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Morphological assessment of the mandibular canal trajectory in dentate subjects

VALENTIN DANIEL SÎRBU[1)], PAULA PERLEA[2)], VANDA ROXANA NIMIGEAN[3)], DANIELA GABRIELA BĂDIŢĂ[4)], AUGUSTIN ŞERBAN[5)], VICTOR NIMIGEAN[6)]

[1)]*Department of Implant Prosthetic Therapy, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania*

[2)]*Department of Endodontics, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania*

[3)]*Department of Oral Rehabilitation, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania*

[4)]*Department of Physiology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania*

[5)]*Private Dental Practice, Bucharest, Romania*

[6)]*Department of Anatomy, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania*

Abstract

Background: The mandibular canal is the most important vital structure within the mandibular body. The aim of the present study was to determine the course of mandibular canal in relation to external surfaces of the mandible (buccal, lingual) and to root apices of the lateral teeth, in order to minimize the risk of its content being injured during either conservative or radical treatment of the mandibular lateral teeth. *Materials and Methods*: Morphometric evaluations were performed on 11 dried dentate human mandibles and on cone-beam computed tomography (CBCT) cross-sectional images of the mandible, from 18 dentate patients. By means of both methods, the following parameters were assessed: (*i*) the distance between the mandibular canal and the buccal (lateral) surface of the mandible (MC-BS distance); (*ii*) the distance between the mandibular canal and the lingual (medial) surface of the mandible (MC-LS distance); (*iii*) the distance between the mandibular canal and the root apices of the second premolar, the first and second molars (MC-T distance). The results were statistically processed in Stata MP/13 software package using analysis of variance (ANOVA). *Results*: With respect to buccal-lingual location, the mandibular canal passed horizontally through the mandibular trabecular bone, from posterior to anterior, and from lingual to lateral (buccal), and so at premolar level it approached the lateral (buccal) cortical bone plate, main topographic pattern found in 26 (89.65%) of the cases. The mandibular canal had a descending trajectory from the second molar to the first molar, after which it ascended slightly towards the second premolar, main topographic pattern found in 24 (82.75%) of the cases. *Conclusions*: According to the results, the second mandibular molar is the most common tooth involved in the accidental damaging of the content of the mandibular canal, during various therapeutic procedures. Overlooking the location of the mandibular canal can lead to complications in endodontic therapy and in dentoalveolar surgical procedures in the posterior region of the mandible.

Keywords: morphometrics, cross-sectional anatomy, CBCT, trajectory pattern, dentoalveolar surgery.

Introduction

In dental medicine, the high-risk maxillo-mandibular anatomical elements related to dentoalveolar surgery, are mainly represented by the mandibular canal and by the posterior wall of the maxillary sinus, but also by the greater palatine foramen [1–4].

The mandibular canal has a varying trajectory, in dentate and in edentulous individuals. It must be mentioned that, in dentate subjects, it shows a series of particularities regarding its relations with the roots of lateral teeth. Sometimes, the trajectory of the mandibular canal can differ, even between the two hemi-mandibles of the same individual [1–5].

The reviewing of morphological aspects and of anatomical variations regarding the trajectory of the mandibular canal is important in oral rehabilitation, the mandibular canal being anatomic obstacle in endodontic treatment of lateral teeth, and in dentoalveolar surgery in the posterior region of the mandible [5–7].

In order to avoid the damaging of the mandibular canal content during various conservative or radical treatments applied to the mandibular lateral teeth, practitioners must take into account local topographic anatomy and individual variations regarding the trajectory of the mandibular canal [8, 9].

The present study, regarding the morphological assessment of the mandibular canal trajectory in relation to the horizontal and the vertical anatomical reference planes, was designed in order to offer an accurate determination, so as to establish a topographic pattern that would be useful to practitioners when deciding on an adequate and efficient therapeutic approach for every clinical situation and that can be associated with anatomical variations. Under these conditions, we consider

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that a double morphometric evaluation related to the course of the mandibular canal, using both dried mandibles and cone-beam computed tomography (CBCT) data, is more accurate and eloquent.

Materials and Methods

Morphometric evaluations were performed on 11 dried dentate human mandibles, available at the Department of Anatomy, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania and on CBCT cross-sectional images of the mandible, from 18 dentate patients (10 females and eight males), who went through the imaging procedure for dental treatment purpose. The investigations were conducted according to the current national legislation, and each patient gave informed consent to the use of his X-ray examination in scientific research.

Five mandibular buccal-lingual sections on each hemi-mandible were used both in direct and in radiographic measurements (for the second premolar and each root of the first and second molars). Overall, 10 buccal-lingual sections were analyzed and measured, on each studied mandible. The following parameters were assessed:

▪ the distance between the mandibular canal and the root apices of the second premolar, the first and second molars (MC-T distance);

▪ the distance between the mandibular canal and the buccal (lateral) surface of the mandible (MC-BS distance);

▪ the distance between the mandibular canal and the lingual (medial) surface of the mandible (MC-LS distance).

The dried human mandibles were sectioned using a circular diamond edge saw blade, with a diameter of 40 mm, held by a mandrel and activated by a micromotor hand-piece running at conventional speed, continually cooled with saline solution. The measurements were made with a Workzone digital caliper (Globaltronics GmbH & Co. KG, Singapore). Part of the sections was photographed with a Canon DS 126191 digital camera.

The machine used for the CBCT was a NewTom VGi imaging unit, with the following technical parameters: 110 kV, 1–20 mA, X-ray emission during a period of 18 seconds, and effective dose being 100 μSV. Data were processed using Planmeca Romexis® Viewer on a computer with the following specifications: Intel® Core™ i7 Processor, 16 GB System Memory, NVIDIA GTS 250 graphics card, Hard Disk 2 TB, Windows 10 Pro Operating System. The measurements expressed in millimeters, on mandibular sections, are at a scale of 1:1.

The results obtained both by the direct and by the imaging methods were processed in Stata MP/13 software package using analysis of variance (ANOVA) test. *P*-value ≤0.05 was considered statistically significant.

Results

One mandibular canal was found bilaterally in all examined cases. The most suggestive results are presented in the following images and tables.

A series of mandibular cross-sections carried out through CBCT and morphometrically evaluated, can be observed in Figures 1 and 2.

In Figures 3 and 4, morphometric evaluations on cross-sections of dried mandibles are shown.

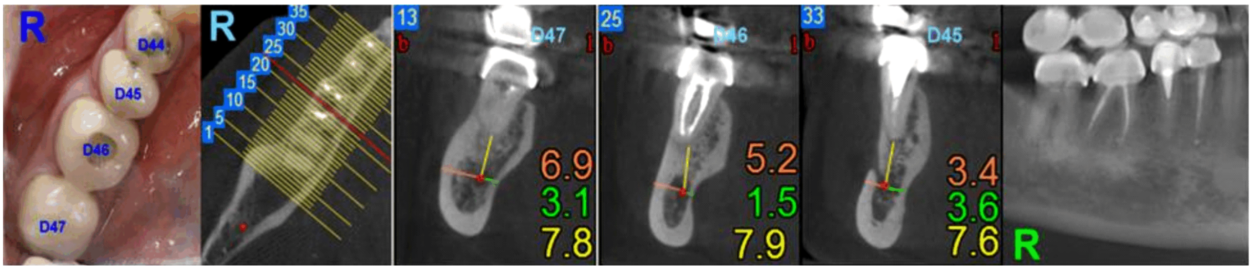

Figure 1 – ***CBCT: right hemi-mandible. Bucco-lingual sections at the level of teeth 4.5, 4.6, 4.7. Orange – MC-BS distance; yellow – MC-T distance; green – MC-LS distance. CBCT: Cone-beam computed tomography; MC-BS distance: Distance between the mandibular canal and the buccal (lateral) surface of the mandible; MC-T distance: Distance between the mandibular canal and the root apices of the second premolar, the first and second molars; MC-LS distance: Distance between the mandibular canal and the lingual (medial) surface of the mandible.***

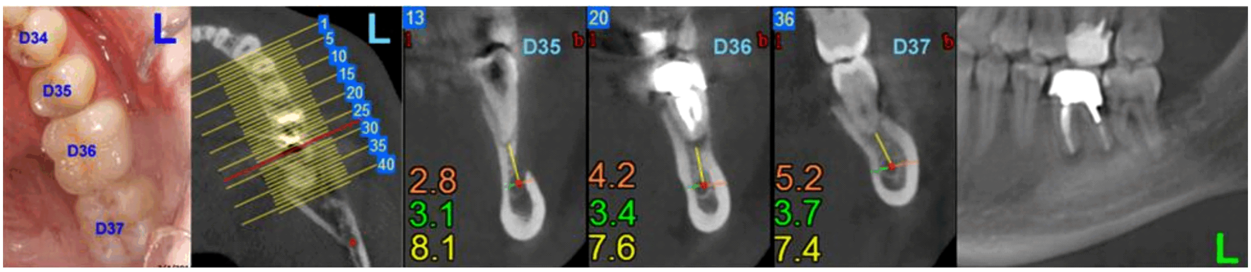

Figure 2 – ***CBCT: left hemi-mandible. Bucco-lingual sections at the level of teeth 3.5, 3.6, 3.7. Orange – MC-BS distance; yellow – MC-T distance; green – MC-LS distance. CBCT: Cone-beam computed tomography; MC-BS distance: Distance between the mandibular canal and the buccal (lateral) surface of the mandible; MC-T distance: Distance between the mandibular canal and the root apices of the second premolar, the first and second molars; MC-LS distance: Distance between the mandibular canal and the lingual (medial) surface of the mandible.***

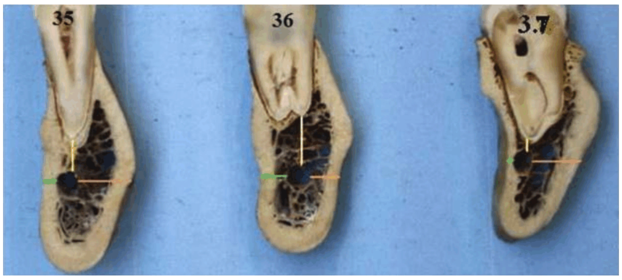

Figure 3 – ***Left hemi-mandible. Bucco-lingual sections at the level of teeth 3.5, 3.6, 3.7. Orange – MC-BS distance; yellow – MC-T distance; green – MC-LS distance. MC-BS distance: Distance between the mandibular canal and the buccal (lateral) surface of the mandible; MC-T distance: Distance between the mandibular canal and the root apices of the second premolar, the first and second molars; MC-LS distance: Distance between the mandibular canal and the lingual (medial) surface of the mandible.***

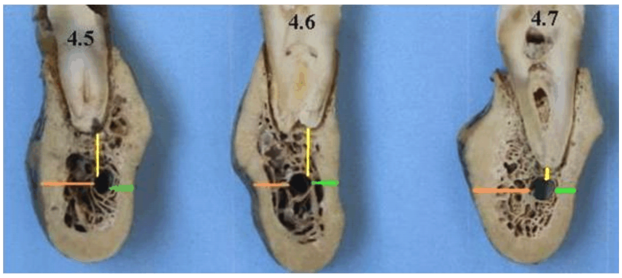

Figure 4 – ***Right hemi-mandible. Bucco-lingual sections at the level of teeth 4.5, 4.6, 4.7. Orange – MC-BS distance; yellow – MC-T distance; green – MC-LS distance. MC-BS distance: Distance between the mandibular canal and the buccal (lateral) surface of the mandible; MC-T distance: Distance between the mandibular canal and the root apices of the second premolar, the first and second molars; MC-LS distance: Distance between the mandibular canal and the lingual (medial) surface of the mandible.***

In the following Tables (1–6), statistical analysis of the radiographic and direct findings for the three studied parameters can be observed. It must be noted that N – No. of cases, SD – Standard deviation, SE – Standard error, and 95% CI – 95% Confidence interval for the average.

Table 1 illustrates the results regarding the distance between the mandibular canal and the buccal (lateral) surface of the mandibular body (MC-BS distance), measured on CBCT, on the three levels. This distance, varied between 2.4–6 mm at the level of the second premolar, between 2.8–7.5 mm at the level of the first molar, and between 4.2–8 mm at the level of the second molar. The mean values of this distance were as follows: 3.91 mm at the level of the second premolar, 5.22 mm at the level of the first molar and 6.52 mm at the level of the second molar. These values show that the MC-BS distance progressively decreases from the second molar to the second premolar.

Table 2 illustrates the results regarding the distance between the mandibular canal and the buccal (lateral) surface of the mandibular body (MC-BS distance), measured on dried mandibles, on the three levels. This distance, varied between 3–5.5 mm at the level of the second premolar, between 4.5–8 mm at the level of the first molar, and between 4–8 mm at the level of the second molar. The mean values of this distance were as follows: 4.08 mm at the level of the second premolar, 5.69 mm at the level of the first molar and 6.23 mm at the level of the second molar. These values show that the MC-BS distance progressively decreases from the second molar to the second premolar.

Table 3 illustrates the results regarding the distance between the mandibular canal and the lingual (medial) surface of the mandibular body (MC-LS distance), measured on CBCT, on the three levels. This distance varied between 3.0–7.5 mm at the level of the second premolar, between 1.5–5.2 mm at the level of the first molar, and between 1.5–4.7 mm at the level of the second molar. The mean values of this distance were: 4.33 mm at the level of the second premolar, 3.24 mm at the level of the first molar, and 2.91 mm at the level of the second molar. These results show that the MC-LS distance progressively decreases from the second premolar to the second molar.

Table 4 illustrates the results regarding the distance between the mandibular canal and the lingual (medial) surface of the mandibular body (MC-LS distance), measured on dried mandibles, on the three levels. This distance varied between 2–4.5 mm at the level of the second premolar, between 1.8–4 mm at the level of the first molar, and between 1.2–2.5 mm at the level of the second molar. The mean values of this distance were: 3.24 mm at the level of the second premolar, 2.65 mm at the level of the first molar, and 2 mm at the level of the second molar. These results show that the MC-LS distance progressively decreases from the second premolar to the second molar.

Table 5 illustrates the results regarding the distance between the mandibular canal and the root apices of the lateral teeth (MC-T distance), measured on CBCT, on the three levels. This distance varied between 2.1–9.7 mm at the level of the second premolar, between 4.3–9.4 mm at the level of the first molar and between 1.5–8.8 mm at the level of the second molar. The mean values of this distance were as follows: 5.5 mm at the level of the second premolar, 6.27 mm at the level of the first molar and 5.21 mm at the level of the second molar. These results show that the MC-T distance progressively increases from the second premolar to the first molar and progressively decreases from the first molar to the second molar.

Table 6 illustrates the results regarding the distance between the mandibular canal and the root apices of the lateral teeth (MC-T distance), measured on dried mandibles, on the three levels. This distance varied between 3.0–5.5 mm at the level of the second premolar, between 1.5–8 mm at the level of the first molar and between 0.1–6 mm at the level of the second molar. The mean values of this distance were as follows: 4.08 mm at the level of the second premolar, 4.42 mm at the level of the first molar and 1.7 mm at the level of the second molar. These values show that the MC-T distance progressively increases from the second premolar to the first molar and decreases from the first molar to the second molar.

Table 1 – *MC-BS distance (measurements on CBCT images)*

MC-BS distance								
Region	***N***	***Mean***	***SD***	***SE***	***95% CI***	***Minimum***	***Median***	***Maximum***
Right								
Second premolar	18	3.88	0.22	0.93	3.41–4.34	2.4	3.8	5.5
First molar	18	5.27	0.30	1.28	4.63–5.90	2.8	5.55	7.5
Second molar	18	6.53	0.27	1.14	5.96–7.09	4.2	6.7	8
ANOVA test; $p<0.0001$								
Left								
Second premolar	18	3.96	0.24	1.03	3.45–4.47	2.4	3.7	6
First molar	18	5.18	0.28	1.19	4.59–5.77	3	5.35	7.3
Second molar	18	6.52	0.28	1.17	5.93–7.10	4.4	6.75	8.4
ANOVA test; $p<0.0001$								

MC-BS distance: Distance between the mandibular canal and the buccal (lateral) surface of the mandible; CBCT: Cone-beam computed tomography; N: No. of cases; SD: Standard deviation; SE: Standard error; CI: Confidence interval; ANOVA: Analysis of variance.

Table 2 – *MC-BS distance (measurements on dried mandibles)*

MC-BS distance								
Region	***N***	***Mean***	***SD***	***SE***	***95% CI***	***Minimum***	***Median***	***Maximum***
Right								
Second premolar	11	4.09	0.27	0.90	3.49–4.70	3	4	5.5
First molar	11	5.75	0.34	1.11	5.00–6.49	4.5	5.5	8
Second molar	11	6.25	0.37	1.22	5.42–7.07	4.7	6.2	8
ANOVA test; $p=0.0002$								
Left								
Second premolar	11	4.08	0.26	0.86	3.50–4.66	3	4.2	5
First molar	11	5.63	0.32	1.06	4.92–6.34	4.5	5.5	7.6
Second molar	11	6.21	0.42	1.40	5.27–7.15	4	6.3	8
ANOVA test; $p=0.0004$								

MC-BS distance: Distance between the mandibular canal and the buccal (lateral) surface of the mandible; N: No. of cases; SD: Standard deviation; SE: Standard error; CI: Confidence interval; ANOVA: Analysis of variance.

Table 3 – *MC-LS distance (measurements on CBCT images)*

MC-LS distance								
Region	***N***	***Mean***	***SD***	***SE***	***95% CI***	***Minimum***	***Median***	***Maximum***
Right								
Second premolar	18	4.37	0.31	1.33	3.71–5.03	3	4.15	7.4
First molar	18	3.23	0.26	1.10	2.68–3.78	1.5	3.25	5
Second molar	18	2.93	0.21	0.87	2.50–3.37	1.7	3	4.7
ANOVA test; $p=0.0007$								
Left								
Second premolar	18	4.29	0.32	1.36	3.61–4.96	3	4	7.5
First molar	18	3.26	0.25	1.07	2.72–3.79	1.8	3.25	5.2
Second molar	18	2.89	0.19	0.80	2.49–3.29	1.5	2.85	4.5
ANOVA test; $p=0.0011$								

MC-LS distance: Distance between the mandibular canal and the lingual (medial) surface of the mandible; CBCT: Cone-beam computed tomography; N: No. of cases; SD: Standard deviation; SE: Standard error; CI: Confidence interval; ANOVA: Analysis of variance.

Table 4 – *MC-LS distance (measurements on dried mandibles)*

MC-LS distance								
Region	***N***	***Mean***	***SD***	***SE***	***95% CI***	***Minimum***	***Median***	***Maximum***
Right								
Second premolar	11	3.16	0.23	0.75	2.66–3.67	2	3	4.5
First molar	11	2.56	0.19	0.64	2.13–2.99	1.8	2.4	3.5
Second molar	11	2.03	0.10	0.32	1.81–2.24	1.5	2.1	2.5
ANOVA test; $p=0.0005$								
Left								
Second premolar	11	3.33	0.20	0.66	2.89–3.77	2	3.4	4.3
First molar	11	2.75	0.21	0.70	2.27–3.22	2	2.5	4
Second molar	11	1.97	0.10	0.34	1.75–2.20	1.2	2	2.4
ANOVA test; $p<0.0001$								

MC-LS distance: Distance between the mandibular canal and the lingual (medial) surface of the mandible; N: No. of cases; SD: Standard deviation; SE: Standard error; CI: Confidence interval; ANOVA: Analysis of variance.

Table 5 – ***MC-T distance (measurements on CBCT images)***

Region	N	Mean	SD	SE	95% CI	Minimum	Median	Maximum
				MC-T distance				
				Right				
Second premolar	18	5.53	0.54	2.28	4.40–6.67	2.1	5.25	9.7
First molar	18	6.30	0.24	1.02	5.79–6.81	4.5	6.2	8
Second molar	18	5.30	0.42	1.80	4.33–6.12	1.7	4.9	7.8
ANOVA test; p=0.1856								
				Left				
Second premolar	18	5.47	0.49	2.10	4.42–6.51	2.2	5.4	9.3
First molar	18	6.24	0.29	1.24	5.62–6.85	4.3	6.1	9.4
Second molar	18	5.13	0.45	1.93	4.18–6.09	1.5	4.85	8.8
ANOVA test; p=0.1753								

MC-T distance: Distance between the mandibular canal and the root apices of the second premolar, the first and second molars; CBCT: Cone-beam computed tomography; N: No. of cases; SD: Standard deviation; SE: Standard error; CI: Confidence interval; ANOVA: Analysis of variance.

Table 6 – ***MC-T distance (measurements on dried mandibles)***

Region	N	Mean	SD	SE	95% CI	Minimum	Median	Maximum
				MC-T distance				
				Right				
Second premolar	11	4.09	0.27	0.90	3.49–4.70	3	4	5.5
First molar	11	4.46	0.47	1.55	3.42–5.50	2	4.4	8
Second molar	11	1.76	0.51	1.70	0.62–2.90	0.1	1.2	6
ANOVA test; p<0.0001								
				Left				
Second premolar	11	4.08	0.26	0.86	3.50–4.66	3	4.2	5
First molar	11	4.39	0.45	1.48	3.40–5.38	1.5	4.2	7.6
Second molar	11	1.64	0.43	1.43	0.67–2.60	0.2	1	5
ANOVA test; p<0.0001								

MC-T distance: Distance between the mandibular canal and the root apices of the second premolar, the first and second molars; N: No. of cases; SD: Standard deviation; SE: Standard error; CI: Confidence interval; ANOVA: Analysis of variance.

Discussion

Our results fell in line with other studies regarding the topography of the mandibular canal, but they also put forward aspects otherwise unnoticed in the reviewed specialized literature.

The values obtained through direct morphometric evaluation on dried mandibles and the values obtained through radiographic morphometry regarding the MC-BS and MC-LS distances were similar, the differences not exceeding 1 mm. However, statistically significant differences (over 1 mm) were noted in case of the MC-T distance. Regarding the values obtained when studying parameters on the right and left sides, these were comparable and similar, the differences not exceeding 1 mm.

Regarding the buccal-lingual trajectory of the mandibular canal within the mandibular body, we determined both on dried mandibles and on radiographic imaging, and statistically analyzed, the distances between the mandibular canal and the external mandibular surfaces, the MC-BS and MC-LS distances.

The distance between the mandibular canal and the buccal (lateral) surface of the mandibular body, the MC-BS distance, varied between 2.4–6 mm at the level of the second premolar, between 2.8–8 mm at the level of the first molar, and between 4.0–8.4 mm at the level of the second molar. The mean values of the MC-BS distance, measured on dried mandibles and on CBCT images and statistically determined, were as follows: 4 mm at the level of the second premolar, 5.45 mm at the level of the first molar and 6.37 mm at the level of the second molar. These values show that the distance between the mandibular canal and the buccal (lateral) surface of the mandibular body progressively decreases from the second molar to the second premolar, which indicates that in its anterior trajectory, the mandibular canal approaches the buccal (lateral) cortical plate of the mandible.

Statistical analysis shows that the MC-BS distance differs significantly between the areas of the second premolar, the first molar, and the second molar, both on the right and left sides (p<0.05).

The distance between the mandibular canal and the lingual (medial) surface of the mandibular body, MC-LS distance, varied between 2–7.5 mm at the level of the second premolar, between 1.5–5.2 mm at the level of the first molar, and between 1.2–4.7 mm at the level of the second molar. Statistical analysis showed that the mean values of the MC-LS distance, measured on dried mandibles and on CBCT images, were: 3.78 mm at the level of the second premolar, 2.95 mm at the level of the first molar, and 2.45 mm at the level of the second molar. These results show that the distance between the mandibular canal and the lingual (medial) surface of the mandibular body progressively decreases from the second premolar to the second molar, situation opposed to that of the distance between the mandibular canal and the buccal surface of the mandible. This indicates that in its anterior trajectory, the mandibular canal distances itself from the lingual cortical plate of the mandible. The statistical analysis shows that the MC-LS distance differs significantly between the area of the second premolar, the first molar and the second molar, both on the right and left side ($p<0.05$).

Certain similarities regarding this type of horizontal course of the mandibular canal had been found in the reviewed specialized literature, but the values obtained in this study were different.

Following these results, we established the main pattern regarding the buccal-lingual trajectory of the mandibular canal: it has an anterior-lateral direction, from the second molar to the second premolar, going from the lingual surface to the buccal surface of the mandibular trabecular bone, being located below the apices of the first molar, in the middle of the trabecular bone. This main buccal-lingual topographic pattern of the mandibular canal was present in 26 (89.65%) of the analyzed cases. In three (10.36%) cases, the mandibular canal was located in the middle third of the mandibular trabecular bone.

The horizontal trajectory of the mandibular canal varies and is mainly related to the buccal-lingual dimension of the mandible [1].

These results contradict those found by Kim *et al.* (2009), which indicated that within the mandibular body, the horizontal trajectory of the mandibular canal had three topographic patterns [5].

Our study also contradicts authors who argued that, the mandibular canal buccal-lingual pathway followed in S-shaped curve, in 31% of cases [10].

Other authors, when studying the trajectory of the mandibular canal on human dentate specimens, showed that it approaches a distance of 4.9 mm to the buccal surface of the mandible, the buccal-lingual position of the mandibular canal being associated with the age and race of the subjects. Therefore, both elderly and Caucasian patients showed a smaller distance between the mandibular canal and the buccal surface of the mandible [6, 11, 12].

No sexual dimorphism in the mandibular canal trajectory was found through our study, which is consistent with specialized literature findings [13].

Moreover, it has been noted that, in most cases, the mandibular canal crosses the trabecular bone from lingual to buccal, being located halfway the distance between external mandibular compacts, in the middle of the spongious bone, at the level of the first molar [14].

Similar results to those found in our study regarding the horizontal trajectory of the mandibular canal were showcased by other authors. According to them, the mandibular canal was located closer to the lingual cortical in the molar region, and, in the anterior region, closer to the buccal cortical, nearing it most at the level of the second premolar [15–18].

In order to establish the vertical trajectory pattern of the mandibular canal within the mandibular body, we morphometrically determined both on dried mandibles and on imaging data, and statistically analyzed, the distance between the mandibular canal and the apices of the second molar, the first molar, and the second premolar, MC-T distance. We did not analyze these topographic relations at the level of the third molar due to the morphological variations and the particular pathology. In our opinion, such aspects require a separate study.

The distance between the mandibular canal and the root apices of the lateral teeth, MC-T distance, varied between 2.1–9.7 mm at the level of the second premolar, between 1.5–9.4 mm at the level of the first molar and between 0.1–8.8 mm at the level of the second molar. Therefore, the MC-T distance varies greatly, between 0.1–9.7 mm. The statistical analysis showed that this distance, measured both on dried mandibles and on CBCT images, had the following mean values: 4.79 mm at the level of the second premolar, 5.34 mm at the level of the first molar and 3.45 mm at the level of the second molar.

The statistical analysis shows that MC-T distance differs significantly between the second premolar area, the first molar area and the second molar area, on both the right and left sides, just in case of direct morphometric evaluation on dried mandibles ($p<0.05$).

These values show the main pattern of the mandibular canal's vertical trajectory that comes closest to the root apices of the second molar, and even to the root apex of the second premolar, and that is furthest away from the root apices of the first molar. Therefore, going from the second molar to the first molar, the mandibular canal has a descending trajectory and then slightly ascends towards the second premolar.

Significant differences, exceeding 1 mm, between the values obtained through direct morphometric evaluation and the values obtained through radiographic morphometry regarding the MC-T distance can be explained by the fact that the scanning plane of the CBCT scanner was not always parallel to the mandibular basal plane, which could modify the results, especially when the angle between the aforementioned planes grew.

This main anatomic pattern of the mandibular canal's vertical trajectory contradicts that found in other studies, which show the root apices of the first molar as being closer to the mandibular canal than the root apex of the second premolar, or it contradicts the fact that this canal has a descending trajectory [1, 19, 20].

Similar results to those found in this study, regarding the vertical trajectory of the mandibular canal, are illustrated in literature. Thus, Denio *et al.* (1992) showed that the second premolar and the second molar have the closest connection with the mandibular canal, MC-T distance having a mean value of 4.7 mm for the second premolar, and 3.7 mm for the second molar [10]. Anderson *et al.* (1991) showed that the inferior alveolar nerve has a posterior descending segment in the mandibular canal, which precedes an ascending segment, in the anterior trajectory, and the existence of bilateral symmetry (location of the canal in each half of the mandible) [21]. The above-mentioned data are partially comparable with that of our study.

Based on the results shown above, the second molar and the second premolar are the most susceptible to being involved in the accidental injury of the mandibular canal's content during conservative or radical odontal treatments at this level.

Furthermore, we support some authors' conclusion that the trajectory of the mandibular canal does not differ concerning gender, age, or left or right side of the subjects [6].

Consensus regarding the relationships of the mandibular canal to the anatomical structures around it, especially to the root apices of the lateral teeth, has yet to be reached in the specialized literature [1, 5].

Anatomical variations of the mandibular canal trajectory are important and can have outstanding clinical implications, because they increase the risk of damaging the inferior alveolar nerve [22].

The analyzed references show topographical variations and severe deviations, or controversial situations regarding the mandibular canal trajectory, which may explain clinical situations where neuro-vascular elements contained in the canal, are injured. These situations require the revision of the regional anatomical data, of the therapeutic considerations, and of the potential consequences of an inadequate therapy [12, 23–28].

In order to plan conservative or radical treatment in the mandibular posterior region, CBCT is essential, so as to obtain additional information regarding the mandibular canal trajectory and to establish its connections with nearby anatomical structures [29].

Conclusions

It is important that the topographic–anatomical data regarding the trajectory of the mandibular canal be taken into account in everyday practice, during endodontic treatment, and during dentoalveolar surgery at the level of the mandibular lateral teeth, the danger zone being that of the second molar. In order to avoid the injury of the inferior alveolar neurovascular bundle during endodontic therapy and during surgical procedures, the imaginary line that passes 1.5–2 mm above the mandibular canal should be considered a safety limit.

Conflict of interests

The authors declare that they have no conflict of interests.

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Author contribution

Valentin Daniel Sîrbu, Paula Perlea and Daniela Gabriela Bădiţă have equal contributions to this paper and thus are main authors.

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Corresponding author
Vanda Roxana Nimigean, Associate Professor, DMD, PhD, Head of Department of Oral Rehabilitation, Faculty of Dental Medicine, “Carol Davila” University of Medicine and Pharmacy, 17–23 Calea Plevnei Street, 060015 Bucharest, Romania; Phone +40721–561 848, e-mail: vandanimigean@yahoo.com

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