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MAXILLARY LATERAL INCISOR WITH TWO SEPARATED CANALS DIAGNOSED WITH CBCT TECHNOLOGY: A SIX-MONTH FOLLOW-UP CASE REPORT AND MINIREVIEW

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ABSTRACT

Most in-vivo and in-vitro studies as well as technical case reports indicate that permanent maxillary lateral incisors have only one root, with 100% having a single-canal anatomy, but when the pulp canal system is complex, canals may branch, divide, and rejoin. The current case report describes a male patient with a symptomatic maxillary left lateral incisor with an undiscovered type IV root canal system revealed by cone beam computed tomography (CBCT). The patient complained of spontaneous dull pain at maxillary frontal left area. We also provide a minireview that summarizes previous published cases in this report. There are more variations in the root canal structure of permanent maxillary lateral incisors than population cases would suggest.

Keywords: Cone beam computed tomography; endodontic treatment; maxillary lateral incisor; root canal morphology.

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INTRODUCTION

Root canal treatment (RCT) is a type of endodontic treatment that deals with disorders associated with tooth pulp and its

adjacent conventional soft tissue. RCTs can lead to the preservation of natural teeth as a result of function and form of the patient's chewing scheme [1]. The cleaning and

shaping of RCs are the key procedures in RCT, and its function is to eliminate tissue remnants and microbial biofilms in order to allow adjustment of the root filling to canal walls [2]. It is generally accepted that a major cause of RCT failure is the inability to localize and treat all the canals of the RC system. The risk of missing anatomy during RCT is high because of the complexity of the canals and roots [3]. Unfortunately, endodontic configurations differ greatly between populations and even in distinct people within the same population. Hence, an accurate knowledge of RC morphology and its structural alterations is essential for effective RCTs [4].

Failure to find and fill canals during nonsurgical RCT has proven to be a contributing factor in the failure of endodontic treatment, and this is of the greatest importance in detecting and curing

canal disorders [5]. This can be overcome by the use of cone beam computed tomography (CBCT) imaging. It has the potential to become the leading choice for RCT planning and outcome evaluation, particularly when new scanners with less radiation will be available [6-8].

A total of 35 case reports in the peer review published journals illustrate alterations in both root and pulp canal structure of maxillary incisors are abundant [8-44]. The majority of maxillary teeth case reports were for central 24 and 11 for lateral incisors with 2 separate roots and, therefore, two root canals (25 tooth/cases) or one root with two canals (7 cases). Nevertheless, others report three RCS [11-12,26,29,35,42], while Kottoor and Murugesan [22] and Mangani and Ruddle [39] reported up to four RCS. The distribution of the cases were three from different Arab countries, 16 from Asia (the

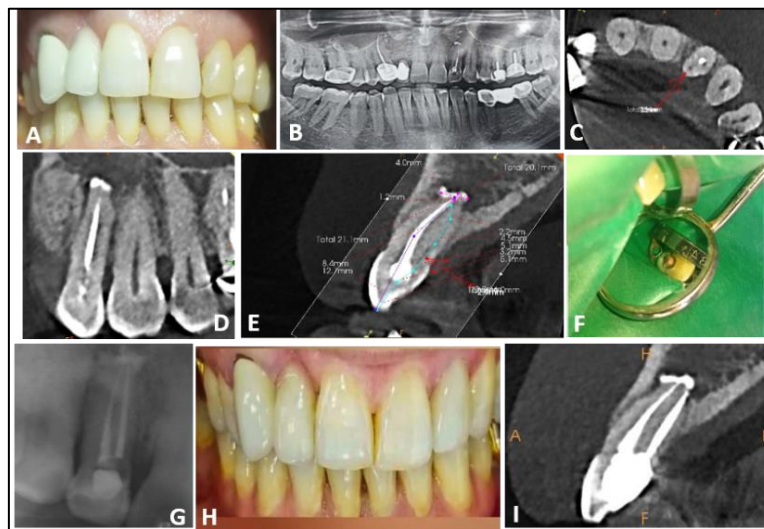


Figure 1A; Preoperative intra-oral view, Figure B; Pre-operative Panoramic view, Figure C; Axial CBCT view shows both canal and the distance between them, Figure D; Coronal section of the CBCT image does not presents the second canal. Figure E; Sagittal section of CBCT image confirms the second palatal canal. Figure F: Rubber dam application with the access opening of the two canals. Figure G; Preapical x-ray after obturations. Figure H: Postoperative intra-oral view with the final filling. Figure I; Sagittal section of CBCT image after six months.

highest was India with nine cases followed by Iran with five cases), nine from Europe, eight from America, and eight from Latin America (with the highest number, eight, in Brazil). Regarding gender, the distribution for the number of cases was approximately equally. Twenty-one cases were on the left side, whereas the remaining cases were on the right. Among the two or more teeth presented in a single patient, only those treated by Kavitha et al (2014) crossed the midline [17]. Approximately 21 cases were diagnosed as retreatments or discovered during X-ray. While only four cases came for retreatments [10,13,20,24] or because the patient was complaining of pain, quite a few cases were associated with abnormalities such as gemination with dilaceration of the root [16,18], incomplete apical formation [44], gemination or fusion of the roots [37], enamel hypoplasia [41], and dens invaginatus [39]. The objective of the current case report and minireview was to describe a symptomatic maxillary left lateral incisor with undiscovered type V root canal system using CBCT imaging.

CASE REPORT

A 53-year-old male patient reported to our private dental clinic in the city of Sana'a in Yemen. The patient complained of yellowish discoloration of left maxillary lateral incisors (Figure 1) and spontaneous dull pain related to the maxillary left frontal side. The patient was healthy and did not have any relevant medical history or any allergies. The patient stated that he complained of severe pain 3 years prior, and he had RCT previously. The pain disappeared, but a few months later he felt a

dull spontaneous pain that occurred suddenly. The extraoral examination showed bilateral symmetry without any abnormality. Intraoral examination showed normal texture of the gingiva and healthy cantilever bridge in the counterpart of the mouth (Figure 1A). Upon intraoral clinical examination, cold, palpation, and percussion tests were negative for teeth #21, 22.

The panoramic radiograph showed multicarious teeth, teeth with improper RCT in relation to teeth #13, 22, 25, 26, and a preapical radiolucent area in relation to tooth #35 mostly related to mental foramina. Tooth #22 showed a discontinuity of apical lamina dura. In addition, panoramic X-ray revealed gutta-percha extending from tooth #22 and reaching to the apex with apical puff (Figure 1B). The CBCT images were taken using the Pax-Flex3D imaging system (VATECH Global, Hwaseong-si, Korea) operated at 50-90 kVp and 2-10 mA. A 5*5 cm slice view of the affected area was taken to help diagnose and select the proper treatment plan. The axial section of the CBCT revealed the presence of labial and palatal canals. The labial canal was filled with gutta-percha, while the palatal canal was not. Distance between the palatal and labial canals was 1.5 mm (Figure 1C). Because of overlapping, the X-ray of the coronal section does not show the presence of the second canal (Figure 1D), but the sagittal section shows the missing second palatal canal in relation to the buccal filled one (Figure 1E).

After finalizing the diagnosis, the retreatment of tooth #22 was the treatment of choice. Then, a rubber dam was used to isolate the tooth. After that, work area was

disinfected with 5.25% sodium hypochlorite (Na OCl) (CLOROX, Yemen) before access opening. Access opening was performed, and the palatal canals were negotiated using a stainless steel #10 K file (TG Company, China) (Figure 1F). The gutta-percha was removed using orange oil (GSOL, Marcdental, India) by soaking a cotton pellet with the solvent and placing it on the RCF (gutta-percha) material, leaving it for several minutes as recommended by manufacturer instructions, and then using Hedstrom file size #20 (TG Company, China). The working length was determined with an electronic apex locator (Woodpercker Gold, China) with the help of the preexisting CBCT image. Instrumentation was done using M Pro gold files (UDG, China), up to file number 35/04 and 40/04 for labial and palatal canals, respectively. During instrumentation, an irrigation with an irrigating regimen of NaOCl (5.25%) followed by saline, EDTEA 17% (Meta MD - Cleanser 17% EDTA), saline, and CHX 2%. EDETA gel with peroxide was used as a chelating agent (Sure Prep, South Korea). Activation was done with sonic activation (E2 woodpecker tip, China), and manual dynamic activation. The final irrigation used distilled water. Sealer type BS (On Fill Bioceramic Sealer, South Korea) with GP coated with BC Sealer (UDG Company, China), and lateral compaction technique were used for obturation (Figure 1G). The coronal portion of the tooth was filled with flowable composite resin (EsFlow, Spident, South Korea), followed by packable composite resin (Tetric-N-Ceramic, IvoclarVivadent, Lichenestine) using an

incremental technique according to manufacturer instructions. Intra-oral photograph was taken immediately after crown cementation (Figure 1H).

The post-operative CBCT image was also taken after six months and showed uniform bone trabeculation at the apex of tooth #22 with excellent obturation and normal anatomy of the tooth as periodontal ligaments and continuous lamina dura (Figure 1I).

DISCUSSION

Morphological variations are often in the form of accessory roots/root canals in normal maxillary anterior teeth with no developmental anomalies or with developmental anomalies. Type IV (2-2) is the most commonly reported RC configuration [5,14-16,24], which is the most common accessory anatomical variation reported in single- and double-rooted maxillary lateral incisor teeth, followed by one canal divided into two separated canals (1-2) considered as type V [7,19,27]. The present case emphasizes the importance of CBCT as a mandatory aid in proper RCT for any symptomatic lateral maxillary teeth that show failure after traditional endodontic treatments. Table 1 summaries case reports published from the beginning of the eighties to the middle of 2020. Advances in dental imaging techniques such as cone-beam computed tomographic scanning may deliver a scientific device to investigate the root canal configuration in greater population records and challenge the outcomes of traditional investigations. Interestingly, our case is in

Table 1. Summary of previous case reports of Maxillary central and lateral incisors with variations as gender, tooth type, side, and canal morphology according to Vertucci's Classification

Author (s) & Year Publication	Country/Gender	Tooth type	Vertucci's Classification	Canal (s) : Root (s)	Special findings
Present Case	Yemen/Male	Lateral, left	IV	2 : 1	Re-treatment
Dallak et al, 2020 [9]	Yemen/Male	Lateral, left	V	2 : 1	Non - Vital
Al-Madi et al, 2020 [10]	Saudi Arabia/Female	Central, left	IV	2 : 2	Re-treatment
Singh et al, 2019 [11]	India/Female	Lateral, left	VIII	3 : 1	Non-vital
Buonvivere & Buonvivere , 2019 [12]	Italy/Female	Lateral, left	VIII	3 : 1	Non-vital
Arya et al, 2018 [13]	India/Male	Central, left	IV	2 : 1	Re-treatment
Saberi et al, 2018 [14]	Iran/Female	Lateral, left	IV	2 : 1	Non-vital
Yadav et al, 2016 [15]	India/Male	Lateral, left	IV	2 : 2	Non-vital
Elbay et al, 2016 [8]	Turkey/Female	Central, right Lateral, right	IV IV	2 : 2 2 : 2	Non-vital
Romano et al, 2016 [16]	Brazil/Male	Lateral, left	IV	2 : 1	Gemination & root dilaceration
Kavitha et al, 2014 [17]	India/Female	Central, right Central left	IV IV	2 : 1 2 : 1	Non-vital
Sharma et al, 2014 [18]	India/Male	Central, right	V	1 : 2	Crown dilaceration
Makade et al, 2014 [19]	India/Male	Lateral, right	V	2 : 1	Non-vital
Calvert G, 2014 [20]	U K/Male	Central, right	V	2 : 1	Re-treatment
Krishnmurti et al, 2012 [21]	India/Female	Central, right	IV	2 : 1	Root resorption
Kottoor & Murugesan, 2012 [22]	India/Male	Lateral, left	-----	4 : 1	Non-vital
Almda-Goms et al, 2011 [23]	Brazil/Male	Central, left	IV	2 : 1	Non-vital
Venugopal & Sreelkha, 2010 [24]	India/Male	Lateral, left	IV	2 : 2	Re-treatment
Nabavizadeh et al, 2010 [25]	Iran/Male	Central, left	IV	2 : 2	Non-vital
Gondim et al, 2009 [26]	Brazil/Male	Central, right		3 : 2	-----
Shokouhinejad et al, 2009 [27]	Iran/Female	Central, left Lateral, left	V V	1 : 2 1 : 2	Non-vital
Rodrigues & Silva, 2009 [28]	Brazil/Female	Central, right	IV	2 : 2	Non-vital
Shikh-Nezmi M, 2007 [29]	Iran/Male	Central, right	-----	3 : 1	Non-vital
Sponchiado et al, 2006 [30]	Brazil/Female	Central, right	IV	2 : 2	Non-vital
Indra et al, 2006 [31]	Italy/Female	Lateral, left	IV	2 : 2	Non-vital
Lin et al, 2006 [32]	China/Female	Central, right	IV	2 : 2	-----
Benenati FW, 2006 [33]	-----	Central, left	IV	2 : 2	Non-vital
Khojastehpour & Khaya, 2005 [34]	Iran/Female	Central, left	IV	2 : 2	Non-vital
Zaitoun & Makie, 2004 [35]	U K/Female	Central, right	VIII	1 : 3	Non-vital
Genovese & Marsico, 2003 [36]	Italy/Female	Central, right	IV	2 : 2	Non-vital
Cimilli & Kartal, 2002 [37]	Turkey/Male	Central, left	IV	2 : 2	Fusion of roots
Cabo-Valle & Gonzalez-Gonzalez, 2001 [38]	Spain/Female	Central, right	IV	2 : 2	Non-vital
Mangai & Ruddie, 1994 [39]	Italy/Female	Central, right	-----	4 : 1	Dens invaginatus
Lambruschini & Camps, 1993 [40]	France/Male	Central, right	IV	2 : 2	-----
Al-Nazhan S, 1991 [41]	Saudi Arabia/Female	Central, left	IV	2 : 2	Enamel Hypoplasia
Hosomi et al, 1989 [42]	Japan/Male	Central, right		3 : 2	Gemination
Madr & Konzlan, 1980 [43]	U S A/Male	Central, left	IV	2 : 2	-----
Sinai & Lutbader, 1980 [44]	U S A	Central, right	IV	2 : 2	Incomplete apical formation

parallel to most of the reported cases with regard to the side of the unusual canal configuration which is the left side [8,11-12, 14-16].

Only ten case reports were published relating to maxillary left lateral incisors, and most of the cases were in Asian countries (seven cases). A single study describes a case on the right side and the same number was associated with tooth abnormality (gemination with dilaceration of root), and it is from Brazil [16]. Gemination arises when the tooth bud of a single tooth attempts to divide, presenting most often as two crowns either fully or partially separate with a single root and root canal [45].

The clinical significant of this case is related to two things. First is the ability to maintain the tooth and preserve the bone and surrounding structure, in which normal healing occurs, without any surgery either by endo-surgery or extraction, and preparation of the adjacent teeth for construction of three united bridges. Second is the ability to save or minimize the treatment costs in which only composite restoration was done as a final restoration.

CONCLUSION

The findings in the current case revealed the management of a maxillary lateral incisor with a type IV root canal morphology, which was previously unrecorded among Yemeni patients. In addition, the importance of the anatomical knowledge of root configuration as well as the canals obtained using recent CBCT tools along with proper examination can aid dentists in diagnosing, managing, and minimizing complications

associated with additional root canal treatments.

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