Relationship Between Hard And Soft Tissue Of Lower Third Of Face Having Different Growth Patterns- A Lateral Cephalometric Study

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Abstract:

Introduction: Facial aesthetics are largely determined by soft tissue contours, which can develop independently or in conjunction with the underlying skeletal structures. However, the influence of hard tissue variation on soft tissue profiles, particularly across different growth patterns, is not fully understood.

Objective: To evaluate the relationship of soft tissue of lower third of face and nasolabial angle with the underlying hard tissue in adults with hypodivergence, normodivergence, and hyperdivergence pattern.

Materials and Methods: The study sample consisted of 90 pre-treatment lateral cephalograms of adult patients, divided into three groups i.e. hypodivergence (Group I), normodivergence (Group II), hyperdivergence (Group III) and compared in terms of soft tissue parameters. One-way Anova for comparison between three groups and post hoc Tukey test for intergroup comparison were carried out. Correlations between soft tissue variables and hard tissue variables were also investigated.

Conclusion: The lip thickness and lower lip height was more in hypodivergent group. Upper lip thickness was more in hypodivergence. Chin length and chin thickness was more in hypodivergence group. Assessment of the correlations between soft and skeletal/dental variables evidenced vertical development of the upper and lower lips, commensurate with the vertical development of the skeleton. The thickness of the lips was strongly influenced by the lower incisors.

Keywords: Soft tissue, Growth pattern, Cephalometry

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I. Introduction

Facial esthetics is of prime importance to orthodontists¹. Soft tissue outlines are believed to significantly influence facial esthetics, as these dynamic structures may develop with or independently of the underlying skeleton². While traditional orthodontics emphasized hard tissue relationships and ideal occlusion, the modern approach focuses on soft tissue function and esthetics, acknowledging variation as the norm rather than ideal occlusion³. Soft tissue thickness varies among individuals and is widely studied in orthodontics, mainly using lateral cephalometric radiographs.

The orthodontic literature often describes and classifies the facial growth patterns into: high angle (hyperdivergent), low angle (hypodivergent) and normal angle (normodivergent)⁴. There are several factors like the growth of the jaws, dentoalveolar development, eruption of the teeth, and function of the tongue and lips which influence the development of facial growth patterns.

Orthodontic treatment does improve lip form and increases the soft tissue chin thickness^{5,6,7}. But the contribution of variation in hard tissues to the soft tissue profile is not fully understood and little attention given to patients with different growth patterns.

The null hypothesis: There is no relationship between the hard and soft tissue of lower third of face in different growth patterns.

II. Material And Methods

This study aimed to evaluate differences in the lower third of the face among adults with varying growth patterns by assessing:

1. Soft tissue morphology.

2. Skeletal (hard tissue) morphology.

3. Dental (hard tissue) morphology.

4. Correlation between soft tissue and underlying skeletal and dental structures.

The present study was carried out on the lateral cephalograms from the pre-treatment records of the patients. A total of 90 subjects between 18 to 25 years of age were selected.

Study Design: Prospective study.

Study Location: This study was done in Department of Orthodontics and Dentofacial Orthopedics, at College of Dental Sciences and Research Centre, Bopal, Ahmedabad.

Study Duration: May 2023 to January 2025.

Sample size: 90 subjects.

Subjects & selection method: This prospective study was conducted utilizing lateral cephalometric radiographs obtained from the pre-treatment records of 90 subjects aged between 18 and 25 years. The research was carried out in the Department of Orthodontics and Dentofacial Orthopedics at the College of Dental Sciences and Research Centre, Bopal, Ahmedabad. The study was undertaken over a period extending from May 2023 to January 2025, with a total sample size comprising 90 individuals selected based on predefined inclusion criteria.

Exclusion criteria:

- 1. Developmental disorders
- 2. Over retained deciduous or any supernumerary teeth
- 3. Deleterious oral habits
- 4. History of trauma
- 5. TMJ disorders
- 6. Cleft lip and palate
- 7. Syndromes involving jaws and teeth
- 8. Previous orthodontic treatment/orthognathic surgery

Procedure methodology

After written informed consent was obtained, a good quality lateral cephalogram of all the samples were taken in natural head position (NHP) with Cephalostat machine giving true size image, which is installed in the department of Oral Medicine and Radiology of our institute. The Cephalostat machine, which was used for the study was CS8000C, (Care Stream Dental (NY, USA)). The subjects were divided into three groups on the basis of different mandibular plane angles. Each cephalogram was traced for various hard and soft tissue parameters by a single operator in a standardized manner to minimize inter-operator errors. Figure 1 shows the landmarks marked on each tracing, and Figure 2 illustrates the planes and lines considered.

The patients were selected in hypodivergent, normodivergent or hyperdivergent growth pattern when 2 of the 3 criteria indicated a particular mandibular divergence i.e. SN-MP, FMPA, FH-GoMe.



Group I- Hypodivergent, Group II- Normodivergent, Group III- Hyperdivergent.

The following parameters were measured:

Planes used for skeletal, dental and soft tissue parameters

- 1. Sella-Nasion to Mandibular Plane (GoGn) [SN-MP]
- 2. Frankfort-mandibular plane angle (tangent) [FMPA]

3. Frankfort-mandibular plane (GoMe) [FH-GoMe]

Skeletal parameters

- 1 Lower Anterior Facial Height (LAFH)
- 2 Posterior Facial Height (PFH)
- 3 Maxillary Length
- 4 Mandibular Length

Dental parameters

- 1 Upper Anterior Dental Height
- 2 Lower Anterior Dental Height
- 3 Upper Posterior Dental Height
- 4 Lower Posterior Dental Height
- 5 U1 TO NA
- 6 L1 TO NB
- 7 U1 TO NA
- 8 L1 TO NB

Soft tissue parameters

- 1 Upper lip length
- 2 Upper lip thickness at base
- 3 Upper lip thickness at vermillion border
- 4 Upper lip height
- 5 Upper sulcus depth
- 6 Upper lip-S line
- 7 Lower lip thickness at base
- 8 Lower lip thickness at vermilion border
- 9 Lower lip height
- 10 Lower sulcus depth
- 11 Lower lip to S line
- 12 Gn-Gn'
- 13 Pg-Pg'
- 14 Me-Me'
- 15 Nasiolabial angle
- 16 Chin throat angle

Statistical analysis

The mean and standard deviation values of hard and soft tissue parameters in all three groups were calculated. Inter-group differences were evaluated using one-way ANOVA. Intergroup comparisons between hypodivergent, normodivergent, and hyperdivergent groups were assessed using the Post hoc Tukey test. The Pearson correlation coefficient was applied to evaluate the relationship between soft tissue and hard tissue parameters.

To assess the reliability of measurements, intraobserver and interobserver errors were evaluated. A set of 20 randomly selected cephalograms was retraced after a two-week interval by the same observer to check for intraobserver consistency. For interobserver variability, the same cephalograms were traced by another observer, and the results were compared. The differences were found to be statistically insignificant, confirming the reliability and reproducibility of the measurements.

III. Result

Tables 1, 2, and 3 show significant differences in skeletal, dental, and soft tissue parameters between the hypodivergent, normodivergent, and hyperdivergent groups. Skeletal analysis (Table 1) found that PFH, maxillary, and mandibular lengths were significantly greater in the hypodivergent group. In dental analysis (Table 2), U1-PP and L1-NB (L) showed significant variations, with hypodivergent groups showing less proclination of the incisors. Soft tissue analysis (Table 3) revealed differences in upper lip length, upper sulcus depth, and lower

lip to S-line, especially between the hypodivergent and hyperdivergent groups, with the hypodivergent group showing more favorable lip positions.

Tables 4A, 4B, 5A, 5B, 6A, and 6B examine correlations between skeletal, dental, and soft tissue features within each group. In the hypodivergent group (Tables 4A and 4B), positive correlations were seen between upper lip length and LAFH, while negative correlations appeared with L1-NB (A). The normodivergent group (Tables 5A and 5B) showed significant correlations between upper lip length and LAFH. In the hyperdivergent group (Tables 6A and 6B), positive correlations were found between L1-NB and lower lip height. These findings emphasize the impact of vertical skeletal patterns on facial soft tissue features.

Skeletal Parameters	Hypo V/S Normo	Hypo V/S Hyper	Normo V/S Hyper
LAFH	0.091 ^{NS}	<0.001*	0.133 ^{NS}
PFH	0.005*	<0.001*	<0.001*
MAX LENGTH	0.06*	0.006*	0.683 ^{NS}
MAND LENGTH	<0.001*	0.006*	0.644 ^{NS}

 Table 1: Intergroup comparison of skeletal hard tissue parameters

*P<0.05: Significant, **P<0.001: Highly Significant, NS: Not Significant

Dental Parameters	Hypo V/S Normo	Hypo V/S Hyper	Normo V/S Hyper
Ul - PP	<0.001*	<0.001*	0.854 ^{NS}
U1 - NA (L)	0.467 ^{NS}	0.243 ^{NS}	0.9 ^{NS}
U1 – NA (A)	0.467 ^{NS}	0.243 ^{NS}	0.9 ^{NS}
U6 - PP	0.945 ^{NS}	0.668 ^{NS}	0.854 ^{NS}
Ll - MP	0.241 ^{NS}	0.11 ^{NS}	0.91 ^{NS}
L1 – NB (L)	0.019*	0.001*	0.499 ^{NS}
L1 – NB (A)	0.019*	0.001*	0.499 ^{NS}
L6 - MP	0.002*	0.267 ^{NS}	0.112 ^{NS}

 Table 2: Intergroup comparison of dental hard tissue parameters

Soft Tissue	Hypo V/S Normo	Hypo V/S Hyper	Normo V/S Hyper
Upper lip length	0.006*	0.449 ^{NS}	<0.001**
Ult at base	0.039*	0.849 ^{NS}	0.135 ^{NS}
Ult at vemillion border	0.054*	0.159 ^{NS}	0.873 ^{NS}
Upper sulcus depth	0.097*	0.979 ^{NS}	0.062*
Upper lip-S line	0.188 ^{NS}	0.268 ^{NS}	0.977 ^{NS}
LLT at base	0.993 ^{NS}	0.03*	0.023*
LLT at vermilion border	0.33 ^{NS}	0.51 ^{NS}	0.034*
Lower lip height	0.782 ^{NS}	0.394 ^{NS}	0.124 ^{NS}
Lower sulcus depth	0.024*	0.108 ^{NS}	0.80 ^{NS}
Lower lip to S line	0.066*	<0.001**	0.192 ^{NS}
Gn-Gn'	0.353 ^{NS}	<0.001**	0.026*
Pog-Pog'	0.998 ^{NS}	0.608 ^{NS}	0.574 ^{NS}
Me-Me'	0.988 ^{NS}	0.109 ^{NS}	0.147 ^{NS}
Nasiolabial angle	0.969 ^{NS}	0.09*	0.148 ^{NS}
Chin throat angle	0.013 ^{NS}	0.422 ^{NS}	0.237 ^{NS}

Table 3: Intergroup comparison of soft tissue parameters*P<0.05: Significant, **P<0.001: Highly Significant, NS: Not Significant</td>

Parameters	Upper lip length	ULT at base	ULT at vermillion border	Upper sulcus depth	Upper lip- S line	LLT at base	LLT at vermillio n border	Lower lip height	Lower sulcus depth	Lower lip to S line	Gn- Gn'	Pog- pog'	Me- Me'	Nasolabial angle	Chin throat angle
LAFH	.443*	-0.168	0.1	0.044	0.194	0.026	-0.087	.741**	-0.145	.510**	-0.015	-0.088	0.133	-0.048	0.184
PFH	0.266	0.183	0.296	0.195	0.124	0.037	0.164	0.124	0.161	0.039	0.231	-0.195	0.194	0.068	0.33
MAX LENGTH	0.278	0.038	0.304	0.286	.485**	0.167	0.147	0.28	0.041	0.258	-0.079	-0.313	0.198	-0.253	-0.145
MAND LENGTH	0.125	0.211	.460*	.462*	0.053	-0.336	0.043	0.354	-0.121	.365*	0.269	0.087	0.036	385*	0.079
	Table 4A: Correlation between skeletal hard tissue and soft tissue parameters in Hypodivergent group														

0 to 0.2	0.2 to .4	0.4 to .6	0.6 to .8	0.8 to 1.	Positive correlation
Poor correlation	Fair correlation	Good correlation	Very good correlation	Excellent correlation	
0 to -0.2	-0.2 to4	-0.4 to6	-0.6 to8	-0.8 to -1.	Negative correlation

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Parameters	Upper lip length	ULT at base	ULT at vermillion border	Upper sulcus depth	Upper lip to S line	LLT at base	LLT at vermillion border	Lower lip height	Lower sulcus depth	Lower lip to S line	Gn- Gn'	Pog- Pog'	Me- Me'	Nasolabial angle	Chin throat angle
U1 - PP	.387*	-0.168	-0.064	0.116	0.299	0.198	-0.126	.480**	0.172	0.331	0.012	-0.1	0.251	-0.151	0.124
U1 - NA (L)	0.093	0.025	-0.317	0.287	-0.151	-0.061	0.187	-0.283	0.325	403*	-0.066	-0.127	-0.122	-0.055	-0.056
U1 - NA (A)	-0.037	0.009	-0.293	-0.012	0.053	0.052	0.195	388*	-0.190	407*	0.053	-0.055	-0.057	-0.004	0.266
U6 - PP	0.281	0.092	0.172	-0.064	0.273	0.217	0.029	0.308	-0.054	0.269	-0.072	-0.03	-0.124	-0.044	0.282
L1 - MP	.370*	0.006	0.001	0.2	-0.082	0.295	0.258	.445*	-0.096	0.038	.520**	0.208	0.288	-0.116	0.163
L1 - NB (L)	0.252	-0.303	-0.271	0.177	-0.033	-0.286	-0.264	0.351	0.073	.376*	0.022	-0.193	0.098	0.163	-0.04
L1 - NB (A)	0.046	460*	466**	399*	0.185	-0.233	-0.34	0.33	0.029	.421*	-0.134	-0.247	-0.02	0.055	492**
L6 - MP	.590**	0.203	0.278	0.347	0.147	0.015	-0.134	0.171	0.189	0.26	-0.082	0.048	0.024	0.102	0.259
	Table 4B :Correlation between dental hard tissue and soft tissue parameters in Hypodivergent group														

0 to 0.2	0.2 to .4	0.4 to .6	0.6 to .8	0.8 to 1.	Positive correlation
Poor correlation	Fair correlation	Good correlation	Very good correlation	Excellent correlation	
0 to -0.2	-0.2 to4	-0.4 to6	-0.6 to8	-0.8 to -1.	Negative correlation

Parameters	Upper lip length	ULT at base	ULT at vermillion border	Upper sulcus depth	Upper lip to S line	LLT at base	LLT at vermillion border	Lower lip height	Lower sulcus depth	Lower lip to S line	Gn- Gn'	Pog- Pog'	Me- Me'	Nasolabial angle	Chin throat angle
LAFH	.569**	0.254	0.003	0.042	0.009	0.344	0.15	.462*	-0.075	.401*	-0.051	0.168	0.153	0.115	0.116
PFH	.481**	0.273	0.129	-0.165	-0.031	.393*	0.073	0.018	0.132	0.129	-0.066	0.059	0.049	0.128	0.027
MAX LENGTH	.572**	.413*	0.305	.381*	0.222	.378*	.392*	0.326	-0.096	.468**	0.01	0.05	0.207	-0.158	0.119
MAND LENGTH	.510**	0.325	0.043	0.075	-0.095	0.289	0.089	0.149	0.096	-0.034	0.236	0.314	0.213	0.087	-0.042

Table 5A: Correlation between skeletal hard tissue and soft tissue parameters in Normodivergent group

0 to 0.2	0.2 to .4	0.4 to .6	0.6 to .8	0.8 to 1.	Positive correlation
Poor correlation	Fair correlation	Good correlation	Very good correlation	Excellent correlation	
0 to -0.2	-0.2 to4	-0.4 to6	-0.6 to8	-0.8 to -1.	Negative correlation

Parameters	Upper lip length	ULT at base	ULT at vermillion border	Upper sulcus depth	Upper lip- S line	LLT at base	LLT at vermillion border	Lower lip height	Lower sulcus depth	Lower lip to S line	Gn- Gn'	Pog - Pog'	Me- Me'	Nasolabial angle	Chin throat angle
U1 - PP	.630**	0.162	0.221	.382*	0.048	0.239	0.164	0.36	0.168	0.081	0.181	0.282	0.22	-0.224	0.264
U1 - NA (L)	0.168	0.305	-0.268	0.064	0.199	0.211	.389*	0.292	-0.167	.414*	0.116	0.168	0.128	0.094	408*
U1 - NA (A)	-0.043	0.294	-0.167	-0.322	-0.311	0.216	0.246	-0.103	0.003	0.052	0.039	0.11	0.075	0.054	-0.35
U6 - PP	.393*	0.167	0.158	0.27	-0.003	.410*	0	.444*	0.019	0.077	-0.065	-0.066	-0.01	-0.097	0.348
L1 - MP	.405*	0.22	-0.012	0.294	0.241	0.276	.401*	.801**	-0.241	.454*	0.208	0.064	0.145	-0.077	0.002
L1 - NB (L)	0.25	0.066	-0.187	.546**	.393*	0.268	0.237	.515**	441*	.610**	0.042	-0.008	0.06	-0.003	-0.03
L1 - NB (A)	0.043	0.204	0.167	0.322	0.311	0.216	0.246	0.103	0.003	0.02	0.039	0.11	0.075	0.045	-0.35
L6 - MP	.491**	0.075	-0.202	0.028	0.142	.391*	0.085	.482**	-0.039	0.299	0.176	0.198	0.256	0.222	0.026
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Table 5B: Correlation between dental hard tissue and soft tissue parameters in Normodivergent group

0 to 0.2	0.2 to .4	0.4 to .6	0.6 to .8	0.8 to 1.	Positive correlation
Poor correlation	Fair correlation	Good correlation	Very good correlation	Excellent correlation	
0 to -0.2	-0.2 to4	-0.4 to6	-0.6 to8	-0.8 to -1.	Negative correlation

Parameters	Upper lip length	ULT at base	ULT at vermillion border	Upper sulcus depth	Upper lip- Sline	LLT at base	LLT at vermillion border	Lower lip height	Lower sulcus depth	Lower lip to S line	Gn- Gn'	Pog - Pog'	Me- Me'	Nasolabial angle	Chin throat angle
LAFH	0.194	.387*	-0.053	0.12	0.066	-0.031	0.195	.392*	-0.022	.371*	0.249	0.276	.464**	0.246	0.352
PFH	0.225	0.255	-0.018	0.064	0.035	-0.061	0.204	0.317	-0.168	0.336	0.06	0.22	.403*	0.228	0.281
MAX LENGTH	0.143	0.16	0.209	-0.043	0.071	0.2	-0.067	0.253	0.155	0.223	0.198	.362*	.413*	0.309	0.346
MAND	-0.011	0.14	0.084	-0.183	-0.193	0.227	-0.115	0.255	-0.073	0.043	.487**	.415*	.502**	0.305	0.209

Table 6A: Correlation between skeletal hard tissue and soft tissue parameters in Hyperdivergent group

0 to 0.2	0.2 to .4	0.4 to .6	0.6 to .8	0.8 to 1.	Positive correlation
Poor correlation	Fair correlation	Good correlation	Very good correlation	Excellent correlation	
0 to -0.2	-0.2 to4	-0.4 to6	-0.6 to8	-0.8 to -1.	Negative correlation

Parameters	Upper lip length	ULT at base	ULT at vermillion border	Upper sulcus depth	Upper lip to S line	LLT at base	LLT at vermillion border	Lower lip height	Lower sulcus depth	Lower lip to S line	Gn- Gn'	Po- Pog'	Me- Me'	Nasolabia I angle	Chin throat angle
U1 - PP	0.274	-0.06	-0.359	0.134	-0.04	-0.181	0.057	0.306	375*	0.146	-0.254	0.104	0.036	0.171	-0.065
U1 – NA(L)	0.089	0.181	-0.109	0.122	-0.132	0.24	0.233	.408*	362*	0.036	0.209	0.252	0.223	-0.022	-0.193
U1 - NA (A)	-0.166	0.246	0.166	-0.256	390*	0.132	-0.025	0.005	-0.135	-0.245	0.204	-0.056	-0.112	-0.076	0.172
U6 - PP	0.288	.376*	0.276	0.299	0.202	0.213	0.285	0.341	0.008	.484**	0.288	0.226	.435*	0.035	.550**
L1 - MP	.684**	0.111	468**	.434*	0.233	0.013	.464**	.694**	-0.291	.416*	0.101	0.341	.393*	0.107	0.258
L1 - NB (L)	.725**	0.075	-0.302	.612**	.565**	0.018	0.244	.736**	-0.126	.662**	0.102	.373*	.555**	0.205	.394*
L1 - NB (A)	.520**	-0.04	-0.121	.384*	0.351	0.052	-0.01	.512**	-0.21	.384*	0.099	0.135	0.32	0.155	0.317
L6 - MP	.370*	0.179	0.182	.428*	.462**	0.15	0.076	.391*	0.175	.571**	-0.044	0.15	0.323	0.066	.512**
	0 to 0.2		0.2 t	0.2 to .4 0.4 to .6		0.6 to .8			0.8 to 1.		Positive correlation		tion		
	Poor correlation		n Fair corr	air correlation Good correlati		relation	Very good correlation		on Exce	Excellent correlation					
	0 to -0.2		-0.2 to	o4	-0.4 to6		-0.6	-0.6 to8 -0.8 to		-0.8 to -1. Negative correlati		tion			

IV. Discussion

Orthodontists once prioritized structural issues, but soft tissues now play a greater role in treatment potential³. This shift makes soft tissue evaluation vital for diagnosis, planning, and facial harmony. Soft tissue size differs across facial patterns, influencing individual features⁸. In this study, upper lip thickness and soft tissue at Point B positively correlated with facial height and lower incisor protrusion in the hyperdivergent group, consistent with Kasai et al⁹, but showed no significant correlation in hypodivergent and normodivergent groups. Hence, long-faced patients may have a thick upper lip and soft tissue at Point B.

In the present study, upper lip length showed a positive correlation with L1 to MP across all three groups. It was shortest in the hyperdivergent group, which differs from findings by Feres et al¹⁰ and Blanchette et al⁸, who reported longer upper lips in hyperdivergent individuals—likely due to their younger age groups (12–16 and 7–17 years) with ongoing growth. So, it can be concluded that irrespective of growth pattern if lower incisors are protrusive there might be increase in upper lip length.

Upper lip features were also studied by Yan et al¹¹, who found upper sulcus depth to be the only parameter linked to vertical growth. This matches the current study, where sulcus depth was least in the hyperdivergent group and associated with L1 to NB. Additionally, upper lip protrusion showed a positive correlation with ANB angle, indicating greater protrusion in Class II cases.

Luffingham et al¹² found lower lip height closely linked to incisor position. In this study, it showed a negative correlation with U1 to NA in the hypodivergent group and a positive correlation in the hyperdivergent group. Lower lip height was positively correlated with LAFH in hypodivergent, normodivergent, and hyperdivergent groups. The lower lip height was maximum in hyperdivergent group, which was in similarity with Feres et al¹⁰. In the present study, even lower lip thickness showed positive correlation with upper incisor proclination in normodivergent group.

Lower lip protrusion and lower incisor proclination showed strong correlation in this study which was in concordance with the study done by Nassif et al¹³. He also concluded that the subjects having more chin prominence had more upright lower incisors, this observation was non-significant in the present study.

In this study, soft tissue chin thickness was least in the hyperdivergent group, aligning with findings by Ashraf et al¹⁴ as well as Mevlut et al and Macari et al¹⁵ and Subramaniam et al¹⁶, who reported minimum thickness in hyperdivergent and maximum in hypodivergent groups. Contrarily, Nanda et al¹⁶ found maximum thickness at Pogonion in hyperdivergent individuals in a European population. The current study also showed a significant positive correlation between soft tissue chin thickness and Beta angle across all growth patterns. However, unlike Kasai et al⁹—who found thicker chins associated with larger ANB angles—this study linked chin thickness at Gnathion with a higher Beta angle. Chin-throat angle was highest in the hypodivergent group, consistent with Kamble et al¹⁷. In study conducted by Bhardwaj et al¹⁸ in 2018 nasolabial angle showed variance in vertical growth patterns, being increased in hyperdivergent pattern, again being concordant with the present study.

Soft tissue thickness measured by CBCT tool can be proven to be more accurate. A study done by Nora et al¹⁹ in 2023, with the help of CBCT showed variance in thickness in different growth patterns. The results of current study were concordant with above mentioned literature which showed increased thickness in hyperdivergent group in the present study while decreased in the same group in the former study. These significant findings should guide orthodontists in delivering an efficient treatment plan.

V. Conclusion

In conclusion, the hypodivergent group exhibited greater upper and lower lip thickness, lower lip height, and more pronounced upper lip thickness compared to other groups. Additionally, chin length and thickness were also more prominent in this group. The study highlighted a strong correlation between the vertical development of the upper and lower lips and the vertical growth of the skeletal structure. Moreover, lip thickness was significantly influenced by the position of the lower incisors, emphasizing the interplay between soft tissue and skeletal/dental variables in facial development.

This study highlights that soft tissue characteristics vary significantly with hyperdivergent growth patterns. In hypodivergent individuals, increased lip thickness and chin prominence offer favorable esthetic support, guiding more conservative treatment, while in hyperdivergent cases, careful planning is needed to manage reduced soft tissue thickness and vertical facial proportions effectively.

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