

Alveolar and Skeletal Chin Dimensions Associated with Lower Facial Height Among Different Divergent Patterns

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ABSTRACT

Introduction: Alveolar and skeletal chin dimensions with facial height have an impact on diagnosis and treatment planning in orthodontic patients and serves as a reference landmark for facial aesthetics.

Aim: To evaluate the alveolar and skeleton chin dimensions among different divergent patterns, to evaluate the lower face height in different divergent growth patterns, to give an estimate to the oral surgeon for any adjunctive procedure.

Materials and Methods: The study includes a total sample of 45 non-growing individuals (26 males and 19 females) from the archival records of the Orthodontic Department with age ranging between 18-25 years, classified into different divergent patterns based on the mandibular plane angle. The sample was divided into three groups, of which 15 patients in each group were evaluated: Group-1: Normodivergent, Group-2: Hypodivergent and Group-3: Hyperdivergent patterns respectively. Standardized digital lateral cephalograms and antero-posterior cephalograms of these patients were obtained in Natural Head Position (NHP).

Results: The results of the retrospective cephalometric study were statistically analyzed by using ANOVA and Tukey's multiple post hoc test which showed that hard tissue chin measurement were greater in hypodivergent group (13.7mm) and the increased lower facial height showed statistically significant difference in high mandibular plane angle group (59.6mm). In antero-posterior cephalograms the transverse width showed statistically significant difference in normodivergent group (32.60mm).

Conclusion: The antero-posterior width of the symphysis was higher in hypodivergent growth pattern, whereas vertical height of the symphysis was greater in hyperdivergent group. The lower facial height among three groups showed statistically significant difference among hyperdivergent group. In comparison of all the three groups in Anterio-Posterior (AP) cephalograms, statistically significant difference was noted in normodivergent group when compared with the other two groups.

Keywords: Cephalometry, Facial types, Growth patterns, Mandibular symphysis

INTRODUCTION

While the primary goal of orthodontics is to create an aesthetically pleasing and functional occlusion, patient motivation and expectations must be addressed to ensure treatment success. Alveolar and skeletal chin dimensions with facial height have an impact on diagnosis and treatment planning in orthodontic patients and serves as a reference landmark for facial aesthetics. The shape of chin can have a significant effect on the patient's facial appearance, with the height, projection of its basal symphysis and the lower face height ultimately influencing the position of the adjacent soft tissues and lower third of the facial skeleton [1,2].

Orthodontic treatment planning should consider both the hard and soft tissues in terms of stable results and esthetic benefits of the patient. Executing an ideal treatment plan becomes difficult when both hard and soft tissues are taken under consideration among different divergent patterns. Blumenbach (1975) identified the 'chin' as being the most fundamental features in the craniofacial complex that he considered uniquely human. Mandibular symphysis morphology has an impact on diagnosis and treatment planning in orthodontic patients. It serves as a reference anatomical guide for aesthetics and beauty of the face in general and in particular to the lower third of the face [3].

Mandibular symphysis is an anatomical structure of the mandible and is divided into two regions, the dento-alveolar and basal symphysis [4]. The dento-alveolar symphysis includes the alveolar process and lower incisors. The long axis of the lower incisors cephalometrically matches the long axis of the alveolar process and its inclination is influenced by facial type. Cephalometrically,

the long axis of the basal symphysis is different from that of the alveolar symphysis with the shape and position being independent of the tooth movement of the lower incisors. Among the Bjork's five criteria for establishing the mandibular rotation pattern, the relationship between the height and width of the mandibular symphysis remains critical with an emphasis on the symphysis with its long axis and greater lingual inclination [5,6]. Nevertheless, the sagittal growth also plays an important role in influencing the morphology of the mandibular symphysis. The height and projection of basal symphysis has an important role in influencing the position of the adjacent soft tissue, thereby determining the esthetic and facial harmony [2,7].

The chin being a critical zone in determining the esthetics of the lower face the same depends primarily on the chin height, particularly in the zones of the lower and total anterior face height [8]. Even though the lower facial height can be altered during the orthodontic therapy, the main reason for seeking and receiving orthodontic surgical treatment has been the vertical discrepancy. When dealing with such cases with a vertical discrepancy, the main areas of interest have been the relationship between the sagittal, vertical and transverse changes with their concomitant effect on facial attractiveness [9]. Aufricht in 1958, described the esthetic significance of chin prominence on the perceived attractiveness of the nose with a concluding statement that, "the nose and chin are conspicuous components of the profile line, and there is a marked esthetic interrelation between the two components." [10,11]. Therefore, the purpose of the present study was to evaluate the alveolar and skeletal chin dimensions, and the lower face height among different divergent patterns to give an estimate to the oral

surgeon for any adjunctive procedures among diverging growth patterns.

MATERIALS AND METHODS

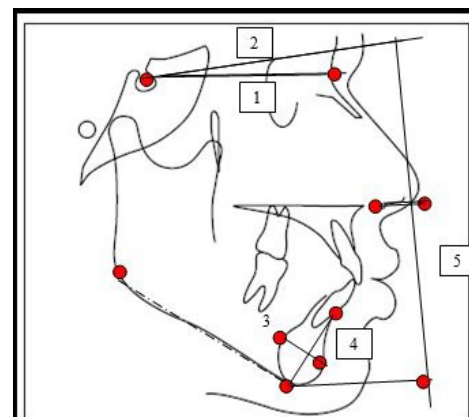
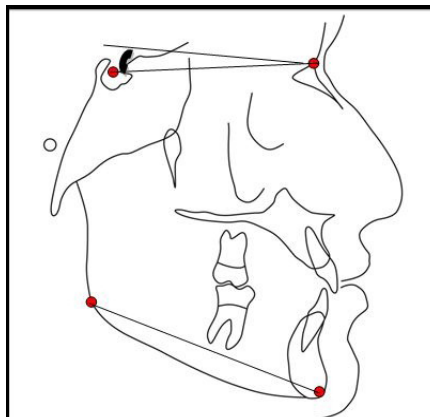
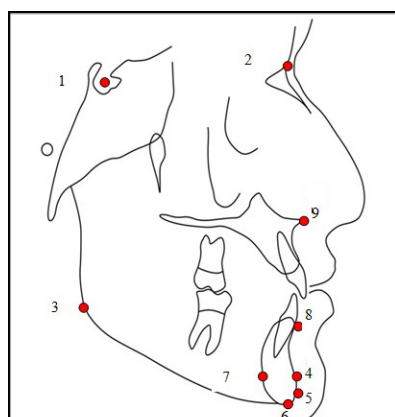
The sample for the study was selected from the archival records of the patients who had reported to the Department of Orthodontics and Dentofacial Orthopaedics, SVS Institute of Dental Sciences Mahabubnagar, Telangana, India, for orthodontic treatment. A total sample of 45 patients was selected from the archival records as per the statistical sample size calculation for the study. A total of 45 digital lateral cephalograms and 45 digital posterior-anterior cephalograms from the patient's records were chosen which had been taken in a standardized NHP in the cephalostat with the clinical Frankfort Horizontal plane parallel to the floor with the eyes at a distant vision as described by Moorrees and Kean [12]. The lateral profile photographs derived from these 45 patients (26 males and 19 females) who had completed their growth of different divergent patterns based on the mandibular plane angle with age range of 18-25yrs were also selected from their pre-treatment orthodontic records. The inclusion criteria included only those patients who were non-growing, had never undergone any orthodontic treatment or cosmetic treatment and had all maxillary and mandibular teeth present. All the patients with mutilated malocclusion, history of trauma, presence of fixed partial dentures or extensive prosthetic rehabilitation, facial asymmetry and presence of craniofacial anomaly were excluded.

The sample was divided into three groups of 15 each, based on the mandibular plane angle that is Mandibular Plane (MP) to the Sella-Nasion (SN) Plane : Group-A Hyperdivergent (MP/SN: >35), Group-B Hypodivergent (MP/SN: <25) and Group-C Normodivergent (MP/SN: 32). All the cephalograms were traced by one of the authors who was sufficiently trained in identifying and locating the required landmarks on acetate paper tracing using 0.3mm lead pencil. The measurements were repeated after a gap of two weeks randomly on eight lateral cephalograms and eight PA cephalograms to reduce the intra-observer errors, which were then statistically evaluated with an intra-observer reliability test (ICC) and a student's paired t-test with a result of clinically non-significant r and p-values. These tracings were evaluated for the linear and angular measurements of hard and soft tissue chin dimensions. Two angular and six linear measurements from various analyses of Steiner's, Burstone's, Riolo's and Butow's were employed in the study. A true horizontal was established to FH plane by drawing 7 degrees to the S-N plane. The total duration of the study from tracing to results on a sequential manner took around eight months.

The cephalometric landmarks used in this study are:

Definition of Landmarks [Table/Fig-1].

1. Point S (Sella): Geometric center of the pituitary fossa located by visual inspection.



[Table/Fig-1]: Landmarks located in lateral cephalogram. [Table/Fig-2]: Planes used in the study. [Table/Fig-3]: Linear measurements in lateral cephalograms.

2. Point N (Nasion): Located on the most anterior aspect of the frontonasal suture.
3. Go (Gonion): Using two lines, one tangent to the inferior border of the mandible and the other tangent to the posterior border of ramus, gonion is constructed on the curvature of the mandibular angle by bisecting the angle formed by the two lines.
4. Pogonion (Pog): The most prominent point in the symphysis.
5. Gnathion (Gn): Lowest and most anterior edge of the hard tissue symphysis.
6. Menton (Me): The inferior most point of the symphysis.
7. Lingual Pogonion (L-Pog): Suggested by Nojima et al., represents the most posterior point located in the external lingual cortices of the mandibular symphysis [13].
8. Infra dentale (Id): The highest and most anterior point on the alveolar process, usually found near the cemento enamel junction of the mandibular central incisors. Also termed inferior prosthion.
9. Anterior Nasal Spine (ANS): The most anterior point on the maxilla.

The planes used in this study are [Table/Fig-2]:

1. Go-Gn: Mandibular Plane
2. S-N Plane: Sella- Nasion
3. True Frankfort Horizontal is a surrogate of Frankfort plane, constructed by drawing 7 degree from SN plane.

Linear measurements used in the study:

Lateral Cephalogram [Table/Fig-3]:

Anterior posterior

Pog"-Pog': Horizontal distance between pogonion to lingual pogonion on the lingual border of the symphysis.

Vertical

Id-Me: The linear distance from Infra dentale to Menton.

Lower Facial Height: (ANS-Me) – ANS to Menton.

Posterior Anterior (PA) Cephalogram.

Transverse

Chin (CH): The most inferior lateral point on the anterior inferior border of the mandible with CHL designating the left CH and CHR, the right CH [Table/Fig- 4].

STATISTICAL ANALYSIS

Descriptive statistical analysis tests were carried out in the present study on continuous measurements being presented on mean SD (Min-Max). The measurements are also described in numbers at 5 % level of significance. Analysis of variance (ANOVA) has been

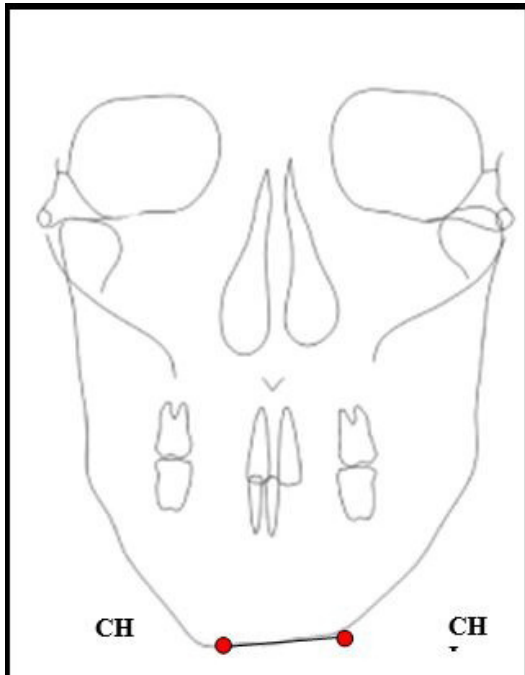
used to find the significance of study parameters between three or more groups of patients, Student unpaired t test has been used to find the significance of study parameters on a continuous scale between two groups (Inter group analysis) on metric parameters. Levene's test for homogeneity of variance has been performed to assess the homogeneity. Tukey's multiple post hoc procedure was used after ANOVA application, to know the pair wise comparison.

RESULTS

The statistical results of the sample size showed no significance among the age groups studied with a p-value of 0.6537 [Table/Fig-5,6]. Comparison of male and females in all groups with respect to different variables by t-test showed statistical significant difference for Gonion /Gnathion-Sella Nasion (Go-Gn/SN) with a p-value of 0.0303 and AP (Pognion-Pognion) with a p-value of 0.0139 [Table/Fig-7].

The standard mean deviation of the studied variables for Gonion-Gnathion/Sella Nasion(Go-Gn/SN), Infradental-Menton (vertical), Lower Facial Height (ANS-Menton) showed higher mean values for Hyperdivergent groups, higher values for AP Plane (Pognion-Pognion) in Hypodivergent group and for values of Transverse (Chin left-Chin right)in Normodivergent group [Table/Fig-8].

Comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with one way ANOVA showed no statistical significance for Vertical (Infradental-Menton) scores, with a p-value



[Table/Fig-4]: Landmarks located in posterior anterior cephalogram.

Groups	Male	%	Female	%	Total	%
Normodivergent	5	33.33	10	66.67	15	33.33
Hypodivergent	10	66.67	5	33.33	15	33.33
Hyperdivergent	4	26.67	11	73.33	15	33.33
Total	19	42.22	26	57.78	45	100.00

[Table/Fig-5]: Distribution of male and females in three groups (Normodivergent, Hypodivergent and Hyperdivergent). Chi-square=5.6482 p=0.0593

Sources of variation	Sum of Squares	Degree of Freedom	Mean Sum of Squares	F-value	p-value
Between Groups	2.98	2	1.49	0.4295	0.6537
Within Groups	145.60	42	3.47		
Total	148.58	44			

[Table/Fig-6]: Comparison of three groups (Normodivergent, Hypodivergent and Hyper divergent) with mean age by one way ANOVA.

Variable	Gender	n	Mean	SD	t-value	p-value
Go/Gn-Sn	Male	19	24.53	6.97	-2.2404	0.0303*
	Female	26	29.42	7.43		
Vertical (Id-Me)	Male	19	28.95	2.44	0.6762	0.5026
	Female	26	28.31	3.55		
AP (Pog-pog)	Male	19	13.00	1.53	2.5645	0.0139*
	Female	26	11.81	1.55		
Transverse (CHR-CHL)	Male	19	31.63	2.27	-0.1003	0.9206
	Female	26	31.73	3.84		
Lower Facial Height (ANS-Me)	Male	19	56.79	3.85	-0.0359	0.9716
	Female	26	56.85	6.04		

[Table/Fig-7]: Comparison of male and females in all groups with respect to different variables by t-test. *Statistically significant

Variable	Summary	Normo divergent	Hypo divergent	Hyper divergent
Go/Gn-Sn	Mean	26.87	18.93	36.27
	SD	2.61	2.37	2.46
	SE	0.68	0.61	0.64
Vertical (Id-Me)	Mean	28.73	27.87	29.13
	SD	3.88	2.75	2.64
	SE	1.00	0.71	0.68
AP (Pog-pog)	Mean	12.07	13.07	11.80
	SD	0.96	1.79	1.82
	SE	0.25	0.46	0.47
Transverse (CHR-CHL)	Mean	32.60	30.33	32.13
	SD	2.38	2.92	3.96
	SE	0.62	0.75	1.02
Lower Facial Height (ANS-Me)	Mean	56.67	54.13	59.67
	SD	4.32	5.73	4.03
	SE	1.12	1.48	1.04

[Table/Fig-8]: Summary of all variables in three groups (Normodivergent, Hypodivergent and Hyperdivergent).

Sources of variation	Sum of Squares	Degree of Freedom	Mean Sum of Squares	F-value	p-value
Between Groups	12.58	2	6.29	0.6374	0.5337
Within Groups	414.40	42	9.87		
Total	426.98	44			

[Table/Fig-9]: Comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean Vertical (Id-Me) scores by one way ANOVA.

Sources of variation	Sum of Squares	Degree of Freedom	Mean Sum of Squares	F-value	p-value
Between Groups	13.38	2	6.69	2.6944	0.0793
Within Groups	104.27	42	2.48		
Total	117.64	44			

[Table/Fig-10]: Comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean AP (Pog-Pog) scores by one way ANOVA.

Sources of variation	Sum of Squares	Degree of Freedom	Mean Sum of Squares	F-value	p-value
Between Groups	2258.71	2	1129.36	182.7155	0.0001*
Within Groups	259.60	42	6.18		
Total	2518.31	44			

[Table/Fig-11]: Comparison of three groups (Normodivergent, Hypodivergent and Hyper divergent) with mean Go-Gn/Sn scores by one way ANOVA. *p<0.05

of 0.5337 [Table/Fig-9]. AP (Pognion-Pognion) scores, with a p-value of 0.0793 [Table/Fig-10], but a statistically significant

Groups	Normodivergent	Hypodivergent	Hyperdivergent
Mean	28.73	27.87	29.13
SD	3.88	2.75	2.64
Normodivergent	-		
Hypodivergent	p=0.7320	-	
Hyperdivergent	p=0.9353	p=0.5168	-

[Table/Fig-12]: Pair wise comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean Vertical (Id-Me) scores by Tukey's multiple post-hoc procedures.

Groups	Normodivergent	Hypodivergent	Hyperdivergent
Mean	12.07	13.07	11.80
SD	0.96	1.79	1.82
Normodivergent	-		
Hypodivergent	p=0.2033	-	
Hyperdivergent	p=0.8887	p=0.0826	-

[Table/Fig-13]: Pair wise comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean AP (Pog-pog) scores by Tukey's multiple post-hoc procedures.

Groups	Normodivergent	Hypodivergent	Hyperdivergent
Mean	26.87	18.93	36.27
SD	2.61	2.37	2.46
Normodivergent	-		
Hypodivergent	p=0.0001*		

[Table/Fig-14]: Pair wise comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean Go/Gn-Sn scores by Tukey's multiple post-hoc procedures.
* p<0.05

Sources of variation	Sum of Squares	Degree of Freedom	Mean Sum of Squares	F-value	p-value
Between Groups	230.18	2	115.09	5.0967	0.0104*
Within Groups	948.40	42	22.58		
Total	1178.58	44			

[Table/Fig-15]: Comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean Lower facial height (ANS-Me) scores by one way ANOVA.
* p<0.05

difference with the p-value of 0.0001 between the groups for Gonion-Gnathion/Sella Nasion (Go-Gn/SN) and a p-value of 0.0104 for Lower Facial Height (ANS-Menton) scores [Table/Fig-11].

Pair wise comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) by Tukey's multiple post hoc procedures showed no significant statistical difference for vertical (Infradental-Menton) scores with a p-value of 0.7320 between Normodivergent and Hypodivergent, p-value of 0.9353 between Normodivergent and Hyperdivergent and, p-value of 0.5168 between Hypodivergent and Hyperdivergent [Table/Fig-12]. There was also no significant statistical difference for Antero-posterior (Pognion-Pognion) scores with a p-value of 0.2033 between Normodivergent and Hypodivergent, p-value of 0.8887 between Normodivergent and Hyperdivergent and, p-value of 0.0826 between Hypodivergent and Hyperdivergent [Table/Fig-13]. However, there was a significant statistical difference noted for Go-Gn/Sn scores with a p-value of 0.0001 between Normodivergent and Hypodivergent, Normodivergent and Hyperdivergent and between Hypodivergent and Hyperdivergent [Table/Fig-14]. Lower Facial Height (ANS-Menton) scores by Tukey's multiple posthoc procedures also showed a statistical significant difference between Hypodivergent group and Hyperdivergent group with a p-value of 0.0104 [Table/Fig-15].

The statistical tests when applied for the comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent)

Sources of variation	Sum of Squares	Degree of Freedom	Mean Sum of Squares	F-value	p-value
Between groups	42.98	2	21.49	2.1557	0.1285
Within groups	418.67	42	9.97		
Total	461.64	44			

[Table/Fig-16]: Comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean Transverse (CHR-CHL) scores by one way ANOVA.

Groups	Normodivergent	Hypodivergent	Hyperdivergent
Mean	32.60	30.33	32.13
SD	2.38	2.92	3.96
Normodivergent	-		
Hypodivergent	p=0.1334		
Hyperdivergent	p=0.9139	p=0.2736	-

[Table/Fig-17]: Pair wise comparison of three groups (Normodivergent, Hypodivergent and Hyperdivergent) with mean Transverse (CHR-CHL) scores by Tukey's multiple post-hoc procedures.

with mean Transverse (Chin Right-Chin Left) scores by one way ANOVA showed no statistical significant difference with a p-value of 0.1285 between and within the groups [Table/Fig-16]. However, a pair wise comparison of three groups with mean Transverse (Chin Right-Chin Left) scores by Tukey's multiple post hoc procedures showed no statistical significant difference with a p-value of 0.1334 between Normodivergent and Hypodivergent, p-value of 0.9139 between Normodivergent and Hyperdivergent and, p-value of 0.2736 between Hypodivergent and Hyperdivergent [Table/Fig-17].

DISCUSSION

The chin is one of the most noticeable structures of the face not only in the frontal view but also in the profile view and demands special attention in the overall assessment of facial esthetics. With the shift of orthodontic paradigms, greater emphasis is being placed on hard and soft tissue chin examination during clinical diagnosis and treatment planning. The size and position of chin is a potentially important determinant of perceived attractiveness of the face. In profile view, in particular, the chin establishes much of the character of the lower face. In fact, the prominence of the chin is one of the facial characteristics that society tends to associate with an individual's personality. The differential evaluation of facial types is important, as the prognosis and treatment approaches may differ by diagnosis. Karlson reported that high and low angle cases exhibit completely different craniofacial growth patterns between years of age [14].

This study describes the cephalometric characteristics of the chin dimensions in anterior-posterior, vertical and transverse plane, associated with lower facial height among different divergent patterns. Previous studies on chin were studied in different jaw relationships mandibular symphysis in different antero-posterior jaw relationships (Class I, Class II and Class III). No study has been conducted till now by evaluating chin dimensions with lower facial height among different divergent patterns. In this study we have evaluated the chin dimensions associated with lower facial heights among different divergent patterns. The discussion of this study was carried out in three different groups: Group-1: Hyperdivergent, Group-2: Normodivergent, Group-3: Hypodivergent.

In this study, the sagittal position of the hard tissue chin point (Pognion) and soft tissue chin projection (Pognion) are measured from the reference lines which are drawn perpendicular to the true horizontal line (70 to the SN plane) passing through Point A and subnasale respectively. As shown in [Table/Fig-5] gender distribution among the sample population shows female dominance, as it was documented in previous studies. Symphysis height and depth are greater in male population when compared to female population.

Therefore, there is a possibility of obtaining mean values which are lesser than the normal population.

According to variables studied in these three groups Gonion-Gnathion Sella Nasion(Go-Gn/SN), Vertical (Infra dental to Menton), lower anterior facial height shows highest mean value in Hyperdivergent group and lowest value in Hypodivergent group. AP (Pognion-Pognion) shows highest mean value among Hypodivergent subjects and least among Hyperdivergent subjects, while transverse (Chin right–Chin left) shows highest mean value in Normodivergent group. Similar observations were noted in study done by Mangla R et al.,[15]. Comparing mean Gonion-Gnathion–Sella Nasion(Go-Gn/SN) values of three groups statistically significant difference was noticed between the groups and pair wise comparison shows significance between Hypodivergent and Normodivergent subjects and also Hyperdivergent and Hypodivergent subjects. Similar concordance was seen in a study conducted by Arat Z.M et al.,[7]. Comparison of Vertical (Infra dental-Menton), AP (Pognion-Pognion), transverse (Chinleft-Chin right) showed in significant results. According to the study by Ceylan I et al., [16] and Mangla R et al., [15] there was statistical significance noted between hyper and hypo groups. Comparison of lower anterior facial height among subjects showed statistically significant difference between the three groups. Pair wise comparison shows significant difference between Hypodivergent group and Hyperdivergent group. This is also supported by other studies done by Siddegowda R et al., [17].

Characteristics of each group derived from this study are:

GROUP-1

Hyperdivergent Group: Hyperdivergent group consisted of predominantly female subjects with a mean age of 21.93 years. Cephalometric variables measured in this group presented with increased values of Go/Gn-SN, Vertical (Infradental-Menton) with the value of 2.46mm and lower facial height (ANS-Menton) was increased with the value of 59.67mm. Pair wise comparison showed statistically significant difference in Gonion-Gnathion to SellaNasion values with increase in Hyperdivergent group with the p-value of 0.0001 when compared to Normodivergent group and Hypodivergent group. This group also presented with statistically significant increase in lower anterior facial height with normo and hyper divergent group with the values of (56.67mm, 59.67mm respectively) when compared to Hypodivergent group (54.13mm).

Group-2

Hypodivergent Group: Hypodivergent group shows dominance of female population. Significant cephalometric variables noticed in this sample are AP (Pognion-Pognion) which is highest in this group with the value of 13.07mm, whereas Gonion-Gnathion-Sella Nasion and vertical (Infradental-Menton), Transverse (Chin left-Chin right) and Lower Anterior Facial Height were noticed to be least with the values of (2.32mm, 27.87mm, 30.33mm respectively). Statistically significant variation is noticed in Gonion-Gnathion-Sella Nasion (Go-Gn/SN) with the value of 2.37mm and in lower anterior facial height 54.13mm. Pair wise comparison shows significant variation in Gonion-Gnathion-Sella Nasion (Go-Gn/SN) values between Hypodivergent to Hyperdivergent and also between Hypodivergent to Normodivergent groups, while lower anterior facial height is significant when compared to Hyperdivergent group as of Ceylan I et al., study [16].

Group-3

Normodivergent Group: Normodivergent group shows dominance of female patients. All the cephalometric variables studied lie between Hypodivergent and Hyperdivergent values, except transverse Chin right–Chin left which was noticed to be highest in

the Normodivergent group. Pair wise comparison shows statistically significant variation in Gonion-Gnathion/Sella Nasion (Go-Gn/SN) value between Normodivergent group and Hypodivergent group. As shown in [Table/Fig-5], gender dichotomy was estimated in two variables as considered in the study.

1) Gonion Gnathion-Sella Nasion- statistically significant variation was found in Gonion-Gnathion-Sella Nasion (Go-Gn/SN) values between male and females subjects with value being consistently higher among female subjects, however as the sample was dominated by female subjects further analyses of this should be carried out, as documented by Samuel G et al..[18]. Gonion Gnathion-Sella Nasion(Go-Gn/SN) values were suggested to be high in Hyperdivergent group as found in the study of Karlseen A et al.,[19].

2) AP (Pognion–Pognion), as well documented in other studies by Mangla et al., [15], Berlanga et al., [20] found symphysis to be more prominent in male subjects when compared to female subjects with symphysis depth, width values noticing higher among male subjects. Similarly in this study statistically significant results were to differentiate male and female subjects. Comparison of males and females in all groups with respect to different variables shows significant difference relating to gender variation noticed in Go-Gn/SN value and antero-posterior Pog value. Gonion-Gnathion to Sella-Nasion (Go-Gn/SN) value is higher in females while anterior posterior Pog-Pog value is lower. Similar characteristics were found in the growth rotation studies by Bjork's [5], the mandibular symphysis swings forward in Hypodivergent cases to a marked degree, and the chin becomes prominent. This is supported by antero-posterior (Pognion-Pognion) value which is higher in our studies in Hypodivergent group.

Clinical Implication: Taking into consideration the outcomes of the study, it is assumed that the anatomical compensatory changes in the skeleton are better evaluated among all the groups in the study for comparing and correlating the clinical and radiographic findings of each individual for ideal treatment planning. Nevertheless, the study can also help in giving an estimate to the oral and maxillofacial surgeon for any adjunctive procedures for orthognathic surgery.

LIMITATION

Being a retrospective cephalometric study the sample size with respect to gender could have been equal in distribution. Owing to the limitations of the representation of a 3-D individual by using 2-D radiographic images of radiograph, the study would have been more useful if it was a 3-D study.

CONCLUSION

In light of the results obtained in this study, the following conclusions can be drawn: Mandibular plane angle among different divergent pattern Gonion /Gnathion –Sella Nasion showed highest in Hyperdivergent group and least in Hypodivergent group. The antero-posterior width of the symphysis was higher in hypodivergent growth pattern, whereas vertical height of the symphysis was greater in hyperdivergent group. The lower facial height among three groups shows statistically significant difference and more so in Hyperdivergent group.

REFERENCES

- [1] Park H, Ellis E, Fonseca R, Reynolds S, Mayo K. A retrospective study of advancement genioplasty. *Oral Surgery Oral Medicine Oral Pathology*. 1989; 67(5):481-89.
- [2] Schwartz J, Tattersall I. The human chin revisited: what is it and who has it? *Journal of Human Evolution*. 2000; 38(3):367-409.
- [3] Nandaa R. The contributions of craniofacial growth to clinical orthodontics. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2000; 117(5):553-55.
- [4] Arruda K, Valladares Neto J, Almeida G. Assessment of the mandibular symphysis of Caucasian Brazilian adults with well-balanced faces and normal occlusion: the influence of gender and facial type. *Dental Press J Orthod*. 2012; 17(3):40-50.

- [5] Björk A. Prediction of mandibular growth rotation. *Am J Orthod.* 1969; 55(6):585-99.
- [6] Björk A. Facial growth in man, studied with the AID of metallic implants. *Acta Odontologica Scandinavica.* 1955; 13(1):9-34.
- [7] Arat ZM, Rübendüz M. Changes in dentoalveolar and facial heights during early and late growth periods: a longitudinal study. *The Angle Orthodontist.* 2005; 75(1): 69-74.
- [8] Marshall S, Low L, Holton N, Franciscus R, Frazier M, Qian F et al. Chin development as a result of differential jaw growth. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2011; 139(4):456-64.
- [9] Varlik S, Demirba E, Orhan M. Influence of lower facial height changes on frontal facial attractiveness and perception of treatment need by lay people. *The Angle Orthodontist.* 2010; 80(6):1159-64.
- [10] Naini F. Facial aesthetics. Chichester, West Sussex, UK: Wiley-Blackwell; 2011.312 p.
- [11] Beckmann S, Kuitert R, Prah-Andersen B, Segner DR, Tuinzing D. Alveolar and skeletal dimensions associated with lower face height. *American Journal of Orthodontics and Dentofacial Orthopedics.* 1998; 113(5):498-506.
- [12] Moorrees C, Kean M. Natural head position, a basic consideration in the interpretation of cephalometric radiographs. *Am J Phys Anthropol.* 1958;16(2):213-34.
- [13] Nojima K, Nakakawaji K, Sakamoto T, Isshiki Y. Relationships between mandibular symphysis morphology and lower incisor inclination in skeletal Class III malocclusion requiring orthognatic surgery. *Bull Tokyo Dent. Coll* 1998;39:175-81.
- [14] Hoffelder L, de Lima E, Martinelli F, Bolognese A. Soft-tissue changes during facial growth in skeletal Class II individuals. *American Journal of Orthodontics and Dentofacial Orthopedics.* 2007; 131(4):490-95.
- [15] Mangla R, Dua V, Khanna M, Singh N, Padmanabhan P. Evaluation of mandibular morphology in different facial types. *Contemporary Clinical Dentistry.* 2011; 2(3):200.
- [16] Ceylan I, Eröz ÜB. The effects of overbite on the maxillary and mandibular morphology. *Angle Orthodontics.* 2001; 71(2):110-15.
- [17] Siddegowda R, N R, B.M.S. Mandibular morphological study using Bjorks signs. Saarbrücken: LAP LAMBERT Academic Publishing; 2013.80 p.
- [18] Samuel G. The variation in skeletal and denture patterns in excellent adult facial types. *Angle Orthodontist.* 1959; 29(2):63-92.
- [19] Karlsen T. Association between facial height development and mandibular growth rotation in low and height MP-SN angle faces. *The Angle Orthodontist.* 1997;67(2):103-10.
- [20] Molina-Berlanga N, Llopis-Perez J, Flores-Mir C, Puigdollers A. Lower incisor dentoalveolar compensation and symphysis dimensions among Class I and III malocclusion patients with different facial vertical skeletal patterns. *The Angle Orthodontist.* 2013; 83(6):948-55.

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