Effective Use of Cone Beam Computed Tomography to Detect a Lateral Root Perforation: A Case Report

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Abstract

Post space preparation may lead to lateral root perforations. These can be subsequently challenging to diagnose using conventional radiography, especially in the labio-lingual plane due to the two-dimensional nature of conventional radiography. This paper demonstrates an effective use of a three-dimensional imaging technique, cone beam computed tomography (CBCT), for diagnosis and management of a lateral root perforation. A root perforation on the labial surface of a maxillary central incisor was detected using CBCT imaging. This perforation was repaired surgically using mineral trioxide aggregate (MTA). At one year recall, the clinical and radiographic outcome of treatment was considered satisfactory.

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Introduction

Root perforation is a communication created between the root canal system and the external root surface.[1]It is a significant complication that may occur during endodontic treatment. Although perforation may occur as a result of extension of internal resorption into the periradicular tissues, it most commonly occurs as a result of iatrogenic damage during access cavity preparation, endodontic debridement or during post space preparation.[2]Such communications result in loss of integrity of the root and destruction of the adjacent periodontal tissues. Repair of a root perforation is indicated when the tooth has a strategic value.[3] Perforations can be repaired externally by surgical approach as well as internally through the root canal. Surgical repair is indicated when a perforation is inaccessible through the root canal or when repair of a perforation fails using an intracanal approach.[1] Prevention and control of bacterial infection at the perforation site will determine the prognosis of a tooth with a perforation[1]. Additionally, the use of a biocompatible repair material will limit periodontal inflammation and further periodontal breakdown.[2]

Perforations that may occur during endodontic procedures or post space preparation may remain unnoticed and result in formation of a sinus tract which may be

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detected on recall appointments.[2] An important step in treatment planning and evaluation of the prognosis is to accurately determine the presence and location of the perforation. Detection of a perforation on the labial or lingual root surface by a conventional periapical radiograph is challenging. This is due to the two dimensional (2-D) nature of conventional radiography which results in superimposition of the image of the perforation on that of the root.[2, 4]

A three-dimensional (3-D) imaging technique, cone beam computed tomography (CBCT) is now widely available, specifically for use in dentistry. CBCT involves the use of an assembly where a small cone shaped X-ray beam is directed through an area of interest onto an X-ray detector on the opposing side. This assembly makes a 360-degree rotation about the patient's head and captures a cylindrical or spherical volume of data which is reconstructed by computer algorithm.[4] This multi-planar reconstruction of the primary data allows creation of both 3-D images and 2-D images of any selected plane. Thus, CBCT provides more information for oral diagnostic purposes than conventional radiography at a radiation dose which is similar to that from two to three intraoral radiographs.[5, 6] In this case report we demonstrate the use of CBCT to detect a lateral root perforation which was repaired surgically using mineral trioxide aggregate (MTA).

Case Report

A 40-year-old healthy female patient was referred to the Department of Conservative Dentistry, Universiti Sains Malaysia for consultation and treatment concerning tooth 11. The patient's dental history indicated that tooth 11 had been endodontically treated 20 years ago. The tooth had been asymptomatic since then. In January 2014, the patient visited her general dental practitioner (GDP) with a complaint of discoloration on tooth 11 & 21. Following examination and diagnosis, her GDP carried out endodontic treatment of tooth 21. All ceramic crowns were planned for both tooth 11 and 21 to address the patient's complaint. However, one month following fiber reinforced composite (FRC) post placement in both11 and 21, a sinus tract developed on the labial attached gingiva adjacent to tooth 11 (Figure 1). The patient was then referred for consultation and treatment.

Figure 1: Pre-treatment photograph showing a sinus tract on the labial attached gingiva adjacent to tooth UR1.

On presentation, the patient did not report of any symptoms. Clinically, the patient's dentition was heavily restored. Most of her posterior teeth were restored with amalgam which appeared normal clinically. A temporary acrylic crown was present on tooth 21. Tooth 11 was heavily restored with composite restoration covering most of the clinical crown. A sinus tract was noted on the labial attached gingiva adjacent to tooth 11 (Figure 1). Tooth 11 was not tender to percussion, and the adjacent soft tissues were not tender to palpation. Probing depths were within normal limits. A guttapercha inserted into the sinus tract traced to the labial surface of the mid root region of tooth 11 (Figure 2).

Figure 2: Pre-treatment radiograph showing gutta-percha cone tracing a sinus tract to the labial root surface of tooth UR1.

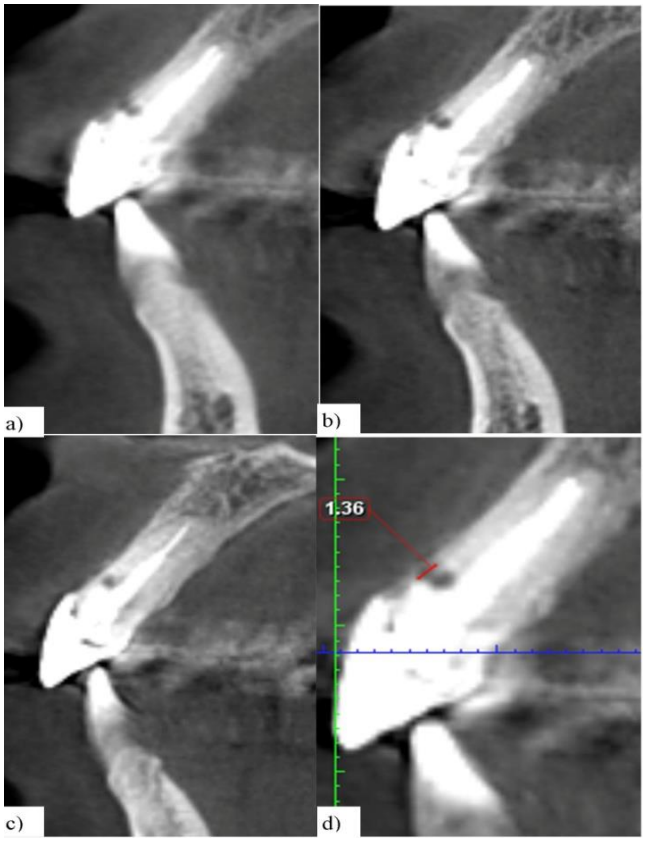

Figure 3: Sagittal sectional images of a CBCT scan through tooth UR1 from mesial to distal. (a) and (b) showing a communication of the root canal space and the periodontal ligament (PDL) space on the labial surface of tooth UR1. (c) showing a perforation space within the root canal not communicating with PDL space. (d) showing the size of the perforation, approximately 1 mm.

A diagnosis of 'chronic periradicular periodontitis with sinus tract' was made for tooth 11. Possible etiologies included, leaching of microbial irritants via a lateral canal, root fracture or lateral root perforation. To confirm the etiology, CBCT imaging was done using Planmeca ProMax 3D unit (Planmeca, USA). Presence of a perforation at coronal third on the labial root surface of tooth 11 was confirmed by CBCT (Figure 3 and 4).

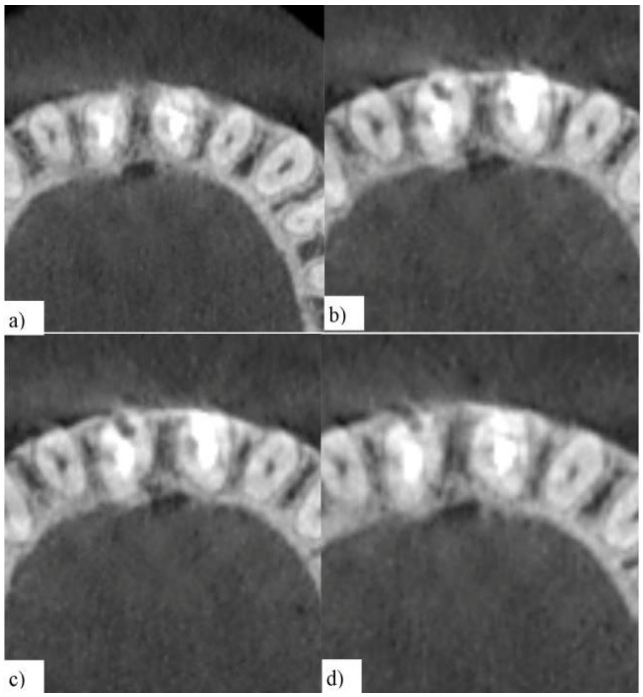

Figure 4: Transverse sectional images of a CBCT scan through tooth UR1 (a-d) from apical to coronal direction.

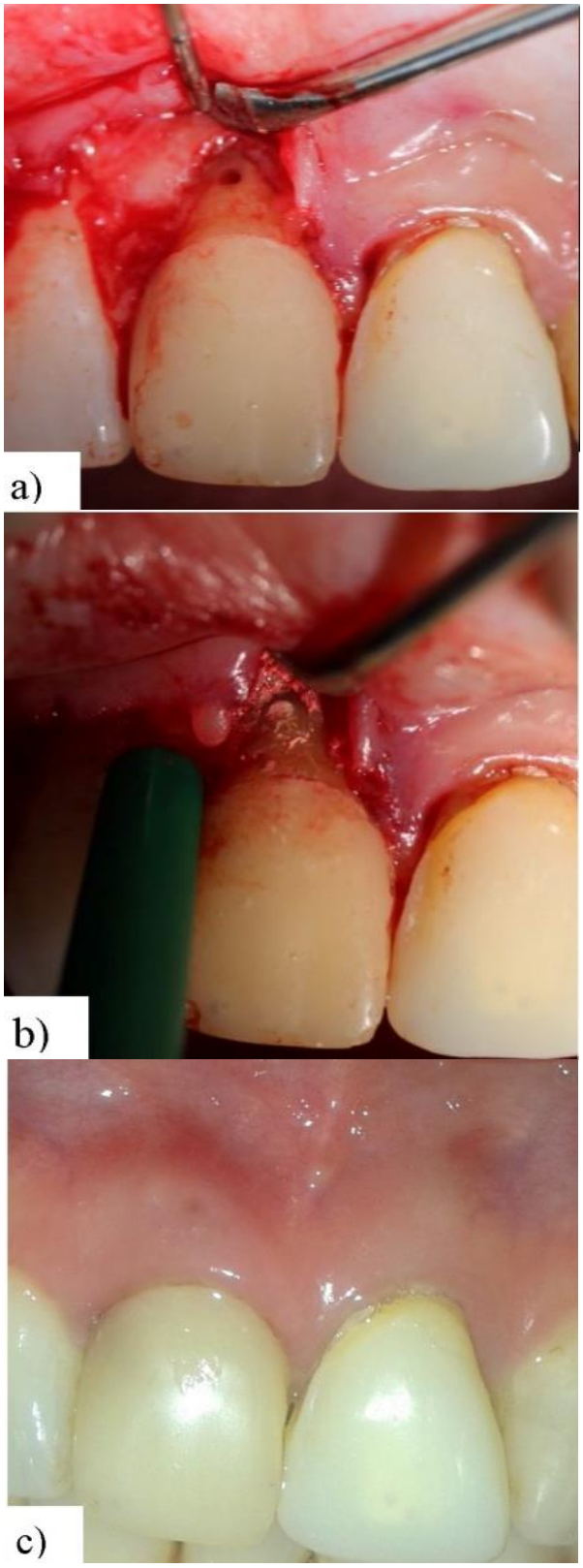

Figure 5: a) Perforation on labial root surface of tooth UR1 exposed surgically. b) Perforation filled with MTA. c) Photograph two weeks post-surgery, note the healing of the sinus tract with residual scar.

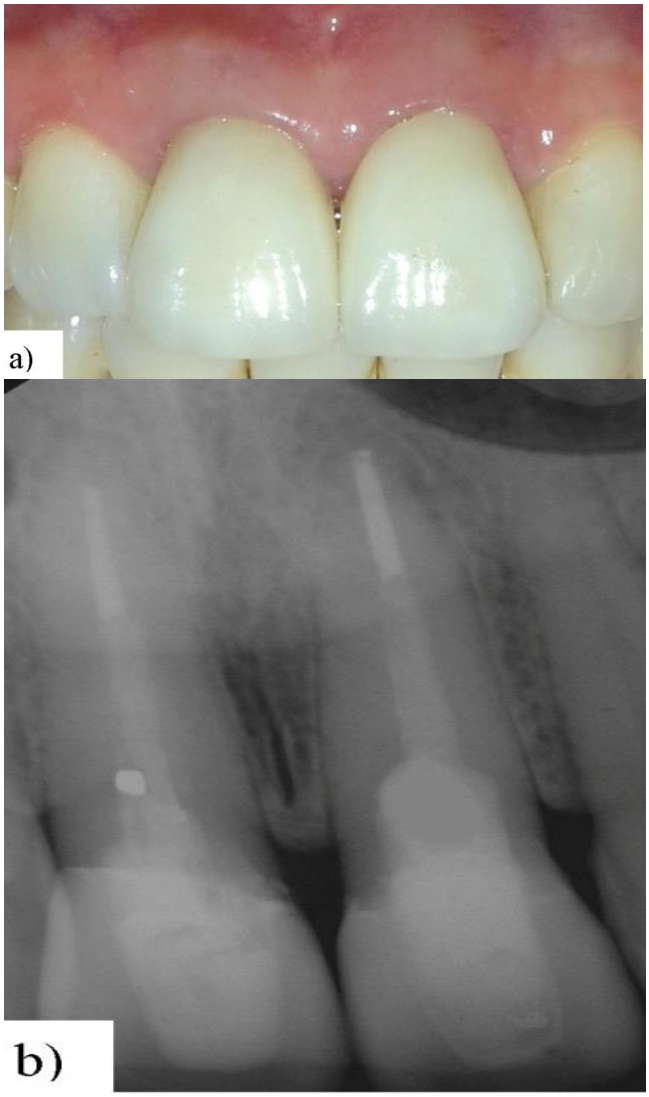

Figure 6: a) Photograph 1 year following perforation repair and after teeth UR1 and UL1 were restored with all ceramic crowns. The sinus tract has completely resolved. d) Periapical radiograph 2 years following perforation repair. Note the MTA in place over the perforation.

Treatment options that were considered for tooth 11 included: (i) surgical root repair with MTA; or (ii) internal perforation repair with MTA followed by construction of a new post-core and crown. After the options were discussed with the patient, the patient agreed for surgical repair of the perforation with MTA. Non-surgical approach would involve multiple visits for treatment which was not feasible for this patient due to her professional commitments.

Furthermore, as seen from the CBCT images (Figure 2), a large, deep coronal restoration was present. In orthograde re-treatment, removal of this restoration would involve the risk of creating an additional perforation. Additionally, CBCT imaging showed that the post was properly positioned within the root canal. Hence, surgical root repair was chosen as the treatment modality.

Informed consent was obtained from the patient before the minor surgical procedure. The surgical site was anesthetized by giving labial infiltration injection using 2% mepivacaine (Scandonest 2% special, Septodont, USA) with epinephrine (1:100,000). A three-cornered full thickness mucoperiosteal flap was raised to expose the root surface of tooth 11. A perforation approximately 1 mm x 1 mm, 4 mm apical to the CEJ was seen on the labial root surface of tooth 11 (Figure 5 a). The perforation site was cleaned by rinsing with sterile saline solution and then filled with ProRoot MTA (Dentsply Tulsa Dental, USA) (Figure 5 b). The flap was repositioned and sutured with Dafilon 5-0 (Aesculap, USA) non absorbable suture. Post-surgery, healing was uneventful and no complications were noted. At two weeks recall post-surgery, the sinus tract had healed completely (Figure 5 c).At this stage, tooth 11 was prepared and restored with an all ceramic crown.

Temporary acrylic crown on tooth 21 was also replaced with an all ceramic crown.

At 2-years recall, the treatment outcome was satisfactory. Clinically and radiographically there were no signs of failure (Figure 6 a, b). No loss of attachment was noted clinically and radiographically no peri-radicular radiolucency was present. Tooth 11 was not tender to percussion and tooth mobility was within normal limits. There was no sinus tract, and probing depths were within normal limits. The patient was encouraged to come at regular intervals for long-term follow up.

There are many instances in endodontic practice when conventional radiography does not provide adequate information on pathologic conditions and positional relationships. Use of 3-D imaging in endodontics has now become a possibility with the introduction of CBCT scanners.[6] A major advantage of this 3-D imaging is that the imaged area can be arbitrarily sliced and observed from three different directions. Additionally, a higher resolution image can be obtained using CBCT as compared to conventional medical CT at a much smaller radiation dose.[5,7] In the present case, examination of the 3-D images revealed clearly the presence of a lateral root perforation on the labial surface of tooth 11. Thus, the presence and position of a perforation was confirmed preoperatively. This enabled the operator to be confident in diagnosis and treatment planning. Additionally, CBCT images were extremely helpful in explaining the endodontic problem to the patient. While the use of CBCT is becoming increasingly popular in the field of endodontics, very few cases have reported the use of this technology for the diagnosis of lateral root perforation.

The CBCT radiographs were worthwhile tool for the diagnostic investigation in dentistry.[8] CBCT is an advantageous tool for the numerous oral surgical application, orthodontic records, periodontology and endodontic assessment made easier by the precious advent.[9] It show the 2d and 3d data of the subjects via single exposure through various software. Also as an adjunct for the investigation of various dental anomalies.[10]

In endodontic investigations radiograph is a vital part for the exploration and management of dental pathologies. The 2D and 3D x-rays are very common in routine diagnosis. However the 2D radiographs has many limitation in exploring complete tooth anatomy. CBCT may overcome problems of endodontic treatment. Current case report the exploration of lateral canals with help of 3D CBCT acquisitions.[11, 12, 13] Therefore, with the advent of CBCT the tooth can be examined for its complete anatomy.[13] Consequently, with the wise

management of endodontic treatment the tooth can be easily saved for it function in the oral cavity.

An important criteria that determines the treatment success of root perforations is the time elapsed since its occurrence.[1, 3] In this case the perforation is believed to have occurred very recently during post space preparation (around one month ago). Thus, the time elapsed since the occurrence of perforation was considered short. Other factors that affect the prognosis are the size of the perforation, and site of the perforation in relation to the crestal bone and epithelial attachment.[1,2] In this case the perforation was small(around 1 mm in diameter) and it was in the mid-root region where there was no evidence of pocketing to the perforation site. Hence, considering these factors, the treatment of this defect was deemed possible by surgical repair, provided the defect was sealed effectively with a suitable repair material. Mineral trioxide aggregate (MTA) is one such suitable perforation repair material.

It has demonstrated excellent biocompatibility and good sealing ability.[14] Additionally, MTA also allows regeneration of hard tissues on its surface.[15] Moreover, presence of blood or moisture does not affect the setting and sealing ability of MTA.[16]

Conclusions

Radiological examination is essential for diagnosis and management of various endodontic problems. This case demonstrates the use of CBCT imaging technology as an important tool for diagnosis and management of complex endodontic problems. In this case, a lateral root perforation was effectively detected using CBCT imaging and treated surgically using MTA. At two years' recall, the treatment outcome was considered satisfactory.

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