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Assessment of position of mandibular canal in relation to mandibular plane in different growth patterns



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ABSTRACT

Objectives: To evaluate the position and curvature of mandibular canal in relation to mandibular plane in horizontal (HG), average (AG) and vertical (VG) growth patterns.
Methods: 100 lateral cephalograms were screened & analysed from amongst patient's records available in the institution. The growth pattern was assessed by FMA angle, Y-Axis, SN-Go-Gn angle and Jaraback's ratio, on the basis of these values, a sample was selected of 20 lateral cephalographs each in horizontal, average and vertical growth pattern. Rickett's Xi point was identified and mandibular canal was traced on each lateral cephalogram using Xi point which denotes the origin of mandibular canal. Distance between, Gonial point to Xi point, Mental foramen to mandibular plane (M_F–M), Mandibular foramen to pterygoid vertical (X_i–PTV) and from deepest point on mandibular canal to mandibular plane (Mc–M) were measured to evaluate the position and curvature of mandibular canal in different growth patterns.
Results: It was observed that, the distance from gonial point to mandibular foramen, mental foramen to mandibular border, mandibular foramen to pterygoid vertical was increased in horizontal growth pattern i.e., 22.05 mm ± 1.82, 15.12 mm ± 1.06, 57.20 mm ± 1.23, whereas it was reduced in vertical growth pattern i.e., 14.90 mm ± 1.55, 8.84 mm ± 1.41, 47.95 mm ± 2.25 respectively. Depth of curvature of mandibular canal was increased in horizontal growth pattern, 22.25 mm ± 4.89; while it was reduced in vertical growth pattern i.e., 16.32 mm ± 1.18.
Conclusions: The findings of this study showed that the position and curvature of the mandibular canal reflect the outer morphology and growth pattern of the mandible.

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1. Introduction

Growth of mandible plays an important role in facial growth and development. Diagnosing a case with varied growth pattern and prediction of growth pattern is important for accurate treatment & better prognosis. It requires a thorough understanding of growth, growth rotations and morphology of skeletal structures.

Studies of growth, using metallic implants in jaws was carried out by Bjork and co-workers in Copenhagan in 1960's, where in the extent to which mandible and maxilla rotates during growth was appreciated. Rotation that occurs in core of each jaw is called as internal rotation whereas surface changes produce external rotation.[1]

The rotation of jaw is considered as "forward" if there is more growth posteriorly than anteriorly, where in the mandible rotates in anticlockwise direction and growth pattern is said to be horizontal with tendency of deep bite.

The rotation is considered as "backward" when anterior dimension lengthens more than posterior, causing clockwise i.e., downward and backward rotation of chin and the growth pattern is said to be vertical with tendency of open bite.

It is known that in pre-natal life, the mandibular canal has a horizontal orientation and that the mental foramen is not developed. The mental foramen develops at 9–10 weeks gestational age. The curvature of the mandibular and mental canals will develop during growth and apposition is seen in the late pre- and post-natal periods.[2,3]

As the mandibular canal has a curved course post-natally, it is presumed that the mandibular growth pattern is reflected in its curvature. In vertical type of condylar growth the curvature of canal tends to be greater than that of mandibular contour, including the angle of jaw, whereas in sagittal type the opposite is generally seen.[2,3]

A study of mandibular canal curvature primarily help an orthodontist to determine the growth pattern thereby the treatment planning and prognosis, but in addition this knowledge is helpful during placement of orthodontic implants, to plan third molar extractions and in planning of various orthognathic surgeries.

Considering the above facts, the aim of this study was to evaluate, whether the position and curvature of mandibular canal be used for assessing the different growth patterns and in growth prediction.

2. Aims & objectives

Aim of the study was to evaluate the position and curvature of mandibular canal in relation to mandibular plane in horizontal (HG), average (AG) and vertical (VG) growth patterns patients.

3. Materials and methods

Lateral cephalograms from amongst the patients' records with the age range 18–25 years, available in the institution, were screened & analysed. The growth pattern was assessed on the basis of FMA angle, Y-Axis, SN-Go-Gn angle and Jaraback's ratio. 20 Lateral Cephalograms for each group i.e., Horizontal, Average and Vertical growth pattern were selected as shown in Table 1.

Cephalometric tracing was done for all the selected cephalograms. A geometric centre of ramus was determined, by bisecting the height and width of ramus at its narrowest dimension i.e., Rickett's Xi point, which corresponds with the mandibular foramen.[4] Mandibular canal was traced on each lateral cephalogram, using Ricketts Xi point which denotes the origin of mandibular canal and its position and curvature was evaluated using the following measurements.

A perpendicular distance in millimetre was measured from (Fig. 1)

1. Gonial point to mandibular foramen at Xi point (G_o–X_i),
2. Mental foramen to mandibular plane (M_F–M),
3. Mandibular foramen to pterygoid vertical (X_i–PTV),
4. Deepest point on mandibular canal to mandibular plane. (Mc–M).

4. Observation and results

Mandibular canal was traced in all the lateral cephalograms with the help of Xi point and its position and curvature was evaluated using various measurements and the comparison between three groups was made. All the measurements were tabulated and mean was calculated (Table 2). On evaluating the position of mandibular canal it was observed that, the perpendicular distance from gonial point to mandibular foramen, mental foramen to mandibular border, mandibular foramen to line drawn from PTV point was increased in horizontal growth pattern i.e., 22.05 mm ± 1.82, 15.12 mm ± 1.06, 57.20 mm ± 1.23 respectively, whereas it was reduced in vertical growth pattern i.e., 14.90 mm ± 1.55, 8.84 mm ± 1.41, 47.95 mm ± 2.25 respectively. The depth of curvature of mandibular canal as measured from the deepest point on mandibular canal to mandibular plane was increased in horizontal growth pattern, 22.25 mm ± 4.89, while it was reduced in vertical growth pattern i.e., 16.32 mm ± 1.18.

Table 1 – Selection criteria for samples for the study.

Growth Pattern	FMA (deg)	Y-Axis (deg)	SN-Go-Gn angle (deg)	Jaraback's ratio (deg)
Horizontal Growth Pattern (HG)	<20	<53	<25	<62
Average Growth Pattern (AG)	20–30	53–63	25–35	62–65
Vertical Growth Pattern (VG)	>30	>63	>35	>65

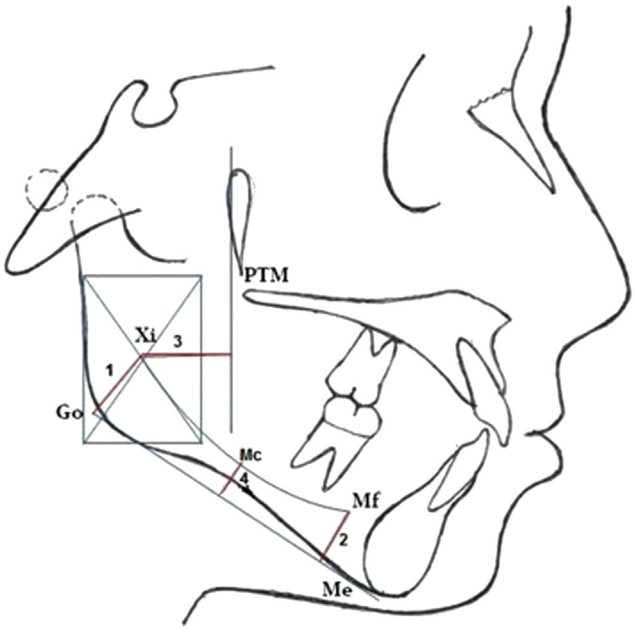


Fig. 1 – Figure showing the tracing and the measurements 1.Gonial point to mandibular foramen at Xi point (G_o–X_i); 2. Mental foramen to mandibular plane (M_F–M); 3. Mandibular foramen to pterygoid vertical (PTV point) (X_i–PTV); 4. Deepest point on mandibular canal to mandibular plane.

For statistical analysis, One way ANOVA and TUKEY multiple comparison test was done with help of SPSS software version 17. The results obtained using One way ANOVA and Tukey Multiple Comparison Test revealed statistically significant difference between all three growth patterns. (Table 3)

5. Discussion

Björk gave seven signs of mandibular rotation, i.e., inclination of condylar head, inferior border of mandible, inclination of symphysis, interincisal angle, intermolar angle and curvature of mandibular canal and anterior lower facial height.[5] To obtain reliable results, the reference structures have to be stable during growth. Since mandibular canal is not remodelled to the same extent as the outer surface of the mandible, the trabeculae related to the canal are relatively stationary. Therefore, the curvature of the mandibular canal reflects earlier shape of mandible. Hence the internal morphology of the mandible, i.e., the mandibular canal, is stable on a profile radiograph, whereas the external morphology is not.[6]

Hence the present study was carried out to evaluate the position and curvature of mandibular canal and compare the values in horizontal, average and vertical growth patterns, so as to assess whether these values can be used to determine and predict the growth pattern.

The position of mandibular canal when evaluated showed that, the perpendicular distance from gonial point to mandibular foramen, mental foramen to mandibular border, and mandibular foramen to line drawn from PTV point was increased in horizontal growth pattern, whereas it was reduced in vertical growth pattern. The depth of curvature of mandibular canal as measured from the deepest point on mandibular canal to mandibular plane was increased in horizontal growth pattern, while it was reduced in vertical growth pattern and the difference is statistically significant. It shows that the mandibular canal is positioned nearer to the mandibular border and its curve is deep in vertical growers whereas in horizontal growers the canal is nearer to the alveolar bone and away from the mandibular border. The position and curvature of the mandibular canal is an important factor in orthodontic treatment planning as it reflects the

Table 2 – Mean values of measurements in mm.

Parameter	Horizontal growth Pattern (HG) n = 20	Average growth Pattern (AG) n = 20	Vertical growth Pattern (VG) n = 20
Gonial point to mandibular foramen	22.05 ± 1.82	18.35 ± 1.34	14.90 ± 1.55
Mental foramen to mandibular border	15.12 ± 1.06	12.12 ± 0.91	8.84 ± 1.41
Mandibular foramen to pterygoid vertical	57.20 ± 1.23	52.45 ± 1.58	47.95 ± 2.25
Mandibular foramen to mandibular plane	22.25 ± 4.89	19.60 ± 1.57	16.32 ± 1.18

Table 3 – Tukey Multiple comparison test.

		Horizontal vs		Average vs Vertical
		Average	Vertical	
Gonial point to mandibular foramen	Mean	3.70	7.15	−3.45
	P – Value	**0.000 S, p<0.05**	**0.000 S, p<0.05**	**0.000 S, p<0.05**
Mental foramen to mandibular border	Mean	3.00	6.28	−3.28
	P – Value	**0.000 S, p<0.05**	**0.000 S, p<0.05**	**0.000 S, p<0.05**
Mandibular foramen to pterygoid vertical	Mean	4.75	9.25	−4.5
	P – Value	**0.000 S, p<0.05**	**0.000 S, p<0.05**	**0.000 S, p<0.05**
Mandibular foramen to mandibular plane	Mean	2.65	5.92	−3.27
	P – Value	**0.021 S, p<0.05**	**0.000 S, p<0.05**	**0.004 S, p<0.05**

morphology and growth pattern of the mandible as orthodontic treatment influences the mandibular rotation and mandibular remodelling. In addition, this knowledge is also important in implant placement, third molar extractions and orthognathic surgeries.

The position of mandibular foramen lies anterior to Xi point in horizontal growers, posterior to Xi point in vertical growers, whereas it coincides with Xi point in normal growers. This knowledge is important while giving inferior alveolar block during various surgical procedures in mandible.

The results of this study are not only efficient in determining growth pattern but also provide knowledge about the morphology of mandibular canal. Morphological and topographic knowledge of the mandibular canal is of paramount importance as dental procedures involve extraction of mandibular third molars, implant surgeries, orthognathic surgeries, and those to reduce and fix fractures done in the posterior mandible region close to the mandibular canal, increasing the risks of injuries to the inferior alveolar nerve (IAN).[7]

Many critical factors must be kept in mind when placing implants, or while performing surgical procedures in posterior mandible since any damage to inferior alveolar nerve will result in postoperative neurosensory disturbance of the lower lip and chin. The knowledge about the morphology of mandibular canal in various growth patterns will avoid risk of injuries to Inferior Alveolar Nerve.

The bone height at the first and second molars and the second premolar of individuals with horizontal growth pattern is greater than that of those with the vertical growth pattern.[8,9] This supports the hypothesis that the height of the mandibular bone is associated with the growth pattern and since position and curvature of mandibular canal determines the type of growth pattern, this knowledge is also helpful in deciding the position for placement of implants.

6. Conclusion

The position & curvature of mandibular canal should be assessed to determine the growth pattern.

- In horizontal growers mandibular canal was away from mandibular plane with average value of 22.05 mm ± 1.82, whereas it was nearer to mandibular plane in vertical growers with average of 14.90 mm ± 1.55.
- In vertical growers the curvature of mandibular canal was more with average depth of 16.32 mm ± 1.18 as compared to linear path in horizontal growers with 22.25 mm ± 4.89 as average.
- Distance between mental foramen and mandibular plane was highest in horizontal growers, average of 15.12 mm ± 1.06.
- Mandibular foramen lies anterior to Xi point in horizontal growers, posteriorly in vertical and coincides with Xi point in average growers.

The findings of this study showed that the position and curvature of the mandibular canal reflect the outer morphology and growth pattern of the mandible. As orthodontic treatment influences the components of mandibular rotation and thus induces a change in the remodelling of the mandible, the morphology of mandibular canal is an important factor in orthodontic treatment planning, assessment of treatment progress, and the determination of treatment outcomes and should be taken into consideration. Morphological and topographic knowledge of the mandibular canal is also helpful in planning 3rd molar extraction, orthognathic surgeries and implant placements.

Conflicts of interest

The authors have none to declare.

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