# Aberrant anatomy in endodontically treated teeth in a Nigerian Teaching Hospital

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**ABSTRACT**

**Objective:** The anatomical features of teeth show wide morphological variations. These variations include coronal and radicular aberrations. They are thought to be influenced by age, gender, race and evaluation methods. Therefore, an in-depth knowledge of both normal and unusual dental morphology is vital in the practice of endodontics**.** The objective of the study was to investigate the incidence of aberrant root anatomy in endodontically treated teeth among adult patients attending the Endodontic unit of a tertiary hospital in Southern Nigeria.

**Methods:** A retrospective review of all clinical records of adult patients who attended the Endodontic unit of the Department of Restorative Dentistry, University of Benin Teaching Hospital (UBTH) Edo State, Nigeria from January 2013 to January 2018 for root canal treatment (RCT). The demographic and clinical data were retrieved from the patients' records and analyzed using IBM SPSS version 20.

**Results:** A total of 927 patients, comprising445 (48.0%) males and 482 (52.0%) females (a ratio of 1:1.1) underwent endodontic treatment during the study period. The age range of patients was 18-80 years. The total number of teeth treated was 1016. Aberrant root anatomy was observed in 161 (15.8%) of the studied sample. It was more frequently seen in mandibular 118 (29.9%) than maxillary 43 (6.9%) teeth. Aberrant root anatomy occurred most frequently in mandibular second molars 42 (38.9%) followed by the maxillary first molars 32 (38.1%). These aberrations were observed in the roots and canal numbers of treated teeth while the occurrence of aberrant anatomy was higher in females (9.9%) than males (5.9%).

**Conclusion:** In this study, aberrant root anatomies were mostly observed in mandibular teeth and among female patients. Clinicians should be aware of the existence of wide variations in root form and canal morphology during endodontic procedures. The alertness is helped by the use of Dental operating microscopes or other magnification devices, multiple periapical radiographs with angular cone shift or other contemporary imaging modalities in revealing tooth anatomy that would otherwise be missed.

**Keywords:** Aberrant anatomy, endodontic treatment, Nigerian

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## INTRODUCTION

The anatomical features of teeth show wide morphological variation. These include variations in coronal and radicular anatomy.[1]It is thought that these variations may be influenced by age, sex, race and evaluation methods.[2]

The dentist must be familiar with the various pathways that root canals take to the apex[3] in order to successfully carry out endodontic treatment. Therefore, a thorough knowledge and understanding of both normal and unusual root canal anatomy and morphology is critical. This knowledge will facilitate proper cleaning, shaping and obturation of all canals, resulting in a better treatment outcome.[4]

The exact reason for aberrant root and canal formation remains uncertain.[1] However, ethnic

background, local traumatic injuries to Hertwig's epithelial root sheath during root formation, genetic factors and some diseases are considered to be the main causes.[5,6] Gender has also been postulated as a factor affecting root form and canal anatomy variations.[7] However, there is little evidence correlating its influence on these variations. Studies and case reports show aberrations in root anatomy in various tooth types and populations.[1,5-13] They include the presence of supernumerary or fewer roots, additional or fewer numbers of canals in one or more roots of studied teeth.[1,5-13]

Detection and treatment of teeth with aberrant anatomy can be challenging.[1] However, the diagnostic phase prior to treatment may alert the clinician to typical signs of the presence of aberrant anatomy. Gingival recession may reveal the bifurcation of the buccal root indicating two canals in maxillary and mandibular premolar teeth[3] while an aberrant occlusal anatomy may be indicative of aberrant pulp chamber and root canal anatomy.[1]

The challenges of missed canals or other aberrant anatomy during root canal treatment may be reduced by employing the appropriate imaging technologies. The aim of this study was to determine the incidence of aberrant root anatomy and gender influence if any, in teeth that received endodontic treatment among adult patients attending the Endodontic unit of a Tertiary Hospital in Southern Nigeria.

## MATERIALS AND METHODS

The study was carried out at the Endodontic unit of the Department of Restorative Dentistry University of Benin Teaching Hospital (UBTH), Benin City, Nigeria. Ethical approval for this study was obtained from the Ethics and Research Committee of the University of Benin Teaching Hospital, Benin City, Nigeria.

A retrospective study of endodontic treatment was carried out in adult patients in the Endodontic unit of the Department of Restorative Dentistry, University of Benin Teaching Hospital over a 5-year period (January 2013 – January 2018). The clinical endodontic records of patients seen within the study period constituted the sample. Only clinical records of patients aged 18 and above that required non-surgical endodontic treatment were included in the study. Clinical records with incomplete data were excluded from the study. Patient's names and record numbers were omitted to preserve confidentiality.

The radiographic images were obtained from among the records acquired using the RVG 5100 (Care stream Dental, Germany) in the Digital Radiography unit of the department. The diagnostic, working length, master cone and post obturation digital radiographs as well as clinical records were evaluated for number of roots and canals. After a thorough review of the digital radiographs of all teeth; those with unusual root anatomy were identified and segregated by two examiners (ACN and NSU) who were calibrated prior to the study. The Cohen's Kappa value for inter-examiner reliability in the assessment of the digital radiographs was 0.89. A proforma was used to record the demographic and clinical data extracted from patient's clinical records. These included; the age of patient, gender, treated teeth, number of roots and canals. Data collected was analysed using IBM SPSS Software.

## RESULTS

A total of 927 patients, comprising 445 (48.0%) males and 482 (52.0%) females (a ratio of 1:1.1) underwent endodontic treatment during the study period (Table 1). An increase was observed in the number of patients demanding endodontic treatment during the study period (Figure 1). The age range of patients treated was 18-80 years while the mean age was 31.6±8.0 years. The frequency of teeth with aberrant anatomy was higher in females (9.9%) than males (5.9%) (Table 1).

A total of 1016 teeth were treated in 927 patients. Aberrant root anatomy was observed in 161 (15.8%) teeth in the study population (Table 1); being more frequent in the mandible118 (29.9%) than in maxilla 43 (6.9%) (Table 2). The aberrations identified included the presence of supernumerary or fewer roots, additional or fewer numbers of canals in one or more of the roots in the treated teeth.

In the maxillary arch, first premolars had a third root with three canals in 2 (1.8%) teeth (Table 3). In this study 32 (38.1%) extra mesiobuccal canals (MB-2) were observed in maxillary first molars while 8 (18.2%) were seen in the second maxillary molars (Table 3). Based on gender variation, females had a higher percentage of teeth with MB-2 (21.4%) compared to males (16.7%) in maxillary first molars. In contrast, there was no gender predilection for maxillary second molars with MB-2 in this study (Table 3). One (33%) maxillary third molar had two roots with two canals among the treated teeth. This variation was observed in a male participant in this study (Table 3).

In the mandibular arch, the first and second premolars each had a single root with an extra canal in 5(18.5%) and 6 (15.4%) teeth respectively. Two

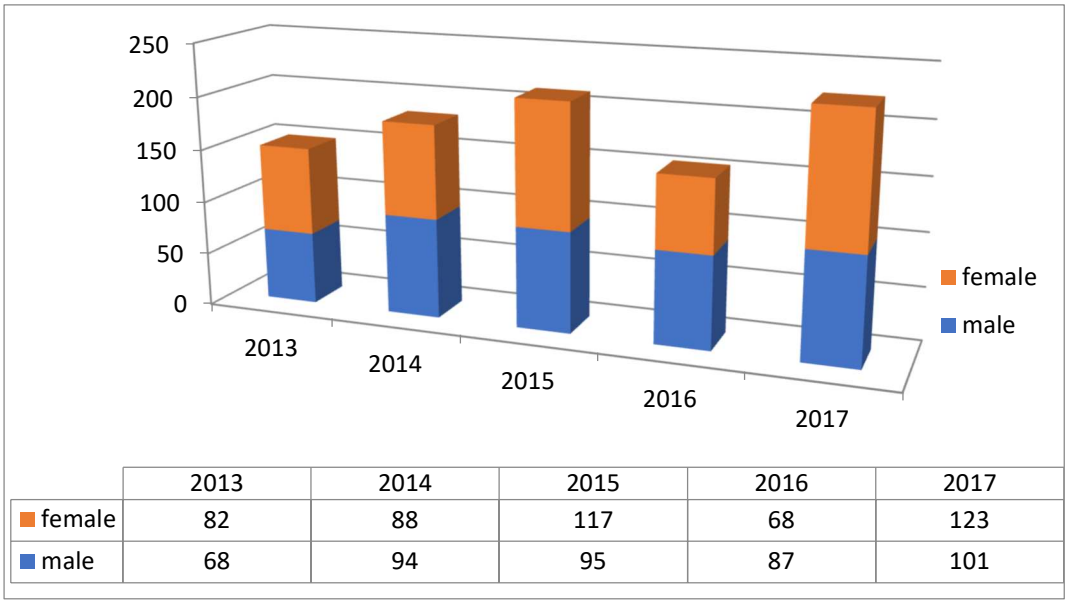
roots were detected in mandibular first premolar 2 (7.4%) while the second premolars had 1 (2.6%) (Table 4). In this study, mandibular first premolars with supernumerary roots were found only in males (7.4%). (Table 4).

Mandibular first molars had extra root in 5 (3%) treated teeth. Extra canals in the distal root or third root were recorded in 63 (37.5%) mandibular first molar teeth in this study (Table 4). Females had more (2.4%) mandibular first molars with three roots than males (0.6%). In the mandibular second molars, a single root with one canal was observed in 1 (0.9%) tooth while three roots were recorded in 2(1.8%) other teeth studied (Table 4). Extra canals in the distal root or third root were recorded in 31 (28.7%) of mandibular second molar teeth studied (Table 4).

Table 1: Socio demographic characteristics of the study participants

| Variable | Patients treated(n=927) n (%) | ETT (n=1016) n (%) |
|---|---|---|
| **Age group (years)** | | |
| <20 | 73 (7.9) | 80 (7.9) |
| 21 – 30 | 326 (35.2) | 332 (32.7) |
| 31 – 40 | 350 (37.7) | 409 (40.3) |
| 41 – 50 | 92 (9.9) | 96 (9.4) |
| 51 – 60 | 53 (5.7) | 64 (6.3) |
| >60 | 33 (3.6) | 35 (3.4) |
| Mean age (Mean ± SD) | 31.6 ± 8.0 | |
| **Gender** | | |
| Male | 445 (48.0) | 490 (48.2) |
| Female | 482 (52.0) | 526 (51.8) |
| **Aberrant anatomy** | | |
| Male | 51 (5.5) | 60 (5.9) |
| Female | 96 (10.4) | 101 (9.9) |

*ETT- Endodontically treated teeth




| | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| female | 82 | 88 | 117 | 68 | 123 |
| male | 68 | 94 | 95 | 87 | 101 |

Figure I: Distribution of patients treated during study period

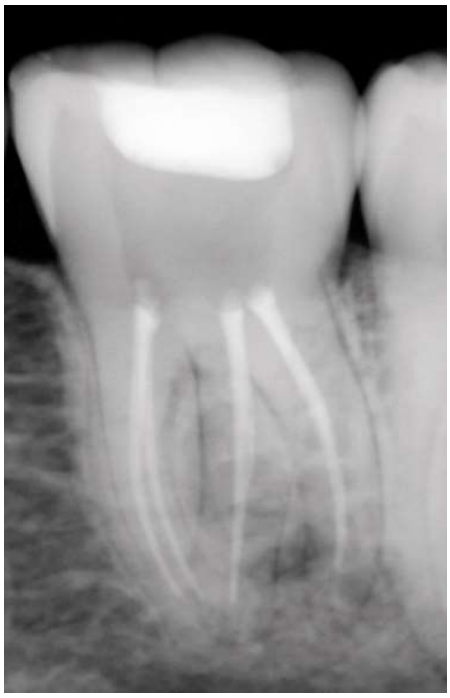


Figure 2: Mandibular second molar with four (4) Canals

Table 2: Distribution of endodontically treated teeth with aberrant root anatomy.

| Tooth | Aberrant root anatomy | | Total n (%) |
|---|---|---|---|
| | **Absent n (%)** | **Present n (%)** | |
| **Maxillary** | | | |
| Central incisors | 159(100.0) | 0 (0.00) | 159(100.0) |
| Lateral incisors | 61 (100.0) | 0 (0.00) | 61 (100.0) |
| Canines | 28 (100.0) | 0 (0.00) | 28 (100.0) |
| First premolars | 108 (98.2) | 2 (1.8) | 110 (100.0) |
| Second premolars | 133 (100.0) | 0 (0.0) | 133 (100.0) |
| First molars | 52 (61.9) | 32 (38.1) | 84 (100.0) |
| Second molars | 36 (81.8) | 8 (18.2) | 44 (100.0) |
| Third molars | 2 (66.7) | 1 (33.3) | 3 (100.0) |
| **Total** | **579(93.1)** | **43 (6.9)** | **622(100.0)** |
| **Mandibular** | | | |
| Central incisors | 32 (100.0) | 0 (0.0) | 32(100.0) |
| Lateral incisors | 10 (100.0) | 0 (0.0) | 10 (100.0) |
| Canines | 7 (100.0) | 0 (0.0) | 7 (100.0) |
| First premolars | 20 (74.1) | 7 (25.9) | 27 (100.0) |
| Second premolars | 33 (84.6) | 6 (15.4) | 39 (100.0) |
| First molars | 105 (70.2) | 63 (37.5) | 168 (100.0) |
| Second molars | 66 (64.5) | 42 (38.9) | 108 (100.0) |
| Third molars | 3 (100.0) | 0 (0.0) | 3 (100.0) |
| Total | 276(70.1) | 118(29.9) | 394 (100.0) |

Table 3: Gender distribution by number of roots and canals in maxillary teeth with aberrant root anatomy

| Tooth / Gender | Number of roots n (%) | Number of canals n(%) | n(%) | n(%) | n(%) |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Maxillary first premolar | | | | | |
| | One root | | | | |
| Male | 1 (0.9) | 1 (0.9) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 2 (1.8) | 1 (0.9) | 1 (0.9) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 56 (50.9) | 0 (0.0) | 56 (50.9) | 0.0 (0.0) | 0 (0.0) |
| Female | 49 (44.5) | 0 (0.0) | 49 (44.9) | 0.0 (0.0) | 0 (0.0) |
| | Three roots | | | | |
| Male | 1 (0.9) | 0 (0.0) | 0 (0.0) | 1 (0.9) | 0 (0.0) |
| Female | 1 (0.9) | 0 (0.0) | 0 (0.0) | 1 (0.9) | 0 (0.0) |
| **Total** | **110 (100.0)** | **2 (1.8)** | **106 (96.4)** | **2 (1.8)** | **0 (0.0)** |
| Maxillary first molar | | | | | |
| | One root | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0.0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0.0 (0.0) | 0 (0.0) |
| | Three roots | | | | |
| Male | 36 (42.9) | 0 (0.0) | 0 (0.0) | 22 (26.2) | 14 (16.7) |
| Female | 48 (57.1) | 0 (0.0) | 0 (0.0) | 30 (35.7) | 18 (21.4) |
| **Total** | **84 (100.0)** | **0 (0.0)** | **0 (0.0)** | **52 (61.9)** | **32 (38.1)** |
| Maxillary second molar | | | | | |
| | One root | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0.0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0.0 (0.0) | 0 (0.0) |
| | Three roots | | | | |
| Male | 26 (59.1) | 0 (0.0) | 0 (0.0) | 22 (50.0) | 4 (9.1) |
| Female | 18 (40.9) | 0 (0.0) | 0 (0.0) | 14 (31.8) | 4 (9.1) |
| **Total** | **44 (100.0)** | **0 (0.0)** | **0 (0.0)** | **36 (81.8)** | **8 (18.2)** |
| Maxillary third molar | | | | | |
| | One root | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 1 (33.3) | 0 (0.0) | 1 (33.3) | 0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Three roots | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 2 (66.7) | 0 (0.0) | 0 (0.0) | 2 (66.7) | 0 (0.0) |
| Total | 3 (100.0) | 0 (0.0) | 1 (33.3) | 2 (66.7) | 0 (0.0) |

Table 4: Gender distribution by number of roots and canals in mandibular teeth with aberrant root anatomy

| | Number of roots n (%) | Number of canals n (%) | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Mandibular first premolar | | | | | |
| | One root | | | | |
| Male | 14 (51.9) | 12 (44.4) | 2(7.4) | 0 (0.0) | 0 (0.0) |
| Female | 11 (40.7) | 8 (29.6) | 3(11.1) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 2 (7.4) | 0 (0.0) | 2 (7.4) | 0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| **Total** | **27 (100/0)** | **20 (74.1)** | **7 (25.9)** | **0 (0.0)** | **0 (0.0)** |
| Mandibular second premolar | | | | | |
| | One root | | | | |
| Male | 17 (43.6) | 15 (38.5) | 2 (5.1) | 0 (0.0) | 0 (0.0) |
| Female | 21 (53.8) | 17 (43.6) | 4 (10.3) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 1(2.6) | 0 (0.0) | 1 (2.6) | 0 (0.0) | 0 (0.0) |
| **Total** | **39 (100.0)** | **32 (82.1)** | **7 (17.9)** | **0 (0.0)** | **0 (0.0)** |
| Mandibular first molar | | | | | |
| | One root | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 70 (41.7) | 0 (0.0) | 0 (0.0) | 50 (29.8) | 20 (11.9) |
| Female | 93 (55.4) | 0 (0.0) | 0 (0.0) | 55 (32.7) | 38 (22.6) |
| | Three roots | | | | |
| Male | 1 (0.6) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.6) |
| Female | 4 (2.4) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 4 (2.4) |
| **Total** | **168 (100.0)** | **0 (0.0)** | **0 (0.0)** | **105 (62.5)** | **63 (37.5)** |
| Mandibular second molar | | | | | |
| | One root | | | | |
| Male | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Female | 1 (0.9) | 1 (0.9) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Two roots | | | | |
| Male | 56 (51.9) | 0 (0.0) | 4 (3.7) | 34 (31.5) | 18 (16.7) |
| Female | 49 (45.4) | 0 (0.0) | 6 (5.6) | 32 (29.6) | 11 (10.2) |
| ` | Three roots | | | | |
| Male | 1 (0.9) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.9) |
| Female | 1 (0.9) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.9) |
| Total | 108 (100.0) | 1 (0.9) | 10 (9.3) | 66 (61.1) | 31 (28.7) |

**DISCUSSION**

The number of patients that underwent root canal treatment during the study period is significantly higher than previously reported in Nigeria.[14,15] The distribution of the patients showed a progressive increase in the number of patients demanding endodontic treatment year on year under review; an indication of their desire to retain teeth in a disease free and functional state. This trend may be due to increased dental awareness, the desire to maintain good oral health,[16] expanding population and increased life expectancy.[17]

Over half of the patients encountered in this study were females 482 (52%). This is in agreement with similar studies[14,18] which also reported a higher demand for endodontic treatment by females. This may be justified by the inherent concern of females for their oral health and appear to be more motivated to demand oral health care.[14,18] However, in an earlier study[15] in South Western Nigeria, Oginni et al.,

reported a higher demand for endodontic treatment by males.

A higher demand for endodontic treatment will lead to an increased probability of encountering teeth with aberrant anatomy; consequently, the practitioner must treat each tooth assuming that complex anatomy occurs often enough to be considered normal.[3] Aberrant anatomy relating to root form and/or number of canals were found in 15.8% of all endodontically treated teeth during the study period.

Gender has also been postulated as a factor affecting root form and canal anatomy variations.[7] However, there is limited evidence correlating the variations in root form and canal anatomy with gender.[4] In this study, the frequency of teeth with aberrant root anatomy was higher in females (19.2%) than males (12.2%). Sert and Bayirli[7] evaluated root canal configurations in 2800 teeth by gender in a Turkish population. They concluded that gender plays a role in determining canal morphology and that both gender and ethnic origin should be considered during the preoperative evaluation stage of root canal treatment.

This study reveals the presence of aberrant root anatomy in teeth in both maxillary and mandibular arches. The aberrations include the presence of supernumerary or fewer roots, additional or fewer numbers of canals in one or more of the roots in the treated teeth. The maxillary first premolar typically presents with two roots, one buccal and one palatal [19]; with variations ranging from one to three roots.[19] Three root forms are rare but have been reported in literature with percentages ranging from 0-9.2%.[20] Studies suggest that the presence or absence of a third root canal is influenced by racial factors; since three-rooted premolars are more frequent in Caucasian populations and rare in African and Asian populations.[21] In this study, 1.8% of maxillary first premolars treated had three roots with three canals. This is at variance with findings from a previous study [22] in a Nigerian population where no maxillary first premolars had three roots. Sulaiman et al., [10] however reported a case of a maxillary premolar with three canals in South-Western Nigeria.

The prevalence of maxillary first premolars with a third root did not show any gender predilection in this study. This is in contrast with an *in vitro* study by Ng'ang'a et al [23] in a Kenyan population which reported a higher incidence of three rooted maxillary first premolars in males than females.

The maxillary first and second molars have complex anatomy and frequently present with unusual canal configurations and anomalies.[8] The most commonly reported aberration is a second canal in the mesiobuccal root.[24,25]An extra mesiobuccal canal (MB-2) was observed in 38.1% of maxillary first molars studied. This is corroborated by the findings of an earlier study[24] done ten years prior in same locality that reported a similar incidence of MB-2 canal in maxillary first molars. The frequency of MB-2 canal in maxillary second molars was 18.2% in this study. Betancourt et al.,[8] found a significantly higher number (46.9%) of maxillary second molars with MB-2 canals in a Chilean population. This disparity may be due to difference in racial background of the studied populations.

In the maxillary first molars, females had a higher percentage of teeth with MB-2 than males. This is at variance with the findings of Betancourt et al.,[8] which reported a statistically significant association between the presence of MB-2 canal and male gender in maxillary first molars. This may be due to racial factors. The prevalence of MB-2 in maxillary second molars studied however, did not show any gender predilection. This is also in contrast to findings by Betancourt et al.,[8]

The root anatomy of maxillary third molars has been described as highly variable.[12] Its number of roots/canals in maxillary third molars vary from one to five.[12] In this study, 33.3% of treated maxillary third molars had two roots with two canals. Sidow et al.,[13] reported a similar incidence of maxillary third molars with two roots in a previous study.

In this study, aberrant root anatomy was more frequently observed in mandibular than maxillary endodontically teeth. Mandibular first and second premolars were observed to have a single root with an extra canal in 18.5% and 15.4% of treated teeth respectively. A second root was recorded in 7.4% of mandibular first and 2.6% of mandibular second premolars. Similarly, Trope et al.[11]in their study observed that black patients had a higher number of mandibular premolars with extra canals than Caucasians. This is suggestive of racial differences in the morphology of mandibular premolar teeth in these various groups.

Majority of studies on mandibular first and second molar teeth have reported the presence of two roots;[9,26] while the existence of a third root (radix entomolaris or radix premolaris) is said to be higher in Asians, Mongolians and Eskimos compared to other populations.[9] In this study, 3% of mandibular

first molars and 1.8% of mandibular second molars had three roots. Although neither of both teeth in this study had four roots; its occurrence in mandibular first molars is very rare and has been sparingly reported in case reports.[27,28]

In some cases, the aberration found may not be extra roots but fewer roots than usual. In this study, 1 (0.9%) mandibular second molar had a single conical root with one canal. Root fusion resulting in a single root, conical or C-shape form, has been reported to occur in up to 21.8% of mandibular second molars.[29]

The number of canals in mandibular first and second molars show wide variations; [9,26] notably in the presence of two or four canals instead of the frequently occurring three canals, supernumerary roots, taurodontism, additional or fewer number of canals in one or more of the roots.[29] In this study, two canals were observed in 9.3% of mandibular second molars while 28.7% had four canals (Figure 2). Also, 37.5% of mandibular first molars were recorded to have four canals. Similar findings were reported by Valencia de Pablo et al[9] in a systematic review of eighteen studies in which a total of 4745 mandibular first molars were studied, they reported the presence of three canals in 61.3%, 4 canals in 35.7%, and 5 canals in about 1% of the total number of cases.

An evaluation of the influence of gender on the incidence of aberrant root anatomy in this study revealed that mandibular first molars with three roots were more frequently seen in females than males. In contrast, the incidence of three roots in the mandibular second molars had no gender predilection.

Detection and treatment of teeth with aberrant anatomy can be challenging.[1] The diagnostic phase prior to treatment may alert the clinician to typical signs of the presence of aberrant anatomy. Gingival recession may reveal the bifurcation of the buccal root indicating two canals in maxillary and mandibular premolar teeth.[30] Similarly, an aberrant occlusal anatomy may also be indicative of aberrant pulp chamber and root canal anatomy.[1] The challenges of missed canals or other aberrant anatomy during root canal treatment may be reduced by varying the angle of inclination of the x-ray tube[31] and the used of contemporary imaging modalities like cone beam computed tomography (CBCT). [2]

Operative strategies may include access cavity modification in order to gain straight line access to all canals.[30] Others include the use of dyes like 1% methylene blue, warmed NaOCl (champagne/ bubble test) in order to locate canals.[30]Also, the use of magnifying aids such as loupes or Dental Operating Microscope with illumination helps the clinician to appreciate the intricacies of the pulp chamber anatomy, visualize the pulpal floor and locate root canal orifices;[4] aiding complete chemo-mechanical preparation and a three dimensional obturation of the root canal system.

## CONCLUSION

Endodontic management of teeth with aberrant anatomy is expected to become more common in contemporary endodontic specialist practice. Clinicians should be aware of the wide variations of root form and canal morphology that exist when carrying out endodontic procedures on patients. Also, the use of Dental operating microscopes or other magnification devices, multiple periapical radiographs with cone shift technique or other contemporary imaging modalities are useful in revealing tooth anatomy that would otherwise be missed.

**Source of Support**
Nil.

**Conflict of Interest**
None declared.

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