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CBCT assisted management of severely calcified root canal system – A case report

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Abstract

Introduction: To describe the endodontic treatment protocol of a necrotic maxillary canine with calcified root canal system associated with acute periapical periodontitis with the aid of cone-beam computer tomography (CBCT).

Methods: a 30-year-old female patient was referred to our practice after an unsuccessful attempt to reached a full working length of the infected canal. The patient reported a traumatic injury some years ago, affecting her right anterior maxilla and recent episodes of pain and biting discomfort. Upon evaluating the CBCT slices and projections the negotiable part of the canal was revealed and by comprehending the spatial location of the canal and the previous access cavity the canal was re-accessed easily, and the rest of the treatment steps has followed predictably.

Results: At three months follow up, the patient reported no signs or symptoms and the intraoral radiograph showed promising signs of periapical bone healing.

Conclusion: Pulpal calcification induced by a traumatic incidence and associated with pulpal septic necrosis can hinder the outcome and the implementation of the root canal treatment. However, CBCT has proven itself valuable in the contemporary arsenal of modern endodontic tools preventing mishaps while localizing and exploring those calcified systems.

Introduction

Root canal treatment aims to eradicate the causes of periapical pathologies by removing the infected pulpal tissue and debriding the root canal system space[1]. Ultimately, a proper shape has to come into place in order to obtain a three-dimensional (3D) hermetic sealing preventing future bacterial colonization[2] . It is well known that Primary Pulpal infection and subsequent periapical inflammation happen after the bacterial invasion to the pulpal space[3]. Nevertheless, sterile pulp necrosis after traumatic injuries has a rather distinct presentation. Traumatic Luxation cause extensive or total severance of apical blood supply, leaving a little to no chance of pulpal healing and lead to

pulp necrosis[4]. This unfavourable scenario will ease the bacterial invasion to the vulnerable and defenceless pulp space through cracks, marginal plaque accumulation, blood clots around the broken periodontal ligaments (PDL) or even through the bloodstream (anachoresis) [5,6]. Sequentially, dentine apposition inside the canal system space is drastically accelerated in teeth affected by traumatic injuries leading to obliteration of the pulpal cavity [7]. This combination of the unfavorable outcomes of the traumatic injury, from canal calcification to septic necrosis, will but a considerable burden on the success chance of the root canal treatment. Dental operating microscopes (DOM) have been a great adjunct and a standard of care in the field of endodontics. Their value is outstanding when dealing with cases of extreme calcification with high efficiency [8]. Nevertheless, this potentiality can be neutralized if not accompanied by a thorough understanding of the presented anatomy of the case [9].Radiographs have played a significant role in clinical endodontics, from diagnosis to treatment planning and follow-ups [10]. Conventional two-dimensional (2D) intraoral radiography, are the go-to imaging modality in everyday clinical use. However, they are deficient in cases of extreme pulpal calcification providing the clinician with not enough information regarding the location and actual size canal inside the root [11]. Even with the aid of DOM, treatment was always carried on with some uncertainty while searching for canal entrances, putting the integrity of the peri-cervical dentine at jeopardy, especially in cases where the clinician does not have a comprehensive 3D understanding of the anatomy of the tooth to be treated [12]. The introduction of Cone-beam computed tomography (CBCT) has helped tremendously overcome the limitation of the conventional 2D photos [13]. This technology offers an extensive and a global appreciation of the tooth and morphological details and the spatial anatomy of its root canal system related to the tooth and the surrounding anatomical structure[14]. The aim of presenting this a case is to shed more light on the importance of CBCT in the everyday endodontic practice and to appreciate more the fine details that the current CBCT systems can provide.

Case report

A 30 –year-old female with no history of systematic diseases was referred to our practice. Her referring dentist held on the initial treatment. By then, the patient's chief complaint was intense pain in the anterior right region of the maxilla. During clinical evaluation, a buccal swelling was noticed apical to the right upper canine that also suffered from percussion induced pain. The patient reported a traumatic injury years ago and transient biting discomfort after the accident. After the initial treatment, the patient reported a relative relief of pain. Failure of achieving the full working length of the canal was the reason for referral. At that time, gingival sulcus measurement and mobility were within normal limits; however, there was a palpation tenderness buccally. The preoperative intraoral X-ray showed a periapical lesion associated with the tooth and extreme calcification in the middle and apical root third justifying the difficulty reaching the apex by the previous clinician (Figure 1 – A/B). In order not to jeopardize the root integrity anymore, CBCT examination was done after the patient's consent. In this case, NewTom VGi evo (NewTom, Verona, Italy) was used operating at 0.2 mm voxel size. The 3D examination Unfolded the extent of calcification and off-centred access that was 1 mm short of the negotiable canal part (Figure 2). After discussing the treatment options and plan with the patient, the tooth was isolated with the aid of a rubber dam and the temporary filling

was removed. With the aid of DOM (Carl Zeiss, Oberkochen, Germany), the access cavity was extended a further 1 mm. by a 34 mm length Munce Discovery Bur size 2 (CJM Engineering, Santa Barbara, C A, USA) rotating at 5000 RPM with an angulation that was already planned by the sagittal slice from the CBCT (Figure 3). Once the original path of the canal was declared, mechanical instrumentation was carried on to the CBCT measured canal length (Figure 4). FANTA AF ONE rotary file (FANTA DENTAL MATERIALS CO. - SHANGHAI – China) was used as a primary file (size 25, 0.06 taper). Copious irrigation of sodium hypochlorite (NaOCl) 5.25 % was administered during the canal preparation at a rate of 3 CC every 2 mm advancement of the rotary file. Working length was re-secured with the aid of apex locator (Propex Pixi™ - Dentsply Sirona - Switzerland) and paper points. Final irrigation protocol consisted of 20 cc. of Naocl with three cycles of 1 min sonic activation (Endoactivator-Dentsply Sirona, Ballaigues, Switzerland) followed by 17% EDTA solution for 1 minute, 5.25% NaoCl and final saline solution NaCl 0.9%. The canal was then dried with the aid of sterile Paper Points and filled with ProRoot MTA (Dentsply-Tulsa Dental Specialties, Johnson City, TN, USA). SDR bulk-fill Composite (Dentsply DeTrey, Konstanz, Germany) was then used to seal the access cavity following the appropriate filling and bonding protocol (Figure 5). At three months intraoral x-ray showed promising signs of periapical bone healing and complete absence of pain or discomfort (Figure 6).

Discussion

In the case of sterile pulpal necrosis and with the absence of cracks, caries, restorations dentinal exposure and or periodontal disease, the necrotic pulp is likely to stay sterile showing no adverse effect on the surrounding periodontium[15]. Bacteria can find its way to the compromised pulp and infecting it [16]. In order to bring those teeth and their surrounding periodontal complex back to a healthier status, full canal length debridement and obturation is a must [17]. It has been reported that up to 25% of traumatized teeth can develop a varying degree of canal space calcification[18]. Negotiating those calcified structures can hold a danger of mishaps such as root wall perforations leading to lower the prognosis of the treatment [19,20]. In this respect, many modern modalities have been implemented in the practice of microscope aided endodontics to overcome those difficulties and obtaining a higher percentage of the outcome [21]. In recent years, CBCT had played a significant role in diagnosing and treatment planning of root canal related pathologies [22]. Unlike its 2D counterpart, the images provided from the CBCT are not distorted, providing uniform resolution in all the slides and aspects. Thanks to the isotropic voxels produced by the CBCT, all images are geometrically accurate [23]. Even though the spatial resolution of the current CBCT systems is still a tenth of what the contemporary intraoral radiographs have to offer[24], however, the information provided by the 3D radiology and the corresponding slices and projections are invincible. New CBCT systems come with rather good enough quality of image, with voxel sizes ranging from 0.1 to 0.4 in most of them that have been reported to be satisfactory in detecting canals [25]. These findings are in accordance with the robust correlation that has been shown between roots histological sections and dental cone beam reconstructions [26]. However, 3D scans come with the expense of exposing the patient of a higher radiation dose compared to intraoral radiograph [27]. That's why a thorough clinical justification has to be made before implementing this complementary radiographic modality

[28]. After all, It is the clinician's responsibility to weigh, per case, the advantages and disadvantages of implementing this technology in a Patient and outcome centred decision-making setting.

Conclusion

Treating root canals with severe calcification associated with septic necrosis can come with treatment challenges. However, CBCT has proven its efficacy in dealing with those challenging cases predictably.

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Legend Figure

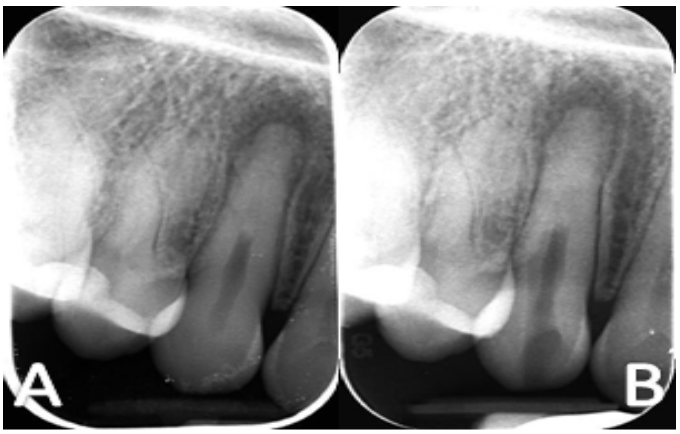

Figure 1: 1-A A preoperative radiograph provided by the referring dentist, taken before starting the treatment. 1-B A diagnostic image showing the extent of the previous access cavity.

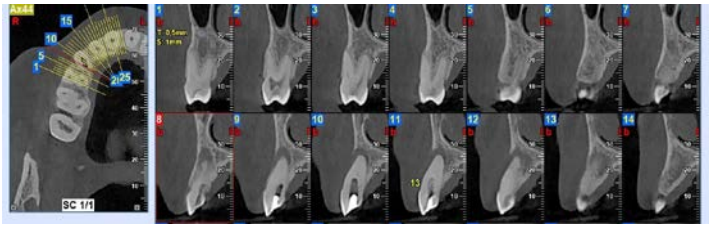

Figure 2: Snapshot of the relevant sagittal slices taken from the CBCT examination

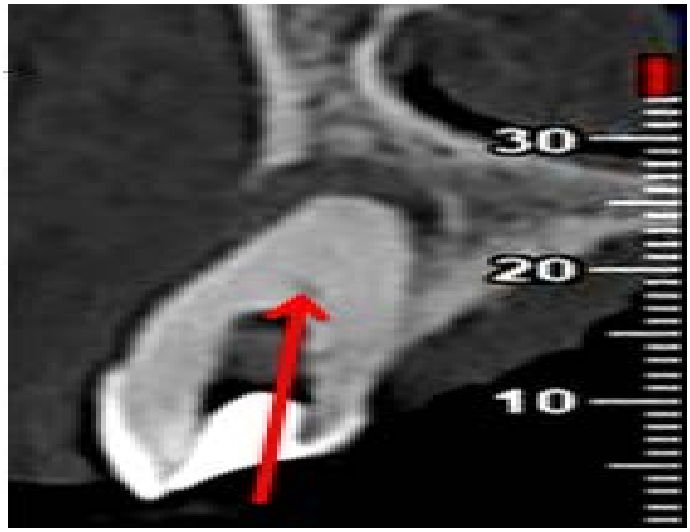

Figure 3: Magnified sagittal projection with an arrow representing the intended direction of the munce bur

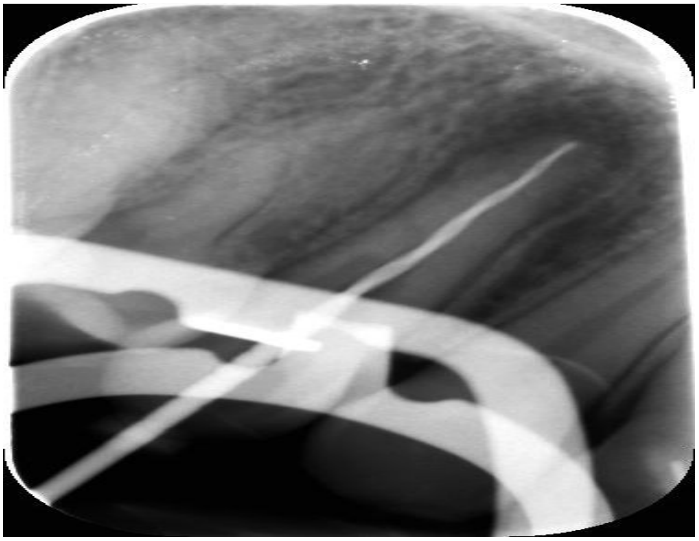

Figure 4 : Working length confirmation X-ray.

Figure 5: Immediate postoperative X-ray.

Figure 6: Three months follow up X-ray.