

Diagnosis, treatment planning and root canal of a lower first premolar with two canals using 3D computed tomography: Case Report.

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Abstract: The morphology of the root canal system is highly variable and complex. Therefore, comprehensive knowledge of its anatomy and the planning of the procedure using imaging systems, such as 3D cone beam computed tomography (CBCT), prior to performing endodontic treatment, improve the prognosis, increasing the chances of success. The aim of this report is to show the sequence of a clinical outcome of a lower first premolar (tooth 4.4) with a complex anatomy, using CBCT in diagnosis and planning.

Keywords: Root canal treatment; endodontics; treatment plan; Cone-Beam Computer Tomography.

INTRODUCTION.

It has been widely reported that an adequate cleaning of the canals is essential in order to successfully perform a root canal treatment and decrease the risk of failure. This is a fundamental part of an appropriate chemo-biomechanical preparation, which allows the subsequent three-dimensional filling of the tooth.¹ To effectively perform the previously described procedures, adequate access must be created as well as optimal sealing of the coronal area to prevent filtration of microorganisms from the outside to the inside of the tooth, as they may cause the procedure to fail.²

Detailed knowledge of the root anatomy contributes significantly to the success of root canal therapies. It should always be considered that teeth present anatomical variations, such as the number and shape of roots and canals in the same individual or among different populations.³

In recent years the use of 3D computed tomography (CBCT) has significantly helped in the three-dimensional imaging diagnosis, planning and prognosis of endodontic treatments.⁴ The information regarding the anatomy of teeth provided by CBCT is more accurate and of higher quality than that offered by periapical radiographs, and its use can modify the treatment plan in approximately 62% of cases.⁵

The first mandibular premolars usually present the greatest anatomical complexity, which justifies the indication of a CBCT scan over two-dimensional imaging. It has been reported that the first mandibular premolar could present a canal at the apical level in 74% of cases, two canals in 25.5%, and three in 0.5%. However, 1 in 5 have complex root canals with 2 or more canals.⁶

The aim of this report is to show the clinical outcome of a lower first

premolar (tooth 4.4) involving two canals with complex anatomy, using CBCT and its software as a diagnostic tool to plan the root canal treatment, since there is no evidence or protocols on how to deal with this type of cases.

CASE REPORT.

A 24 year-old female patient was treated at the endodontics service of Hospital of Lautaro to continue root canal treatment of tooth 4.4, previously treated. The periapical radiograph revealed loss of continuity of the main canal at the level of the apical third of the root. Subsequently, a CBCT (Planmeca, Promax 3D, Series TPX360061, Finland) was requested. The radiologist's report included the following specifications: CBCT 0.5cmx0.5cm; voxel size: 150µm (micrometers); Kv 14;mA 14.0; duration of acquisition: 14,996; absorbed dose: 841 (mGyxc²).

A single-rooted tooth was observed, with a curved root towards a distal direction and a bifurcation of the root canal starting at the middle third (Figure 1. A and Figure 1. B). The vestibular canal at the level of the apical third showed a slight lingual and distal curvature, with a decrease in its size. On the other hand, the lingual canal had a clearly diminished size, and it was curved distally in the apical third. Clinically, only the vestibular canal was previously treated. The location of the lingual canal

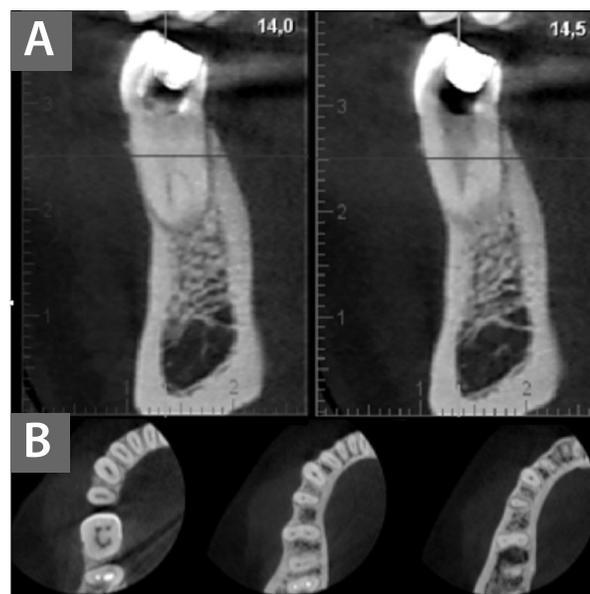
is complex due to the angle of entry. In the CBCT image of tooth 4.4, a line is drawn at the entry of the lingual canal and another line from the crown of the tooth to the bifurcation zone, which generates a 101° angle between both canals. The spot where the instrument should be bent is also indicated. (Figure 2. A and Figure 2. B)

The length was then measured from the occlusal side of the tooth at the beginning of the bifurcation, which was 14 millimeters in this case. (Figure 2. C) This length was transferred to the exploratory file by curving it 1 mm at its lower end. The crown down technique and a SX Protaper file and Gates Glidden drills were used (Dentsply Maillefer, Switzerland), rectifying the lingual wall up to the beginning of the bifurcation. Subsequently, with the canal flooded with 5.25% sodium hypochlorite solution, a N010 M-ACCESS K-FILE (Dentsply Maillefer, Switzerland), previously pre-bent, was introduced, making smooth in and out along the entire circumference of the canal.

Once the entry point was secured, it was followed with short and gentle movements, slowly descending to the apical area. Then a Proglider file (Dentsply Maillefer, Switzerland) was used for permeabilization. Odontometrics was performed by using a Raypex 6 apical localizer (VDW, Germany).

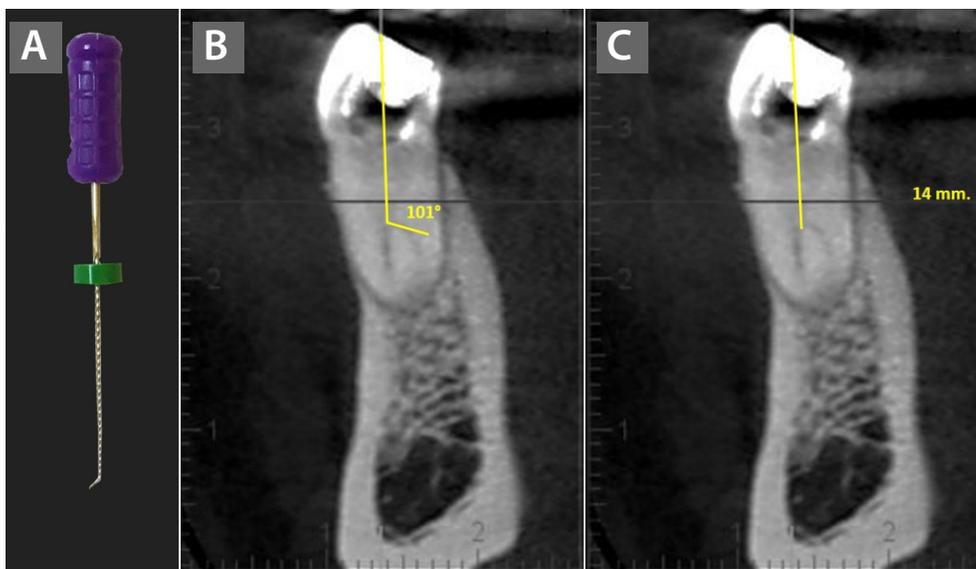
Then the biomechanical preparation of both canals was performed with Nickel Titanium (Niti) manual

Figure 1. CBTC of tooth 4.4.



A. The bifurcation of the root canal is observed at the level of the middle third of the root. B. Serial cross sections where the morphology at the level of the cervical, middle and apical third of the root, respectively, is observed from right to left.

Figure 2. CBCT image of tooth 4.4, line the entrance of the lingual canal .



A. Curvature of the file at its lower end. B. Angle between the vestibular canal and the lingual canal. C. Distance from occlusal side to bifurcation.

Figure 3. Radiographic control of the filling of tooth 4.4 with different angulations.



A. Distal tilting. B. Orthocentric. B. Mesial tilting.

instrumentation, irrigating constantly with 5.25% sodium hypochlorite, applied with lateral irrigation syringes and activated with Endoactivator (Dentsply). A final wash was performed with 17% EDTA (Ultradent, USA). The filling of the canals was carried out using a lateral condensation filling technique with Top Seal cement (Dentsply Sirona, USA). The filling was assessed by means of periapical radiographs. (Figure 4. A and Figure 4. C)

DISCUSSION.

Conventional radiographs do not always show the number of root and accessory canals in the tooth;

however, new technologies such as 3D computed tomography (CBCT) allow obtaining detailed data of root anatomy, such as the exact number of root canals and their location;¹ such morphological information will help to establish a clinical diagnosis and perform an appropriate treatment planning using the CBCT software.⁵

The use of CBCT in endodontics has contributed to the identification of the anatomy of the root canal and the root, identification of internal and external reabsorptions, location and detection of root canals, fractured instruments and the presence of other foreign materials. Furthermore it can be used for the planning

and for the performance of retreatments, identification and verification of the extension of apical periodontitis, diagnosis of non-odontogenic diseases, control of root canal treatments with unclear clinical signs or symptoms, assess teeth affected by trauma, and support the planning of procedures in apical microsurgery.^{7,8} Many studies report greater accuracy and specificity of the CBCT image in comparison with conventional periapical or panoramic radiographs, regarding the detection of anatomical and clinical findings that may interfere with the success of the treatment.⁹

Before requesting a CBCT scan, it should be considered that the patient will receive a higher dose of radiation than with a periapical radiograph;⁴ however, CBCT should be the first imaging choice in patients whose teeth seem to have complex internal morphology. This is achieved through the analysis of the different sections. For example, the coronal section was fundamental in planning access as well as in the permeabilization and instrumentation of the lingual canal of the clinical case under study. The software provided the tools to analyze and plan the complex canal system, as it was performed in the present clinical case, which allowed the access of the canal in a simpler way.¹⁰⁻¹²

There is no information in the literature on how to approach teeth with complex anatomy in a systematic way. Therefore, data collected from this clinical case may be useful for the adoption of a procedure protocol in the case of complex canals, such as this tooth with Vertucci type V root canal morphology.⁶

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The prevalence of the different configurations varies according to different studies, in relation to ethnicity and the number of teeth analyzed. A study conducted on 138 extracted mandibular premolar teeth reported that the type I morphology accounts for 67.39% of cases; type II, 7.97%, type III, 3.62%; type IV, 2.89%; type V, 17.39%; and type VI, 0.72%.¹³ Another study that evaluated 100 extracted mandibular premolar teeth reported a type I configuration in 72%, type II in 6%, type III in 3%, type IV in 10% and type V in 8%.¹⁴

A recent study showed the presence of Vertucci type I morphology in 65% of first mandibular premolars, followed by type V in 14%, and type IV in 3%.¹⁵

The above information is very important since among the main causes of failure in endodontic treatments we can find an incorrect diagnosis, persistence of bacteria, inadequate filling and disinfection of the canal, overfilling, inadequate coronal sealing, untreated canals, iatrogenic procedural errors, such poor access cavity design, and complications of instrumentation.^{16,17}

CONCLUSION.

It is very important to have supportive imaging technology such as 3D cone-beam computed tomography (CBCT) for treatment planning, as it improves the prognosis and increases the chances of success by targeting the main canals during endodontic treatment.

The information collected can contribute to treat clinical cases with complex anatomy and, at the same time, it can serve as a starting point for the adoption of a clinical procedure protocol.

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