OROMAXILLOFACIAL RADIOLOGY

OBSERVER AGREEMENT ON RADIOGRAPHIC ASSESSMENT OF MENTAL FORAMEN APPEARANCE IN PANORAMIC RADIOGRAPHS

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ABSTRACT

The aim of this study was to examine the inter-observer's variability in radiographic interpretation of variable appearances of mental foramen from panoramic radiograph. Four examiners; two dental radiologists, one oral surgeon and one dental implantologist independently evaluated 100 panoramic radiographs for appearance of the mental foramen according to Yosue and Brooks classification. The level of agreement was calculated using Kappa statistics.

The most frequent appearance of mental foramen was the continuous and separated type for both sides. Diffuse type of the foramen was identified in a few cases, almost at a similar rate of the invisible ones. Fair to moderate agreement among the four observers have been demonstrated. The agreement in the interpretation varied, ranging from 0.34 to 0.49. There was considerable variability between the four examiners. This variation in interpretation was independent of the observers experience but dependent on individual's selection of reference anatomical landmarks for identification of the mental foramen. The panoramic images may not be considered a reliable method to identify the appearance of mental foramen.

Key words: Observer agreement, panoramic radiograph, mental foramen

INTRODUCTION

Recent trend in replacement of missing teeth by dental implant and the increasing frequency of orthognatic surgery have increased the possibility of surgical procedures near the mental foramen. In this context, almost every dental implantologist uses the panoramic radiograph for presurgical evaluation prior to placement of osseointegrated implants.' With orthognathic and subapical surgery, preoperative radiographic examination considered essential in order to avoid injury to the vulnerable inferior dental nerve.' Additionally, local anesthesia of the terminal incisive branches of the inferior alveolar and mental nerves can be obtained effectively if the mental foramen is correctly identified. Thus, accurate identification of the mental foramen location and appearance is therefore important for both diagnosis and clinical procedures.'

The mental foramen is an important anatomical structure located on the lateral surface of the mandible, most often in a higher position to the mandibular canal.' It opens onto the surface in an oblique direction and represents the termination of the mental canal and the later may have a so-called anterior loop, or may form a curve during its course mesial to the mental

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foramen.⁵ The mental bundle passes through the men- sor according to manufacturer instructions. The pantal foramen and supplies sensory innervations and nutrition to the soft tissue of the chin, lower lip, and gingiva on the ipsilateral side of the mandible.⁶ The foramen may occasionally misdiagnose with a radiolucent lesion in the apical area of the mandibular premolar teeth.

Localization of the mental foramen radiographically is difficult due to lack of consistent anatomical landmarks for reference and the foramen cannot be clinically visualized or palpated.³ As a result, variable anatomical positions of the foramen have been described.⁷⁻⁹ Direct observation and measurements on dry specimens have identified the vertical position of the foramen to be generally inferior to the second premolar tooth. It lies midway between the free alveolar border and the inferior border of the mandible, often closer to the border of the mandible. The radiographic appearance of the mental foramen was classified into four types by Yosue and Brooks10 and the most frequently reported appearance was the separated type whereas the continuous and diffuse types scored almost the same. Absence of mental foramen (unidentified type) on panoramic radiograph may result most often from superimposition of teeth, trabecular pattern of bone, thinning of mandible and overall dark radiographs.

The purpose of this study was to examine the level of agreement between four dental specialists; two dental radiologists, one oral surgeon, and one dental implantologist in the determination of the appearance of mental foramen in conventional panoramic radiographs using Yosue and Brooks10 classification.

MATERIAL AND METHODS

This study was done on one hundred panoramic radiographs of dentate adult individuals and which were chosen randomly from inactive files at the college of dentistry, King Saud University. The appearance of mental foramen was determined on panoramic radiograph for both sides by four observers. The panoramic radiographs were performed with orthopantomograph 10 machine (Siemens, Germany) with exposure parameters of 57-90 KVP, 5-12 mA, and equivalent filtration of 2.5 mm Al / 80 IEC-522 using cronex intensifying screen HI plus regular speed and Kodak X-OMAT RP pan Df 75 .The films were processed using HP proces-

oramic radiographs were originally made for various dental purposes and not for the evaluation of the appearance of the mental foramen. Thus, no attempt was made to pre-select the panoramic radiograph, however, only high quality panoramic radiographs with correct positioning were included in this study.

For the purpose of interpretation, a baseline standardization session was conducted to define the reference for radiographic interpretation of the different appearances of the mental foramen. The radiographs were numbered for evaluation by the four calibrated observers; two dental radiologists (A, B), oral surgeon (C) and dental implantologist (D). They were all familiar with the classification of the mental foramen as proposed by Yosue and Brooks10° which recognized the appearance of the mental foramen as follows: a continuous type, which shows the mandibular canal through the mental canal; a separate type, in which the foramen is distinctly separated from the mandibular canal; a diffuse type, in which the foramen has an indistinct border; and finally, an unidentified type where the mental foramen can not be seen on the radiograph under ordinary exposure and viewing condition.

The 100 panoramic radiographs were evaluated by each observer individually, in a standard viewing condition in a slightly dimmed room. For each panoramic radiograph, the right and left mental foramina were observed individually and recorded on a specially designed form. The statistical Package for the Social Sciences (SPSS) was used for the analysis of Kappa statistics for multiple observers and the inter-observer agreement was calculated at 95 % of confidence interval.

RESULTS

The frequencies of different types of appearance for each observer are shown in table 1. The most common appearance was the continuous type followed by the separate type. The rate of diffuse type and the unidentified type was almost equal. The agreement between the four different specialists varied with Kappa statistics ranging from 0.34 - 0.49 (Table 2). There was no significant variation in radiographic interpretation between the right and left sides of the radiographs for the four observers. The level of agreement between the two dental radiologists was fair (0.36) for the right side

Observer	Side	Continuous	Separate	Diffuse	Unidentified
A	Right	40	43	3	14
	Left	39	49	3	9
В	Right	38	29	20	13
	Left	41	27	18	14
С	Right	48	31	16	5
	Left	49	27	17	7
D	Right	58	20	8	14
	Left	48	29	11	12

TABLE 1: FREQUENCIES OF DIFFERENT APPEARANCES OF MENTAL FORAMEN FOR BOTH SIDES OF THE 100 PANORAMIC RADIOGRAPHS OBTAINED BY THE FOUR OBSERVERS.

TABLE 2: KAPPA VALUE FOR DETECTION OF MENTAL FORAMEN FOR THE RIGHT AND LEFT SIDE ON PANORAMIC RADIOGRAPH FOR 100 SUBJECTS BY THE FOUR OBSERVERS.

	Right side						
	Observers	Α	В	С	D		
Left side	A		.364	.427	.342		
	В	.452		.437	.360		
	С	.455	.484		.391		
	D	.372	.390	.490			

and moderate for the left side (0.45). Moderate level of agreement between the oral radiologist (author) and the oral surgeon (C) was recorded as 0.42 and 0.45 for the right and left side respectively. The agreement between the oral radiologist and oral implantologist on the other hand was fair ranging from 0.34 for the right side and 0.37 for the left side. Nevertheless, the level of agreement between the oral surgeon and oral implatologist was 0.39 for the right side and 0.49 for the left side. The level of agreement between oral radiologist and oral surgeon was better than the level of agreement between both the oral surgeon and oral radiologist with oral implantologist.

DISCUSSION

The relative simplicity of taking panoramic radiograph in addition to its value for preoperative presentation favor its routine use by many surgeons and implantologists prior to placement of dental implants and before performance of any surgical procedure to the mentum. It has the advantages of displaying a greater area ofhard tissue, continuity of the visualized area and rapidity with which the view is formed.¹¹ Nevertheless, in spite of its limitation in providing sufficient information about bone morphology in two dimensions and the likely distortion and lack of sharpness, the importance of this radiographic examination is considered as an initial diagnostic aid before any surgical treatment, therefore, it has been recommended by the American Academy of Oral and Maxillofacial Radiology.¹²

Radiographic landmarks of the mental foramina are visible on most panoramic radiographs. However, the appearance of these landmarks varies without any change of radiographic condition. In this study, visualization of the mental foramen accomplished on the basis of individual subjective variable landmarks. The most frequent appearance of the mental foramen observed was the continuous and separated types followed by the diffuse and unidentified type. The former two types were identified by the four observers in nearly 50% of radiographs and the diffuse type was detected less frequently.

The mental foramen was rarely unidentifiable on panoramic radiographs, in the present study, it was

recorded in few cases as unidentified type. Errors in patients positioning or processing will affect the diagnostic quality of the panoramic radiograph. This may hinder the identification of mental foramen on panoramic radiograph.^{10°} Moreover, the apparent lack of visualization of the mental foramen can be due to the thickness of the lingual cortex that increases the overall bone mineral content enough to be invisible.

Since observer agreement is often used as a method of assessing the reliability of subjective classification or assessment procedures, 13-15 the present study evaluated the level of agreement among four observers with different dental background using conventional panoramic radiographs for the appearance of mental foramen. Results showed fair to moderate agreement among the four observers. The inconsistency between observers was the major source of inter-examiner variability, which was appeared to be independent of their experience. The selection of the different reference anatomical landmarks by the different observers during identification of the mental foramen explains the variation between all observers. In addition, the method of classification used for appearance of mental foramen in this study was based on presence of the mandibular canal, thus, inconsistency may be related to the difficulty in identifying the mandibular canal itself."

Nevertheless, the moderate agreement verified in this study among the four observers might be attributed to the standardization session conducted before radiographic interpretation. Such session provided the reliability in radiographic interpretation of the appearance of the mental foramen. In this study the separate and continuous type of mental foramen were not very difficult to identify. Nevertheless, there was considerable difficulty in differentiating between the diffuse and unidentified type, which could be the cause of the fair agreement demonstrated among the four observers. Although several studies have been reported to evaluate the appearance and location of mental foramen on panoramic radiographs, panoramic radiographs alone did not always permit accurate identification of mental foramen. This might be attributed to the subjectivity of the method and the intrinsic characteristics of the examiner, such as emotional, visual and neurological features.5,11,15

In spite of the absence of gold standard for identification and evaluation of the mental foramen in this study, one important aspect of this paper was the fair to moderate agreement level demonstrated between the four observers. However, it was not possible to state which observer interpretation was correct or to determine the diagnostic value of conventional panoramic radiograph for detection of mental foramen. Therefore, advanced imaging modalities are required for correct identification of the mental foramen.

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