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A Comparative Evaluation of Assess Mandibular Canal Visibility in CBCT Images

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Abstract

Background: The mandibular canal (MC) is a bilateral anatomical structure extending from the mandibular foramen to the mental foramen carrying the inferior alveolar nerve, artery and vein The present study was conducted to assess mandibular canal visibility in CBCT images.

Materials & Methods:102 subjects in age ranged 18- 40 years of age underwent CBCT imaging (i-CAT) performed with voxel size of 0.3 mm and exposure cycle of 8.5 seconds. The visibility of the MC on the cross-sectional images was assessed in one of four mandibular regions at the first premolar (PM1), second premolar (PM2),first molar (M1) and second molar (M2) sites as positive or negative.

Results: Out of 102 subjects, males were 42 and females were 60. Mandibular canal at first premolar (PM1) region was present in 40 and absent in 62, at second premolar (PM2) region was present in 52 and absent in 50, at first molar (M1) region was present in 100 and absent in 2, at second molar (M2) region was present in 102 regions, in females was present in 54 and in males in 40 patients. The difference was significant ($P< 0.05$).

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Conclusion: Mandibular canal visibility was maximum at second molar region and in males as compared to females.

Keywords: CBCT,Mandibular canal, Implant

Introduction

The mandibular canal (MC) is a bilateral anatomical structure extending from the mandibular foramen to the mental foramen carrying the inferior alveolar nerve, artery and vein. During implant placement, the contents of the MC may be at risk. The available height of the potential implant site is determined by the distance between the alveolar crest of ridge and the superior cortical bone of the MC.[1]

The interforaminal region is usually known as the safest area for dental implant surgery. Therefore, panoramic radiographs are used as the single preoperative diagnostic or radiographic tool for implant planning.[2] However, panoramic radiographs have some disadvantages: the magnification in the anterior region is small on panoramic radiographs, there are often distortions and magnifications of the anatomical structures, which result in either over- or underestimation of the real size of the anatomical structures.[3]

Several imaging modalities have been used to assess the course of the MC, including panoramic radiography, conventional tomopraphy, CT, intraoral periapical films and CBCT.[4] Panoramic radiography lacks accuracy and reliability with regards to calculations of distances made using them. Conventional tomography provides uniformly magnified images in two dimensions, usually sagittal and coronal cross-sections, but the images are of only a few teeth in the arch.[5] Blurring occurs of the areas not in focus and can make it difficult to identify structures and interpret the images. The clarity of conventional tomography has increased as a result of the increasingly complex, synchronized, poly-directional movement patterns during imaging.[6] The present study was conducted to assess mandibular canal visibility in CBCT images.

Materials & Methods

The present study was conducted among 102 subjects in age ranged 18- 40 years of age of both genders. All were informed regarding the study and their consent was obtained.

Data such as name, age, gender etc. was recorded. All subjects underwent CBCT imaging (i-CAT) performed with voxel size of 0.3 mm and exposure cycle of 8.5 seconds. Cross-sectional

images perpendicular to the occlusal plane were deidentified and reformatted using a NNT imaging software. All cross-sectional images were examined by a board-certified oral and maxillofacial radiologist. The visibility of the MC on the cross-sectional images was assessed in one of four mandibular regions at the first premolar (PM1), second premolar (PM2),first molar (M1) and second molar (M2) sites. The visibility of the MC was registered as either positive or negative. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

Results

Table I Distribution of subjects

Total- 102		
Gender	**Males**	**Females**
Number	42	60

Table I shows that out of 102 subjects, males were 42 and females were 60.

Table II Assessment of mandibular canal

Parameters	**Visibility**	**Number**	**P value**
First premolar (PM1)	Present	40	0.04
	Absent	62	
Second premolar (PM2)	Present	52	0.98
	Absent	50	
First molar (M1)	Present	100	0.001
	Absent	2	
Second molar (M2)	Present	102	0.001
	Absent	0	
Females	Present	54	0.05
Males	Absent	40	

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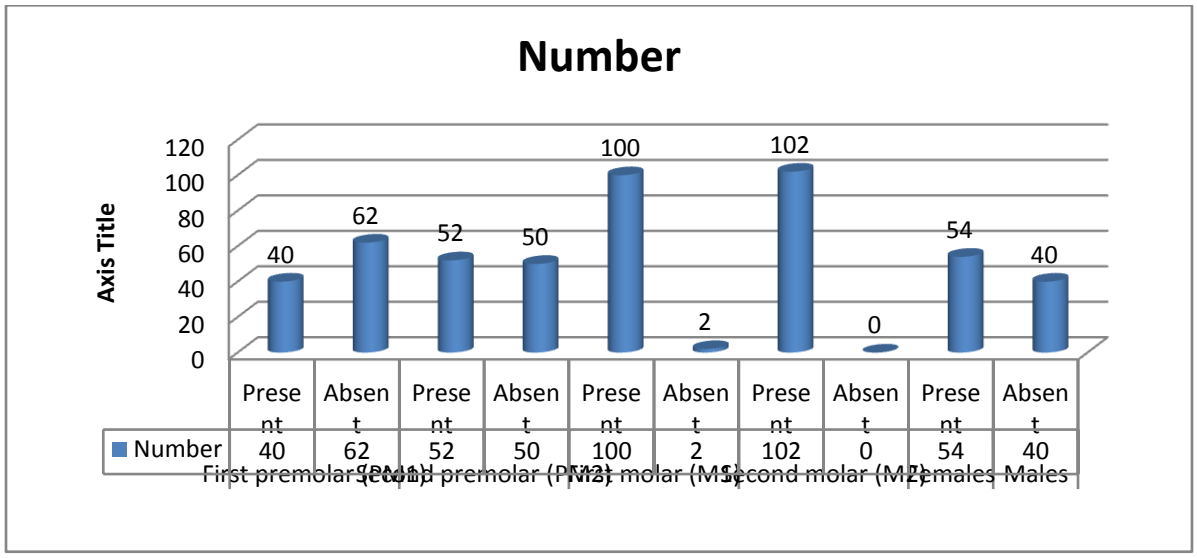
Table II, graph I shows that mandibular canal at first premolar (PM1) region was present in 40 and absent in 62, at second premolar (PM2) region was present in 52 and absent in 50, at first molar (M1) region was present in 100 and absent in 2, at second molar (M2) region was present in 102 regions, in females was present in 54 and in males in 40 patients. The difference was significant (P< 0.05).

Graph IAssessment of mandibular canal



Discussion

In the past, computer tomography (CT) with special dental software programs was used to determine the anatomical structures for dental implant planning, and it has been recognized as a useful imaging device.[7,8] Today, cone beam CT (CBCT), as a three-dimensional dental diagnostic tool, provides reliable data for correct distance measurements and can be used to obtain detailed information for three-dimensional analysis of the region of interest.[9] Currently, the use of CBCT imaging is increasing, especially in dental implant planning as a result of low cost, fast image acquisition and lower exposure dose compared to CT.[10]The present study was conducted to assess mandibular canal visibility in CBCT images.

In present study, out of 102 subjects, males were 42 and females were 60. Miles et al[11]in their study CBCT images were evaluated for the visibility of the MC by a board-certified oral and maxillofacial radiologist, a board-certified periodontist and a periodontics resident. Representative slices were examined for the first premolar (PM1), second premolar (PM2), first

molar (M1) and second molar (M2) sites by all examiners. The visibility of the MC was registered as either present or absent. 360 total CBCT cross-sectional images were examined, with the MC identified in 204 sites (56%). Age had a significant effect on MC visibility, but it differed by location: for PM1, age 47–56 had lower visibility than age 651 ($p < 0.0377$). Gender also had a significant effect on canal visibility, where females had lower visibility than males overall ($p<0.0178$) and had the most pronounced difference for PM1 ($p < 0.0054$). Location had a significant effect on visibility, but it differed by age and by gender: for age 651, M2 had lower visibility than PM1 ($p < 0.0411$) and PM2 ($p < 0.0180$), while for females, PM1 had lower visibility than M1 ($p < 0.0123$) and M2 ($p < 0.0419$).

We found that mandibular canal at first premolar (PM1) region was present in 40 and absent in 62, at second premolar (PM2) region was present in 52 and absent in 50, at first molar (M1) region was present in 100 and absent in 2, at second molar (M2) region was present in 102 regions, in females was present in 54 and in males in 40 patients. Oliveira-Santos et al[12] evaluated hemimandibles cross-sectional images taken using a similar CBCT imaging system as used in this study. The visibility of the MC was registered as either positive or negative in six regions posterior to the mental foramen by an experienced maxillofacial radiologist. The scores of the regions were then grouped together so that each hemimandible received an overall visibility score: E (easy identification of the MC—5 or 6 positive scores), D (difficult identification—3 or 4 positive scores) and VD (very difficult identification—0–2 positive scores). The authors reported that the MC was easily visible in 53% of the hemimandibles assessed. Positive identification of the MC was 65% (131/202) for dentate regions and 68% (179/262) for edentulous regions. It was also determined that the visibility of the MC at the most distal sites was greater when compared with sites near the mental foramen.

The shortcoming of the study is small sample size.

Conclusion

Authors found that mandibular canal visibility was maximum at second molar region and in males as compared to females.

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