Management of two-rooted maxillary central and lateral incisors: A case report with a multidisciplinary approach involving CAD/CAM and CBCT technology

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ABSTRACT

A thorough knowledge of the root morphology and variations closely relates with the success of endodontic therapy. Although it is rare, additional roots or canals may exist in maxillary incisors, which is an important variation to consider. This paper describes the multidisciplinary management of a maxillary central incisor and a lateral incisor, both of which presented two roots with aberrant crown morphology that was verified by cone beam computed tomography and restored with prosthetic rehabilitation involving full-contour monolithic zirconia crown after root canal treatment.

Key words: Computer-aided design-computer-aided manufacturing, Cone beam computed tomography, Maxillary incisors, Monolithic zirconia, Root canal treatment

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INTRODUCTION

The extra root canal presence is one of the important abnormalities in root canal morphology.[1] Even though the dental literature supports a 100% single root canal anatomy with maxillary incisors,[1] variations in the number of root canals and morphological alterations of apical foramina have been reported.[1-4] Additional root canal formation in both maxillary central and lateral incisors is an infrequent situation and has been reported in only one case in the literature. Shokouhinejad *et al.*[3] described a maxillary central incisor with two roots and a lateral incisor with a single root but two canals located buccopalatally. To the best of our knowledge, there are no case reports presenting maxillary lateral and central incisors that have two separate roots and are also rotated in different dimensions.

Additional root variations are generally related with the tooth shape anomalies of "fusion" or "gemination."[5] Fusion of teeth results from the union of adjacent tooth germs and can happen between both normal teeth or with a supernumerary tooth. Fusion may be total or partial. The result can vary from a normal tooth size to twice of the normal size. In contrary, gemination arises when a single tooth bud attempts to divide.[5] Clinically, a germinated tooth is characterized by bifid crown with a single root with a single or partly divided pulp. The etiology is related to the physical force or pressure produced during development and genetic background. In addition, trauma to primary teeth during the eruption of the permanent teeth was also related for an explanation of root canal and crown variations.[2,5]

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Identifications of the variations in tooth morphology and canal systems are crucial. Inadequate management may result in under-filled or missed root canals; the common failures which may result in extraction.[6] From this perspective, evaluation of preoperative radiographs is crucial for recognizing aberrant root morphology. On the other hand, due to their two-dimensional limitations, intraoral radiographies may cause superimposition, distortion, and magnification.[7,8] Alternative techniques have been suggested to eliminate these limitations. Recently, cone beam computed tomography (CBCT) was introduced as a noninvasive tool for evaluating tooth and root canal morphology and with specific algorithms to facilitate undistorted three-dimensional assessment of dento-maxillofacial region with a remarkably lower radiation dose when compared to medical computed tomography.[7-9] Nevertheless, it is not indicated for routine use, regarding that the lower radiation dose in the imaging of children must be a strict consideration in accordance with the general principles of radiology, as low as reasonably achievable.[9] It may be justifiable for endodontic treatment of a tooth having abnormal root canal morphology where the two-dimensional intraoral radiographies do not allow the completion of treatment successfully.[9]

The purpose of this case report is to describe the multidisciplinary treatment of a pediatric patient who had a maxillary central incisor with two separate mesiodistal roots and an adjacent lateral incisor with two separate bucco-palatal roots, as confirmed by CBCT.

CASE REPORT

A 12-year-old girl was referred to the pediatric dentistry clinic. The patient was asymptomatic and with a noncontributory medical history, she had a poor oral hygiene and presented left central and lateral incisors with hypoplastic crowns and gingival hyperplasia [Figure 1a and b]. According to patient history, these teeth had sensitivity to thermal irritants and had severe pain previously but decreased over time. Probing revealed no periodontal pocketing around the teeth; although the teeth had mild tenderness to percussion. Intraoral examination revealed no swelling in the related area. For both incisors, there was no accurate response to electrical/thermal vitality tests and mobility was within physiologic limits.

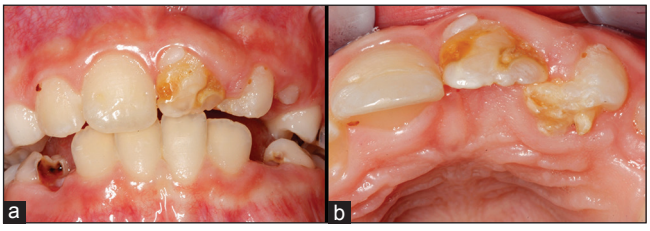

Figure 1: Intraoral view of central and lateral incisors, (a) buccal aspect, (b) occlusal aspect

Radiographic evaluation revealed the presence of extra roots with widening of the periodontal ligament space [Figure 2a]. Based on the clinical and radiographic findings, nonsurgical endodontic root canal therapy was planned. For better visibility of the teeth, an 810 nm AlGaAs diode laser (Cheese Laser Systems, China) with 400 micron fiber was used in contact mode at a 3-3.5 W output power. Continuous and controlled movement was used to reconstruct excess buccal and palatal gingival tissues. The access cavity was prepared using high-speed round diamond burs (Kendo, VDW GmbH, Germany) under continuous water irrigation and working lengths of the mesial, and distal root canals of the central incisor were determined. However, the opening of the additional root canal of the maxillary lateral incisor was not found. Further evaluation was conducted using a CBCT scan to investigate the number and position of the roots of the lateral incisor (Planmeca ProMax 3D Max, Planmeca Oy, Helsinki, Finland). The CBCT scan was taken with a lead thyroid collar and a lead apron using a limited field of view at the smallest volume at 96 kV, 8 mA, and 200 μm of voxel size. Three-dimensional images were reconstructed, and the images were analyzed using viewer software (Romexis, Planmeca Oy, Helsinki, Finland). The CBCT images identified the additional roots/canals and their location [Figures 3 and 4]. For location of the orifices of the buccal and palatal roots of the lateral incisor, the access cavity was extended in a bucco-palatal direction, and coronal flaring for all root canal orifices was performed using Gates Glidden drills. By the use of an apex locator, the working lengths were determined (Tri-auto ZX; Morita, Tokyo, Japan) with radiographical confirmation [Figure 2b]. The chemo-mechanical preparation was carried out using the step back technique with 2.5% sodium hypochlorite (Wizard, Rehber Chemistry, Istanbul, Turkey) and 17% EDTA solution (Wizard, Rehber Chemistry, Istanbul, Turkey). After paper point drying of the root canals (MMPP, Diadent, Canada), calcium hydroxide paste (Meta paste, Meta Biomed, Korea) was used as an inter-appointment medicament. After that application, the access cavities were sealed temporarily with Cavit (3M ESPE AG, Seefeld, Germany). When the teeth became asymptomatic, the canals were obturated using a resin based sealer (AH Plus, Dentsply, Middle East and Africa) and the lateral condensation technique was utilized

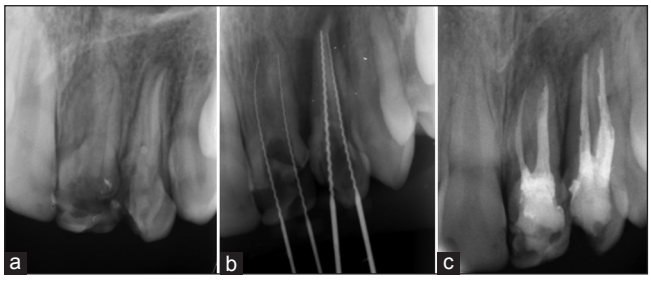

Figure 2: Periapical radiographs of two-rooted incisors, (a) before treatment (b) determining working lengths (c) after endodontic therapy

with gutta-percha (Gutta Percha Points, Diadent, Canada) and the obturation quality was confirmed radiographically [Figure 2c]. After completing the endodontic therapy, the teeth were restored with composite resin (Clearfil Majesty Esthetic, Kuraray, Japan) [Figure 5a]. Three weeks after restoration of the teeth, the patient sustained trauma to his left central incisor tooth involving complicated crown fracture [Figure 5b]. For esthetic reasons, the central incisor was restored with prosthodontic rehabilitation.

To accomplish a better retention of the restoration, a glass fiber post (Interlig, Angelus, Brasil) was placed in the mesial root of the central incisor and the tooth was prepared for a monolithic zirconia (Bruxzir Solid Zirconia, Glidewell Laboratories; California, USA) restoration with no porcelain overlay [Figure 6a]. An impression was made with a polyether impression material (Impregum Soft; 3M ESPE, Seefeld, Germany). The zirconia coping was fabricated using a computer-aided design-computer-aided manufacturing machine. After controlling the fit of the coping, it was veneered with zirconia and the zirconia crown was cemented using resin cement (Panavia F2.0 Kuraray; New York, USA) [Figure 6b]. The patient was given postoperative instructions for the prosthetic restoration, and oral hygiene instructions were given. The patient was scheduled for follow-up appointments for every 6 months. At follow-up, the teeth were asymptomatic without gingival inflammation after 6 months. Radiographs showed normal healing of the periapical areas. In addition, the patient was satisfied with her appearance and was smiling [Figure 7].

DISCUSSION

Disturbances during morpho-differentiation of tooth germs are seldom in permanent dentition.[1] Mostly, the occurrence of two roots or two root canals in maxillary incisors should force a clinician to consider conditions such as fusion, gemination. These variations are usually seen with an unusually large crown or labially/lingually defective crown surfaces.[5] In the present case, both crowns were clinically normal in size mesiodistally but larger buccopalatinally. Furthermore, they were considered defective when compared with the ipsilateral teeth. Radiologically, two separate pulp chamber and two root canal systems have been detected in both teeth and considered that they were fused. Gemination was disregarded as they did not have single or large root canal system. In addition, there were no missing teeth in the dental arch, so it was thought that the maxillary central and lateral teeth may have been fused with a supernumerary tooth.

CBCT has become a commonly used diagnostic tool for evaluating the root canal configuration of maxillary incisors with aberrant morphology in various studies.[8,10] However, justification of use of CBCT in children is especially important because of the higher risks associated with exposure in children.[9] The smallest volume size

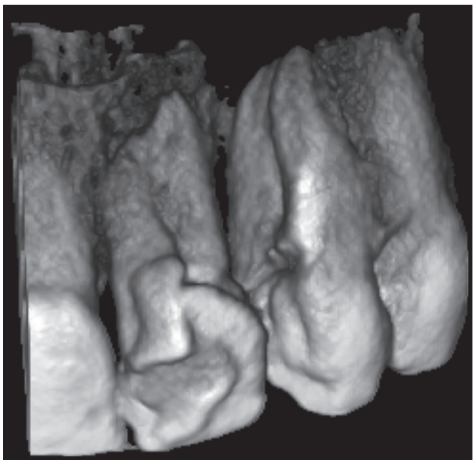

Figure 3: Three-dimensional reconstruction of the case demonstrating the root formations of the maxillary left central and lateral incisors

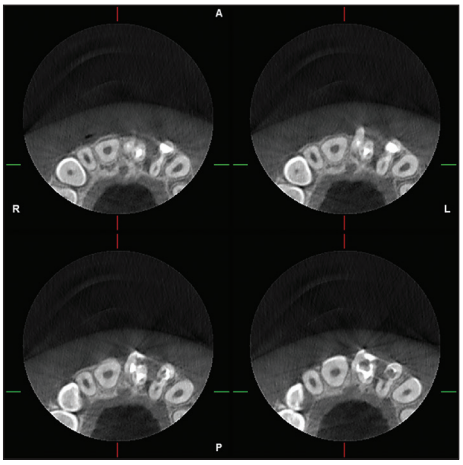

Figure 4: Axial images of the case at 1 mm slice thickness from apical to coronal direction. Note the separate root canals of the maxillary left central and lateral incisors

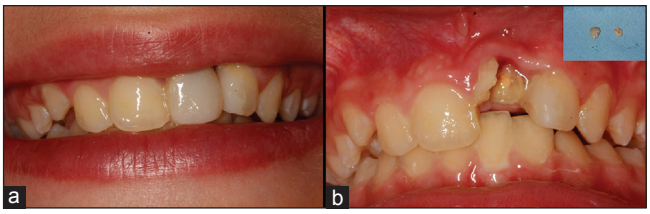

Figure 5: (a) Prepared tooth for monolithic zirconia restoration, (b) after prosthodontic rehabilitation

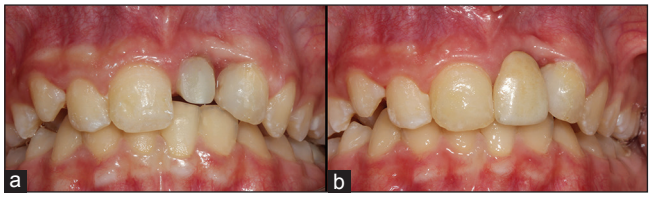

Figure 6: (a) Prepared tooth for monolithic zirconia restoration, (b) after prosthodontic rehabilitation

Figure 7: Intraoral appearance at the 6 months follow-up

compatible with the situation should be selected because of reduced radiation dose. The use of CBCT units offering only large volumes requires very careful justification and is generally discouraged, especially for orthodontic purposes. CBCT might be justifiable in the assessment of teeth which have aberrant root canal morphology, where conventional radiographs provide inadequate information.[9] In the present report, CBCT scan was not the first choice of imaging but the orifice of the second root could not be identified with clinical methods, so CBCT scan was taken using a limited field of view at the smallest volume with the radiation beam collimated to the restricted area. Considering that there was no interference with the scan, a lead thyroid collar was also used with a lead apron to reduce thyroid exposure. CBCT and three-dimensional reconstruction of the case provided valuable information regarding the unusual root canal and crown morphology.

In reviewing the literature, different treatment alternatives have been reported for teeth which have an extra root. Garlapati *et al.*[4] presented a case of an inadequately filled maxillary central incisor with an additional palatal root with a periapical radiolucent lesion. They performed retreatment procedures and restored the tooth with a metal ceramic crown to enhance the esthetics. Kulkarni *et al.*[6] reported a maxillary right lateral incisor with an accessory root in a 14-year-old boy. For the main canal of the tooth, conventional root canal therapy was performed, and surgical amputation of the accessory root was implemented considering the amount of bone loss. In a case by Sharma *et al.*,[10] a dilacerated maxillary central incisor having two root canals was treated with surgical endodontic treatment and an esthetic restoration was performed using composite resin due to the hypoplastic nature of the tooth. In our case, evaluation of CBCT images revealed additional root canals and facilitated the endodontic treatment. Surgical intervention was not considered due to healing of the periapical lesion from the conventional endodontic treatment.

For the esthetic rehabilitation, a conservative approach was planned. Composite resin was used to restore the maxillary incisors. However, due to excessive loss of tooth structure from the maxillary central incisor after subsequent traumatic injury, the tooth was restored using a monolithic zirconia restoration. A full-contour (monolithic) zirconia crown was selected to overcome the disadvantages of conventional metal-ceramic full crown restorations. Furthermore, zirconia crowns are optimal when considering their flexural strength (1000+ MPa), minimal wear on opposing teeth, conservative tooth preparation, tooth color, and potential for successful long-term clinical success.[11]

In this case, the successful treatment of a maxillary central incisor and a lateral incisor, which both presented two roots with aberrant crown morphology as confirmed by CBCT, was presented. A multidisciplinary approach is necessary for a good long-term prognosis of challenging cases such as this. Furthermore, the clinician must have adequate knowledge of the variations of the maxillary incisor root canal morphology and potentials of advanced diagnostic and treatment modalities for a successful management of anomalous root canals.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol 1984;58:589-99.
2. Rao Genovese F, Marsico EM. Maxillary central incisor with two roots: A case report. J Endod 2003;29:220-1.
3. Shokouhinejad N, Sheykhrezaee MS, Assadian H. Endodontic treatment of two-canalled maxillary central and lateral incisors: A case report. Iran Endod J 2009;4:79-80.
4. Garlapati R, Venigalla BS, Chintamani R, Thumu J. Re-treatment of a two-rooted maxillary central incisor: A case report. J Clin Diagn Res 2014;8:253-5.
5. Lam EW. Dental anomalies. In: White SC, Pharoah MJ, editors. Oral Radiology, Principles and Interpretation. U.S.A.: Elsevier, Mosby; 2014. p. 582-611.
6. Kulkarni VK, Deshmukh J, Sharma DS, Banda NR. Rare and unusual presentation of maxillary lateral incisor with an accessory root. NJDSR 2014;2:18-20.
7. Tyndall DA, Rathore S. Cone-beam CT diagnostic applications: Caries, periodontal bone assessment, and endodontic applications. Dent Clin North Am 2008;52:825-41, vii.
8. Jaju PP, Jaju SP. Clinical utility of dental cone-beam computed tomography: Current perspectives. Clin Cosmet Investig Dent 2014;6:29-43.
9. European Commission. Radiation Protection No. 172, Cone Beam CT for Dental and Maxillofacial Radiology, Evidence Based Guidelines. Luxembourg: Directorate-General for Energy Directorate D-Nuclear Energy Unit D4-Radiation Protection; 2014.
10. Sharma S, Grover S, Sharma V, Srivastava D, Mittal M. Endodontic and esthetic management of a dilacerated maxillary central incisor having two root canals using cone beam computed tomography as a diagnostic aid. Case Rep Dent 2014;2014:861942.
11. Guess PC, Zavanelli RA, Silva NR, Bonfante EA, Coelho PG, Thompson VP. Monolithic CAD/CAM lithium disilicate versus veneered Y-TZP crowns: Comparison of failure modes and reliability after fatigue. Int J Prosthodont 2010;23:434-42.