statistically non-significant difference($p>0.05$) for both.(Table 2)

The ULT had a weak negative correlation with the facial axis (BaNptGN) with statistical significance ($p<0.05$) i.e. when one ULT increases facial axis decreases. Similarly, LLT, ULH, and SCT had a very weak negative correlation with facial axis (BaNptGN) respectively with statistically non-significant findings ($p>0.05$). Though statistically non-significant LLH had a very weak positive correlation with the facial axis.(Table 3)

LLT had a weak positive correlation with ULT with a statistically significant finding($p<0.05$). LLH and SCT both had a very weak positive correlation with ULT with no statistically significant finding($p>0.05$).While ULH had a very weak negative correlation with ULT with non-significant findings ($p>0.05$). ULH and SCT both had a very weak positive correlation with LLT with statistically non-significant findings ($p>0.05$). However, LLH had a weak positive correlation with LLT with significant findings ($p<0.05$). LLH and SCT both had a very weak positive correlation with ULH with statistically non-significant findings ($p>0.05$). While SCT had a very weak positive correlation with

Table 1. Different dimensions of facial soft tissues

Parameter	Minimum	Maximum	Mean	Std. Deviation
Age (year)	18	39	21.83	4.79
Facial axis (BaN.PtGn) (Degree)	83	98	90.02	4.14
Upper Lip Thickness (ULT) (mm)	8	23	14.51	2.74
Lower Lip Thickness (LLT (mm)	11	22	16.33	1.87
Upper Lip Height (ULH) (mm)	14	40	28.21	3.66
Lower Lip Height (LLH) (mm)	31	62	47.43	4.66
Soft tissue Chin Thickness(SCT) (mm)	10	22	14.70	2.54

Table 2. Comparison of facial axis and soft tissue measurements with vertical facial types

Parameter	Facial type	Mean	SD	Minimum	Maximum	ANOVA	Tukey test	p-value
BaN.PtGn	Mesofacial	90.05	2.08	84	93	<0.001*	M-B	<0.001*
	Brachyfacial	85.36	1.50	83	91		M-D	<0.001*
	Dolicofacial	94.66	1.06	94	98		B-D	<0.001*
ULT	Mesofacial	13.27	2.71	8	18	0.002*		0.001*
	Brachyfacial	16.07	2.48	11	23			0.46
	Dolicofacial	14.18	2.33	10	19			0.04*
LLT	Mesofacial	16.46	2.28	11	22	0.50		
	Brachyfacial	16.59	1.26	13	19			
	Dolicofacial	15.96	1.96	12.5	21			
ULH	Mesofacial	28.46	2.81	23	33	0.41		
	Brachyfacial	28.80	3.51	22	40			
	Dolicofacial	27.36	4.48	14	35			
LLH	Mesofacial	47.64	5.40	31	56	0.97		
	Brachyfacial	47.36	4.01	38	58			
	Dolicofacial	47.30	4.69	40	62			
SCT	Mesofacial	14.00	3.02	10	22	0.03*	M-B	0.04*
	Brachyfacial	15.86	1.73	13	20		M-D	0.49
	Dolicofacial	14.23	2.37	11	19		B-D	0.07

LLH with non-significant findings (p>0.05). (Table 3)

DISCUSSION

Our study included 66 patients with 22 in each group found that facial axis, Upper Lip thickness, and Soft tissue Chin Thickness were significantly different between the three types of facial types. Brachyfacial facial types had higher upper lip thickness than mesofacial and dolichofacial types and higher soft chin thickness than mesofacial types. The correlation analysis between the various soft tissue measurements revealed that the strength of the associations was weak to very weak. Specifically, the correlation coefficients were generally low, indicating that there is minimal to no linear relationship between the measurements.

Males showed significantly longer upper facial height than females in all facial types when it came to soft tissue facial lengths; similarly, in average and short facial types, males showed longer chin height and lower facial height. These findings are consistent with those of European white population studied done by Fernandez–Riveiro et al.[17] and Kalha et al.[18] regarding lower facial height. In both the short and long facial types, males had considerably higher lower lip heights than females, but only in the short type did the upper lip heights differ significantly. These results are consistent with those of North European study by Blanchette et al.[19], who found that sex disparity was more prominent for the lower lip than the upper lip in patients with long and short faces. In our study, a higher number of females had dolichofacial types than males while mesofacial

Table 3. Correlation coefficient between different soft tissue measurement variables and facial axis

Parameter	Test	BaNptGN	ULT	LLT	ULH	LLH
ULT	Pearson Correlation	-.317**	-	-	-	-
	Sig. (2-tailed)	0.009				
LLT	Pearson Correlation	-0.177	.309	-	-	-
	Sig. (2-tailed)	0.156	0.011*			
ULH	Pearson Correlation	-0.165	-0.116	0.053	-	-
	Sig. (2-tailed)	0.185	0.354	0.674		
LLH	Pearson Correlation	0.016	0.086	.254	0.158	-
	Sig. (2-tailed)	0.897	0.491	0.039*	0.206	
SCT	Pearson Correlation	-0.187	0.121	0.136	0.042	0.027
	Sig. (2-tailed)	0.133	0.333	0.275	0.74	0.827

was more common in the male population. Though the soft tissue measurement was not compared according to gender it might affect the result. The results showed that men have thicker soft tissue thickness across all groups due to the effect of testosterone on collagen synthesis; females, on the other hand, have thinner skin due to the synthesis of hyaluronic acid and decreased collagen synthesis due to the influence of estrogen on females.[20]

The criterion employed by Blanchette et al.,[19,21] Lai, Gosh, and Nanda[22], and Boneco and Jardim[21] differs from the one used in this study to determine the face groups (BaN.PtGn), but it was nevertheless considered appropriate for the morphological classification of patients. This is because the groups that were established using this criterion, particularly the face patterns at the two extremes (brachyfacials and dolichofacials), were very different from the parameters that the authors cited earlier to categorize their respective samples. [19,21,22]As a result, we thought it relevant to contrast their findings with the findings of this investigation.

Dolichofacials have longer lips than brachyfacials, according to studies conducted by Blanchette et al.[19], Lai, Gosh, and Nanda [22], Boneco, and Jardim. These findings are consistent with the study's results , albeit coming from measurements that differ slightly from those used here. Since dolichofacials are more likely than other people to have lip incompetence, their lips are larger in the vertical direction to compensate for lip seal difficulties.[19,21] A study conducted between both Genders aged 12 to 16 years showed that there were no changes in the thickness of the soft tissue chin, lower lip, or upper lip across all morphological categories. However, dolichofacials had noticeably higher upper and lower lip heights. Mesofacials and brachyfacials both had lower upper lip heights, but there were no variations in lower lip heights between the two groups.[11] The thickness of the soft tissues in the lip and chin varies, according to the Blanchette et al study,[19] to make up for a lack or surplus of underlying hard structure. Therefore, dolichofacial people have thicker lips and a softer chin because their basal bones are typically more retruded. Furthermore, because of their noticeably stronger underlying structure, brachyfacials, in the opinion of these authors, exhibit lower horizontal soft tissue profile magnitudes. In the study from Iraq found that the hypo-divergent group had the largest mean thickness of their upper and lower lips (8.95 mm and 9.35 mm, respectively). The hyperdivergent group had the highest mean upper lip height (11.3 mm), while the hypodivergent group had the highest mean lower lip height (25.32 mm). The hyperdivergent group had the thickest mean chin (7.84 mm). Significant statistical differences between the three groups were only seen in ULT's Hypo vs. Normo-divergent groups. Similar study found that the majority of the variations across the three facial type groups were found in the vertical soft tissue measurements. The thickness of the lower lip was the sole area where a difference in the soft tissue drape's thickness was found. The patients with shorter facial types displayed the smallest measurements for both lower lip height and lower facial height. Compared to the other two facial types, the long face had the thickest lower lip at in terms of thickness.[12]

Changes after orthodontic treatment are the main focus of most studies on the soft tissues of the face, and in particular, on the thickness of the soft tissue chin (STC). Research on the properties of soft tissues in various growth patterns is necessary. This information will help determine a unique soft tissue prognosis for each growth pattern and aid in the planning of orthodontic treatment.[24,25] Comparing patients with clinically normal and hypo-divergent vertical skeletal patterns to those with hyper-divergent patterns, In the study from southeastern china revealed that soft tissue thickness measurements were lower in the former group. Men exceeded women in all STC measurements.[26]

In the study from Brazil, there was a very strong correlation between lower anterior facial height and upper lip height. Lower anterior and total face heights also showed a strong correlation with lower lip height. This suggests a tendency for the upper lip and lower vertical face development to be in "alignment." The vertical placement of the upper incisors and upper lip height had a strong correlation that, in part, maintained these teeth's continuous exposure throughout the various morphological groups.[11]In a Study from India concluded a strong positive association between the underlying skeletal pattern and the size of the nose and lips. Likewise, there was a strong correlation found between the lower anterior face height and the incisal display at rest, the nasolabial angle, and the procumbency of the upper and lower lips.[27] Our study found weak and very weak correlations between different parameters.

The current study produced optimistic results, although they are still constrained by the sample size and methodology used. The findings may be used to plan orthodontic cases based on these characteristics and could determine the soft tissue prognosis for each vertical pattern in the face both before and after orthodontic surgery.

CONCLUSION

Upper lip thickness and soft tissue chin thickness were significantly different between mesofacial, brachyfacial and dolichofacial facial types. Brachyfacial facial types had higher upper lip thickness than mesofacial and dolichofacial types and higher soft chin thickness than mesofacial

types. The correlation between different soft tissue measurements showed only weak or very weak strength association. There is no difference among gender in brachyfacial types, whereas male predominance was seen in mesofacial and dolichofacial type. There is variation in thickness and height of Upper lip and Lower lip. Similar variations of soft tissue chin thickness among different facial pattern. Hence clinicians and researchers must give due considerations while working on these parameters.

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The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

RY, NY : Research Concept, Research Design, literature Review, Data collection, Data analysis, Statistical analysis, Manuscript Preparation.

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