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Facial Soft Tissue Profile Differences in Various Vertical Facial Patterns: A Cephalometric Analysis

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Abstract

Introduction: The orthodontic treatment is aimed at achieving a proper functional occlusion, as well as balanced and aesthetic face. The purpose of this study was to identify how facial soft tissue parameters correlate with the vertical facial pattern that might impact diagnosis and treatment plan construction.

Methodology: A cross-sectional quantitative study involving 265 orthodontic patients was conducted in Islamic International Dental Hospital, Islamabad. Pretreatment lateral cephalograms records were assessed and soft tissue parameters were measured. Statistical comparisons were performed on SPSS v23 using the One-way ANOVA and Post Hoc Scheffe tests.

Results: Dolichofacial individuals had significantly longer upper and lower lips compared with mesofacial and brachyfacial faces, while brachyfacial faces showed the greatest upper lip thickness ($p \leq 0.05$). No significant differences were observed for lower lip thickness, soft tissue chin thickness, nasolabial angle, or nasal height across facial types ($p > 0.05$). These results indicate that vertical facial pattern mainly influences lip dimensions, whereas other soft tissue parameters remain relatively stable, providing guidance for orthodontic diagnosis and esthetic treatment planning.

Conclusions: While correlating facial soft tissue parameters with the vertical facial patterns it was found out that upper and lower lip lengths and upper lip thickness varied significantly between various facial types. However, Lower lip thickness, Soft Tissue Chin, Nasolabial Angle and Nasal Height didn't show significant difference among the three facial patterns.

Keywords: Face, Soft tissue, Soft tissue, Vertical dimension, Facial growth

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Introduction

Soft tissue paradigm has substantially transformed the orthodontics nowadays. According to this paradigm, the orthodontic treatment planning is now based on the facial soft tissues rather than dental and skeletal structures alone.[1]

It is a widely accepted fact that facial appearance is a significant factor in communication and social interaction.[2] A pivotal facet of facial form is facial balance, which is dependent upon balanced proportion of hard and soft tissues. Some studies emphasize on the importance of soft tissue more than hard tissue.[3] Regarding the importance of soft tissues, they can possibly cover some of the facial asymmetry that could be due to underlying bony structure because of the facial muscle tone and the varying soft tissue thickness.[4] The disassociation in facial harmony due to variations between skeletal

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and soft tissues might lead to surgical treatment options.[5]

Proper evaluation of soft tissues is important for achieving an harmonized aesthetic outcome.[6] Therefore, in order to have an accurate analysis and appropriate treatment planning based on the skeletal discrepancy, it is important to carefully evaluate and consider soft tissue parameters in the examination utilizing concept of retro-engineering and Soft tissue paradigm shift.[7,8]

If the facial soft tissues do not follow the underlying vertical skeletal framework, it can adversely affect the facial esthetics.[9] This highlights the importance of assessing soft tissue features of patients with different vertical patterns.[10] According to Rasool et al., 2016, orthodontic diagnosis and treatment planning are influenced by vertical dimension and needs to be correlated with soft tissue thickness.[4]

Vertical facial pattern classification, originally described by Sassouni, continues to be supported by recent cephalometric evidence demonstrating its significant influence on facial soft tissue morphology.[11] Contemporary studies show that hyperdivergent (long-face) individuals exhibit increased lower facial height, altered lip length, and reduced chin soft tissue thickness compared with normodivergent and hypodivergent patterns, indicating that vertical skeletal divergence directly affects the soft tissue profile and facial esthetics. Recent cephalometric and CBCT-based analyses further confirm that these soft tissue variations are more strongly related to vertical facial pattern than sagittal skeletal relationships alone, emphasizing the importance of incorporating vertical dimension assessment into orthodontic diagnosis and treatment planning.[12-14] In the current study, patients were categorized into dolico-facial, meso-facial and brachyfacial though inadequate data concerning the basic differences between facial patterns lacks.[14]

Despite extensive research on facial soft tissue analysis, gaps remain regarding outcome-relevant variables in orthodontic diagnosis. Most studies emphasize sagittal skeletal relationships while under exploring how vertical facial patterns influence soft tissue morphology, often examining isolated parameters or small, non-representative samples. In addition, limited South Asian–specific evidence exists, despite known ethnic variations in lip and soft tissue thickness. Conflicting findings regarding chin and nasal parameters further obscure clinically meaningful outcomes. By systematically evaluating multiple soft tissue parameters across all vertical facial patterns in a large regional sample, this study generates outcome-focused evidence that clarifies which soft tissue features vary with vertical morphology and which remain stable, thereby strengthening diagnostic accuracy and esthetic treatment planning.[15-17] Given the limited and inconsistent evidence on how vertical facial patterns influence clinically relevant soft tissue outcomes-particularly in Pakistani populations-there is a need for population-specific, outcome-focused data. This study aims to identify which facial soft tissue parameters vary with vertical facial morphology in Pakistani patients to enhance esthetic diagnosis and support more individualized orthodontic treatment planning.

Methodology

A cross-sectional, comparative, quantitative study was executed with the approval from the Ethics Research Committee of Islamic International Dental College and Hospital under IRB# IIDC/IRC/2018/001/010. The sample size was calculated by using WHO calculator using following statistical assumptions: Confidence level = 95%, Alpha error = 5% and Study power = 80%. In this study, Lateral Cephalograms of 265 orthodontic patients with different facial patterns (66 dolichofacial, 119 mesofacial, and 80 brachyfacial), whose records were achieved from the Islamic International

Dental College and Hospital, were evaluated. The cut- off limit for inclusion criteria was 11-38 years of age for patients attending orthodontic OPD during 2012-2017. Regarding Cephalometric norms analysis, the radiographs were taken with the patients oriented in natural head position, the teeth in centric occlusion with relaxed lips. All the patients were of Pakistani origin and had dental malposition. The exclusion criteria included patients who had undergone orthodontic treatment and Patients in whom the teeth were not in occlusion or in which lips were not relaxed with visible mentalis strain.

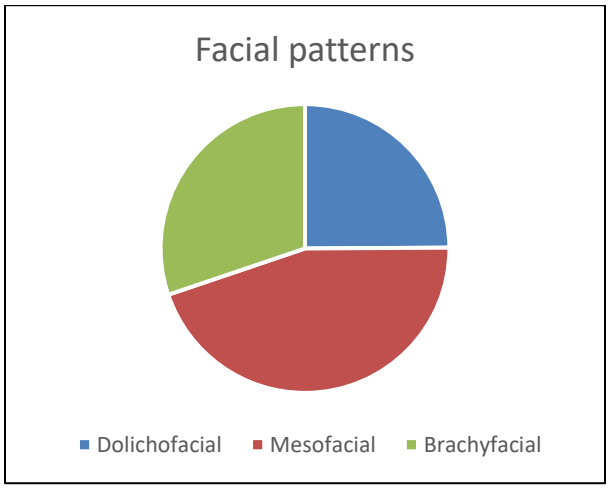

Fig. I: Facial Pattern distribution

The measurements were performed by principal author of this study. Anatomical structures were traced first on the tracing sheet (acetate tracing sheet with a thickness of 0.003 inch.) and then measurements including both linear and angular measurements were made with the help of a millimeter ruler, and protractor, respectively. The parameters such as age and gender were recorded. In the current study we have used Maxillo Mandibular Angle for this classification because of the chances of discrepancy in SN-MP angle, due to Sella being an unreliable factor.[16]

Patients were divided into Dolichofacial, Mesofacial, and Brachyfacial on the basis of MMA. The 3 facial types were classified as: Dolichofacial MMA angle ≥30°, Mesofacial MMA angle 21°-29°, and Brachyfacial MMA angle ≤20°.[17,18]

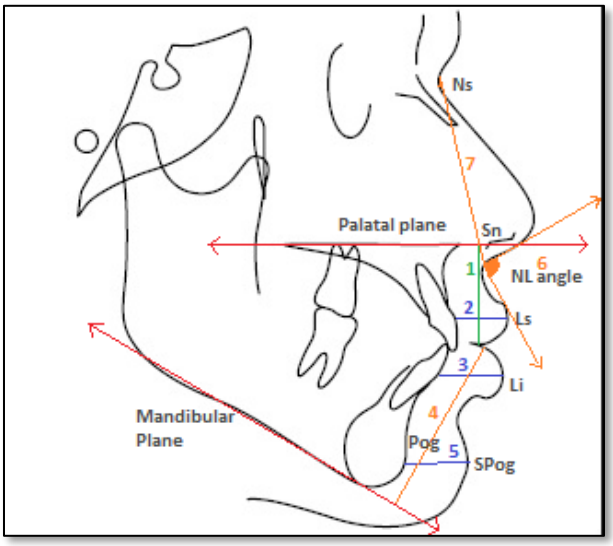

Fig. II: 1=Upper Lip Length (ULL), 2=Upper Lip Thickness (ULT), 3=Lower Lip Thickness (LLT), 4=Lower Lip Length (LLL), 5=Soft Chin Thickness (SCT), 6=Nasal Length (NL), 7=Nasal Height (NH)

All assessments were performed by orthodontist in a darkened room using a radiographic illuminator to ensure contrast enhancement between hard and soft tissues and re-assessed for measurement error repeated by the principal investigator.

Statistical Analysis:

Frequencies/percentages were calculated for categorical variables like gender, whereas mean was calculated for quantitative variables like age and cephalometric measurements. Intergroup comparisons for each cephalometric measurement was conducted using one-way ANOVA. For variables showing statistical significance ($p < 0.05$) Scheffé test was performed. All tests were performed by using SPSS 23.0.

Result

The sample had a mean age of 17.0 range 11 and 38 years, and were 34% (n=90) males and 66% (n=175) females. Table I shows the mean values of soft tissue parameters recorded for all the groups in the study. Thickness of lower

lip, soft tissue chin, nasolabial angle and nasal height showed no statistical differences in all morphological groups. However, upper and lower lip lengths and upper lip thickness varied significantly as depicted by the Table-I.

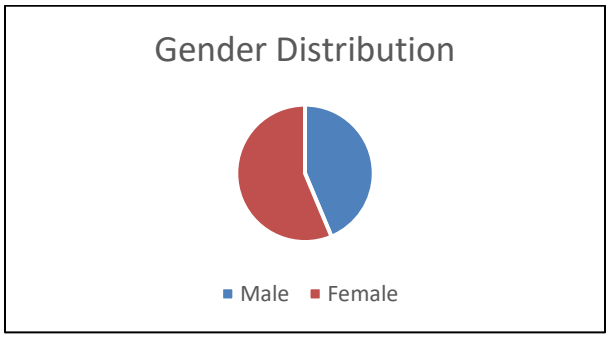

Fig. III: Gender Distribution

Variables	Face Type	Mean	Post-Hoc	Schefe
ULL (mm)	Mesofacial	22.24	M-D	0.01
	Dolichofacial	23.80	M-B	0.00
	Brachyfacial	19.25	B-D	0.00
LLL (mm)	Mesofacial	38.85	M-D	0.02
	Dolichofacial	41.33	M-B	0.00
	Brachyfacial	34.81	B-D	0.00
ULT (mm)	Mesofacial	10.66	M-D	0.85
	Dolichofacial	10.83	M-B	0.00
	Brachyfacial	11.76	B-D	0.05
LLT (mm)	Mesofacial	13.82	M-D	0.97
	Dolichofacial	13.90	M-B	0.99
	Brachyfacial	13.84	B-D	0.99
SCT (mm)	Mesofacial	11.55	M-D	0.43
	Dolichofacial	10.37	M-B	0.42
	Brachyfacial	10.28	B-D	0.99
NLA (°)	Mesofacial	104.00	M-D	0.78
	Dolichofacial	102.63	M-B	0.25
	Brachyfacial	100.52	B-D	0.65
NH (mm)	Mesofacial	49.87	M-D	0.93
	Dolichofacial	50.18	M-B	0.84
	Brachyfacial	49.32	B-D	0.69

Table-I: Comparison of soft tissue parameters among three facial types (Mesofacial, Dolichofacial, and Brachyfacial)

The results showed no differences ($p \geq 0.05$) among all vertical patterns for four variables, i.e., thickness of lower lip and soft chin, nasolabial angle and nasal height. However, upper and lower lip lengths varied significantly ($p < 0.05$) among dolichofacial, brachyfacial and mesofacial cases. Both upper and lower lip lengths were shortest in brachyfacial when compared with other two types. However, mesofacial and dolichofacial types had longer lips. Lastly, the upper lip thickness was found highest in short faces and varied significantly ($p < 0.05$) from other two patterns.

Discussion

In the present study, brachyfacial individuals exhibited the shortest upper lip length, while mesofacial and dolichofacial subjects showed significantly greater values (22.24 mm and 23.80 mm, respectively), with significant differences between dolichofacial vs. brachyfacial and mesofacial vs. brachyfacial groups. This pattern—where long face (hyperdivergent/dolichofacial) individuals tend to demonstrate greater upper lip vertical dimensions compared to short face (brachyfacial) types—echoes findings from recent cephalometric research reporting. In one of the studies published in 2025 it was found that hyperdivergent patients have incresed lip length similar to the findings in our study.[18] Similar findings were found in astudy conducted by Yadav R & Yadev.[19] These results were in agreement with Jeelani et al., who also found a significant difference in lip lengths of 3 face types.[9]

In the current study lower Lip Length, was short in brachyfacial patients when compared with other two types (Table-I). Jeelani et al., on the other hand found a statistically insignificant difference for lower lip length between mesofacial and brachyfacial group, dolicofacials however have larger lip lengths.[9] Rasool et al. reported significantly increased upper and lower lip heights in dolichofacial individuals, whereas the brachyfacial group exhibited a reduced upper lip height compared to the mesofacial group.[4] Another study confirmed that dolicofacials have larger lip lengths and brachyfacials have shorter lower lip.[20]

In the current study, differences were detected in the soft chin thickness among

different groups. During Post-Hoc Analysis, however, this difference did not reach a statistically significant level (Table-I). Similar results were found by Jeelani et al.[9] Gomez concluded that soft tissue chin thickness varies according to facial type, with brachyfacial individuals exhibiting a greater soft tissue chin thickness than those with a dolichofacial pattern.[21,22] The results of the study of Rasool et al., were also in agreement with the rest of studies. In another study soft tissue chin thickness was statistically significantly different at Gn and Me but not at Pog.[23,24]

A statistically significant difference was found in upper lip thickness (ULT) between brachyfacial and both mesofacial and dolichofacial groups in the present study, whereas no significant difference was observed between mesofacial and dolichofacial types. This outcome aligns with recent cephalometric findings demonstrating that vertical facial pattern can influence upper lip thickness: Yadav R and Yadav N reported that brachyfacial facial types exhibited higher upper lip thickness than mesofacial and dolichofacial types, indicating vertical pattern–specific variation in ULT.[17] Similarly, Shah et al.'s investigation in a Peshawar population found no statistically significant differences in lip thickness (both upper and lower) across high angle, normal angle, and low angle vertical groups, underscoring persistent variability in soft tissue responses among populations.[25,26] In contrast, a regional study with larger samples indicate that though upper lip thickness may vary with vertical divergence, but lower lip thickness often remains consistent.[27]

In the current study, statistically insignificant difference in nasolabial angle was observed among the three vertical facial forms. This finding aligns with other recent cephalometric researches showing statistically insignificant changes in nasolabial angle with orthodontic interventions.[28,29] However, contrasting evidence exists: a cross sectional analysis among adults found significant variations in nasolabial angle among vertical facial pattern groups, with short (brachyfacial) patterns showing more acute angles than long (dolichofacial) ones.[30] These mixed results emphasize the gap in the existing literature.

In the current study, nasal height did not differ significantly among different vertical facial patterns, indicating that vertical morphology may not influence nasal length in this sample. Shi et al reported that nasal dimensions may not consistently vary with vertical facial type.[28,29] In contrast, Gupta et al observed that nasal length and depth were increased in patients with greater lower anterior facial height, indicating that vertical facial proportionality can be associated with nasal dimensions.[30] Mixed literature outcomes emphasizred the existing gap.

The study had some strengths and a few limitations. The current study used Cephalograms for all measurements but a CBCT could have provided more precise measurements and a three-dimensional evaluation of facial soft tissue.

Conclusion

The results of current study, through a comparative analysis of the different facial pattern groups, concluded that: Thickness of lower lip and soft chin, nasolabial angle and nasal height showed no differences among all vertical patterns. Upper and lower lip length varied significantly among dolichofacial, brachyfacial and mesofacial cases. Both upper and lower lip lengths were shortest in brachyfacial when compared with other two types. However, mesofacial and dolichofacial types had longer lips. Upper lip thickness was found highest in short faces and varied significantly from other two patterns.

Ethical Approval

The study was approved by the Ethics Research Committee of Islamic International

Dental College and Hospital under IRB# IIDC/IRC/2018/001/010.

Disclaimer

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Conflict of Interest

It is declared that the authors don't have any conflict of interest.

Authors' Contribution

MZ: Study design and acquisition of data
BY: Manuscript writing
MH: Critical review
TM: Analysis and interpretation of data
AQ: Analysis and interpretation of data

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