Original Article

Appearance of Mandibular Para-radicular Third Molar Radiolucencies on Cone-Beam Computed Tomography

Abstract

Aims: Mandibular para-radicular third molar radiolucencies (MPRs) may be mistaken for pathological lesions, leading to misdiagnosis and mistreatment. This study sought to assess the appearance of MPRs on cone-beam computed tomography (CBCT). **Settings and Design:** This was a descriptive, cross-sectional study. **Materials and Methods:** This study evaluated 770 CBCT of patients presenting to the dental school of Hamadan University of Medical Sciences. Demographic information, unilateral or bilateral presence, shape and prevalence of MPRs observed on axial and sagittal sections, their density, thinning of cortical margin, internal trabeculation, bony expansion, and mean height and width of MPRs were all evaluated. **Statistical Analysis Used:** Data were analyzed using SPSS version 22.0 and descriptive statistics. Chi-square test was used. **Results:** Seventy (9.1%) patients had a total of 82 MPRs, including 51 (72.86%) females. The prevalence of MPRs in females was more than males ($P = 0.011$). The majority of MPRs were unilateral 58 (70.73%), mostly round in shape 48 (58.54%), and were mostly associated with third molars with distoangular impaction 47 (57.31%); this difference was statistically significant ($P < 0.001$). Furthermore, in 47 (57.32%) patients, MPRs had less density than the surrounding bone. MPRs were not associated with expansion or root resorption in any patient. **Conclusion:** Differentiation of MPRs from the pathological lesions is important to make a decision about further imaging or referral for surgical treatment. MPRs are often considered normal since they do not cause root resorption or bone expansion and do not affect the lamina dura. MPRs are more commonly found adjacent to third molars with distoangular impaction.

Keywords: *Cone-beam computed tomography, mandibular third molar, para-radicular radiolucencies*

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Introduction

Mandibular para-radicular third molar radiolucencies (MPRs) are defined as unilocular, oval, or round radiolucencies with well-defined, thin sclerotic borders. They are commonly found adjacent to the distal root of mandibular third molars. MPRs have no adverse effect on the lamina dura or the periodontal ligament (PDL) space. They are all located above the inferior alveolar canal or are superimposed over it. They are never found below the inferior alveolar canal. MPRs are often associated with impacted or semi-impacted third molars.[1,2] MPRs were first described by Bohay *et al.*,[1] in 2004, as well-defined, oval radiolucencies with a thin sclerotic border distal to the roots of mandibular third molars. They used panoramic radiography to assess MPRs.

Many pathologies may be found around impacted third molars. Dentigerous cyst is the most commonly found cyst around impacted third molars, whereas ameloblastoma is the most common tumor in this area.[3] The presence of pathologies is one indication for extraction of impacted and semi-impacted third molars. Thus, it is important to differentiate normal radiolucencies from pathological lesions.

The majority of previous studies on this topic used panoramic radiography. However, this modality provides two-dimensional views of three-dimensional structures. Furthermore, exposure geometry, object shape, and incorrect head positioning all affect the image quality. Multiple superimpositions and magnification in both the horizontal and vertical dimensions also affect correct interpretation of images. Moreover, it is not possible to accurately assess the magnitude of expansion, effect

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of lesion on the adjacent structures, or position of inferior alveolar canal relative to the lesion/defect.[4-6]

Cone-beam computed tomography (CBCT), as a three-dimensional modality, does not have many of the shortcomings of panoramic radiography. Furthermore, it has high-resolution (<1 cm) and low patient radiation dose and, therefore, is preferred to medical CT.[7,8]

Recently, a new radiographic sign (periapical or paradental radiolucent area (juxta-apical area) has been associated with paresthesia after mandibular third molar removal. This radiographic sign is a well-circumscribed radiolucent area lateral to the root rather than at the apex.[9] One study found that juxta-apical radiolucencies were separate from the mandibular canals with CBCT in most cases. Most of the mesioangular impacted mandibular third molar cases were associated with juxta-apical radiolucencies. In some cases Panoramic is not enough to know the relationship of tooth apex to the alveolar canal alone.[10] Their results are contrary to previous studies in which juxta- apical radiolucencies were suggested to be predictive of injuries to mandibular canals.[11,12]

Studies on the prevalence and characteristics of MPRs using CBCT are limited. The differential diagnosis for MPRs include some lesions/defects of the jaw such as paradental cysts, pericoronitis, Stafne defect, periapical inflammatory lesions, and pathological dental follicle. This study aimed to assess the prevalence and characteristics of MPRs using CBCT scans of patients to help differentiate MPRs from pathological lesions/defects.

Materials and Methods

This descriptive, cross-sectional study evaluated 770 CBCT of patients presenting to the Oral and Maxillofacial Radiology Department of School of Dentistry, Hamadan University of Medical Sciences. The inclusion criteria were presence of mandibular third molars on CBCT scans, no history of tooth extraction or exfoliation in this region, no systemic disease, and no history of trauma. Age and gender of patients were retrieved from the patient files.

All CBCT scans had been taken with NewTom 3G CBCT system (NewTom, Verona, Italy) with 110 kVp, 0.5 mA, and 3.6 s time and 6-inch field of view. All images were saved in NNT Viewer software (NewTom, Verona, Italy) and reconstructed in axial, coronal, and sagittal planes with 1 mm slice thickness and 1 mm interval.

Two observers, who were oral and maxillofacial radiologists, evaluated the CBCT images twice (2 weeks apart) and made the measurements. In case of disagreement, a third radiologist evaluated the images. After reaching a consensus, data were recorded in a checklist.

Before analysis, the observers were standardized using some teaching scans demonstrating what is interpreted as an MPR and to be ensure that the observers are familiar with the MPR appearance? These scans were not included in the study.

Images were observed on a computer display (Dell 23.8 inch liquid-crystal display monitor with 1920 × 1080 resolution; Dell, Round Rock, TX) in a b quiet room under dim lighting conditions. The axial, coronal, and sagittal sections were evaluated using NNT Viewer software.

MPRs were considered as well-defined unilocular radiolucencies distal to the mandibular third molar roots above the inferior alveolar canal or superimposed on it. Cases with radiolucencies in the third molar regions related to inflammatory periapical lesions, endodontic–periodontic lesions, advanced pericoronitis, paradental cysts, or follicular pathology were excluded from the study.[1,2,13]

In the axial, sagittal, and coronal planes, unilateral or bilateral presence of MPRs, their shape, position of third molar tooth and its type of impaction (distoangular, mesioangular, or vertical), radiographic density of MPRs relative to the surrounding trabecular bone, cortical margin thinning and at the location of MPRs presence of bone expansion or root resorption were all evaluated [Figures 1 and 2]. Moreover, the height and width of MPRs were measured on sagittal and axial sections using the ruler feature of NNT Viewer software. Data were analyzed using SPSS version 22 (SPSS Inc., IL, USA) via descriptive statistics. The Chi-square test was used to

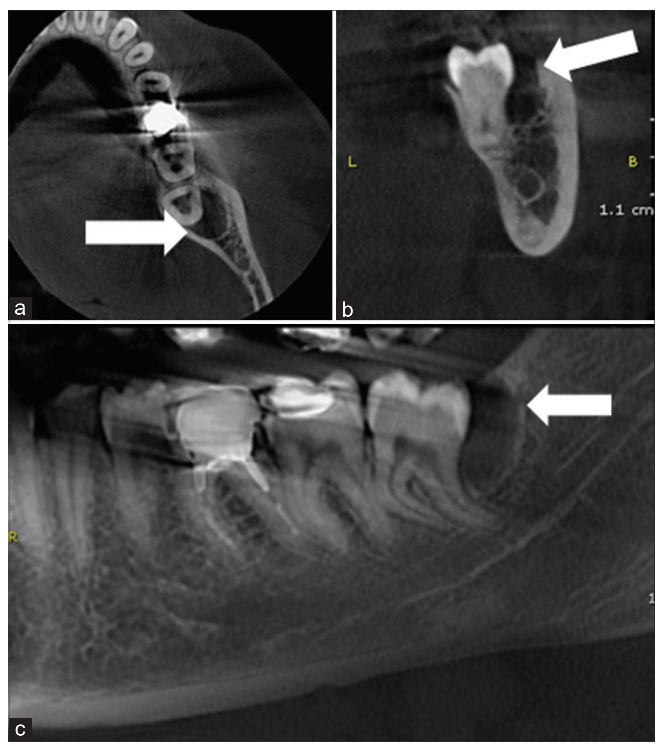

Figure 1: Axial (a), cross-sectional (b), and panoramic-like (c) cone-beam computed tomography scans show an oval homogeneous hypodense structure on distal of the third mandibular semi-erupted molar (above the inferior alveolar nerve canal). Bony expansion and root resorption were not seen

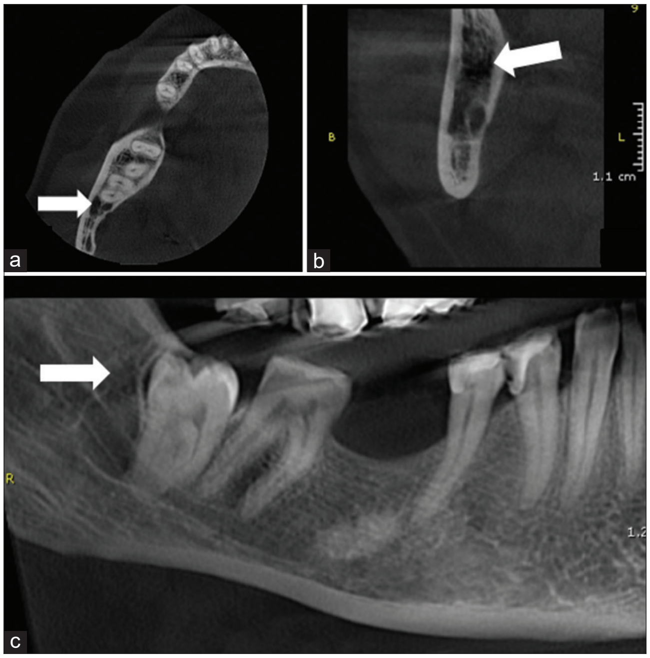

Figure 2: Axial (a), cross-sectional (b), and panoramic-like (c) cone-beam computed tomography scans show an oval homogeneous hypodense structure on distal of the third mandibular molar (above the inferior alveolar nerve canal). Bony expansion and root resorption were not seen. Thinning of the lingual plate is obvious in axial scan

assess the correlation of gender, involved side, type of third molar impaction, and shape with the prevalence of MPRs. The level of significance was set at $P = 0.05$.

Results

A total of 770 CBCT of patients were evaluated. There was no significant intraobserver difference ($P > 0.05$), and the intraobserver consistency was rated as 94.5%.

The CBCT scans belonged to 455 (59.1%) females. The mean age of patients was 35.73 ± 8.27 years (range, 22–60 years).

Seventy patients (9.1%) had a total of 82 MPRs. The frequency of MPRs according to gender, type of impaction, shape, and position is presented in Table 1.

Of 82 MPRs observed, 47 (57.32%) had a density less than that of the surrounding bone, 56 (68.3%) had caused cortical margin thinning, and 61 (74.39%) had poor internal trabeculation. No case of bone expansion or root resorption around MPRs was noted.

Dimension measurements of MPRs on sagittal and axial sections of CBCT images are presented in Table 2.

Discussion

Radiolucencies adjacent to third molars with a vital pulp do not have an endodontic origin and may be natural anatomical structures. Thus, it is important for dental clinicians to be able to differentiate MPRs from the mandibular third molar pathologies for appropriate management since patients with

Table 1. Frequency of Mandibular para-radicular third molar radiolucencies (MPRs) according to gender, type of impaction, shape and position

Characteristic	Type	Number (percentage)	*P*
Sex	Female	51 (72.86%)	*P*<0.001*
	Male	19 (27.14%)	
Type of impaction	Distoangular	47 (57.31%)	*P*<0.001*
	Mesioangular	27 (32.93%)	
	Vertical	8 (9.76%)	
Shape	Round	48 (58.54%)	0.122
	Oval	34 (41.46%)	
Position	Unilateral	58 (70.73%)	*P*<0.001*
	Bilateral	24 (29.27%)	

*Statistically significant

Table 2. Dimension measurements of Mandibular para-radicular third molar radiolucencies (MPRs) on sagittal and axial sections of CBCT images

Section	Measurements	Mean±SD (mm)	Minimum-Maximum (mm)
Sagittal	Height	5.83±2.03	2.28-8.89
	Width	4.8±1.92	2.1-8.1
Axial	Mesiodistal	4.87±1.86	3.1-6.75
	Buccolingual	2.92±1.03	1.59-5.95

SD: Standard Deviation

pathological lesions may need to be referred for further imaging or surgical procedures.[10]

In line with our findings, Bohay *et al*.[1] reported the prevalence of MPRs to be 7.8%; they were 2.6 times more frequent in females than males. Furthermore, 90.6% of MPRs were unilateral. Ahire *et al*.[13] reported that only 0.8% of third molars had para-radicular radiolucencies. Of three cases, two were females and one of them had bilateral MPRs. Dalton *et al*.[2] reported the prevalence of MPRs to be 8.4%; their frequency in females was 2 times that in males. Furthermore, 66.7% of MPRs were unilateral and 64.3% were located on the left side; 50% of MPRs were associated with third molars with distoangular impaction, whereas 42.9% were associated with third molars with mesioangular impaction and 7.1% were associated with third molars with vertical impaction. Kaur *et al*.[14] reported the prevalence of MPRs to be 3.4%. Of 16 patients, 13 were females and 3 were males. One female had bilateral MPRs. MPRs were mostly associated with the distal root of mandibular right third molar, followed by the distal root of mandibular left third molar.

In the current study, most of them were round in shape. All MPRs were detectable on axial, 50% were detectable on coronal, and 42.68% were detectable on sagittal sections. Most of them had a density less than that of the surrounding bone and caused cortical margin thinning. Bohay *et al*.[1] reported that most MPRs (58.6%) were round in shape. Dalton *et al*.[2] showed that most MPRs (71.4%) were round and the remaining were oval in shape. All MPRs were detectable on axial sections, 57.1% were detectable on coronal, and 50% were detectable on sagittal sections. In terms of density, 76.9% had a density lower than that of the adjacent bone, whereas 23.1% had a density comparable to that of the adjacent bone.[1] Dalton *et al*.[2] also reported that 78.6% of MPRs had caused cortical margin thinning, whereas 21.4% had not caused cortical margin thinning. Their results were in agreement with ours.

In our study, most of them had poor internal trabeculation. No case of bone expansion or root resorption was seen around MPRs. Similar to our findings, Dalton *et al*.[2] reported that 85.7% of MPRs had poor internal trabeculation. They observed no expansion or root resorption around MPRs either. They reported the height and width of MPRs in the sagittal plane to be 2.26–9.0 mm (mean of 5.85 mm) and 2.0–8.0 mm (mean of 4.7 mm), respectively. In the axial view, the height and width of MPRs were 3.0–6.75 mm (average of 4.97 mm) and 1.58–6.0 mm (mean of 2.82 mm), respectively.[2]

The difference between our study and that of Bohay *et al*. was that they used panoramic radiographs, which are two-dimensional, and their quality is affected by the exposure geometry, magnification in horizontal and vertical dimensions, and patient's head position; whereas, we used CBCT for assessment of MPRs. Three-dimensional imaging is the modality of choice for assessment of odontogenic cysts and other lesions in the mandible. On panoramic radiographs, the radiographic shadow of the posterior surface of third molars may be misinterpreted as MPR due to the opaque nature of tooth compared to the surrounding bone. However, MPRs can be accurately detected on CT and small field of view of CBCT.

The difference between our study and that of Dalton *et al*. was that they used CT scans for evaluation of MPRs. CT and CBCT both provide three-dimensional images with no superimposition of the third molar region. There is no difference between CT and CBCT with regard to accuracy of measurements. However, determination of density of MPRs on CT scans is more accurate than that on CBCT.

As demonstrated in our study and previous investigations, MPRs are not pathologic because they do not cause bone expansion or root resorption. It is believed that MPRs are spontaneously resolved after tooth extraction since MPRs are not seen on radiographs of patients with extracted third molars. MPRs do not usually affect the lamina dura or the PDL space, except for three cases reported by Dalton *et al*.,[2] which may be due to low resolution of panoramic radiography or head rotation.

Some oral and maxillofacial surgeons believe that MPRs may cause excessive bleeding during or after third molar extraction surgery.[2] However, there is no published study supporting this statement. Excessive bleeding may be due to osteoporotic bone marrow defects or vascular malformations. Focal osteoporotic bone marrow defects are defined as asymptomatic radiolucencies, especially at the location of mandibular molars.[15] Vascular malformations are bone-resorbing lesions that cause different grades of jaw swelling. In terms of internal structure, they have rough and curved trabeculae.[16] However, MPRs are areas with decreased bone density that can cause thinning of cortical bone but are not associated with bone swelling or other pathological symptoms. MPRs are considered in the list of differential diagnosis of inflammatory lesions, Stafne defect, and paradental cysts. Mesgarzadeh *et al*.[17] reported that the frequency of pathological changes around the impacted third molars was 53%. Such a high rate highlights the need for assessment of dental follicle tissue and prophylactic extraction of impacted third molars. In total, radiographic findings are not reliable for assessment of pathological lesions around third molars because a high percentage of such lesions have no specific radiographic manifestation. The normal size of follicular space is 2–3 mm, and since the size of MPRs is larger than that, they may be mistaken for lesions such as cysts. Dentigerous cyst is the most common cyst in this region. dentigerous cysts are mostly found in the third decade of life; whereas, according to our findings, MPRs accur at an older age. Moreover, attachment of the cyst to the cementoenamel junction of the impacted tooth on radiographs is an important finding that aids in diagnosis of dentigerous cyst, which is not the case in MPRs.[18] The absence of clinical and radiographic signs and symptoms of inflammation in MPRs can help in their differentiation from inflammatory lesions. Differentiation of MPRs from the Stafne defect is based on the fact that the Stafne defect is always located below the inferior alveolar canal, whereas MPRs are always located above the inferior alveolar canal or superimposed on it.[19] Furthermore, the Stafne defect more commonly occurs in males, with mean age of 53 years old,[20] whereas according to our study and some others, MPRs are common in females at younger ages. Moreover, the overall prevalence of the Stafne defect is much lower than that of MPRs such that the Stafne defect has a prevalence of 0%–0.5%.[21]

Kaur *et al*.[14] stated that thorough evaluation of patient history in their study revealed that some patients had a history of pericoronitis; therefore, MPRs may develop following long-term inflammation or infection at the site of impacted third molars. However, most researchers believe that MPRs are a type of anatomical variation.[16,17]

Conclusions

Dental clinicians must be acquainted with radiolucencies adjacent to mandibular third molars in order to differentiate them from the common pathological lesions in this region. By doing so, unnecessary surgical procedures can be avoided. MPRs are often considered normal since they do not cause root resorption or bone expansion and do not affect the lamina dura. MPRs are more commonly found adjacent to third molars with distoangular impaction.

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Conflicts of interest

There are no conflicts of interest.

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