# Anatomic Study of Mandibular Posterior Teeth Using Cone-beam Computed Tomography for Endodontic Surgery

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## Abstract

**Introduction:** The present study aimed to anatomically assess mandibular posterior teeth using cone-beam computed tomographic (CBCT) imaging for endodontic surgery. **Methods:** A total of 170 CBCT scans were evaluated for anatomic variations of mandibular posterior teeth. All the scans were obtained using a Planmeca Promax CBCT unit (Planmeca, Helsinki, Finland) with exposure settings of 90 kVp, 12 mA, 12 seconds, and 0.3-mm resolution. All CBCT images were reconstructed by Romexis Viewer 3.8.2. software (Planmeca) on a 16-inch LCD monitor (22MP47HQ; LG, Seoul, South Korea), and axial, coronal and sagittal views were evaluated. **Results:** The thickest buccal cortical plate was observed over the distal root of second molars (12.30 mm) among the molar teeth and over the second premolar root (5.41 mm) among the premolar teeth. The thinnest buccal cortical plate was observed over both the first and second premolar roots (0.42 mm) and over the mesial root of the first molar (0.62 mm) tooth. A 20.38-mm section was removed for surgical access during buccal resection of the distal root of the left second molar, and the closest distance from the apex to the inferior alveolar canal was 0 mm. **Conclusions:** Adequate knowledge of the anatomic dimensions of teeth and their surrounding structures is imperative for endodontic surgery. Information concerning the root thickness of mandibular posterior teeth at the site of root resection (apical 3 mm), buccal cortical plate thickness, and the distance from the apex of each tooth to the inferior alveolar canal and mental foramen can guide the surgeon before and during surgery. *(J Endod 2018;■:1–6)*

## Key Words

Cone-beam computed tomography, mandible, molar, premolar

### Significance

It is imperative that the endodontic surgeon be knowledgeable of the anatomic dimensions of the surgical site. An understanding of the anatomic dimensions of the surgical site will help the surgeon before and during the surgical procedure.

In the past decade, the art and science of endodontic surgery have improved considerably. Endodontic surgery was generally limited in the past to anterior teeth because of easier access. With the introduction of surgical microscopes and new root-end filling materials, teeth that were set to be extracted now have a chance of survival (1).

Contemporary periapical microsurgical techniques have advantages compared with older techniques that use rotary instruments and do not involve the use of visual aids. These advantages include smaller access preparation requiring less bone removal to create a surgical window and a more ideal cutting angle relative to the longitudinal axis of the tooth (2). For this purpose, adequate information on the anatomy and dimensions of teeth, buccal and lingual cortical bone thickness, root dimensions (diameter and shape), and proximity to important anatomic landmarks such as the nerves and vasculature is critical for adequate treatment planning and efficient osteotomy and resection of the root end via endodontic surgery (3).

The exact location of the inferior alveolar canal needs to be determined before dental procedures, such as sagittal osteotomy, dental implant placement, third molar extraction surgery, endodontic treatment, and periapical surgery. The relationship of the inferior alveolar canal and the posterior root apices is important for endodontic treatment and apical surgery (4–6).

Apical surgery of the mandibular molars is technically difficult because of the posterior location of the teeth, which makes access challenging; the notable thickness of the buccal cortical plate; and the proximity to the inferior alveolar canal (7). The buccal bone at the site of the second and third molars is the thickest, further complicating and limiting surgical access to this region, along with the lingual inclination of molar roots (8).

Several studies have been conducted on this topic in different ethnic populations. In 1992, Eberhardt and Torabinejad (9) evaluated the relationship of the apices of maxillary posterior teeth and the maxillary sinus using computed tomographic (CT) scans. Jin et al (10) measured the distance from the mesiobuccal and distobuccal roots of maxillary second molars to the buccal bone plate and the thickness of the palatal bone plate in the apical region of individuals in a Chinese population.

Some studies have also evaluated the distance between the inferior alveolar canal and the mental foramen and the apex of mandibular molars. Martí al (11) evaluated the

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12-month prognosis of mandibular molars after apical surgery and reported that patients with a 2-mm distance from the apical lesion to the mandibular canal on panoramic radiographs experienced a higher level of postoperative pain and had a failure rate of 19.4%. A retrospective study reported that lower lip paresthesia was present in 20%–21% of patients after apical surgery of mandibular molars (12). Additionally, there are several case reports on sensory disorders (paresthesia or anesthesia) of the lower lip, gingiva, and mental foramen immediately after root canal treatment (13–15).

Radiography is often used as part of surgical treatment planning. Periapical radiography provides information about periapical lesions and root anatomy and the adjacent anatomic structures, but because of their 2-dimensional nature and superimposition of structures, such radiographs provide a limited view of anatomic landmarks (16). Cone-beam computed tomographic (CBCT) imaging provides 3-dimensional (3D) images of the maxillofacial bones with a low radiation dose compared with conventional CT imaging. Moreover, by providing 3D views and eliminating distortion and superimposition, CBCT imaging provides more accurate information than 2-dimensional images. Thus, it is currently the best presurgical imaging technique for the assessment of hard tissue dentofacial structures (17). A review of the existing literature revealed a single study that comprehensively evaluated the anatomy of teeth for endodontic surgery (3). In the aforementioned study, all measurements required for endodontic surgery of the maxillary posterior teeth were performed, consisting of root dimensions, buccal and palatal bone plate thickness, and the distance from the root apex to the adjacent anatomic structures.

Because there are no current studies assessing mandibular anatomy using CBCT imaging for purposes of endodontic surgery, this investigation analyzed mandibular teeth. This analysis includes the measurement of the root thickness of mandibular premolars and molars in both mesiodistal and buccolingual dimensions, buccal and lingual bone thickness covering the mandibular premolar and molar roots, the distance between the apices of posterior teeth and the inferior alveolar canal, and the distance between the apices of premolar teeth and the mental foramen for endodontic surgery using CBCT imaging.

## Materials and Methods

A total of 170 CBCT scans were used to evaluate anatomic variations in mandibular posterior teeth. The scans had been provided for different dental purposes in the northwest of Iran, including dental implant treatment. All of the CBCT scans were obtained with a Promax 3D CBCT imaging unit (Planmeca, Helsinki, Finland) with exposure settings of 90 kVp, 12 mA, 12 seconds, and 0.3-mm resolution. The Ethics Committee of Urmia University of Medical Sciences, Urmia, Iran, approved the protocol of the study under the code ir.umsu.rec.1395.374. CBCT scans showing the absence of more than 2 mandibular posterior teeth at each side (except for third molars); periodontal disease; significant bone loss; molar teeth with C-shaped canals; fused roots; and root resorption of mandibular teeth, primary teeth, or open-apex permanent teeth were excluded. The sex and date of birth of the patients were also recorded.

Two observers evaluated the images. Intraobserver and interobserver reliability was assessed by calculating the intraclass correlation coefficient. To standardize the images, the 2 observers were calibrated by evaluating 10% of the CBCT scans at the beginning of the study. All of the CBCT scans were reconstructed using Romexis Viewer software version 3.8.2 (Planmeca). The reconstructed axial, coronal, and sagittal sections were observed on a 16-inch LCD monitor (22MP47HQ; LG, Seoul, South Korea).

Each observer evaluated 170 CBCT scans. To prevent eye strain, more than 3 scans were not consecutively evaluated, and breaks were scheduled after the assessment of 3 scans. The observers could magnify the images or use enhancement filters to change the density, contrast, or brightness of the images.

All teeth were evaluated in 3 planes to assess the root thickness in buccolingual and mesiodistal dimensions and the thickness of the buccal and lingual bone plates; first, in the sagittal plane, the longitudinal axis of the tooth was positioned parallel to the coronal plane such that it was perpendicular to the axial plane. Next, a line was drawn from the tooth apex along the longitudinal axis of the tooth with a 3-mm length (Fig. 1). Next, in the axial plane, the buccolingual and mesiodistal dimensions and the thicknesses of the buccal and lingual bone plates were measured (Fig. 2). In measurement of the buccolingual and mesiodistal dimensions, the largest size in the axial plane was recorded. When measuring the buccal and lingual bone plate thickness, the horizontal distance from the root surface to the external surface of the buccal and lingual bone plates was measured. In multirooted teeth, these measurements were separately obtained for each root.

To measure the distance from the root apex to the inferior alveolar canal, first, the panoramic line was adjusted on the respective tooth in the axial plane; next, the distance from the apex to the most superior cortical wall of the inferior alveolar canal was measured in the mesiodistal section obtained from sections perpendicular to the panoramic line (18) (Fig. 3).

To determine the distance from the apex to the mental foramen, the closest tooth to the mental foramen was considered. First, in the axial plane, a section was made at the level of bone where the mental foramen was visible. The points were localized in the coronal plane, and the distance from the apex of the closest tooth to the mental foramen was measured (19) (Fig. 4). The amount of bone and root removed for complete surgical resection in apicoectomy was also

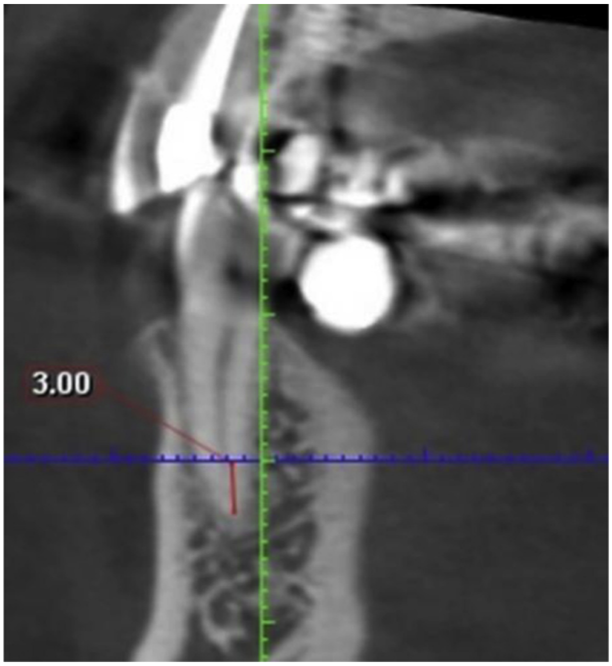


**Figure 1.** The sagittal plane. The longitudinal axis of the tooth was positioned parallel to the green coronal line such that it was perpendicular to the blue axial plane. The thickness of the apical 3 mm of the root was measured along the vertical axis of the tooth.