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Cross-sectional Morphology and Minimum Canal Wall Widths in C-shaped Roots of Mandibular Molars

Wen Lin Chai, BDS, FDSRCS, and Yo Len Thong, BDS, MSc

The cross-sectional canal morphology and minimum widths of buccal and lingual canal walls were studied in 20 mandibular molars with C-shaped roots and canal orifices. The roots were mounted in clear resin blocks and sectioned transversely at 1-mm intervals. A total of 154 cross-sections were evaluated with an image analyzer. Twelve different longitudinal canal configurations were identified. The most prevalent were types 1-2 and 1-2-1 with each type occurring in four roots. Evaluation of the cross-sectional morphology showed that the configurations were complete "C" (27%), incomplete C (64%), and non-C (9%). The mean value for the minimum width of the lingual canal wall was 0.58 ± 0.21 mm and the buccal wall was 0.96 ± 0.26 mm. This suggests that there is a higher risk of root perforation at the thinner lingual walls of C-shaped canals during shaping and post canal preparation procedures. Both buccal and lingual canal walls were frequently narrower at mesial locations.

A thorough knowledge of the anatomy of root canal systems is required to achieve successful root canal therapy. The anatomy of C-shaped canals has been reported by a number of investigators (1–8). Yang et al. (2) described a C-shaped root canal as having a ribbon-shaped canal that includes the mesiobuccal and distal canals, and sometimes the mesiolingual canal. The complexity of C-shaped canals prevents these canals from being cleaned, shaped, and obturated effectively during root canal therapy. Melton et al. (4) had shown histologically that very little dentin separates the external surface from the C-shaped canal system, thereby increasing the possibility of stripping perforation during endodontic or restorative treatment. To avoid perforation of the root, Abou-Rass et al. (9) described an anticurvature filing technique in which the bulkier root structure was filed away from the curvature and the thinner danger zone. An evaluation of the actual thickness of canal walls in C-shaped roots should identify which walls are danger zones for anticurvature filing, and whether these zones are present at different levels of the root. This study was designed to evaluate the cross-sectional morphology of C-shaped canals and to identify the location and measure the minimum widths (MWs) of buccal and lingual canal walls.

MATERIALS AND METHODS

Extracted mandibular second and third molars with C-shaped roots were stored in polypropylene tubes filled with 10% buffered formalin saline. A unique identifier for each patient, including race, gender, age, and tooth type, was recorded. Fusion of the root surfaces was noted. After preparation of standard access cavities, the canal orifices were identified. Only those mandibular molars with complete or incomplete C-shaped canal orifices were selected. Consequently, 19 mandibular second molars, 1 mandibular third molar of Chinese origin, and 1 mandibular second molar of Malay origin were selected as the samples for this study.

The canals were irrigated with 5.25% sodium hypochlorite. To stain the canal walls, infiltration of methylene blue dye under vacuum suction was used. A line was drawn according to Fujita's method (10) on the cervical area to identify the plane perpendicular to the longitudinal axis of each tooth. This was performed by marking the mesial, distal, buccal, and lingual crests of the CEJ. A horizontal line was then drawn to join the midpoints of all the crests marked on the four surfaces. A second line, which was parallel with the first line, was drawn immediately below the lingual root bifurcation.

During the mounting procedure, each tooth was positioned with wax in a hole cut in a piece of Perspex to allow the first line on the tooth surface to be level with the Perspex surface. The tooth was then embedded in clear cold curing epoxy resin (Mirapox 950–230A, Miracon Sdn. Bhd, Malaysia) in a 18 × 30 mm plastic tube mold. After setting, the blocks were removed from the molds and were sectioned with a 0.3-mm Kerf diamond blade (Isomet Low Speed Saw, Buehler, Lake Bluff, IL) starting from the second line and then at intervals of 1 mm toward the apex.

Each section was coded to identify the buccal and mesial sides of each tooth. An image of the occlusal surface of each section was captured with a video camera (Sony, CCD-IRIS, Model DXC-107P, 470 TV lines, Japan) connected to a zoom microscope (VZM300, Edmund Industrial Optics, Japan) at a magnification of ×1 or ×1.5. Each magnification was precalibrated in an image analyzer (Leica Qwin Pro, Leica Microsystems Ltd, UK) that was linked to the video camera.