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Follow-up of Non-Surgical Endodontic Treatment of Permanent Mandibular First Molars with Middle Mesial Root Canals –Four Clinical Case Series Report with a Mini Literature Review

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Abstract **Case Report**

***Introduction*:** Root canal treatment's long-term favorable prognosis is dependent on a good pulpal-periapical diagnosis and periodontium health, clear preoperative radiographs, an adequate understanding of complex root canal anatomy and endodontic pathology, proper treatment protocol that involves careful examination of root anatomy, identifying unusual root canal anatomy, access modification, negotiation of all the canals, complete debridement by shaping and chemical disinfection of all the portals of entry and exit within the root canal system, hermetic three-dimensional obturation of root canal space with an inert filling material followed by a fluid-tight tooth coronal seal. Clinicians are challenged with aberrations in the root canal anatomy of permanent mandibular molars especially when this anatomy is difficult to visualize from radiographs. The presence of a middle mesial root canal in permanent mandibular molars has been reported. Extensive exploration of the groove between mesiobuccal and mesiolingual orifices in mandibular permanent molars may reveal the presence of additional middle mesial canal orifice. ***Objectives*:** This clinical case series discusses the Follow-up of non-surgical endodontic management of four mandibular permanent first molars with an additional Middle Mesial (MM) canal in the mesial root. A mini literature review of this anatomical anomaly is also presented. ***Materials and Methods*:** The four mandibular molars with middle mesial canal endodontic cases done at Endodontics Clinic, Primary Health Care Corporation (PHCC), Qatar by the author in the year 2021 were reviewed with follow-up in the year 2023, address the endodontic management from identification of additional canals to complete obturation and follow up. ***Results*:** Clinical follow-up post endodontic treatment demonstrated that the treated molars with extra canals were asymptomatic with no sensitivity to percussion or palpation, no swelling or tooth mobility, and normal periodontal probing depth. The follow-up radiograph showed teeth with normal periapical surrounding tissues with no signs of periradicular periodontitis. ***Conclusion*:** Accurate clinical and radiographic evaluations are the first step in any successful endodontic treatment. For ethical endodontic practice, clinicians must be aware of any potential anatomic variations such as the middle mesial canal of the mandibular molars.

Keywords: Anatomic variation, middle mesial canal, extra root canal, five root canals permanent mandibular first molar, non- surgical root canal treatment, clinical endodontic follow-up, Primary Health Care Corporation Qatar, case series report.

INTRODUCTION

The permanent mandibular first molars are the most common teeth to be treated endodontically followed by permanent maxillary first molars. This may be related to mandibular permanent first molars being the first permanent posterior tooth to erupt in the oral cavity and pits and fissures present causing plaque retention and deep caries [1]. The mandibular first molar poses a series of anatomical challenges such as extra roots, extra canals, isthmuses, deltas, fins, lateral canals, and apical ramifications [1,2]. Due to its morphological complexities, endodontic failure occurs highest in this tooth.

Vertucci and Williams [3] and Barker *et al.*,[4] verified the first independent middle mesial (MM) canal incidence in mandibular molars in 1974. In 1981, Pomeranz *et al.*,[5] discussed the in vivo occurrence

and classified three separate morphological possibilities in the middle mesial root depending on its clinically recognizable pathway (a) fin: an isthmus exists between the middle mesial (MM) canal and a mesiobuccal(MB) or mesiolingual (ML) canal during any stage of course from the orifice to the apex, or an instrument can pass between MM canal and MB or ML canal easily, as the orifices will merge coronally after the instrumentation,(b) confluent when the prepared middle mesial canal originated as a separate orifice later join more apically the mesiobuccal or mesiolingual canal before exiting from the apex and (c) independent, where mid mesial canal run independently from separate orifice to the separate apical terminus. The middle canal is also interchangeably called intermediate canal, mesio-central canal, third mesial canal, accessory mesial canal, and medial mesial canal [2, 6-9].

Based on the number of canals from orifice to apex, Weine FS *et al.*,[10] were the first to categorize root canal configurations within a single root into four basic types. Later Vertucci FJ [11] further elaborated Weine's classification into eight types. Gulabivala K *et al.,* [12] added seven additional configurations to Vertucci's classification as Type I to Type VII. Sert S and Bayirli GS [13] added fourteen new root canal configurations to Vertucci's classification. They were categorized as Type IX through Type XXIII. Al-Qudah AA [14] observed four new types of configurations in their study on root canal morphology of mandibular molars Type XX to Type XXIII.

This clinical non-surgical endodontic case series of mandibular first permanent molars with an additional Middle Mesial (MM) canal done at Endodontics Clinic, Primary Health Care Corporation (PHCC), Qatar, is documented following the PRICE guidelines [15] and reviews the follow-up. To date, only very few clinical reports have reported follow-up of more than two canals in the mesial root of mandibular molars.

CASE SERIES Case 1:

A 21-year-old male Qatari patient presented with subjective symptoms of prolonged pain caused by sensitivity to cold/hot food and drinks, over his right mandibular region. The patient has no significant medical history and no drug allergies. On intraoral clinical examination, seen defective temporary filling in the right mandibular first molar (tooth 46), The tooth was negative to percussion, with no pain on palpation in the buccal and lingual vestibule of the tooth 46, mobility within normal limits, periodontal probing around the tooth was within normal limits. A very deep proximal- distal carious lesion cavity below the earlier defective filling near the distal pulp and periodontal ligament widening was seen on the pre-operative diagnostic radiographic examinations (Figure 1) (Repeat preop xray 46 was taken at the time of treatment, showing the same tooth radiographic features as a year ago, but the xray was deleted by default, so the previous xray taken a year ago is used for publication). Diagnosis**:** Symptomatic Irreversible pulpitis 46. Endodontic treatment was started, and the treatment was completed in two visits. In the first visit, after a right-side inferior alveolar nerve block anesthetic was administered, a proper rubber dam isolation was achieved even though the tooth was undergoing orthodontic treatment. The previous temporary filling was removed, and all secondary caries excavated exposing the carious distal pulp, pre-endodontic distal wall build-up was done using intermediate restorative material, and an endodontic access cavity was prepared. Initially, four root canal orifices were detected Mesiobuccal (MB), Mesiolingual (ML), Distobuccal (DB), and Distolingual (DL).Root canals' working length was taken with apex locator with 10 K files and verified radiographically, complete pulpectomy initial shaping and cleaning of canals were done, and then on probing the groove with endodontic explorer between MB & ML orifices noticed Middle Mesial (MM) canal orifice, was then negotiated and observed that MM canal was merging with ML canal in the apical third. The working lengths of MB, MM, ML, DB, and DL canals were 22, 20.5, 20.5, 20, and 20 mm, respectively (5 separate canal orifices). A calcium hydroxide dressing was used between appointments, and a provisional temporary filling was placed. In the second visit, the canals were re-instrumented, the five root canals were enlarged up to NiTi rotary files size 25 for the mesials and size 40 in distals under copious irrigation saline, sodium hypochlorite 3% and the last irrigant being sodium hypochlorite 3% and ethylenediaminetetraacetic solution (EDTA)17%. The canals were dried with sterile paper points, the root canals were filled with resin sealer and guttapercha by using the cold lateral compaction technique. Access was sealed with a temporary filling. Post-operative x-ray was taken (Figure 2), the MM canal was joining with the ML canal, the MB canal was separate, and the 2 distal canals joined apically. The tooth build-up is done with glass ionomer cement and composite resin materials. A 20-month post-treatment clinical follow-up tooth 46 confirmed the patient had no symptoms, no tenderness on percussion and palpation, and a fully functional tooth. Radiographically, no abnormality was detected as shown in the latest radiograph (Figure 3a, Figure 3b).

Figure 1: Pre-operative periapical radiograph tooth 46 showing defective temporary restoration.

Figure 2: Immediate post-op distal oblique shift x-ray 46. Mesial configuration (3-2) MM canal joining ML canal: Gulabivala Type II [12]/ Sert S type XV [13]. Distal canals configuration (2-1): Vertucci type 2 [11]

Figure 3a: Follow-up 20 months post-op tooth 46: horizontal x-ray with 20 degrees distal angulated shift (notice the MM canal joining ML canal- SLOB technique)

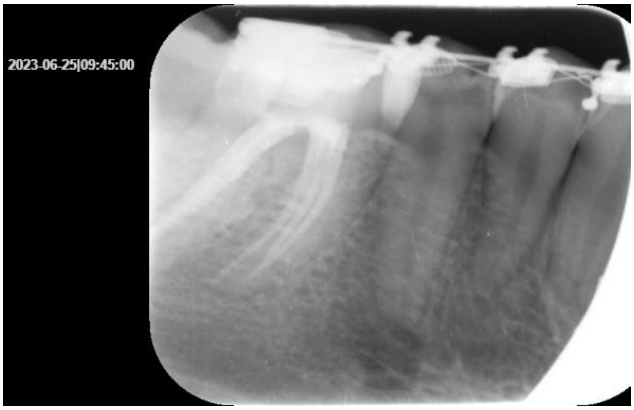

Figure 3b: Follow up 20 months post-op tooth 46: horizontal x-ray with 20 degrees mesial angulated shift (notice the MM canal joining ML canal -SLOB technique) *xray cone cut distally.*

CASE SERIES Case 2:

A 39-year-old male Egyptian patient reported severe pain from hot-cold food and drinks and food stagnation in his lower left mandibular tooth 36. The medical history has no abnormality seen. Clinical examination revealed a defective temporary filling on the distal proximal surface of tooth 36 with food impaction between teeth 36 and 37. A percussion test of the involved tooth revealed very minimal tenderness. The tooth was not mobile, periodontal probing around the tooth was within physiological limits on all sides except it was 4mm on the distal side. The preoperative diagnostic radiograph (Figure. 4) showed defective temporary filling closely approximating the distal pulp with slight periodontal ligament widening. From the clinical tests and radiographic findings, a diagnosis of symptomatic irreversible pulpitis 36 was made and endodontic treatment was initiated. Left side inferior alveolar nerve block anesthesia was given, and under rubber dam isolation all caries were excavated with hand instruments and slow-speed handpiece bur, noticed distal pulp carious exposure, and pre-endodontic distal wall build-up was done with glass ionomer restoration. Access cavity prepared with non-end cutting endodontic high-speed burs. Four root canal orifices mesio buccal (MB), mesio lingual (ML), disto buccal (DB), and disto lingual (DL) were negotiated until the working length (working length was determined with an electronic apex locator verified with x-rays) initially with 6,8,10 K files and rotary path files (mesial canals were narrow). The developmental groove between the mesio lingual (ML) and mesio buccal (MB) canals was further evaluated and explored with a DG16 endodontic explorer and an additional orifice was identified and located near the MB canal. The working lengths of MB, MM, ML, DB, and DL canals were 21, 21, 21, 21, and 21 mm, respectively (5 separate canal orifices). Canals shaping was done with rotary endodontic files up to size 25 in mesial and 30 size in distal. The root canals were disinfected with copious irrigation of 3% sodium hypochlorite and EDTA 17% solution, and a calcium hydroxide dressing was placed, cavity was sealed with a sterile cotton pellet under temporary filling. On the second visit, the tooth was asymptomatic, the root canal obturation was completed with resin sealer and cold lateral compaction guttapercha technique. Post obturation distal angulated x-ray was taken, the MM canal was joining the MB canal, and the distal canals also joined apically (Figure 5). The 23-month follow-up showed no clinical or radiographic pathological findings, a crown prosthesis was seen, and the tooth is functional (Figure 6a, 6b).

Figure 4: Pre-op x-ray tooth 36

Figure 5: Immediate post-obturation tooth 36: distal shift x-ray. Mesial configuration (3-2) MM canal joining MB canal: Gulabivala Type II [12]/ Sert S type XV [13] . Distal canals configuration (2-1): Vertucci type 2 [11]

Figure 6a: Follow-up 23-month post-op x-ray tooth 36: mesial angulated x-ray

Figure 6b: Follow-up 23-month post-op tooth 36: distal angulated x-ray

CASE SERIES Case 3:

A 12-year-old Egyptian boy was referred for root canal treatment of his right mandibular first molar tooth 46. The patient's chief complaint was intense pain associated with sensitivity to cold/hot food and drinks for many days in the lower right jaw with spontaneous pain also. The pain was relieved temporarily by taking analgesics. His medical history was unremarkable. Clinically occlusal temporary filling was seen in tooth 46. There was slight tenderness on percussion but no pain to palpation, tooth mobility was within physiological limits, and gingival attachment was normal. On the pre-treatment radiograph (Figure 7), a deep occlusal carious cavity below the temporary filling, close to the pulp horn seen, and no periapical changes were seen. The clinical-radiographic diagnosis was Symptomatic irreversible pulpitis 46. Root canal treatment was initiated (patient's father is the guardian). The treatment was completed in a single visit. The tooth was anesthetized using right-side inferior alveolar nerve blocks. After placing a rubber dam for isolation, the previous temporary filling was removed, all caries excavated, and a carious pulpal exposure was readily visible, and uncontrolled hemorrhage was noticed confirming pulp hyperemia and endodontic access was performed with endo access bur. After the pulp tissue was excavated from the pulp chamber, an initial examination of the pulpal floor with an endodontic explorer revealed that the pulp chamber had four canal orifices, mesio buccal (MB), mesio lingual (ML), disto buccal (DB), disto lingual (DL). The canals were negotiated to the working length as indicated by an apex locator, and radiographically verified with a size 10 K-type file. After a closer inspection exploring and cleaning the grooves between MB & ML canals, a depression was felt, middle mesial (MM) canal was located and negotiated. The three mesial root canals had three distinct root canal orifices but merged in the apical area once they were instrumented. The working lengths of MB, MM, ML, DB, and DL canals were 24, 23, 24, 22.5, and 22.5 mm, respectively (5 separate canal orifices). Cleaning and shaping were performed using NiTi rotary files, MB & ML canals up to size 30, MM canal up to size 25, and distal canals size 45. The canal patency was obtained using a no. 10K file. All instrumentation was performed under continuous and abundant syringe irrigation with 3% sodium hypochlorite at room temperature, with a side-vented needle. Final irrigation was done with 17% ethylene diaminetetraacetic solution. Canals dried with paper points and obturation done with cold lateral compaction technique. Post-obturation radiographs were taken (Figure8a,8b). The patient experienced no post-operative pain, and the tooth was restored with a

composite restoration. In the 25-month follow-up x-rays taken (Figure9a, 9b), no periodontal pockets were presented, no periapical infection was noted, and clinically the tooth was asymptomatic and functional.

Figure 7: Pre-operative radiograph of tooth 46

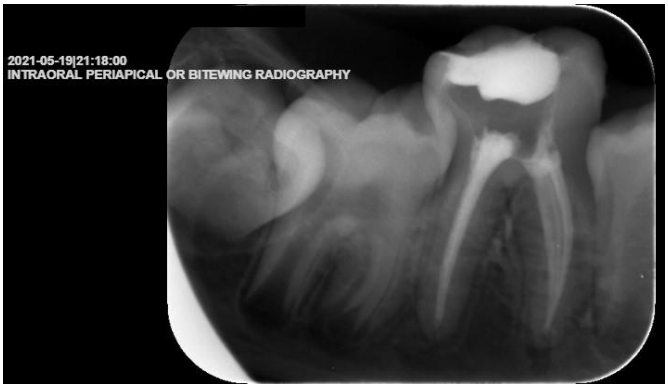

Figure 8a: Immediate post-op distal-angulated radiograph of tooth 46, presenting a Gulabivala Type 1 (3 -1) [12] mesial canal configuration and Vertucci Type2 (2-1) [11] in the distal canal configuration

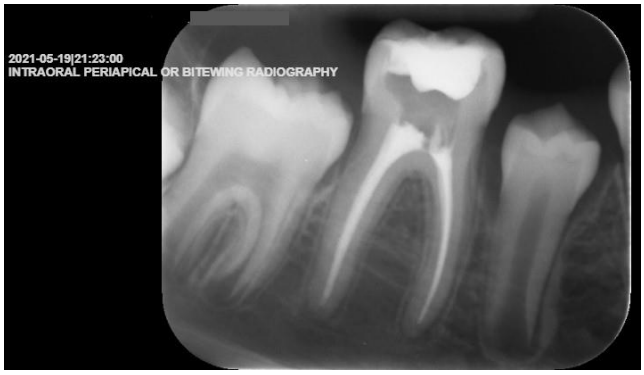

Figure 8b: Immediate post-op radiograph of tooth 46 with no angulation

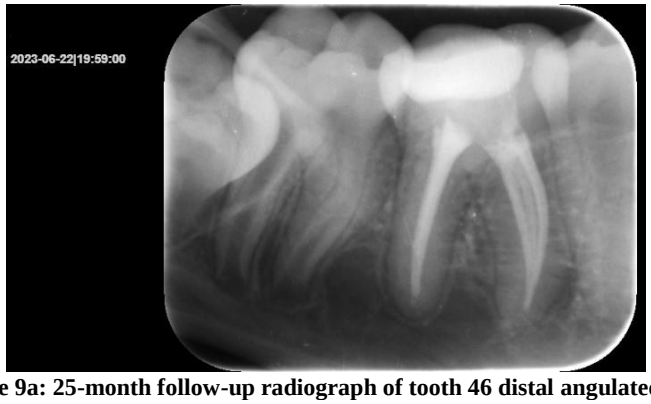

Figure 9a: 25-month follow-up radiograph of tooth 46 distal angulated shift

Figure 9b: 25-month follow-up radiograph of tooth 46 mesial angulated shift

CASE SERIES Case 4:

A 39-year-old male Indian patient was referred to perform a non-surgical endodontic treatment of tooth 46 (mandibular right first molar). His medical history was non-contributory. The patient had severe pain in tooth 46, Clinical examination revealed that the tooth had an endodontic access opening done three months back and restored with temporary cement seen as defective, and the tooth was mildly tender to percussion. Clinically periodontal probing was within normal depths in all surfaces except at distolingual surface where a localized 4mm periodontal pocket was observed, and severe interdental gingival bleeding was seen between 46 and 47 due to food impaction. The tooth had pain to percussion. Upon radiographic examination (Figure 10), seen defective distal filling and periodontal ligament widening. Diagnosis: Previously root canal initiated 46. After proper anesthesia and rubber dam isolation, distal caries was excavated, and pre-endo-build-up distally was done with glass ionomer cement. The access cavity was re-modified. Inspection of the pulp chamber floor showed orifices corresponding to mesio buccal (MB), mesio lingual (ML), disto buccal (DB), and disto lingual (DL) canals. Noticed the presence of necrotic pulp tissue in distal canals and the mesial canals were partially pulp vital. The root canals were negotiated with 8 and 10 K-files, and the working length determination was performed with an electronic apex locator and verified radiographically. On careful examination of the groove and troughing between the mesiobuccal and mesio lingual canal orifices, the middle mesial (MM) canal orifice was identified, and the canal was subsequently negotiated. The working lengths of MB, MM, ML, DB, and DL canals were 21.5, 23, 23, 20, and 20 mm, respectively (5 separate canal orifices). All root canals were shaped with rotary files according to the manufacturer's instructions. Continuous irrigation of 5.25% sodium hypochlorite was performed during the procedure, the root canals were dried, and calcium hydroxide was used as medication in between appointments, access was sealed with a temporary filling. On the second visit, the tooth was asymptomatic. A final irrigation protocol was performed with 17% EDTA and 5.25% sodium hypochlorite. The root canals were dried with paper points and the final root canal filling was performed with cold lateral compaction guttapercha technique and a resin-based sealer. Post obturation x-ray at distal angulation taken (MM canal joining MB canal and apically MB ML canals joining, distal canals joining apically) (Figure 11). The tooth was restored with composite restoration and the patient experienced no postoperative sequelae. A radiographic 27-month follow-up (Figure12a,12b) showed no periapical lesions, no secondary decay or fractures, and the tooth remained asymptomatic. The patient's tooth 46 also had a crown prosthesis as advised and the tooth was functional.

Figure 10: Pre-op x-ray tooth 46

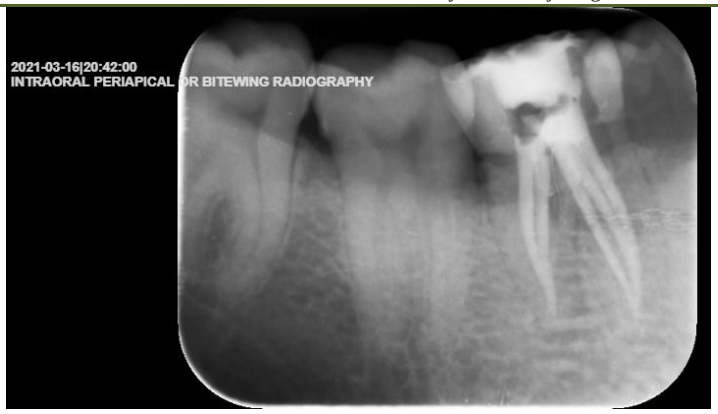

Figure 11: Immediate post-op distal shift x-ray tooth 46: Mesial canals configuration Al-Qudah AA Type XXII (3-2-1) [14] MM canal joining MB canal later MB & ML canals joining apically. Distal canals configuration (2-1): Vertucci [11] type 2

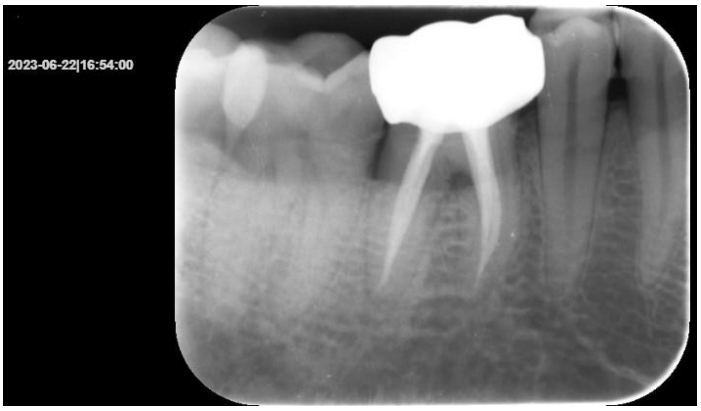

Figure 12a: 27-month follow-up mesial shift x-ray 46

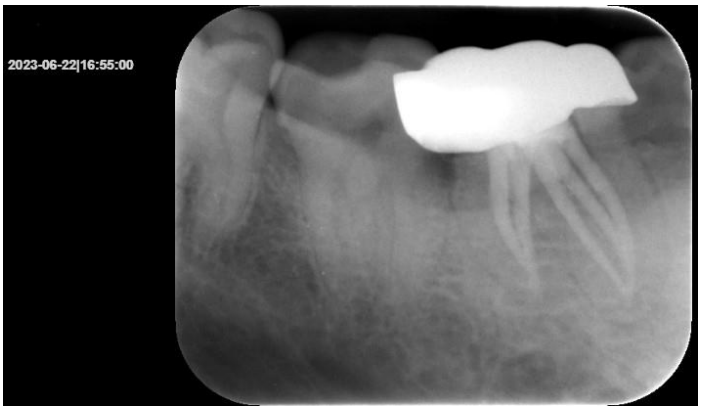

Figure 12b: 27-month follow-up distal shift x-ray 46

DISCUSSION

Aside from numerous procedural errors, missing the treatment of a root canal has been considered one of the major factors associated with root canal therapy failure, the incidence of untreated canal space and missed canals reported to be as high as 42% [16, 17]. Untreated canals and spaces within the root canal system, that are missed during endodontic procedures, contain necrotic tissue and serve as a reservoir of microorganisms and their by-products [16, 18- 20] that may sometimes be unaffected by endodontic disinfection procedures [21] leading to persistent chronic apical periodontitis and ultimately, failing endodontic treatment necessitating re-treatment. Most untreated canals were found in the maxillary and mandibular first molars, where the frequency of apical periodontitis in teeth with missing canals after root canal treatment was considerable (85.5–90%) [22, 23]. Cases have been reported of root canal retreatment of mandibular first molars with a previously unnoticed middle mesial canal [24, 25].

The prevalence of a third canal in the mesial root of mandibular first molars has been reported to have an incidence rate of an average of 0.26-48% **[**26, 27, 28]. The prevalence rates of c-shaped canals, middle mesial canals, and radix entomolaris in Qatari and Kuwaiti populations were remarkably low [29, 30]. In

China, the overall prevalence of middle mesial (MM) canals was 10.8% in the mesial roots of mandibular first molars [31] which was much lower than the prevalence reported as 26% in an American population [32]. The prevalence of middle mesial canals was detected to be significantly higher in the Brazilian (22.1%) compared with the Turkish population (14.8%) [33]. The middle mesial canal is present in 14.65% of mandibular molars in the Lebanese population [34]. In the Egyptian population, more than half of the mesial roots had complex canal configurations and 51% had middle mesial canals [35]. In the Indian population, the number of MM canals found in the first mandibular molar ranges from 29% to 45.85% [26]. In the Iraqi population, MM was found on average 17 % with no significant differences for age or gender, and frequently MM canal merged with mesio lingual canal [36]. The findings of multiple studies have pointed to the geographical difference in the prevalence of middle mesial (MM) canals in lower molars which suggests that MM canals in mandibular first molars might be related to ethnicity and race.

The many diagnostic methods used for the location of extra middle mesial root canals in mandibular molars include the use of good multiple-angled pre-op radiographs, a proper access cavity preparation, knowledge of the law of symmetry and canal location, classical 'white line' between the mesio buccal and mesio lingual orifices should invite further exploration in this area, examination of the pulp chamber floor with a sharp endodontic explorer like DG16 and micro opener for a 'catch', troughing of grooves to remove any dentinal protuberance with ultrasonic tips, staining the chamber floor with 1% methylene blue dye, and performing the sodium hypochlorite "champagne bubble" test, fibreoptic transillumination, visualizing canal bleeding points despite complete instrumentation [37, 38], use of magnification are important aids in locating root canal orifices. Once found, negotiate the extra canal by using a thin 08 or 10 K File in an alternating 45-deg rotating motion [6]. CBCT imaging is also used in some cases.

Azim *et al.,* [28] and Nosrat *et al.,* [39] reported the occurrence of middle mesial (MM) canals with age and concluded that younger patients, aged below 40 years, had a significantly higher incidence of a MM canal. The significantly higher incidence of a MM canal in younger patients is explained by the calcification process of the pulp in older patients, which undergoes a reduction in size due to the continuous deposition of dentin with age. The average distance between the MB and ML canals was higher when there was an MM orifice [40], while some reports say there does not appear to be a correlation between the presence of MM canal and an increased or decreased mesial MB-ML intra-canal distance [41]. Nosrat *et al.*, [39] stated that the MM orifice was closer to the ML orifice most of the time, followed by the middle region between MB and ML orifices. In the case series presented in this paper, the patients are also below 40 years of age, and not any increased intra-canal distance was noticed between the MB & ML canal orifices. In Case 1-MM orifice was seen nearer to ML orifice, in Case 2-MM orifice was nearer to MB orifice, and in Case 3 & 4 - MM orifice was in the middle of the MB & ML orifices.

These middle mesial (MM) canals are narrow, the mesial root of a mandibular first molar is more curved and has less dentin thickness than distal canals [42]. According to reports, the MM canal orifice's mean minor diameter is 0.16 mm, which is three times smaller than the 0.50 mm diameter of the two main mesial orifices, MB and ML [33]. The geometry of the mesial root shows it to be hourglass shaped and so a preparation in the mid-section of the root is automatically closer to the danger zone [2]**.** But some reports also say that when there is an MM canal, the thickness of the dentin in the danger- zone area is almost the same as that of patients without an MM canal [40]. Less taper rotary endo files would be preferred to prepare the MM canal than to prepare the other canals. It is recommended that careful examination of the canal 3mm apical to the cementoenamel junction should be carried out when trying to detect an MM canal [40]. In this article case series, MM canals were enlarged to up to size 25.

Out of the three anatomical variants of MM canals classified by Pomeranz *et al.,*[5], the confluent canal is the most common type [9, 33, 39]. The more frequent the middle mesial joins are to the mesiobuccal canal in the apical or middle third of the root as per reported literature [2, 43, 44]. In Case 1 -MM canal joined ML canal apically (3-2) [12, 13], in Case 2 – MM canal joined MB canal at the apical third (3-2) [12, 13], As for Case 3 -all three mesial canals started independently and joined in one at the apical third (3-1) [12] which is also in the available literature documented by Mohsen *et al.*, [44]. In Case 4 -MM canal joined MB canal and later apically MB & ML canals joined (3-2-1) [14, 44]. This morphology of the middle mesial (MM) canal in all four Case Series reported was thus termed "confluent" according to Pomeranz's classification [5].

At present, there is no evidence that either single-visit or multiple-visit root canal treatment is more effective than the other. Neither can prevent pain and other complications during the 12-month postoperative period [45]. In terms of healing or success rate, neither single-visit endodontic therapy nor multiple-visit endodontic treatment is superior to the other [46]. Single-visit root canal therapy is not contradicted in unusual endodontic cases, but multiple-visit root canal therapy is also acknowledged due to the complexity of the canal system. In this case series report, Case 3 was completed in a single visit, and the rest of Cases 1, 2 & 4 were completed in two visits.

A variety of mesial oblique and distal oblique intraoral periapical x-ray horizontal angle projections have been suggested for separating the canals in a multi-canaled root that will reveal additional information about the number of canals and apex visibility. Walton [47] has suggested the 20° distal projection for mandibular molars to accurately depict the morphologic features of the mandibular molar root canal systems. Ingle [48] proposed a 20° to 30° mesial shift. The change in angulation of the radiograph helps in differentiating the three mesial canals. Here, in all four case series reports, we noticed that mesial canals were found to be more clearly separated on distally angulated x-rays, the SLOB technique (same side lingual opposite side buccal) was used.

During endodontic case follow-up, clinical and radiographic details should be recorded. Detailed clinical details include (i) tenderness to pressure and percussion of the tooth, (ii) tenderness to palpation of adjacent soft tissues, (iii) presence of an associated sinus tract or swelling in the adjacent soft tissues, (iv) periodontal probing profile around the tooth, and (v) the type and a presence of an adequate coronal restoration and 'seal' [49]. The clinical details are also to be cross-checked using reference radiographs representing the four categories of radiographic healing: (i) complete, with a healthy periodontal ligament space, (ii) incomplete, if there was a reduction in the size of the lesion without return to normal periodontal ligament space width, (iii) uncertain, when it was radiographically impossible to make a definitive decision on the status of postoperative healing (iv) failure, if a pre-existing periapical lesion had increased in or remained the same size; or a previously normal periodontal ligament space had increased in width or developed into a radiolucent area [49]. So accordingly, endodontic treatment outcomes should be defined about healing and disease [50- 52] as follows: (i) Healed: Both the clinical and radiographic presentations are normal. (ii) Healing: Reduced radiolucency combined with a consistent normal clinical presentation can be regarded as healing because healing is a dynamic process (iii) Disease: Even when the clinical presentation is normal, radiolucency has developed or persisted without alteration, OR when clinical signs or symptoms are present even when the radiographic presentation is normal. In the follow-up of the four clinical cases reported in this article, all four cases presented as "healed".

CONCLUSION

Treatment of all possible variations in the anatomy of multirooted teeth when performing endodontic treatment, though *challenging*, should be the standard practice for clinicians for the long-term success of endodontic therapy. Each endodontic case should be carefully evaluated clinically and correlated radio graphically for any extra canals (including middle mesial canals in lower molars) with mesial or distal angled horizontal intraoral periapical x-rays, analyzing based on ethnicity and age keeping in mind the peculiarities in the population around us. Follow-up of all varied endodontic cases should be the norm.

Declaration of Patient Consent

The author certifies that informed consents have been obtained from patients before initiating the treatment and informed that dental radiographic images and other clinical information may be reported in the literature journals. Patients understand that their names will not be published.

CONFLICT OF INTEREST

The author has no conflict of interest to declare.

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