

ORIGINAL RESEARCH



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Endodontic anatomy of lower premolars in a subpopulation from the Mureş county.

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Abstract

Background/Aim: Thorough knowledge of the endodontic anatomy and comprehensive understanding of root canal morphological variations are mandatory to ensure the successful outcome of the endodontic treatment. The purpose of this study was to compare the number of root canals of first and second lower premolars in a selected population to the root canal pattern reported by endodontic literature and to analyze the gender distribution.

Material and methods: A total of 376 preoperative periapical radiographs were obtained from patients living in the Mureş County of Romania. The X-rays were analyzed by 3 endodontists into determining whether the mandibular premolars had one, two or three root canals. The difference between male and female gender distribution was also examined. Endodontic treatment was then performed using the operating microscope to confirm the root canal configuration of the radiographic analysis. The results were compared to common knowledge of the endodontic literature.

Results: In this study, by using the radiographic method combined with direct observation aided by the operating microscope, 31.3% of first premolars and 14.6% of second premolars were found to have two root canals. A higher percentage of two root canals were found in females for both first (60.97%) and second premolars (76.9%).

Conclusion: In the Mureş County region, mandibular premolars with two root canals have a significantly higher rate than the literature reports. Female patients have a higher prevalence than male patients. This should concern clinicians from this area to be aware of these facts as it can unquestionably influence the tooth's long-term prognosis.

Keywords: lower premolar; anatomy; radiograph; root canal.

Introduction

The most common cause of root canal therapy failure in lower premolar teeth is the erroneous consideration that they have one single root canal. As the successful approach of the nonsurgical endodontic treatment is closely related to a comprehensive knowledge of the root canal system anatomy, clinicians must be familiar with these various configurations. Distribution of the number of roots and root canals varies widely in the literature [1]. Root canal configuration for the first and second lower premolars is complex and variable, making root canal therapy quite challenging [2,3].

The morphology of the root canal system is strongly related to ethnicity. Thus, important anatomical variations at different population groups, even from neighboring regions of the same country, are highly likely [4]. Numerous studies have shown that certain regions of several countries have an unexpectedly high prevalence of two root canal configured lower

premolars, especially first premolars [5]. This fact must draw the attention of clinicians practicing in these geographical areas, into fulfilling the conditions of a correct endodontic treatment by locating all root canals, properly cleaning and shaping, and filling the endodontic system in a three-dimensional way [6,7].

Data regarding the complexity of endodontic anatomy has its origins in the 19th century. Relevant evidence on this subject could be obtained until recently only with in vitro studies [8]. Nowadays, with the aid of the operating microscope, digital radiographs and micro CTs, detection of the second root canal in lower premolars has increased considerably. As most one-rooted teeth including lower premolars, appear to have one single root canal on periapical X-rays, mesial or distal shift radiographs can determine the type of canal system present. These can provide a clearer image of the tooth, necessary to locate all existing root canals [9,10].

Slowey's study has shown that amongst the permanent dentition, mandibular premolars are the most difficult teeth to manage endodontically and have the highest failure rate when it comes to root canal therapy [11]. Lower premolars usually have a single root canal which appears to be oval shaped on a transversal section, the buccolingual dimension being wider than the mesiodistal one [12]. In

situations when there are two root canals present, these usually have a round shape on a cross section. The bifurcation can take place at various levels of the root, generating complex shaping and cleaning issues. Numerous studies regarding the endodontic anatomy of lower premolars were published over the years. Some of these are presented in Table 1 [14,15].

Table 1 – Studies on endodontic anatomy of lower premolars

Year	Researcher	First lower premolars with two root canals	Second lower premolars with two root canals
1978	Vertucci	25%	12%
1988	Messing	27%	N/A
1992	Beters	25,5%	2,5%
2002	Rhodes	33%	11%
2006	Lu	46%	N/A
2007	Cleghorn	N/A	9%
2008	Ingle	32,8%	7,8%
2011	Kuttler	25.8%	1,2%
2014	Iliescu	N/A	10%
2014	Singh	22%	N/A
2021	Martius	23,6%	5,3%

N/A – not applicable

Knowledge of endodontic anatomy is the premise for a correct approach to root canal therapy. The awareness of possible internal root morphology variations of lower premolars in a certain population guides the clinician towards the correct radiological and clinical interpretation followed by the successful outcome of the endodontic treatment [16].

Materials and methods

A comprehensive radiographic analysis of first and second lower premolars' endodontic morphology was undertaken. The purpose of this study was to demonstrate a higher percent of two root canaled lower premolars in patients from the Mureş County and to raise awareness of this critical fact among clinicians.

Demographic data regarding gender was collected from the patients. A total of 376 periapical X-rays belonging to patients from a private practice were included in this research.

The private practice of CMI Dr. Lazăr Luminița gave permission to use the database of the patients for the purpose of this research on 6th of January 2020. Written and verbal consent from each patient was obtained along.

Personal data was processed in accordance with the data protection rules.

Inclusion criteria:

- Lower premolars without previous endodontic treatment
- Unmodified endodontic configuration by internal resorption
- Intact, fully developed root
- Exclusion criteria:
- Root fracture
- Root with external resorption

The X-rays were analyzed by 3 endodontists to establish the number of root canals of the lower premolars. This analysis was followed by the endodontic treatment of these teeth using the operating microscope to confirm the number of root canals discovered by the radiographic findings. The data was collected in Microsoft Excel work sheets (Microsoft Corporation, 2018) and subsequently analyzed with GraphPad (GraphPad Prism version 7.00 for Windows, GraphPad Software, La Jolla California USA) using Chi-square test without Yates' correction. The significance level was set at $P < 0.05$.

Results

Out of the 262 first premolars included in this study, 82 (31.3%) had two root canals. From the total of 356 second premolars analyzed, 52 had two root canals, which represents a ratio of 14,6% (Table 2, Figure 1).

Table 2 – Number of root canals in the investigated lower premolars

Number of canals	First premolar (n=262)	Second premolar (n=356)
One	68.7%	85.4%
Two	31.3%	14.6%

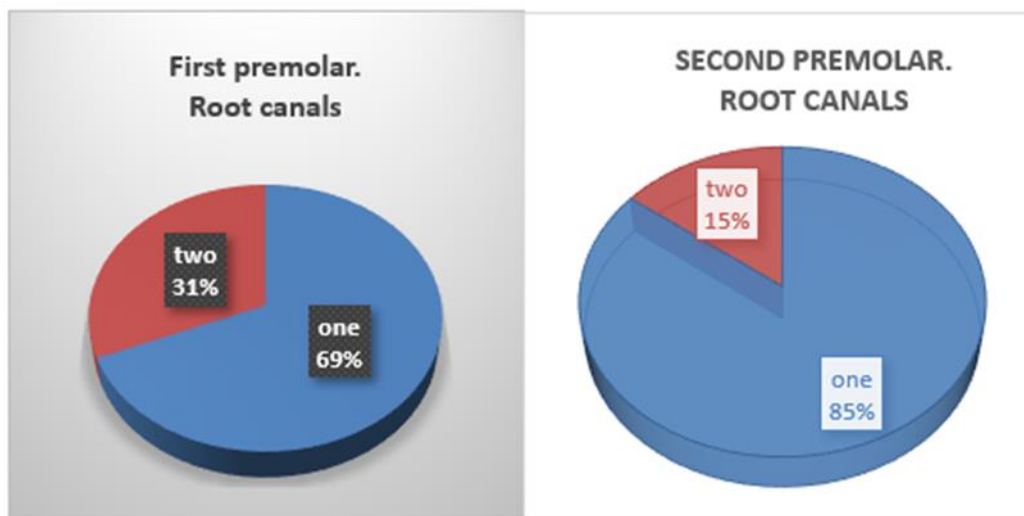


Figure 1. Distribution of one and two root canals in lower premolars

Out of the 82 first premolars with two root canals, 50 (60.97%) were found in female patients and 32 (39.02%) in male patients. Among 52 patients with two root canal configured second premolars, 40 (76.9%) were woman and 12 (23.07%) were men. The prevalence of two root canals was higher for female patients in both first and second premolars but the occurrence of two root canals between genders did not display any significant difference ($p=0.055$) (Figure 2).

	1st premolar	2nd premolar	Total
Males	32 (24%)	12 (9%)	44 (33%)
Females	50 (37%)	40 (30%)	90 (67%)
Total	82 (61%)	52 (39%)	134 (100%)

$p=0.055$

Figure 2. Gender distribution for lower premolars with two root canals

Discussion

The misconception that root therapy of lower premolars is straightforward as they only have one root canal should be disbanded.

Clinicians must be aware of anatomical variations of the root canal system of these teeth as it can play a decisive role in the long-term success of root canal therapy. If the entire root canal system is not located and properly cleaned, a large number of cases could result in failures and flare-ups. Furthermore, careful interpretation of preoperative radiographs and direct observation with the operating microscope is equally important [17,18].

The canal pattern of mandibular premolars may vary from one region to another, and it is closely linked to ethnicity and gender. The results of our research showed that the prevalence of lower premolars with two root canals is higher in patients from the Mureş County compared to regions from other countries. Studies on canal morphology using a variety of techniques were undertaken over time. Lu et al used the cross-sectioning method and found a percentage of 22% of first premolars that had two root canals, while Baisden et al identified similar results (24%) [19].

Decalcification and clearing methods were used by Caiskan et al who found a percentage of 19% of two canals configured first premolars [20]. The 3D reconstruction and computed tomography techniques are also popular within ways that determine root canal patterns. Mikrogeorgis' research reported a 11.59% of first premolars with two root canals while Robinson's study showed a percentage of 14. These studies reported a close link between root canal morphology and male/female gender [21,22]. The results of our study revealed a considerably higher rate of first premolars with two root canals. Results similar to previously mentioned authors were discovered by Willerhausen et al which, similar to our study, using radiological and direct observational means, found a percentage of 24.2% [23].

The findings of a study done by Habib et al on a Syrian population were in agreement with our research, with a 15.3% of second premolars with two root canals. Also, Geiger et

al observed a similar percent in a French population (13.4%) [24,25]. Other authors reported significantly lower rates of two canals configured mandibular second premolars: Zaatari et al (4.7%), Yu et al (2.2%), Ok et al (2.5%) [26,27,28].

Within the limitations of our study, the rate of lower premolars with a two root canal configuration, were high in the researched area, but further investigations in other parts of the country are required for comparison.

Conclusion

Variations of the endodontic anatomy of lower premolars in the Mureş area are quite significant. Gender is an important factor that needs to be considered prior to the endodontic treatment of lower premolars. Both first and second premolars should receive more attention of the clinicians treating patients from this region as knowledge of anatomical patterns, radiographic and clinical interpretation could play a critical role in the successful outcome of these challenging situations.

Conflict of interest: None to declare.

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