Original Research Paper

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Dentistry

ASSOCIATION BETWEEN FIRST CERVICAL VERTEBRA MORPHOLOGY AND MANDIBULAR SYMPHYSIS MORPHOLOGY IN DIFFERENT GROWTH PATTERN ASSESSED BY LATERAL CEPHALOGRAM AND 3d CT SCAN IN INDIAN POPULATION – CROSS SECTIONAL ANALYTICAL STUDY.

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ABSTRACT **Introduction:** This study was performed to evaluate association between first cervical vertebra morphology and symphysis menti morphology in different growth patterns. **Method:** The sample of study included 240 lateral cephalograms, which were collected from department of Orthodontic and Dentofacial Orthopaedics. The lateral cephalograms were traced, by using Nemoceph software. Depending on this measurement samples were divided into average, horizontal and vertical growth patterns. Tracing was done for all of these cephalometric films, 3 linear measurements for the atlas and symphysis menti and 1 angular measurements of symphysis menti. These measurements were done by using computer software SPSS version 26. **Result:** The results showed that there was no significant difference in first cervical vertebra parameters but symphysis menti angle and depth had significant difference in horizontal growth pattern. **Conclusion:** It is concluded that in average growth pattern, there is increase in length of cervical vertebra with deficient chin and in horizontal growth pattern, there is decrease in length of cervical vertebra with more prominent chin having more depth than in vertical growth pattern. There is no correlation between cervical vertebra morphology and mandibular growth rotation but in horizontal growth pattern, there is more prominent chin than with vertical and average growth pattern.

KEYWORDS :

INTRODUCTION

In diagnosis and treatment planning of orthodontic cases, knowledge of mandibular growth pattern is highly beneficial for assessing and predicting mandibular growth.[1]The growth pattern of jaw influence the final position of facial bone, soft tissue and teeth. Different parameters have been used to determine mandibular growth pattern with varying success rate, such as morphology of first cervical vertebra and morphology of symphysis.[2]

According to Bjork with his implant studies, described multiple structural signs seen in extreme types of mandibular rotators. The forward inclination of the condylar head was associated with forward mandibular rotators, along with a greater curvature of the mandibular canal than the mandibular contour. A tendency toward backward mandibular rotation is associated with a pronounced apposition below the symphysis with more overall concavity of the lower mandibular border. An inclination of the symphysis with proclination is an indicator of a backward rotating mandible.[3]

According to Jarabak's cephalometric analysis, other parameter to predict the direction of mandibular growth is from a facial polygon (sum of three angle)including the saddle angle (N-S-Ar), articular angle (S- Ar-Go), and gonial angle (Ar-Go-Me). With sums of these three angles greater than 396□, posterior mandibular growth patterns were predicted, while less than 396□ was associated with anterior mandibular growth. Also a ratio of posterior (S-Go) to anterior face height (N- Me) of 56% to 62% indicated a posterior growth pattern, whereas a ratio of 65% to 80% indicated an anterior growth tendency.[1,4] The first cervical vertebra is thought to be of particular interest to orthodontist, which form the connecting element between the head and vertebral column proper.[5,6]

The morphology of the atlas has been regarded as an indicator of direction of mandibular growth. Huggre, Nisayit and Al Sahat had showed that there is significant relationship between the atlas dorsal arch, atlas anterior-posterior and the mandibular growth.[6,7,8] Kylamarkula S. concluded that vertical and horizontal dimensions of firstcervical vertebra is directly related with mandibular shape, mandibular growth and cervical base angle.[9]

Kjær I investigated symphysis menti in the human foetus related to fetal skeletal maturation in the hand and foot. On the basis of reaction of glycosaminoglucuronoglycans and activity of hydrolytic enzyme, the symphysis is characterized as a growth zone, active in mandibular growth in width as well as length during the 1st half of the prenatal period.[10]Ricketts stated that, mandibular symphyseal morphology can be used as a parameter to predict the direction of mandibular growth.[11] According to study of Aki T et al height, depth, their ratio (height by depth) was measured and they showed that there is strong relationship between symphyseal morphology in different mandibular growth patterns.[1]

Individual studies regarding morphology of first cervical vertebra and morphology of symphysis in different growth patterns had been done. Therefore purpose of this study is to find out if there is any association between first cervical vertebra morphology and mandibular symphysis morphology in different growth patterns.

MATERIALS AND METHODOLOGY

The sample of study includes 240 lateral cephalograms, which were collected from department of Orthodontic and Dentofacial Orthopaedics. The selection criteria for sample were (i) Patient between age group of 18-25 years prior to orthodontic treatment (ii)No history of any habit (personal and pernicious) (iii) No history of Orthodontic, Orthopaedic and Surgical treatment. (iv)Absence of malformation in morphology of symphysis and first cervical vertebra (v) Complete erupted permanent dentition except 3rd molar with normal nasal breathing.

The lateral cephalograms were traced, by using Nemoceph software, to determine the mandibular rotation by measuring different angles (N-S-Gn Angle, Sum of posterior Angle, SN-MP Angle). Depending on this measurement samples were divided into 3 groups, Group A - Average growth pattern,Group B – Vertical growth pattern and Group C – Horizontal growth pattern.

In each group morphology of first cervical vertebra and morphology of symphysis menti were measured.The outline of the odontoid process of the axis and the outline of the first cervical vertebra (atlas) were

traced on the cephalometric radiographs according to Vastardis and Evans.[12]

The first cervical vertebra was measured by following 3 parameters; Atlas Dorse, Atlas A-P, Atlas ventre. Atlas A-P was the maximum antero-posterior extent of the atlas. Atlas ventre was the maximum vertical extent of the atlas ventral arch perpendicular to the length of the atlas (a-p). Atlas dorse was the maximum vertical extent of the atlas dorsal arch perpendicular to the length of the atlas (a-p)[6](Fig no.1)

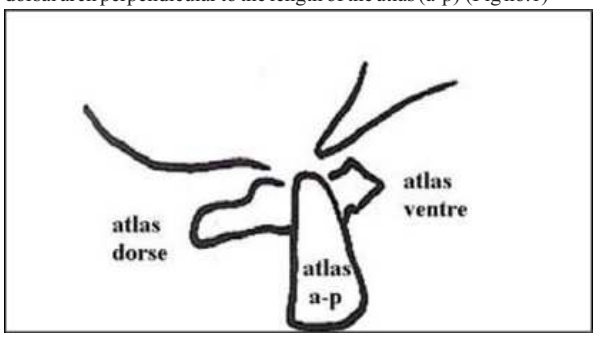

Fig no. 1- Morpholgy Of First Cervical Vertebra

The mandibular symphysis menti morphology was measured in terms of Height, Depth, Ratio(height by depth) and Angle.

Determination of symphysis menti height and depth were done as shown in (Fig no.2a). A line tangent to point B was used as the long axis of the symphysis, and a grid was formed with the lines of the grid parallel and perpendicular to the constructed tangent line. The superior limit of the symphysis was taken at point B.

The inferior, anterior, and posterior limits taken at the most inferior, anterior, and posterior borders of the symphysis outline, respectively. The symphysis height was defined as the distance from the superior to the inferior limit on the grid. The symphysis depth was defined as the distance from the anterior to the posterior limit on the grid. Symphysis ratio was calculated by dividing symphysis height by symphysis depth[1](Fig no.2a)The symphysis angle was determined by the posterior-superior angle formed by the line through menton and point B and the mandibular plane[1](Fig no.2b)

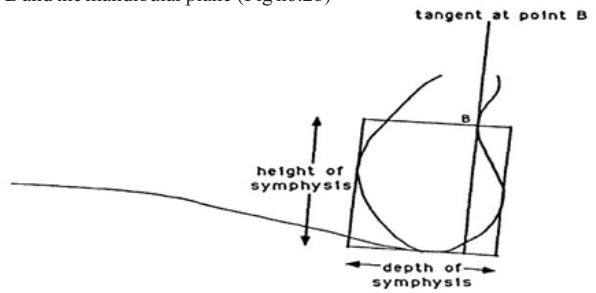

Fig no. 2a- Symphysis Menti Height, Depth And Ratio

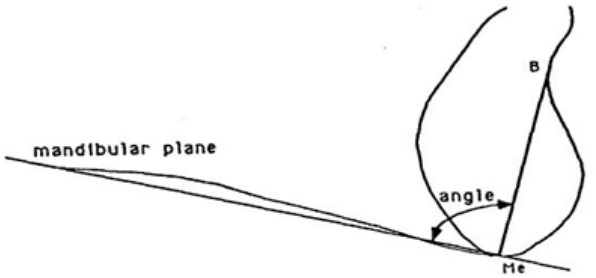

Fig No.2b- Symphysis Menti Angle

Tracing was done for all of these cephalometric films, 3 linear measurements for the atlas and symphysis menti and 1 angular measurements of symphysis menti, these measurements were done by using software SPSS version 26 computer programme.

The means and standard deviation were calculated for the total sample, Pearson correlation coefficient was done to detect the significant of relation between atlas measurements and symphysis measurement, T-test for intra-examiner and Anova test for inter- examination were used.The subjects in which the morphology of first cervical vertebra not seen properly on lateral cephalograms were measured by 3D CT scan to check the accuracy of morphology of first cervical vertebra. In present study 3 subjects were calculated by 3D CT scan.

RESULTS

Table No.1 shows comparison of cervical vertebra parameter with symphysis menti parameter in average growth pattern.

When symphysis menti angle compared with cervical vertebra ventre (P=0.68), cervical vertebra dorse (P=0.29) and vertebra antero-posterior (P=0.14), there was no any significant relation seen.When symphysis height compared with cervical vertebra ventre (P=0.43),cervical vertebra dorse (P= 0.79), there was no significant difference seen , but there was highly significant relation seen in cervical vertebra antero- posterior with symphysis menti height (P=0.020). When cervical vertebra antero- posterior increases there was decrease in symphysis menti height and vice versa. When symphysis menti depth compared with cervical vertebra ventre (P=0.65),cervical vertebra dorse (P= 0.34), there was no significant difference seen,but there was highly significant relation seen in cervical vertebrae antero-posterior with symphysis menti depth (P=0.002). When cervical vertebra antero-posterior increases, there was decrease in symphysis menti depth and vice versa. When symphysis menti ratio compared with cervical vertebra ventre(P=0.25), cervical vertebra dorse (P=0.20) and vertebra antero-posterior (P=0.68), there was no any significant relation seen.

Table 1: Comparison Of First Cervical Vertebra Morphology With Symphysis Menti Morphology In Average Growth Pattern.

Growth Pattern	Co- Relation	Co Relation Coefficient	P- Value
Average Growth Pattern	C1- V to SY- A	-.040	0.682
	C1- D to SY- A	-.102	0.296
	C1- A-P to SY- A	-.142	0.147
	C1- V to SY- H	-.077	0.433
	C1- D to SY- H	.026	0.790
	C1- A-P to SY- H	.226	0.020
	C1- V to SY- D	.044	0.653
	C1- D to SY- D	.090	0.345
	C1- A-P to SY- D	.291	**0.002**
	C1- V to SY- H/D	-.109	0.256
	C1- D to SY- H/D	-.123	0.208
	C1- A-P to SY- H/D	-.039	0.688

Table No.2 shows comparison of cervical vertebra parameter with symphysis menti parameter in Horizontal growth pattern

When symphysis menti angle compared with cervical vertebra ventre(P=0.61), cervical vertebra dorse (P=0.87) and vertebra antero-posterior (P=0.71), there was no any significant relation seen.When symphysis menti height compared with cervical vertebra ventre (P=0.40), cervical vertebra dorse (P=0.18) and vertebra antero-posterior (P=0.39), there was no any significant relation seen.When symphysis menti depth compared with cervical vertebra ventre (P=0.10) and cervical vertebra dorse (P=0.34) there was no any significant relation seen, but it showed highly significant relation in cervical vertebra antero-posterior with symphysis menti depth (P=0.007). When cervical vertebra antero-posterior increases there was decrease in symphysis menti depth and vice versa.When symphysis menti ratio compared with cervical vertebra ventre (P=0.16), cervical vertebra dorse (P=0.68) and vertebra antero-posterior (P=0.69), there was no any significant relation seen.

Table 2: Comparison Of First Cervical Vertebra Morphology With Symphysis Menti Morphology In Horizontal Growth Pattern.

Growth Pattern	Co- Relation	Co Relation Coefficient	P- Value
Horizontal Growth Pattern	C1- V to SY- A	-.048	0.613
	C1- D to SY- A	-.015	0.875
	C1- A-P to SY- A	.035	0.714
	C1- V to SY- H	-.080	0.402
	C1- D to SY- H	-.127	0.181
	C1- A-P to SY- H	-.080	0.396
	C1- V to SY- D	.153	0.107
	C1- D to SY- D	.090	0.345

	C1- A-P to SY- D	.254	**0.007**
	C1- V to SY- H/D	-.133	0.161
	C1- D to SY- H/D	-.039	0.683
	C1- A-P to SY- H/D	.038	0.690

Table No.3 shows comparison of cervical vertebra parameter with symphysis menti parameter in vertical growth pattern.

It did not show change in any parameter of cervical vertebra morphology as well as symphysis menti morphology. All values of symphysis menti when compared with cervical vertebra were below P value ($P \leq 0.05$)

Table 3: Comparison Of First Cervical Vertebra Morphology With Symphysis Menti Morphology In Vertical Growth Pattern.

Growth Pattern	Co- Relation	Co Relation Coefficient	P- Value
Vertical Growth Pattern	C1- V to SY- A	-.270	.223
	C1- D to SY- A	-.131	.561
	C1- A-P to SY- A	-.043	.851
	C1- V to SY- H	0.194	.387
	C1- D to SY- H	0.334	.129
	C1- A-P to SY- H	-.012	.958
	C1- V to SY- D	0.287	.196
	C1- D to SY- D	0.174	.438
	C1- A-P to SY- D	0.214	.339
	C1- V to SY- H/D	-.269	.226
	C1- D to SY- H/D	.121	.593
	C1- A-P to SY- H/D	-.252	.258

Further result showed comparison of cervical vertebra parameters and symphysis menti parameters individually in three growth patterns. (Table No.4)

There was no significant result ($P \geq 0.05$) when cervical ventre, cervical antero- posterior and cervical dorse was compared in vertical growth pattern, average growth pattern and horizontal growth pattern. There was significant result ($P \leq 0.05$) seen, when symphysis menti depth and symphysis menti angle compared in vertical growth pattern, average growth pattern and horizontal growth pattern. Symphysis menti depth increases more in horizontal growth pattern than in average and vertical growth pattern and symphysis menti angle was more obtuse in horizontal growth pattern than in vertical and average growth pattern. But there was no significant result ($P \geq 0.05$) seen when symphysis menti height and symphysis menti ratio compared.

Table 4: Comparison Of Morphology Of First Cervical Vertebra And Symphysis Menti Morphology In Average, Vertical And Horizontal Growth Patterns.

	Growth Pattern	N (Number of observations)	Mean	Std Deviation	F Value	P value
C1-V	Average	106	7.8	1.099		
	Horizontal	112	7.95	1.03	0.64	0.052
	Vertical	22	8	0.976		
C1-D	Average	106	6.67	1.307		
	Horizontal	112	6.41	1.027	2.51	0.84
	Vertical	22	6.95	1.397		
C1-A-P	Average	106	31.79	2.393		
	Horizontal	112	31.47	3.084	2.25	0.11
	Vertical	22	32.82	2.423		
Sy-H	Average	106	16.28	1.921		
	Horizontal	112	18.19	11.904	1.48	0.23
Sy-A	Average	106	86.59	5.275		
	Horizontal	112	89.48	6.546	9.43	**0**
	Vertical	22	84.45	7.939		
Sy-D	Average	106	12.24	1.754	7.27	**0.01**
	Horizontal	112	13	1.655		
	Vertical	22	11.95	1.362		
Sy-H/D	Average	106	1.307	0.1873	2.15	0.12
	Horizontal	112	1.289	0.1813		
	Vertical	22	1.377	0.1631		

DISCUSSION

In the present study, cervical vertebra antero-posterior and cervical vertebra dorse showed no significant difference in mandibular growth rotation. But by Nisayif DH, Al-Sahaf NH.[6] cervical antero-posterior and cervical dorse were decreased with increased in mandibular growth rotation. This indicates in vertical growth rotation of the mandible there was short dorsal arch and the length of atlas.

Huggare J[8]concluded that atlas dorsal height was higher in forwardly rotating mandible than backward rotating mandible. But in present study, atlas dorsal height were more in backwardly rotating mandible than forwardly rotating mandible.

Kylamarkula S and Huggare J[9]concluded that the atlas dorsal arch was low and the length of atlas was short in vertical growth rotation of the mandible. Butin present study vertical growth rotation of mandible showed high dorsal arch and long atlas length.

In present study, there were no any significant differences between cervical vertebra morphology and mandibular divergent patterns. The comparable study by Mahmood HT, Fida M[13] concluded there was weak correlation between atlas morphology and maxillo-mandibular divergence pattern.

In present study there was significant difference seen, when symphysis menti depth and symphysis menti angle compared in vertical growth pattern, average growth pattern and horizontal growth pattern. Symphysis menti depth increases more in horizontal growth pattern than in average and vertical growth pattern and symphysis menti angle was more obtuse in horizontal growth pattern than in vertical and average growth pattern. Comparable study of Aki T[1] concluded that the symphysis with an anterior growth direction of the mandible had a large depth and large angle. In contrast, a symphysis menti with a small depth and small angle demonstrated a posterior growth direction.

Present study showed there were no significant differences seen when symphysis menti height compared in three growth patterns but symphysis menti height was more in horizontal growth pattern than average and vertical growth pattern.

But by Oz U, Rubenduz M[14]concluded that upper symphyseal height increased in hyper class II subject and decreased in hypo class II subjects but in present study symphysis menti height was more in horizontal growth pattern than average and vertical growth pattern.

Present study showed there were no significant differences seen when symphysis menti ratio compared in three growth patterns but symphysis menti ratio was low in horizontal growth pattern than average and vertical growth pattern.

Moshfeghi M, Nouri M, Mirbeigi S, Baghban AA[15] concluded symphyseal ratio (Height/Depth) was small in a mandible with a vertical growth pattern Class II or Class III. Conversely, a horizontal growth pattern of a Class II or Class III mandible was associated with a larger ratio of the symphysis in comparison with the normal group. But in present study symphysis menti ratio was low in horizontal growth pattern than average and vertical growth pattern.

Ricketts in 1960[11]concluded that the large symphysis ratio (height/depth) was associated with a receding chin and high mandibular plane and in small symphysis ratio, there was large chin and low mandibular plane. But in present study there was low symphysis ratio with horizontal growth pattern than vertical growth pattern.

Present study showed recessive chin with increase in cervical vertebra length with average growth pattern while prominent chin with horizontal growth pattern. But when cervical vertebra morphology compared with symphysis menti morphology in vertical growth pattern, there was no correlation seen.

CONCLUSION

This study demonstrated the following-

1) In average growth pattern, there is increase in length of cervical vertebra with deficient chin.
2) In horizontal growth pattern, there is decrease in length of cervical vertebra with more prominent chin having more depth.
3) In vertical growth pattern, there is no correlation among cervical vertebra morphology and symphysis menti morphology.
4) There is no correlation between cervical vertebra morphology and mandibular growth rotation.
5) In horizontal growth pattern, there is more prominent chin than with vertical and average growth pattern.

Limitation Of Study

1) Inadequate sample size of vertical growth pattern might gave non significant result.

2) Chances of error due to manual tracing and reading in lateral cephalogram for cervical vertebra and symphysis menti morphology

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