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Prevalance of mandibular incisive canal in CBCT: A retrospective study

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Abstract
Background: To avoid postoperative injuries in the interforaminal region, presence of the Mandibular Incisive Canal (MIC), its extension and canal positioning in relation to the cortical bone and alveolar process were investigated by cone beam computed tomography (CBCT).
Material and Methods: One hundred CBCT examinations obtained by means of the i-CAT CBCT imaging system were analyzed in multiple-plane views (axial, panoramic and cross-sectional) and three-dimensional representations were performed using iCAT CBCT software. The MIC was evaluated for its presence, measurement and proximity to the buccal and lingual plates, alveolar process and inferior border of the mandible.
Results: The MIC was visible in all (100%) CBCT images.
Conclusions: Due to the high prevalence of MIC, its variation in length and distance up to the cortical bone, suggested that preoperative radiographic evaluation of the MIC must be carried out case-by-case using CBCT, which could clearly show the three-dimensional structure and adjacent structure of the MIC.

Keywords: Prevalance, CBCT, retrospective study

Introduction

Advances over the past century have meant that surgical procedures in the lower anterior segment of the mandible including orthognathic surgeries, dental implant placement, bone grafting, and lowering genial spines procedures of edentulous patents have become more frequent [1]. This area has traditionally been considered a “surgical safe zone” because of the absence of important superficial nerves or vessels [2]. However, recent reports of unexplained bleeding and sublingual hematoma after genioplasty and endosseous implant placement have spurred research into the content and the vascularity of the area [3].

Therefore thorough knowledge of the anatomy of nerves is essential for proper anesthetic techniques and also for any surgical procedures performed on the mandible. The mandibular nerve (V3) is the largest of the three branches or divisions of the trigeminal nerve, the fifth cranial nerve (V). The lingual nerve supplies the anterior two-third of the tongue and the lingual surface of the mandibular gingiva. The inferior alveolar nerve (IAN) is the largest branch of the posterior division of the mandibular nerve and is the only one containing sensitive fibers and motor fibers. The IAN enters the mandible through the mandibular foramen and crosses the body of the mandible through the mandibular canal until it reaches the apex of the second premolar, where it is divided into two terminal branches: the mental nerve, which exits through the mental foramen, and the incisive nerve, which continues its journey to the anterior mandible [4].

The advent of computed tomography (CT) has enabled the detailed study of bony structures with accuracy that was previously only possible by examination of cadavers. Cone-beam CT (CBCT) offers three-dimensional radiographic imaging with greatly reduced doses of radiation (as compared to traditional CT) and is becoming a routine diagnostic tool in implant planning [5].

The aim of this study was to evaluate the prevalence and location of the incisive canal in CBCT scans.

Materials and Methods

60 CBCT images were retrospectively collected from TMDDC CBCT center in punjagutta, Hyderabad. All these images were made using a CS9300 3Dunit, with field of view of 17cm×13.5cm, voxel size – 90µm, X-ray pulse time of 30 ms, kVp – 60 to 90 kV (max), mA – 2 to 15 Ma, exposure time of 10.8 s. Images were reconstructed using a high spatial frequency reconstruction algorithm.

Inclusion Criteria

1. Age between 18-50years.
2. Images involving mandible

Exclusion Criteria

1. Syndrome patients & congenital deformity cases.
2. History of trauma, pathology, surgery involving mandible.
3. Distorted or blurred CBCT images.

Images were analyzed by DICOM software cross sectional, sagittal, and coronal sections were examined to ensure that the recognized structures were anatomic findings and not radiographic artifacts. The locations of the incisive foramina and their connections to the incisive canal were assessed.

Localization of the foramen

The slices from the software program were used to localize the location of the foramen on two planes.

Sagital plane

The vertical coordinates of the anatomical midline were subtracted from the vertical coordinate of the medial aspect of the anterior lingual foramen. The difference yielded the distance from the midline of the foramen. Since all scans were taken in a left-to-right manner, a positive value indicated a foramen on the right side while the negative value indicated a foramen on the left side.

Transverse plane

The horizontal coordinates of the lower border of the mandible were subtracted from the horizontal coordinate of the lower border of the anterior lingual foramen. The difference yielded the distance of the foramen in mm from the lower border of the mandible.

Number of foramina: The total number of anterior incisive foramina was observed.

Results

At least one incisive canal was observed in all subjects. Double incisive canals were seen only in 8% of cases. There is no difference in the number of incisive canal between male and female.

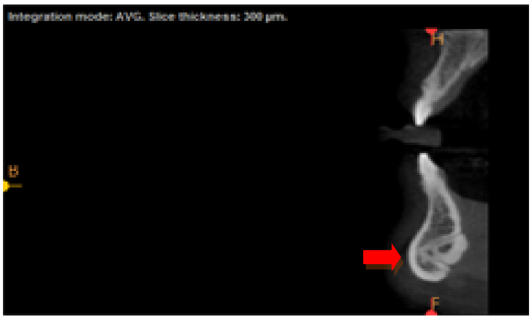

Fig 1: Red arrow showing incisive foramen

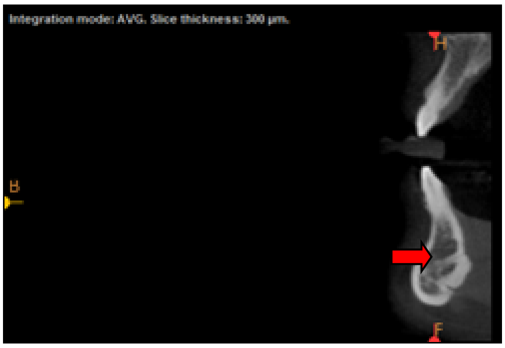

Fig 2: showing incisive canal.

Discussion

The aim of all surgical procedures is to restore or improve form and function, without causing avoidable injuries in terms of violating important anatomical structures. A thorough knowledge of the anatomy of the area involved is essential, including not only the anatomical standards but also the most common modifications.

Previous studies have investigated the mandibular incisive canal (MIC), but its existence is still widely debated, especially because it is considered an anatomical variation in this interforaminal region[6]. This concept is due to the precarious detection of MIC by conventional radiography, a diagnostic method most frequently used up until recent times [7]. Studies have reported that panoramic radiographs failed to detect the incisive canal [8]. Thus, it has been suggested that this deficiency could be attributed to the smaller diameter and corticalization of the MIC, associated with the superposition of images observed in bidimensional radiographs [9].

Recent studies have reported that the mandibular incisive nerve has been found to be present in normal and atrophic mandibles, which justifies the inclusion of scans taken of dentate and partial edentulous patients. In this study was possible to identify the incisive canal in all CBCT scans, in reformatted cross-sectional images shown as a round radiolucent area within the mandibular trabecular bone, surrounded by a radiopaque rim representing the canal walls. These results were comparable with those reported by Al-Ani *et al*. [10]

According to the reports of Al-Ani *et al.*, the MIC was visible in all (100%) CBCT images, also using the original iCAT CBCT software program.[10] Other authors have also found a high prevalence of MIC using CBCT, these with a variable visibility of 83-97.5%. In the study of Sokhn *et al*. [11], the incisive canal was identified in 97.5% of the images. Sahman *et al*. [12] reported the MIC was visible in 459 (94.4%) CBCT images.

Differences in the prevalence of this canal have been observed, when the canal is too small to be visualized on the CBCT, and when different systems have been used for obtaining tomographic images [13]. These differed in sensitivity and slice thickness, because the smaller the voxel size used, the greater will be the detail of the reconstructed image. For this study, the voxel size used was 0.25 mm, less than all other studies. Another possible reason can be attributed to the fact that the MIC becomes smaller while progressing in the mesial direction to the mental foramen, to the most anterior part of the mandible, when it may be too small to be visualized on CBCT, but in the present study, it could be identified.

In conclusion, there is a high prevalence of the MIC for all CBCT images, with significant proximity of the terminal part of the incisive canal with to the buccal plate and the alveolar process. No statistically significant difference could be determined between the right and left sides or with regard to gender. The variation in length and distance up to the cortical bone suggested that preoperative radiographic evaluation of the MIC should be carried out case-by-case, using CBCT, which could clearly show the three-dimensional structure and adjacent structure of the MIC.

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