ANATOMIC FEATURES OF THE MIDDLE MESIAL CANAL AND MESIAL ROOT OF THE MANDIBULAR MOLARS ANALYZED BY MICRO-CT

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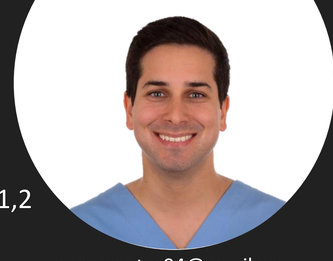

Nuno Rodrigues dos Santos[1], Sofia Moura Furtado[1], Mário Rito Pereira[1], Jorge Martins[1,2] and António Ginjeira[1,2]

1 – Department of Endodontics, Faculty of Dental Medicine, University of Lisbon

2 – Oral and Biomedical Investigation Unit (UICOB) - Faculty of Dental Medicine, University of Lisbon

nunorsantos94@gmail.com

INTRODUCTION

The mesial root of mandibular molars exhibits a highly complex internal anatomy, including multiple canals, isthmuses, and apical deltas. This complexity poses challenges to chemomechanical procedures and has been linked to a significantly lower success rate compared with other teeth. However, studies indicate that the internal and external anatomy of mandibular molars is highly variable, and numerous authors have reported the presence of an additional main canal in the mesial root, known as the middle mesial canal (MMC).

In recent years, micro-computed tomography (micro-CT) imaging has become increasingly important in the study of root canal system morphology. Due to its ability to provide high-resolution 3D imaging without causing any damage to the sample, micro-CT has become the gold standard in root canal morphology research.

Therefore, this study aimed to characterize the morphological features of the mesial root of mandibular molars with an MMC using micro-CT imaging.

METHODOLOGY

469 mandibular molars with two roots and complete apices were randomly selected from a local tooth bank, following prior approval by the local ethics committee. Each tooth was mounted and scanned with micro-CT [SkyScan 1275 scanner (Bruker, Kontich, Belgium)] at 19.61 µm pixel size, 80 kV, 125 µA, 0.5º rotation step, 360º rotation, and 1944×1536 resolution. Images were reconstructed with NRecon and analyzed in DataViewer to assess mesial root and canal morphology.

The mesial roots with MMC (n=25) were evaluated for several morphological aspects, including the type of chamber orifice (whether independent or confluent with the MBC and/or MLC); its position within the root (coronal, middle, and/or apical); and its anatomical configuration (confluent with the MBC and/or MLC, or independent). The minimum periradicular dentin thickness (the smallest distance between the inner canal surface and the external root surface in any direction) was also measured in millimeters for each root canal at the 2 mm axial level below the furcation area, using the measurement tool in the software.

RESULTS

Sample	**Mesial root canal configuration**	**Middle-mesial root canal configuration**				**Periradicular minimal dentin thickness (mm)**		
		Configuration Type	Chamber Orifice	Root position	Anatomy	Mesiobuccal	Middle-mesial	Mesiolingual
1	2-3-2-1	Confluent with isthmus	CONF-ML	Middle	CONF-ML	1.33	0.94	1.13
2	3-4-2-3-4	Confluent without isthmus	IND	Coronal and Apical	CONF MB	0.90	0.94	1.41
3	3-2-1-3	Confluent with isthmus	IND	Coronal and Apical	CONF-MB	1.12	0.94	1.14
4	2-1-2-3	Confluent with isthmus	CONF-ML	Apical	CONF-MB	1.06	0.94	1.14
5	2-3-2	Confluent with isthmus	CONF-MB	Middle	CONF-ML	1.02	1.06	1.14
6	3-2-1-2-3	Confluent with isthmus	IND	Coronal and Apical	CONF-MB	1.53	-	1.41
7	3-1	Confluent with isthmus	IND	Coronal	CONF-MB AND ML	1.29	-	1.22
8	3-2-1	Confluent with isthmus	IND	Coronal	CONF-ML	1.18	-	1.33
9	2-3-2-1-2	Confluent with isthmus	CONF-MB AND ML	Middle	CONF-ML	1.09	0.90	0.78
10	3-4-3-2	Confluent with isthmus	IND	Coronal and Middle	CONF-MB	1.18	0.86	1.09
11	3-2-3-2	Confluent without isthmus	IND	Coronal and Middle	CONF-MB	1.37	0.98	1.09
12	3-4-3-2-1	Confluent without isthmus	IND	Coronal and Middle	CONF-ML	1.18	0.90	1.14
13	3-2-1-3	Confluent with isthmus	IND	Coronal and Apical	CONF-ML	1.38	0.98	1.22
14	1-2-3	Fin	CONF-ML	Middle and Apical	CONF-ML	0.71	0.90	0.82
15	2-3-2-1	Confluent with isthmus	CONF-MB	Middle	CONF-MB	1.38	-	1.14
16	3-2-1	Confluent with isthmus	IND	Coronal	CONF-ML	1.09	-	1.13
17	3-4-5-3-2	Confluent with isthmus	IND	Coronal and Middle	CONF-ML	1.29	1.02	1.53
18	2-3-2-1-3-1-2-3	Confluent with isthmus	CONF-MB	Coronal	CONF-MB	1.29	1.29	1.41
19	3-3	Independent	IND	All	IND	1.33	-	1.45
20	2-3	Fin	CONF-MB	Middle and Apical	CONF-MB	1.37	125	1.49
21	2-3-2-3	Confluent without isthmus	CONF-MB	Coronal and Apical	CONF-ML	1.61	1.09	1.25
22	3-1-3	Confluent with isthmus	IND	Coronal and Apical	CONF-MB	1.28	1.10	1.25
23	3-2	Confluent without isthmus	IND	Coronal and Middle	CONF-ML	1.55	0.96	1.31
24	3-2-3	Confluent without isthmus	IND	Coronal and Apical	CONF-ML	1.41	0.92	1.29
25	3-2-3	Confluent without isthmus	IND	Coronal and Apical	CONF-ML	1.22	0.78	1.29

Table 1 – Mesial root and mesial root canals major characteristics

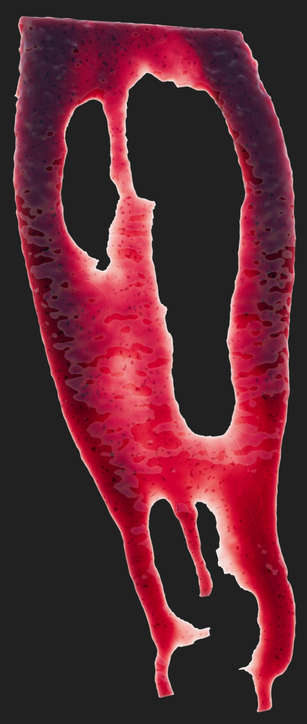

Figure 1 – Reconstructed 3D model of the confluent configuration with isthmus

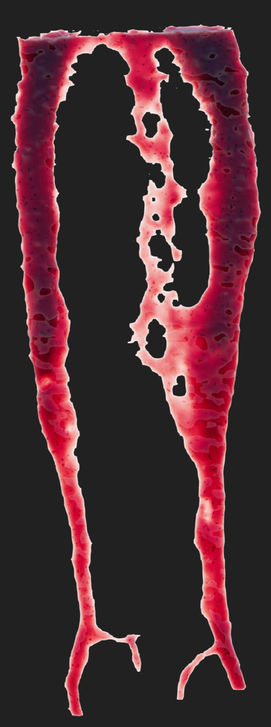

Figure 2 – Reconstructed 3D model of the confluent configuration without isthmus

Figure 3 – Reconstructed 3D model of the fin configuration

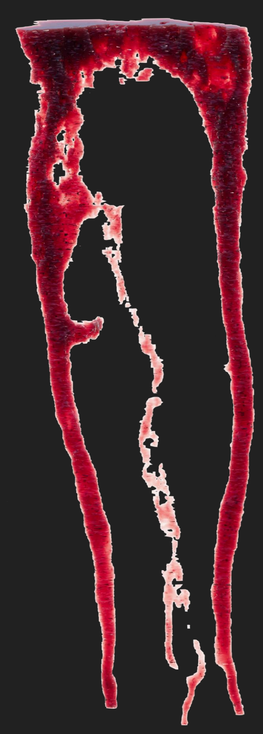

Figure 4 – Reconstructed 3D model of the independent configuration

CONCLUSIONS

The micro-CT analysis of the mesial roots of mandibular molars with an MMC revealed considerable variations in internal root canal anatomy. The confluent configuration was the most prevalent anatomic variation, while an independent MMC was observed in only one specimen. The lowest average periradicular dentin thickness at the 2-mm level below the furcation was observed in the MMC, measuring less than 1 mm. Clinicians should be aware of these anatomical variations before initiating root canal treatment to minimize the risk of iatrogenic complications.

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