

Multidisciplinary Rehabilitation of Discoloured and Calcified Maxillary Incisors using MTA, EndoGuide-Assisted Canal Negotiation, and Aesthetic Restoration: A Case Report

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ABSTRACT

Managing calcified root canals and discoloured anterior teeth remains a clinical challenge due to diagnostic complexity and the risk of procedural complications. This case report presents a multidisciplinary approach for the rehabilitation of maxillary incisors affected by pulp canal obliteration, apical pathology and aesthetic concerns. A 28-year-old male patient reported with discolouration of the maxillary right central incisor, while the adjacent lateral incisor exhibited complete canal calcification. Tooth 11 was treated through surgical endodontic intervention involving apicectomy and retrograde Mineral Trioxide Aggregate (MTA) obturation, supplemented with Platelet-Rich Fibrin (PRF) membrane and collagen plug placement to promote periapical healing, followed by non-vital bleaching. Tooth 12 was successfully managed using static guided endodontics, enabling safe negotiation of the obliterated canal and subsequent obturation. The combined use of Cone-Beam Computed Tomography (CBCT)-guided planning, surgical intervention, and aesthetic rehabilitation resulted in favourable functional and aesthetic outcomes at the six-month follow-up. This report underscores the clinical value of guided endodontics and a multidisciplinary treatment strategy in managing complex anterior endodontic cases.

Keywords: Computer-assisted surgery, Cone-beam computed tomography, Dental pulp calcification, Dental pulp diseases, Endodontics

CASE REPORT

Male patient aged 28 years came to the department of conservative dentistry and endodontics with complaint of tooth discolouration in the upper right front region of the jaw for the past two years. The patient gave a history of blunt trauma to the maxillary anterior region following a fall at the age of 16 years, which was considered a probable aetiological factor. No dental treatment was sought immediately after the traumatic incident, and the patient remained asymptomatic for several years thereafter. There was no history of prior restorative, endodontic, or surgical intervention involving the involved teeth. The patient's medical history was non-contributory, and there were no contraindications to dental treatment.

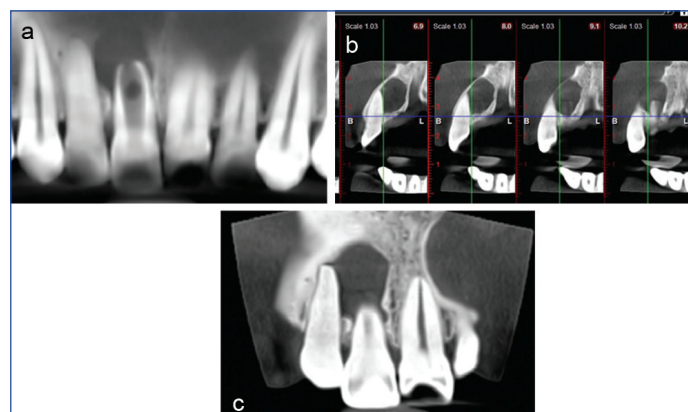
An intraoral examination showed that the right maxillary central incisor was discoloured [Table/Fig-1]. There was no evidence of caries, fracture, or previous restoration with tooth 11. The adjacent maxillary right lateral incisor (tooth 12) appeared clinically normal in colour and morphology. Both teeth were firm, with normal periodontal probing depths and no mobility. Tenderness on percussion was absent with respect to teeth 11 and 12. Neural sensibility tests were done using electric pulp test and cold test which yielded negative responses for both teeth, suggestive of pulpal necrosis.

A cone beam tomography image [Table/Fig-2a] revealed a well-defined periapical radiolucency measuring approximately 10×13 mm in relation to tooth 11, suggestive of asymptomatic apical periodontitis. The pulp chamber and root canal area of tooth 12 was completely obliterated. CBCT was used to determine the degree of calcification and prevent iatrogenic consequences. Complete pulp canal obliteration was confirmed by cross-sectional [Table/Fig-2b] and coronal CBCT [Table/Fig-2c] images of tooth 12, which showed widespread radiopacity throughout the pulp chamber and canal space extending from the cervical to apical third. With respect to teeth 11 and 12, a diagnosis of pulpal

necrosis with asymptomatic apical periodontitis was made based on clinical and radiographic evidence; calcific degeneration was visible in tooth 12.



[Table/Fig-1]: Preoperative intraoral view showing discolouration of maxillary right central incisor (tooth 11).



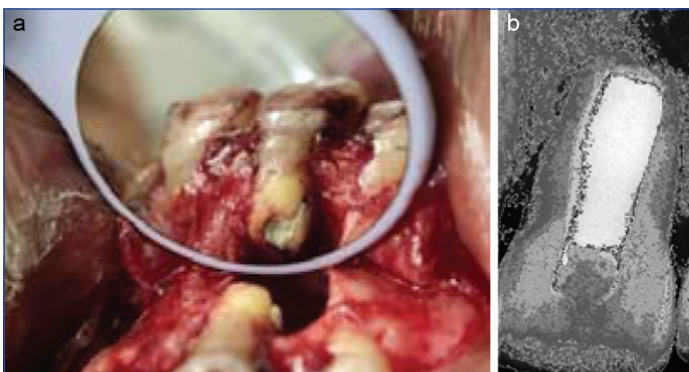
[Table/Fig-2]: a) Preoperative CBCT image showing a well-defined periapical radiolucency associated with tooth 11; b) CBCT cross-sectional image of tooth 12 showing diffuse radiopacity within the pulp chamber and root canal; c) CBCT coronal section of tooth 12 confirming complete pulp canal obliteration from cervical to apical third.

A comprehensive management approach was established. In order to facilitate accurate and cautious canal negotiation, tooth 12 was scheduled for root canal therapy using static guided endodontics. Tooth 11 was scheduled for surgical endodontic treatment, including apicectomy and collagen plug-assisted MTA obturation, because of ongoing apical disease. Non-vital bleaching of tooth 11 and final aesthetic rehabilitation were scheduled after endodontic and surgical treatment.

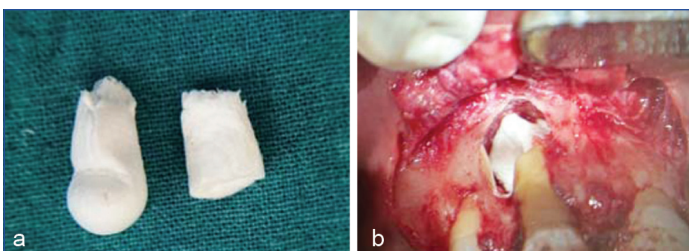
Under local anaesthesia, a full-thickness mucoperiosteal flap was raised in the maxillary anterior region to reveal the periapical region of tooth 11 [Table/Fig-3]. Periapical curettage was done to remove the granulation tissue. After achieving sufficient haemostasis, retrograde MTA obturation was done for obtaining effective apical seal [Table/Fig-4a,b]. Following retrograde MTA obturation, a collagen plug (CollaPlug) was placed [Table/Fig-5a,b] in the periapical defect to stabilise surgical site and to further support rapid bone regeneration, subsequently a PRF membrane [Table/Fig-6] was positioned over it to enhance soft tissue and bone healing through sustained release of growth factors. The flap was repositioned and sutures were given [Table/Fig-7]. The postoperative instructions were given to the patient.



[Table/Fig-3]: Surgical phase—full-thickness mucoperiosteal flap reflected in relation to tooth 11.

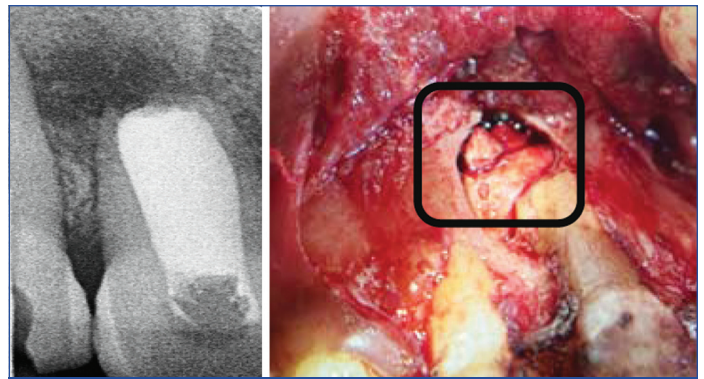


[Table/Fig-4]: a) Retrograde MTA obturation with tooth 11; b) Postoperative intraoral periapical radiograph showing MTA obturation of the canal.



[Table/Fig-5]: a) Collaplug; b) Placement of collagen plug (CollaPlug) at the apical region of tooth 11.

For the management of tooth 12, CBCT data and surface scans were merged into the BlueSky Bio Software for virtual planning [Table/

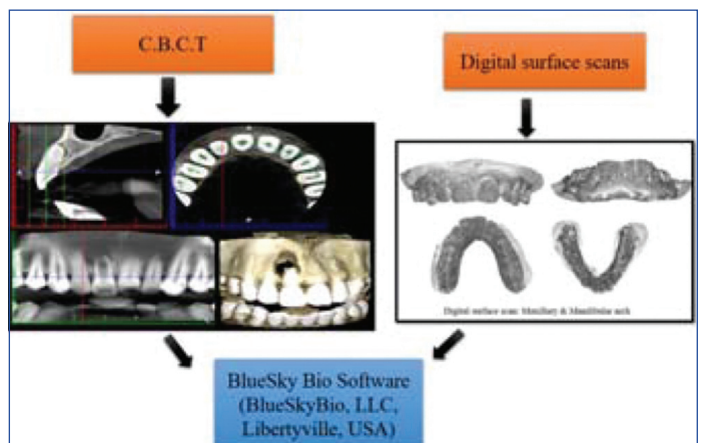


[Table/Fig-6]: Placement of Platelet Rich Fibrin (PRF) membrane at the apical region of tooth 11.



[Table/Fig-7]: Sutures given.

Fig-8). A static endodontic guide was designed and fabricated using 3D printing technology [Table/Fig-9]. The guide was checked intra-orally for proper fit [Table/Fig-10]. Under dental operating microscope, access opening was done through the guide using a long-shank bur (28 mm length, size 014) [Table/Fig-11a]. The radiograph was taken to check the proper orientation of the bur [Table/Fig-11b]. The calcified canal was successfully negotiated and located in the middle third [Table/Fig-12a]. After determining the working length at 19 mm [Table/Fig-12b], hand stainless steel instruments were used for cleaning and shaping, while EDTA and sodium hypochlorite were used for irrigation. Following obturation [Table/Fig-12c], a post-endodontic composite restoration was completed [Table/Fig-12d]. Non-vital bleaching of tooth 11 was performed using the walking bleach technique with a mixture of 35% hydrogen peroxide and sodium perborate, sealed temporarily with glass ionomer cement. Three bleaching sessions resulted in satisfactory shade improvement [Table/Fig-13]. At six-month follow-up, the patient was asymptomatic, radiographs showed favourable periapical healing, and the aesthetic outcome was satisfactory [Table/Fig-14].



[Table/Fig-8]: Digital planning of static endodontic guide using CBCT and surface scan data.

DISCUSSION

Clinical management of teeth with pulp canal obliteration and anterior discolouration is difficult because of the requirement to obtain appropriate aesthetic results, the difficulty of canal localisation, and



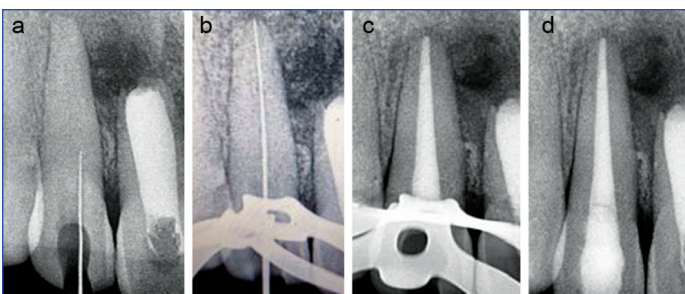
[Table/Fig-9]: 3D-printed static endodontic guide used for guided access preparation in a calcified maxillary lateral incisor.



[Table/Fig-10]: Intraoral verification of endodontic guide fit prior to access preparation.



[Table/Fig-11]: a) Guided access cavity preparation of tooth 12 through the endodontic stent; b) Radiograph taken to confirm the direction of preparation.



[Table/Fig-12]: a) The canal was located and negotiated in the middle third; b) Working length determination radiograph following guided access and initial canal negotiation using the static endodontic guide; c) Radiograph showing obturation of the root canal following chemomechanical preparation; d) Postoperative radiograph demonstrating satisfactory obturation and coronal seal.



[Table/Fig-13]: Postoperative intraoral view after three visits of non-vital bleaching.



Preoperative Image



Six Month Follow-up

[Table/Fig-14]: Preoperative and six-month follow-up intraoral photographs showing improvement in aesthetics of the maxillary anterior teeth.

the increased risk of procedural mistakes. With varying success rates documented in the literature, conventional methods for finding calcified canals using long-neck burs, ultrasonic tips, and magnification are technique sensitive and may lead to excessive dentin removal, canal distortion, or perforation [1,2].

For tooth 12, static guided endodontics was used in this instance to provide accurate and minimally invasive access to a totally calcified canal. The risk of iatrogenic problems was decreased by the precise virtual planning and manufacture of an endodontic guide made possible by the combination of CBCT data with digital surface images. When compared to traditional access cavity preparation, prior research has shown that guided endodontics dramatically minimises tooth material loss and angular deviation, justifying its application in teeth with pulp canal obliteration [3-5].

In order to achieve a predicted apical seal using an orthograde technique, Tooth 11 had chronic apical disease. Therefore, apicectomy and retrograde filling were recommended as surgical endodontic therapy. MTA was chosen as the retrograde filling material because of its exceptional sealing ability, biocompatibility, and potential to promote cementogenesis and periapical healing. Several experimental and clinical studies have demonstrated the effectiveness of MTA as a root-end filling material in periapical surgery [6,7].

Similar clinical scenarios have been reported in the literature, with guided endodontics successfully used to manage calcified anterior teeth, particularly after traumatic injuries. Krastl G et al., described guided endodontic access in teeth with pulp canal obliteration and associated apical pathology, reporting high accuracy in canal localisation and a reduced risk of perforation [3]. Connert T et al., further demonstrated, in a comparative study, that guided endodontics resulted in significantly less dentin removal and greater precision than conventional access techniques in calcified canals [4]. Case reports by Bansal RK et al., and Yang YM et al., have also highlighted the usefulness of CBCT-assisted guided approaches in managing obliterated canals that would otherwise pose a high-risk of procedural errors with traditional techniques [5,6]. These findings corroborate the clinical outcome observed in the present case, where static guided endodontics enabled predictable negotiation and successful obturation of a completely calcified canal.

Regenerative adjuncts were added to improve periapical healing in addition to retrograde MTA obturation. The main intention of incorporating a PRF membrane into the periapical defect was to encourage soft tissue repair, and bone regeneration by releasing autologous growth factors over time. As an adjuvant to surgical endodontic operations, PRF has been shown to improve regeneration results in periapical lesions and accelerate wound healing [8,9]. A biologically favourable environment for healing was created by the subsequent placement of a collagen plug, which helped stabilise the clot and act as a scaffold for bone regeneration.

Non-vital bleaching was done to address the aesthetics of tooth 11, which remains a conservative and successful strategy for minimising discolouration in non-vital anterior teeth. By preserving the natural tooth structure and avoiding aggressive restorative or prosthetic interventions, the walking bleach technique gives reliable and consistent improvement in tooth shade [10,11]. Overall, the coordinated use of guided endodontics, surgical endodontic therapy with regenerative support, and conservative aesthetic rehabilitation resulted in stable functional outcomes and enhanced aesthetic harmony.

CONCLUSION(S)

An integrated treatment approach and meticulous diagnostics are necessary for the management of anterior teeth that are discoloured and calcified. In this instance, surgical endodontic intervention with MTA effectively managed apical disease, while static guided endodontics allowed for predictable and less invasive negotiation of a completely obliterated canal. Adequate aesthetic recovery was facilitated by adjunctive non-vital bleaching. The combined approach resulted in stable clinical outcomes and improved patient satisfaction.

When used carefully, guided endodontics can greatly improve the predictability and safety of endodontic treatment in teeth with pulp

canal obliteration and should be regarded as a useful supplement in modern endodontic therapy.

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