Morphological Characteristics and Classification of Mandibular First Molars Having 2 Distal Roots or Canals: 3-Dimensional Biometric Analysis Using Cone-beam Computed Tomography in a Korean Population

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Abstract

Introduction: The aim of this study was to determine the morphologic characteristics of mandibular first molars having 2 canals in distal roots. Interorifice distance, buccal bone thickness, and root curvature were evaluated using cone-beam computed tomography images in a Korean population. **Methods:** In total, 1958 mandibular first molars were evaluated in axial, coronal, sagittal, and paraxial planes. Distal roots having 2 canals were classified according to their root and canal shapes (2 roots, 2 canals [2R2C]; 1 root, 2 canals with 2 apical foramina [1R2C(2-2)]; and 1 root, 2 canals with 1 apical foramen [1R2C(2-1)]). The distances between orifices and the distance from the apex to the buccal bone plate were measured for each root canal shape (2R2C, 1R2C[2-2], and 1R2C[2-1]). The curvature of distolingual (DL) roots was classified according to severity using 3-dimensional reconstructed images, and the direction of curvature was determined. The relationships of these characteristics to sex and side were evaluated. **Results:** The prevalences of 2R2C, 1R2C(2-2), and 1R2C(2-1) were 25.89%, 10.32%, and 14.15%, respectively. The distances between distobuccal (DB) and DL orifices were 3.77 ± 0.74 mm for 2R2C, 3.02 ± 0.65 mm for 1R2C(2-2), and 2.44 ± 0.64 mm for 1R2C(2-1). The distances from the buccal plate to the DB canal were 3.84 ± 1.35 mm for 2R2C, 5.33 ± 1.41 mm for 1R2C(2-2), and 5.96 ± 1.63 mm for 1R2C(2-1). The distance from the buccal plate to the DL canal was 9.85 ± 1.46 mm for 2R2C, and 8.28 ± 1.50 mm for 1R2C(2-2). All distances differed significantly according to root canal configurations, and all were greater in men than women ($P < .05$), except for the DB-DL orifice distance in 1R2C(2-2) and the DB to buccal cortical plate distance in all root configurations ($P > .05$). No significant difference between the left and right sides was found ($P > .05$). The prevalence of most severely curved DL roots (type III) was 62.92%, and the direction was commonly toward the buccal side (69.03%). **Conclusions:** The prevalence of mandibular first molars having 2 canals in distal roots was more than 50% in a Korean population. Interorifice distances between DB and DL canals and distances from the apex to the buccal cortical plate differed according to root and canal numbers and shapes. *(J Endod 2017;■:1–5)*

Key Words

Buccal bone thickness, cone-beam computed tomography, distolingual root, interorifice distance, Korean, mandibular first molar, root curvature

Significance

The interorifice distance and buccal bone thickness of mandibular first molars differed according to root and canal numbers and shapes. Prior knowledge of those morphologic characteristics is essential for preoperative treatment planning and prevention of possible complications during endodontic procedures.

Prior knowledge of anatomic variations in root canal systems is essential for improving the success rate of root canal treatment. Mandibular first molars are known to typically have 2 roots located mesiodistally and 3 root canals (1–3). However, an extra distolingual (DL) root or a DL canal has been found in mandibular first molars in several populations, and their prevalence varies significantly by race (4–10). Higher prevalences of extra DL roots have been reported in American Indian, Chinese, and Eskimo (5.8–32%) populations (9, 10) than in white populations (0.7–4.2%) (7, 8). Other research found a higher prevalence of an extra DL canal in Korean and Chinese (40.5–51.4%) (11, 12) than in white populations (8.1%) (13). Although some studies have evaluated the prevalence of DL roots or DL canals (2, 3, 14), few have provided biometric measurements and morphologic characteristics related to root curvature. Prediction of canal location at the orifice level could provide guidance for locating canal orifices during nonsurgical root canal treatment. Knowledge of root proximity to the buccal bone is

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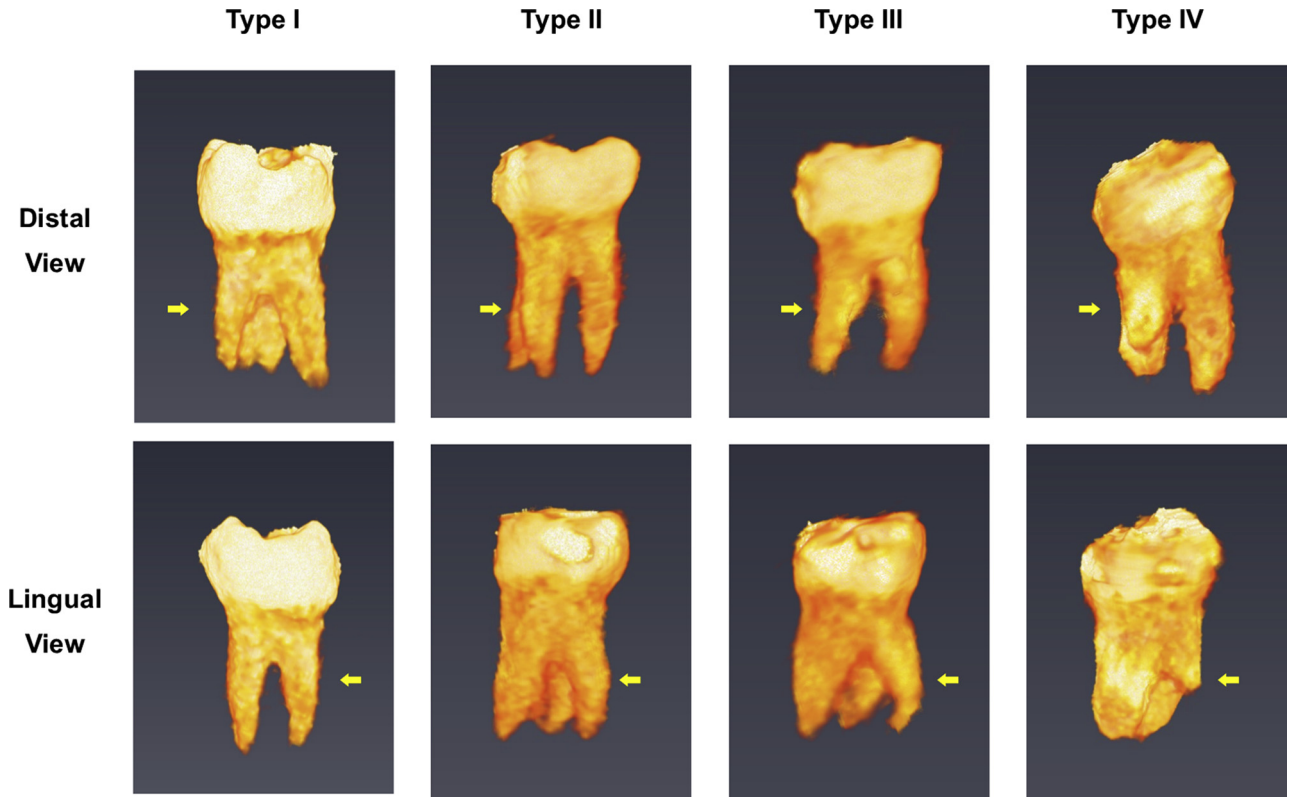

Figure 1. Three-dimensionally reconstructed images of 4 types of root curvature (distal and lingual views). Type I, straight root; type II, curvature in the coronal third and straight continuation to the apex; type III, initial curve in the coronal third of the root canal and a second curve starting from the middle third; type IV, small, with length less than half the length of the distobuccal root.

helpful for locating apices during surgical endodontic treatment. The curvature of the DL root also can be a challenge for clinicians, especially when they curve toward the buccal side, as this cannot be seen in 2-dimensional (2D) periapical radiographs. However, little information is available regarding morphologic characteristics, such as the length and direction of DL root curvature beyond the prevalence of DL roots or canals (14). Numerous studies have suggested the usefulness of cone-beam computed tomography (CBCT) analyses for determining root canal anatomy. The advantages of using CBCT in studying root canal morphology are the 3D images and a reasonable radiation dose (2, 15). The prevalence and morphologic diversity of DL roots appeared to be underestimated in previous studies using extracted teeth because of the possibility of root fracture during extraction (14, 16). The aim of this study was to determine the morphologic characteristics of mandibular first molars with 2 canals in distal roots. Interorifice distance, buccal bone thickness, and root curvature were evaluated using CBCT images in a Korean population.

Materials and Methods

Subjects

This study was approved by the Ethics Committee of the Ewha Womans University Hospital. CBCT images of mandibular first molars taken between January 2011 and October 2012 were evaluated. The criteria for CBCT included insufficient information from intraoral and panoramic radiographs and the need for more radiographic details for adequate diagnosis and treatment planning. Most CBCT images were taken for implant surgery, extraction of impacted teeth, or orthodontic treatment. This retrospective analysis of CBCT images required no additional radiation exposure for patients, so the principle of radiation dosage as low as reasonably achievable (ALARA) was followed. CBCT images of 979 subjects who met the following inclusion criteria were evaluated:

1. Ethnic Korean patients aged between 13 and 75 years
2. Scans containing the fully erupted mandibular first permanent molars bilaterally

TABLE 1. Prevalence of 2 Distal Roots or Canals in Mandibular First Molars

	Left				Right					
Root canal shape	Female	Male	Subtotal		Female	Male	Subtotal		Total	
2R2C	108	114	222	22.52%	146	139	285	28.90%	507	25.89%
1R2C (2-2)	61	46	107	10.85%	52	43	95	9.63%	202	10.32%
1R2C (2-1)	95	72	167	16.94%	62	48	110	11.16%	277	14.15%

2R2C, 2 roots, 2 canals; 1R2C(2-2), 1 root, 2 canals with 2 apical foramina; 1R2C(2-1), 1 root, 2 canals with 1 apical foramen.