A Radiographic Study to Evaluate the Course and Visibility of the Mandibular Canal in Darbhanga Population: An Original Research

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ABSTRACT

Introduction: Mandibular canal or inferior alveolar canal is an important anatomical landmark in mandible which contains neurovascular bundles. Mandibular canal is considered as reference anatomical landmark in maxillofacial surgeries. The aim of this study was to evaluate the course and visibility of the mandibular canal in Darbhanga (Bihar) population on digital panoramic radiographs, and the objective was to assess the normal variation of mandibular canal on panoramic radiographs

Material and Methods: A total of 500 panoramic radiographs were selected from the archives of our department as soft copies. The course of mandibular canal was evaluated on panoramic radiographs. The collected data were subsequently processed and analyzed using SPSS statistical package version 17.

Results: We found that elliptic curve is most common curve. Visibility of mandibular canal is more in the third molar region compared to first molar region. **Conclusion:** In the present study, most common curve was elliptic curve (64.8%) followed by linear curve (22.2%). Visibility of mandibular canal in third molar region was 98.1%. In both gender, elliptic curve was most common curve.

Keywords: Elliptic, Linear, Mandibular canal, Panoramic radiographs, Surgery

INTRODUCTION

The mandibular canal is an important landmark in the maxillofacial region. Mandibular canal is a tube- like passage through the bone that travels the length of the mandible.[1] Radiographically, it appears as radiolucent band outlined by two thin radiopaque lines representing the cortical walls of the canal. It may appear below or superimposed on the mandibular molar teeth. The mandibular canal contains the neurovascular bundle (inferior alveolar artery and inferior alveolar nerve), which further branches to provide innervations to the mandibular teeth and adjacent structures.[2] Changes to mandibular canal can be characteristic to specific disease processes. Superior displacement of the mandibular canal is strongly associated with fibrous dysplasia. Widening of the mandibular canal with the maintenance of a cortical boundary may indicate the presence of a benign lesion of vascular or neural origin within the canal. Irregular widening with cortical destruction may indicate the presence of a malignant neoplasm growing down the length of the canal. Various studies on the topography of mandibular canal shows variation in its course and in its path.[3] Visibility of the mandibular canal varies according to individuals and its path in the same individual.[4] Knowledge of the course of the mandibular canal and its visibility along the roots of mandibular teeth helps in proper placement of implants, third molar surgery, mandibular osteotomy or any surgery involving the posterior mandible on either side. Lack of knowledge may lead to iatrogenic damage which may result in paresthesia, numbness, pain, bleeding,[5] Studies have shown that the incidence of these neurological complications ranges from 0.2 to 1% for a permanent injury and from 3.3 to 13% for a temporary injury.[6] Mandibular canal is visible on various radiographs like intra oral panoramic radiographs (IOPAR), panoramic radiographs and cone beam computed tomography. Among all these, panoramic radiographs are easily accessible, have the benefit of bilateral evaluation simultaneously etc. Till now, no study has been done in this part of Bihar to evaluate the course and visibility of the mandibular canal. Hence, this study was planned to evaluate the course and visibility of the mandibular canal in Darbhanga (Bihar) population.

MATERIAL AND METHODS

This study was conducted in the Department of Oral Medicine and Radiology and Department of Public Health Dentistry. The study was approved by ethical committee of the institute. A total of 500 panoramic radiographs were obtained from

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the archives of our department as soft copies. All panoramic radiographs were obtained from Genoray Papaya Plus Extor-C digital panoramic system using standard exposure parameters (Tube Potential: 66–85 kv, Tube Current: 6–10 mA, Total Filtration: 2.8 mm, time: 12 sec), as recommended by the manufacturer. The magnification factor for the region from the posterior border of ramus to canine, as reported by the manufacturer, is 1.25. Other parameters which were followed are: (1) The Frankfort horizontal plane was parallel to the floor, (2) the medial sagittal plane bisected the face into two equal halves, (3) the canine plane passed through the long axis of the canine. All images were taken by same radiologist following a standardized protocol for patient positioning and exposure parameter settings. All radiographs were analyzed by the same radiologist. No intraobserver variability was assessed. Assessment of radiographs was made digitally. No alteration of image was done digitally to facilitate better visibility. The course of the mandibular canal was divided into 4 types. They are as follows

i. Linear curve
ii. Elliptic curve
iii. Spoon shaped curve
iv. Turning curve

The visibility of mandibular canal was assessed on panoramic radiograph according to classification given by Nortje et al.[7] Classification of visibility of mandibular canal is as follows: i) clearly visible: if both the upper and lower radiopaque cortex were identified in the panoramic radiography; ii) partially visible: if only the lower cortex is visible; iii) invisible: if the two cortex were not identifiable. Visibility of mandibular canal was evaluated in three mandibular regions: the first molar, second molar, and third molar regions. The selected radiographs were of patients aged 18 years and above. The radiographs were chosen according to the following criterias:

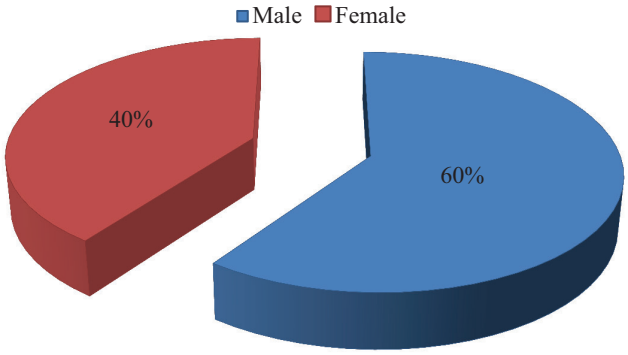
i. Selected radiographs were of patients aged 18 or above,
ii. All three molars were completely erupted,
iii. No radiolucent or radiopaque lesions in mandibular posterior region,
iv. Radiographs showing no radiographic exposure or processing artefacts,
v. Fracture of mandible posterior region,
vi. Course of mandibular canal was visible.

STATISTICAL ANALYSIS

The collected data were subsequently processed and analyzed using SPSS statistical package version 17. Chi square test was applied to test the significance of study. P value of less than 0.5 is considered to statistically significant. In our study, we observed p value less than 0.001 which showed study was highly significant.

RESULTS

A total of 500 radiographs were evaluated. Out of 500 radiographs, 300 radiographs were of male (60%) and 200 radiographs were of female (40%). Male to female ratio is 3:2 [Graph 1]. In our study, age range of 18 years to 65 years was taken. Mean age of our study was 37.458 $\pm$ 10.322 years. In the age group of 18 years to 25 years, most common curve observed was elliptic curve (55.7%), followed by linear curve (22.9%), turning curve (11.4%) and spoon shaped



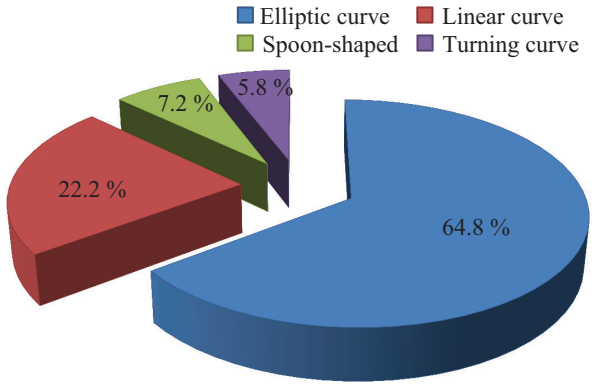
Graph-1: Gender distribution of subjects

Age	Elliptic curve		Linear curve		Spoon-shaped		Turning curve		Total
	N	%	N	%	N	%	N	%	
18-25	39	55.7	16	22.9	7	10.0	8	11.4	70
25-34	91	66.9	20	14.7	13	9.6	12	8.8	136
35-44	115	66.9	38	22.1	10	5.8	9	5.2	172
45-54	53	63	26	31.0	5	6.0	-	-	84
>=55	26	68.4	11	28.9	1	2.6	-	-	38
Total	324	64.8	111	22.2	36	7.2	29	5.8	500
x2 = 25.039; df = 12; p = 0.015; Significant									

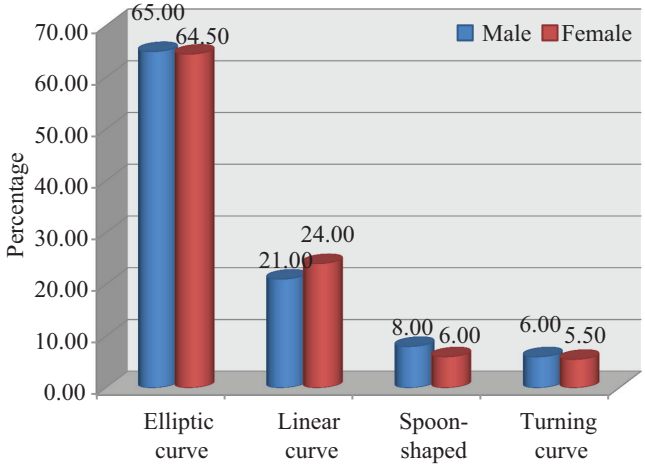
Table-1: Age wise distribution of curves

Visibility	Elliptic curve		Linear curve		Spoon-shaped		Turning curve		Total
	N	%	N	%	N	%	N	%	
Invisible	65	10.03	41	18.47	0	0.00	12	20.69	118
Partially visible	466	71.91	159	71.62	30	41.67	38	65.52	693
Clearly visible	117	18.06	22	9.91	42	58.33	8	13.79	189
Total	648	100.00	222	100.00	72	100.00	58	100.00	1000
x2 =101.106; df = 6; p < 0.001; Highly significant									

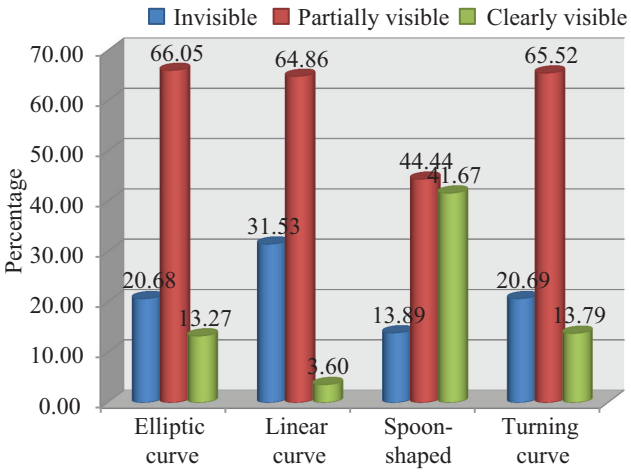
Table-2: Relationship between the course and the visibility of the mandibular canal on panoramic radiographs in second molar region on either side



Graph-2: Graph showing distribution of curve in 500 subjects



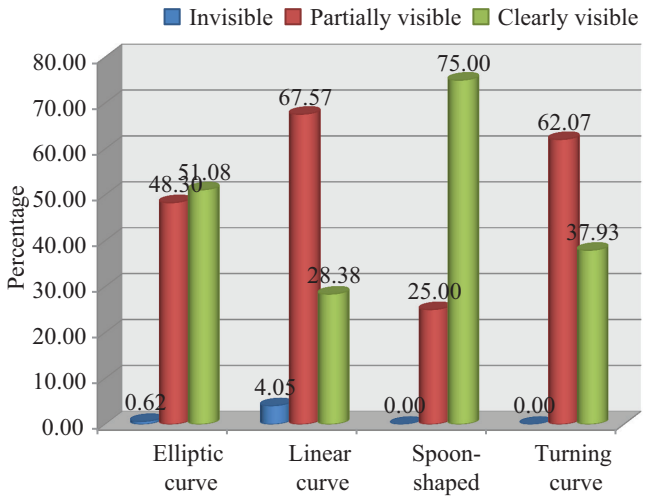
Graph-3: Sex wise distribution of curves



Graph-4: Relationship between the course and the visibility of the mandibular canal on panoramic radiographs in first molar region on either side

curve (10%) whereas in the age group of 25-34 years, most common curve seen was elliptic curve (66.9%), followed by linear curve, spoon shaped curve and turning curve. In the age group of 45-54 years, most common curve was elliptic (63%), followed by linear curve (31%) and spoon shaped curve (6%). Turning curve was not seen in this age group [Table 1].

Out of 500 panoramic radiographs, most common curve observed was elliptic (324, 64.8%), followed by linear curve (111, 22.2%), spoon shaped curve (36, 7.2%), and turning



Graph-5: Relationship between the course and the visibility of the mandibular canal on panoramic radiographs in third molar region on either side

curve (29, 5.8%) [Graph 2]. Out of 300 male subjects, 195 (65%) showed elliptic curve, followed by linear (63, 21%), spoon shaped (24, 8%) and turning curve (18, 6%). In 200 female radiographs, most common curve was elliotic (64.5%) and the least common curve was turning curve (5.5%) [Graph 3].

On panoramic radiographs, the percentage of invisible mandibular canal in first molar region was 22.6%, partial visible in 64.2% and clearly visible in 13.2%. In first molar region, elliptic curve was invisible in 20.68%, partially visible in 66.05%, and clearly visible in 13.27% of subjects. Linear curve was invisible in 31.53%, partially visible in 64.86% and clearly visible in 3.6% of total sites in 500 radiographs [Graph 4].

In second molar region, elliptic curve was clearly visible in 18.06%, partial visible in 69.3% and invisible in 10.03%. Overall, in second molar region, course of mandibular canal was partially visible in 69.3%, clearly visible in 18.9% and invisible in 11.8% of cases [Table 2]. In the third molar region, partial visible mandibular canal was visible in 51.7%, followed by clearly visible in 47% and invisible in 1.3% [Graph 5].

DISCUSSION

Before any invasive surgery in mandible posterior region, the course and visibility of mandibular canal should be properly assessed to minimize any iatrogenic complications. Mandibular canal appears completely radiolucent in panoramic radiographs. In this study, the course of mandibular canal was observed along with its visibility in mandibular posterior region. Study conducted by Abdallah Edrees MF et al classified course of mandibular canal as straight, catenary like configurations and progressive descent.[8] We followed the classification given by Yun-Hoa Jung et al who classified it into elliptic, linear, spoon shaped and turning types. In our study, most common course of mandibular canal was elliptic (64.8%) followed by linear (22.2%), spoon shaped (7.2%) and turning (5.8%) curve. Similar result was observed in study conducted by Jung YH et al.[4] Result of various studies

showed different observations too. Study conducted by Liu et al showed most common course to be elliptic in 48.5% followed by spoon-shaped curve (29.25%), liner curve (12.75%) and turning curve (9.5%).[9]

Radiography is the only available noninvasive method for diagnosis and treatment planning of major surgical procedures of the mandible. Panoramic radiographs are commonly used for screening, diagnosis, and selecting the best possible surgical approach. Panoramic radiographs are useful as they help in comparing the right and left side of mandible simultaneously which cannot be appreciated in IOPAR. It is important to know the proximity of mandibular canal with the roots of the mandibular molars on either side. This knowledge will help dental surgeon in reducing post operative complications. Our study showed that visibility of mandibular canal increased as distal portion of canal was approached. In the third molar region, clearly visible mandibular canal was observed in 47% of sites, followed by partial visible in 51.7% and invisible in only 1.3%. Visibility of mandibular canal is not same on all the site of mandible. Different sites have different visibility percentage. Study conducted by Klinge et al and Naitoh et al showed that the mandibular canal was not visible in 36.1% and 32% of examined sites on radiographs.[10,11] In our study, mandibular canal was not visible or invisible in 22.6% of sites in first mandibular region, 11.8% in second molar regions and 1.3% in third molar region. The difference in visibility of mandibular canal may be due to difference in bone density in alveolar region in different individuals. Visibility of mandibular canal increased as we moved distally. Visibility of mandibular canal was better in third molar region than visibility in first molar region. Mandibular canal was visible in 98.7% of sites in third molar region followed by second molar (88.2%) and first molar region (77.4%). This result coincides with the study done by Jung YH et al. Hence to avoid any neurological complications, correct knowledge of course and visibility of mandibular canal is important. Therefore, this study was conducted to evaluate the course and visibility of the mandibular canal in Darbhanga (Bihar) population. This is the only study which has been done till date in this region of Bihar. However, further studies are recommended with larger sample size, so that radiographic evaluation of course and visibility of mandibular canal can be done.

CONCLUSION

Mandibular canal is an important anatomical landmark in mandible. Precise knowledge of its course and visibility is important for dentist for various mandibular surgeries in this region. Dentist should be aware of these variations to prevent treatment complications. Elliptic curve was most common curve. Visibility of mandibular canal was more on distal regions of canal. Hence, this study was conducted to evaluate the course and visibility of the mandibular canal in Darbhanga (Bihar) population.

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