Mandibular first and second premolars with challenging root canal anatomy - Part 1: Review of the literature

INTRODUCTION (Part 1)

Mandibular premolars can be one of the most difficult teeth to treat endodontically because of the variations in root canal anatomy.\textsuperscript{1,2}

According to England, Hartwell and Lance,\textsuperscript{3} variation in root canal anatomy is one of the main reasons why mandibular premolars have a high frequency of failures and flare-ups. The literature indicates that the incidence of the number of roots and the number of canals varies greatly in human teeth.\textsuperscript{4,5}

MANDIBULAR FIRST PREMOLARS

Mandibular first premolars can present with an extremely complex internal root canal morphology.\textsuperscript{6,7} A study by the University of Washington showed mandibular first premolars to have the highest failure rate when evaluating non-surgical root canal therapy, with a reported failure rate of 11.4%.\textsuperscript{8}

This high incidence of failure could be attributed to the high incidence of variations in these teeth and the difficulty of negotiating, shaping and cleaning these canals if present. Age, sex and ethnicity are some of the factors that contribute to the variations in canal configurations between different studies.\textsuperscript{9-11}

According to Cleghorn, Christie and Dong,\textsuperscript{12} who reported on eight anatomical studies that include 4,462 teeth, most mandibular first premolars have a single root with a single root canal (97.9%) (Figure 1).

Vertucci\textsuperscript{4} shows that a single canal is found in 70% of cases; in 4% of cases there could be two canals joining at a common apical foramen (Figure 2); in 24% of cases one root canal bifurcates at the apical third of the root into two branches (Figure 3); and in 1.5% of cases there could be two independent canals (Figure 4).

In 1990, Hülsmann\textsuperscript{13} reported a mandibular first premolar with three root canals and, according to Baisden, Kulild and Weller,\textsuperscript{14} this tooth can also present with a C-shaped root canal.

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A review by Cleghorn, Christie and Dong reports on the internal morphology of 4,733 mandibular first premolar teeth. One canal was present in 75.8% of the teeth studied, compared to 24.2% of teeth having two or more canals.

A single apical foramen was found in 78.9% of teeth, whereas two or more apical foramina were found in 21.1% of teeth. They also reported that mandibular first premolars with two roots were found in 1.8% of cases and that three-rooted (0.2%) and four-rooted (<0.1%) varieties were quite rare.

Mandibular Second Premolars

The mandibular second premolar usually has one root with a single root canal system that can occur in 65% to 100% of cases.4,5,7,12,15,16 (Figure 5). A review of the literature on root configuration of mandibular second premolars when 4,019 teeth were assessed showed a 99.6% incidence of single-rooted teeth.12

The single root can also present with two canals in 1–11%12,17,18 with a single apical foramen in 91.8% (Figure 6), or two or more apical foramina in 8.2% of cases (Figure 7).12

Several authors have also reported single roots with three root canals in approximately 0.4% of cases (Figures 8A–E).16,18–21

Rhodes22 and Macri and Zwemer23 have reported mandibular second premolars with four and five root canals respectively. According to a literature review by Cleghorn, Christie and Dong,12 mandibular second premolars can have two separate roots in 0.3% of cases (Figure 10) and three separate roots in 0.1% of cases (Figure 11).

Although normal root canal anatomy and canal configuration are well documented in the literature,8 there are still large variations in data on anomalies and the incidence thereof.12

Similar findings are reported by Park et al.24 These authors report an incidence of 0.6% of mandibular second premolars presenting with two separate roots. According to Sachdeva et al.25 an investigation of available literature revealed no cases of four separate roots and four distinct root canals in mandibular second premolars.

It is important to note that the root and canal morphology of the second mandibular premolar can be influenced by gender, age and ethnicity.26–28 Park et al.24 and co-workers conclude in their study that no significant differences could be found between female and male patients or between left and right sides of the mandibula.

Tzanetakis et al.29 report a unique case of a mandibular second premolar with four canals diagnosed and treated with the use of the dental operating microscope, emphasising the vital role of proper magnification in diagnosis and treatment of challenging anatomy. The use of conventional radiographs provides limited information; investigation using specialised radiographic techniques in conjunction with traditional two-dimensional images is advocated to confirm challenging anatomy.25

In part two of this article the authors will provide the clinician with guidelines and clinical techniques that might aid in root canal treatment on mandibular premolars that present with unusual root canal anatomy.

Figure 5. Periapical radiograph of a mandibular right second premolar with a single root with two separate root canal systems joining in the apical third of the root to form one apical foramen.

Figure 6. Periapical radiograph of a mandibular right second premolar with a single canal. Note the multiple ports of exit that are visible after irrigation and obturation.

Figure 7. Periapical radiograph of a mandibular right second premolar with a single root and two separate root canal systems with two apical foramina. Note the midroot lateral portal of exit that is visible after irrigation and obturation.
References


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1. Go to the SADA website www.sada.co.za.
2. Log into the ‘member only’ section with your unique SADA username and password.
3. Select the CPD navigation tab.
4. Select the questionnaire that you wish to complete.
5. Enter your multiple choice answers. Please note that you have two attempts to obtain at least 70%.
6. View and print your CPD certificate.