

MORPHOLOGICAL VARIABILITY OF PREMOLARS ROOTS

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ABSTRACT

Aim of the study The successful endodontic therapy is due to the knowledge of the root and canal morphological variability of premolars. The aim of this study is to present this variability of number of roots/canals for the first and second premolars, both upper and lower, and to compare the results with data from literature. **Material and methods** Our study was done on a group of 52 teeth (28 upper premolars and 24 lower premolars) selected respecting some criteria, and were extracted for orthodontic purposes. **Results** Regarding the root morphology, the study showed that, for the first maxillary premolars, were registered 12 premolars with 2 roots (75%), 3 had a single root, and a single first maxillary premolar, 3 roots. The second maxillary premolars showed less variability: thus, the premolars with 2 roots were 9 in number, while only 3 second premolars were found with a single root. The root and canal morphology of the upper premolars in our studied group revealed a morphological pattern already mentioned in the literature. **Conclusions** The root morphology, especially the endodontic configuration of the root structure can be a decisive aspect in treating and maintaining a tooth on the dental arch, and use it for a prosthetic restoration.

Key words: premolars, root morphology, variability

INTRODUCTION

Knowledge of common root canal morphology and its frequent variations together with diagnosis and treatment planning is a basic requirement for endodontic success. [1,2] Numerous factors contribute to the variations found in root canal studies including ethnicity,[3] age,[4] gender,[5] and study design.[6] The maxillary first premolars are among the most difficult teeth to be endodontically treated due to their variation in number of roots, canal configuration, the direction and longitudinal depressions of the roots, and various pulp

cavity configurations.[7] However, it is important to point out that the morphology or anatomy, both of the root and canal, of the premolars can be extremely complex, requiring a careful approach and evaluation in order to avoid risks of therapeutic failures.

MATERIAL AND METHODS

The aim of this study is to present the variability of number of roots and canals for the first and second premolars, both upper and lower, and to compare the results with data from literature.

For this study, the selected teeth respected

the following criteria: ● the teeth were complete, had no fracture, no restorations; ● fully developed root; ● were extracted for orthodontic purposes. Then, the teeth were cleaned in 3% hydrogen peroxide solution, and dried at room temperature. Our study was realised on a group of 52 teeth, including a number of 28 maxillary premolars and 24 mandibular premolars, respectively.

The evaluation was done on 16 first upper premolars and 12 second upper premolars. From the group of mandibular premolars (28), the assessment was made on 12 first lower and 12 second maxillary premolars.

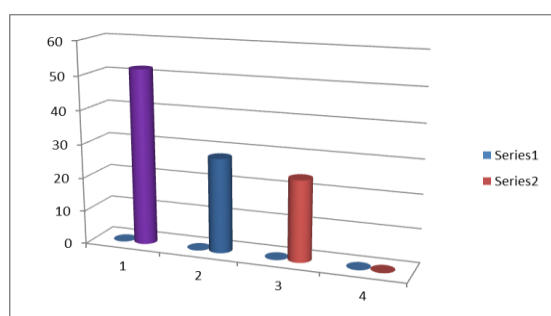


Figure 1. Premolars studied

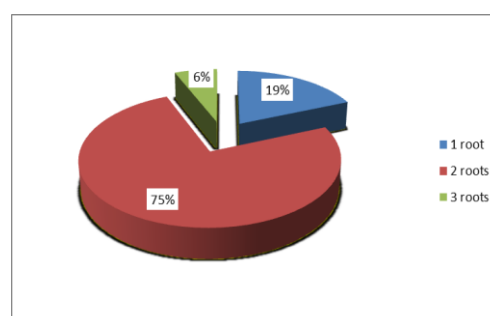


Figure 2. First upper premolars.

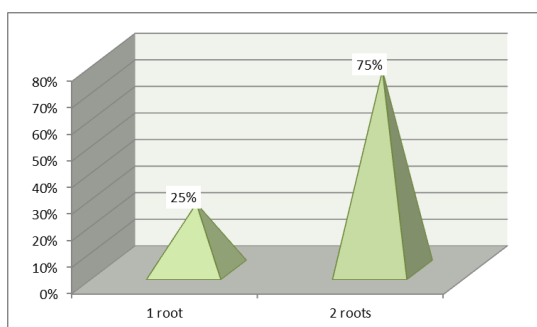


Figure 3. Second upper premolars

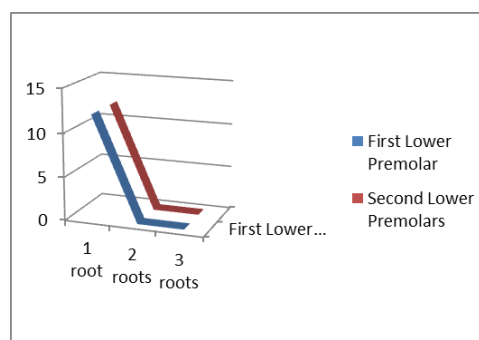


Figure 4. Lower Premolars

RESULTS AND DISCUSSIONS

Regarding the root morphology, the study showed that, for the first maxillary premolars, were registered 12 premolars with 2 roots (75%), 3 had a single root (6%), and one single first maxillary premolar with 3 roots. The second maxillary premolars showed less variability: thus, the premolars with 2 roots were 9 (75%), while only 3 second premolars were found with a single root (25%). No second lower premolar with 3 roots was found. Also, for the lower premolars, the distribution proved to be entirely for the first and second premolars, with a unique root pattern.

The root and canal morphology of the upper premolars in our studied group revealed a morphological pattern already mentioned in the literature. For this reason it is important to know very well the morphological aspects that can exist, the variation of the number of roots and canals, in order to treat such teeth as optimum as possible.

The morphology of the first upper premolars is complex due to the variability of the number of roots and the configuration of the root canals. Several researchers have reported a low incidence of single maxillary root canal premolars (Okamura, Green, Vertucci and Gegauff, Walker) observed in

their studies a single canal, and an incidence of about 10% [8,9].

The presence of 3 root canals at the first premolars is relatively low; 3% is the value found by Bellizzi.

The large discrepancy in the number of multiple canals, which was found according to the authors, is due to various factors, such as: the great anatomical variability of these teeth, the methods used and the number of teeth, etc. On a number of 240 upper first premolars extracted, Pecora et al., conducted in Brazil, a study on the anatomy of the first maxillary premolars, following the number of roots and the direction of root curvature. Of the 240 first maxillary premolars, 55.8% had a single root, 41.7% - 2 roots, and 2.5% - 3 roots. [10].

It is difficult to evaluate the root canal configuration correctly by using only an intraoral periapical (IOPA) radiograph, as is a 2-dimensional (2D) image of a 3-dimensional (3D) structure. It possesses the limitation of providing a clear image of root canal anatomy due to super-imposition. To identify an extra canal, multi-angulated IOPA radiographs are often required. With the newer advances in the imaging techniques such as cone beam computed tomography (CBCT) and Spiral CT, the identification of root canal anatomy becomes easier due to its accuracy and virtual 3D reconstruction. [11, 12]

Abella et al, (2015) used CBCT scans to analyse the morphology of the second maxillary premolars and found an incidence of 1.6% of three-rooted teeth. [13]

Julian B. Woelfel, in "Dental Anatomy, its relevance to Dentistry" presents the anatomical configuration of the root of the first upper premolar as follows:

□ out of 200 teeth examined, 61% have 2

roots; 38% one root and 1% three roots

□ the oral root of the first maxillary premolar frequently is shorter than the buccal root by 0.8 mm, for 93 teeth

□ the apex of the root can be oriented both distally and mesially: distally 66% of the 426 teeth examined and only 13% mesially, and the bifurcation of the root is in the 1/3 apical part or at 1/2 the root. [14]

The second upper premolar is among the most often endodontically treated teeth. Hull and colab. found their frequency to be 10.3%. [15] Usually, there is only one root canal in the second maxillary premolar. However, there is sufficient evidence in the literature on the presence of the second or third root canal. Pecora and al., reported that of the 435 second premolars studied, 76.3% had two canals. The incidence of the two canals separated at the apex is reported to vary between 4 and 50%. [10]

Aberrant anatomy is far more common in today's endodontic practice because of the advances in the field of magnification. The anatomy can be predictably managed following identification and negotiation. [16]

The root canal system comprises of complex anatomical features where the presence of extra-canals is an endodontic challenge. The canal systems were classified by Weine [17] and Vertucci, [18] respectively (Fig. 5).

Vertucci et al. reported that the mandibular second premolar is having an incidence of one root canal at the apex in 97.5% and two canals in 2.5% of the teeth studied. [19] While the incidence of three root canals reported to range from 0% to 0.4%. [20] Moreover, reports of mandibular second premolar with four and five root canals have been published. [21], [22], [23]

Table 1. Classification for number of roots

Classification	Number of roots
Type 1	One root
Type 2	Two roots a. Bifurcation at coronal third b. Bifurcation at middle third c. Bifurcation at apical third
Type 3	Three roots a. Trifurcation at coronal third b. Trifurcation at middle third c. Trifurcation at apical third
Type 4	More than three roots

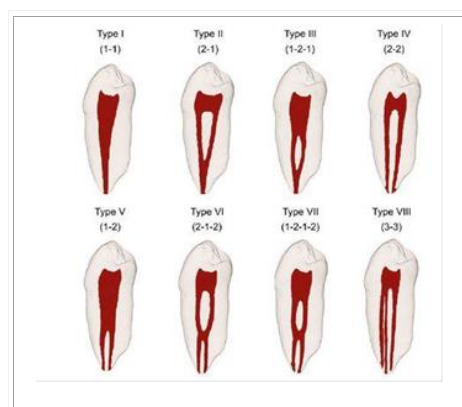


Figure 5. Vertucci's classification

Table 2. Case studies for mandibular second premolars showing percentage of atypical canal anatomy, technique used, and number of examined teeth

Author	Year	Study	% of atypical root/canal morphology	Number of teeth examined	Type of technique
He et al.	2006	<i>In vitro</i>	Teeth with multiple canals – 2.63	38	Radiographic
Awawdeh et Al-Qudah	2008	<i>In vitro</i>	72 – Type I system (Vertucci) / 22.8 – teeth with 2 canals	900 (first/second premolars)	Clearing technique
Rózyło et al.	2008	<i>In vivo</i>	68.2 – one canal / 31.8 – two canals	56	Clinical visualization
Yu et al.	2012	<i>In vivo</i>	77.2 – one root / 2.2 – two canals	178	CBCT
Baroudi et al.	2012	<i>In vitro</i>	34 – one canal / 25 – two canals	40	Radiographic
Llena et al	2014	<i>In vivo</i>	83.3 – one canal	126	CBCT
Singh and Pawar	2014	<i>In vitro</i>	92 – one root / 8 – two or more roots	100	Clearing
Ok et al.	2014	<i>In vivo</i>	98.5 – one canal – Type I Vertucci	849	CBCT
Kazemipoor et al.	2015	<i>In vivo</i>	93.5 – one root / 6.5 – two roots (male) and 96.1 – one root / 3.9 – two roots (female)	230 (115- males, 115- females)	CBCT

CONCLUSIONS

1. The mentioned/reviewed studies ensure information about the various root patterns for premolars and especially for two or more roots and canals, observed by clinical and radiographic examinations.
2. Compared with other studies for the first upper premolars, we founded similar results for two root and three canals, while for the second premolars, the values are closer to data from literature.
3. The root morphology, especially the endodontic configuration of the root structures can be a decisive aspect in maintaining a tooth on the dental arch, to treat it endodontically and use it for a prosthetic restoration.

REFERENCES

- 1 Reuben J, Velmurugan N, Kandaswamy D. The evaluation of root canal morphology of the mandibular first molar in an Indian population using spiral computed tomography scan: An in vitro study. *Int Endod J.* 2011;44:990–9. [PubMed] [Google Scholar]
- 2 Cleghorn B, Christie W, Dong C. Root and canal morphology of the human mandibular first premolar: A literature review. *J Endod.* 2007;33:509–16. [PubMed] [Google Scholar]
- 3 Gulabivala K, Aung TH, Alavi A, Ng YL. Root and canal morphology of Burmese mandibular molars. *Int Endod J.* 2001;34:359–70. [PubMed] [Google Scholar]
- 4 Neaverth EJ, Kotler LM, Kaltenbaoh RF. Clinical investigation (in vivo) of endodontically treated maxillary first molars. *J Endod.* 1987;13:506–12. [PubMed] [Google Scholar]
- 5 Sert S, Bayirli GS. Evaluation of the root canal configuration of the mandibular and maxillary permanent teeth by gender in the Turkish population. *J Endod.* 2004;30:391–8. [PubMed] [Google Scholar]
- 6 Awawdeh L, Abdullah H, Al-Qudah A. Root form and canal morphology of Jordanian maxillary first premolars. *J Endod.* 2008;34:391–8. [PubMed] [Google Scholar]
- 7 Kothapalli KR. Two-rooted mandibular first premolar: Case report. *Ann Essences Dent* 2010;2:93-5.
- 8 Vertucci F – Root canal anatomy of the human permanent teeth – *Oral Surg Oral Med Oral Pathol*, 1984, 58, 589-599
- 9 Walker RT. Root form and canal anatomy of mandibular first molars in a southern Chinese population. *Endod Dent Traumatol* 1988;4:19-22.
- 10 Pecora JD, Saquy PC, Sousa Neto ND, Woelfel JB. Root form and canal anatomy of maxillary first premolars. *Braz Dent J.* 1991;2:87–94. [PubMed] [Google Scholar]
- 11 Scarfe WC., et al. “Use of cone beam computed tomography in endodontics”. *International Journal of Dentistry* (2009).
- 12 Apurva Sagale., et al. “Cone Beam Computed Tomography - Assisted Endodontic Management of an Atypical Four Canalled Mandibular Second Premolar - A Rare Case Report”. *Oral Health and Dentistry* 3.6 (2019): 789-795.
- 13 Abella F, Teixidó LM, Patel S, Sosa F, Duran-Sindreu F, Roig M. Cone-beam Computed Tomography Analysis of the Root Canal Morphology of Maxillary First and Second Premolars in a Spanish Population. *J Endod.* 2015 Aug; 41(8):1241-7.
- 14 Woelfel J, Scheid R. *Dental Anatomy: Its Relevance to Dentistry.* Philadelphia: Lippincott Williams and Wilkins; 2002

- 15 Hull TE, Robertson PB, Steiner JC, del Aguila MA – Patterns of endodontic care for a Washington state population – J Endod 2003; 29:553-556
- 16 Tanaya Kumar, Anita, Sanap, Karan Bhargava, Shalini Aggarwal, Gunpriya Kaur, Priyanka Patil. Management of A Maxillary Premolar With Three Roots: A Case Report. Int J Cont Med Res. 2015;2(1):136-14
- 17 Weine F. – Endodontic Therapy – 6th edition, Mosby Co., 2003
- 18 Vertucci FJ. Root canal morphology of mandibular premolars. J Am Dent Assoc 1978;97:47-50.
- 19 Vertucci F, Seelig A, Gillis R. Root canal morphology of the human maxillary second premolar. Oral Surg Oral Med Oral Pathol 1974;38:456-64.
- 20 Zillich R, Dowson J. Root canal morphology of mandibular first and second premolars. Oral Surg Oral Med Oral Pathol 1973;36:738-44. Back to cited text no. 8
- 21 Al-Abdulwahhab B, Al-Nazhan S. Root canal treatment of mandibular second premolar with four root canals. Saudi Endod J 2015;5:196-8. Back to cited text no. 11
- 22 Al-Fouzan KS. The microscopic diagnosis and treatment of a mandibular second premolar with four canals. Int Endod J 2001;34:406-10. Back to cited text no. 12
- 23 Macri E, Zmener O. Five canals in a mandibular second premolar. J Endod 2000;26:304-5. Back to cited text no. 13