Juxta-apical radiolucency: relation to the mandibular canal and cortical plates based on cone beam CT imaging

Eduarda Helena Leandro Nascimento, DDS,[a] Anne Caroline Costa Oenning, DDS, MS, PhD,[a] Mariana Rocha Nadaes, DDS, MS,[a] Gláucia Maria Bovi Ambrosano, MS, PhD,[b] Francisco Haiter-Neto, DDS, MS, PhD,[a] and Deborah Queiroz Freitas, DDS, MS, PhD[a]

Objective. To evaluate the relation of juxta-apical radiolucency (JAR) to the mandibular canal and cortical plates on cone beam computed tomography images, as well as to assess whether the presence of JAR is related to the position of the mandibular canal.

Study Design. Forty-seven JAR cases were evaluated by cone beam computed tomography. JAR position and its relationship to the mandibular canal and cortical plates were investigated. The position of the mandibular canal was recorded and compared with a control group. Descriptive analyses and χ^2 tests were performed.

Results. A significant association was established between JAR and the position of the mandibular canal ($P = .0193$), which was positioned lingually in 59.6% of JAR cases. In most cases, JAR was located distal to the tooth (66%) and in contact with the mandibular canal, either with (53.2%) or without (40.4%) preservation of the cortical border of the canal. In 22 cases (46.8%), thinning of cortical plates was observed, but no statistical differences were found between buccal and lingual sides ($P = .5728$).

Conclusions. The mandibular canal is located lingually in the third molar region in most JAR cases. JAR is located distal to the tooth and is generally in contact with the mandibular canal. These relations may increase the risk of nerve injury during surgical removal of third molars. (Oral Surg Oral Med Oral Pathol Oral Radiol 2017;123:401-407)

Proper planning in third molar surgery is one of the keys to preventing transsurgical and postsurgical complications such as dry socket, pain, infection, and, especially, nerve damage.[1-3] Therefore, imaging examination is essential for allowing the noninvasive presurgical visualization of important anatomic landmarks.

Preoperative assessment of mandibular third molars should consider morphology, angulation, and relationship to adjacent structures (mandibular canal and cortical plates).[4-8] Although the panoramic radiograph is the most widely used imaging modality for this purpose, 2-dimensional images can only show the superior–inferior and mesiodistal relationships between the mandibular canal and the third molars; the buccolingual relationship cannot be assessed.[4,6] Thus, when a panoramic radiograph suggests an intimate relationship between the roots of a third molar and the mandibular canal, cone beam computed tomography (CBCT) is a very reasonable choice for further evaluation.[2,9]

Classic radiographic signs suggestive of surgical risk of damage to the inferior alveolar nerve (IAN) are well established in the literature and include darkening of the roots, diversion of the canal, and interruption of the lamina dura.[6,10,11] The juxta-apical radiolucency (JAR), a recently described and still little-studied radiographic sign, has also been pointed out as an important predictor of IAN damage during third molar surgery.[1] The JAR appears as a hypodense area adjacent (*juxta*, meaning near, nearby, or close) to the apices and roots of mandibular third molars and has been considered a variation of the normal aspect of the trabecular bone in this region.[12] Nevertheless, a study using CBCT images to assess the JAR and mandibular canal reported that there is no definitive intimate relationship between these structures, supporting the idea that more research is still needed to clarify this issue.[13] Moreover, there is evidence that JAR is related to thinning of the cortical plates, which

Statement of Clinical Relevance

Juxta-apical radiolucency is frequently in close relationship with the mandibular canal, and its presence is related to risk factors for inferior alveolar nerve injury. Therefore, knowing its characteristics is fundamental for patient care during third molar surgery.

Supported by Coordination for the improvement of Higher Education Personnel (CAPES) and the Department of Oral Diagnosis, Piracicaba Dental School, University of Campinas. The authors deny any conflicts of interest related to this study.

[a]Department of Oral Diagnosis, Division of Oral Radiology, Piracicaba Dental School, University of Campinas (UNICAMP), Piracicaba, Sao Paulo, Brazil.

[b]Department of Community Dentistry, Piracicaba Dental School, University of Campinas (UNICAMP), São Paulo, Brazil.

Received for publication Aug 26, 2016; returned for revision Nov 7, 2016; accepted for publication Dec 3, 2016.

2212-4403/$ - see front matter

http://dx.doi.org/10.1016/j.oooo.2016.12.001

may be one of the factors leading to an increased incidence of IAN injuries.[14,15]

The position of the mandibular canal is one determinant of surgery-related nerve damage,[6,16,17] but thinning of cortical plates still needs further investigation.[13] To the best of our knowledge, an analysis of the influence of JAR on the mandibular canal trajectory and of JAR position on cortical plate thinning has not been conducted. Furthermore, the relationship between JAR and the mandibular canal needs to be elucidated because integrity of the mandibular canal cortices is critical to preservation of the neurovascular bundle,[18] and JAR may pose a challenge to this cortical preservation.

The purpose of this study was to investigate, through CBCT images, the anatomic relationship of JAR with the mandibular canal and cortical plates of the mandible. We also aimed to assess whether the presence of JAR would influence the position of the mandibular canal.

METHODS AND MATERIALS

The present study was approved by the local institutional research ethics committee (protocol # 074/2015).

From an initial sample of 252 patients who had both panoramic radiography and CBCT performed preoperatively for removal of mandibular third molars, 40 of them had JAR and composed the final sample (JAR prevalence of 15.9% in the study population). They were selected for this study after identification of JAR in the panoramic images. JAR was considered as a well-defined radiolucency located in the juxta-apical region of mandibular third molars, regardless of size (Figure 1). Thus, 2 groups were formed: the JAR group, comprising 47 cases of JAR observed in the 40 patients (10 males and 30 females, mean age 22.4 years), and the control group, comprising the same total number of patients (12 males and 28 females, mean age 24.8 years) and third molars (47) randomly selected from the initial sampling. Teeth were included independent of their angulation; however, teeth with radiographic evidence of carious lesions, large restorations, or endodontic treatment, or that were associated with intraosseous lesions, were excluded from the study.

Images were obtained using a Picasso Trio CBCT unit (Vatech, Hwaseong, South Korea). The acquisition parameters (kVp, mA, and field of view) were selected according to each patient's treatment needs, but the field of view included the mandibular third molar and surrounding tissues. Moreover, only examinations acquired with a 0.2-voxel size were used to avoid spatial resolution variations. All images were evaluated independently by 2 experienced oral radiologists (E.H.L.N., M.R.N.) on a 23.8-inch LCD monitor with a

Fig. 1. Cropped panoramic radiograph shows a juxta-apical radiolucency image (arrow), which appears as a well-circumscribed radiolucent area located laterally to the roots and continuously with the root apex of the third molar on the right side.

spatial resolution of 1920 × 1080 pixels (Dell, Round Rock, TX) under dim lighting conditions. Examiners were allowed to use conventional image adjustment tools (zoom, gamma curve, brightness, and contrast). In cases of disagreement, the images were re-evaluated by the examiners together, and they discussed their findings until consensus could be reached.

CBCT images were analyzed with the Ez3D Plus Software (E-WOO Technology Giheung-gu, South Korea). Oblique multiplanar reconstructions (axial, coronal, and sagittal) for each selected volume, adjusted to the long axis of the third molar, were assessed using the following parameters:

1. JAR position in relation to the roots of the third molar (buccal, lingual, apical, between the dental roots, mesial, or distal). If the JAR extended to more than one region adjacent to the tooth, it was recorded in the region in which it was predominantly located.
2. Relationship between the JAR and the mandibular canal: (1) distant, (2) contact with preservation of the cortical border, and (3) contact without preservation of the cortical border (Figure 2).
3. Thinning of buccal and lingual cortical plates in the JAR region, according to the methodology proposed by Kapila et al.[13] Briefly, the narrowest point of the