ORIGINAL RESEARCH

Mandibular Morphology in 10-12 years Children with different Growth Patterns: A Comparative Cephalometric Study

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ABSTRACT

Aim: In facial growth and development, mandibular growth is a factor that plays an important role. It requires a thorough understanding of growth, growth rotations and morphology of skeletal structures to diagnose a case of varied growth patterns, especially in mixed dentition. Hence the aim of the study is to compare the mandibular morphology in 10-12 years children with hypodivergent and hyperdivergent growth patterns. **Materials and method:** Lateral cephalogram of total 45 subjects were taken and were divided into three groups, hypodivergent, normodivergent and hyperdivergent. Cephalogram were traced and linear and angular parameters were measured. **Results and Conclusion:** According to the results, condyle is more inclined forward, antegonial notch is more prominent and inter-molar angle is more acute in hyperdivergent group. Also the anterior lower facial height is more in hyperdivergent group than that in hypodivergent group.

KEYWORDS: Mandibular Morphology, Mixed Dentition, Cephalometric Analysis

INTRODUCTION

In facial growth and development, mandibular growth is a factor that plays an important part. It requires a thorough understanding of growth, growth rotations and morphology of skeletal structures to diagnose a case of varied growth patterns. Facial growth relative to the cranial baseline proceeds along a vector composed of variable amount of horizontal forward growth and vertical downward growth[1]. As the mandible articulates with the cranium, it is essential that proportionate growth is achieved between anterior and posterior face heights or excessive clockwise or counter-clockwise mandibular rotation may occur [2].

Hypodivergent and hyperdivergent are the terms for describing the different growth patterns of face. Increased vertical growth and clockwise mandibular rotation will result in the hyperdivergent; while anti-clockwise rotation will result in hypodivergent facial pattern.

This can be easily be diagnosed on lateral projection of the mandible which is almost free from superimpositions of other bones. Its outline could be thus traced from the conventional cephalogram with sufficient precision [3]. A quantitative analysis of mandibular shape could provide valuable information concerning the whole arrangement of facial and cranial skeleton [3].

Schudy correlated the morphologic patterns and facial morphologic characteristics [4]. Björk's structural signs of mandibular growth rotation are associated with hyperdivergent or hypodivergent skeleto-facial morphology.

Also, timing of the treatment is an arena of controversy when it comes to orthodontic treatment in mixed dentition. For that, we need to be thorough with the growth patterns in mixed dentition. There is abundance of studies on mandibular morphology in adult patients but very sparse literature on mandibular morphology in mixed dentition. Hence, it requires more studies so that we can get more accurate results.

So the aim of the study is to compare the mandibular morphology in 10-12 years children with hypodivergent and hyperdivergent growth patterns.

MARERIALS AND METHODS

Lateral cephalogram of total 45 subjects were taken.

Inclusion Criteria:

- Subjects in the age group of 10-12 years with intact teeth.
- No history of orthodontic treatment.
- No facial asymmetry.

Three groups were taken with 15 samples each, divided according to SN-MP angle:

- Hypodivergent group with SN-MP angle less than 28°.
- Normodivergent group

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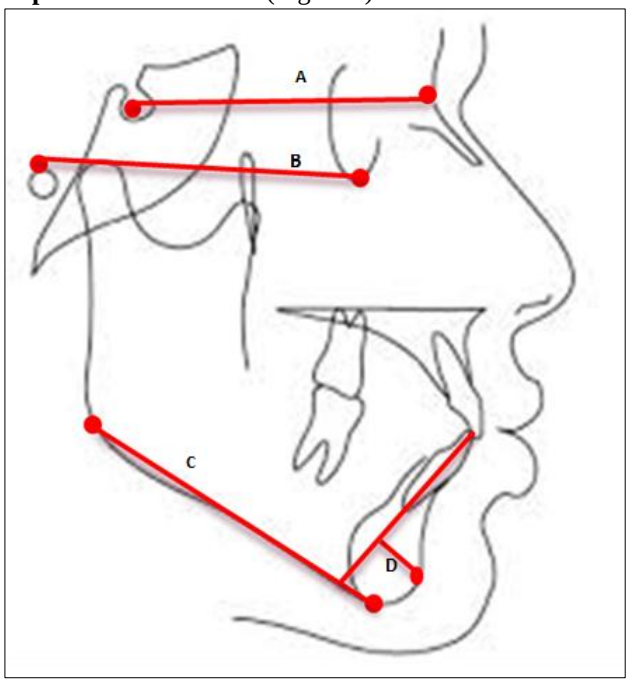
- Hyperdivergent group with SN-MP angle greater than 32°

Cephalometric Landmarks:
Sella (S): Mid-point of pituitary fossa.
Nasion (N): the anterior most point of the fronto-nasal suture in the median plane.
Orbitale (Or): The lowest point on the inferior bony margin of the orbit.
Porion (Po): Most superior point on the external auditory meatus' upper bony margin.
Anterior nasal spine (ANS): Point ANS is the tip of the bony anterior nasal spine in the median plane.
Point B (supramentale): It is the most posterior point on the outer contour of the mandibular alveolar process between infra-dentale and pogonion in the median plane.
Pogonion (Pg): Most anterior point on the bony chin, in the median plane.
Menton (Me): Is the most caudal point on the outline of the symphysis. It is regarded as the lowest point of the mandible.*FHC'*: The inside angle from Frankfort horizontal plane to the most anterior point on the condyle.
Gonion (Go): Point which is constructed by intersecting the lines tangent to the posterior margin of the ascending ramus and the mandibular base.
Condylion (C'): Most anterior point on the head of the condyle.

Cephalometric Planes: (Figure 1)



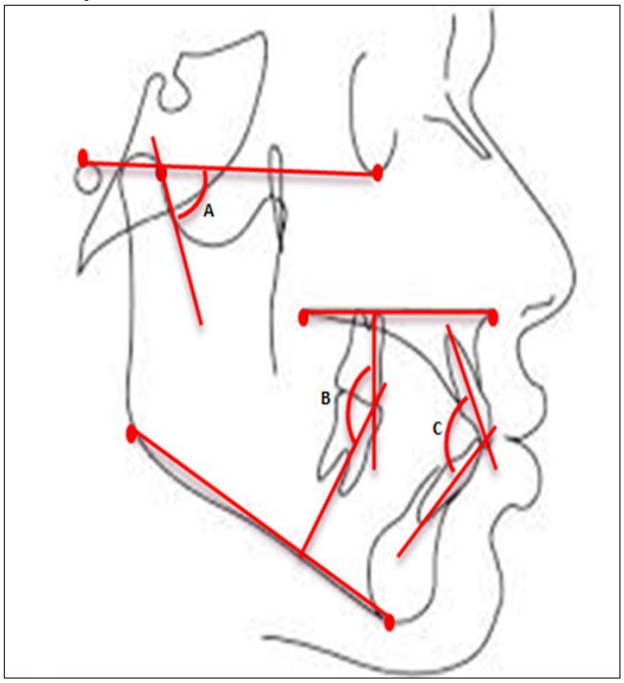
A-S-N Plane, B-Frankfort Horizontal Plane, C-Mandibular Plane, D-Symphysis inclination-linear

Figure 1: Cephalometric Planes and linear measurement used in the present study

S-N plane: Plane extending from sella to nasion
FHP: Extending from Porion to Orbitale, Frankfort Horizontal Plane.
Mandibular Plane: Plane extending from gonion to menton.

Linear Measurements:
MP-AN: deepest linear measurement taken on the line perpendicular to the line drawn from the greatest convexities on the both sides of the antegonial notch.
MI-PO: A line drawn from lower incisors to mandibular plane, a linear measurement from this line to the pogonion.

Angular Measurements: (Figure 2)
IIA: An angle between the long axis of the upper and lower central incisors.
FHC: The inside angle from Frankfort horizontal plane to the most anterior point on the condyle.
IMA: An angle between a perpendicular drawn from the mesio-buccal cusp of upper first molar to the palatal plane and a perpendicular from the mesio-buccal cusp of lower first molar to the mandibular plane.
Angular and linear measurements were taken and subjected to analysis.
Björk seven signs of mandibular rotation were used for the analysis.



A- Condylar Head Angle, B- Inter-Molar Angle, C-Inter-Incisal Angle

Figure 2: Cephalometric Angles used in the present study

1. Inclination of condylar head,
2. Inferior border of mandible,
3. Inclination of symphysis,
4. Inter-incisal angle,
5. Inter-molar angle
6. Curvature of mandibular canal
7. Anterior lower facial height

RESULTS

Table 1 shows the Means, Standard Deviation and Standard Error Mean of hypodivergent, normodivergent

and hyperdivergent growth patterns.

		N	Mean	Standard deviation	Std. Error Mean
Condyle head (°)	Hypodivergent	15	68.4000	3.15776	.81533
	Normodivergent	15	74.9333	5.32470	1.37483
	Hyperdivergent	15	78.8667	4.82355	1.24544
Antegonial notch linear (mm)	Hypodivergent	15	1.0667	.45774	.11819
	Normodivergent	15	1.3333	.44987	.11616
	Hyperdivergent	15	2.3667	.78982	.20393
Inter-incisal angle (°)	Hypodivergent	15	125.067	15.8811	4.10048
	Normodivergent	15	117.067	3.47371	.89691
	Hyperdivergent	15	118.667	6.73654	1.73937
Inter-molar angle (°)	Hypodivergent	15	160.033	3.84739	.99339
	Normodivergent	15	152.933	6.99456	1.80599
	Hyperdivergent	15	133.333	3.59894	.92924
Symphysis inclination-linear (mm)	Hypodivergent	15	9.2333	2.17836	.56245
	Normodivergent	15	8.4667	.54989	.14198
	Hyperdivergent	15	9.6000	1.67118	.43150
Anterior Lower Facial Height (mm)	Hypodivergent	15	59.1333	3.48193	.89903
	Normodivergent	15	67.4000	3.66060	.94516
	Hyperdivergent	15	72.4000	6.33358	1.63532

Table 1: Means, Standard Deviation and Standard Error Mean of hypodivergent, normodivergent and hyperdivergent growth patterns.

Table 2 shows Paired Samples Test of hypodivergent, normodivergent and hyperdivergent patterns.

		Paired Differences		Significance
		Mean	Standard deviation	
Condyle head (°)	Hypo/ Normo	-6.53333	6.52322	.002***
	Hyper/Normo	3.93333	6.19293	.028**
	Hypo/Hyper	-10.4667	5.08312	**.000*** **
Antegonial notch linear (mm)	Hypo/ Normo	-.26667	.62297	.120*
	Hyper/Normo	1.03333	.87560	.000***
	Hypo/Hyper	-1.30000	.86189	**.000*** **
Inter-incisal angle (°)	Hypo/ Normo	8.00000	16.40557	.080*
	Hyper/Normo	1.60000	7.97138	.450*
	Hypo/Hyper	6.40000	12.89407	**.075***
Inter-molar angle (°)	Hypo/ Normo	7.10000	7.13693	.002***
	Hyper/Normo	-19.6000	8.09585	.000***
	Hypo/Hyper	26.70000	5.40436	**.000*** **
Symphysis inclination-linear (mm)	Hypo/ Normo	.76667	2.27460	.213*
	Hyper/Normo	1.13333	1.70573	.022*
	Hypo/Hyper	-.36667	3.39362	**.682***
Anterior Lower Facial Height (mm)	Hypo/ Normo	-8.26667	4.62086	.000***
	Hyper/Normo	5.00000	6.96932	.015**
	Hypo/Hyper	-13.2667	7.14609	**.000*** **

*P ≥ 0.05 = Non-Significant, **P ≤ 0.05 =Significant, *** P ≤ 0.01 = Highly Significant

Table 2: Paired Samples Test of hypodivergent, normodivergent and hyperdivergent patterns.

Condylar head, antegonial notch, inter-molar angle and anterior lower facial height were highly significant, while inter-incisal angle, symphysis inclination linear were non-significant.

DISCUSSION

10-12 years of patients were taken as the developing occlusion at this stage has the following characteristics:

- Between the ages of 5-10 years, the inter-canine dimension may increase by 3 mm (on the average).
- After the age of 10, there are no width increases.
- The space in the maxillary arch (from molar to molar) increases by an average of 2 mm. The change in the mandible varies from a decrease of 2 mm to an increase of 4 mm.
- The fronto-palatal suture closes at around age 2.
- The mandible is a single bone (no sutures) after the age of 1.

As the curvature of the mandibular canal was impossible to measure, it was not included in this study. Rest of the Bjork's signs was included.

Condylar head: According to the results, as the condylar angle in hyperdivergent group is more than that of hypodivergent group; it is concluded that there is forward rotation of condyle in hyperdivergent group. Our study is in agreement with those of Fields [5]. According to Gail [2], Patients with vertical facial morphology displayed decreased superior joint spaces and posteriorly angled condyles, whereas, patients with horizontal facial morphology demonstrated increased superior joint spaces and anteriorly angled condyles.

Antegonial notch: As the antegonial notch of the mandibular lower border shows a highly significant result (.000), this study shows that the lower border of mandible in hyperdivergent patients show a prominent antegonial notch than those of the hypodivergent patients which is rather flat.

Studies by Singer [6], Karlsen [7] have also come up with the same conclusions. Due to the masseter muscle pull, the antegonial notch deepens. Mangla [8] et al. also concluded the depth of the antegonial notch was found to be highest in hyperdivergent group with no sexual dichotomy.

On the contrary, Kolodzielj [9] et al. stated the there is no association between the antegonial notch and the mandibular growth pattern. So it shouldn't be used to predict the facial growth.

Inter-incisal angle: The present study showed that there is not much difference in the inter-incisal angle of the hypodivergent, hyperdivergent and the normodivergent groups as the significance came to be 0.075**.** The result is in conflict with that of Björk's [10] findings, who concluded that hyperdivergent group has more mesially inclined upper and lower incisors. Hence, the angle between them is less obtuse.

Inter-molar angle: As the inter-incisal angle came to be highly significant (0.000), which concludes that the molars are slightly tilted forward in hyperdivergent group. It is in conformity with the results of Björk [10] et al. who stated that the forward growth rotation leads to uprighting of lower posterior teeth than usual in relation to the upper posterior teeth, with an increase in what may be called inter-premolar and inter-molar angles.

Symphysis inclination linear: As the significance value in the study came out be more than 0.05, it illustrates that there is not much difference in the inclination of the symphysis of hyperdivergent and hypodivergent groups. Our study is conflict with that of Haskel [11] et al. and

Gowda [12] et al. who concluded that forward rotating patterns of growth allow pogonion to move in a relatively forward direction resulting in a prominent chin point and backward rotating mandibles move pogonion backward and downward producing a less prominent chin.

Anterior lower facial height: This study shows that highly significant difference (0.000) concluding that in hyperdivergent group, anterior lower facial height is more as compared to hypodivergent group. Gowda [12] et al. also stated similar results in their study. Karlsen [7] too stated the same that hyperdivergent group has increased lower anterior facial height which is due to the backward rotation of mandible, where maxilla also descends down to counteract for the mandibular growth.

Taking the above parameters into consideration, present study suggests that the antegonial notch, condylar head angle, inter-molar angle and anterior lower facial height will help in differentiating between hypodivergent and hyperdivergent growth patterns in mixed dentition stage and thus any malocclusion if present can be intervened at an early stage accordingly.

CONCLUSION

Antegonial notch, condylar inclination and anterior lower facial height are the most prominent mandibular morphological features when it comes to differentiating between hypodivergent and hyperdivergent groups. Condyle is inclined forwardly, antegonial notch is more accentuated, inter-molar angle is less obtuse as well as the anterior lower facial height is more in hyperdivergent group than those of hypodivergent group.

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