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"MORPHOMETRIC EVALUATION OF MANDIBULAR INCISIVE CANAL AND ANATOMICAL LANDMARK CORRELATIONS: A CBCT-BASED OBSERVATIONAL STUDY"

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ABSTRACT
The head and neck region is a complex anatomical structure composed of hard and soft tissues, along with cranial nerves. The skull protects the brain, while facial bones like the maxilla and mandible provide structural support. The mandibular incisive canal contains the mandibular incisive nerve, which supplies sensation to the lower incisors and canines. The mandibular incisive canal is a sensitive area during mandibular surgeries, and damage to it can result in complications such as poor implant integration, pulp sensitivity changes, sensory disturbances, swelling, and hematoma, making its identification crucial. This study conducted a comprehensive morphometric evaluation of the mandibular incisive canal and its relationship to nearby anatomical structures using Cone Beam Computed Tomography. The results showed that the mandibular incisive canal was visible in 94% of scans. Its diameter decreased as it extended toward the midline, making detection more difficult in some cases. Additionally, the study found that males generally had a longer mandibular incisive canal compared to females.

KEYWORDS: Anatomy, Cone Beam Computed Tomography, Incisive Canal, Mandibular Canal

INTRODUCTION
The head and neck region is a complex anatomical unit composed of hard and soft tissues, along with cranial nerves. The skull protects the brain, while facial bones like the maxilla and mandible provide

essential support for both structure and function. Muscles, nerves, and organs in the orofacial region facilitate sensory and motor functions[1]. The mandibular incisive canal (MIC), a small bilateral canal, houses the neurovascular bundle containing the mandibular incisive nerve, which innervates the mandibular incisors and canines. It is located mesial to the mental foramen and is the intra-bony terminal branch of the inferior alveolar nerve (IAN), extending anteriorly and inferiorly.

Key anatomical landmarks in this area include the mental nerve, the incisive canal with its neurovascular bundle, and the lingual foramen with its contents[2]. During surgical procedures such as genioplasty, implant placement, and bone harvesting, the MIC region is prone to risks that can lead to anatomical and functional damage. Failing to detect the MIC during pre-surgical planning can result in poor osseointegration of implants, pulp sensitivity changes, sensory disturbances, oedema, and hematoma[3]. Therefore, it became crucial to conduct a study to evaluate the dimensions of the MIC and its relationship to adjacent anatomical landmarks using Cone Beam Computed Tomography (CBCT) in the native population.

AIM & OBJECTIVES

To assess the dimensions of the Mandibular Incisive Canal and its relationship to adjacent anatomical landmarks using Cone Beam Computed Tomography.

MATERIALS & METHOD

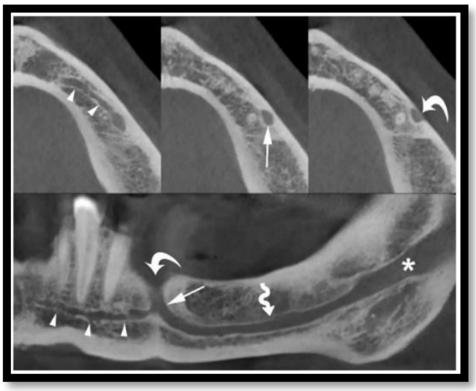
A prospective observational study was conducted in the Department of Oral Medicine & Radiology at Sri Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh. The inclusion criteria were patients aged 18-80 years with at least one tooth in the lower jaw. While complete edentulous patients, those with syndromes, congenital diseases, jaw pathology, previous surgery or poor-quality images were excluded.

After obtaining written consent from the subjects and approval from the institutional ethics committee, Cone Beam Computed Tomography scans were performed on patients who met the inclusion criteria. The CBCT system used was VATECH PAX-I3D SMART, with settings of 94 Kvp, 8.1 mA, and a resolution of 0.2 x 0.2 x 0.2 mm. The scan covered the entire mandible from the anterior two-thirds of the ramus on both sides and the mandibular body region anterior to the mental foramen bilaterally. The images were reviewed by two trained examiners, including experienced Oral & Maxillofacial radiologists certified in using EzDent-i software.

Measurements were taken and averaged for each site, and the data were analyzed for variations between genders and sides in adult dentate patients. The mental foramen's location and the tracing of the mandibular incisive canal (MIC) were identified using cross-sectional images from axial, sagittal, and panoramic views (Fig-1,2). The MIC measurements included its position relative to the inferior border of the mandible, buccal and lingual cortexes, root tip, and the canal's diameter. Each measurement is represented such as D1(YELLOW), D2(PURPLE), D3(BLUE), D4(MAROON), D5(ORANGE) D6(RED) (Fig-3)

STATISTICAL ANALYSIS

The data was analyzed using the SPSS statistical software 22.0 Version. The level of significance for the present study was fixed at 5%. The descriptive statistics included frequency and percentage. The intergroup comparison of the ordinal variable was calculated using the t-test and Pearson's correlation test.



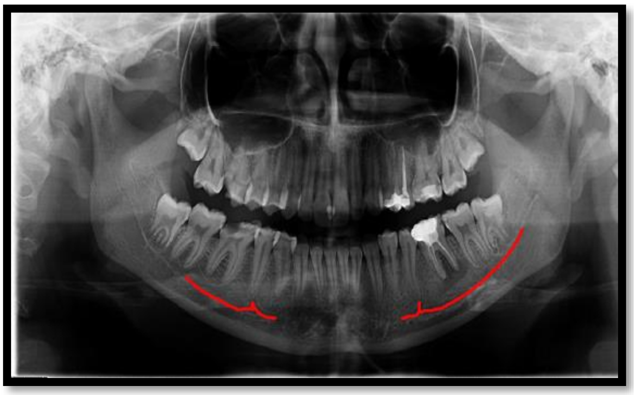
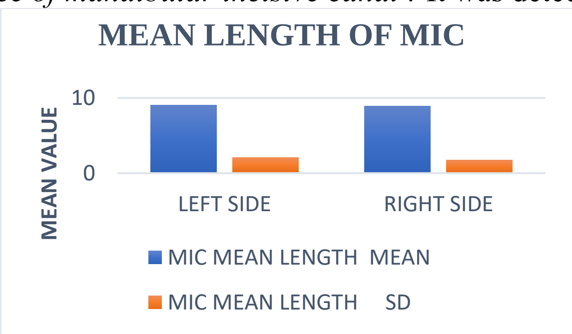


Fig-1. Mandibular Incisive Canal showin in Axial Section & Panoramic View
Fig-2.Panoramic view showing the tracing of Mandibular Incisive Canal

Fig-3. Cross-section images showing measurement of Mandibular Incisive Canal
NOTE: D1 – INFERIOR BORDER (Yellow); **D2** – BUCCAL CORTEX (Purple); **D3** – LINGUAL CORTEX (Blue); **D4** – ROOT TIP (Maroon); **D5** – CANAL DIAMETER (orange)

RESULTS

Prevalence of mandibular incisive canal : It was detected in 94% of individuals. (Fig-4).



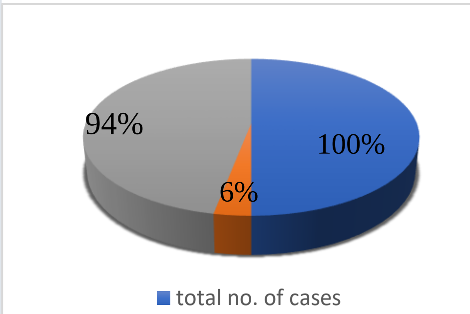


Fig-4.Prevalence of MIC **Fig-5. Mean Length Of**

Mandibular Incisive Canal (MIC)

*Mean length of mandibular incisive canal (MIC):*The mean length of the mandibular incisive canal from the mental foramen was more on the left side (9.06 ± 2.08 mm) as compared to right side (8.92 ± 1.77 mm). Also, the difference between the two was statistically non-significant (p-value – 0.54) (fig-5).

Tooth number	Gender	Mean ± Std. Deviation (SD)	p-value
33	Male	9.60 ± 2.41	0.0001
	Female	7.86 ± 1.87	
34	Male	10.42 ± 2.10	0.0001
	Female	8.43 ± 1.41	
43	Male	10.25 ± 2.15	0.0001
	Female	8.49 ± 1.86	
44	Male	10.23 ± 1.85	0.0001
	Female	8.69 ± 1.46	

Table 1: Comparison Of Gender In Inferior Border (D1) Dimensions

Tooth Number	Gender	Mean ± Std. Deviation (SD)	p-value
33	Male	4.08 ± 1.56	0.229
	Female	3.67 ± 1.66	
34	Male	3.43 ± 1.64	0.967
	Female	3.44 ± 1.84	
43	Male	4.10 ± 1.46	0.142
	Female	3.620 ± 1.72	
44	Male	3.61 ± 1.36	0.150
	Female	3.19 ± 1.45	

Table 2: Comparison Of Gender In Buccal Cortex (D2) Dimensions

Tooth number	Gender	Mean ± Std. Deviation (SD)	p-value
33	Male	4.19 ± 1.63	0.699
	Female	4.06 ± 1.58	
34	Male	4.19 ± 1.62	0.708
	Female	4.06 ± 1.70	
43	Male	3.85 ± 1.99	0.842
	Female	3.78 ± 1.55	
44	Male	4.13 ± 1.83	0.575
	Female	3.94 ± 1.46	

Table 3: Comparison Of Gender In Lingual Cortex (D3) Dimensions

Tooth number	Gender	Mean ± Std. Deviation (SD)	p-value
33	Male	5.73 ± 2.77	0.012
	Female	4.43 ± 2.20	
34	Male	6.06 ± 2.57	0.044
	Female	5.04 ± 2.33	
43	Male	5.10 ± 2.50	0.068
	Female	4.22 ± 2.19	
44	Male	6.04 ± 2.26	0.009
	Female	4.75 ± 2.45	

Table 4 : Comparison Of Gender In Root Tips (D4) Dimensions

Tooth number	Gender	Mean ± Std. Deviation (SD)	p-value
33	Male	1.81 ± 0.34	0.979
	Female	1.82 ± 0.40	
34	Male	1.82 ± 0.33	0.479
	Female	1.86 ± 0.34	
43	Male	1.85 ± 0.31	0.827
	Female	1.83 ± 0.34	
44	Male	1.89 ± 0.34	0.398
	Female	1.83 ± 0.35	

Table 5: Comparison Of Gender In Diameter of Canal (D5) Dimensions

*p-value < 0.05 (significant); 0.001 (highly significant)

DISCUSSION

Our study revealed that the mandibular incisive canal (MIC) was identifiable in 94% of the scans from a cohort of 100 patients, which included 55 females and 45 males. Among the female participants, the MIC was not visible in 2 cases, while it was undetectable in 4 of the male participants. The difficulty in tracing the MIC in these 6 patients may be attributed to the canal's progressive decrease in diameter as it approaches the midline, making visualization more challenging. These findings are consistent with the results of Obradovic et al. (1993)[4], who reported the presence of a well-defined MIC in 92% of 70 dentate mandibles from 105 cadavers, and with Mraiwa et al. (2003)[5], who observed the MIC in 96% of mandibles in their examination of 50 cadaveric specimens. The coherence between our study and these previous investigations further reinforces the anatomical consistency of MIC visibility.

In this study, we observed that the mean length of the mandibular incisive canal (MIC) was slightly longer on the left side compared to the right. Specifically, the mean length on the right side was 8.92±1.77 mm, while on the left, it measured 9.06±2.08 mm, with a non-significant p-value of 0.54. This finding aligns with Pereira-Maciel P (2015)[6], who also reported a longer mean length of the MIC on the left side (9.84±3.82 mm) compared to the right (9.64±3.97 mm). Similarly, Ayesha et al. (2020)[7] noted a greater MIC length on the left side. However, in contrast to our results, studies by Pires et al. (2009)[8] and Ramaswamy P et al. (2020)[9] reported a longer MIC on the right side, although, like our study, the difference was not statistically significant.

In our research, we found that the mean distance from the lower border of the mandibular incisive canal (MIC) to the inferior cortical border of the mandible decreases as it moves from the premolar to the canine region, ranging from 10.42 mm in the posterior region to 7.86 mm in the anterior region. This decrease in distance may be attributed to the downward slope of the MIC from the posterior toward the anterior region. Similar findings were reported by Kazan ZD et al. (2012)[10] and Mraiwa N et al. (2003)[5] who also observed that the MIC follows a downward course from the first premolar to the canine region. Interestingly, they noted that the canal then changes direction, extending upward from the canine to the incisor region. This anatomical pattern further supports the understanding of the variable course of the MIC across different regions of the mandible.

Current study found that the distance from the buccal part of the cortical border of the mandibular incisive canal (MIC) to the outer side of the buccal cortical plate increased from 3.19 mm in the posterior region to 4.10 mm in the anterior region. This indicates that the bone in the mandibular anterior region is thicker than in the posterior, providing better soft tissue support and reducing the risk of peri-implant soft tissue recession. Our findings align with Malusare et al. (2019)[11] who also reported that the distance between the buccal cortical plate and the MIC increases from the posterior to the anterior region, with dimensions ranging between 3.2 mm and 3.7 mm.

In course of research the distance measured from the inner side of the lingual cortical border of the incisive canal to the outer edge of the lingual border ranges from 3.78 mm (anteriorly) to 4.19 mm (posteriorly) in diameter meaning, the distance between the lingual cortical border of MIC and the lingual cortical border of the mandible is more in premolar region than in the canine region. This suggests more availability of bone lingually in the premolar region in comparison to the canine region. Also, it is known from the literature that the thickness of lingual bone increases as it approaches the midline in the incisor region. This is in accordance with the study conducted by Malusare et al. (2019)[11] and Pires et al. (2009)[9] who also found that the distance measured from the inner side of the lingual cortical border of the incisive canal to the outer edge of the lingual border decreases from the premolars to the canines.

In our analysis, the distance from the upper border of the mandibular incisive canal to the root tip ranged from 4.22 mm in the anterior (canine) region to 6.06 mm in the posterior (first premolar) region. This shows that the distance between the tooth root and the canal decreases as you move from the first premolars to the canines. Similar findings were reported by Malusare et al. (2019)[11], who also found this decrease. The shorter distance near the canines could be due to their longer roots, which bring them closer to the canal without affecting the canal's position in the mandible.

In this study, we observed that the mean length of the mandibular incisive canal (MIC) was slightly greater on the left side than on the right. Specifically, the mean length on the right was 8.92±1.77 mm, while on the left, it measured 9.06±2.08 mm, with a non-significant p-value of 0.54. Similarly, Pereira-Maciel P (2015)[6] found a longer MIC on the left side (9.84±3.82 mm) compared to the right (9.64±3.97 mm). Ayesha et al. (2020)[3] also reported that the MIC was longer on the left side. However, studies by Pires et al. (2009)[8] and Ramaswamy P et al. (2020)[9] found the opposite, with a longer MIC on the right side, though the difference was not statistically significant.

Additionally in the analysis of the mandibular incisive canal (MIC) dimensions by gender reveals that males tend to have a longer canal compared to females. This disparity may be attributed to inherent differences in bone structure between the sexes. Males typically have larger mandibles, which results in greater overall dimensions of both bone and associated structures. This finding aligns with the observations of Yi Fan et al. (2019)[12], who noted that the increased size of the male mandible contributes to the more substantial dimensions of the MIC and related anatomical features.

The use of CBCT to study the mandibular incisive canal and its anatomical landmarks has become increasingly important due to the demands of advanced dental procedures. This imaging technique improves the precision of treatment planning in dental implantology, aids in the diagnosis of pathologies, and contributes to the safety and success of surgeries in the anterior mandibular region.

CONCLUSION

The mandibular incisive canal (MIC) was visible in most patients, with detection issues in only 6 out of 100 cases, likely due to the canal's thinness. The MIC was found closer to the buccal cortical plate than the lingual in the anterior region. Its diameter decreases from posterior to anterior, and it shows a downward tilt from the premolars to the canines. The MIC was longer on the left side, though not significantly so. Males had a greater distance between the MIC and the mandible’s inferior border, while females had a larger canal diameter. The distance from the canal’s upper border to the tooth root increased from canines to premolars, indicating more bone availability in the premolar region. Given its anatomical variations and importance, careful tracing of the MIC is essential to prevent neurosensory complications in anterior mandibular surgeries.

REFRENCES

1. Roesch ZK, Tadi P. Anatomy, Head and Neck, Neck. [Updated 2023]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; Jan-2024
2. Dimitar Yovchev, Elitsa Deliverska, Jermen Indjova & Maya Zhelyazkova. Mandibular Incisive Canal: A Cone Beam Computed Tomography Study, Biotechnology & Biotechnological Equipment.2013.27:3, 3848-3851.
3. Ayesha RT, Pachipulusu B, Govindaraju P. Assessment of prevalence and position of mandibular incisive canal: A cone beam computed tomography study. Ci Ji Yi Xue Za Zhi. 2019;32(2):205-210.
4. Obradovic O, Todorovic L, Pesic V, Pejkovic B, Vitanovic V. Morphometric analysis of mandibular canal: clinical aspects. Bull Group Int Rech Sci Stomatol Odontol. 1993 Jul-Sep;36(3-4):109-13.
5. Mraiwa N, Jacobs R, Moerman P, Lambrichts I, van Steenberghe D, Quirynen M. Presence and course of the incisive canal in the human mandibular interforaminal region: two-dimensional imaging versus anatomical observations. Surg Radiol Anat. 2003 Nov-Dec;25(5-6):416-23.
6. Pereira-Maciel P, Tavares-de-Sousa E, Oliveira-Sales MA. The mandibular incisive canal and its anatomical relationships: A cone beam computed tomography study. Med Oral Patol Oral Cir Bucal. 2015 Nov 1;20(6):e723-8. doi: 10.4317/medoral.20644. PMID: 26449433; PMCID: PMC4670253.
7. Ayesha RT, Pachipulusu B, Govindaraju P. Assessment of prevalence and position of mandibular incisive canal: A cone beam computed tomography study. Ci Ji Yi Xue Za Zhi. 2019;32(2):205-210

8. Pires CA, Bissada NF, Becker JJ, Kanawati A, Landers MA. Mandibular incisive canal: cone beam computed tomography. Clin Implant Dent Relat Res. 2012 Mar;14(1):67-73
9. Ramaswamy, P.; Kiran, Ch Sai; Raju, B. Mrudula; Swathi, Myla; Sharanya, Goteti Elizabeth. Evaluation of mandibular incisive canal and its relationship to adjacent anatomical landmarks using cone-beam computed tomography. Journal of Oral and Maxillofacial Radiology 8(2):p 23-29, May–Aug 2020.
10. Kajan, Z.D., Salari, A. Presence and course of the mandibular incisive canal and presence of the anterior loop in cone beam computed tomography images of an Iranian population. *Oral Radiol.*2012 28, 55–61.
11. Malusare PC, Navalkar A, Das D, Patil B. Assessing the dimensions of mandibular incisive canal and its relationship to adjacent anatomical landmarks using cone beam computed tomography in Indian sub-population – A retrospective study. J Indian Acad Oral MedRadiol 2019;31:100-6
12. Yi Fan, Ci Ji, Yi Xue & Za Zhi. Anatomic study on mental canal and incisive nerve canal in interforaminal region in Chinese population. Surg Radiol Anat. 2019 Aug;37(6):585-9.