Relationship between Root Apices and the Mandibular Canal: A Cone-beam Computed Tomographic Analysis in a German Population

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Abstract

Introduction: The purpose of this study was to assess the mean distance between the mandibular canal and the apices of the adjacent teeth. **Methods:** Six hundred twenty-seven full-size cone-beam computed tomographic radiographs (Planmeca Promax3D; Planmeca, Helsinki, Finland; volume 8 × 8cm, voxel size ≤0.2 mm) of a German population (female = 58.2%, male = 41.8%, mean age = 51 years) were analyzed to establish the shortest distance between the mandibular canal and the root apices of the second premolar and all molars using the multiplanar reconstruction of the manufacturer's software in 3 mutually orthogonal planes. The obtained metric data were statistically analyzed using Student-Neumann-Keuls and Scheffé tests. Concerning the position of the tooth, the left or right side, and the sex of the patients, the chi-square test was used. **Results:** A total of 821 second mandibular premolars and 597 first, 508 second, and 48 third mandibular molars were included, and the mean distances were 4.2, 4.9, 3.1, and 2.6 mm, respectively. The occurrence of a direct relationship between the root tips and the mandibular canal was found in 3.2%, 2.9%, 15.2%, and 31.3% of the teeth. Women were almost twice as often affected as men. No significant differences were found concerning the location (right/left) of the teeth ($P > .05$). Significantly shorter distances from the mandibular canal to the root apices were found in patients younger than 35 years compared with older patients ($P < .0012$). **Conclusions:** Direct communication between the root apices and the mandibular canal is not rare and has to be taken into consideration when performing surgical or endodontic procedures to avoid iatrogenic nerve damages. Distances depend on sex and age. *(J Endod 2015;41:1696–1700)*

Key Words

Anatomy, cone-beam computed tomography, inferior alveolar nerve, root apex, sex

The inferior alveolar canal originates from the mandibular foramen, descends in the ramus of the mandible, and then runs horizontally in the body of the mandible just below the dental alveoli or even in contact to the root apices and ends at the mental foramen. Here the mental nerve makes a loop and exits through the mental foramen in the premolar region, spreading into the soft tissue. The dental nerve continues from the premolar region as the incisive nerve in the incisive canal (1).

The close relationship of the inferior alveolar nerve (IAN) to the roots of the lower molars and premolars is of utmost clinical relevance, especially when performing surgical procedures like surgical extraction of wisdom teeth or surgical endodontic treatment of both premolars and molars. Even during nonsurgical root canal treatment, the IAN may be affected by mechanical or chemical irritation (2). Direct nerve damage caused by overinstrumentation with endodontic instruments (3) or extrusion of irrigants or root canal filling material may cause temporary or permanent damages to the IAN (4). Root canal sealers are neurotoxic during the setting time (5). Additionally, gutta-percha products are claimed to cause reactions varying from none to chronic inflammation in soft and hard tissues because of antioxidants and oxides associated with the gutta-percha compound (5). Hence, any extrusion of root canal filling materials in close proximity to the IAN should be avoided.

In this respect, numerous case reports described anesthesia of the lower lip, paresthesia and anesthesia of the gums, or paresthesia and anesthesia of the mental nerve appearing immediately after root canal treatment (6–8). Usually, paresthesia and anesthesia of the lip and gums decreased over time, but in worse cases the mental nerve paresthesia and anesthesia may be irreversible.

In view of these potential complications, several studies were conducted to assess the distances between the mandibular canal (MC) and the root apices of mandibular molars. However, most studies included only a limited number of specimens (9) or were based on orthogonal and eccentric periapical radiographs or even solely on panoramic radiographs (10). The value of such analyses is limited because of superimpositions of surrounding structures or distortions. Cone-beam computed tomographic (CBCT) examination allows exact linear measurements with high accuracy and high reliability because of the isotropy of the voxels (11, 12). Therefore, the aim of this study was to determine the distances of the MC to the root apices of second premolars and molars without any superimpositions of adjacent structures.

Materials and Methods

A total of 627 full-size CBCT scans (Planmeca Promax 3D; Planmeca, Helsinki, Finland) with a field of volume of 8 × 8 cm and a voxel size ≤200 μm showing the full mandible were selected and analyzed randomly. Imaging parameters were 200°

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TABLE 1. Detailed Data of the Distances (mm) from the Root Apex to the Mandibular Canal (MC) and Enumeration of Direct Communication between the Root Apex and the MC

					Women				Men			
Tooth	Total no. of patients	Distance root apex to MC	Direct communication to MC (roots)	Direct communication to MC (teeth)	No.	Distance root apex to MC	Direct communication to MC (roots)	Direct communication to MC (teeth)	No.	Distance root apex to MC	Direct communication to MC (roots)	Direct communication to MC (teeth)
2nd premolar (left)	434	4.2 ± 2.4	14	14	242	3.9 ± 2.3	10	10	192	4.5 ± 2.4	4	4
2nd premolar (right)	387	4.3 ± 2.3	12	12	210	4.0 ± 2.3	8	8	177	4.6 ± 2.3	4	4
2nd premolar (sum)	821	4.2 ± 2.4	26	26	452	4.0 ± 2.3	18	18	369	4.6 ± 2.4	8	8
36 mesial root	298	5.1 ± 2.5	8	10	160	4.5 ± 2.4	6	8	138	5.8 ± 2.4	2	2
46 mesial root	299	5.1 ± 2.5	6	7	167	4.6 ± 2.2	3	4	132	5.7 ± 2.7	3	3
1st molar (mesial root) (sum)	597	5.1 ± 2.5	14	17	327	4.6 ± 2.3	9	12	270	5.8 ± 2.6	5	5
36 distal root	298	4.6 ± 2.4	7	10	160	4.0 ± 2.2	5	8	138	5.3 ± 2.4	2	2
46 distal root	299	4.6 ± 2.4	5	7	167	4.1 ± 2.1	3	4	132	5.2 ± 2.7	2	3
1st molar (distal root) (sum)	597	4.6 ± 2.4	12	17	327	4.1 ± 2.2	8	12	270	5.3 ± 2.5	4	5
1st molar (total)	597	4.85 ± 2.5	26	17	327	4.3± 2.3	17	12	270	5.6 ± 2.4	9	5
37 mesial root	218	3.5 ± 2.3	29	32	139	3.1 ± 2.3	22	24	79	4.1 ± 2.3	7	8
47 mesial root	290	3.4 ± 2.3	40	44	181	2.9 ± 2.0	31	34	109	3.9 ± 2.6	9	10
2nd molar (mesial root) (sum)	508	3.4 ± 2.3	69	76	320	3.0 ± 2.2	53	58	188	4.0 ± 2.4	16	18
37 distal root	218	2.7 ± 2.2	31	32	139	2.7 ± 2.2	24	24	79	3.7 ± 2.2	7	8
47 distal root	290	2.9 ± 2.3	44	44	181	2.5 ± 1.9	34	34	109	3.5 ± 2.6	10	10
2nd molar (distal root) (sum)	508	2.8 ± 2.3	75	76	320	2.6 ± 2.1	58	58	188	3.6 ± 2.4	17	18
2nd molar (total)	508	3.13 ± 2.3	134	76	320	2.8 ± 2.1	111	58	188	3.8 ± 2.3	33	18
38 mesial root	39	2.3 ± 2.3	12	12	26	2.2 ± 2.4	9	9	12	2.4 ± 2.0	3	3
48 mesial root	9	2.4 ± 2.1	3	3	7	2.5 ± 2.2	2	3	3	2.2 ± 1.9	0	0
3rd molar (mesial root) (sum)	48	2.3 ± 2.0	15	15	33	2.3 ± 2.1	11	12	15	2.3 ± 1.9	3	3
38 distal root	39	2.2 ± 1.9	11	12	26	2.1 ± 2.0	8	9	12	2.3 ± 1.6	3	3
48 distal root	9	2.1 ± 1.9	3	3	7	2.0 ± 1.9	3	3	3	2.1 ± 1.9	0	0
3rd molar (distal root) (sum)	48	2.2 ± 1.9	14	15	33	2.1 ± 2.0	11	12	15	2.2 ± 1.8	3	3
3rd molar (total)	48	2.21 ± 1.9	29	15	33	2.1 ± 2.0	22	12	15	2.2 ± 1.8	6	3
Total (all roots)	3127	—	224	—	1812	—	168	—	1315	—	56	—
Total (all teeth)	1974	—	—	134	1132	—	—	100	842	—	—	34
Prevalence (all roots)	—	—	7.16%	—	—	—	9.27%	—	—	—	4.26%	—
Prevalence (all teeth)	—	—	—	6.79%	—	—	—	8.83%	—	—	—	4.04%