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# Perioral Soft Tissue Evaluation of Skeletal Class II Div I with Vertical Discrepancy: A Lateral Cephalometric Study.

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## Abstract

Emerging soft tissue paradigm is based on the fact that soft tissue plays a vital role in function, stability and esthetics after orthodontic treatment. Therefore orthodontic treatment plan should be done considering the soft tissue morphology too. This study was carried out to analyse the the soft tissue pattern in Skeletal Class I subjects with average growth pattern and compare it with Skeletal Class II Div I subjects with different growth patterns for which 120 subjects of 18- 25 yrs age were selected and their lateral cephalogram were studied. The subjects were divided into 4 groups of 30 subjects each based on their skeletal base and vertical growth patterns. The Soft tissue and Skeletal parameters were manually calculated and analysed statistically using SPSS version 23. Tests performed were descriptives, Pearson correlation coefficient, One way ANOVA with Post Hoc Scheffe for intergroup comparison. On comparing the soft tissue and skeletal parameters of various groups statistically significant difference was observed in skeletal parameters SN-MP, FMA, SNB, ANB and Facial height ratio between Skeletal Class I, Class II Div 1 (with Average, Horizontal and Vertical growth patterns). Statistically no significant difference was observed in soft tissue parameters between Skeletal Class I and Skeletal Class II Div 1 (with Horizontal, Average, and Vertical growth

pattern except in linear (Subnasale- H line, Rickett's E line to upper lip and H- angle) between Skeletal Class I and Skeletal Class II Div 1 with vertical growth pattern. The findings shows that soft tissue developes independently of hard tissue. However, positive correlation is observed between hard and soft tissue in Facial length and Facial depth. Therefore, soft tissue morphology should be considered independently of hard tissue for orthodontic diagnosis before treatment planning.

**Keywords:** Skeletal Class II Base, Growth pattern, Soft tissue parameters, Skeletal parameters, Lateral cephalometry.

**Introduction**

Perioral soft tissue drape has unique role in making or marring the beauty of the face. Angle's paradigm was focused comprehensively on the hard tissues considering that the soft tissues follow it. Subtelny1 stated that orrelation of soft tissue with hard tissue might not show a linear correlation as only few soft tissue parameters directly follow the horizontal and vertical skeletal pattern of the underlying skeletal structure. Burstone2 has stated "Analysis of both dental and skeletal patterns alone may prove inadequate or misleading, for marked variation exists in the soft tissue covering the dentoskeletal framework."

Kim et al in his study showed significant difference in the length of the soft tissues between Skeletal Class I and Skeletal Class II subjects. Young-Joo Lee et al also showed that soft tissue variation exists between different growth patterns of Class II Div 1 subjects and related the soft tissue values with the dental inclination. Various authors state that the soft tissue pattern varies according to growth patterns.

This study was carried out to analyse the soft tissue pattern in Skeletal Class I subjects with average growth pattern and compare it with Skeletal Class II Div I subjects with different growth patterns. This understanding of soft tissue features may help improvising the treatment approach so as to satisfy the demands for esthetically driven orthodontics.

**Materials and method**

The present was carried out in the Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College & Hospital, Ahmedabad. Pre-treatment lateral cephalograms of 120 subjects with age group of 18-25 years of which 30 subjects with Class I malocclusion having pleasant soft tissue profile were taken as controls.

Group I ( Skeletal Class I with Average Growth pattern) included 30 subjects with Pleasant soft tissue profile, Angle's Class I molar and Class I canine relation on Skeletal Class I base relationship, with normal overjet and overbite with no craniofacial anomaly, no history of trauma to face or past orthodontic treatment, no missing or supernumerary teeth present with clinically present all teeth except third molar.

Group II included 90 Subjects having Angle's Class II molar and canine relation on Skeletal Class II base with increased overjet and convex facial profile. Group II is further divided into three subgroups with 30 subjects each. They are denoted as Group II A, Group II B and Group II C as per various growth patterns having Horizontal, Average and Vertical growth pattern respectively based on their SN-MP values, Facial height ratio (%), and FMA values.

The lateral cephalograms were traced by a standard technique using 2H 0.5 lead pencil on acetate tracing paper.

Skeletal -Angular and Linear Measurements included SNA, SNB, ANB, Wit's appraisal (AO-BO), SN-MP, FMA, Facial length (S-Gn), Facial depth (N-Go), Facial height ratio, (S-Go/N-Me). Soft Tisssue Linear and Angular Measurements included Upper lip length, Basic

upper lip thickness, Upper lip thickness, Upper lip strain, Lower lip length, Lower lip thickness, Basic lower lip thickness, Chin thickness-H, Chin thickness-V, Subnasale to H-line, Lower lip to H line, Ricketts' E-line to upper lip, Ricketts' E-line to lower lip, Nasolabial angle and H-angle.

**Results & Discussion**

Various skeletal and soft tissue parameters thus obtained were analysed using SPSS version 23. Tests performed were descriptives, Pearson correlation coefficient, One way ANOVA with Post Hoc Scheffe for intergroup comparison.

One way Anova for intergroup comparison of skeletal parameters showed these groups differ from each other skeletally for SN-MP, FMA ,SNB, ANB, Facial height ratio (%) and Wit's (mm).

One-way Anova test for comparison of soft tissue parameters between Group I, Group II A, Group II B, and Group II C showed no statistical difference between these groups (Murilo Feres et al40). Moreover, Group II C showed decreased basic upper lip thickness, upper lip thickness, increased upper lip strain, increased nasolabial angle and H angle as compared to Group II A and II B. This finding is in accordance with the study by Tania Arshad et al29, Waqar Jeelani et al41, and Blanchett et al42 were they observed an increased nasolabial angle in vertical growth pattern. Farkli et al43 also showed increased nasolabial angle and H angle in their study.

The study by Mevlut celikoglu et al44 shows thin upper lip thickness and increased lip strain for vertical growth pattern subjects in accordance with the finding of the present study.

The finding for Basic upper lip thickness is in contrary with the study by Blanchett et al42 in which a significant difference was observed in Basic upper lip thickness and upper lip thickness between various growth pattern and increased Basic upper lip thickness and upper lip thickness in vertical growth pattern.

Statistical high significance ($p < 0.001$) was observed when Subnasale to H line (linear) was compared between Group I, Group II A, II B and II C, highest being in Growth II C indicating vertical growth pattern due to posterior positioning of Point Pogonion'.

Rickett's E line – upper lip (linear) shows statistically significant difference ($p= 0.024$) when skeletal Class I Group was compared with Skeletal Class II Group with various growth pattern with maximum being in vertical growth pattern. This could be attributed to posterior positioning of the mandible.

This is in accordance with the study by Cristena Boneco et al45 in which he observed increased Rickett's E line – upper lip (linear) in dolichofacial subjects and this is due to greater lip protrusion in dolichofacial subjects.

No statistically significant difference is observed in soft tissue parameters of lower lip. (Murilo Feres et al40).

Lower lip thickness ($p= 0.199$), Basic lower lip thickness ($p=0.305$), Chin thickness H ($p=0.307$), Chin thickness V ($p=0.257$), Lower lip to H Line ($p=0.051$), Rickett's E line- lower lip ($p=0.55$) with more increased value in Group II C for Basic lower lip thickness, Lower lip to H Line, Rickett's E line- lower lip followed by Group II B indicating more posterior positioning of pogonion due to vertical growth pattern. This finding is in accordance with the study by Cristena Boneco et al45 and Blanchette et al42 in which he observed increased thickness of the Basic lower lip and greater protrusion of lips in relation to H-line and Rickett's E- line to mask the lack of skeletal support in long vertical pattern subjects. This finding for lower lip strongly correlates with the study by Kazutaka Kasai46 in which they observed that the lower lip has a correlation with vertical skeletal pattern more than the upper lip.

Lower lip thickness, Chin thickness-H, and Lower lip length (mm) are the least as compared to Group II A and Group II B supporting the features for vertical growth pattern. This finding is in accordance with Mevlut Celikoglu et al44 , Khalid Ashraf et al47 and Anam Sattar et al48 in which Lower lip thickness and Chin thickness-H was least in dolichofacial individuals.

Comparison of soft tissue parameters between Group I to Group II A showed no significant difference in soft tissue parameters except Sn to H-line (P = 0.046) whereas no significant difference was observed when Group I is compared with Group II B.

When Group I was compared with Group II C highly statistically significant difference is observed in Sn to H-line (linear) (p< 0.001) and Rickette's E line to upper lip (p=0.027), H angle (P=0.040). This suggests more convex profile due to retrognathic position of mandible. This finding is in accordance with the study by Blanchette et al42 and Cristena Boneco et al45 in which they observed vertical growth pattern is associated with protrusive lips and consequent increase in value of Rickette's E line to upper lip in vertical growers. This finding is also in accordance with the study by Anam Rehan et al35 in which they found Rickette's E line to upper lip and H angle are greater in Skeletal Class II subjects. The finding for H angle is in accordance with the study by Farkli et al43 in which they observed increase in H-angle with the vertical growth pattern subjects.

No significant difference is observed in soft tissue parameters between Skeletal Class II Div I subjects with horizontal, average and vertical growth pattern. This is in accordance with the study by Murilo Feres et al40.

Since no significant difference was observed in soft tissue parameters between Group I, Group II A, Group II B and Group II C, Pearson correlation test was carried out to correlate soft tissue parameters to skeletal parameters.

On correlation of soft tissue parameters to Skeletal parameters in Group I, Basic upper lip thickness showed highly significant positive correlation to Facial length and Facial depth (p=0.003 and 0.001) respectively and significant correlation for upper lip thickness (p= 0.01 and p=0.015). This is in accordance with the study by Kazutaka Kasai46 in which he observed the upper lip shows variation with the position of the jaw and the study by Young Joo Lee et al7 in which they showed a positive correlation of Basic upper lip thickness to Facial length and Facial Depth. Basic upper lip thickness and upper lip thickness shows negative correlation with ANB. No significant correlation was observed in upper lip strain, lower lip thickness, basic lower lip thickness, chin thickness (H and V), Sn- H line and lower lip - H- line to skeletal parameters.

Rickett's E-line- upper lip correlates positively to ANB (p = 0.004) and SNA (p=0.035) whereas no significant correlation is observed between Rickett's E line -lower lip.

On comparison of soft tissue parameters to Skeletal parameters in Group II A Basic upper lip thickness showed highly significant correlation (p= 0.00 and 0.00) to Facial length and Facial depth respectively. Upper lip thickness had positive correlation with Facial length (p=0.008) but had no correlation with Facial depth. Upper lip strain, Lower lip thickness, Chin thickness (H and V), Sn – H line, Upper lip length showed significant positive correlation with Facial length and Facial depth (p=0.006, 0.001, 0.019, 0.000, 0.006, 0.001, 0.019, 0.000, 0.006, 0.031,and 0.000) respectively and (p= 0.013, 0.007, 0.004, 0.013, 0.033,and 0.000) respectively. Rickett's E line to Upper lip and Lower lip had positive correlation with ANB and SN – MP (p= 0.000 and 0.008) and (p= 0.010 and p= 0.003) respectively. This also showed negative correlation with Facial length and Facial depth which is

not significant. This showed that Rickett's E line correlates with Vertical as well as Sagittal parameters. H angle showed positive correlation to ANB suggesting its Sagittal correlation (p= 0.017).

On comparison of soft tissue parameters to Skeletal parameters in Group II B Soft tissue pattern of Group II B showed non-significant correlation to skeletal parameters. Sn- H line showed positive correlation with SN- MP (p= 0.02) suggesting that increase in SN- MP angle will increase linear distance between Sn – H line. Rickett's E line to upper lip showed positive correlation to FMA, ANB, and Wit's (p= 0.037, 0.025 and 0.039) respectively. Whereas, H angle showed positive correlation with SNA, ANB, Wit's, Facial length and Facial depth (p= 0.008, 0.000, 0.028, 0.009 and 0.009) respectively suggesting it varies with the position of the maxilla and is affected by both Facial length and Facial depth.

On comparison of soft tissue parameters to Skeletal parameters in Group II C, Soft tissue pattern of Group II C showed significant correlation of Basic upper lip thickness and Upper lip length to Facial length and Facial Depth (p= 0.027, 0.018, 0.001 and 0.001) respectively. This finding is in accordance with study by Young Joo Lee et al7 in which they showed a positive correlation of Basic upper lip thickness to Facial length and Facial Depth. Similarly, Basic lower lip thickness also correlates with Facial length and Facial Depth (p= 0.000, 0.000, 0.048) respectively.

In subjects with vertical growth pattern, Facial length and Facial depth correlates with both Upper and Lower lip thickness. This finding is in accordance with study by Young Joo Lee et al7 in which they showed a positive correlation between upper lip thickness with Facial depth and between lower lip thickness and Facial length and Facial depth.

Rickett's E line to Upper lip showed positive correlation with ANB and Wit's (p= 0.032, 0.019). This finding is in accordance with study by Merina Joshi et al38 who observed greater value of Rickett's E line to upper lip in Skeletal Class II subjects. whereas, E line to Lower lip showed positive correlation to Wit's (p= 0.011) and SN-MP and FMA (p= 0.007,0.013) respectively suggesting dependence of lower lip to vertical skeletal parameters. This finding is in accordance with the study by Kazutaka kasai46 in which they observed the lower lip has a correlation with vertical skeletal pattern more than the upper lip.

Statistically significant difference was observed between Skeletal Class I and Skeletal Class II Div I subjects with different growth patterns. However soft tissue parameters when compared between these groups doesn't show statistically significant difference except H angle, Rickette's E line and Subnasale-H line between Skeletal Class I and Skeletal Class II Div I subjects with vertical growth pattern.This may be due to variable soft tissue compensation to mask for skeletal discrepancy.

**Summary and Conclusion**

Stomatognathic system is highly capable of developing adaptive pattern therefore we need to understand interaction between hard and soft tissue in different facial patterns. Statistically significant difference is observed in skeletal parameters SN-MP, FMA, SNB, ANB and Facial height ratio between Skeletal Class I, Class II Div 1 (with Average, Horizontal and Vertical growth patterns).

Statistically no significant difference is observed in soft tissue parameters between Skeletal Class I and Skeletal Class II Div 1 (with Horizontal, Average, and Vertical growth pattern except in linear (Subnasale- H line, Rickett's E line to upper lip and H- angle) between Skeletal Class I and Skeletal Class II Div 1 with vertical growth pattern.

Our study confirms the findings that soft tissue developes independently of hard tissue. However, positive

correlation is observed between hard and soft tissue in Facial length and Facial depth. Therefore, soft tissue morphology should be considered independently of hard tissue for orthodontic diagnosis before treatment planning. In this study, gender dimorphism is not considered. So further study with gender dimorphism and large sample size may be needed.

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**Abbreviations**

Fma - Frankfort Mandibular Plane Angle, Impa - Incisor Mandibular Plane Angle, Chin Thickness-H - Chin Thickness Horizontal, Chin Thickness-V - Chin Thickness Vertical.