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ORIGINAL ARTICLE

Anatomical and radiographic study of the mandibular retromolar canal

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Abstract *Background/purpose:* As the demand for surgical procedure in the retromolar area of the mandible has been increasing, the identification of the retromolar foramen (RMF) and canal involving the retromolar triangle (RMT) has become an issue of clinical concern. We examined the shape of the RMT, incidence of the RMF, and intraosseous trajectory of the retromolar canal (RMC).
Materials and methods: A total of 118 sides of dry mandibles, 22 sides of mandibles of 13 cadavers, and cone-beam computed tomography (CT) images of 100 patients were examined. Micro-CT data of 13 cadavers were reconstructed using imaging analysis software for the presence of an RMC. RMCs were classified into three types according to the courses. The width and location of the RMCs were evaluated.
Results: The shape of the RMT was classified into three categories, with the most common type being the triangular type (81.4%). Forty-seven retromolar foramina (33.6%) were observed in 140 sides of mandibles. The horizontal distances from the RMF to the second and third molars were 12.1 ± 3.3 mm and 5.8 ± 3.6 mm (mean $\pm$ standard deviation), respectively, and the distance from the mandibular foramen to the arising point of the RMC and the vertical distance from the RMF to the mandibular canal were 21.5 ± 11.2 mm and 15.3 ± 4.6 mm, respectively.
Conclusion: This study used various methods to obtain precise anatomical data on the RMT,

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foramen, and canal in Koreans. The reported findings may be helpful for the clinical management of patients.

Introduction

The retromolar triangle (RMT) is a depressed area formed by the bifurcation of the mandibular temporal crest and the posterior edge of the last mandibular molar. The gross anatomy of the RMT, which is an area of great importance in dental practice, varies greatly according to the presence of the mandibular third molar and alveolar bone resorption.[1] The retromolar canal (RMC) normally arises from the mandibular canal behind the third molar, and travels anterosuperiorly to the retromolar foramen (RMF), which is located within or around the RMT.[2] Several studies on the RMC and RMF have reported considerable diversity with a frequency from 1.7% to 72% depending on the study design and the race of the participants.[3–5] However, the precise location of these structures relative to each other does not appear to have been determined.

Knowledge of the location of the RMC and of its anatomical variations can facilitate surgical intervention and protect the patient from the potential complications thereof. The RMT is relevant to surgical procedures, such as extraction of an impacted third molar, dental implant treatment, bone harvesting as a donor site for bone graft surgery, and sagittal split ramus osteotomy.[6] Moreover, the content of the RMC is an issue of clinical concern in surgical procedures involving the RMT. The neurovascular content of the RMC has been evaluated in cadavers[5,7] and in clinical biopsy specimens.[8–11] According to these reports, the neurovascular bundle within the RMC contains predominantly thin nerve fascicles of myelinated nerve fibers branching from the inferior alveolar nerve, small arteries, and numerous venules accompanying those arteries. Therefore, damage to the RMC contents could lead to unexpected bleeding and iatrogenic nerve damage, potentially resulting in paresthesia.

In clinical practice, anatomical variations, such as supplemental or accessory canals and foramina, can only be detected by radiologic methods. However, conventional two-dimensional (2D) radiographs such as panoramic images are insufficient for detecting all anatomical structures, and in particular the presence of an RMC.[12] Sectional imaging, such as computed tomography (CT) and cone-beam CT (CBCT), has been used successfully in dentistry,[13] and CBCT systems are available for routine investigation in dental clinics. However, studies that have evaluated the location of the RMCs using CBCT images have found incidences ranging from 14.6% to 47.4%, with no agreement between the various reports.[6,12,14,15] Kawai et al[6] investigated the occurrence of the RMC in Japanese cadaver mandibles using CBCT images prior to dissection and macroscopic observation, and reported that the subsequent cadaver dissection revealed some RMCs that had not been identified in the CBCT images. Therefore, a more precise description of the anatomy of the RMC requires a high-resolution imaging modality and no movement of objects during imaging. Over the past few years, micro-CT systems have been used for the evaluation of the bony canal morphology because of their high resolution.[16] The system can also be used to assess the characteristics of the RMC/RMF both qualitatively and quantitatively.

The present study (1) carried out an anatomical and morphometric analysis of the RMT/RMF, (2) investigated the incidence of the RMF in Korean cadaver mandibles, (3) described the microanatomy of the RMC using three-dimensional (3D) reconstruction of micro-CT images, and (4) evaluated how frequently the RMC is visible on CBCT images.

Materials and methods

A total of 118 sides of dry, adult Korean mandibles from 59 cadavers (i.e., 59 right sides and 59 left sides) of unspecified sex and age were obtained from the Department of Anatomy of Pusan National University (Yangsan, Korea). The single inclusion criterion was that the first permanent molars or their identifiable socket needed to be present on each mandible bilaterally. Twenty-two sides of mandibles from 13 embalmed Korean adult cadavers (11 males and 2 females, with a mean age at death of 65.3 years) were also evaluated.

The RMT was identified and demarcated on 140 mandible sides. The boundaries of the RMT were defined by the bifurcation of the mandibular temporal crest and the posterior edge of the last mandibular molar. The maximum height and width (sagittal and transverse distances) were measured using a digital caliper with a sensitivity of 0.01 mm (Model CD-15CP; Mitutoyo, Kawasaki, Japan). All measurements were made by the same person in triplicate, and the mean values of these three measurements are reported. The RMTs were classified into three categories based on their shape, according to the classification of Suazo et al.[17]

The RMF was identified macroscopically; its diameter was determined using round stainless-steel orthodontic wires with a diameter of 0.5 mm. The wires should enter the RMF without excessive force and exhibit minimal play. Any foramina having a diameter of less than 0.5 mm were not considered as the RMF.

Micro-CT images and 3D reconstruction

Twenty-two sides of mandible from 13 cadavers were scanned using a micro-CT system (SkyScan 1076 in-vivo X-ray microtomograph; SkyScan, Kontich, Belgium) with a