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Research Article

Comparative Evaluation of Chin-Throat Morphology in Different Sagittal and Vertical Skeletal Patterns - A Cephalometric Study

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ARTICLE INFO

ABSTRACT

Aim: To Evaluate and Compare Chin-Throat Morphology in various Sagittal and Vertical Skeletal Patterns.

Material and Method: Seventy-eight standardized lateral cephalometric radiographs (True Size Lateral Cephalograms with 1:1 Magnification Ratio) were equally divided into Three groups Class I (n=26), Class II (n=26) & Class III (n=26). Further Chin Throat Angle, Mento-cervical Angle and Anterior and Posterior portions of the Mandibular border were measured for sagittal assessment within all three Groups. For Vertical Assessment all 78 standardized lateral cephalometric radiographs were further divided into Hypodivergent, Normodivergent and Hyperdivergent Growth Patterns and total 3 parameters (Chin Throat Angle, Mento-cervical Angle and Anterior and Posterior portions of the Mandibular border) were measured.

Results: Chin Throat Angle showed highest mean value in Class II Malocclusion with Normodivergent Growth Pattern (130.2±2.78) and Lowest mean value in Cass II Malocclusion with Hyperdivergent Growth Pattern (97.43) and this difference (32.77) is clinically significant with $p<0.001$. Mento-cervical Angle showed highest mean value in Class II Malocclusion with Hypodivergent Growth Pattern (95.14±3.11) and lowest mean value in Class I Malocclusion with Hypodivergent Growth Pattern (72.38±1.9). This difference (22.76) is clinically significant with $p<0.001$. Posterior portion of the Mandibular border showed highest mean value in the Class I Malocclusion with Hyperdivergent Growth Pattern (60.17±0.98) and Lowest mean value in Class I Malocclusion with Hypodivergent Growth Pattern (46.08 ± 1.04) and this difference (14.09) is clinically significant with $p<0.001$. Anterior portion of the Mandibular border showed highest mean values in Class I Malocclusion with Hypodivergent Growth Pattern (53.92±1.04) and Lowest mean value in Class I Malocclusion with Hyperdivergent growth pattern (39.83 ± 0.98) and this difference (14.09) is clinically significant with $p<0.001$.

Conclusion: The Chin Throat Angle, Mento-cervical Angle and Anterior and Posterior portions of the Mandibular border are reliable indicators for Orthodontic Diagnosis and Treatment planning.

Keywords: Chin-Throat Morphology, Chin Throat Angle, Mento-cervical Angle, Anterior and Posterior portion of the Mandibular border.

1. INTRODUCTION

Hofrath [(1)] in Germany and Broadbent [(2)] in the United States first introduced Cephalometric analysis in1930s. Frontal and lateral cephalometric radiographs were used to evaluate the Craniofacial Complex, Dentofacial proportions, status of Malocclusion and growth-related changes. All of these are crucial for Orthodontic Diagnosis and treatment planning. A traditional cephalometric radiograph depicts three-dimensional features in two dimensions. Cephalometric analysis emphasises on relationship among the hard tissue (bone and teeth) and their association with surrounding soft tissues (nose, lips, and chin) [(3)].

Facial beauty is associated with psychosocial wellbeing and success. The main motivation of patients for visiting Orthodontic clinic is the Enhancement of Appearance. Aesthetics is one of the primary aim for successful Orthodontic Treatment. Aesthetic corrections require knowing the factors affecting the Attractiveness and the extent of modifications needed. Therefore, assessment of the variables contributing to the attractiveness has significant clinical implications in Orthodontics. While the perception of beauty varies widely among individuals and Racial and Ethnic groups [4], many investigators have tried to quantify their clinical impressions of the soft tissue profile. Yet, the quantification of the soft tissue profile is neglected because of its variability.

Soft tissue Profile changes along with Dentoalveolar correction play an essential part in Orthodontic treatment. The facial profile is determined by the lips and the chin position, extreme forward or backward position of these points makes the profile unattractive. Chin position is related to facial structures, most particularly the lips and/or nose (e.g., E-line, Holdaway's H-line, Steiner's S-line), or Cranial references (vertical projections from soft tissue nasion, soft tissue glabella) and these assessments aid in orthodontic analyses. The Chin-Throat relationship, together with the chin's position relative to the lips and nose, enables the practitioner to establish the chin extension in the facial profile, which is an important step when the therapeutic influence is limited to the lower face. A chin may be suitably extended in the anterior region yet lacking harmony due to an increased chin-throat angle.

Chin-throat examination is more common in orthognathic surgery compared to plastic surgery [5]. The chin-Throat angle (CTA) is also called as the Cervico-Mental Angle or Submental-Cervical Angle. CTA has been reported at a low of 90° [6] but also at 124° [7]. A recent survey of this angle's attractiveness reported an optimal value of 95° [8]. Form of the chin "button," evaluated through angular measurements acknowledged differently by various authors: the Mento-cervical angle, by Farkas [9]; the lower face–throat angle by Legan and Burstone [10]; and the "Lip-Chin-Throat" angle by Worms et al [11]. This measurement is vastly dependent on lip position relative to the chin, rather than on chin form.

The assessment of chin throat angle plays a major role with regards to Diagnosis and Treatment planning in different Sagittal and Vertical Skeletal Pattern and hence chin-throat relationship requires proper analysis because of its variability

Need of the Study

Chin-Throat Morphology is one of the essential yet highly neglected part in orthodontic Diagnosis and Treatment Planning. After appraising the literature till 20th January, 2023 from PubMed, Google Scholar and Research Gate there were very few studies regarding Chin-Throat Morphology in different skeletal growth Patterns. Hence comparative evaluation of Chin-Throat Morphology by different parameters (Chin-Throat Angle, Mento-Cervical Angle and 'T' Line) in Sagittal as well as Vertical Skeletal growth Pattern becomes need of an hour.

Aim & Objectives

Aim:

To Evaluate and Compare Chin-Throat Morphology in various Sagittal and Vertical Skeletal Patterns.

Objectives:

- To evaluate Mento-Cervical angle in various Sagittal and Vertical Skeletal Pattern.
- To evaluate Chin-Throat angle in various Sagittal and Vertical Skeletal Pattern.
- To evaluate 'T' Line (Tangent to the throat) in various Sagittal and Vertical Skeletal Pattern.
- To compare Mento-Cervical angle, Chin-throat angle and 'T' Line (Tangent to the throat) in various Sagittal and Vertical Skeletal Pattern.

2. MATERIALS AND METHODS

A. Study design: -

I. Place of the Study: Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital, Sumandeep Vidyapeeth Deemed to be University.

II. Source of Sample: Patients records (Lateral Cephalograms) from the Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital, Sumandeep Vidyapeeth Deemed to be University.

III. Sample Description:

$$N = \frac{2(Z_{1-\frac{\alpha}{2*k}} + Z_{1-\beta})^2 \sigma^2}{d^2}$$

N= 2[(2.3939797981851+0.841621233572915) ^2 x (8.91) ^2]/ (8) ^2
= [2 x (10.4691140472837) x (79.3881)]/ (64)
= [1662.24614579432]/ (64)

=25.97259603
=26

Based on the key article titled 'A Retrospective Study on variations In Chin-Throat Angle in Different Skeletal Malocclusions' [13] and Considering 3 groups, with a power of 80 % and an alpha error rate of 5 % the Z score is 0.841621233572915 and 2.39397979981851 respectively. Having a standard deviation of 8.91 and to assess a clinically relevant difference (d) of 8, we need a sample of 26 per group.

So, **the final estimated Sample size will be 26 x 3 = 78**

IV. **Time Scale of the Study**: Study was started after obtaining SVIEC approval and was concluded within 8 months from the date of approval.

V. **Study Design**: Retrospective Study

VI. **Selection Criteria**:

1. Inclusion Criteria:

I. Age 18 years and above
II. Lateral Cephalograms with Good image Quality, Standard Proportion (1:1) and high Resolution

2. Exclusion Criteria:

I. History of Orthodontic/Orthognathic/Surgical treatment
II. Presence of any Craniofacial anomalies
III. Presence of Double Chin
IV. History of Maxillofacial Trauma

B. Equipment and Material used for the study: -

1. Carestream 9600 X-Ray Machine having 73Kv, 8.0mA and Exposure Time of 12.3 sec.
2. Standardized Lateral Cephalograms of Dimension's 8 x 10 inches
3. Acetate Matte Tracing Paper (8x10x0.003 inches)
4. A shape 3H Drawing pencil.
5. Tracing Table with X-ray View box
6. 12 Inch Scale, big Protractors, Sharpener and Eraser

Methodology: -

After obtaining Ethical approval from Sumandeep Vidyapeeth Institutional Ethical Committee (SVIEC), the study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital.

After sample size estimation, as per the inclusion / exclusion criteria, Lateral Cephalograms were obtained from the patient's record from the Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital. All the Lateral Cephalograms were obtained from Carestream 9600 X-Ray Machine having 73Kv, 8.0mA and Exposure Time of 12.3 sec.

All 78 standardized lateral cephalometric radiographs (True Size Lateral Cephalograms with 1:1 Magnification Ratio) were equally divided into Three groups Class I (n=26), Class II (n=26) & Class III (n=26). Further Chin Throat Angle, Mento-cervical Angle and Anterior and Posterior portions of the Mandibular border will be measured for sagittal assessment for all the three Groups. For Vertical Assessment all 78 standardized lateral cephalometric radiographs will be further divided into Hypodivergent, Normodivergent and Hyperdivergent Growth Patterns and total 3 parameters (Chin Throat Angle, Mento-cervical Angle and Anterior and Posterior portions of the Mandibular border) will be measured (Fig 1).

Values of all the parameters were obtained by manual cephalometric tracing by Principal Investigator. After 15 Days, to determine the measurement Reliability and to avoid intra-observer variation, the same investigator repeated the manual cephalometric tracing with 10% of randomly chosen lateral cephalograms from the sample. All the collected data were further subjected to suitable statistical analyses to conclude the results

Following tables shows soft and hard tissue landmarks and parameters to be evaluated (Table 1 & 2)

Table-1: Cephalometric Landmarks

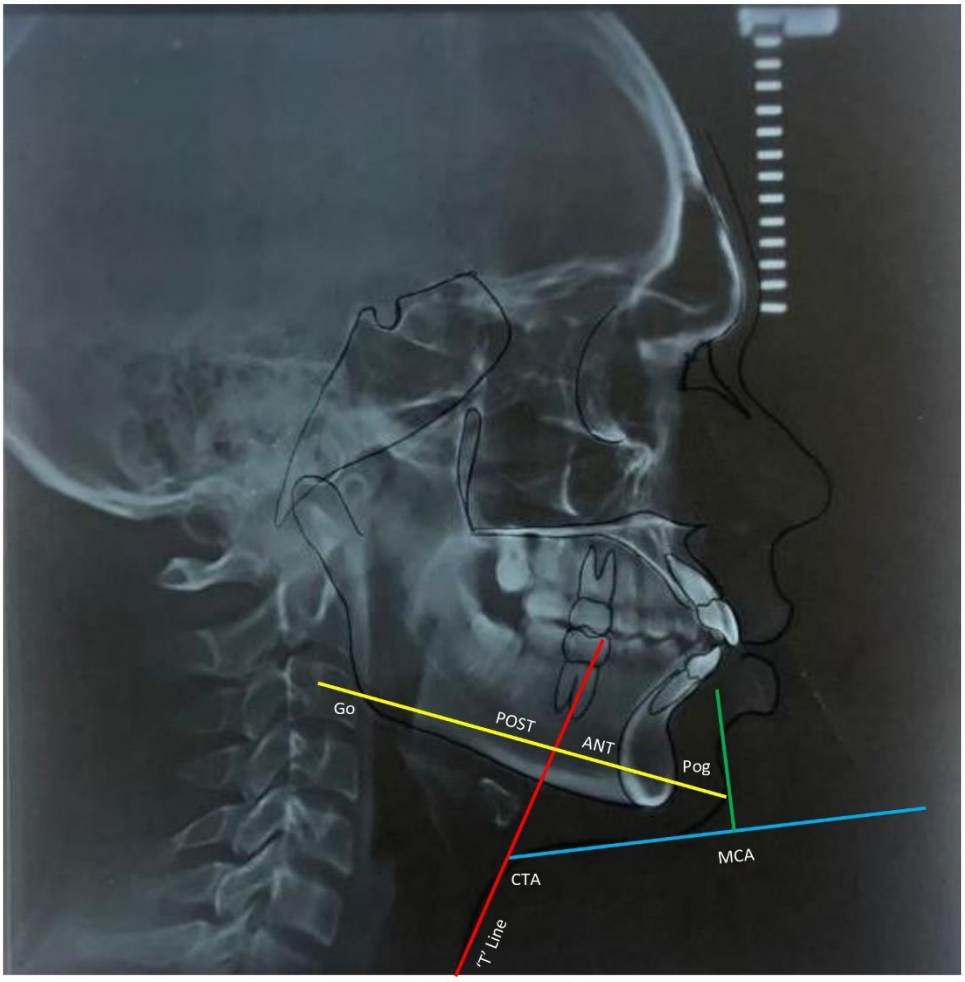
Sr. No.	Landmark	Name of Landmark	Description
1.	Pog	Hard tissue pogonion	Most Anterior point in chin
2.	Pog'	Soft tissue Pogonion	The most prominent or anterior point on the chin in the midsagittal plane
3.	Go	Gonion	The Point on the curvature of the angle of Mandible located by bisecting the angle formed by lines Tangent to the Ramus and Inferior border of

			Mandible
4.	Me	Menton	The most inferior point on the mandibular symphysis in the midsagittal plane
5.	Me’	Soft tissue menton	The lowest point on the contour of the soft tissue chin determined by dropping a perpendicular from horizontal plane through Menton.
6.	Sm	Submental line	Tangent to the Submental contour passing through soft tissue Menton.

Table-2 Cephalometric Parameters

Sr. No.	Parameter	Name of Parameter	Description
1.	“T” line [12]	“T” line	Tangent to the throat (cervical plane)
2.	CTA[12]	Chin-throat angle	Angle between T-line and Submental plane
3.	MCA[12]	Mentocervical angle	Angle at the intersection of the tangents to the upper contour and inferior border of the chin
4.	ANT/POST[12]	Anterior and Posterior portions of the Mandibular border	Anterior and Posterior portions of the Mandibular border determined by the intersection of T-line with Go-pog line

Fig 1: Landmarks and Lines used for Linear and Angular measurements



3. RESULTS

Age and sex distribution

	Mean	Standard Deviation
Age	20.88	3.49

Growth Pattern	Hypodivergent	Age	20.24	2.85
	Normodivergent	Age	21.78	3.93
	Hyperdivergent	Age	21.29	4.05
Class	Class I	Age	20.36	3.09
	Class II	Age	20.62	2.76
	Class III	Age	21.65	4.39

				Count	Column N %
Gender	**F**			41	51.9%
	M			37	48.1%
Growth Pattern	Hypodivergent	Gender	F	14	36.8%
			M	24	63.2%
	Normodivergent	Gender	F	13	72.2%
			M	6	27.8%
	Hyperdivergent	Gender	F	13	61.9%
			M	8	38.1%
Malocclusion	Class I	Gender	F	14	56.0%
			M	11	44.0%
	Class II	Gender	F	11	42.3%
			M	15	57.7%
	Class III	Gender	F	15	57.7%
			M	11	42.3%

Table 3: Comparison of the Growth Patterns in Class I (n=26) Malocclusion

Parameters	Hypodivergent (N=13) Mean ± SD	Normodivergent (N=6) Mean ± SD	Hyperdivergent (N=6) Mean ± SD	F / Welch Statistics (*represents welch test)	P value	Hypodivergent vs Normodivergent Difference (p value)	Hypodivergent vs Hyperdivergent Difference (p value)	Normodivergent vs Hyperdivergent Difference (p value)
Chin-throat angle CTA	120.85 ± 2.04	113.33 ± 5.16	120.33 ± 1.03	5.572 *	**0.022**	7.51(<0.001)	0.51(0.933)	-7(0.001)
Mentocervical angle MCA	72.38 ± 1.9	94.67 ± 0.52	89.67 ± 1.51	735.01 *	**<0.001**	-22.28(<0.001)	-17.28(<0.001)	5(<0.001)
Posterior Portion of the mandibular border	46.08 ± 1.04	53.33 ± 1.03	60.17 ± 0.98	405.375	**<0.001**	-7.26(<0.001)	-14.09(<0.001)	-6.83(<0.001)
Anterior Portion of the mandibular border	53.92 ± 1.04	46.67 ± 1.03	39.83 ± 0.98	405.375	**<0.001**	7.26(<0.001)	14.09(<0.001)	6.83(<0.001)

Table 3 shows Comparison of the Growth Patterns in Class I Malocclusion in four different Parameters (Chin-throat angle, Mentocervical Angle, Posterior Portion of Mandibular Border and Anterior Portion of Mandibular Border)

Comparison of the parameter Chin-throat angle (CTA) showed significant difference between the three groups (test value of 5.572 and p value of 0.022). The highest mean values were seen in Hypodivergent (120.85±2.04) followed by Hyperdivergent (120.33±1.03) and Normodivergent (113.33±5.16) (Fig:2). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Normodivergent (7.513) which was significant, followed by Normodivergent vs Hyperdivergent (7, significant) and Hypodivergent vs Hyperdivergent (0.513, not significant)

Comparison of the parameter Mento-cervical angle (MCA) showed significant difference between the three groups (test value of 735.01and p value of <0.001). The highest mean values were seen in Normodivergent

(94.67±0.52) followed by Hyperdivergent (89.67±1.51) and Hypodivergent (72.38±1.9) (Fig:3). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Normodivergent (22.282) which was significant, followed by Hypodivergent vs Hyperdivergent (17.282, significant) and Normodivergent vs Hyperdivergent (5, significant)

Comparison of the parameter Posterior Portions of the mandibular border between the three groups showed significant difference (test value of 405.375and p value of <0.001). The highest mean values were seen in Hyperdivergent (60.17±0.98) followed by Normodivergent (53.33±1.03) and Hypodivergent (46.08±1.04) (Fig:4). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Hypodivergent (14.09) which was significant, followed by Hypodivergent vs Normodivergent (7.256, significant) and Normodivergent vs Hyperdivergent (6.833, significant)

Comparison of the parameter Anterior Portions of the mandibular border between the three groups showed significant difference (test value of 405.375and p value of <0.001). The highest mean values were seen in Hypodivergent (53.92±1.04) followed by Normodivergent (46.67±1.03) and Hyperdivergent (39.83±0.98) (Fig:5). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Hyperdivergent (14.09) which was significant, followed by Hypodivergent vs Normodivergent (7.256, significant) and Normodivergent vs Hyperdivergent (6.833, significant)

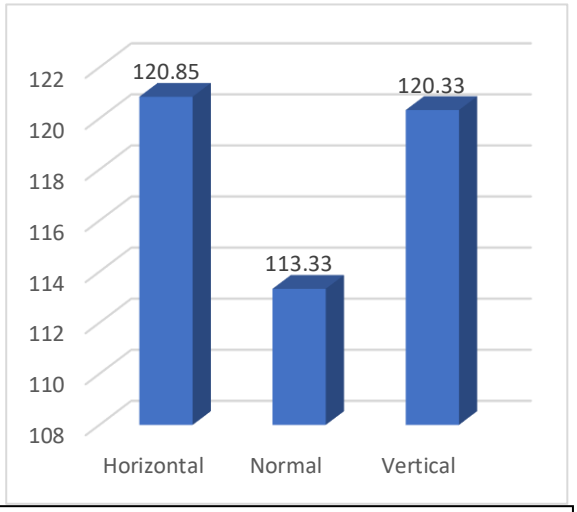


Fig:2 Comparison of Chin-throat angle (CTA) in Growth Patterns of Class I Malocclusion

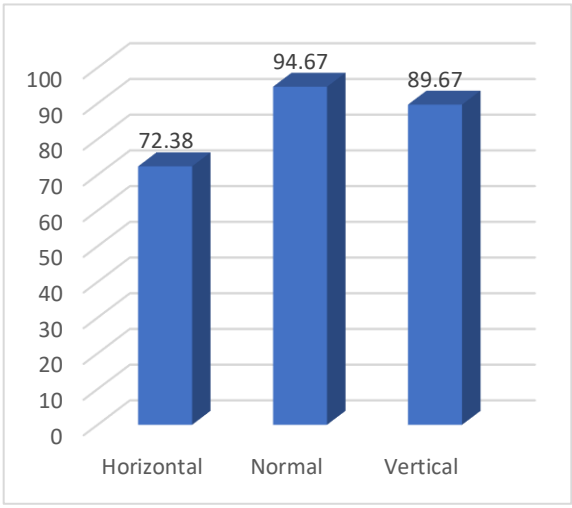


Fig:3 Comparison of Mentocervical angle MCA in Growth Patterns of Class I Malocclusion

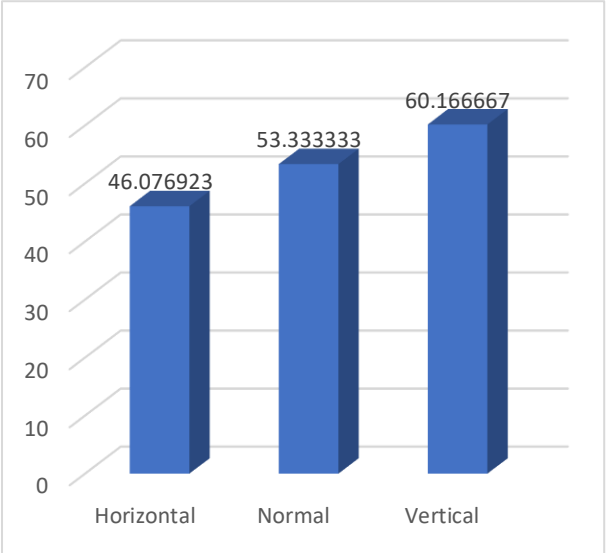


Fig:4 Comparison of Posterior Portion of the Mandibular border in Growth Patterns of Class I Malocclusion

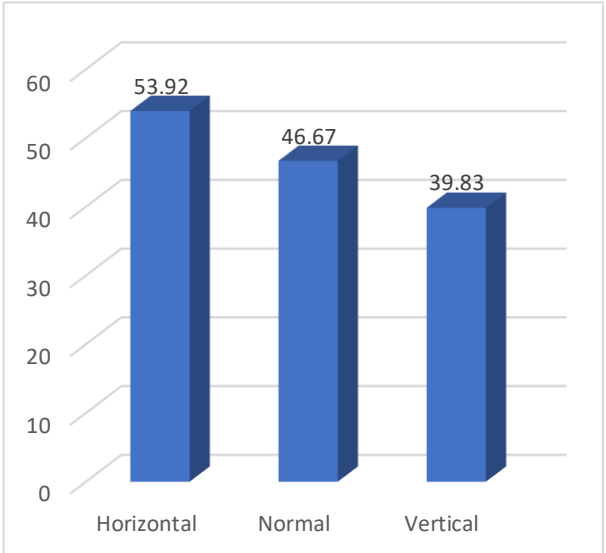


Fig:5 Comparison of Anterior Portion of the Mandibular border in Growth Patterns of Class I Malocclusion

Table 4: Comparison of the growth patterns in Class II(n=26) Malocclusion

Parameters	Hypodivergent (N=14) Mean ± SD	Normodivergent(N=5) Mean ± SD	Hyperdivergent (N=7) Mean ± SD	F / Welch Statistics (*represents welch test)	P value	Hypodivergent vs Normodivergent Difference (p value)	Hypodivergent vs Hyperdivergent Difference (p value)	Normodivergent vs Hyperdivergent Difference (p value)
Chin-throat angle CTA	118.5 ± 1.74	130.2 ± 2.78	97.43 ± 2.15	409.227	**<0.001**	-11.7(<0.001)	21.07(<0.001)	32.77(<0.001)
Mentocervical angle MCA	95.14 ± 3.11	93.4 ± 0.89	89.29 ± 5.35	3.913 *	**0.049**	1.74(0.63)	5.86(0.005)	4.11(0.149)
Posterior Portions of the mandibular border	52 ± 1.11	55 ± 3	53.57 ± 2.15	3.449 *	0.088	-3(0.014)	-1.57(0.184)	1.43(0.404)
Anterior Portions of the mandibular border	48 ± 1.11	45 ± 3	46.43 ± 2.15	3.449 *	0.088	3(0.014)	1.57(0.184)	-1.43(0.404)

Table 4 shows Comparison of the Growth Patterns in Class II Malocclusion in four different Parameters (Chin-throat angle, Mentocervical Angle, Posterior Portion of Mandibular Border and Anterior Portion of Mandibular Border)

Comparison of the parameter Chin-throat angle CTA between the three groups showed significant difference (test value of 409.227 and p value of <0.001). The highest mean values were seen in Normodivergent (130.2±2.78) followed by Hypodivergent (118.5±1.74) and Hyperdivergent (97.43±2.15) (Fig:6). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Normodivergent vs Hyperdivergent (32.771) which was significant, followed by Hypodivergent vs Hyperdivergent (21.071, significant) and Hypodivergent vs Normodivergent (11.7, significant)

Comparison of the parameter Mento-cervical angle MCA showed significant difference between the three groups (test value of 3.913and p value of 0.049). The highest mean values were seen in Hypodivergent (95.14±3.11) followed by Normodivergent (93.4±0.89) and Hyperdivergent (89.29±5.35) (Fig:7). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Hyperdivergent (5.857) which was significant, followed by Normodivergent vs Hyperdivergent (4.114, significant) and Hypodivergent vs Normodivergent (1.743, not significant)

Comparison of the Posterior Portion of the mandibular border between the three groups showed no significant difference between the three groups (test value of 3.449and p value of 0.088). The highest mean values were seen in Normodivergent (55±3) followed by Hyperdivergent (53.57±2.15) and Hypodivergent (52±1.11) (Fig:8). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Normodivergent (3) which was significant, followed by Hypodivergent vs Hyperdivergent (1.571, not significant) and Normodivergent vs Hyperdivergent (1.429, significant)

Comparison of the parameter Anterior Portion of the mandibular border between the three groups showed no significant difference between the three groups (test value of 3.449and p value of 0.088). The highest mean values were seen in Hypodivergent (48±1.11) followed by Hyperdivergent (46.43±2.15) and Normodivergent (45±3) (Fig:9). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Normodivergent (3) which was significant, followed by Hypodivergent vs Hyperdivergent (1.571, not significant) and Normodivergent vs Hyperdivergent (1.429, significant)

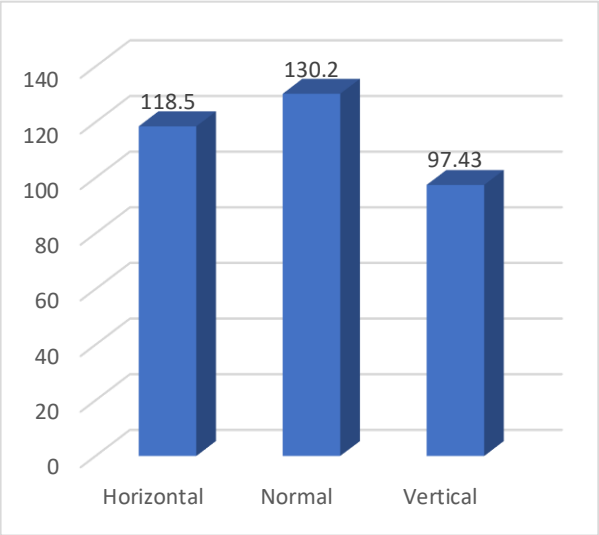


Fig:6 Comparison of Chin-throat angle (CTA) in Growth Patterns of Class II Malocclusion

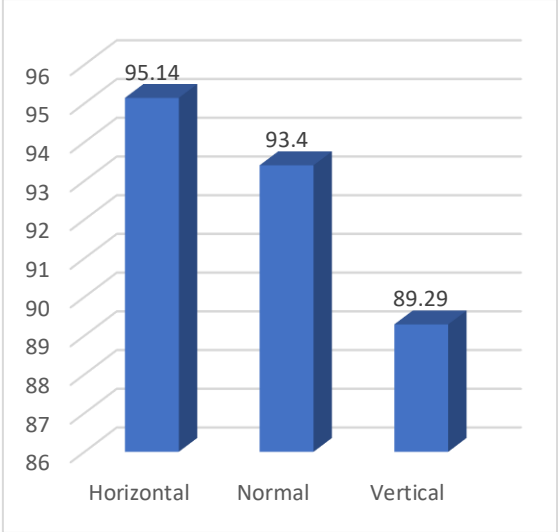


Fig:7 Comparison of Mentocervical angle MCA in Growth Patterns of Class II Malocclusion

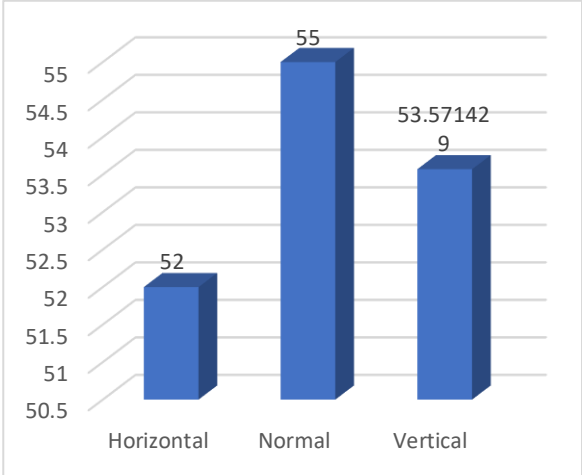


Fig:8 Comparison of Posterior Portion of the Mandibular border in Growth Patterns of Class II Malocclusion

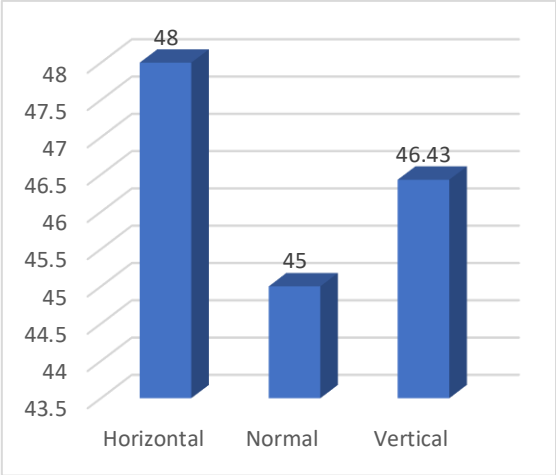


Fig:9 Comparison of Anterior Portion of the Mandibular border in Growth Patterns of Class II Malocclusion

Table 5: Comparison of the growth patterns in Class III (n=26) Malocclusion

Parameters	Hypodivergent (N=11) Mean ± SD	Normodivergent (N=7) Mean ± SD	Hyperdivergent (N=8) Mean ± SD	F / Welch Statistics (*represents welch test)	P value	Hypodivergent vs Normodivergent Difference (p value)	Hypodivergent vs Hyperdivergent Difference (p value)	Normodivergent vs Hyperdivergent Difference (p value)
Chin-throat angle CTA	117.91 ± 2.43	110.57 ± 1.4	113.88 ± 2.64	22.908	**<0.001**	7.34(<0.001)	4.03(0.003)	-3.3(0.026)
Mentocervical angle MCA	83.45 ± 1.44	81.57 ± 1.72	92.13 ± 7.64	12.979	**<0.001**	1.88(0.656)	-8.67(0.001)	-10.55(<0.001)
Posterior Portions of the	59.09 ± 4.91	52.29 ± 1.6	58.5 ± 2.51	8.482	**0.002**	6.81(0.002)	0.59(0.934)	-6.21(0.008)

mandibular border								
Anterior Portions of the mandibular border	40.91 ± 4.91	47.29 ± 2.14	41.5 ± 2.51	7.132	**0.004**	-6.38(0.004)	-0.59(0.937)	5.79(0.016)

Table 5 shows Comparison of the Growth Patterns in Class III Malocclusion in four different Parameters (Chin-throat angle, Mentocervical Angle, Posterior Portion of Mandibular Border and Anterior Portion of Mandibular Border)

Comparison of the parameter Chin-throat angle CTA between the three groups showed significant difference (test value of 22.908 and p value of <0.001). The highest mean values were seen in Hypodivergent (117.91±2.43) followed by Hyperdivergent (113.88±2.64) and Normodivergent (110.57±1.4) (Fig:10). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Normodivergent (7.338) which was significant, followed by Hypodivergent vs Hyperdivergent (4.034, significant) and Normodivergent vs Hyperdivergent (3.304, significant)

Comparison of the parameter Mento-cervical angle MCA between the three groups showed significant difference (test value of 12.979and p value of <0.001). The highest mean values were seen in Hyperdivergent (92.13±7.64) followed by Hypodivergent (83.45±1.44) and Normodivergent (81.57±1.72) (Fig:11). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Normodivergent vs Hyperdivergent (10.554) which was significant, followed by Hypodivergent vs Hyperdivergent (8.67, significant) and Hypodivergent vs Normodivergent (1.883, not significant)

Comparison of the parameter Posterior Portion of the mandibular border between the three groups showed significant difference (test value of 8.482and p value of 0.002). The highest mean values were seen in Hypodivergent (59.09±4.91) followed by Hyperdivergent (58.5±2.51) and Normodivergent (52.29±1.6) (Fig:12). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Hypodivergent vs Normodivergent (6.805) which was significant, followed by Normodivergent vs Hyperdivergent (6.214, significant) and Hypodivergent vs Hyperdivergent (0.591, not significant)

Comparison of the parameter Anterior Portion of the mandibular border between the three groups showed significant difference (test value of 7.132and p value of 0.004). The highest mean values were seen in Normodivergent (47.29±2.14) followed by Hyperdivergent (41.5±2.51) and Hypodivergent (40.91±4.91) (Fig:13). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Horizontal vs Normodivergent (6.377) which was significant, followed by Normodivergent vs Hyperdivergent (5.786, significant) and Hypodivergent vs Hyperdivergent (0.591, not significant)

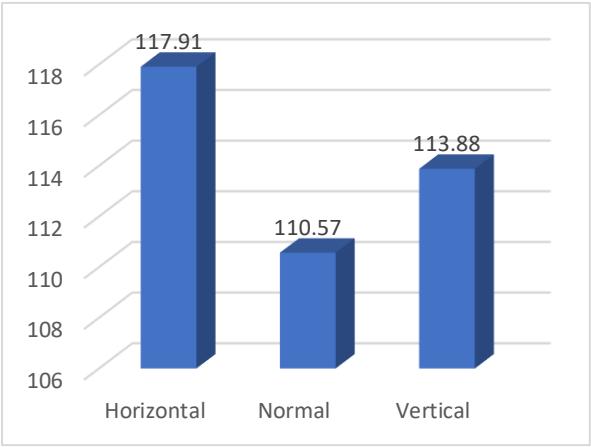


Fig:10 Comparison of Chin-throat angle (CTA) in Growth Patterns of Class III Malocclusion

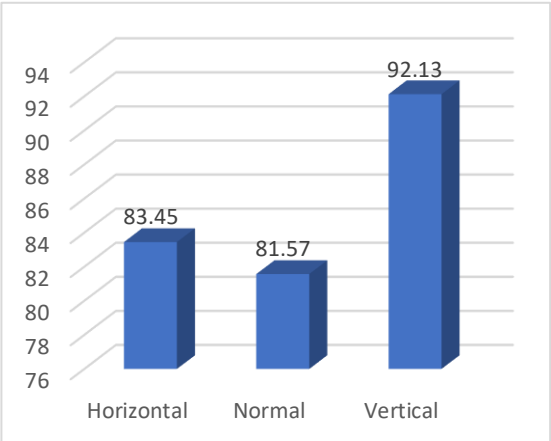


Fig:11 Comparison of Mentocervical angle MCA in Growth Patterns of Class III Malocclusion

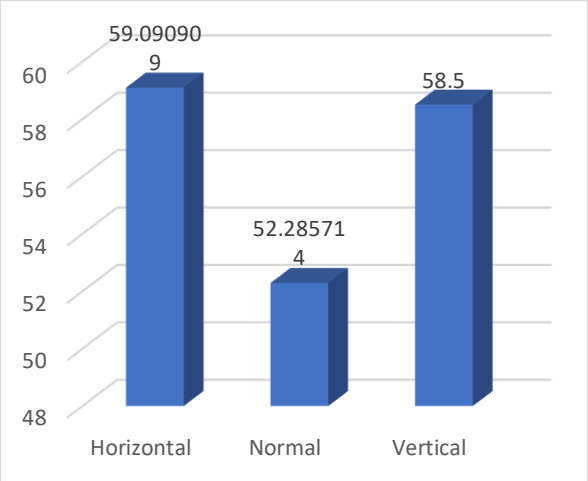


Fig:12 Comparison of Posterior Portion of the Mandibular border in Growth Patterns of Class III Malocclusion

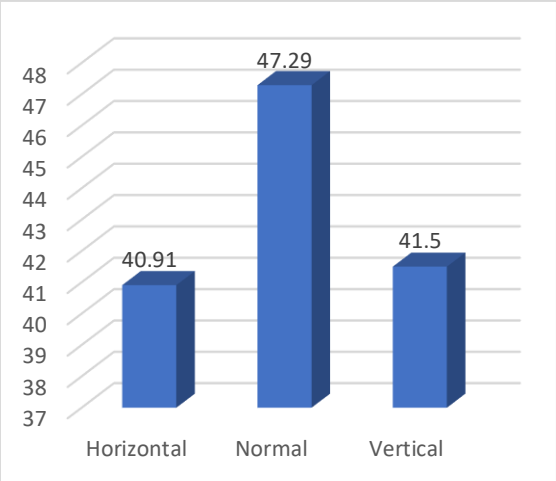


Fig:13 Comparison of Anterior Portion of the Mandibular border in Growth Patterns of Class III Malocclusion

Table 6: Comparison of Malocclusions in Hypodivergent Growth Pattern (n=38)

Parameters	Class I (N=13) Mean ± SD	Class II (N=14) Mean ± SD	Class III (N=11) Mean ± SD	F / Welch Statistics (*represents welch test)	P value	Class I vs Class II Difference (p value)	Class I vs Class III Difference (p value)	Class II vs Class III Difference (p value)
Chin-throat angle CTA	120.85 ± 2.04	118.5 ± 1.74	117.91 ± 2.43	7.118	**0.003**	2.35(0.015)	2.94(0.004)	0.59(0.758)
Mentocervical angle MCA	72.38 ± 1.9	95.14 ± 3.11	83.45 ± 1.44	322.768	**<0.001**	-22.76(<0.001)	-11.07(<0.001)	11.69(<0.001)
Posterior Portions of the mandibular border	46.08 ± 1.04	52 ± 1.11	59.09 ± 4.91	121.571*	**<0.001**	-5.92(<0.001)	-13.01(<0.001)	-7.09(<0.001)
Anterior Portions of the mandibular border	53.92 ± 1.04	48 ± 1.11	40.91 ± 4.91	121.571*	**<0.001**	5.92(<0.001)	13.01(<0.001)	7.09(<0.001)

Table 6 shows Comparison of Malocclusion in Hypodivergent Growth Pattern in four different Parameters (Chin-throat angle, Mentocervical Angle, Posterior Portion of Mandibular Border and Anterior Portion of Mandibular Border)

Comparison of the parameter Chin-throat angle (CTA) between the three groups showed significant difference between the three groups (test value of 7.118 and p value of 0.003). The highest mean values were seen in Class I (120.85±2.04) followed by Class II (118.5±1.74) and Class III (117.91±2.43) (Fig:14). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class III (2.937) which was significant, followed by Class I vs Class II (2.346, significant) and Class II vs Class III (0.591, not significant)

Comparison of the parameter Mento-cervical angle (MCA) between the three groups showed significant difference between the three groups (test value of 322.768and p value of <0.001). The highest mean values were seen in Class II (95.14±3.11) followed by Class III (83.45±1.44) and Class I (72.38±1.9) (Fig:15). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between

Class I vs Class II (22.758) which was significant, followed by Class II vs Class III (11.688, not significant) and Class I vs Class III (11.07, significant)

Comparison of the parameter Posterior Portions of the mandibular border between the three groups showed significant difference between the three groups (test value of 121.571and p value of <0.001). The highest mean values were seen in Class III (59.09±4.91) followed by Class II (52±1.11) and Class I (46.08±1.04) (Fig:16). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class III (13.014) which was significant, followed by Class II vs Class III (7.091, not significant) and Class I vs Class II (5.923, significant)

Comparison of the parameter Anterior Portions of the mandibular border between the three groups showed significant difference between the three groups (test value of 121.571and p value of <0.001). The highest mean values were seen in Class I (53.92±1.04) followed by Class II (48±1.11) and Class III (40.91±4.91) (Fig:17). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class III (13.014) which was significant, followed by Class II vs Class III (7.091, not significant) and Class I vs Class II (5.923, significant)

Fig:14 Comparison of Chin-throat angle (CTA) in Malocclusions of Hypodivergent Growth Pattern

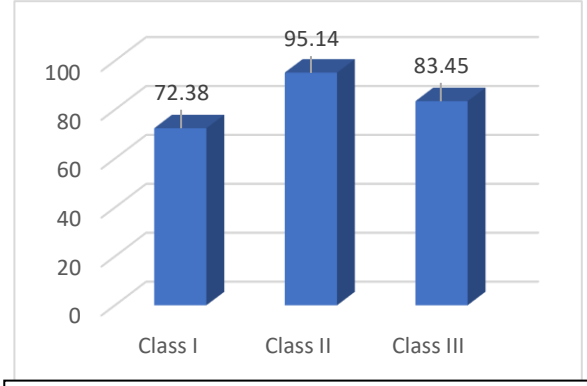


Fig:15 Comparison of Mentocervical angle (MCA) in Malocclusions of Hypodivergent Growth Pattern

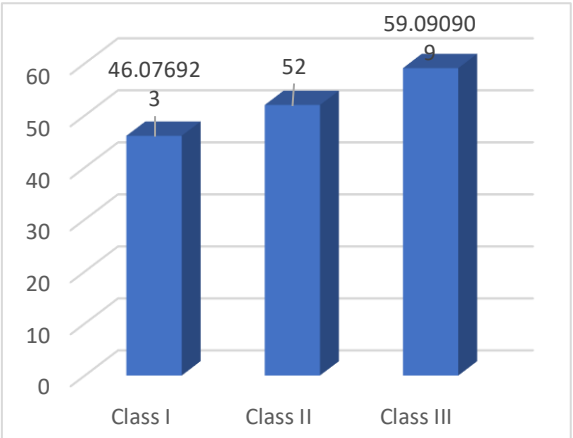


Fig:16 Comparison of Posterior Portion of the Mandibular border in Malocclusions of Hypodivergent Growth Pattern

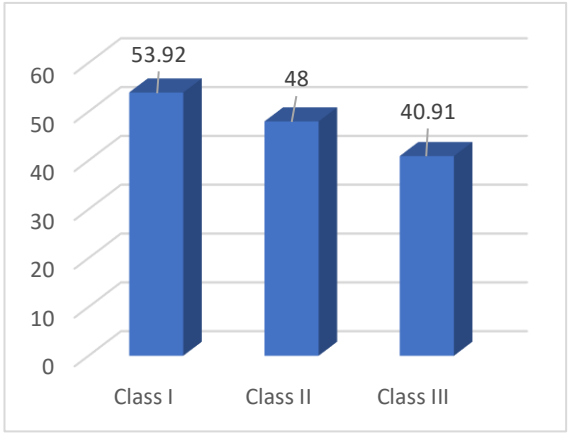


Fig:17 Comparison of Anterior Portion of the Mandibular border in Malocclusions of Hypodivergent Growth Pattern

Table 7: Comparison of Malocclusions in Normodivergent Growth Pattern (n= 19)

Parameters	Class I (N=6) Mean ± SD	Class II (N=5) Mean ± SD	Class III (N=7) Mean ± SD	F / Welch Statistics (*represents welch test)	P value	Class I vs Class II Difference (p value)	Class I vs Class III Difference (p value)	Class II vs Class III Difference (p value)

Chin-throat angle CTA	113.33 ± 5.16	130.2 ± 2.78	110.57 ± 1.4	96.966 *	**<0.001**	-16.87(<0.001)	2.76(0.342)	19.63(<0.001)
Mentocervical angle MCA	94.67 ± 0.52	93.4 ± 0.89	81.57 ± 1.72	170.399 *	**<0.001**	1.27(0.231)	13.1(<0.001)	11.83(<0.001)
Posterior Portions of the mandibular border	53.33 ± 1.03	55 ± 3	52.29 ± 1.6	1.902 *	0.21	-1.67(0.359)	1.05(0.607)	2.71(0.075)
Anterior Portions of the mandibular border	46.67 ± 1.03	45 ± 3	47.29 ± 2.14	0.982 *	0.416	1.67(0.424)	-0.62(0.863)	-2.29(0.196)

Table 7 shows Comparison of three classes in Normodivergent Growth Pattern in four different Parameters (Chin-throat angle, Mentocervical Angle, Posterior Portion of Mandibular Border and Anterior Portion of Mandibular Border)

Comparison of the parameter Chin-throat angle CTA between the three groups showed significant difference between the three groups (test value of 96.966 and p value of <0.001). The highest mean values were seen in Class II (130.2±2.78) followed by Class I (113.33±5.16) and Class III (110.57±1.4) (Fig:18). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class II vs Class III (19.629) which was significant, followed by Class I vs Class II (16.867, significant) and Class I vs Class III (2.762, not significant)

Comparison of the parameter Mento-cervical angle MCA between the three groups showed significant difference between the three groups (test value of 170.399and p value of <0.001). The highest mean values were seen in Class I (94.67±0.52) followed by Class II (93.4±0.89) and Class III (81.57±1.72) (Fig:19). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class III (13.095) which was significant, followed by Class II vs Class III (11.829, significant) and Class I vs Class II (1.267, not significant)

Comparison of the parameter Posterior Portions of the mandibular border between the three groups showed no significant difference between the three groups (test value of 1.902and p value of 0.21). The highest mean values were seen in Class II (55±3) followed by Class I (53.33±1.03) and Class III (52.29±1.6) (Fig:20). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class II vs Class III (2.714) which was significant, followed by Class I vs Class II (1.667, not significant) and Class I vs Class III (1.048, not significant)

Comparison of the parameter Anterior Portions of the mandibular border between the three groups showed no significant difference between the three groups (test value of 0.982and p value of 0.416). The highest mean values were seen in Class III (47.29±2.14) followed by Class I (46.67±1.03) and Class II (45±3) (Fig:21). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class II vs Class III (2.286) which was significant, followed by Class I vs Class II (1.667, not significant) and Class I vs Class III (0.619, not significant)

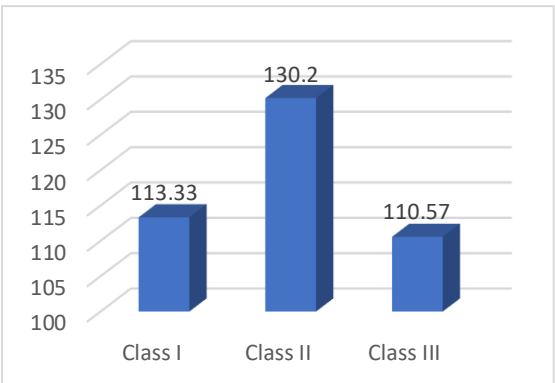


Fig:18 Comparison of Chin-throat angle (CTA) in Malocclusions of Normodivergent Growth Pattern

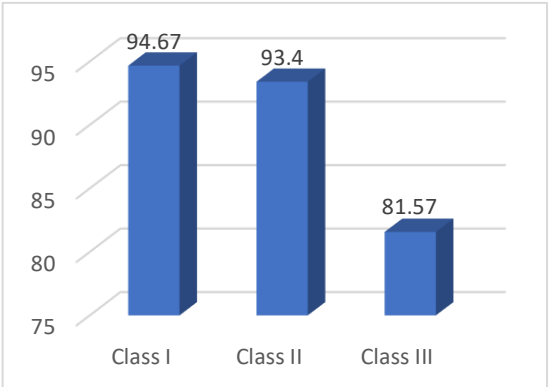


Fig:19 Comparison of Mentocervical angle (MCA) in Malocclusions of Normodivergent Growth Pattern

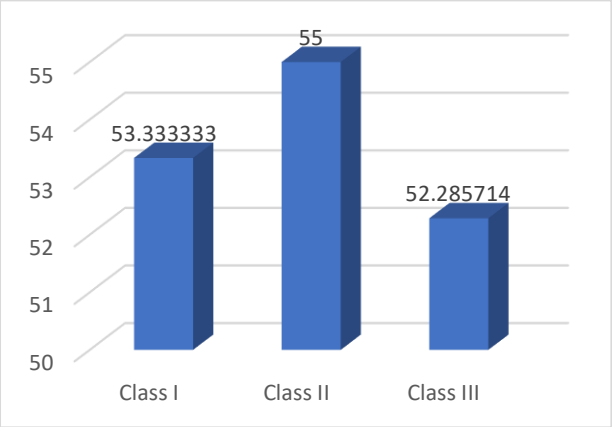


Fig:20 Comparison of Posterior Portion of the Mandibular border in Malocclusions of Normodivergent Growth Pattern

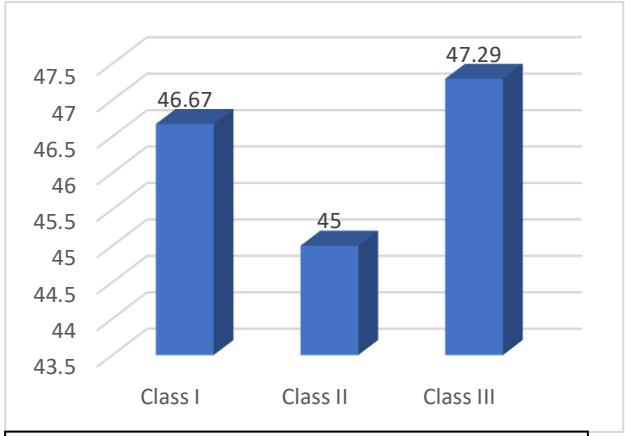


Fig:21 Comparison of Anterior Portion of the Mandibular border in Malocclusions of Normodivergent Growth Pattern

Table 8: Comparison of the Malocclusions in Hyperdivergent Growth Pattern (n=21)

Parameters	Class I (N=6) Mean ± SD	Class II (N=7) Mean ± SD	Class III (N=8) Mean ± SD	F / Welch Statistics (*represents welch test)	P value	Class I vs Class II Difference (p value)	Class I vs Class III Difference (p value)	Class II vs Class III Difference (p value)
Chin-throat angle CTA	120.33 ± 1.03	97.43 ± 2.15	113.88 ± 2.64	204.986	**<0.001**	22.91(<0.001)	6.46(<0.001)	16.45(<0.001)
Mentocervical angle MCA	89.67 ± 1.51	89.29 ± 5.35	92.13 ± 7.64	0.542	0.591	0.38(0.992)	-2.46(0.711)	-2.84(0.612)
Posterior Portions of the mandibular border	60.17 ± 0.98	53.57 ± 2.15	58.5 ± 2.51	25.065 *	**<0.001**	6.6(<0.001)	1.67(0.316)	-4.93(0.001)
Anterior Portions of the mandibular border	39.83 ± 0.98	46.43 ± 2.15	41.5 ± 2.51	25.065 *	**<0.001**	-6.6(<0.001)	-1.67(0.316)	4.93(0.001)

Table 8 shows Comparison of three classes in Hyperdivergent Growth Pattern in four different Parameters (Chin-throat angle, Mentocervical Angle, Posterior Portion of Mandibular Border and Anterior Portion of Mandibular Border)

Comparison of the parameter Chin-throat angle CTA between the three groups showed significant difference between the three groups (test value of 204.986 and p value of <0.001). The highest mean values were seen in Class I (120.33±1.03) followed by Class III (113.88±2.64) and Class II (97.43±2.15) (Fig:22) Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class II (22.905) which was significant, followed by Class II vs Class III (16.446, significant) and Class I vs Class III (6.458, significant)

Comparison of the parameter Mento-cervical angle MCA between the three groups showed no significant difference between the three groups (test value of 0.542and p value of 0.591). The highest mean values were seen in Class III (92.13±7.64) followed by Class I (89.67±1.51) and Class II (89.29±5.35) (Fig:23). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class II vs Class III (2.839) which was significant, followed by Class I vs Class III (2.458, not significant) and Class I vs Class II (0.381, not significant)

Comparison of the parameter Posterior Portions of the mandibular border between the three groups showed significant difference between the three groups (test value of 25.065and p value of <0.001). The highest mean values

were seen in Class I (60.17±0.98) followed by Class III (58.5±2.51) and Class II (53.57±2.15) (Fig:24). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class II (6.595) which was significant, followed by Class II vs Class III (4.929, significant) and Class I vs Class III (1.667, not significant)

Comparison of the parameter Anterior Portions of the mandibular border between the three groups showed significant difference between the three groups (test value of 25.065and p value of <0.001). The highest mean values were seen in Class II (46.43±2.15) followed by Class III (41.5±2.51) and Class I (39.83±0.98) (Fig:25). Subgroup analysis using posthoc Tukey HSD test shows that the largest difference between the groups was noted between Class I vs Class II (6.595) which was significant, followed by Class II vs Class III (4.929, significant) and Class I vs Class III (1.667, not significant)

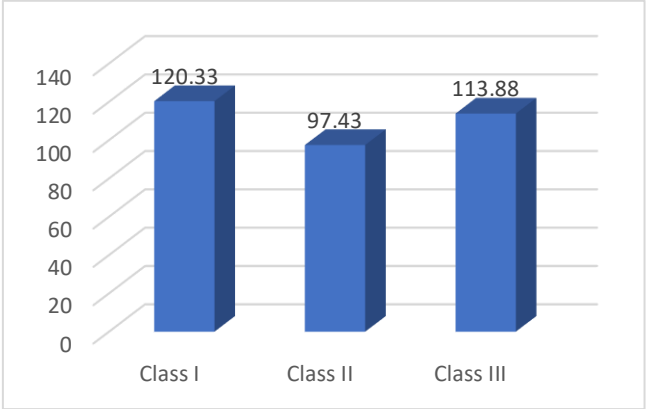


Fig:22 Comparison of Chin-throat angle (CTA) in Malocclusions of Hyperdivergent Growth Pattern

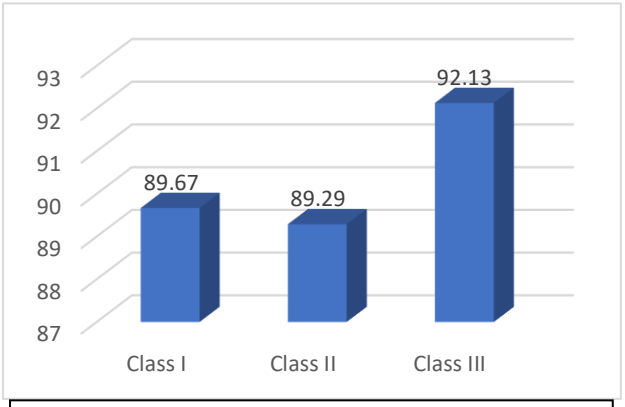


Fig:23 Comparison of Mentocervical angle (MCA) in Malocclusions of Hyperdivergent Growth Pattern

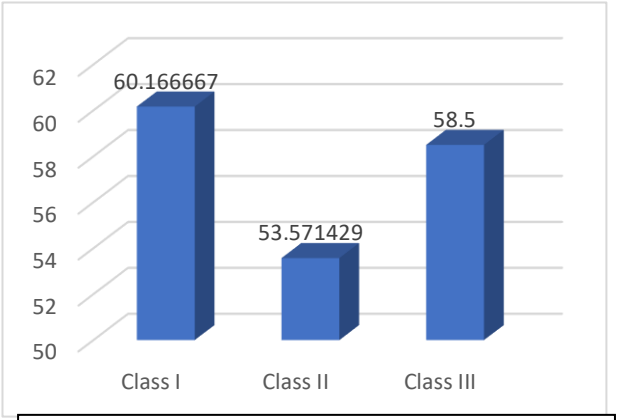


Fig:24 Comparison of Posterior Portion of the Mandibular border in Malocclusions of Hyperdivergent Growth Pattern

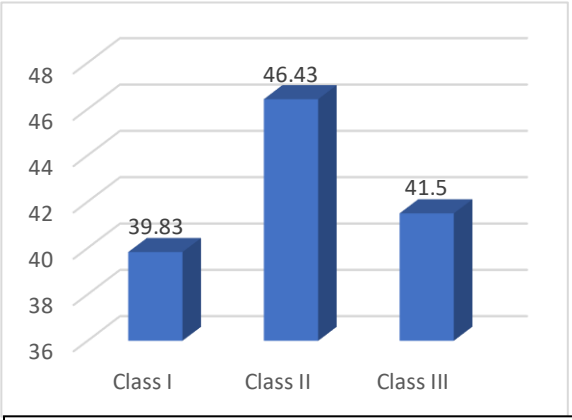


Fig:25 Comparison of Anterior Portion of the Mandibular border in Malocclusions of Hyperdivergent Growth Pattern

4. DISCUSSION

A pleasant profile requires perfect balance between the nose, lips, chin, and throat. In ordinary orthodontic practice, chin-throat morphology is often overlooked in favor of focusing on the nose-lip relationship. Evaluation of chin-throat morphology includes lower lip-chin-throat angle, length, and neck angle. For diagnosis and treatment of mandibular and chin abnormalities, it's important to evaluate the Chin-Throat Angle, Mento-Cervical Angle. Patients are increasingly opting for combined orthodontic and orthognathic surgery to enhance their face look. To effectively diagnose and treat these patients, it's important to evaluate the chin-throat relationship thoroughly.

In this study comparative evaluation of Chin-Throat Morphology by different parameters (Chin-Throat Angle, Mento-Cervical Angle and 'T' Line) in Sagittal as well as Vertical Skeletal growth Pattern was done and concluded that Chin Throat Angle is highest in Class II Malocclusion with Normodivergent Growth Pattern and Lowest in Cass II Malocclusion with Hyperdivergent Growth Pattern. Mento-cervical Angle is highest in Class II Malocclusion with Hypodivergent Growth Pattern and lowest in Class I Malocclusion with Hypodivergent Growth Pattern. Posterior portion of the Mandibular border is greater in the Class I Malocclusion with Hyperdivergent Growth Pattern and smaller in Class I Malocclusion with

Hypodivergent Growth Pattern. Anterior portion of the Mandibular border is greater in Class I Malocclusion with Hypodivergent Growth Pattern and smaller in Class I Malocclusion with Hyperdivergent growth pattern.

A study Conducted by **Ramzi V et al** [12] to evaluate facial line (T), tangent to the throat, intersects the mandibular border in anterior and posterior parts in proportions varying with facial configuration, and their association between chin projection and throat inclination and the potential for the T-line to reflect this association. The study concluded that mandibular border in anterior was nearly equal to mandibular border in posterior in Class I and Class III subjects and shorter in Class II subjects. Chin throat angle and Mento-cervical angle were greater in Class II profiles and smaller in Class III profiles. In surgically treated patients, posttreatment measurements were similar to Class I values. In the early-treatment group, mandibular border in anterior increased but remained smaller than mandibular border in posterior; Chin Throat Angle reduced by nearly 13%.

Another study conducted by **Dr. Ravi Kumar Mahto et al** [14] to evaluate normative value for chin-throat morphology in Nepalese adult male and female adult subjects with normal occlusion and aesthetic facial profile and study variation of chin throat morphology between the two sexes. It was a cross-sectional study in which lateral cephalograms of adult subjects with normal occlusion and pleasing facial profiles were selected from the records for Manual tracing and measurement of three parameters evaluating chin-throat morphology i.e. lip-chin-throat angle, chin-throat length and chin-throat-neck angle were done. The study concluded The values of the lip-chin-throat angle, chinthroat length and chin-throat-neck angle of Nepalese adults were found to vary in comparison to the norms reported for different populations by previous investigators. Sexual dimorphism was observed in all the 3 parameters. However, the differences were statistically insignificant.

Ilanchezhian J et al [13] Conducted a study to evaluate the variations in Chin Throat Angle in different skeletal malocclusions. Profile photographs and lateral cephalograms of 102 adults aged between 18-28 years were included. ANB angle and Chin Throat Angles were measured. Chin Throat Angle was increased in class II group than class I and Class III groups also Chin Throat Angle on profile photographs between the three classes were significant also in class I occlusion with well-proportioned faces the Chin Throat Angle appears to be normal.

5. CONCLUSION

- Chin Throat Angle is highest in Class II Malocclusion with Normodivergent Growth Pattern and Lowest in Cass II Malocclusion with Hyperdivergent Growth Pattern
- Mento-cervical Angle is highest in Class II Malocclusion with Hypodivergent Growth Pattern and lowest in Class I Malocclusion with Hypodivergent Growth Pattern.
- Posterior portion of the Mandibular border is greater in the Class I Malocclusion with Hyperdivergent Growth Pattern and smaller in Class I Malocclusion with Hypodivergent Growth Pattern.
- Anterior portion of the Mandibular border is greater in Class I Malocclusion with Hypodivergent Growth Pattern and smaller in Class I Malocclusion with Hyperdivergent growth pattern.

6. REFERENCE

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14. Chin-throat morphology of Nepalese adults with normal occlusion and aesthetic facial profile - A cephalometric study Dr. Ravi Kumar Mahto1, Dr. Dashrath Kafle2, Dr. Diwash Rai3, Dr. Rabina Sakha4, Dr. Nikita Rajbhandari5;