"CORRELATION BETWEEN MORPHOLOGY OF MANDIBULAR SYMPHYSIS AND SOFT TISSUE CHIN THICKNESS IN SUBJECTS WITH DIFFERENT FACIAL DIVERGENCE PATTERN"

DISSERTATION

Submitted to

BABU BANARASI DAS UNIVERSITY,

LUCKNOW, UTTAR PRADESH

In the partial fulfillment of the requirements for the degree

of

MASTER OF DENTAL SURGERY

In

ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS

By

Dr. BHANU PRATAP

Under the guidance of

Dr. RANA PRATAP MAURYA

Reader

Department of Orthodontics and Dentofacial Orthopaedics

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW

(Faculty of Babu Banarasi Das University)

YEAR OF SUBMISSION: 2023 **BATCH: 2020-2023**

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I hereby declare that this dissertation entitled " **CORRELATION BETWEEN MORPHOLOGY OF MANDIBULAR SYMPHYSIS AND SOFT TISSUE CHIN THICKNESS IN SUBJECTS WITH DIFFERENT FACIAL DIVERGENCE PATTERN"** is a bonafide and genuine research work carried out by me under the guidance of ***Dr. Rana Pratap Maurya***, Reader, Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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Dr. Bhanu Pratap

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-Dr. Bhanu Pratap

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S.NO	ABBREVIATED FORM	FULL FORM
1.	N	Nasion
2.	S	Sella
3.	Go	Gonion
4.	Id	Infra Dentale
5.	B	Point B
6.	Pg	Pogonion
7.	Gn	Gnathion
8.	Me	Menton
9.	Lg-POg	Lingual Pogonion**,**
10.	B’	Soft-tissue B point
11.	Pg’	Soft tissue Pogonion
12.	Gn’	Soft tissue Gnathion
13.	Me’	Soft tissue menton
14.	G point	Center of mandibular symphysis

Aim- To evaluate hard and soft tissue morphology of mandibular symphysis in subjects with different facial divergence pattern and to find correlation between mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern.

Material method- The sample for the study included 180 pre-treatment lateral cephalograms of Orthodontic patients with different facial divergence selected from a total of 220 lateral cephalograms was devided on the basis of Jaraback ratio and SN-GoGn angle. Sample was divided into three groups, Group I: Normodivergent (n=60), Group II: Hypodivergent (n=60) and Group III: Hyperdivergent (n=60). Tracing was done using nemoceph software and various parameters to evaluate hard and soft tissue symphyseal morphology were measured after location of points and landmarks. Data was taken and adequate inter and intra group comparision were made. Pearson correlation was used to correlate hard tissue symphyseal morphology with soft tissue chin thickness.

Result- For hard tissue symphyseal morphology, lower symphyseal height **(**Group II (21.22±1.86)> Group III (20.43±1.97)>Group I (19.24±2.17), symphysis convaxity (Group II (149.16±5.73) >Group III (128.53±7.91) >Group I (122.72±5.51), symphysis concavity (Group III (148.31±8.93) >Group I (145.83±6.57) >Group II (128.89±7.66), symphysis Inclination (Group II (64.75±6.29) >Group I (61.77±7.65)> Group III (59.41±6.42), symphysis convexity at point G (Group I (132.37±9.58) >Group III (125.47±5.37) >Group II (122.08±7.86) showed statistically significant difference in between the groups and soft tissue chin height (Group II (30.96±2.57) >Group III (30.05±3.30) >Group I (26.46±4.64), soft tissue symphysis inclination (B'-Pog'-Mp) (Group II (68.40±9.79) >Group III (63.26±5.08) >Group I (62.60±7.74) showed statistically significant difference between the groups. soft tissue chin thickness differed significantly at Gn' and Me' between groups, however it was not statistically significant at Pog'.

Conclusion- Hard and Soft tissue symphysis morphology varies with facial divergence. No definitive trend or strong correlation was found between hard tissue symphysis morphology with soft tissue chin thickness at Pog', Gn' and Me' for all the groups.

KEY WORD- Chin, Symphysis, Soft tissue, Hard tissue, Divergence,

Orthodontic treatment planning should consider both hard and soft tissues in order to achieve consistent results in terms of harmonious facial aesthetics and optimal occlusion[1]. The sole consideration of hard tissues alone, may help in achieving ideal cephalometric values but not ideal profile as soft tissue drape compounds the problem[2].

For facial proportions to be harmonious, the upper, middle and lower facial thirds need to be approximately equal in size. The impact of these areas is governed by the morphologic relationships of the nose, lips, chin and dentition. Any imbalance in these structures results in hampering of the facial esthetics, which is the main reason for patients seeking orthodontic treatment

Many investigations have emphasized on the importance of soft tissue in determining facial aesthetics, on the basis, that soft tissue behaves independently from the underlying skeleton[1]. The covering facial soft tissues (muscles, fat, skin) can develop in proportion or disproportion to the corresponding skeletal structures. Also, variations in thickness, length, and tonicity of the soft tissues may affect the position and the relationships among the facial structures. [3]

Variation in lip thickness influences the amount of reduction in lip protrusion with retraction of anterior teeth. Thinner lips tend to follow retraction of incisors more closely than thicker lips.

Various studies by **Roos et al[4],** had statistically significant demonstrated changes in upper and lower lip, following retraction of maxillary and mandibular anterior teeth. According to **Srivastava K et al[5],** retraction of upper incisor correlates well with upper lip retraction (r=0.68) and ratio was 2.68:1 and lower incisor with lower lip retraction (r=0.90 and the ratio was 1.2:1 which significantly improves the patient profile. **Looi and Mills,** noticed an average change of 5.98 degree for the nasolabial angle on statistically significant difference in retraction maxillary anterior teeth from pre to post, following extraction of all first premolar, but **Talas et al[6]**, discovered the angle was dramatically increased by an average of 10.50 degree. The decision to remove teeth for rectifying an underlying dental disparity is influenced by a prominent nose and an acute nasolabial angle**.** Studies by **Lo F D et al[7]** had evaluated relationship between changes in nasolabial angle with retraction of anterior teeth. The amount of movement of retraction of anterior teeth must be judicious, so as not to worsen, nasolabial angle if obtuse, as it can hamper facial esthetic. Thus, there is a shift in paradigm from "hard tissue" to "soft tissue" with more focus on esthetics and basing orthodontic diagnosis and treatment planning, predominantly on soft tissue considerations and not merely on skeletal/ dental relationships[8].

The amount of thickness of soft tissue at chin and menton region along with chin form influences facial esthetics of lower 1/3rd of face after correction of protrusion of maxillary and mandibular teeth. Mandibular symphysis (MS) morphology serves as a reference anatomical landmark for esthetics and beauty of the face in general and of the lower part in particular. Hard tissue chin form along with overlying soft tissues play a great role in final treatment outcome of Orthodontic patient. The size and shape of symphysis results from an inter play of various factors that can be genetic, non-genetic or the adaptive factors (as area just above prominence of chin is resorptive in nature and rest is depository in nature)[9]. It had been believed by some authors that the Symphyseal morphology could be good indicator of mandibular rotation[10]. Bjork et al[11] investigated the anatomy of the symphysis as a predictor of mandibular growth. There is reduced chin prominence in vertical grower because of clockwise rotation of mandible and normal chin prominence in horizontal grower owing to anticlockwise rotation of mandible[12]. The shape of symphysis during growth may also be affected by mandibular incisors inclination and dentoalveolar compensation occurring during growing period as a response of underlying sagittal discrepancy of jaws.

The relationship of hard tissue symphysis to mandibular incisors protrusion is very important as it is esthetically acceptable to leave an incisors proclined in subjects with good chin form. Steiners et al had stated 1:1 ratio for mandibular incisor to NB line and Pog to NB line.

Considering this importance of symphysial morphology as evaluated by symphysial depth, height, symphysial inclination had been evaluated in previous studies with respect to gender, facial divergence, mandibular incisor inclination etc.

Khan et al[12] investigated that anterio-posterior width of the symphysis was higher in hypodivergent growth pattern, whereas vertical height of the symphysis was greater in hyperdivergent group. Aki et al[8] found that shorter and wider symphysis in male was related with anterior growth of the jaw, while a narrower and longer symphysis was associated with posterior growth and difference was statistically significant. Females had a comparable tendency, but it was not statistically significant. Sassouni et al[13] linked skeletal deep bite to short (vertically) and broad (antero-posteriorly) symphysis, along with a prominent chin button, and skeletal open bite was linked to narrow (antero-posteriorly) and longer (vertically) symphysis, with lack of good button form chin. Patil et al[14] conducted a study where males showed greater soft tissue chin thickness in hypodivergent, average and hyperdivergent group than females.

Some studies have found changes in soft tissue chin thickness after orthodontic treatment. as soft tissue adapts to underlying symphysis and soft tissue chin thickness is not uniform, hence visible chin prominence is variable in different subjects. Also, soft tissue chin thickness is variable in subjects with different growth pattern, hence it can be assumed that there could be a correlation between symphyseal morphology and soft tissue chin thickness in subjects with different growth pattern. So far, research have investigated about symphysis morphology and soft tissue chin thickness in different facial divergence, but no previous studies have discovered a correlation between them. As a result, it was decided to explore this correlation in this current study.

Soft tissue profile is primarily studied through lateral cephalometric radiographs, that are routinely taken as pretreatment record for all subjects undergoing fixed orthodontic treatment, hence mandibular symphysial morphology along with overlying soft tissues was evaluated on lateral cephalogram in the present study.

Considering this, the aim of this study was to evaluate hard and soft tissue symphysis morphology in subjects with different facial divergence pattern and find the correlation between morphology of mandibular symphysis and soft tissue thickness in subjects with different facial divergence pattern.

AIM

- To find the correlation between morphology of mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern.

OBJECTIVES:

1. To evaluate hard tissue symphyseal morphology in subjects with different facial pattern (Normodivergent, Hypodivergent, hyperdivergent).

2. To evaluate soft tissue symphyseal morphology in subjects with different facial pattern (Normodivergent, Hypodivergent, hyperdivergent).

3. To compare hard tissue symphyseal morphology between subjects with different facial pattern (Normodivergent, Hypodivergent, hyperdivergent).

4. To compare soft tissue symphyseal morphology between subjects with different facial pattern (Normodivergent, Hypodivergent, hyperdivergent).

5. To correlate hard tissue symphyseal morphology and soft tissue chin thickness in subjects with different facial pattern (Normodivergent, Hypodivergent, hyperdivergent).

Todd A, Nanda R S et al (1994)[10] assessed the growth changes of the symphysis and determine whether symphysis morphology could be used as a predictor of the direction of mandibular growth. They Included lateral cephalometric radiograph of 115 adults with the longitudinal sample a subset of 62 subjects at 4 age groups. mandibular symphysial morphology was found to be associated with the direction of mandibular growth specially in male subjects with symphysis ratio having the strongest relationship. A mandible with an anterior growth direction was associated with a small height, large depth, small ratio and large angle of the symphysis. A posterior growth direction was associated with a large height, small depth, large ratio and small angle of the symphysis.

Nojima K et al (1998)[15] conducted a study to clarify symphysis morphological characteristics in skeletal class III malocclusion requiring orthognathic surgery and their relationships with symphysis morphology and inclination of the long axis of the lower incisor. lateral cephalometric (50 subjects) radiograph as requiring orthognathic surgery and 30 adults with normal occlusion and well-balanced faces was taken. In the surgical group, the long axis of the lower incisor demonstrated a significant lingual inclination in relation to the mandibular plane and symphysis. The symphysis labial external surface in the alveolar and basal bone regions demonstrated lingual inclination in relation to the mandibular plane, however, there was no difference in curvature. Small mean values were obtained for Pt. B width, Pog width, and Symphysial height. Significant differences were observed only in Pt. B width. In both the surgical and normal occlusion groups, a significant correlation was observed between the inclination of the long axis of the lower incisors and symphysis inclination. however, there was no significant correlation.

Arruda E M et al (2012) [16] established cephalometric reference values for mandibular symphysis in adults. Sixty cephalometric Radiograph were taken and standardize according to gender (30 males and 30 females) and facial type (20 were dolichofacial, 20 mesofacial and 20 brachyfacial). Result found that male and female symphyses were similar, except for symphyseal height, which was greater in males. In terms of facial type, the dolichofacial group presented narrower symphysis in dentoalveolar and basal areas, with a more accentuated lingual dentoalveolar inclination. The brachyfacial group showed broader symphysis in the dentoalveolar and basal areas and a greater buccal dentoalveolar inclination.

Macari A T, Hanna A T et al (2013)[3] evaluated the association between soft tissue at the chin thickness and mandibular divergence. Nong rowing patients seeking orthodontic treatment (113 women and 77 men), who were stratified in four subgroups based on cephalometric mandibular plan. The soft tissue chin thicknesses were measured at pogonion, gnathion, and menton. They found that the soft tissue chin thickness was greater in men than women (P, .02) and were smaller in the higher group than in all other groups. The soft tissue chin thickness is thinner at Gn and Me in hyperdivergent facial patterns, apparently in contrast to Pog'. This differential thickness warrants focused research as it implies that it is possible to vertically grow hard tissues impinging on the inferior soft tissue envelope in patients with severe hyperdivergent pattern.

Al-Khateeba S N, Al-Maitahb E F et al (2014)[17] conducted a study to evaluate the morphology and dimensions of mandibular symphysis (MS) in different anteroposterior jaw relationships and to investigate whether craniofacial parameters have any correlation with its shape and/or dimensions. Lateral cephalograms of subjects with Class I, Class II, and Class III skeletal relationships were traced. Larger angle of concavity of the chin, more inclination of the alveolar bone toward the mandibular plane, and larger MS dimensions and area (P, .001) were found when Class III skeletal relationship was compared to Class I and Class II relationships. MS dimensions were strongly correlated to anterior facial dimensions.

Khan M Y A, Kishore M S V et al (2016)[12] evaluated the alveolar and skeleton chin dimensions among different divergence patient in 45 non-growing individuals and classified into different divergent patterns based on the mandibular plane angle. Results show that hard tissue chin measurement was greater in hypodivergent group (13.7mm) and the increased lower facial height showed statistically significant difference in high mandibular plane angle group (59.6mm). they concluded that in antero-posterior cephalograms the transverse width showed statistically significant difference in normodivergent group (32.60mm).

Celikoglua M, Buyukb S K, Ekizerc A, Sekercid A E, Sismane Y et al (2014) [18] evaluateD and compareD the soft tissue thickness at the lower anterior face among adult patients with different vertical growth patterns using cone-beam computed tomography. 105 adult patients with a normal sagittal skeletal pattern divided into three groups according to the vertical growth pattern: high-angle, low-angle, and normal-angle groups. The soft tissue thickness measurements at the lower anterior face in each group were done and analyzed using the one-way analysis of variance and Tukey tests. Result showed that soft tissue thickness was the lowest in the high-angle group for both women and men. For women, the thickness at the labrale superius, labrale inferius, and pogonion were found to be statistically significantly smaller in the high-angle group compared to normal-angle group. For men, however, no statistically significant differences were found among the vertical growth patterns.

Sadeghian R et al (2016)[19] Investigated the relationship between anteroposterior profile cephalometric indicators and indicators related to the chin in lateral cephalometric radiography. 201Lateral cephalometry. 67 samples in each group containing 67 class I Patient, 67 adult patients with class II and 67 adult class III patients. Indices that analyzed was: B-B1-GN, Si to Li-PGS B-B1-GN, Id-B to Mp ,Id-B to Mp , Si to Li-PGS ,PG-ME-GO ,Basal Symphisis Width, Alveolar Symphysis Width , Symphysial Axis , Basal Ratio ,Alveolar Ratio , Basal Symphysis Angle and Alveolar Symphysis Angle . results showed that there is a correlation between anteroposterior and factor B-B1-GN and SitoLi-PGs. Based on the results of analysis of variance, and Tukey test of classification I and II factor POGME- GO, the classification I and III factor of B-B1-GN and Si to Li-PGS and the classification II and III B -B1-GN, Id-B to Mp, Id-B to Mp, Si to Li-PGS, PG-ME-GO, Alveolar Symphysis Width, Alveolar Ratio, Basal Symphysis Angle and Alveolar Symphysis Angle, there was a significant difference. There was a significant difference in chin form in various skeletal classes.

Sofyanti E et al (2016)[20] conducted a study to evaluate the difference of soft tissue chin thickness in various mandibular divergence patterns. 71 Pretreatment lateral cephalograms of adult patients (≥21 years) were taken and divided into three groups (hypo divergent, average, hyper divergent). Soft tissue chin (STC) thickness was measured from skeletal Pogonion (Pog) to soft tissue pogonion (Pog’). Result showed significant differences of soft tissue chin thickness in various mandibular pattern. Mandibular pattern might camouflage lower third of the face from soft tissue profile, especially pogonion as the most anterior point on the contour of the chin. The average of normal soft tissue chin thickness which 11.68±2.0mm (according to Holdaway) can be served as guidelines to predict the appearance of the chin, so that the multidisciplinary treatment approach, like genioplasty can be informed from the beginning in camouflage orthodontics treatment.

Somaiah S, Khan M U et al (2017)[21] conducted a study to enumerate and compare soft tissue chin thickness in adult patients with various mandibular divergence pattern and to find the difference in soft tissue chin thickness. Eighty patients were stratified into four groups based on the divergence pattern. the soft tissue chin thickness was measured at three different levels: Pogonion (Pog)‑Pog’, gnathion (Gn)‑Gn’, menton (Me)‑Me’. The soft chin thickness at Pog-Pog' and Me-Me' was the highest in medium low followed by medium high, low and was least in high. At Me-Me', the soft tissue chin thickness was the highest in medium low followed by low, medium high and was least in high. Soft tissue chin thickness was found greater in men than in women in all the groups except high mandibular divergence pattern

Go´mez Y, Garcı´a-Sanz V, et al (2017)[22] Analyzed the relationships between the symphysis soft tissue dimensions and the underlying osseous structures and facial type. Cone-beam computed tomography (CBCT) images of 385 patients (206 women and 179 men). Subjects were taken and classified according to their skeletal class and vertical pattern. Twelve measurements were taken for each mandibular symphysis using software. Symphyseal measurements were found larger in males than in females. Skeletal Class II and III hyperdivergent patients showed the highest symphysis height values. Hypodivergent individuals showed lower symphysis convexity angles. Concavity of the symphysis was greater for Class II hyperdivergent patients. Moderate and weak correlations were found between hard tissue and soft tissue parameters. Only a few characteristics of symphysis morphology depend on sex, incisor position, skeletal class, and vertical pattern. The shape of the symphysis soft tissue is not directly correlated with the underlying skeletal structures.

Syeda S T et al (2017)[23] measured symphysis morphological traits of patients with deficient mandibles versus normal mandible patients. Thirty-four normal angle patients divided into two groups, first group of patients with short mandible and the second group of patients with normal mandible. On cephalogram, angle B-Pog-Me, angle B-B1-Gn and perpendicular distance from Pog to B-Me line were measured for all patients. Result showed the angle B-B1-Gn (symphysis vertical dimension) and anterior prominence of MS (perpendicular distance between Pogonion and B-Me line) showed no significant differences between the two groups (P>0.05). The angle B-Pog-Me (symphysis convexity) was found to be greater in short mandible group of patients. This parameter showed statistically significant difference between the two groups (P<0.05). They concluded that the Patients with short mandible had different symphyseal morphology than patients with normal mandible. Anterior prominence of symphysis and its vertical dimensions was increased in long mandible patients. But symphyseal convexity was increased in short mandible patients.

Manea I, Pineda A I, Mendoza B S, Reina A S, Reina J E S, et al (2017)[24] determined whether there was a statistically significant relationship among the position of the lower incisor, Holdaway ratio, symphyseal morphology, and facial pattern. 100 patients were randomly selected. Measurements were made manually on pretreatment cephalograms by two operators using Aki analysis to assess the height/width ratio (H/A), mandibular plane with point B-Menton, and the retro-occlusion of the Jarabak/MSE analysis to determine the facial biotype. A descriptive analysis of the data was made evaluated the possible correlations between the Holdaway ratio and H/A, and the Holdaway ratio and mandibular angle. They concluded that there were biological limits to movements of the lower incisor in narrow symphysis, which are usually found in vertical growth patterns. This study reveals that anterior mandibular bone support and the position of the lower incisors was different between patients with a normal or a horizontal growth pattern There are limits to lower incisor movements in patients with a vertical growth pattern and a narrow symphysis.

Cezairli N (2017)[25] evaluated soft tissue profile among different vertical patterns using the Holdaway analysis and the soft tissue thickness measurements. The study sample, comprised of 90 patients (54 women and 36 men) divided into low-angle, normal-angle and high angle groups based on vertical growth pattern using the SN/GoGn angle (high-angle group >37°; low-angle group <27°; and control group or normal angle group 27-37°). It was observed that there was a significant difference among vertical patterns for the ‘gnathion’, ‘menton’, ‘stomion’ and ‘inferior sulcus to H line’ when both genders were combined. These measurements were thinner in the high-angle group. Significant differences among vertical patterns were observed for ‘gnathion’ and ‘lower lip to H line’ in women; for ‘stomion’ and ‘nose prominence’ in men when examined separately. Facial soft tissue measurements except some for in high angle group were thinner than in low angle group. All soft tissue measurements were greater except for gnathion in low angle group in men than in women.

Gupta S, Singh P, Dhingra, Chatha S, et al (2018)[26] compared ante-gonial notch depth and symphysis morphology in different growth patterns in Angle’s Class II Division 1 malocclusan. 90 cephalograms were traced and Antegonial notch depth, symphysis height, depth, ratio (height/depth) and symphysis angle, and ramus height and width were evaluated and analyzed statistically. They concluded that antegonial notch depth, symphysis morphology, and ramus morphology are significantly correlated with different growth patterns but was highly significant in horizontal growth pattern.

Ashraf K, Kulshrestha R, et al (2018)[27] compared soft tissue chin, upper lip thickness and length in patients with different mandibular divergent patterns in 180 patients. Based on the mandibular plane angle. Soft tissue chin thickness (Pog-Pog'), (Gn-Gn') and (Me-Me') showed statistically significant difference only between hyperdivergent & hypodivergent groups respectively. Soft tissue chin thickness was greatest in the hypodivergent group as compared to the other groups. Greater values for lip thickness were observed for hypodivergent patients.

Foosiri P, Mahatumarat K, Panmekiate S, et al (2018)[28] Determined the relationship between symphysis dimensions and alveolar bone thickness (ABT) of the mandibular anterior teeth. Cone-beam computed tomography images of 51 patients were collected and measured. The symphysis ratio was the ratio of symphysis height to symphysis width. Apical ABT was positively correlated with symphysis width (p <0.05). Moreover, these thicknesses negatively correlated with the symphysis ratio (p <0.05). In mandibular anterior teeth, the apical alveolar bone and lingual alveolar bone tended to be thicker in patients with a wide and short symphysis, compared to those with a narrow and long symphysis. Buccal alveolar bone was, in general, very thin and did not show a significant relationship with most symphysis dimensions.

Kar B, Aggarwal I, Mittal S, et al (2019)[9] Evaluated the ante-gonial notch depth, mandibular symphysis morphology, and symphysis inclination in various facial types categorized into the normo-, hypo-, and hyperdivergent groups using various parameters on pretreatment lateral cephalograms of 45 adult patients. They found that the mandible with the hyperdivergent growth pattern was associated with an increased ante-gonial notch depth, increased symphysis height, reduced symphysis depth, large ratio, small symphysis angle, and large inclination angle of the symphysis.

Shinde N, et al (2019)[29] compared Soft Tissue Chin Thickness in Skeletal Class I and Class II Adults with Three Mandibular Divergence**.** 120 lateral cephalogram were taken, who were stratified on the basis of ANB in to skeletal class I and skeletal class II above the age of 18 years and were divided in to three subgroups based on the cephalometric mandibular plane inclination (MP) to anterior cranial base (SN) as Hypodivergent-($<28^0$). Normodivergent-(28^0-36^0) and Hyperdivergent -($>36^0$). Result showed all soft tissue chin thickness had the highest measurement in class II hypodivergent group as compared to class I and gradually decrease across the groups, lowest being in hyperdivergent group in both males and females and concluded, the result provide evidence of strong but complex relationship between soft tissue chin thickness and skeletal class.

Tiwari A, Jain R K, Varghese R M, et al (2020)[1] Evaluated and compared soft tissue thickness in skeletal class I and class III pattern. on 20 lateral cephalogram. Soft tissue chin thickness was found significantly increased in females as compared to males and it was increased in class III malocclusion when compared to class I malocclusion.

Linjawi A I, Afify A R et al (2020)[8] Compared the dimensions of mandibular symphysis (MS) between gender and the different sagittal and vertical skeletal relationships. A 104 Pre-treatment records of orthodontic patients were divided according to gender, sagittal (Class I, II and III) and vertical (decreased, average and increased mandibular plane [MP] angle) skeletal relationships. Measurements of MS parameters were performed on lateral cephalograms using IMAGEJ software. they found that Males had significantly greater MS surface area, dentoalveolar length, skeletal symphysis length, total symphysis length, vertical symphysis dimension and symphysis convexity ($p < 0.05$). The morphology of the mandibular symphysis was affected by gender, sagittal and vertical skeletal patterns. Among sagittal malocclusion Class II patients had greater dentoalveolar length whereas when vertical malocclusion was considered chin length was greater in patients with an average MP angle.

Sodawala J, A Akolkar et al (2020)[30] evaluated the association between mandibular growth pattern and soft tissue chin (STC) thickness measured at different chin levels and the gender differences in STC thickness at these different chin levels. Pretreatment lateral cephalograms of 161 subjects aged 18–45 years were selected, and subjects were divided into 4 groups depending on mandibular growth pattern defined by the mandibular plane to cranial base angle. The soft tissue chin thicknesses were measured at pogonion (Pog), gnathion (Gn), and menton (Me). Result shows the STC thickness was greater ($p < .05$) in the low-angle group, and it gradually decreased across the groups, the least being in the high-angle group. No sexual dimorphism was observed among the groups ($p > .05$). there were soft tissue chin thickness measurements were smaller in high-angle group compared to low-angle group.c7

Sandhya J, Prateek P, et al (2020)[31] assessed the symphyseal morphology and lower incisor angulation in different anteroposterior relationship and in different growth patterns and to investigate whether the symphyseal morphology had any correlation with dentofacial parameters. lateral cephalograms of 90 subjects, the dimensions and configuration of Mandibular Symphysis in class III was found to be different than those in Class I and Class II relationships; the alveolar part of Mandibular Symphyseal compensated for the skeletal relationship in the Class III pattern. Mandibular Symphysis dimensions were strongly correlated to anterior facial dimensions. Similarly, the dimensions and configuration of Mandibular Symphysis was also different in vertical growers as compared to horizontal and average growers, moreover symphyseal morphology and lower incisor angulation had a correlation with dentofacial parameters.

Tunis T S et al (2020)[32] determined how chin and symphysis size and shape vary with sex, and to discuss "sexual selection" theory as a reason for its formation. Head and neck computed tomography (CT) scans of 419 adults were utilized to measure chin and symphysis sizes and shapes. The chin and symphysis measures were compared between the sexes using an independent-samples t-test, a Mann–Whitney test, and the F-statistic. The chin width was significantly greater in males than in female, whereas the chin height, area, and size index were significantly greater in females. Symphysis measures did not significantly between the sexes. Size accounted for 2–14% of the chin variance and between 24–33% of the symphysis variance. Overall, the chin was found to be a more heterogeneous anatomical structure than the symphysis, as well as more sexually dimorphic

Jamal N et al (2021)[33] conducted a study to find Correlation between symphyseal morphology and mandibular length in class 1 malocclusion between males and female, 80 lateral cephalograms (40 – males and 40 – females) were used in the study and mandibular lengths (Schwarz analysis) were measured for males and females separately. Pearson correlation coefficient showed no statistically significant correlation between symphyseal morphology and mandibular length both in males and females. there was no correlation between mandibular length and symphysis morphology. Although sexual dimorphism exists.

Khare V et al (2021)[34] evaluated area and morphology changes of soft tissue chin after orthodontic incisors retraction. 100 cephalogram of male subjects were taken. The soft tissue changes, including the area, thickness and morphology were evaluated and showed a significant increase in the soft tissue thickness, and a significant decrease in the soft tissue thickness of B-B′ were seen. The multiple correlations between the soft tissue thickness changes and incisor retractions were Y = 1.02–0.42a + 0.42b for L1c-LL, and Y = 0.17–0.31b for B-B′. they concluded that the orthodontic incisor retraction could cause soft tissue thickness changes (an increase in L1c-LL and Pog-Pog' and a decrease in B-B′) without area alterations.

Marghalani H Y A et al (2021)[35] Evaluated the association between mandibular symphysis dimensions and anteroposterior and vertical skeletal patterns in adults. 90

lateral cephalograms were included of untreated subjects and Analyzed by anteroposterior vs keletal classification (ANBo), there was no significant differences in symphyseal dimensions were found. Multiple linear regression analyses showed that Gonion-Nerve (mm) and Gonial angle were significantly associated with symphyseal height. Gonion-Nerve (mm), basal bone width (mm), and alveolar bone height (mm) were associated with symphyseal thickness. Basal bone width (mm) and alveolar bone height (mm) were associated with symphyseal ratio. There was Symphyseal dimensions was greater in males than in females and significantly associated with vertical but not anteroposterior skeletal patterns.

Patil H S et al (2021)[14] evaluated and compared soft tissue chin thickness in class II subjects with various growth patterns. 150 radiographs adults aged between 18 and 26 years. Males showed greater soft tissue chin thickness at hypodivergent, average and hyperdivergent group than females and soft tissue thickness measurements were smaller in adult patients with vertical hyperdivergent pattern compared with adult patients with clinically normal and hypodivergent patterns. Hyperdivergent group shows greater soft tissue chin thickness at Pog-Pog’ as compared to hypodivergent and average angle groups. Hypodivergent group shows greater soft tissue chin thickness at Me-Me’ and Gn-Gn’ as compared to average and hyperdivergent groups.

Lu Y, Yu S et al (2021)[36] investigated the correlation between soft tissue chin morphology and dento-maxillofacial structure in skeletal class Ⅰ malocclusion without high angle. Forty patients with normal skeletal chin morphology were selected and they were divided into normal chin morphology group and abnormal chin morphology group according to soft tissue chin morphology. There was no significant difference in the parameters reflecting the sagittal pattern and mandibular morphology. the inclination of palatal plane was significantly related to soft tissue chin morphology. When the palatal plane shows a counterclockwise direction, the chin morphology worsens with increased dispersion of the maxilla and mandible.

Gousman J, Park J H, et al (2021)[37] evaluated the bone density (BD) at the mandibular symphysis according to horizontal and vertical patterns using cone-beam computed tomography (CBCT). CBCT images were converted into the lateral cephalometric images. They concluded that for vertical skeletal patterns, a higher cortical bone density was more likely to be associated with a hyperdivergent than a hypodivergent pattern and for horizontal skeletal patterns, a higher cortical BD is more likely to show Class II than Class III pattern. the menton was the most meaningful and statistically significant location to measure bone density. the mandibular symphysis cancellous bone density was higher in Class III and hypodivergent skeletal patterns than with other skeletal patterns, but without statistical significance. the mandibular symphysis cortical and cancellous bone density was higher in females than in males.

Vighanesh K et al (2021)[38] studied to the vertical and horizontal growth influences the height of mandibular ramus and length of the mandibular body. The soft tissue chin thickness, the lower airway space and the chin throat length can vary in different growth patterns and different skeletal patterns. Lateral cephalograms (n=120) of non-growing patient were included and the samples were divided into two subgroups based on skeletal pattern (Cl I & Cl II) according to ANB angle and Wit's appraisal. Further sub divided into four groups based on cephalometric mandibular plane inclination to anterior cranial base (SN-GoGn) and Frankfort's mandibular plane (FMA) angle in hypodivergent and hyperdivergent patterns. Result showed maximum lower airway space, mandibular body, mandibular ramus, chin thickness, and chin throat length in the hypodivergent skeletal Class I group. The minimum lower airway space, mandibular body, mandibular ramus, chin thickness, and chin throat length observed in the hyperdivergent skeletal Class II group. The inter-group comparison of all samples indicates that there was a statistically significant difference between various groups and the measures of the hypodivergent samples are more than the hyperdivergent samples irrespective of the skeletal pattern. they concluded that the soft tissue chin thickness; chin throat length was less in hyperdivergent skeletal Class I and skeletal Class II samples than the skeletal Class I and skeletal Class II hypodivergent.

Mobarak A K et al (2021)[39] assessed long-term changes in the soft tissue profile following mandibular setback surgery and investigate the presence of factors that may influence the soft tissue response to skeletal repositioning. 80 subjects for consecutives mandibular prognathism patients operated with bilateral sagittal split osteotomy and rigid fixation. Lateral cephalograms were taken at 6 occasions: immediate presurgical, immediate postsurgical, 2 and 6 months postsurgical, and 1 and 3 years postsurgical. The subjects were grouped according to gender and magnitude of setback. Ratios of soft tissue to hard tissue movements were calculated for the subgroups. Females generally demonstrated greater ratios than males with a statistically significant difference for the upper lip and chin. Postsurgical alterations in the profiles were more predictable in patients with larger setbacks compared to patients with smaller ones. Skeletal relapse had a profound influence on long-term profile changes. Based on these findings, it is proposed that the database used in prediction software be adjusted to account for such factors in an attempt to improve the accuracy of computerized treatment simulations. Changes in the soft tissue profile following small setbacks were less predictable compared to large setbacks. Females demonstrated greater soft tissue movement in response to skeletal repositioning compared to males (statistically significant for the upper lip and chin). Correlations of preoperative soft tissue thickness and the net change in soft tissue thickness as a result of mandibular setback surgery were too weak to provide clinically useful predictions.

A A Kumar et al (2022)[40] conducted a study to find association between the mandibular divergent patterns and soft tissue chin (STC) thickness measured at different chin levels in nongrowing patients. Pretreatment lateral cephalograms of 400 adult patients were taken and defined by the mandibular plane to cranial base angle (average 32° ± 5°), Group I with low angle (below 27°), Group II with medium low angle (28°–32°), Group III with medium high angle (33°–36°), and Group IV with high angle (above 37°). and difference in the STC thickness at Pog, Gn, and Me was observed among all four groups with hyperdivergent patterns, showing decreased STC thickness than the hypodivergent mandibular pattern.

Azumi E et al (2022)[41] conducted a study to find correlation between the maxillofacial morphology of skeletal Class I malocclusion in Japanese adults and the mandibular symphysis. Considering the morphology of the symphysis, based on the relationship between the labiolingual width and facial height, they found that in terms of facial height, which is a vertical factor of the width diameter of the symphysis, the width at the root apex of the mandibular anterior teeth is significantly smaller when the facial height is large. Moreover, in terms of the ANB angles, which are anteroposterior factors, there was almost no significant difference in the width diameter of the symphysis.c6

Okumura, Y et al (2022)[42] examined the relationship between chin size, skeletal pattern, age, gender, and ethnicity. cone-beam computed tomography images of 208 participants, aged 18 years and older, were used to evaluate the size of the chin in linear dimension, volume, and skeletal pattern. The larger the vertical skeletal pattern, the larger the chin volume and the smaller the width ($p < 0.01$). In the anteroposterior skeletal pattern, Class III showed a larger volume than that of Class II and Class I ($p < 0.01$). Regarding gender, all measurements of chins were larger for men than for women ($p < 0.01$). In terms of ethnicity, Koreans had larger chin volumes than Egyptians $p < 0.01$). Chin volume was related to population, sex, anteroposterior skeletal pattern, and vertical skeletal pattern, indicating the combined effects of various factors.

Nobre R et al (2022)[43] conducted a study to find relation between mandibular symphysis and the Angle class in orthodontic treatment. 495 lateral cephalograms of orthodontic subjects were collected and sample was selected randomly and the height, thickness and inclination of the mandibular symphysis were measured. result showed the mandibular symphysis height did not show significant differences between the three dental classes. The mandibular symphysis thickness was significantly increased in Class II Division 2 and Class I subjects ($p = 0{,}037$). The mandibular symphysis inclination was significantly less in Class III subjects when compared to Class I and Class II Division 1 ($p \leq 0.001$). the mandibular symphysis presented variations, The width of mandibular symphysis had the highest values in Class II Division 2 individuals and the inclination had the lower values in Class III individuals.

Mahajan R et al (2022)[44] compared antegonial notch depth, symphysis morphology and ramus morphology among different growth patterns. lateral cephalogram of total 90 patients were traced. The sample was divided into horizontal, average and vertical growth pattern based on Jarabak's ratio. The antegonial notch depth, symphysis morphology (height, depth, ratio and angle) and ramus morphology (height and width) were evaluated and analyzed statistically. The symphysis ratio is the ratio of symphysis height to symphysis width. Result was that in vertical growth pattern, antegonial notch depth is positively correlated with symphysis height, symphysis depth, ramus height and ramus width whereas it is negatively correlated with symphysis ratio and symphysis angle and exactly opposite is true for horizontal growing individuals.

This study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Babu Banarasi Das college of Dental sciences, BBD University, Lucknow with an aim to evaluate hard and soft tissue morphology of mandibular symphysis in subjects with different facial divergence pattern and to find correlation between mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern. The sample for the study comprised of 180 pre-treatments lateral cephalograms of Orthodontic patients with different facial divergence (Normodivergent, Hypodivergent and Hyperdivergent), in the age range of 18-25years (mean age 23.2+2.6SD years). The sample was collected from the patients coming to OPD of the department for fixed orthodontic treatment and from patient's record files.

CRITERIA FOR SAMPLE SELECTION:

Samples were selected on the basis of following inclusion and exclusion criteria

Inclusion criteria: -

1. Adult patients with age range of 18-25 years to ensure complete growth of hard and soft tissues.
2. Patient having apparently bilateral symmetrical face.
3. Patients willing to participate in the study.

Exclusion Criteria:

1. Patients with abnormal morphology of lip and chin region.
2. Patients with congenital defect in craniofacial region or any facial asymmetry.
3. Patient having history of trauma in facial region.
4. Patient who had undergone surgical intervention in lower third of face (like genioplasty and Orthognathic surgery etc).
5. Mandibular symphysis disorder.

SAMPLE SIZE ESTIMATION

Sample size estimation was done by using **G Power software (version 3.0).** Sample size was estimated for ANOVA: Fixed effects, main effects and interactions

A minimum total sample size of 162 (14 each group) was found to be sufficient for an alpha of 0.05, power of 95 %, 0.40 as effect size (assessed from a similar study).

F tests - ANCOVA: Fixed effects, main effects and interactions

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.40
	α err prob	=	0.05
	Power (1-β err prob)	=	0.95
	Numerator df	=	10
	Number of groups	=	3
	Number of covariates	=	1
Output:	Noncentrality parameter λ	=	25.9200000
	Critical F	=	1.8910679
	Denominator df	=	158
	Total sample size	=	162
	Actual power	=	0.9508764

Estimated sample 162 Considering the attrition of sample in future sample size was rounded off to 180

Sample Distribution:

Samples were divided into three groups based on facial divergence pattern. For this, a total of 220 subjects who came to the department for fixed orthodontic treatment were selected and divided in three group based on clinical examination for facial divergence. The parameters used to ascertain facial divergence were Jaraback ratio (posterior facial height/anterior facial height) and SN-GoGn angle as evaluated by tracing done on lateral cephalogram Table-1 shows normal value as well as mean values as obtained from the sample in the present study for parameters to assess facial divergence.

Table 1: Parameters to assess growth pattern for sample distribution

Parameters	Normodivergent	Hypodivergent	Hyperdivergent
Jarabak's Ratio	62-65%	Less than 62%	More than 65%
SN-GoGn Angle (in degree)	27- 37 degree	< 27 degree	> 37 degree

The subjects who had border line values were excluded. Thus, a total 180 lateral cephalograms were finally selected and divided into 3 groups as shown in Table-2.

Table 2 - Distribution of sample in different groups

Groups	No. of samples (N)	Mean Age±SD (In years)
Group I (Normodivergent)	60	23.1± 1.5
Group II (Hypodivergent)	60	21.5±2.1
Group III (Hyperdivergent)	60	22.2±4.1

ARMAMENTARIUM USED FOR THE STUDY:

A. Material used for obtaining lateral cephalogram:

i. **Cephalostat machine**: Planmeca proline XC cephalostat (Finland) machine were used to take digital lateral cephalograms of selected subjects. The exposure was set at 68KV, 5mA and exposure time of 23 second and receptor was placed at a distance of 60 inches.

ii. **Soft copy of lateral cephalograms**: Pre-treatment cephalograms of each patient saved in CD-ROM were taken from the record files.

iii. **Nemoceph software**: Nemoceph software (Dental studio version 6.0) was used to trace and analyze the lateral cephalogram.

METHODOLOGY:

1. **METHODS OF TAKING RADIOGRAPHS:**

Planmeca proline XC was used to take the digital lateral cephalogram of selected subjects. The lateral cephalograms were taken in natural head position with lips relaxed and teeth in centric occlusion**.** Natural head position is a standardized and reproducible orientation of head. The ear posts were used for correct alignment of the patient head for undistorted symmetrical image of the patient. Relaxed lip was achieved by giving direct instructions to the patient. The receptor- source distance was fixed at 60 inches. The exposure values were set at 68kV, 5mA at 23 second exposure time. All the cephalograms were transferred to a computer loaded with

Planmeca software from where the digital lateral cephalograms were saved in bitmap files and taken in a CD ROM.

Figure 1: Patient position on Cephalostat machine

2. TRACING OF LATERAL CEPHALOGRAM

The soft copies of all the lateral cephalograms were transferred to Nemotec software program (Dental studio-NX, version 6.0). The images were calibrated by identifying two-point 10 mm apart on lateral cephalogram. The image enhancement feature of the software (basic an advanced cephalometric tools), like brightness, contrast adjustment and magnification were used to identify individual cephalometric landmarks as precisely as possible. The landmarks were marked with the help of mouse/cursor.

3. MEASUREMENT OF PARAMETERS FOR HARD AND SOFT TISSUE SYMPHYSIS

After all of the landmarks were marked, they were modified and rectified for exact measurements. The software was used to measure both linear and angular parameters while tracing.

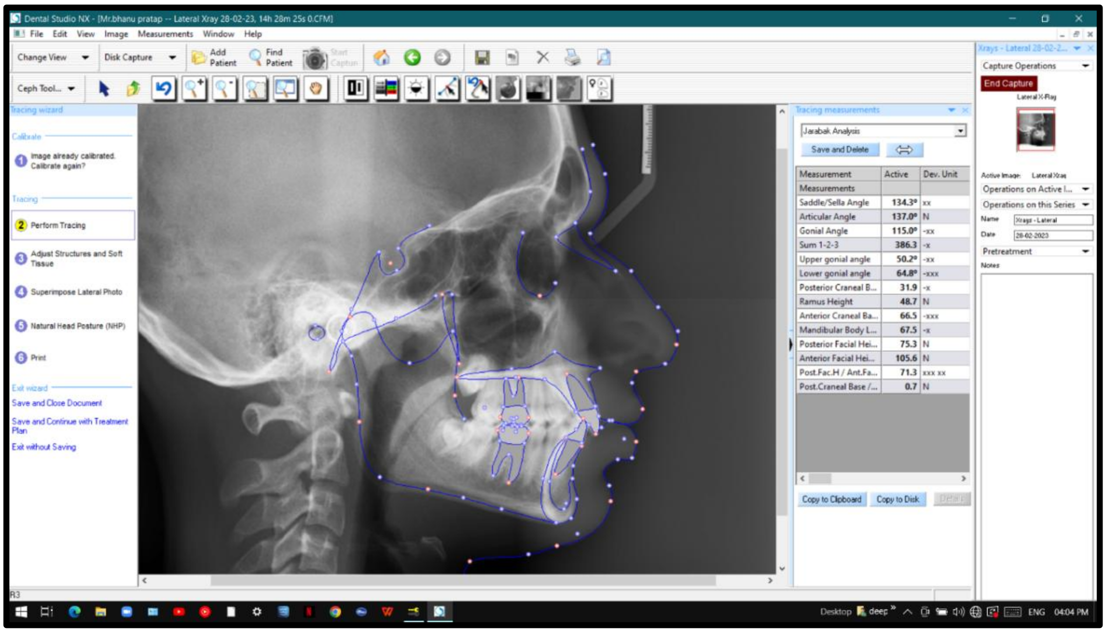


Figure 2 :- Tracing of cephalogram using Nemoceph software

4. CEPHALOMETRIC POINTS AND LANDMARKS USED IN THE STUDY:

The following hard tissue and soft tissue landmarks and reference lines and planes were used for the study[45].

A. ***Hard tissue landmarks:*** (fig-3)

1. Nasion (N): Most anterior point of the Nasofrontal suture in the midsagittal plane.

2. Sella (S): Center of the contour of Sella Turica.

3. Point B: Deepest point in the midsaggital plane between Infradentale and Pogonion.
4. Point Id (Id): Most antero-superior point of labial mandibular alveolar crest, situated between lower central incisors.
5. Pog (Pog): Most anterior point of the bony chin.
6. Lg Pog- Outer contour of lingual symphysis
7. Gnathion (Gn): Anterior-inferior point of bony chin located by drowing perpendicular from midpoint of line (Pogonion) to (Menton) on bony chin.
8. Menton (Me): Inferior most point on inferior contour of bony chin.
9. Gonion (Go): A point on the curvature of the angle of the mandible located by bisecting the angle formed by lines tangent to the posterior ramus and the inferior border of the mandible.
10. G point: Focal point of the biggest circle that is tangent to the inner frontal posterior and lower edge to mandibular symphysis.

B. Soft tissue landmarks: (fig-3)

1. Soft-tissue pogonion (Pog’): The most anterior point on the soft tissue chin in the mid-sagittal plane.
2. Soft-tissue B point (B’): A soft tissue point in deepest concavity between labrale inferioris and soft tissue pogonion.
3. Soft tissue Menton (Me’): The inferior most point on the contour of the soft tissue chin.
4. Soft tissue Gnathion (Gn’): A point located by drawing perpendicular from the midpoint between (soft tissue Pogonion) to (soft tissue Menton) on the outline of soft tissue chin.

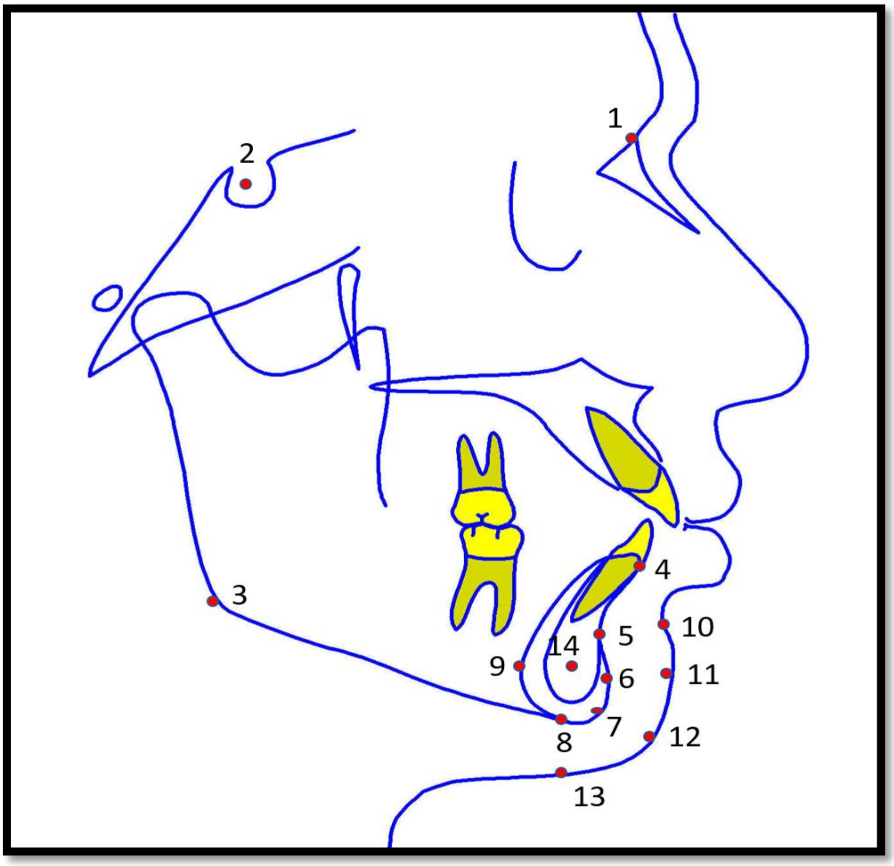


Figure 3 :- Hard tissue and Soft tissue cephalometric landmarks used in the study:

1- Nasion (N), **2-** Sella(S), **3-** Gonion(Go), **4-**Infra dentale (Id)**, 5-** point B, **6-** Pogonion (Pg), **7-** Gnathion (Gn), **8-** Menton (Me), **9**.Lingual Pogonion**, 10-** Soft-tissue B point (B'), **11-** Soft tissue Pogonion(Pg'), **12 -** Soft tissue Gnathion (Gn'), **13-** Soft tissue menton (Me'). **14-** G point

REFERENCE LINES AND PLANES USED IN THE STUDY

1. Sella-Nasion plane (SN): This represents the anterior cranial base. It is constructed by connecting the points sella (S) and the Nasion (N)[46].

2. Mandibular plane (MP): A line connecting the points gonion (Gn) and menton (Me)[47].

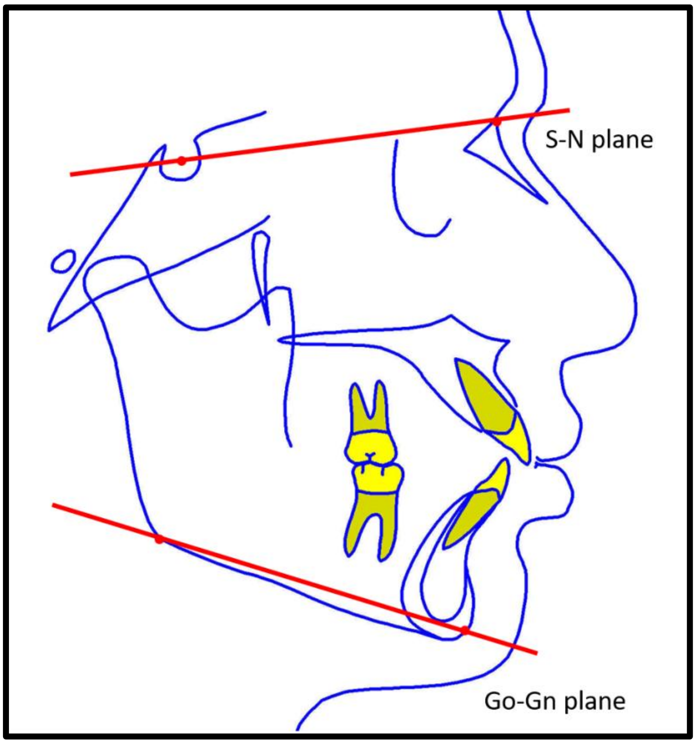


Figure 4 : Reference Planes and Reference lines

1- Sella-Nasion plane (S-N)**, 2-** mandibular plane (Go-Gn)

PARAMETERS USED IN STUDY:

Once all the landmarks were marked, these landmarks were again adjusted and corrected for accurate measurements. All angular and linear parameters were measured on tracing with the help of the software to evaluate hard and soft tissue symphysis morphology.

A. EVALUATEION OF HARD TISSUE SYMPHYSIS MORPHOLOGY

I. LINEAR PARAMETERS

1. Total symphyseal length (Id-Me)- Total length of mandibular symphysis was measured as Linear distance (mm) from Infradentale (Id) to menton (Me) (Fig 1a)

2. Lower symphyseal length (B-Me)-Length of symphysis(mm) as measured from point B to Menton (Me) (fig-1b)

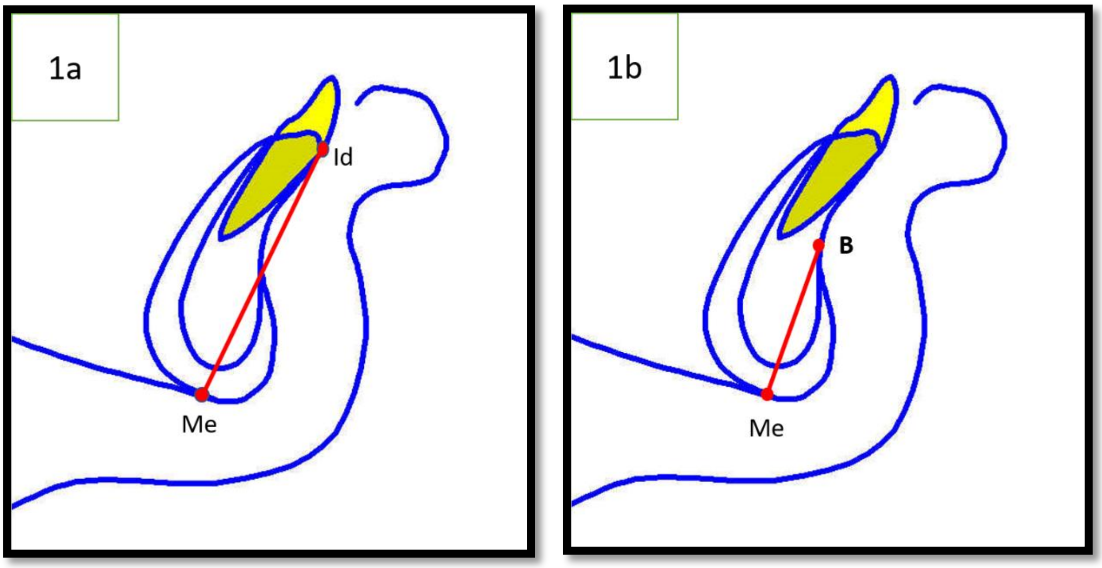


Figure 5 : Height of symphysis- 1a-total symphyseal height (Id-Me), **1b**-lower symphyseal height (B-Me)

3. Total width of symphysis (Pog- Lg Pog)-Linear distance (mm) from most prominent convex point of the lingual pogonion (Lg-Pog) to pogonion (Pog) (fig-2a)

4. Symphyseal projection (Pog to B-Me)-Perpendicular distance (mm) from pogonion to line connecting point B and menton, representing anterior prominence of mandibular symphysis (fig-2b)

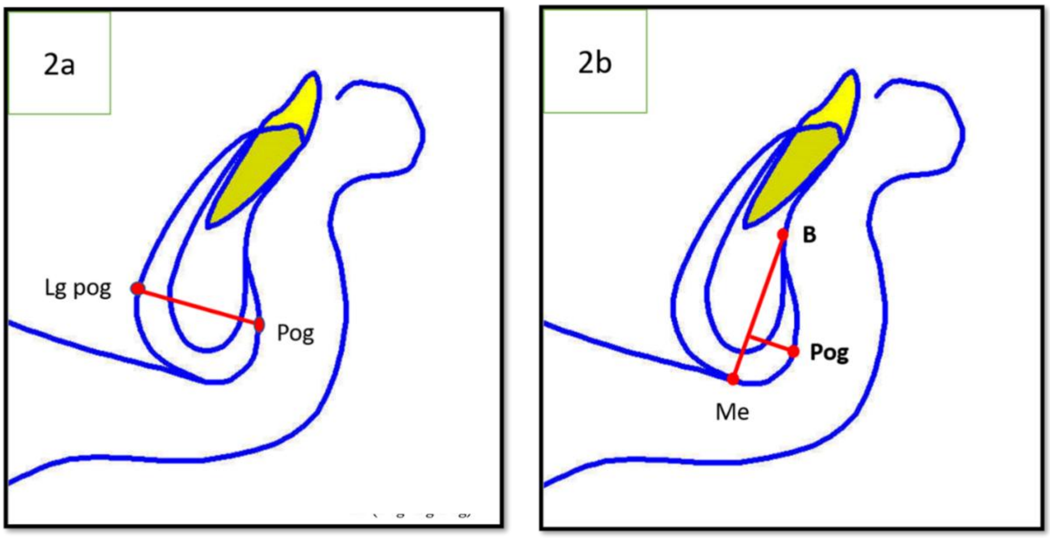


Figure 6 : Width of symphysis -2a- Total width of symphysis (Pog- Lg-Pog), **2b-** Symphyseal projection (Pog to B-Me)

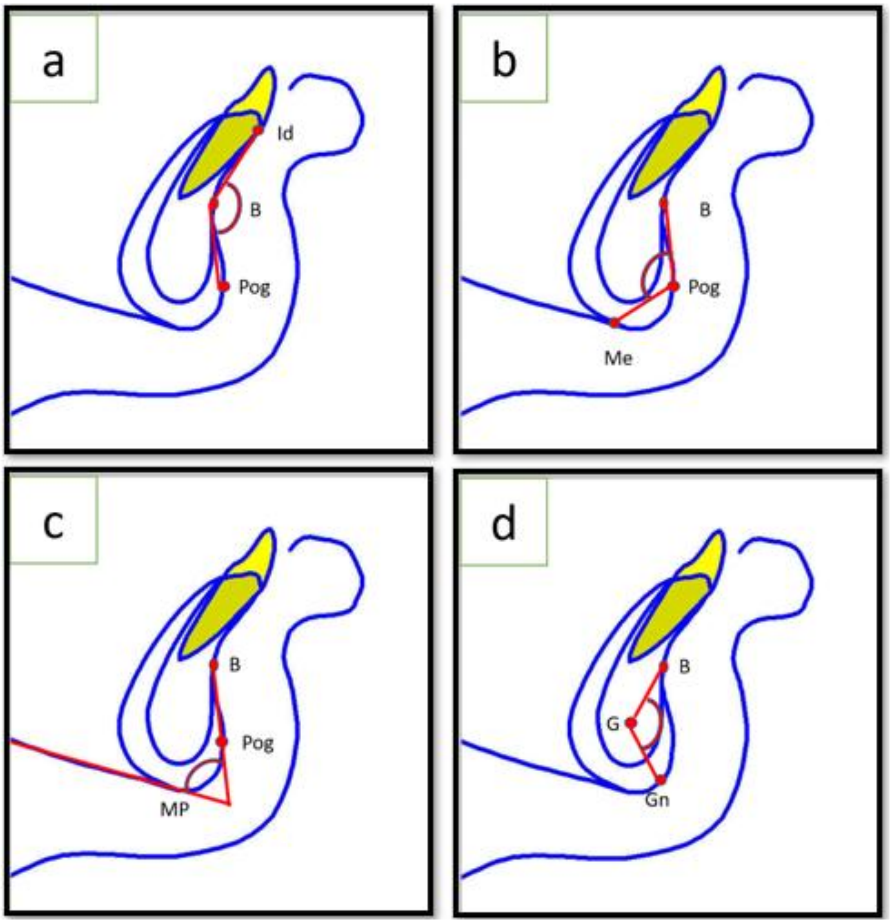
ANGULAR PARAMETERS

1. **Symphyseal concavity (Id-B-Pog)-** Outer angle formed between point Id, point B, and pogonion, reflecting concavity of mandibular symphysis(fig-a)
2. **Symphyseal convexity (B-Pog-Me)-** Inner angle formed between point B, pogonion, and menton, reflecting convexity of mandibular symphysis and symphysis projection(fig-b)
3. **Symphyseal inclination (B-Pog-MP)-** Angle between line connecting point B to pogonion and mandibular plane, reflecting inclination of skeletal part of mandibular symphysis in relation to mandibular plane(fig-c)
4. **Symphysis convexity in relation to point G (B-G-Gn)-**Outer angle formed between point B, point G and Gnathion (fig-d)
5. **Symphysis triangle**-Variation in symphyseal convexity with respect to point B, Me and Pog was assessed by measuring three angles of a triangle constructed from point B to Me, Me to Pog and Pog to point B (fig-e)

a) **Lower symphyseal inclination (Pog- Me- B)-**(fig-e-i)

b) **Symphyseal projection (Me-Pog-B) -**(fig-e-ii)

c) **Upper symphyseal inclination (Pog-B-Me)-**fig-e-iii)



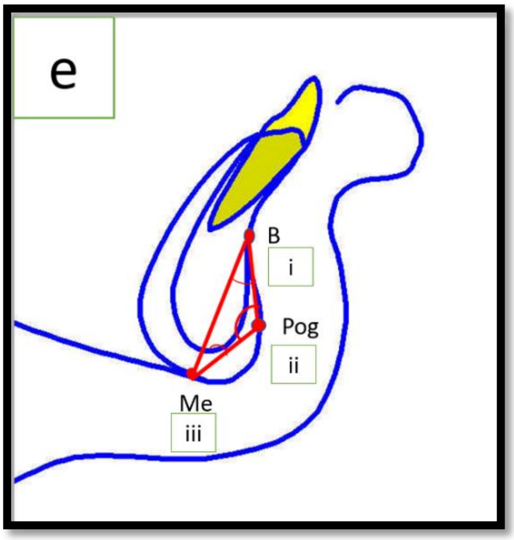


Figure 7: - Hard tissue Angular parameters. a-(B-Pog-Me), b-(Id-B-Pog), c-(B-Pog-MP), d- (B-G-Gn), e: i- (Pog- Me- B), ii-(Me-Pog-B), iii-(Pog-B-Me)

B. EVALUATION OF SOFT TISSUE SYMPHYSIS MORPHOLOGY

I. LINEAR MEASUREMENTS

1. Soft tissue chin thickness

1a. Soft tissue chin thickness at Pogonion (Pog-Pog'): Linear distance measured between the hard tissue pogonion and soft tissue pogonion(4). (fig-1a)

1b. Soft tissue chin thickness at Gnathion (Gn-Gn') Linear distance measured between the hard tissue Gnathion and soft tissue gnathion (4). (fig-1b)

1c. Soft tissue chin thickness at Menton (Me-Me'): Linear distance measured between the hard tissue menton and soft tissue menton (4) (fig-1c)

2. Soft tissue chin height: (B'-Me')-linear distance (mm) from soft B point to soft tissue menton (fig-2**)**

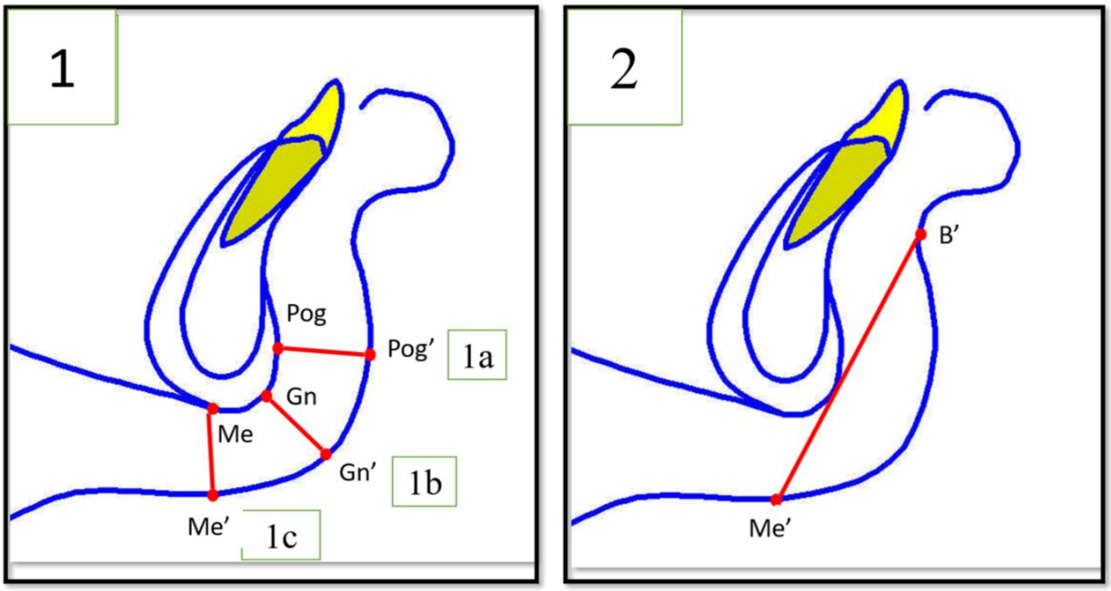


Figure 8 : Soft tissue linear measurements

1. Soft tissue chin thickness — **2. Soft tissue chin height**

1a-(Pog-Pog'), 1b-(Gn-Gn'), 1c-(Me-Me' — **2 - (B'-Me')**

II. ANGULAR PARAMETERS

1. **Soft tissue symphysis convexity (B'-Pog'-Me')-**measured as angle between B' to Pog' and Pog' to Me' (fig-1)
2. **Soft tissue symphysis inclination (B'-Pog'-MP)-** Angle between line connecting point B' to Pog' and mandibular plane, reflecting inclination of soft tissue part of mandibular symphysis in relation to mandibular plane (fig-2)

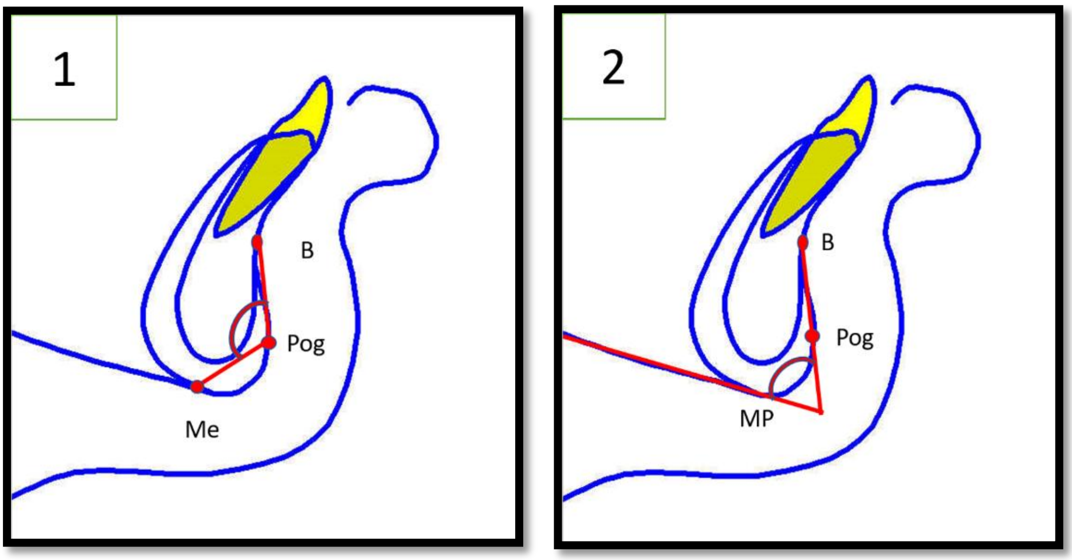


Figure 9: Soft tissue angular parameters

1-(B'-Pog'-Me'), 2-(B'-Pog'-MP)

Table 3 - Measurement of Reliability:

SN	PARAMETERS	1st measurement Mean±SD	2nd measurement Mean±SD	P value	
1	Id-me	29.70±0.37	28.36 ±0.41	P=0.241	NS
2	B-Me	19.43±1.25	19.44±1.42	P=0.530	NS
3	Lg Pog-Pog	15.56±3.11	15.49±2.89	P=0.877	NS
4	Pog to B-me	5.30±2.89	5.32±1.04	P=0.377	NS
5	B-Pog-Me	126.55±0.88	126.61±0.88	P=0.303	NS
6	Id-B-Pog	152.22±4.52	152.42±4.74	P=0.749	NS
7	B-Pog-MP	55.62±5.29	55.41±5.89	P=0.729	NS
8	B-G-Gn	121.27±12.09	121.36±12.16	P=0.688	NS
9	B-Me-Pog	34.30±8.25	29.05±8.18	P=0.218	NS
10	Me-Pog-B	126.55±0.88	126.55±0.82	P=0.254	NS
11	Pog-B-Me	19.14±9.13	19.24±9.24	P=0.295	NS
12	Pog-Pog’	10.80±0.261	10.81±1.50	P=0.205	NS
13	Gn-Gn’	8.84±1.50	8.25±1.44	P=0.899	NS
14	Me-Me’	8.21±0.31	8.23±0.35	P=0.54	NS
15	B-Me’	31.83±1.61	31.85±1.62	P=0.311	NS
16	B’-Pog’-MP	62.25±0.31	62.25±0.35	P=0.830	NS
17	B’-Pog’-Me'	123.35±5.04	123.38±5.06	P=0.360	NS

The data was recorded for the 5 study subjects for the soft tissue and hard tissue parameters on the day of examination and after 5 days by the sane examiner. The intra examiner reliability was found to be statistically non-significant which means there was not much difference in the values recorded on the day of examination and after 5 days by the sane examiner.

STATISTICAL ANALYSIS TOOL

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 23.0 Version. The descriptive statistics included mean, standard deviation. The level of the significance for the present study was fixed at 5%.

The intergroup comparison for the difference of mean scores between independent groups was done using the One Way ANOVA followed by post hoc analysis and correlation between variables was established using Pearson Correlation

The Shapiro–Wilk test was used to investigate the distribution of the data and Levene’s test to explore the homogeneity of the variables. The data were found to be homogeneous and normally distributed. Mean and standard deviation (SD) were computed for each variable

1) **<u>Mean</u>**

$$\overline{X} = \frac{\Sigma X}{N}$$

Where:

$\overline{X}$= the data set mean, $\sum$ = the sum of, X = the scores in the distribution, N = the number of scores in the distribution

2) **<u>Range</u>**

$$range = X_{highest} - X_{lowest}$$

Where: $X_{highest}$ = largest score, X_{lowest} = smallest score

3) **<u>Variance</u>**

$$SD^2 = \frac{\Sigma(X - \overline{X})^2}{N}$$

The simplified variance formula

$$SD^2 = \frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N}$$

Where: SD^2 = the variance, ∑ = the sum of, X = the obtained score, $\overline{X}$ = the mean score of the data, N = the number of scores

4) <u>Standard Deviation (N)</u>

$$SD = \sqrt{\frac{\Sigma(X - \overline{X})^2}{N}}$$

The simplified standard deviation formula

$$SD = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N}}$$

Where: SD = the standard deviation, ∑ = the sum of, X = the obtained score, $\overline{X}$ = the mean score of the data, N = the number of scores

5) <u>The Pearson correlation</u>

$$r = \frac{\Sigma z_X z_Y}{N}$$

Where: r = correlation coefficient, ∑ = the sum of, z_X = Z score for variable X, z_Y = Z score for variable Y, $z_X z_Y$ = the cross product of Z scores, N = the number of scores

6) <u>One Way ANOVA</u>

The formula for the one-way **ANOVA** *F*-test statistic is

$$F = \frac{\text{between-group variability}}{\text{within-group variability}}.$$

The between-group variability" is

$$\sum_{i=1}^{K} n_i(\bar{Y}_{i\cdot} - \bar{Y})^2/(K-1)$$

where Y_i denotes the sample mean in the i^{th} group, n_i is the number of observations in the i^{th} group, $\bar{Y}$ denotes the overall mean of the data, and K denotes the number of groups.

The "within-group variability" is

$$\sum_{i=1}^{K}\sum_{j=1}^{n_i}(Y_{ij} - \bar{Y}_{i\cdot})^2/(N-K),$$

where Y_{ij} is the j^{th} observation in the i^{th} out of K groups and N is the overall sample size.

7) <u>Post Hoc Analysis (Tukey's test)</u>

Tuke's range test, also known as the Tukey's test, Tukey method, Tukey's honest significance test, or Tukey's HSD (honestly significant difference) test,[48] is a single-step multiple comparison procedure and statistical test. It can be used on raw data or in conjunction with an ANOVA (post-hoc analysis) to find means that are significantly different from each other. Named after John Tukey, it compares all possible pairs of means, and is based on a studentized range distribution (q) (this distribution is similar to the distribution of t from the t-test. Tukey's test compares the means of every treatment to the means of every other treatment; that is, it applies simultaneously to the set of all pairwise comparisons $\mu_i - \mu_j$ and identifies any difference between two means that is greater than the expected standard error.Tukey's test is based on a formula very similar to that of the t-test. In fact, Tukey's test is essentially a t-test, except that it corrects for family-wise error rate.

The formula for Tukey's test is:

$$q_s = \frac{Y_A - Y_B}{SE},$$

where Y_A is the larger of the two means being compared, Y_B is the smaller of the two means being compared, and SE is the standard error of the sum of the means. This q_s value can then be compared to a q value from the studentized range distribution. If the

q_s value is *larger* than the critical value obtained from the distribution, the two means are said to be significantly different at level.

8) **Level of significance**: ‘P’ is level of significance

P >0.05	Not significant
P <0.05	Significant
P <0.05	Highly significant
P <0.05	Very highly significant

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Babu Banarasi das College of Dental Sciences, B B D University, Lucknow to evaluate hard and soft tissue morphology of mandibular symphysis in subjects with different facial divergence pattern and to find correlation between mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern using Nemoceph software. All the subjects were within the age range of 18-25 years. The pre-treatment lateral cephalogram of 180 subjects are taken as sample for the study. A total of 17 parameters were used to measure hard tissue and soft tissue morphology of symphysis, out of which eight were linear parameters (4 hard tissue and 4 soft tissue) and nine were angular parameters (seven hard tissue and 2 soft tissue). The data so obtained was subjected to statistical analysis.

The obtained data were evaluated in the following manner:

1. Evaluation of hard tissue and soft tissue symphyseal morphology parameters for Group-I, Group-II and Group-III. (Table 3-4)
2. Overall and individual inter group comparison of various parameters of hard tissue and soft tissue symphyseal morphology using ANOVA (Table 5-6).
3. Overall and individual inter group comparison of various parameters of hard tissue and soft tissue symphyseal morphology using Post HOC test (table 7-8)
4. To find correlation between hard tissue symphyseal morphology and soft tissue chin thickness in Group-I, Group-II and Group-III. (Table 9-10)

Table no. 4: Mean+SD, Minimum and Maximum values for various parameters of hard tissue symphysis in different Groups.

Parameters	Group I			Group II			Group III		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±sD	Min	Max
Linear parameters									
Total symphyseal height (Id-Me)	29.98 ±3.39	21.99	37.86	29.18 ±2.42	22.96	35.88	30.05 ±2.72	24.83	38.41
Lower symphyseal height (B-Me)	19.24 ±2.17	12.97	23.57	21.22 ±1.86	17.06	26.49	20.43 ±1.97	15.45	25.24
Symphyseal width (Pog-Lg Pog)	14.01± 2.27	8.45	19.05	13.66± 1.97	9.68	19.39	14.00± 1.81567	9.12	18.23
Symphyseal projection (Pog to B-Me)	5.06± 1.71	1.53	9.92	4.85± 1.45	2.00	7.67	4.50± 1.45511	1.67	8.03
Angular parameters									
Symphyseal convexity (B-Pog-Me)	122.72 ±5.51	110.90	136.41	149.16± 5.73	135.21	160.81	128.53 ±7.91	106.67	149.02
Symphyseal concavity (Id-B-Pog)	)145.83 ±6.57	131.90	159.39	128.89± 7.66	116.07	150.22	148.31 ±8.93	125.66	166.35
Symphyseal inclination (B-Pog-MP)	61.77 ±7.65	47.94	81.73	64.75± 6.29	49.96	76.79	59.41 ±6.42	46.80	72.83
Symphysis convexity in relation to point -G (B-G-Gn)	132.37 ±9.58	100.33	143.71	122.08 ±7.86	109.61	141.90	125.47 ±5.37	110.69	134.84
Upper Symphysis inclination (Pog-B-Me)	20.49 ±4.49	10.61	27.77	21.07 ±6.56	10.69	38.51	20.60 ±7.82	7.93	37.65
Symphysis projection angle (Me-Pog-B)	120.38 ±18.80	31.89	146.09	127.92 ±6.12	116.36	140.12	129.4 ±5.15	118.74	140.48
Lower symphysis projection (Pog-Me-B)	39.68 ±18.45	19.70	129.01	31.30 ±5.73	19.50	43.59	29.94 ±4.14	19.85	38.31

Table-4 showed mean+SD, Minimum and Maximum values for various parameters of hard tissue symphysis in different Groups. Mean values for total **symphyseal height (Id-Me**), in Group III was maximum (30.05±2.72), followed by Group I **(29.98±3.39)** and Group II **(29.18±2.42);** (Group III > Group I> Group II), for **lower symphyseal height (B-Me),** mean value of Group II (21.22±1.86) was maximum, followed by Group III (20.43±1.97) then Group I (19.24±2.17). '(Group II > Group III > Group I), for **width of symphysis (Pog-Lg Pog),** mean value of Group I (14.01±2.27) was maximum, followed by Group III (14.00±1.815) then Group II (13.66±1.97). (Group I > Group III> Group II), **for symphyseal projection (Pog to B-Me),** mean value of Group II (4.85±.45) was maximum, followed by Group III (4.50±1.45) then Group I (5.06±1.71). (Group II > Group III> Group I)

for **symphysis convaxity (B-Pog-Me),** mean value of Group II (149.16±5.73) was maximum, followed by Group III (128.53±7.91) then Group I (122.72±5.51). '(Group II> Group III> Group I), for **symphysis concavity (Id-B-Pog),** mean value of Group III (148.31±8.93) was maximum, followed by Group I (145.83±6.57) then Group II (128.89±7.66). '(Group III> Group I> Group II), for **symphysis Inclination (B-Pog-MP),** mean value of Group II (64.75±6.29) was maximum, followed by Group I (61.77±7.65) then Group III (59.41±6.42). '(Group II> Group I> Group III), for **symphysis convexity at point G (B-G-Gn),** mean value of Group I (132.37±9.58) was maximum, followed by Group III (125.47±5.37) then Group II (122.08±7.86). '(Group I> Group III> Group II), for **upper symphysial inclination (Pog-B-Me**), mean value of Group III (20.60±7.82) was maximum, followed by Group I (20.49±4.49) then Group II (21.07±6.56). '(Group III> Group I> Group II), for **symphysis projection angle (Me-Pog-B),** mean value of Group III (20.60±7.82) was maximum, followed by Group II (21.07±6.56) then Group I (120.38±18.80). '(Group III> Group II> Group I), for **lower symphyseal projection (Pog-Me-B**) mean value of Group I (39.68±18.45) was maximum, followed by Group II (31.30±5.73) then Group III (29.94±4.14). '(Group I> Group II> Group III)

Table no. 5- Mean+SD, Minimum and Maximum values for various parameters of soft tissue symphysis in different Groups.

Linear parameters	Group I			Group II			Group III		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
Width of symphysis (Pog- Pog’)	10.20±2.20	6.25	15.98	10.13±1.74	6.79	13 .64	9.74±1.94	5.84	14.55
Soft tissue chin thickness at gnathion (Gn-Gn’)	8.17±1.78	4.20	12.94	8.05±1.78	4.41	12.24	6.83±1.76	2.81	10.57
Soft tissue chin thickness at menton (Me-Me’)	7.64 ±2.30	3.31	13.19	7.29±1.55	3.92	10.44	6.38±1.48	3.46	9.55
Height of symphysis (B’-Me’)	26.46±4.64	18.48	36.41	30.96±2.57	23.64	36.85	30.05±3.30	24.13	36.41
Angular parameters									
Soft tissue Symphysis convexity (B’-Pog’-Me’)	118.94±7.88	104.35	134.22	122.92±10.74	99.33	139.93	121.49±8.83	103.86	134.56
Symphysis inclination (B’-Pog’-MP)	62.60±7.74	45.37	79.39	68.40±9.79	53.10	87.77	63.26±5.08	52.38	72.86

Table 5 showed mean+SD, Minimum and Maximum values for all the Hard parameters in different Groups. Mean values for **soft tissue chin thickness at pogonion (Pog-Pog’)** mean value of Group I (10.20±2.20) was maximum, followed by Group II (10.13±1.74) then Group III (9.74±1.94). ‘(Group I> Group II> Group III), **soft tissue chin thickness at Gnathion (Gn-Gn’)** mean value of Group I (8.17±1.78) was maximum, followed by Group II (8.05±1.78) then Group III (6.83±1.76). ‘(Group I> Group II> Group III), **soft tissue chin thickness at Menton (Me-Me’)** mean value of Group I (7.64±2.30) was maximum, followed by Group II (7.29±1.55) then Group III (6.38±1.48). ‘(Group I> Group II> Group III), **soft tissue chin height (B’-Me’)** mean value of Group II (30.96±2.57) was maximum, followed by Group III (30.05±3.30) then Group I (26.46±4.64). ‘(Group II >Group III> Group I)

zsoft tissue symphysis convexity (B'-Pog'-Me') mean value of Group II (122.92±10.74) was maximum, followed by Group III (121.49±8.83) then Group I (118.94±7.88). '(Group II >Group III> Group I), **soft tissue symphysis inclination (B'-Pog'-Mp)** mean value of Group II (68.40±9.79) was maximum, followed by Group III (63.26±5.08) then Group I (62.60±7.74). '(Group II >Group III> Group I)

Table 6: Overall inter group comparison of parameters for hard tissue symphyseal morphology (ANOVA)

Parameters	Group I		Group II		Group III		P Value
	Mean±SD	Std. Error	Mean±SD	Std. Error	Mean±SD	Std. Error	P Value
Total Height of symphysis (Id-Me)	29.98 ±3.39	**0.438**	29.18 ±2.42	**0.305**	30.05 ±2.72	**0.354**	**0.177**
Lower Height of symphysis (B-Me)	19.24 ±2.17	**0.280**	21.22 ±1.86	**0.234**	20.43 ±1.97	**0.256**	**0.001***
Width of symphysis (Pog-Lg Pog)	14.01± 2.27	**0.294**	13.66± 1.97	**0.248**	14.00± 1.81567	**0.236**	**0.542**
Symphyseal projection (Pog to B-Me)	5.06± 1.71	**0.221**	4.85± 1.45	**0.183**	4.50± 1.45511	**0.189**	**0.443**
Symphysis convexity (B-Pog-Me)	122.72 ±5.51	0.712	149.16± 5.73	**0.740**	128.53 ±7.91	**0.102**	**0.001***
Symphysis concavity (Id-B-Pog)	145.83 ±6.57	0.849	128.89± 7.66	**0.989**	148.31 ±8.93	**1.153**	**0.001***
Symphysis inclination (B-Pog-MP)	61.77 ±7.65	**0.988**	64.75± 6.29	**0.812**	59.41 ±6.42	**0.829**	**0.001***
Symphysis convexity in relation to point -G (B-G-Gn)	132.37 ±9.58	**1.292**	122.08 ±7.86	**1.014**	125.47 ±5.37	**0.694**	**0.001***
Upper Symphysis inclination (Pog-B-Me)	20.49 ±4.49	**0.594**	31.30 ±5.73	**0.847**	20.60 ±7.82	**1.010**	**0.872**
Symphysis projection angle (Me-Pog-B)	120.38 ±18.80	**2.468**	127.92 ±6.12	**0.665**	129.4 ±5.15	**0.790**	**0.001***
Lower symphysis projection (Pog-Me-B)	39.68 ±18.45	**2.423**	21.07 ±6.56	0.740	29.94 ±4.14	**0.535**	**0.001***

NS= non-significant (p>0.05); *=Significant (p<0.05); **=Very significant (p<0.01); ***=Highly significant (p<0.001)

Inter group comparison of various parameters assessed for hard tissue symphyseal morphology using ANOVA

On inter group comparison of mean difference of **lower symphyseal height (B-Me)** showed statistically significant difference (P>0.001) in between groups. however other linear parameters **total symphyseal height (Id-Me), Width of symphysis (Pog-Lg Pog), Symphyseal projection (Pog to B-Me),** showed non-significant mean difference.

On inter group comparison of mean difference of **Upper Symphysis inclination (Pog-B-Me),** showed statistically non-significant difference in between groups and other Angular parameters **Symphysis convexity (B-Pog-Me), Symphysis concavity (Id-B-Pog), Symphysis inclination (B-Pog-MP), Symphysis convexity in relation to point -G (B-G-Gn), Symphysis projection angle (Me-Pog-B), Lower symphysis projection (Pog-Me-B)** showed significant mean difference**(P>0.001).**

Table 7. Overall inter group comparison of parameters for soft tissue symphyseal morphology (ANOVA)

Parameters	Group I		Group II		Group III		
	Mean+SD	Std. Error	Mean+SD	Std. Error	Mean+SD	Std. Error	P Value
Width of symphysis (Pog- Pog')	10.20±2.20	0.284	10.13±1.74	0.225	9.74±1.94	0.250	0.395
Soft tissue chin thickness at gnathion (Gn-Gn')	8.17±1.78	0.230	8.05±1.78	0,.230	6.83±1.76	0.228	0.001*
Soft tissue chin thickness at menton (Me-Me')	7.64±2.30	0.297	7.29±1.55	0.200	6.38±1.48	0.192	0.001*
Height of symphysis (B'-Me')	26.46±4.4	0.599	30.96±2.57	0.332	30.05±3.30	0.426	0.001*
Soft tissue Symphysis convexity (B'-Pog'-Me')	118.94±7.88	1.017	122.92±10.74	1.140	121.49±8.83	1.386	0.060
Symphysis inclination (B'-Pog'-MP)	62.60±7.74	0.999	68.40±9.79	1.264	63.26±5.08	0.656	0.001*

Inter group comparison of various parameters assessed for soft tissue symphyseal morphology using ANOVA

On inter group comparison of mean difference of all the soft tissue linear parameters **soft tissue chin thickness at gnathion (Gn-Gn'), soft tissue chin thickness at menton (Me-Me'), Soft tissue chin height (B'-Me')** are statistically significant **(P>0.001)** in between groups. except **soft tissue chin thickness at pogonion (Pog-Pog')** which showed statistically non-significant difference.

For soft tissue angular parameters **soft tissue symphysis convexity (B'-Pog'-Me')** is statistically non-significant mean difference in between groups. however **soft tissue symphysis concavity (B'-Pog'-MP')** showed statistically significant difference in between groups.

Table no. 8: Individual inter group comparison of various parameters for hard tissue symphyseal morphology (Post HOC Analysis)

Linear parameters	**Group I Vs Group II**		**Group I Vs Group III**		**Group II Vs Group III**	
	Mean difference	P Value	Mean difference	P Value	Mean difference	P Value
Total Height of symphysis (Id-Me)	0.798	**0.125**	-.073	**0.889**	0.871	**0.095**
Lower Height of symphysis (B-Me)	-1.975	**0.000***	-1.186	**0.001***	-0.788	**0.031***
Width of symphysis (Pog-Lg Pog)	**0.351**	**0.338**	**0.013**	**0.972**	**0.338**	**0.359**
Symphyseal projection (Pog to B-Me)	**0.208**	**0.455**	**0.557**	**0.051**	**-0.348**	**0.215**
Angular Parameters						
Symphysis convexity (B-Pog-Me)	**-26.437**	**.000***	**-5.803**	**.000***	**-20.634**	**.000***
Symphysis concavity (Id-B-Pog)	**16.940**	**.000***	**-2.485**	**.042***	**19.426**	**.000***
Symphysis inclination (B-Pog-MP)	**-2.973**	0.018	**2.365**	**0.049***	**-5.338**	**.000***
Symphysis convexity in relation to point -G (B-G-Gn)	**10.284**	**0.000***	**6.89**	**.000***	**3.386**	**.018***
Upper Symphysis inclination (Pog-B-Me)	**8.376**	**0.000***	**9.735**	0.000*	**-1.359**	**0.511**

Symphysis projection angle (Me-Pog-B)	**-7.545**	**0.001***	**-9.099**	**0.000***	**1.553**	**0.468**
Lower symphysis projection (Pog-Me-B)	**-0.586**	**0.625**	**-0.111**	**0.926**	**-0.475**	**0.688**

NS= non-significant (p>0.05); *=Significant (p<0.05); **=Very significant (p<0.01); ***=Highly significant (p<0.001)

On inter group comparison **Total symphyseal height (Id-M**e) showed statistically non-significant difference between group I and group II **(P=0.125)** (Group II>Group I) with mean difference (0.798). For Group I vs Group III **(P=0.889)** (Group III>Group I) with mean difference (-.073), Group II vs Group III **(P=0.095)** (Group III>Group II) with mean difference (0.871).

For **Lower symphyseal height (B-Me)** showed statistically significant difference between group I and group II**(P>0.000*)** (Group II>Group I) with mean difference (-1.975). For Group I vs Group III **(P>0.001)** (Group III>Group I) with mean difference (-1.186), Group II vs Group III **(P>0.031)** (Group III>Group II) with mean difference (-0.788).

For symphyseal width (Pog-LgPog) showed statistically non-significant difference between all the groups, group I and group II **(P=0.338)** (Group II>Group I) with mean difference (0.351). For Group I vs Group III **(P=0.971)** (Group III>Group I) with mean difference (0.013), Group II vs Group III **(P=0.359)** (Group III>Group II) with mean difference (0.338).

For Symphyseal projection (Pog to B-Me) showed statistically non-significant difference between all the groups, group I and group II **(P=0.455)** (Group II>Group I) with mean difference (0.208). For Group I vs Group III **(P=0.051)** (Group III>Group I) with mean difference (0.557), Group II vs Group III **(P=0.215)** (Group III>Group II) with mean difference (-0.345).

For symphysis convexity (B-Pog-Me) showed statistically highly significant difference between all the groups, group I and group II **(P<0.000)** (Group II>Group I) with mean difference (-26.437). For Group I vs Group III **(P<0.000)** (Group

III>Group I) with mean difference (-5.803), Group II vs Group III **(P<0.000)** (Group III>Group II) with mean difference (-20.364).

For symphysis concavity (Id-B-Pog) showed statistically highly significant difference between all the groups, group I and group II **(P<0.000)** (Group II>Group I) with mean difference (16.940), and Group II vs Group III **(P<0.000)** (Group II>Group III) with mean difference (19.426), Group I vs Group III **(P<0.042)** (Group III>Group I) with mean difference (-0.485).

For **symphysis inclination (B-Pog-MP)** showed statistically significant difference between all groups, group I and group II **(P<0.018)** (Group II>Group I) with mean difference (-2.973), and Group II vs Group III **(P<0.000)** (Group II>Group III) with mean difference (-5.338), for Group I vs Group III **(P<0.049)** (Group III>Group I) with mean difference (2.365).

For symphysis convexity in relation to point G (B-G-Gn) showed statistically significant difference between all the groups, group I and group II **(P<0.000)** (Group II>Group I) with mean difference (10.284). For Group I vs Group III **(P<0.000)** (Group III>Group I) with mean difference (6.89), Group II vs Group III **(P<0.018)** (Group III>Group II) with mean difference (3.386).

For upper symphysis inclination (Pog-B-Me) showed statistically significant difference between group I and group II **(P<0.000)** (Group II>Group I) with mean difference (8.376). For Group I vs Group III **(P<0.000)** (Group III>Group I) with mean difference (9.735), but Group II vs Group III **(P<0.511)** (Group III>Group II) with mean difference (-1.359) showed statistically non-significant difference between groups.

For upper symphysis angle (Me-Pog-B) showed statistically significant difference between group I and group II **(P<0.000)** (Group II>Group I) with mean difference (-7.545) and Group I vs Group III **(P<0.000)** (Group III>Group I) with mean difference (-9.099). but Group II vs Group III **(P<0.511)** (Group III>Group II) with mean difference (1.553) showed statistically non-significant difference between groups.

For lower symphysis projection (B-Pog-Me) showed statistically non-significant difference between all the groups, group I and group II **(P<0.625)** (Group II>Group I) with mean difference (-0.586). For Group I vs Group III **(P<0.111)** (Group III>Group

I) with mean difference (0.625), Group II vs Group III **(P<0.688)** (Group III>Group II) with mean difference (-0.475).

Table 9- : Individual inter group comparison of various parameters for soft tissue symphyseal morphology (Post HOC analysis)

linear parameters	**Group I Vs Group II**		**Group I Vs Group III**		**Group II Vs Group III**	
	Mean and std. deviation	P Value	Mean and std. deviation	P Value	Mean and std. deviation	P Value
Width of symphysis (Pog- Pog')	0.071	0.843	0.463	0.200	-0.391	0.278
Soft tissue chin thickness at gnathion (Gn-Gn')	0.121	0.710	1.345	0.000*	-1.224	0.000*
Soft tissue chin thickness at menton (Me-Me')	0.341	0.305	1.159	0.000*	-.918	0.006*
Height of symphysis (B'-Me')	-4.499	0.000*	-3.591	0.000*	-0.908	0.170
Angular parameters						
Soft tissue Symphysis convexity (B'-Pog'-Me')	-3.980	0.019*	-2.552	0.132	-1.428	0.398
Symphysis inclination (B'-Pog'-MP)	-5.799	0.000*	-0.661	.642	-5.137	.000*

For width of symphysis (Pog-Pog') showed statistically non-significant difference between all the groups, group I and group II (Group II>Group I) with mean difference

(0.071). For Group I vs Group III (Group III>Group I) with mean difference (0.463), Group II vs Group III (Group III>Group II) with mean difference (-0.391).

For soft tissue chin thickness at Gnathion (Gn-Gn') showed statistically non-significant difference between group I and group II (Group II>Group I) with mean difference (0.121) however in Group I vs Group III **(P<0.000)** (Group III>Group I) with mean difference (1.345), Group II vs Group III **(P<0.000)** (Group III>Group II) with mean difference (-1.224) showed statistically significant difference between groups.

For soft tissue chin thickness at Menton (Mn-Mn') showed statistically non-significant difference between group I and group II (Group II>Group I) with mean difference (0.341) however in Group I vs Group III **(P<0.000)** (Group III>Group I) with mean difference (0.305), Group II vs Group III **(P<0.000)** (Group III>Group II) with mean difference (-0.918) showed statistically significant difference between groups.

For height of soft tissue symphysis (B'-Me') showed statistically significant difference between group I and group II **(P<0.000)** (Group II>Group I) with mean difference (-4.499) Group I vs Group III **(P<0.000)** (Group III>Group I) with mean difference (-3.591), however in Group II vs Group III (Group III>Group II) with mean difference (-0.908) showed statistically non-significant difference between groups.

For Soft tissue Symphyseal convexity (B'-Pog'-Me') showed statistically significant difference between group I and group II **(P<0.019)** (Group II>Group I) with mean difference (-3.980) however in Group I vs Group III (Group III>Group I) with mean difference (-2.552), Group II vs Group III (Group III>Group II) with mean difference (-1.428) showed statistically non-significant difference between groups.

For soft tissue symphyseal inclination (B'-Pog'-MP') showed statistically non-significant difference between group I and group III (Group III>Group I) with mean difference (-0.661) however in Group I vs Group II **(P<0.000)** (Group II>Group I) with mean difference (-5.799), Group II vs Group III **(P<0.000)** (Group III>Group II) with mean difference (-5.137) showed statistically significant difference between groups.

Table 10- Correlation of hard tissue symphysis morphology (linear) and soft tissue chin thickness (linear) of different groups

Group	Parameters		Pog-Pog'	Gn-Gn'	Me-Me'	B'-Me'
Group I (Normo Divergent)	Id-me	Pearson Correlation	-.246	-.055	$-.466^{**}$	$-.251^{*}$
		Sig. (2-tailed)	0.058	.674	.000	.057
	B-Me	Pearson Correlation	$.450^{**}$	.065	.195	.084
		Sig. (2-tailed)	.000	.623	.135	.523
	Pog-Lg Pog	Pearson Correlation	$.282^{*}$	.061	$.583^{**}$	$.321^{*}$
		Sig. (2-tailed)	.029	.643	.000	.012
	Pog to B-Me	Pearson Correlation	$.469^{**}$	.068	$.485^{**}$	$.318^{*}$
		Sig. (2-tailed)	.000	.606	.000	.013
Group II (Hypo Divergents)	Id-Me	Pearson Correlation	$.531^{**}$	.230	$.496^{**}$	$.854^{**}$
		Sig. (2-tailed)	.000	.077	.000	.000
	B-Me	Pearson Correlation	$.649^{**}$	$.458^{**}$	$.613^{**}$	$.592^{**}$
		Sig. (2-tailed)	.000	.000	.000	.000
	Pog-Lg Pog	Pearson Correlation	$.378^{**}$	$.524^{**}$	$.534^{**}$	$.268^{*}$
		Sig. (2-tailed)	.003	.000	.000	.038
	Pog to B-Me	Pearson Correlation	$.654^{**}$	$.656^{**}$	$.691^{**}$	$.401^{**}$
		Sig. (2-tailed)	.000	.000	.000	.001
Group III (Hyper Divergents)	Id-Me	Pearson Correlation	$.547^{**}$	$.272^{*}$	$.411^{**}$	$.534^{**}$
		Sig. (2-tailed)	.000	.035	.001	.000
	B-Me	Pearson Correlation	$.556^{**}$	$.310^{*}$	$.516^{**}$	$.552^{**}$
		Sig. (2-tailed)	.000	.016	.000	.000
	Pog-Lg Pog	Pearson Correlation	$.503^{**}$	$.670^{**}$	$.721^{**}$	.230
		Sig. (2-tailed)	.000	.000	.000	.077
	Pog to B-Me	Pearson Correlation	$.401^{**}$	$.567^{**}$	$.736^{**}$	$.323^{*}$
		Sig. (2-tailed)	.002	.000	.000	.012

Table-10 shows the pearson correlation between linear hard tissue and soft tissue measurements in the Normo Hypo and Hyper divergents.

In the Group I there was non-significant correlation LdMe, BMe and soft tissue parameters. Hard Tissue parameter Pog Pog had significant positive correlation with **Pog-Pog' (=0.282), Me-Me' (r=0.583) and B-Me (r=0.321).** There was increase in the value of Pog-Lg Pog with subsequent increase in the value of these soft tissue parameters. the Pog to B-me had significant positive correlation with **PogPog (=0.469), Me Me (r=0.485) and BMe (r=0.318).**

In the Group II LdMe had significant positive correlation with Pog-Pog' (=0.531), Me-Me' (r=0.496) and B'-Me' (r=0.854). Linear Hard Tissue Parameter B-me had significant positive correlation with Pog-Pog' (=0.649), Gn-Gn' (r=0.458), Me-Me' (r=0.613) and B'-Me' (r=0.592). Linear Hard Tissue Parameter Pog- Lg Pog had significant positive correlation with Pog-Pog' (=0.378), Gn-Gn' (r=0.524), Me-Me' (r=0.534) and B'-Me' (r=0.268) . Linear Hard Tissue Parameter Pog to B-me had significant positive correlation with Pog-Pog' (=0.654), Gn-Gn' (r=0.656), Me-Me' (r=0.691) and B'-Me' (r=0.401)

In the Group III LdMe had significant positive correlation with Pog-Pog' (=0.547), Gn-Gn' (r=0.272), Me-Me' (r=0.411) and B'-Me' (r=0.534). Linear Hard Tissue Parameter Bme had significant positive correlation with Pog-Pog' (=0.556), Gn-Gn' (r=0.310), Me-Me' (r=0.516) and B'-Me' (r=0.552). Linear Hard Tissue Parameter Pog-Lg Pog had significant positive correlation with Pog-Pog' (=0.503), Gn-Gn' (r=0.670), Me-Me' (r=0.721). Linear Hard Tissue Parameter Pog to B-me had significant positive correlation with Pog-Pog' (=0.401), Gn-Gn' (r=0.567), Me-Me' (r=0.736) and B'-Me' (r=0.323)

Table no. 11- Correlation of hard tissue symphysis morphology (angular) and soft tissue chin thickness (angular) of different groups

Group	Parameters		Pog-Pog'	Gn-Gn'	Me-Me'	B-Me'
Group I (Normo Divergent)	B-Pog-Me	Pearson Correlation	.143	.367**	.208	.335**
		Sig. (2-tailed)	.276	.004	.110	.009
	Id-B-Pog	Pearson Correlation	.266*	.441**	.268*	-.199
		Sig. (2-tailed)	.040	.000	0.038	.128
	B-Pog-MP	Pearson Correlation	.208	.244	.731**	.283*
		Sig. (2-tailed)	.111	0.050	0.001	0.028
	B-G-Gn	Pearson Correlation	-.050	-.158	-.307*	-.111
		Sig. (2-tailed)	.716	.249	.022	.421
	B-Me-Pog	Pearson Correlation	-.220	-.100	-.345**	-.433**
		Sig. (2-tailed)	.096	.457	.008	.001
	Me-Pog-B	Pearson Correlation	.246	.156	.398**	.460**
		Sig. (2-tailed)	.063	.243	.002	.000
	Pog to B-ME	Pearson Correlation	-.053	-.061	-.168	-.105
		Sig. (2-tailed)	.698	.654	.213	.437
Group II (Hypo Divergents)	B-Pog-Me	Pearson Correlation	.477**	.593**	.563**	.259*
		Sig. (2-tailed)	.000	.000	.000	.046
	Id-B-Pog	Pearson Correlation	.341**	.220	.053	.039
		Sig. (2-tailed)	.008	.091	.690	.766

	B-Pog-MP	Pearson Correlation	.401**	.249	.623**	.255*
		Sig. (2-tailed)	.002	.055	.000	.049
	B-G-Gn	Pearson Correlation	.270	-.074	-.325*	-.682**
		Sig. (2-tailed)	.044	.576	.011	.000
	B-Me-Pog	Pearson Correlation	.021	-.198	-.371**	-.623**
		Sig. (2-tailed)	.875	.129	.004	.000
	Me-Pog-B	Pearson Correlation	.270	.493**	.268	.263
		Sig. (2-tailed)	.044	.000	.044	.048
	Pog o B-ME	Pearson Correlation	-.110	-.188	.166	.382**
		Sig. (2-tailed)	.403	.150	.206	.003
Group III (Hyper Divergents)	B-Pog-Me	Pearson Correlation	.281*	.474**	.080	.425**
		Sig. (2-tailed)	.029	.000	.543	.001
	Id-B-Pog	Pearson Correlation	.261	.490**	.284	.482**
		Sig. (2-tailed)	.036	.000	.024	.000
	B-Pog-MP	Pearson Correlation	.312*	.645**	.342**	.350**
		Sig. (2-tailed)	.015	.000	.008	.006
	B-G-Gn	Pearson Correlation	.272*	.034	.000	-.046
		Sig. (2-tailed)	.036	.799	.998	.730
	B-Me-Pog	Pearson Correlation	-.281*	-.355**	-.364**	-.237
		Sig. (2-tailed)	.030	.005	.004	.068
	Me-Pog-B	Pearson Correlation	.272*	.245	-.070	.247*

		Sig. (2-tailed)	.036	.049	.595	.047
	Pog-B-ME	Pearson Correlation	.170	.067	.354**	.026
		Sig. (2-tailed)	.195	.613	.006	.843

Table-11 shows the pearson correlation between linear hard tissue and soft tissue measurements in the Group I, group II, group III.

In the normo divergent, hard tissue parameter LiBPog had significant positive correlation with Pog-Pog’ (r=0.457), Gn-Gn’ (r=0.382) and Me-Me’ (r=0.340). B-Pog-MP had significant positive correlation with **Me –Me’** (=0.453), B-G-Gn had significant positive correlation with B’-Me’ (r=0.324). B-Me-Pog had significant positive correlation with Gn-Gn’ (r=-0.317). Me-Pog-B had significant negative correlation with Gn-Gn’.

In the Hypo divergent, hard tissue parameter Id-B-Pog had significant positive correlation with Pog-Pog’ (r=0.404), Gn-Gn’ (r=480) **Me-Me’** (=0.451) B-Gn-Gn had significant positive correlation with Pog-Pog’ (r=0.347), Gn-Gn’ (r=268)and B’-Me’ (r=0.306), Me-Pog-B had significant positive correlation with Pog-Pog’ (r=0.356), Gn-Gn’ (r=413) **Me-Me’** (=0.400) PogBME1 had significant positive correlation with B’-Me’ (r=0.278)

In the Hyper divergent, hard tissue parameter B-Pog-Me had significant positive correlation with Pog-Pog’ (r=0.466), Id-B-Pog had significant positive correlation with B’-Me’ (r=0.598), B-Pog-MP had significant positive correlation with Pog-Pog’ (r=0.474), Gn-Gn’ (r=285) **Me-Me’** (=0.535) and B’-Me’ (r=0.266), Me-Pog-B had significant positive correlation with Pog-Pog’ (r=0.536), Gn-Gn’ (r=259) **Me- Me’** (=0.399) and B’-Me’ (r=0.436).

The facial esthetics and balanced facial profile has already been important to orthodontic practice. Any imbalance in the nose, lip, chin, and dentition compromises facial aesthetics, for which patients seek orthodontic treatment.

There was a trend in orthodontic therapy to rely entirely on hard tissue. The shift from hard tissue paradigm to soft tissue paradigm has emphasized the relevance of soft tissue in case diagnosis and treatment planning, hence evolution of numerous soft tissue characteristics have become an integral part of the Orthodontic problem list[49].

The patients are clearly more interested in witnessing an improvement in the soft tissue profile as compared to bony changes or tooth angulations as shown on a cephalometric radiograph. To restore the harmony in soft tissue structures dictating an individual's profile, alterations in underlying hard tissue structures are brought above through extraction or non-extraction modalities of orthodontic therapy.

Many prior researchers,[3-5, 8-10, 15-44, 55-63] investigated soft and hard tissues in normal subjects having various types of face divergence and discovered heterogeneity in the result.

There are several ways for assessing soft tissue and hard tissue, including clinical method, radiographic method, and photographic methods. Given this, it was decided to employ a radiographic approach (Lateral Cephalogram) to assess changes to soft tissue for subjects with varying degrees of facial divergence.

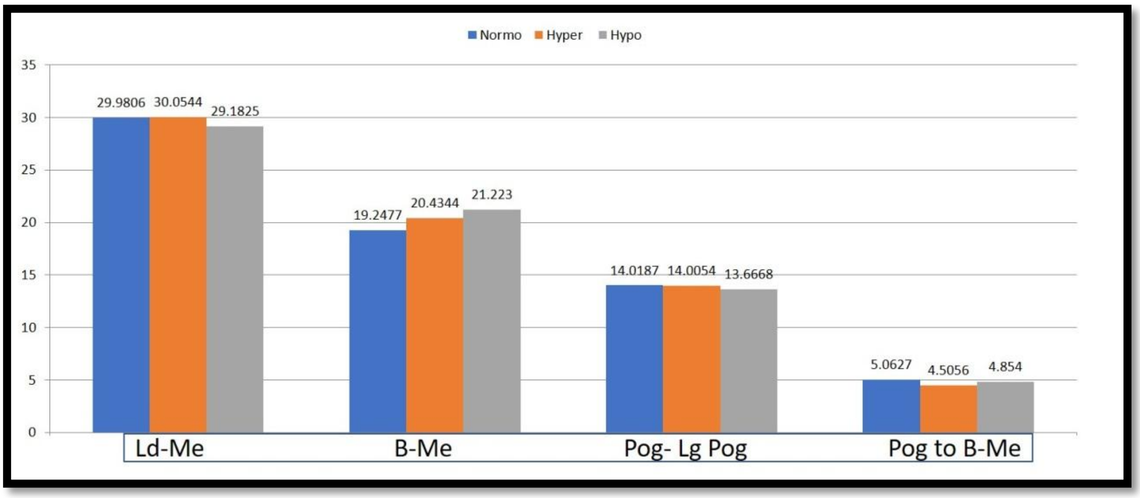
The hard tissue chin shape, as well as the overlying soft tissues, significant effect in the overall treatment outcome of an Orthodontic patient. The size and shape of the symphysis are the result of a combination of hereditary, non-genetic, and adaptive factors[50]. Considering the relevance of symphysial morphology as measured by symphysial depth, height, and symphysial inclination, prior researches had compared these parameters in different races, facial divergence, mandibular incisor inclination, and so on.

As symphysis morphology and soft tissue chin thickness are experienced individually in different facial divergence, hence it was decided to assess various hard tissue and soft tissue parameters related to symphysis morphology and soft tissue chin thickness of face in the present study. Considering this the aim of this study was to evaluate hard and soft tissue symphysis morphology in subjects with different facial divergence pattern and find the correlation between morphology of mandibular symphysis and soft tissue thickness in subjects with different facial divergence pattern

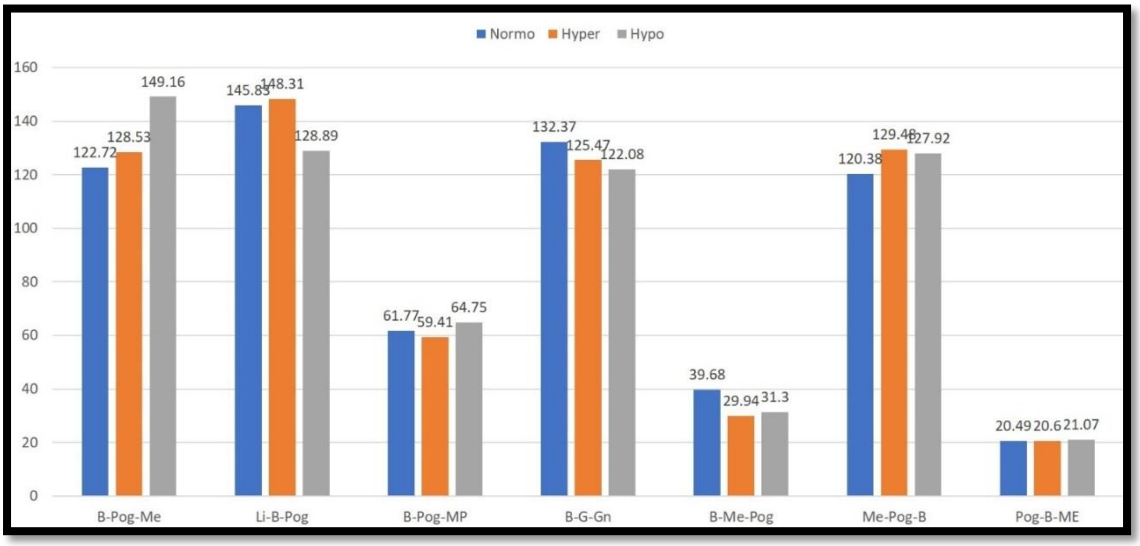
This study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Babu Banarasi das College of Dental Sciences, BBD University, Lucknow, on Pre-orthodontic treatment lateral cephalograms of 220 subjects collected from the OPD and department's record files. Based on facial divergence, as measured by Jaraback ratio (posterior facial height/anterior facial height) and SN-GoGn angle, final sample of 180 subjects was divided into three groups. Group I (n=60) included with normodivergent patterns, Group II (n=60) included with hypodivergent patterns, and Group III (n=60) included with hyperdivergent pattern. The subjects taken were above 18 years of age so that complete growth had occurred in both the sexes hence any variation in the parameters because of differential growth was not present.

The soft copies of lateral cephalograms were transferred to the computer loaded with Nemotech software program. Before beginning tracing, the cephalogram image was calibrated, and cephalometric landmarks and points were discovered and marked using a mouse/cursor. Following the identification of cephalometric points and landmarks, adjustments were made as needed, and tracing will be performed automatically by software. A total of 17 parameters were used to measure hard tissue and soft tissue morphology of symphysis, out of which eight were linear parameters (4 hard tissue and 4 soft tissue) and nine were angular parameters (seven hard tissue and 2 soft tissue) for morphology of mandibular symphyseal and soft tissue chin thickness were measured by the software.

The results of present study for **overall intergroup comparison** for hard and soft tissue suggested that evaluating hard tissue symphyseal morphology, among linear parameters, only lower symphyseal height (B-Me) (Group II >Group III> Group I), in angular, symphyseal convexity (B-Pog-Me) (Group II >Group III> Group I), symphyseal concavity (Id-B-Pog) (Group II >Group III> Group I), symphyseal inclination (B-Pog-MP) (Group II >Group I> Group III), symphyseal symphysis convexity in relation to point G (B-G-Gn) (Group I >Group III> Group II), symphysis projection angle (Me-Pog-B) (Group III >Group II> Group I), lower symphysis projection (Pog-Me-B) (Group I >Group II> Group III), parameters showed statistically significant difference in all the groups. Table no. 4, graph- 1,2

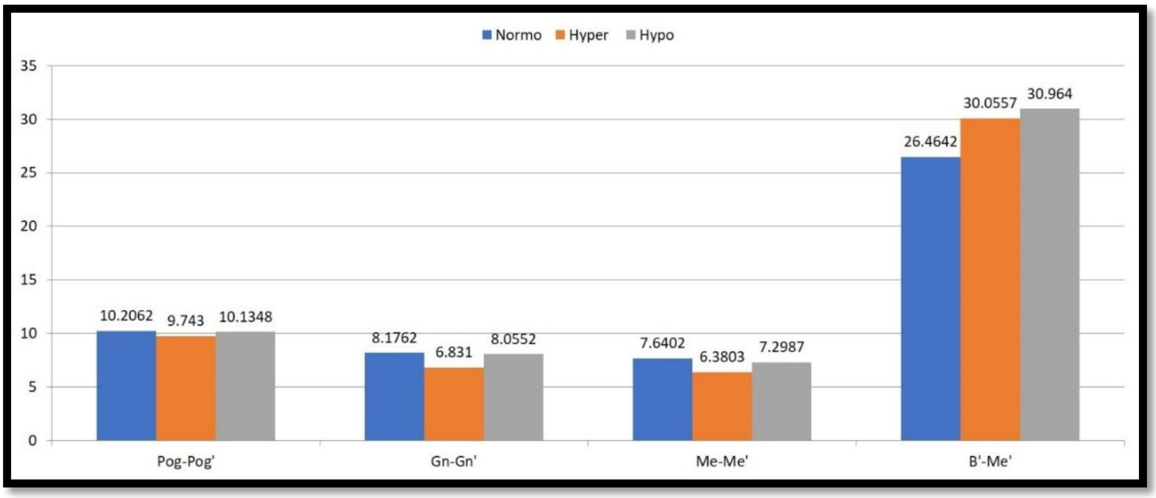


Bar diagram 1: linear parameter of hard tissue symphysis morphology of different group

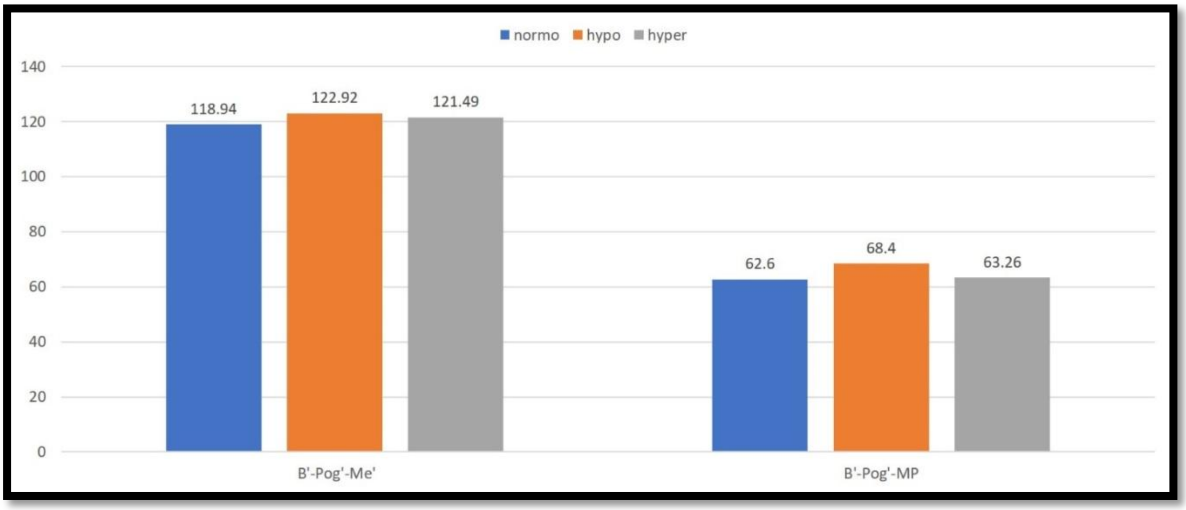


Bar diagram 2: angular parameter of hard tissue symphysis morphology of different group

For soft tissue two linear parameters, symphyseal morphology, soft tissue chin thickness at Gnathion (Gn-Gn’) (group I >Group II> group III), soft tissue chin thickness at Me (Mn-Mn’) (group I >Group II> group III) showed statistically significant difference for all the groups. Table no. 5, Graph- 3,4



Bar diagram 3: Linear parameters of Soft Tissue symphyseal morphology of different group



Bar diagram 3: Linear parameters of Soft Tissue symphyseal morphology of different group

Intergroup comparison between all the groups suggested that while evaluating hard tissue symphyseal morphology

For **I Vs Group III and group I Vs Group III**, among all hard tissue linear parameters only lower symphyseal height (B-Me) showed statistically significant difference. however, in angular parameters, symphyseal convexity (B-Pog-Me), symphyseal concavity (Id-B-Pog), symphyseal inclination (B-Pog-MP), symphyseal symphysis convexity in relation to point G (B-G-Gn), upper symphysis inclination

(Pog-B-Me), symphysis projection angle (Me-Pog-B) showed statistically significant difference.

For **Group II Vs Group III** in linear parameters only lower symphyseal height (B-Me) showed statistically significant difference. however, in angular parameters, symphyseal convexity (B-Pog-Me), symphyseal concavity (Id-B-Pog), symphyseal inclination (B-Pog-MP), symphyseal convexity in relation to point G (B-G-Gn), upper symphysis inclination showed statistically significant difference. Table-5 fig

While comparing the soft tissue parameters,

For **Group I Vs Group II** in linear parameters only height of symphysis (B'-Me'), in angular parameters, soft tissue symphysis convexity (B'-Pog'-Me'), symphysis inclination (B'-Pog'-Me') showed statistically significant difference,

For Group I Vs Group III only linear parameters, soft tissue chin thickness at Gnathion (Gn-Gn'), soft tissue chin thickness at Me (Mn-Mn'), soft tissue height of symphysis (B'-Me') and showed statistically significant difference,

For Group II Vs Group III, soft tissue chin thickness at Gnathion (Gn-Gn'), soft tissue chin thickness at Me (Mn-Mn'), in angular parameters soft tissue symphyseal inclination (B'-Pog'-MP'), showed statistically significant difference.

Correlation of hard tissue symphysis morphology (linear) and soft tissue chin thickness (linear) of different groups showed that no definitive trend or strong correlation was found between hard tissue symphysis morphology with soft tissue chin thickness at Pog', Gn' or Me' for all the groups

In Group I (Normo divergent) Total symphyseal height (Id-me) showed negative correlation with Pog-Pog' (r=-0.246), Gn-Gn' (r=-0.055), Me-Me' (r=-0.466) and B'-Me'(r=-0.251) but it was statistically significant for only with Me-Me'; **Lower symphyseal height** (**B-me)** showed positive correlation with Pog-Pog' (r=0.450) which was statistically significant, whereas with Gn-Gn' (r=0.065), Me-Me' (r=0.195) and B'-Me'(r=0.084) it was statistically non-significant; **Width of symphysis** (**Pog-LgPog)** showed statistically significant positive correlation with Pog-Pog' (r=0.282), Gn-Gn' (r=0.061), Me-Me' (r=0.583) and B'-Me'(r=0.321); **Symphyseal projection** (**B-Me)** also showed statistically significant positive correlation with Pog-Pog' (r=0.469), Gn-Gn' (r=0.68), Me-Me' (r=0.485) and B'-

Me’(r=0.318) and showed statistically significant with Pog-Pog’, Me-Me’ and B’-Me’.

In Group II (hypodivergent) Total symphyseal height (Id-Me) showed statistically significant positive correlation with Pog-Pog’ (r=0.531), Gn-Gn’ (r=0.230), Me-Me’ (r=0.496) and B’-Me’(r=0.854); **Lower symphyseal height (B-Me)** showed significantly positive correlation with Pog-Pog’ (r=0.649), Gn-Gn’ (r=0.458), Me-Me’ (r=0.613) and B’-Me’(r=0.592); **Symphyseal width (Pog-LgPog)** showed statistically significant positive correlation with Pog-Pog’ (r=0.378), Gn-Gn’ (r=0.524), Me-Me’ (r=0.534) and B’-Me’(r=0.268); **symphyseal projection (Pog to B-Me)** showed significantly positive correlation with Pog-Pog’ (r=0.654), Gn-Gn’ (r=0.656), Me-Me’ (r=0.691) and B’-Me’(r=0.401).

In Group III (hyperdivergent) Total symphyseal height (Id-Me) showed statistically significant positive correlation with Pog-Pog’ (r=0.547), Gn-Gn’ (r=0.272), Me-Me’ (r=0.411) and B’-Me’(r=0.534); **Lower symphyseal height (B-Me)** showed statistically significant positive correlation with Pog-Pog’ (r=0.556), Gn-Gn’ (r=0.318), Me-Me’ (r=0.411) and B’-Me’(r=0.534); **Symphyseal width (Pog-LgPog)** showed significantly positive correlation with Pog-Pog’ (r=0.503), Gn-Gn’ (r=0.670), Me-Me’ (r=0.721); **Symphyseal projection Pog to B-Me** showed statistically significant positive correlation with Pog-Pog’ (r=0.401), Gn-Gn’ (r=0.567), Me-Me’ (r=0.736) and B’-Me’(r=0.323).

correlation of hard tissue symphysis morphology (angular) and soft tissue chin thickness (linear) for different groups showed

IN GROUP I (NORMODIVERGENT) hard tissue parameter **symphysis convexity (B-Pog-Me)** showed insignificant positive correlation with **Pog-Pog’** (r=0.143), **Me-Me’** (r=0.208) and significant positive correlation with **Gn-Gn’** (r=0.453), **B-Me’** (r=0.335); **For symphysis concavity (Id-B-Pog)-** showed statistically significant positive correlation with Pog-Pog’ (r=0.266), **Gn-Gn’** (r=0.441), Me-Me’ (0.268), but only **B-Me’** (r=-.199) showed insignificant negative correlation; **For symphysis inclination (B-Pog-MP)** showed statistically insignificant positive correlation with **Pog-Pog’** (r=0.208), **Me-Me’** (r=0.731), **Gn-Gn’** (r=0.244), **B-Me’** (r=0.283) showed statistically significant positive correlation; **For symphysis convexity at point G (B-G-Gn)** showed statistically non-significant negative correlation with **Pog-Pog’** (r=-0.050), **Gn-Gn’** (r=-0.158), **Me-Me’** (r=-0.307), **B-Me’** (r=-0.111); **For lower**

symphyseal projection (B-Me-Pog) showed statistically non-significant negative correlation with Pog-Pog’ (r=-0.220), **Gn-Gn’** (r=-0.100), Me-Me’ (r=-0.345), **B-Me’** (r=-0.433); **For upper symphysis angle (Me-Pog-B)** showed insignificant positive correlation with **Pog-Pog’** (r=0.246), **Gn-Gn’** (r=0.156), **Me-Me’** (r=0.398), **B-Me’** (r=0.460); **For upper symphysis inclination (Pog- B-Me**) showed statistically significant negative correlation with Pog-Pog’ (r=-0.053), **Gn-Gn’** (r=-0.061), Me-Me’ (r=-0.168), **B-Me’** (r=-0.105).

IN GROUP II (HYPODIVERGENT) hard tissue parameter **for symphysis convexity (B-Pog-Me)** showed statistically significant positive correlation with **Pog-Pog’** (r=0.477), **Gn-Gn’** (r=0.593), **Me-Me’** (0.563), **B-Me’** (r=0.259); **For symphysis concavity (Id-B-Pog)** showed insignificant positive correlation with **Pog-Pog’** (r=0.341), **Gn-Gn’** (r=0.220), **Me-Me’** (0.053), **B-Me’** (r=0.039); **For symphysis inclination (B-Pog-MP)** showed statistically significant positive correlation with **Pog-Pog’** (r=0.401), **Me-Me’** (0.623), **B-Me’** (r=0.255) but **Gn-Gn’** (r=0.249) showed statistically non-significant; **For symphysis convexity at point G (B-G-Gn)** showed significantly positive correlation with **Pog-Pog’** (r=0.270) and statistically significant negative correlation with **Me-Me’** (r=-0.325), **B-Me’** (r=-0.682) but **Gn-Gn’** (r=-0.074) showed insignificant negative correlation; **For lower symphysis projection (B-Me-Pog)** showed insignificant positive correlation with **Pog-Pog’** (r=0.021) and insignificant negative correlation **Gn-Gn’** (r=-0.198) but **Me-Me’** (r=-0.371), **B-Me’** (r=-0.623) showed statistically significant negative correlation; **For symphysis projection angle (Me-Pog-B)** showed statistically significant positive correlation with **Pog-Pog’** (r=0.270), **Gn-Gn’** (r=0.493), **Me-Me’** (r=0.268), **B-Me’** (r=0.263); **For Upper symphysis inclination (Pog-B-Me)** showed insignificant negative correlation with **Pog-Pog’** (r=-0.110), **Gn-Gn’** (r=-0.188), and insignificant positive correlation with **Me-Me’** (r=0.166), but **B-Me’** (r=-0.382) showed statistically non-significant positive correlation;

IN GROUP III (HYPERDIVERGENT) hard tissue parameter **Symphysis convexity (B-Pog-Me)** showed statistically significant positive correlation with **Pog-Pog’** (r=0.281), **Me-Me’** (0.080), **B-Me’** (r=0.425) but **Gn-Gn’** (r=0.474) showed statistically non-significant positive correlation; **For symphysis concavity (Id-B-Pog)** showed statistically significant positive correlation with **Pog-Pog’** (r=0.261),

Gn-Gn' (r=0.490), **Me-Me'** (0.284), and **B-Me'** (r=0.482); **For symphysis inclination (B-Pog-MP)** showed statistically significant positive correlation with **Pog-Pog'** (r=0.312), **Gn-Gn'** (r=0.645), **Me-Me'** (0.345), **B-Me'** (r=0.350); **For symphysis convexity at point G (B-G-Gn)** showed significantly positive correlation with **Pog-Pog'** (r=0.272) but showed statistically non-significant negative correlation with **Gn-Gn'** (r=0.034), **Me-Me'** (r=0.000) and with **B-Me'** (r=-0.046); **For lower symphysis projection (B-Me-Pog)** showed statistically significant negative correlation with **Pog-Pog'** (r=-0.281), **Gn-Gn'** (r=-0.355), **Me-Me'** (r=-0.364) but **B-Me'** (r=-0.237) showed statistically significant negative correlation; **For symphysis projection angle (Me-Pog-B)** showed statistically significant positive correlation with **Pog-Pog'** (r=0.272), **Gn-Gn'** (r=0.245), **B-Me'** (r=0.247) and **Me-Me'** (r=-0.070) showed insignificant negative correlation;

For upper symphysis inclination (Pog-B-Me) showed statistically insignificant positive correlation with **Pog-Pog'** (r=0.170), **Gn-Gn'** (r=0.067), **B-Me'** (r=0.026) but **Me-Me'** (r=0.354) showed statistically significant positive correlation**.**

The results obtained the present study would be compared with previous studies [5-10, 15-44] that evaluated Hard and soft tissue symphysis morphology. Direct comparison could not be done for results of correlation as evaluated between hard tissue symphyseal morphology and soft tissue chin thickness as it was not evaluated in any of the previous study.

Gomez Y et al [22] conducted a study to evaluate the relationships between the soft tissue symphysis dimensions and the underlying osseous structures and on 385 Cone-beam computed tomography scan of subjects that were classified according to their skeletal class and vertical pattern. Similar to our study, Total symphysis height (Id - ME) in their study was highest in Hyperdivergent patients (29±3.2 mm) followed by normodivergent (27.3±3 mm) and then hypodivergent (26.8±3.7 mm); for symphysis convexity angles, value was seen in highest in hyperdivergent subjects (129.6±7.9 mm) followed by normodivergent (128.3±8.5 mm) and then hypodivergent (121.9±18.7 mm), symphyseal projection (Pog to B-Me), was higher for hypodivergent (-5±1.4), followed by Hypodivergent (-4.7±1.4), and then hyperdivergent (-4.2±1.4 mm); and these differences were statistically significant. in other parameters concavity of the symphysis was highest in hypodivergent (-

100.6±11.9) and least in hyperdivergent subjects (-95.6±24.8) and difference was statistically non-significant. This variability could be due to the fact that they divided their total sample with included subjects with class III malocclusion also into subjects with variable facial divergence to facial divergence. Moderate and weak correlations were found between hard tissue and soft tissue parameter.

Lingjauvi et al[8] compared the dimensions of mandibular symphysis (MS) between gender and the different sagittal and vertical skeletal relationships in104 subjects. Total symphysis height (Id -ME) in their study was highest in Hyperdivergent subjects (31.94±3.31 mm) followed by hypodivergent subjects (31.73±2.46) and normodivergent subjects (31.02±2.79); similar to trend seen in our study how ever difference was statistically significant. in their study in contrary to our study Symphysis convexity (B-Pog-Me) in their study was highest in Hyperdivergent subjects (131.99±11.21mm) followed by hypodivergent subjects (129.53±13.43) and normodivergent subjects (128.48±9.51); for Symphyseal concavity (Id-B-Me) highest value was seen in normodivergent subjects (151.05±5.29) followed by hyperdivergent subjects (150.05±6.84) and then hypodivergent subjects (148.64±6.38) and difference was statistically non-significant for all these parameters. contrary to this study symphyseal convexity was highest in hypodivergent subjects and symphyseal concavity was highest in hyperdivergent subjects and difference was statistically significant for both these parameters. This could be due to the fact that they included class III subjects also in their study for dividing sample according to divergence, whereas we did not have any class III sample.

They also found that Males had significantly greater mandibular symphysis surface area, dentoalveolar length, skeletal symphysis length, total symphysis length, vertical symphysis dimension and symphysis convexity ($p < 0.05$).

Mahajan et al[44] compare antegonial notch depth, symphysis morphology and ramus morphology among different growth patterns. 90 sample were divided into horizontal, average and vertical growth pattern based on Jarabak's ratio. The antegonial notch depth, symphysis morphology (height, depth, ratio and angle) and ramus morphology (height and width) were evaluated. Symphysis depth was highest in horizontal grower (14.06±1.98) followed by average grower (13.60±1.69) and least in vertical growth (13.43±2.16); for symphysis height highest (B-Me) in horizontal grower (21.40±3.09) followed by vertical grower (20.40±3.26) and average grower (19.83±2.24). In their study they found statistically non-significant difference for all these parameters, symphyseal depth of their study is similar to symphyseal width (Pog-Lg Pog) which did not statistically significant in our study as well. However, we found statistically significant difference for symphysis height (B-Me), these variations could be due to difference in methodology of taking these measurements. They used a grid and perpendicular line to tangent from point B was taken as upper element and inferior base of symphysis as inferior limit but we took direct measurements.

Khateeb et al[17] evaluated the morphology and dimensions of mandibular symphysis in different anteroposterior jaw relationships. They found Total height of symphysis (Id-Me), Symphyseal concavity (Id-B-Me) varied significantly with anteroposterior relationship whereas Symphyseal projection (Pog to B-Me), symphyseal convexity (B-Pog-Me) and symphysis inclination (B-Pog-Md) did not differ significantly in sagittal plane. Though in present study, we evaluated variation in the morphology of symphysis in vertical plane, but results for certain parameters were conflicting. Contrary to their study symphyseal inclination was significantly affected by variation in vertical plane (hypodivergent> normodivergent> hyperdivergent). This could be due to the fact that in hyperdivergent subjects line B-Pog became straighter and Mn plane rotated downward and backward thereby decrease in symphysis inclination was seen. Similar to their study angle of symphysis concavity differed significantly in vertical plane in present study. In their study angle of symphyseal concavity was least in Class III malocclusion in sagittal plane and similar pattern was seen in present study for hypdivergent subjects. Contrary to their study total symphyseal height (Id-Me), did not differ significantly in vertical plane in present study. This could be attributed to the fact that incisors are more proclined in hypodivergent subject resulting in forward positioning of infradentale whereas in hyperdivergent subjects, downward and backward rotation of mandible resulted in inferior positioning of Me, thus increasing total symphysis height.

Also, the results of the present study will be compared with the studies in different skeletal class done by **Sadheghian et al**[19] reported that and symphyseal concavity (Id-B-Me) was higher in skeletal class III patient.

also, the results of the present study will be compared with the studies in different malocclusion done by **Nobre et al**[50] reported that symphysis width (Pog- Lg Pog) was highest in class II division 2, which was statistically significant (P value=0.031)

Another angular parameter, symphysis convexity (B-Pog-Me) did not showed statistically significant difference in sagittal plane in their study, whereas it differed significantly in the present study. This could be attributed to the fact that in hypodivergent subjects, chin prominence was most and mandibular plane was flat, resulting in increased symphysis convexity in present study.

Kar et al[9] evaluated the ante-gonial notch width and mandibular symphysis morphology in subjects with different growth pattern. Lower symphysis height (B-me) was highest in hyperdivergent (21.70±3.06) followed by hypodivergent (20.27±2.25) and then normodivergent (21.707±3.06); symphysis depth (Pog-Lg Pog) was highest in hypodivergent (13.42±0.948) followed by normodivergent (13.23±1.47) and then hyperdivergent (12.063±1.6); symphyseal inclination (B-Pog-MP) was highest in hyperdivergent (66.33±6.63) followed by hypodivergent (66.20±5.30) and normodivergent (63.5±5.73), however, difference was statistically significant only for symphysis height and symphysis depth. These results were contrary however the trend was same as present study.

Tunis T S et al[32] determined the sexual variation for chin and symphysis size and shape in subject with various facial types using CBCT for both the sexes and sexual dimorphism was evident. Similar to our study, for both males and females, total symphyseal height (Id-Me) had a trend of Hyperdivergent > Normodivergent > Hypodivergent; Lower symphyseal height (B-Me) had a trend of Hypodivergent>Hyperdivergent > Normodivergent and different trend was seen for symphysis projection (Pog-Lg Pog) which was Hypodivergent>Hyperdivergent > normodivergent in their study but it was Normodivergent >Hypodivergent>Hyperdivergent in the present study. This difference could be attributed to assessment of symphysis morphology in mixed sample in present study.

Previously it was suggested that short facial height patient are characterized by a stronger masticatory function [51,52]. It is there for plausible that a greater chin thickness acts as a reinforcement mechanism in patient with stronger masticatory muscle function to reduce stress generated at the symphysis area and maintain its structural integrity.

According to author **Macari et al[3],** Patients with hyperdivergence had thinner soft tissue chin. This finding suggests that as the vertical expansion of the skeletal tissues increases, it impinges on the thickness of a soft tissue that no longer displaces in a corresponding ratio of 1:1, rather there is differential differential extension between hard and soft tissue during growth. [53,54]. The soft tissue chin thickness apparently adapts to severe hyperdivergence, presumably through increased stretching of the soft tissue except at Gn and Me region resulting in lesser chin thickness.

Evangelista et al[55] conducted a study to assessed morphology of the mandibular symphysis and soft tissue chin in 195 subjects that were divided according to sex, sagittal and vertical skeletal patterns. Width of symphysis at pogonion (Pog-Pog’) was highest in hypodivergent (12.5±2.5) followed by normodivergent (12.3±2.8) and then hyperdivergent (12.5±2.5) ; width of symphysis at Gnathion (Gn-Gn’) was highest in hypodivergent(Low MP) (11±3) followed by normodivergent (10.4±2.6) and then hyperdivergent(high MP) (9.4±2.4); width of symphysis at Menton (Me-Me’) was highest in hypodivergent(Low MP) (8.5±2.6) followed by normodivergent (Average MP) (8.7±2.1) and then hyperdivergent(high MP) (8.4±2.1)

The trend in present study was different for soft tissue chin thickness at Pogonion (Pog-Pog’) normodivergent > hypodivergent >hyperdivergent, chin thickness of at Menton’ (Me-Me’) normodivergent >hypodivergent >hyperdivergent and similar trend was seen for Gn-Gn’, Soft tissue chin thickness did not differ significantly at Pog-Pog’ but differed significantly at Gn-Gn’, in both the studies. In contrast to the present study, chin thickness at Me-Me’ differed significantly in present study.

Contrary to our study **Sofyanti et al** [20] found that width of symphysis at pogonion (Pog-Pog’) was highest in hypodivergent (13.71±1.54) followed by normodivergent (11.97±1.24) and then hyperdivergent (8.67±2.42) and statistically significant difference was present.

Somaiah et al[21] conducted his study on 80 subjects who were divided into 4 groups based on mandibular plane (MN) to cranial base angle (SN-GoGn). The groups were low (<27), medium low (27-32), medium high (32-37) and high (>37).

The trend for soft tissue chin thickness at Pog-Pog’, Gn-Gn’, me-me’ was mediumlow> medium high> low> high. Similar trend was seen for hyperdivergent subjects in present study where decreased chin thickness in comparision to normodivergent and hypodivergent subjects was seen for all parameters of soft tissue chin thickness.

Similar to present study **Khan et al**[56] did not show statistically significant diffrence between groups divided based on facial divergence for total symphyseal height (Id-B) and symphyseal width (pog-Lg Pog), however trend was slightly different.

Shinde et al[57] evaluated the soft tissue chin thickness in skeletal class I and Class II adults, 120 subjects divided into three groups hypodivergence ($<28^0$), normodivergence (28^o-36^o) and hyperdivergent ($>36^o$). For all the parameters Pog-Pog’, Gn-Gn’ and Me-Me’ highest value was seen in hypodivergent followed by normodivergent and then hyperdivergent. The trend is different than the present study however they did not make statistical comparison between the groups in this study.

Studies by **Feres et al[58], Celikoglu et al[18], Nanda et al[59], Arnett et al[60],** gave the insight the soft tissue chin thickness in various vertical and sagittal discrepancies. Patients with greater hyperdivergent growth pattern had thinner soft tissue at chin, at Pog’, Me’ and Gn’ however difference was statistically significant at Gn’ and Me’ only, was also evaluated in present study. Correlation was assessed between parameters of hard tissue symphyseal morphology with soft tissue chin thickness, however this was not assessed in any of the previous study, hence direct comparison was not possible. No definitive trend or strong correlation was found between hard tissue symphysis morphology with soft tissue chin thickness at Pog’, Gn’ or Me’ for all the groups in present study.

Overall conclusion changes from above studies in context to results of present study is that hard and soft tissue symphyseal morphology varied with facial divergence, however results were conflicting in term of statistical significance and trend of maximum and minimum value of various parameters in subjects with variable facial divergence.

Subtelny et al[61] stated that contours of soft tissues does not give an idea of the skeletal configuration below, in some areas soft tissue contour diverges from the underlying skeletal structure while other shows strong tendency to follow the skeletal change. Also, **Ricketts[62] and Viazis[63],** found that thick symphysis was associated with an anterior growth direction.

Thud the main clinical implication of assessing symphysis morphology is to know, how soft tissue drape has camouflaged underlying hard tissue symphysis morphology this will help us in deciding mandibular incisor inclination during camouflage orthodontic treatment, and help in dividing amount of movement of jaw bases during Ortho-surgical correction of skeletal discrepancies. Also amount of movement of hard tissue symphysis during augmentation or reduction genioplasty with corresponding movement of overlying soft tissue depending on facial divergence could be judged by assessing various parameters of symphysis morphology. It's possible that patients with severe hyperdivergence will require more advanced genioplasty to improve their chin projection since the mandible has grown more vertically at the expense of its anterior projection and soft tissue is more stretched.

Further studies should be aimed at conducting study on larger sample size, to evaluate sex and related variations in symphysis morphology, to compare symphysis morphology between pre and post Orthodontic treatment. also, symphysis morphology should be assessed on 3D imaging technique like CBCT.

This variations in symphysis morphology with facial divergence should also be considered while assessing soft tissue profile while using morphing tool of various cephalometric soft tissue. Along with of displacement at Me’ and Gn’ should as per facial divergence whereas it could be same at Pog’ that did not show much variations.

Following conclusion were drawn from the present study conducted to evaluate hard and soft tissue morphology of mandibular symphysis in subjects with different facial divergence pattern and to find correlation between mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern.

1. For hard tissue symphyseal morphology, Lower symphyseal height (Group II> Group III > Group I), Symphyseal convexity (Group II> Group III > Group I), symphysis concavity (Group III> Group I > Group II), symphysis inclination (Group II> Group I > Group III), symphysis convexity in relation to point G (Group I> Group III > Group II) showed statistically significant difference between the groups.

2. Soft tissue symphyseal height (Group II> Group III > Group I) and symphysis inclination (Group II> Group III > Group I) showed statistically significant difference between the groups.

3. Soft tissue chin thickness differed significantly at Gn’ and Me’ between groups, however it was not statistically significant at Pog’.

4. Hyper divergent subjects had significantly lesser in lower height of symphysis, symphysis convexity and symphysis inclination and greater in symphysis concavity angle than hypodivergent subjects. Also soft tissue chin thickness was significantly greater at Gn’ and Me’ for hypodivergent subjects in comparison to hyperdivergent subjects.

5. No definitive trend or strong correlation was found between hard tissue symphysis morphology with soft tissue chin thickness at Pog’, Gn’ or Me’ for all the groups.

Further studies should be aimed at conducting study on larger sample size, to evaluate sex and are related variations in symphysis morphology, to compare symphysis morphology between pre and post Orthodontic treatment. Also, symphysis morphology should be assessed on 3D imaging technique like CBCT.

Orthodontic treatment planning should consider both hard and soft tissues in order to achieve consistent results in terms of harmonious facial aesthetics and optimal occlusion. The sole consideration of hard tissues alone, may help in achieving ideal cephalometric values but not ideal profile as soft tissue drape compounds the problem.

Many studies have emphasized on the importance of soft tissue in determining facial aesthetics, on the basis, that soft tissue behaves independently from the underlying skeleton. The covering facial soft tissues (muscles, fat, skin) can develop in proportion or disproportion to the corresponding skeletal structures. Also, variations in thickness, length, and tonicity of the soft tissues may affect the position and the relationships among the facial structures.

Thus, there is a shift in paradigm from "hard tissue" to "soft tissue" with more focus on esthetics and basing orthodontic diagnosis and treatment planning, predominantly on soft tissue considerations and not merely on skeletal/ dental relationships.

Mandibular symphysis (MS) morphology serves as a reference anatomical landmark for esthetics and beauty of the face in general and of the lower part in particular. Hard tissue chin form along with overlying soft tissues play a great role in final treatment outcome of Orthodontic patient. The size and shape of symphysis results from an inter play of various factors that can be genetic, non-genetic or the adaptive factors (as area just above prominence of chin is resorptive in nature and rest is depository in nature). As soft tissue adapts to underlying symphysis and soft tissue chin thickness is not uniform, hence visible chin prominence is variable in different subjects with considering, this the aim of this study was to evaluate hard and soft tissue symphysis morphology in subjects with different facial divergence pattern and find the correlation between morphology of mandibular symphysis and soft tissue thickness in subjects with different facial divergence pattern

The sample for the study comprised of 180 pre-treatments lateral cephalograms of Orthodontic patients coming to OPD of Department with different facial divergence. From a total of 220 lateral cephalograms was devided on the basis of Jaraback ratio and SN-GoGn angle. Sample divided into three groups, Group I: Normodivergent (n=60), Group II: Hypodivergent (n=60) and Group III: Hyperdivergent (n=60). The lateral cephalograms of all the groups would then be transferred to a computer loaded with Planmeca software and saved in bitmap files and transfered to CD ROM. The soft copy of lateral cephalograms were transferred to the computer loaded with Nemotech software program. The image of cephalogram was first calibrated, then cephalometric landmarks and point were identified and marked with the help of mouse/cursor. The adjustment were done as per requirement. Angular and linear measurements for hard and soft tissue morphology of mandibular symphysis and soft tissue chin thickness were measured by the software for all the groups Data was tabulated, adequate inter and intra group comparison were made. Pearson correlation was used to correlate hard tissue symphyseal morphology with soft tissue chin thickness.

Following conclusion were drawn from the present study

1. For hard tissue symphyseal morphology, Lower symphyseal height (Group II> Group III > Group I), Symphyseal convexity (Group II> Group III > Group I), symphysis concavity (Group III> Group I > Group II), symphysis inclination (Group II> Group I > Group III), symphysis convexity in relation to point G (Group I> Group III > Group II) showed statistically significant difference between the groups.
2. Soft tissue symphyseal height (Group II> Group III > Group I) and symphysis inclination (Group II> Group III > Group I) showed statistically significant difference between the groups.
3. Soft tissue chin thickness differed significantly at Gn’ and Me’ between groups, however it was not statistically significant at Pog’.
4. Hyper divergent subjects had significantly lesser in lower height of symphysis, symphysis convexity and symphysis inclination and greater in symphysis concavity angle than hypodivergent subjects.

   Also soft tissue chin thickness was significantly greater at Gn’ and Me’ for hypodivergent subjects in comparison to hyperdivergent subjects.

5. No definitive trend or strong correlation was found between hard tissue symphysis morphology with soft tissue chin thickness at Pog’, Gn’ or Me’ for all the groups.

With in the limitations of present study, it can be suggested that hard and soft tissue symphysis morphology varied with facial divergence and soft tissue camouflaged the underlying skeletal discrepancy to certain extent.

Further studies should be aimed at conducting study on larger sample size, to evaluate sex and are related variations in symphysis morphology, to compare symphysis morphology between pre and post Orthodontic treatment. Also, symphysis morphology should be assessed on 3D imaging technique like CBCT.

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ANNEXURE- I

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES (FACULTY OF BBD UNIVERSITY), LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Correlation between Morphology of Mandibular Symphysis and Soft Tissue Chin Thickness in Subjects with Different Facial Divergence Pattern"** submitted by **Dr Bhanu Pratap** Post graduate student from the **Department of Orthodontics and Dentofacial Orthopaedics** as part of MDS Curriculum for the academic year 2020-2023 with the accompanying proforma was reviewed by the Institutional Research Committee present on **12th October 2021** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

ANNEXURE- II

Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the IX[th] Institutional Ethics Sub-Committee

IEC Code: 04 **BBDCODS/04/2022**

Title of the Project: Correlation Between Morphology of Mandibular Symphysis and Soft Tissue Chin Thickness in Subjects with Different Facial Divergence Pattern.

Principal Investigator: Dr Bhanu Pratap **Department:** Orthodontics & Dentofacial Orthopaedics

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr Bhanu Pratap,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 07[th] April, 2022.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow
2.	Dr. Amrit Tandan Member	Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow
3.	Dr. Rana Pratap Maurya Member	Reader, Department of Orthodontics, BBDCODS, Lucknow
4.	Dr. Akanksha Bhatt Member	Reader, Department of Conservative Dentistry & Endodontics, BBDCODS, Lucknow

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.
The comments were communicated to PI thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala

(Dr. Lakshmi Bala)
Member-Secretary
.IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

(Dr. Puneet Ahuja)
Principal
BBDCODS

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

ANNEXURE- III

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Guidelines for Devising a Participant / Legally Acceptable Representative InformationDocument (PID) in English

1. **Study Title**

Correlation between morphology of mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern

2. **Invitation Paragraph**

   You are being invited to take part in a research study. Before you decide it is important for you to understand why the research/study is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your treating physician/family doctor if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3. **What is the purpose of the study?**
   The purpose of the study is to find the correlation between morphology of mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern.

4. **Why have I been chosen?**
   You have been chosen for this study as you are fulfilling the required criteria for this study

5. **Do I have to take part?**
   Your participation in the research is entirely voluntary. If you do, you will be given this information sheet to keep and will be asked to sign a consent form. During the study you still are free to withdraw at any time and without giving a reason**.**

6. **What will happen to me if I take part?**
   Nothing will happen to you if you take part. Radiographs taken routinely for fixed Orthodontic Treatment that is lateral cephalogram will be used.

7. **What do I have to do?**
You do not have to change your regular lifestyles for the investigation of the study

8. **What is the procedure that is being tested?**

morphology of mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern was evaluated on lateral cephalogram.

9. **What are the interventions for the study?**

Lateral cephalogram routinely taken during fixed Orthodontic treatment will be taken

10. **What are the side effects of taking part?**
There is no side effect of taking part in this study

11. **What are the possible disadvantages and risks of taking part?**
No disadvantage or risk is involved

12. **What are the possible benefits of taking part?**

Not applicable

13. **What if new information becomes available?**
Not applicable
.

14. **What happens when the research study stops?**
If the study stops/finishes before the stipulated time, this will be explained to the
patient/volunteer

15. **What if something goes wrong?**
There is nothing going to wrong

16. **Will my taking part in this study be kept confidential?**

Not applicable as it is an in vitro study

17. What will happen to the results of the research study?

Soft tissue chin thickness will help us in deciding (PIP) planned mandibular Incisors position to achieve maximum esthetic goals.

The knowledge of amount of soft tissue camouflage for underlying symphysis will also help us in deciding appropriate surgical option for improvising chin morphology

18. Who is organizing the research?

This research study is organized by the academic institution (BBDCODS).

19. Will the results of the study be made available after study is over?
Yes

20. Who has reviewed the study?
The study has been reviewed and approved by the Head of the Dept, and the IEC/IRC of the institution.

21. Contact for further information

Dr. BHANU PRATAP
Department of orthodontics and dentofacial orthopedics
Babu Banarasi Das College of Dental Sciences.
Lucknow-227105
Mob- 9557394885

Dr. Rana Pratap Maurya (Reader)
Department of orthodontics and dentofacial orthopedics
Babu Banarasi Das College of Dental Sciences.
Lucknow-227105
Mob-9936198408

Dr. Rohit Khanna (HOD)
Department of orthodontics and dentofacial orthopedics
Babu Banarasi Das College of Dental Sciences.
Lucknow-227105
Mob-9415037011

Signature of PI………………………………

Name…………………………………………..

Date…………………………………………..

ANNEXURE-IV

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University, Lucknow)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

प्रतिभागी के लिए सूचना पत्र

1.अध्ययन शीर्षक

मैंडिबुलर सिम्फिसिस और सॉफ्ट टिश्यू चिन थिकनेस की मॉर्फोलॉजी के बीच विभिन्न फेशियल डायवर्जेंस पैटर्न वाले विषयों में सहसंबंध.

2. निमंत्रण अनुच्छेद

आपको एक शोध अध्ययन में भाग लेने के लिए आमंत्रित किया जा रहा है। निर्णय लेने से पहले आपके लिए यह समझना महत्वपूर्ण है कि शोध/अध्ययन क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया निम्नलिखित जानकारी को ध्यान से पढ़ने के लिए समय निकालें और यदि आप चाहें तो दोस्तों, रिश्तेदारों और अपने इलाज करने वाले चिकित्सक/पारिवारिक चिकित्सक के साथ इस पर चर्चा करें। हमसे पूछें कि क्या कुछ ऐसा है जो स्पष्ट नहीं है या यदि आप अधिक जानकारी चाहते हैं। यह तय करने के लिए समय निकालें कि आप भाग लेना चाहते हैं या नहीं।

3. अध्ययन का उद्देश्य क्या है ?

अध्ययन का उद्देश्य निकले जबड़े की वृद्धि की विभीन प्राकारो में मैंडिबल के सिम्फिसिस वा ठोड़ी की मोटाई का आकलन

4. मुझे इस अध्ययन के लिए क्यों चुना गया है?

आप अध्ययन के सभी मानको को पूरा करते हैं

5. क्या इसमें मुझे भाग लेना चाहिए ?

हां

6. मुझे क्या होगा यदि मैं इस अध्ययन में भाग लेता हूं।

दाँतों को पीछे ले जाने के इलाज में लेने वाले क् एक्स-रे का उपयोग

7. मुझे क्या करना है?

लागू नहीं।

8. किस प्रक्रिया का अध्ययन किया जा रहा है?

मैंडिबल के सिम्फिसिस वा ठोड़ी की मोटाई का आकलन

9. इस शोध में कौन से हस्तक्षेप दिए जाएंगे?

कोई हस्तक्षेप नहीं

10. इस अध्ययन में भाग लेने के क्या दुष्प्रभाव हैं ?

कोई दुष्प्रभाव नहीं हैं ।

11. इस अध्ययन में भाग लेने के संभावित जोखिम और नुकसान क्या है?

कोई जोखिम नहीं।

12. अध्ययन में भाग लेने के संभावित लाभ क्या है?

लागू नहीं

13. क्या होगा यदि कोई नई जानकारी उपलब्ध हो जाती है?

मान्या नहीं

14. क्या होता है जब अध्ययन / शोध परीक्षण बंद हो जाता है।

'लागू नहीं

15. क्या होगा अगर कुछ गलत हो जाता है?

कुछ गलत नहीं होगा

16. क्या इस अध्ययन में मेरा हिस्सा गोपनीय रखा जाएगा?

हां

17. अध्ययन / शोध परीक्षण के परिमाण का क्या होगा?

मैंडिबुलर सिम्फिसिस और सॉफ्ट टिश्यू चिन थिकनेस की मॉर्फोलॉजी के बीच विभिन्न फेशियल डायवर्जेंस पैटर्न वाले विषयों में सहसंबंध आपेक्षित है

18. इस अध्ययन को कौन आयोजित कर रहा है और इस परीक्षण के लिए धन कहां से आएगा।

यह शोध अध्ययन शैक्षणिक संस्थान (बीबीडीसीओडीएस) द्वारा आयोजित किया जाता है।

19.क्या सेवाएं शोध खत्म हो जाने के बाद उपलब्ध रहेगी या नहीं?

हां।

20.अध्ययन की समीक्षा किसने की है?

अध्ययन की समीक्षा की गई है और विभाग के प्रमुख, और आईईसी/आईआरसी के द्वारा अनुमोदित किया गया है।

निम्न लोगों से संपर्क करें

21.अधिक जानकारी के लिए संपर्क करें ।

डॉ. भानु प्रताप

ऑर्थोडोंटिक्स और डेंटोफेशियल ऑर्थोपेडिक्स विभाग

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105

मोब- 9557394885

डॉ राणा प्रताप मौर्य (रीडर)

ऑर्थोडोंटिक्स और डेंटोफेशियल ऑर्थोपेडिक्स विभाग

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105

मोब- 9198938374

डॉ रोहित खन्ना (एचओडी)

ऑर्थोडोंटिक्स और डेंटोफेशियल ऑर्थोपेडिक्स विभाग

बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105

मोब-9415037011

bbdcods.iec@gmail.com

पीआईकाहस्ताक्षर ....

नाम ....

दिनांक………………………………

ANNEXURE-V

Consent Form (English)

Title of the Study: Correlation between morphology of mandibular symphysis and soft tissue chin thickness in subjects with different facial divergence pattern

Study Number……..

Subject's Full Name……….

Date of Birth/Age ………

Address of the Subject…………………….

Phone no. and e-mail address………………

Qualification ………………………………

Occupation: Student / Self Employed / Service / Housewife/

Other (Please tick as appropriate)

Annual income of the Subject………………

Name and of the nominees(s) and his relation to the subject……………… (For the purpose of

compensation in case of trial related death).

I confirm that I have read and understood the Participant Information Document dated ……..for the above study and have had the opportunity to ask questions. **OR** I have been explained the nature of the study by the Investigator and had the opportunity to ask questions.

I understand that my participation in the study is voluntary and given with free will without any duress and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.

I understand that the sponsor of the project, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

I permit the use of stored samples (tooth/tissue/blood) for future research. **Yes [ ] No [ ]**
Not Applicable [ ]

I agree to participate in the above study. I have been explained about the complications and side effects, if any, and have fully understood them. I have also read and understood the participant/volunteer's information document given to me.

Signature (or Thumb impression) of the Subject/Legally Acceptable Representative:……………..

Signatory's Name……………. Date ……….

Signature of the Investigator………………… Date………..

Study Investigator's Name.......................... Date………..

Signature of the witness…………………… Date………..

Name of the witness…………………………

Received a signed copy of the PID and duly filled consent form

Signature/thumb impression of the subject or legally Date……..

Acceptable representative

ANNEXURE-VI

सहमति फॉर्म

मैंडिबुलर सिम्फिसिस और सॉफ्ट टिश्यू चिन थिकनेस की मॉर्फोलॉजी के बीच विभिन्न फेशियल डायवर्जेंस पैटर्न वाले विषयों में सहसंबंध.

अध्ययन संख्या……..

विषय का पूरा नाम……….

जन्म तिथि आयु /………

विषय का पता …………………………।

फोन नंबर। और ईमेल पता ………………

योग्यता ……………………………….

व्यवसाय/गृहिणी/सेवा/नियोजित-स्व/छात्र :

अन्य (कृपया जो उपयुक्त हो उस पर सही का निशान लगाएं)

विषय की वार्षिक आय ………………

नाम और नामांकित व्यक्तियों और विषय से उनका संबंध (……………… (के प्रयोजन के लिए मुकदमे से संबंधित मौत के मामले में मुआवजा।(

.1मैं पुष्टि करता हूं कि मैंने उपरोक्त अध्ययन के लिए प्रतिभागी सूचना दस्तावेज़ दिनांक …….. को पढ़ और समझ लिया है और मुझे प्रश्न पूछने का अवसर मिला है। या मुझे अन्वेषक द्वारा अध्ययन की प्रकृति के बारे में समझाया गया है और प्रश्न पूछने का अवसर मिला है।

.2मैं समझता हूं कि अध्ययन में मेरी भागीदारी स्वैच्छिक है और बिना किसी दबाव के स्वतंत्र इच्छा के साथ दी गई है और मैं किसी भी समय, बिना कोई कारण बताए और मेरी चिकित्सा देखभाल या कानूनी अधिकारों को प्रभावित किए बिना वापस लेने के लिए स्वतंत्र हूं।

.3मैं समझता हूं कि परियोजना के प्रायोजक, प्रायोजक की ओर से काम करने वाले अन्य लोगों, आचार समिति और नियामक अधिकारियों को वर्तमान अध्ययन और किसी भी अन्य शोध के संबंध में मेरे स्वास्थ्य रिकॉर्ड को देखने के लिए मेरी अनुमति की आवश्यकता नहीं होगी। इसके संबंध में आयोजित किया जा सकता है, भले ही मैं परीक्षण से हट जाऊं। हालांकि, मैं समझता हूं कि तीसरे पक्ष को जारी या प्रकाशित किसी भी जानकारी में मेरी पहचान प्रकट नहीं की जाएगी।

.4मैं इस अध्ययन से उत्पन्न होने वाले किसी भी डेटा या परिणाम के उपयोग को प्रतिबंधित नहीं करने के लिए सहमत हूं, बशर्ते ऐसा उपयोग केवल वैज्ञानिक उद्देश्यों के लिए हो।

.5मैं भविष्य के शोध के लिए संग्रहीत नमूनों के उपयोग की अनुमत (रक्त/ऊतक/दांत)ि देता हूं। हाँ [ ] लागू नहीं [ ] नहीं [ ]

.6मैं उपरोक्त अध्ययन में भाग लेने के लिए सहमत हूं। मुझे जटिलताओं और दुष्प्रभावों के बारे में समझाया गया है, यदि कोई हो, और उन्हें पूरी तरह से समझ लिया है। मैंने प्रतिभागीस्वयंसेवक द्वारा / मुझे दिए गए सूचना दस्तावेेज़ को भी पढ़ और समझ लिया है।

विषय:(या अंगूठे का निशान) कानूनी रूप से स्वीकार्य प्रतिनिधि के हस्ताक्षर/……………..

हस्ताक्षरकर्ता का नाम …………….तारीख ………।

अन्वेषक के हस्ताक्षर ……………… दिनांक ……… ..

अध्ययन अन्वेषक का नाम .... दिनांक ....

गवाह के हस्ताक्षर ……………… दिनांक ……… ..

गवाह का नाम …………………………

पीआईडी की एक हस्ताक्षरित प्रति और विधिवत भरा हुआ सहमति फॉर्म प्राप्त किया

विषय के हस्ताक्षर अंगूठे का निशान या कानूनी रूप से दिनांक/……..

स्वीकार्य प्रतिनिधि

ANNEXURE-VII

Document Information

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ANNEXURE-VIII

MEASERMENT OF NORMODIVRGENT SUBJECTS

hard tissue											soft tissue							
leniar				angular							Leniar				Angular			
Ld-me	B-Me	Pog-Pog	Pog-B-me	B-Pog-Me	Li-B-Pog	B-Pog-MP	B-G-Gn	B-Me-Pog	Me-Pog-B	Pog-B-ME	Pog-Pog'	Gn-Gn'	Me-Me'	B'-Me'	Li-B'-Pog'	Li-Si-Pog'	B'-Pog'-MP	B'-Pog'-Me
30.21	21.01	15.12	3.8	129.59	157.76	65.15	136.69	129.01	33.12	22.87	13.25	10	7.16	21.6	125.26	133.58	53.59	106.31
28.44	17.36	17.16	4.46	119.16	154.82	67.23	137.39	27.2	128.6	24.2	10.41	6.6	11.56	31.6	141.02	132.23	67.64	120.33
26.7	14.2	14.88	6.91	121.82	133.13	60.04	132.94	41.2	113.5	25.3	9.26	7.18	6.65	26.28	119.43	118.28	62.24	117.67
30.3	19.74	17.42	5.7	134.78	144.88	67.21	135.52	36.47	120	23.53	7.69	7.37	8.99	27.97	116.4	120.9	66.86	123.63
29.41	18.01	14.86	4.16	126.93	142.89	62.18	132.46	34.03	128.3	17.67	10.02	6.86	9.56	29.6	118.5	129.01	67.64	121.6
29.83	19.33	13.42	4.62	122.92	141.8	58.8	136.62	32.77	123.52	23.71	9.36	6.43	7.11	20.86	137.62	137.66	65.46	126.2
28.01	18.59	12.02	3.94	127.12	139.32	68.03	139.26	33.66	129.86	16.48	7.8	4.2	4.81	25.74	124.39	124.92	73.01	132.65
29.5	18.73	12.46	4.26	124.12	146.82	53.09		38.32	126.2	15.48	10.82	5.63	5.42	24.23	119.2	129.41	64.04	129.62
28.91	20.31	15.16	5.96	122.6	141.02	64.62	141.46	39.06	129.1	11.84	10.64	6.03	8.84	31.06	132.62	126.09	63.62	119.6
31.31	18.6	11.62	4.8	128.6	138.09	54.06	138.71	42.39	114.28	23.33	9.89	7.86	6.72	20.04	126.24	116.2	58.61	122.54
33.09	20.7	13.71	5.37	117.8	141.06	61.27	142.14	49.11	117.28	13.61	10.13	7.91	9.34	34.84	120.24	108.36	55.57	109.12
35.71	22.09	14.38	4.36	126.23	148.87	59.67	120.53	32.91	130.39	17.09	11.4	5.81	4.87	20.04	127	129.71	61.83	112.79
32.13	21.51	14.76	8.44	114.58	145.6	58.51	133.78	51	105.52	23.48	14.5	9.85	10.21	28.3	92.27	98.63	54.66	112.1
34.3	20.13	10.01	6.21	117.01	139.6	51.04	135.61	33.1	124.61	22.29	7.85	5.51	4.97	22.42	126.26	118.01	51.83	118.3
34.62	20.13	15.65	5.69	119.53	141.5	49.5	125.84	32.97	120.74	26.29	7.81	6.01	5.1	24.9	121.91	121.7	46.93	117.5
23.55	17.15	14.47	3.09	118.47	155.89	80.25	101.89	28.75	127.47	23.78	9.16	8.67	7.6	21.38	127.36	126.01	77.91	123.84
26.61	18.88	13.01	5.16	120.26	148.76	68.78					9.78	6.62	8.06	24.55	126.48	122.89	71.33	124.82
28.37	21.23	15.34	4.21	112.46	151.4	51.02	138.58	44.6	113.38	22.2	8.75	6.88	6.51	29.4	127	126.84	62.63	106.35
27.7	17.88	10.99	4.21	124.67	152.59	69.82	122	21.26	144.4	14.34	12.59	9.5	8.76	33.34	133.29	132.46	68.82	126.61
25.78	18.05	12.61	4.58	124.49	149.43	63.94	130	33.51	125.99	20.5	11.69	6.98	9.24	29.81	166.72	125.07	56.5	105.91
32.36	19.78	13.89	2.57	128.36	156.53	63.92	135.46	127.78	31.89	21.64	12.02	12.02	5.93	20.37	124.03	132.35	52.36	105.08
30.59	16.13	15.93	3.23	117.93	153.59	66	136.16	25.97	127.37	22.97	9.18	9.18	10.33	30.37	139.79	131	66.41	119.1
28.85	12.97	13.65	5.68	120.59	131.9	58.81	131.71	39.97	112.27	24.07	8.03	8.03	5.42	25.05	118.2	117.05	61.01	116.44
32.45	18.51	16.19	4.47	133.55	143.65	65.98	134.29	35.24	118.77	22.3	6.46	6.46	7.76	26.74	115.17	119.67	65.63	122.4
31.56	16.78	13.63	2.93	125.7	141.66	60.95	131.23	32.8	127.07	16.44	8.79	8.79	8.33	28.37	117.27	127.78	66.41	120.37
31.98	18.1	12.19	3.39	121.69	140.57	57.57	135.39	31.54	122.29	22.48	8.13	8.13	5.88	19.63	136.39	136.43	64.23	124.97
30.16	17.36	10.79	2.71	125.89	138.09	66.8	138.03	32.43	128.63	15.25	6.57	6.57	3.58	24.51	123.16	123.69	71.78	131.42
31.65	17.5	11.23	3.03	122.89	145.59	51.86		37.09	124.97	14.25	9.59	9.59	4.19	23	117.97	128.18	62.81	128.39
31.06	19.08	13.93	4.73	121.37	139.79	63.39	140.23	37.83	127.87	10.61	9.41	9.41	7.61	29.83	131.39	124.86	62.39	118.37
33.46	17.37	10.39	3.57	127.37	136.86	52.83	137.48	41.16	113.05	22.1	8.66	8.66	5.49	18.81	125.01	114.97	57.38	121.31
35.24	19.47	12.48	4.14	116.57	139.83	60.04	140.91	47.88	116.05	12.38	8.9	8.9	8.11	33.61	119.01	107.13	54.34	107.89
37.86	20.526	12.816	2.796	124.666	147.306	58.106	118.966	31.346	128.826	15.526	9.836	9.836	3.306	18.476	125.436	128.146	60.266	111.226

34.28	19.946	13.196	6.876	113.016	144.036	56.946	132.216	49.436	103.956	21.916	12.936	12.936	8.646	26.736	90.706	97.066	53.096	110.536
36.45	18.566	8.446	4.646	115.446	138.036	49.476	134.046	31.536	123.046	20.726	6.286	6.286	3.406	20.856	124.696	116.446	50.266	116.736
36.77	18.566	14.086	4.126	117.966	139.936	47.936	124.276	31.406	119.176	24.726	6.246	6.246	3.536	23.336	120.346	120.136	45.366	115.936
25.7	15.586	12.906	1.526	116.906	154.326	78.686	100.326	27.186	125.906	22.216	7.596	7.596	6.036	19.816	125.796	124.446	76.346	122.276
28.76	17.316	11.446	3.596	118.696	147.196	67.216	132.216	49.436	113.05	-1.564	8.216	8.216	6.496	22.986	124.916	121.326	69.766	123.256
30.52	19.666	13.776	2.646	110.896	149.836	49.456	137.016	43.036	111.816	20.636	7.186	7.186	4.946	27.836	125.436	125.276	61.066	104.786
29.85	16.316	9.426	2.646	123.106	151.026	68.256	120.436	19.696	142.836	12.776	11.026	11.026	7.196	31.776	131.726	130.896	67.256	125.046
27.93	16.486	11.046	3.016	122.926	147.866	62.376	128.436	31.946	124.426	18.936	10.126	10.126	7.676	28.246	165.156	123.506	54.936	104.346
28.98	22.64	16.75	5.43	131.22	159.39	66.78	138.32	130.64	34.75	24.5	14.88	11.63	8.79	23.23	126.89	135.21	55.22	107.94
27.21	18.99	18.79	6.09	120.79	156.45	68.86	139.02	28.83	130.23	25.83	12.04	8.23	13.19	33.23	142.65	133.86	69.27	121.96
25.47	15.83	16.51	8.54	123.45	134.76	61.67	134.57	42.83	115.13	26.93	10.89	8.81	8.28	27.91	121.06	119.91	63.87	119.3
29.07	21.37	19.05	7.33	136.41	146.51	68.84	137.15	38.1	121.63	25.16	9.32	9	10.62	29.6	118.03	122.53	68.49	125.26
28.18	19.64	16.49	5.79	128.56	144.52	63.81	134.09	35.66	129.93	19.3	11.65	8.49	11.19	31.23	120.13	130.64	69.27	123.23
28.6	20.96	15.05	6.25	124.55	143.43	60.43	138.25	34.4	125.15	25.34	10.99	8.06	8.74	22.49	139.25	139.29	67.09	127.83
26.78	20.16	13.59	5.51	128.69	140.89	69.6	140.83	35.23	131.43	18.05	9.37	5.77	6.38	27.31	125.96	126.49	74.58	134.22
28.27	20.3	14.03	5.83	125.69	148.39	54.66		39.89	127.77	17.05	12.39	7.2	6.99	25.8	120.77	130.98	65.61	131.19
27.68	21.88	16.73	7.53	124.17	142.59	66.19	143.03	40.63	130.67	13.41	12.21	7.6	10.41	32.63	134.19	127.66	65.19	121.17
30.08	20.17	13.19	6.37	130.17	139.66	55.63	140.28	43.96	115.85	24.9	11.46	9.43	8.29	21.61	127.81	117.77	60.18	124.11
31.86	22.27	15.28	6.94	119.37	142.63	62.84	143.71	50.68	118.85	15.18	11.7	9.48	10.91	36.41	121.81	109.93	57.14	110.69
34.146	23.57	15.86	5.84	127.71	150.35	61.15	122.01	34.39	131.87	18.57	12.88	7.29	6.35	21.52	128.48	131.19	63.31	114.27
30.566	22.99	16.24	9.92	116.06	147.08	59.99	135.26	52.48	107	24.96	15.98	11.33	11.69	29.78	93.75	100.11	56.14	113.58
32.736	21.61	11.49	7.69	118.49	141.08	52.52	137.09	34.58	126.09	23.77	9.33	6.99	6.45	23.9	127.74	119.49	53.31	119.78
33.056	21.61	17.13	7.17	121.01	142.98	50.98	127.32	34.45	122.22	27.77	9.29	7.49	6.58	26.38	123.39	123.18	48.41	118.98
21.986	18.63	15.95	4.57	119.95	157.37	81.73	103.37	30.23	128.95	25.26	10.64	10.15	9.08	22.86	128.84	127.49	79.39	125.32
25.046	20.36	14.49	6.64	121.74	150.24	70.26					11.26	8.1	9.54	26.03	127.96	124.37	72.81	126.3
26.806	22.92	17.03	5.9	114.15	153.09	52.71	140.27	46.29	115.07	23.89	10.44	8.57	8.2	31.09	128.69	128.53	64.32	108.04
26.136	19.57	12.68	5.9	126.36	154.28	71.51	123.69	22.95	146.09	16.03	14.28	11.19	10.45	35.03	134.98	134.15	70.51	128.3
24.216	19.74	14.3	6.27	126.18	151.12	65.63	131.69	35.2	127.68	22.19	13.38	8.67	10.93	31.5	168.41	126.76	58.19	107.6

MEASERMENT OF HYPODIVERGENT SUBJECTS

Hard tissue											soft tissue						
leniar											Leniar				Angular		
Ld-me	B-Me	Lpog - Pog	Pog□B- me	Ld-B-Pog	B-Pog-Me	B-Pog-MP	B-G-Gn	B-Me- Pog	Me-Pog-B	Pog-B-ME	Pog- Pog'	Gn-Gn'	Me-Me'	B'-Me'	B'-Pog'-MP	B'-Pog'- Me	
28.63	20.32	13.36	4.56	149.02	125.93	59.37	129.82	28.47	125.93	25.6	10.62	7.78	7.99	32.98	62.48	119.78	
30.61	22.48	14.25	5.55	146.27	121.08	61.2	115.65	32.19	121.08	26.73	9.95	7.93	7.52	32.03	56.25	118.65	
31.18	22.2	15.3	5.37	151.34	130.14	71.4	122.11	22.46	130.14	27.4	8.95	7.59	7.25	30.65	81.43	138.3	
30.02	21.68	15.01	5.02	149.33	123.42	58.06	118.61	26.46	123.42	30.12	10.34	8.78	6.96	33.03	68.06	136.38	
28.1	18.55	17.76	6.04	155.42	127.18	51.88	112.72	40.14	127.18	12.68	10.99	9.91	8.43	30.69	62.03	126.92	
28	19.66	15.76	4.06	146.55	134.96	66.87	114.65	29.7	134.96	15.34	9.61	9.03	7.77	30.15	67.38	128.2	
28.13	20.12	13.2	3.49	159.24	138.55	75.22	111.1	20.93	138.55	20.52	8.48	7.28	6.58	27.89	86.2	134.82	
29.05	21.3	11.17	4.23	152.7	133.91	67.76	121.72	31.62	133.91	14.47	11.94	9.02	7.48	29.57	69.34	116.67	
34.31	22.77	13.35	4.53	154.25	136.75	71.24	120.55	24.93	136.75	18.32	11.75	7.03	7.31	34.71	76.85	133.55	
29.33	20.72	11.96	4.08	155.5	122	67.36	135.4	42.02	122	15.98	9	7.9	6.69	31.72	77.52	100.76	
31.47	24.92	13.98	5.16	143.06	127.64	67.33	132.24	29.92	127.64	22.44	11.47	8.7	8.28	32.45	61.75	113.77	
29.44	21.99	13.89	5.93	139.93	123.8	51.5	140.42	41.71	123.8	14.49	10.56	8.28	6.67	32.26	55.5	107.93	
28.09	21.18	13	4.99	155.53	130.6	70.13	114.65	33.27	130.6	16.13	8.22	6.63	7.5	30.45	84.46	130.77	
27.7	22.6	12.67	5.26	149.36	138.21	63.61	126.76	29.67	138.21	12.12	12.16	10.76	8.96	30.41	54.53	113.71	
27.12	20.61	11.74	4.12	148.42	148.74	64.8	129.88	33.41	128.74	17.85	11.62	9.98	8.76	31.21	58.69	109.98	
28.78	21.56	13.86	4.58	143.07	125.7	68.07	122.4	33.75	125.7	20.55	8.38	6.34	5.91	28.8	77.31	135.47	
27.61	20.89	12.97	4.91	150.93	122.05	68.07	121.76	33.09	122.05	24.86	9.09	5.84	5.35	29.01	68.87	116.68	
32.29	21.07	13.07	4.28	145.69	117.79	58.02	116.08	25.39	117.79	36.82	9.85	6.19	7.35	35.16	75.7	132.86	
24.68	19.7	14.79	5.68	136.93	121.68	65.07	117.36	32.61	121.68	25.71	8.83	7.38	5.65	25.07	59.97	117.34	
27.63	21.04	12.35	4.56	146.89	123.33	62.39	122.6	30.76	123.33	25.91	8.96	6.62	5.98	29.39	62.72	119.34	
30.46	20.12	13.36	5.33	151.62	129.03	67.33	116.96	31.98	129.03	18.99	9.63	7.35	6.31	30.61	61.03	126.34	
30.26	21.95	14.99	6.19	150.65	127.56	61	131.45	30.1	127.56	27.23	12.25	9.41	9.62	34.61	64.11	121.41	
32.24	24.11	15.88	7.18	147.9	122.71	62.83	117.28	33.82	122.71	28.36	11.58	9.56	9.15	33.66	57.88	120.28	
32.81	23.83	16.93	7	152.97	131.77	73.03	123.74	24.09	131.77	29.03	10.58	9.22	8.88	32.28	83.06	139.93	
31.65	23.31	16.64	6.65	150.96	125.05	59.69	120.24	28.09	125.05	31.75	11.97	10.41	8.59	34.66	69.69	138.01	
29.73	20.18	19.39	7.67	157.05	128.81	53.51	114.35	41.77	128.81	14.31	12.62	11.54	10.06	32.32	63.66	128.55	
29.63	21.29	17.39	5.69	148.18	136.59	68.5	116.28	31.33	136.59	16.97	11.24	10.66	9.4	31.78	69.01	129.83	
29.7	21.69	14.77	5.06	160.81	140.12	76.79	112.67	22.5	140.12	22.09	10.05	8.85	8.15	29.46	87.77	136.39	
30.62	22.87	12.74	5.8	154.27	135.48	69.33	123.29	33.19	135.48	16.04	13.51	10.59	9.05	31.14	70.91	118.24	
35.88	24.34	14.92	6.1	155.82	138.32	72.81	122.12	26.5	138.32	19.89	13.32	8.6	8.88	36.28	78.42	135.12	
30.9	22.29	13.53	5.65	157.07	123.57	68.93	136.97	43.59	123.57	17.55	10.57	9.47	8.26	33.29	79.09	102.33	
33.04	26.49	15.55	6.73	144.63	129.21	68.9	133.81	31.49	129.21	24.01	13.04	10.27	9.85	34.02	63.32	115.34	
30.92	23.47	15.37	7.41	141.41	125.28	52.98	141.9	43.19	125.28	15.97	12.04	9.76	8.15	33.74	56.98	109.41	
29.57	22.66	14.48	6.47	157.01	132.08	71.61	116.13	34.75	132.08	17.61	9.7	8.11	8.98	31.93	85.94	132.25	
29.18	24.08	14.15	6.74	150.84	139.69	65.09	128.24	31.15	139.69	13.6	13.64	12.24	10.44	31.89	56.01	115.19	

28.6	22.09	13.22	5.6	149.9	150.22	66.28	131.36	34.89	130.22	19.33	13.1	11.46	10.24	32.69	60.17	111.46	
30.26	23.04	15.34	6.06	144.55	127.18	69.55	123.88	35.23	127.18	22.03	9.86	7.82	7.39	30.28	78.79	136.95	
29.09	22.37	14.45	6.39	152.41	123.53	69.55	123.24	34.57	123.53	26.34	10.57	7.32	6.83	30.49	70.35	118.16	
33.98	22.76	14.76	5.97	147.38	119.48	59.71	117.77	27.08	119.48	38.51	11.54	7.88	9.04	36.85	77.39	134.55	
26.37	21.39	16.48	7.37	138.62	123.37	66.76	119.05	34.3	123.37	27.4	10.52	9.07	7.34	26.76	61.66	119.03	
29.32	22.73	14.04	6.25	148.58	125.02	64.08	124.29	32.45	125.02	27.6	10.65	8.31	7.67	31.08	64.41	121.03	
32.15	21.81	15.05	7.02	153.31	130.72	69.02	118.65	33.67	130.72	20.68	11.32	9.04	8	32.3	62.72	128.03	
27.14	18.83	11.87	3.07	147.53	124.44	57.88	128.33	33.19	135.48	16.04	13.51	10.59	9.05	31.14	70.91	118.24	
29.12	20.99	12.76	4.06	144.78	119.59	59.71	114.16	26.5	138.32	19.89	13.32	8.6	8.88	36.28	78.42	135.12	
29.69	20.71	13.81	3.88	149.85	128.65	69.91	120.62	43.59	123.57	17.55	10.57	9.47	8.26	33.29	79.09	102.33	
28.53	20.19	13.52	3.53	147.84	121.93	56.57	117.12	31.49	129.21	24.01	13.04	10.27	9.85	34.02	63.32	115.34	
26.61	17.06	16.27	4.55	153.93	125.69	50.39	111.23	43.19	125.28	15.97	12.04	9.76	8.15	33.74	56.98	109.41	
26.51	18.17	14.27	2.57	145.06	133.47	65.38	113.16	34.75	132.08	17.61	9.7	8.11	8.98	31.93	85.94	132.25	
26.64	18.63	11.71	2	157.75	137.06	73.73	109.61	31.15	139.69	13.6	13.64	12.24	10.44	31.89	56.01	115.19	
27.56	19.81	9.68	2.74	151.21	132.42	66.27	120.23	34.89	130.22	19.33	13.1	11.46	10.24	32.69	60.17	111.46	
32.77	21.23	11.81	2.99	152.71	135.21	69.7	119.01	35.23	127.18	22.03	9.86	7.82	7.39	30.28	78.79	136.95	
27.79	19.18	10.42	2.54	153.96	120.46	65.82	133.86	34.57	123.53	26.34	10.57	7.32	6.83	30.49	70.35	118.16	
29.93	23.38	12.44	3.62	141.52	126.1	65.79	130.7	27.08	119.48	38.51	11.54	7.88	9.04	36.85	77.39	134.55	
27.9	20.45	12.35	4.39	138.39	122.26	49.96	138.88	34.3	123.37	27.4	10.52	9.07	7.34	26.76	61.66	119.03	
26.55	19.64	11.46	3.45	153.99	129.06	68.59	113.11	32.45	125.02	27.6	10.65	8.31	7.67	31.08	64.41	121.03	
26.16	21.06	11.13	3.72	147.82	136.67	62.07	125.22	33.67	130.72	20.68	11.32	9.04	8	32.3	62.72	128.03	

MEASERMENT OF HYPERDIVERGENT SUBJECTS

hard tissue											soft tissue							
leniar				angular							Leniar				Angular			
Ld-me	B-Me	Lg pog - Pog	Pog□B-me	B-Pog-Me	Ld-B-Pog	B-Pog-MP	B-G-Gn	B-Me-Pog	Me-B-Pog	B-Pog-ME	Pog-Pog'	Gn-Gn'	Me-Me'	B'-Me'	Li-B'-Pog'	Li-Si-Pog'	B'-Pog'-MP	B'-Pog'-Me
28.29	20.74	13.51	6.4	108.16	146.13	53.2	123.91	34.39	17.45	128.16	8.7	7.1	7.57	31.71	113.3	109.63	59.29	107.39
29.57	18.51	15.19	4.21	128.71	142.78	59.86	122.89	27.52	23.77	128.71	8.21	8.06	6.59	25.82	127.57	124.14	67.75	118.24
28.32	21.21	15.45	4.28	126.9	139.5	52.02	128.24	33.2	19.9	126.9	9.23	7.36	7.28	27.87	116.66	117.65	62.77	105.58
30.28	20.31	13.52	4.75	121.22	152.59	58.33	126.9	22.76	36.02	121.22	8.86	6.82	5.78	31.48	113.74	117.78	64.33	114.76
31.36	19.92	16.06	3.16	133.3	140.5	53.98	127.13	36.68	10.02	133.3	12.92	8.52	6.89	30.73	121.51	117.93	56.07	105.35
31.18	22.26	14.56	4.72	123.98	144.55	55.29	124.69	28.96	27.06	123.98	11.06	4.3	5.4	34.46	131.18	137.31	55.42	124.83
29.68	19.02	16.66	4.68	127.98	141.69	58.33	121.69	31.98	20.04	127.98	8.79	7.99	6.43	25.62	128.23	123.86	67.66	120.24
33.79	23.27	13.4	4.8	124.04	151.26	56.06	128.79	27.82	28.14	124.04	7.33	4.36	5.39	29.2	132.35	137.84	62.27	131.6
30.61	20.69	12.96	4.67	120.28	127.2	48.34	127.7	27.2	32.52	120.28	8.26	6.33	5.84	25.81	127.57	124.14	68.75	124.42
31.15	20.6	14.29	3.96	134.73	157.68	56.46	130.97	33.69	11.58	134.73	11.04	6.87	5.83	32.41	128.32	136.99	64.53	132.99
31.61	20.61	14.91	4.16	131.8	149.89	51.96	128.62	30.32	17.88	131.8	11.92	9	7.98	32.46	124.63	135.63	58.61	128.62
29.05	19.38	12.48	3.72	135.47	146.35	63.77	126.28	35.06	9.47	135.47	10.29	6.55	6.46	27.64	100.11	117.92	53.92	116.71
26.37	16.99	14.28	4.09	132.25	160.04	64.51	116.31	33.16	14.59	132.25	8.14	4.85	6.04	31.34	137.42	152.02	71.38	131.01
30.68	20.75	13.94	4.69	139	164.87	71.35	121.48	26.4	14.6	139	9.88	5.95	6.33	32.8	133.86	145.61	69.26	129.73
30.36	20.52	13.44	3.57	135.28	153.92	61.55	130	31.31	13.41	135.28	10.72	6.01	7.03	34.07	151.08	151.46	64.26	131.22
36.93	23.76	13.53	4.64	134.53	158.79	66.63	112.23	29.75	15.72	134.53	11.81	6.94	6.66	34.93	121.62	141.95	59.75	121.77
28.23	20.39	13.51	4.09	124.57	151.59	70.44	132.62	21.39	34.04	124.57	9	7.47	5	27.43	143.53	158.2	69.59	120.18
27.52	19.91	13.18	5.07	130.5	149.86	67.36	120.09	26.96	22.54	130.5	8.78	7.48	6.07	26.47	126.95	154.25	62.49	130.5
26.64	19.79	10.84	5.25	129.04	148.64	61.15	133.15	30.09	20.87	129.04	10.58	6.85	5.49	28.53	148.71	154.41	63.84	119.42
29.92	22.37	15.14	8.03	109.79	147.76	54.83	125.54	36.02	19.08	129.79	10.33	8.73	9.2	33.34	114.93	111.26	60.92	109.02
31.2	20.14	16.82	5.84	130.34	144.41	61.49	124.52	29.15	25.4	130.34	9.84	9.69	8.22	27.45	129.2	125.77	69.38	119.87
29.95	22.84	17.08	5.91	128.53	141.13	53.65	129.87	34.83	21.53	128.53	10.86	8.99	8.91	29.5	118.29	119.28	64.4	107.21
31.91	21.94	15.15	6.38	122.85	154.22	59.96	128.53	24.39	37.65	122.85	10.49	8.45	7.41	33.11	115.37	119.41	65.96	116.39
32.99	21.55	17.69	4.79	134.93	142.13	55.61	128.76	38.31	11.65	134.93	14.55	10.15	8.52	32.36	123.14	119.56	57.7	106.98
32.81	23.89	16.19	6.35	125.61	146.18	56.92	126.32	30.59	28.69	125.61	12.69	5.93	7.03	36.09	132.81	138.94	57.05	126.46
31.25	20.59	18.23	6.25	129.55	143.26	59.9	123.26	33.55	21.61	129.55	10.36	9.56	8	27.19	129.8	125.43	69.23	121.81
35.36	24.84	14.97	6.37	125.61	152.83	57.63	130.36	29.39	29.71	125.61	8.9	5.93	6.96	30.77	133.92	139.41	63.84	133.17
32.18	22.26	14.53	6.24	121.85	128.77	49.91	129.27	28.77	34.09	121.85	9.83	7.9	7.41	27.38	129.14	125.71	70.32	125.99
32.72	22.17	15.86	5.53	136.3	159.25	58.03	132.54	35.26	13.15	136.3	12.61	8.44	7.4	33.98	129.89	138.56	66.1	134.56
33.18	22.18	16.48	5.73	133.37	151.46	53.53	130.19	31.89	19.45	133.37	13.49	10.57	9.55	34.03	126.2	137.2	60.18	130.19
30.53	20.86	13.96	5.2	136.95	147.83	65.25	127.76	36.54	10.95	136.95	11.77	8.03	7.94	29.12	101.59	119.4	55.4	118.19
27.85	18.47	15.76	5.57	133.73	161.52	65.99	117.79	34.64	16.07	133.73	9.62	6.33	7.52	32.82	138.9	153.5	72.86	132.49
32.16	22.23	15.42	6.17	140.48	166.35	72.83	122.96	27.88	16.08	140.48	11.36	7.43	7.81	34.28	135.34	147.09	70.74	131.21
31.84	22	14.92	5.05	136.76	155.4	63.03	131.48	32.79	14.89	136.76	12.2	7.49	8.51	35.55	152.56	152.94	65.74	132.7
38.41	25.24	15.01	6.12	136.01	160.27	68.11	113.71	31.23	17.2	136.01	13.29	8.42	8.14	36.41	123.1	143.43	61.23	123.25

29.71	21.87	14.99	5.57	126.05	153.07	71.92	134.1	22.87	35.52	126.05	10.48	8.95	6.48	28.91	145.01	159.68	71.07	121.66
29.21	21.6	14.87	6.76	132.19	151.55	69.05	121.78	28.65	24.23	132.19	10.47	9.17	7.76	28.16	128.64	155.94	64.18	132.19
28.33	21.48	12.53	6.94	130.73	150.33	62.84	134.84	31.78	22.56	130.73	12.27	8.54	7.18	30.22	150.4	156.1	65.53	121.11
26.8	19.25	12.02	4.91	106.67	144.64	51.71	122.42	32.9	15.96	126.67	7.21	5.61	6.08	30.22	111.81	108.14	57.8	105.9
28.08	17.02	13.7	2.72	127.22	141.29	58.37	121.4	26.03	22.28	127.22	6.72	6.57	5.1	24.33	126.08	122.65	66.26	116.75
26.83	19.72	13.96	2.79	125.41	138.01	50.53	126.75	31.71	18.41	125.41	7.74	5.87	5.79	26.38	115.17	116.16	61.28	104.09
28.79	18.82	12.03	3.26	119.73	151.1	56.84	125.41	21.27	34.53	119.73	7.37	5.33	4.29	29.99	112.25	116.29	62.84	113.27
29.87	18.43	14.57	1.67	131.81	139.01	52.49	125.64	35.19	8.53	131.81	11.43	7.03	5.4	29.24	120.02	116.44	54.58	103.86
29.69	20.77	13.07	3.23	122.49	143.06	53.8	123.2	27.47	25.57	122.49	9.57	2.81	3.91	32.97	129.69	135.82	53.93	123.34
28.19	17.53	15.17	3.19	126.49	140.2	56.84	120.2	30.49	18.55	126.49	7.3	6.5	4.94	24.13	126.74	122.37	66.17	118.75
32.3	21.78	11.91	3.31	122.55	149.77	54.57	127.3	26.33	26.65	122.55	5.84	2.87	3.9	27.71	130.86	136.35	60.78	130.11
29.07	19.15	11.42	3.13	118.74	125.66	46.8	126.16	25.66	30.98	118.74	6.72	4.79	4.3	24.27	126.03	122.6	67.21	122.88
29.61	19.06	12.75	2.42	133.19	156.14	54.92	129.43	32.15	10.04	133.19	9.5	5.33	4.29	30.87	126.78	135.45	62.99	131.45
30.07	19.07	13.37	2.62	130.26	148.35	50.42	127.08	28.78	16.34	130.26	10.38	7.46	6.44	30.92	123.09	134.09	57.07	127.08
27.51	17.84	10.94	2.18	133.93	144.81	62.23	124.74	33.52	7.93	133.93	8.75	5.01	4.92	26.1	98.57	116.38	52.38	115.17
24.83	15.45	12.74	2.55	130.71	158.5	62.97	114.77	31.62	13.05	130.71	6.6	3.31	4.5	29.8	135.88	150.48	69.84	129.47
29.14	19.21	12.4	3.15	137.46	163.33	69.81	119.94	24.86	13.06	137.46	8.34	4.41	4.79	31.26	132.32	144.07	67.72	128.19
28.82	18.98	11.9	2.03	133.74	152.38	60.01	128.46	29.77	11.87	133.74	9.18	4.47	5.49	32.53	149.54	149.92	62.72	129.68
35.39	22.22	11.99	3.1	132.99	157.25	65.09	110.69	28.21	14.18	132.99	10.27	5.4	5.12	33.39	120.08	140.41	58.21	120.23
26.69	18.85	11.97	2.55	123.03	150.05	68.9	131.08	19.85	32.5	123.03	7.46	5.93	3.46	25.89	141.99	156.66	68.05	118.64
25.8	18.19	11.46	3.35	128.78	148.14	65.64	118.37	25.24	20.82	128.78	7.06	5.76	4.35	24.75	125.23	152.53	60.77	128.78
24.92	18.07	9.12	3.53	127.32	146.92	59.43	131.43	28.37	19.15	127.32	8.86	5.13	3.77	26.81	146.99	152.69	62.12	117.7
28.2	20.65	13.42	6.31	108.07	146.04	53.11	123.82	34.3	17.36	128.07	8.61	7.01	7.48	31.62	113.21	109.54	59.2	107.3
29.48	18.42	15.1	4.12	128.62	142.69	59.77	122.8	27.43	23.68	128.62	8.12	7.97	6.5	25.73	127.48	124.05	67.66	118.15