Case Report

Stabilizing bony plate in guided endodontic surgery using an innovative approach

Maulee D. Sheth, Ankit V. Arora, Sonali V. Kapoor

Department of Conservative Dentistry and Endodontics, Manubhai Patel Dental College and Hospital, Vadodara, Gujarat, India

Abstract

Endodontic microsurgery in tandem with advanced radiographic techniques has led to the emergence of guided surgeries. Preservation of the cortical bone to enhance the healing and stabilization of tissues surrounding the tooth of concern can now be facilitated by bone cement used in the field of orthopedics. This case report details a guided endodontic surgery technique in 17 years old where a traumatic infliction leads to a phoenix abscess. The technique elaborated emphasizes on the three-dimensional printing of a surgical template with the help of cone-beam computed tomography, followed using a medical-grade bone cement in the most minimal manner to reposition the buccal cortical bone. A 12-month-old follow-up revealed the patient to be asymptomatic with a flawless periapical region radiographically. This case testifies that the optimum use of available biomedical material in surgical endodontics can assure a predictable prognosis.

Keywords: Bone cement; bone window; cone-beam computed tomography; endodontic surgery; guided periapical surgery; root-end resection; three-dimensional printing technology

INTRODUCTION

Traumatic dental injuries are common in permanent dentition with 33% of adults experiencing it before 19 years of age.[1] An incidental finding of large periapical lesions in a traumatized tooth is very common. Most of the cases are responsive to conventional nonsurgical root canal treatment.[2] However, a weeping canal secondary to an infected periapical cyst may require surgical intervention.[3,4]

Cone-beam computed tomography (CBCT) is an advancement which has unleashed multiple avenues to deliver accurate diagnosis, uncover the hidden anatomic details, and has played a vital role in surgical endodontics.[5] Carrying the baton forward, three-dimensional (3D) printing technology has provided new possibilities for surgical planning and execution. Preservation of buccal cortical plates using this technology is a new approach.[6,7]

Adaptation and stability of the buccal plate on the underlying tissue after apicectomy and cyst enucleation have been a matter of concern. The stabilization of the bone plate is necessary to achieve the desired bone healing. Stabilization of the bone plate has been an unexplored area in endodontics. This procedure has been reportedly done through miniscrews in maxillofacial fractures. However, their tendency to fracture makes them less desirable for stabilization in endodontic surgery.[8]

This case report describes a novel method for overcoming the abovementioned disadvantage using a bone cement. It also emphasizes on optimizing the use of surgical guides to preserve and stabilize the buccal cortical plate during endodontic surgery in a predictable manner.

CASE REPORT

A 17-year-old male patient reported to the department of conservative dentistry and endodontics with the chief

Address for correspondence:
Dr. Maulee D. Sheth,
Manubhai Patel Dental College and Hospital, Vadodara, Gujarat, India.
E-mail: shethmaulee@gmail.com

Date of submission : 07.09.2023
Review completed : 13.10.2023
Date of acceptance : 25.10.2023
Published : 13.01.2024

Access this article online

Quick Response Code:

Website: https://journals.lww.com/jcde

DOI: 10.4103/JCDE.JCDE_178_23

How to cite this article: Sheth MD, Arora AV, Kapoor SV. Stabilizing bony plate in guided endodontic surgery using an innovative approach. J Conserv Dent Endod 2024;27:105-9.

complaint of pain and swelling in the upper left anterior region for 10–12 days. He gave a history of trauma 7 years back while playing cricket. The patient's medical history was noncontributory and an informed consent was taken from the patient and his parents.

Clinical examination revealed fractured tooth in relation to 22 with extraoral swelling extending from the lower border of the infraorbital margin to the upper lip [Figure 1a and c]. The tooth was tender on vertical percussion with no signs of mobility and responded negatively to thermal sensibility test. Intraoral periapical radiograph (IOPA) revealed a large periapical radiolucency in relation to 22, extending from the distal surface of 21 to the mesial surface of 23 [Figure 1a]. Based on the findings, a final diagnosis of symptomatic apical periodontitis was formulated.

Nonsurgical endodontic treatment was planned as the initial approach. The possibility of surgical approach requirement was explained to the patient considering the size of the lesion.

Following the administration of local anesthesia using lignocaine with adrenaline (Lignox 2% A, Indoco Remedies Ltd.) and rubber dam application, primary endodontic treatment was initiated with respect to 22. Biomechanical preparation was completed using crown-down technique with K-files with the master apical file being #45 (Mani Inc., Tochigi, Japan). Since it was a weeping canal, calcium hydroxide (RC Cal, Prime Dental, Thane, India) and freshly prepared triple antibiotic paste were used as intracanal medicaments for 2 weeks each. A dry canal could not be achieved even after 4 weeks of intracanal medicament. Thus, a surgical approach was considered and apicectomy was planned.

A small field of view 4 cm × 4 cm CBCT scan (Veraview Pox 3D, J Morita, Japan, 90 kVp and 5 mA) was advised to plan the surgery [Figure 2a-c].

The tooth had one canal, and no deviations from the normal root anatomy could be inferred from the CBCT images. Despite the enormous size of the lesion, the buccal cortical plate was completely intact [Figure 1d and e]. Hence, a guided surgery was planned. The aim was to print a surgical template which would facilitate removal and reposition the buccal cortical bone block back to its original site in a minimally invasive manner.

The inner diameter of the template was designed to be smaller than the lesion size but large enough to access the cystic lining in most peripheral parts [Figure 1f and g]. The template was printed using stereolithography technology [Figure 1f].

Orthograde mineral trioxide aggregate (MTA) (ProRoot MTA, Dentsply Tulsa Dental, Johnson City, USA) obturation was performed 24 h before the surgery in relation to 22 [Figure 1b]. Following a preoperative perioral cleaning, an infraorbital nerve block was achieved using 0.5% bupivacaine hydrochloride 5.0 mg (Anawin, Neon Laboratories, Mumbai, Maharashtra, India). This was followed by local infiltration using lignocaine with adrenaline (Lignox 2% 1:80,000, Indoco Remedies Ltd.). A crevicular with vertical releasing incision was given using blade number #15 and a full thickness mucoperiosteum flap was raised. Disinfection of the template was performed by immersion in 2% chlorhexidine. The surgical template went through a stabilization check [Figure 2a and b]. An eosin pencil was used to mark the inner diameter of the template for accurate removal and preservation of the cortical bone.

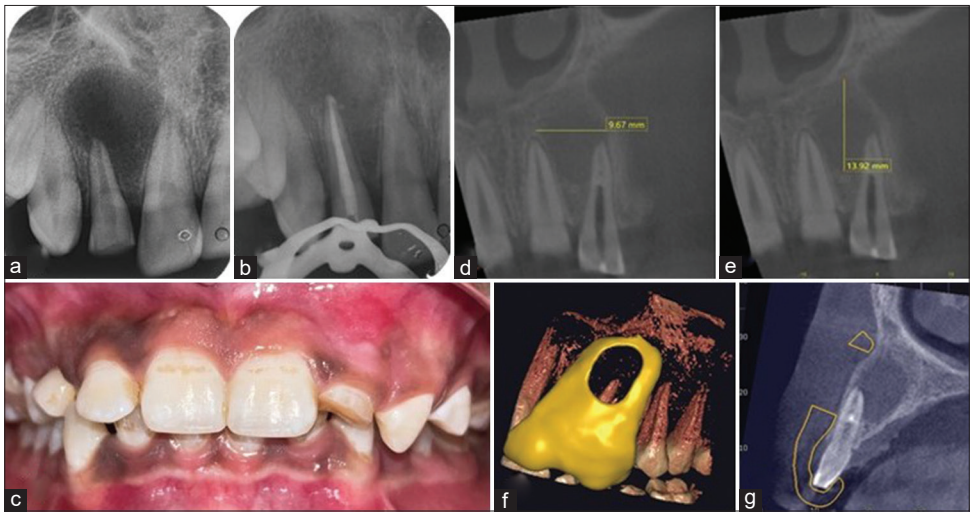

Figure 1: (a) Preoperative periapical radiograph, (b) Orthograde Mineral Trioxide Aggregate Obturation i.r.t. 22, (c) Preoperative intraoral clinical photograph, (d and e) shows the cone-beam computed tomography (CBCT) slices depicting extension of the lesion in all view, (f and g) shows planning of three-dimensional printed template using CBCT imaging

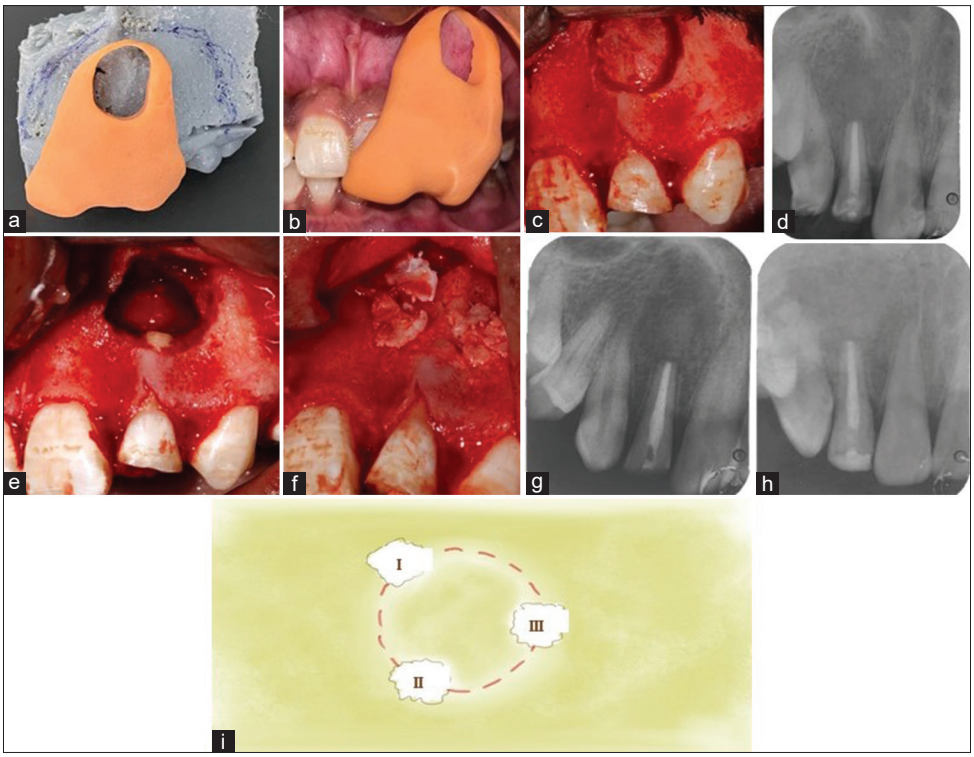

Figure 2: (a) Three-dimensional printed template, (b) Checking the fit of the template before the surgery, (c) Bone window made to preserve the buccal cortical bone plate, (d) Follow-up after 3 months, (e) After root resection, (f) Placement of bone cement at three strategic locations over the bone plate for stabilizing, (g) Radiograph postroot resection, (h) Follow-up after 12 months, (i) A schematic diagram explaining the bone cement placement. Three strategic locations as follows: I: Superomedially, II: Inferomedially, III: Laterally

The template was temporarily removed. A cut was placed in the cortical bone under clear operating vision. This cut had a straight access and was made with the help of long shank straight fissure (Bur no. 702, SS white) surgical bur at slow speed [Figure 2c]. The block of the cortical bone was disengaged from the underlying bone using a surgical curette. It was preserved in normal saline solution for further use. Soft pathological tissues were removed with surgical bone curette and were sent for histopathological evaluation.

Root end was resected up to 3 mm, exposing the MTA-filled canal [Figure 2e and g]. Before the closure of the site, a freshly prepared platelet-rich plasma (PRP) was packed inside the bony crypt along with the bone graft material (SHAG31, G-Bone, G. Surgiwear Ltd., India). Preserved cortical plate was then placed in its position and polymethyl methacrylate (PMMA)-based bone cement (Surgical Simplex P, Stryker, USA) was placed at three strategic locations using a plastic filling instrument. Manipulation of the cement was carried out as per the manufacturer's instructions where achieving a "dough" consistency was the goal [Figure 2f]. Along with the consistency, recommended setting time of approximately 4 min was kept in mind while placing the cement.

Before closing the surgical site, the setting of the bone cement and cortical plate stability was confirmed. The hydrated flap was repositioned and sutured using Mersilk 4.0 (Ethicon, US) black-braided nonabsorbable silk suture. Suture removal was done after 7 days. The progression of healing was satisfactory and asymptomatic. After 3 and 12 months of follow-up, the patient was asymptomatic and IOPA revealed a completely healed site [Figure 2d and h].

DISCUSSION

Endodontic microsurgery using the guide template allows precise localization of root apex, minimally invasive osteotomy, decreased surgical time, favorable postoperative healing, and improved prognosis regardless of clinician's experience.[9]

Surgical approach was chosen for this case considering the large size of the lesion and persistent infection with respect to 22. During endodontic surgery, enucleating granulation tissue in bony lesions makes the reduction of cortical bone inevitable, especially in a large apical lesion. This extensive intraoperative removal of the buccal bone plate may result in delayed healing and dehiscence of the resected roots.[10] The case demanded a "bone window technique" where the buccal cortical plate is preserved as

it provides soft-tissue stability and enhances the healing rate.[11]

This minimal invasive surgical procedure causes less damage to osseous tissues which results in less hemorrhage during surgery, less postoperative complications, shorter healing time and better prognosis, and preservation of cortical plate.[11]

The cortical bone boundary was marked using an eosin pencil. This led to better visualization of the site, accurate orientation of the bur angle, and decreased the contact time of the resin-based stents with the bone. Moreover, it also eliminated the issues that could manifest owing to the stability of the template.[12]

PRP was used in this case as it accelerates the healing process. The established mechanism of PRP involves the release of multiple growth factors, thereby serving as an ideal scaffold.[12]

In the present case, a new technique was adapted to stabilize the intact cortical plate over the PRP and bone graft.

Preservation of intact bone plates has been the new aim of conservative periapical surgeries. However, stabilizing the preserved bone plate remains an unattended issue. Bone cement, which has generally been used in orthopedic surgeries to seal the bone within the defect, was considered in this case. This technique prevents the collapse and displacement of the preserved cortical plate and promotes desired healing.[13]

In this case, PMMA in the bone cement acts as a space filler which stabilizes the bone and thus acts as a "grout." Bone cements have no intrinsic adhesive properties. However, they rely on close mechanical interlock between the irregular bone surface and the prosthesis.[14] Achieving a nonsticky, homogenous dough consistency was a must for the bone cement to gain long-term performance.[15] Bone cement was placed at three locations only to maintain the blood supply to the bone plate [Figure 2i]. As PMMA is known to undergo rapid solidification and has hydrophobicity, it requires a complete isolated field to set.[16] Considering properties such as resorbability and biocompatibility, Badr has proved that bone cement has low cytotoxic effect on fibroblasts making it biocompatible for its use in surgical endodontics.[17]

Although bone cement has been the gold standard in the field of joint replacement surgeries and orthopedics, it is yet to create its roadmap in the field of surgical endodontics. As per our knowledge, this is the first case to incorporate bone cement for stabilizing a preserved intact bone plate. Further studies need to be carried out to confirm the long-term effects of bone cement in the field of periapical surgeries.

CONCLUSION

CBCT-aided 3D printing has turned out to be a boon for surgical endodontics. This technology directly helps in the preservation of the buccal cortical plate which in turn improves bone healing. Incorporating bone cement in the field of surgical endodontics could be beneficial in stabilizing the preserved bone plates.

Acknowledgments

We are thankful to Keyword (https://thekeyword.co.in/) for their editing services.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Diangelis AJ, Andreasen JO, Ebeleseder KA, Kenny DJ, Trope M, Sigurdsson A, *et al*. Guidelines for the management of traumatic dental injuries: 1. Fractures and luxations of permanent teeth. Pediatr Dent 2017;39:401-11.
2. Fernandes M, de Ataide I. Nonsurgical management of periapical lesions. J Conserv Dent 2010;13:240-5.
3. Karthik R, Mohan N. Nonvital tooth- a clue for diagnosis of radicular cyst- a case report and review. Int J Radiol Radiat Ther 2017;2:92-3.
4. von Arx T. Apical surgery: A review of current techniques and outcome. Saudi Dent J 2011;23:9-15.
5. Ye S, Zhao S, Wang W, Jiang Q, Yang X. A novel method for periapical microsurgery with the aid of 3D technology: A case report. BMC Oral Health 2018;18:85.
6. Pinsky HM, Champleboux G, Sarment DP. Periapical surgery using CAD/CAM guidance: Preclinical results. J Endod 2007;33:148-51.
7. Dawood A, Marti Marti B, Sauret-Jackson V, Darwood A. 3D printing in dentistry. Br Dent J 2015;219:521-9.
8. Cornelius CP, Ehrenfeld M. The use of MMF screws: Surgical technique, indications, contraindications, and common problems in review of the literature. Craniomaxillofac Trauma Reconstr 2010;3:55-80.
9. Naik B, Karunakar P, Jayadev M, Marshal VR. Role of platelet rich fibrin in wound healing: A critical review. J Conserv Dent 2013;16:284-93.
10. Bhadra D, Shah NC, Arora A, Dedania MS. Deducing a surgical dilemma using a novel three dimensional printing technique. J Conserv Dent 2018;21:582-5.
11. Arora A, Mody B, Patel N. 3D printed tooth model – A patient education tool and surgical aid in endodontics. Dent Update 2018;45:655-9.
12. Dedania MS, Shah NC, Arora A, Pisal N. Three-dimensional printing: A revealing pathway to an unpredictable maze. J Conserv Dent 2020;23:533-7.
13. Jia C, Wang X, Yu S, Wu H, Shen J, Huang Q, *et al.* An antibiotic

cement-coated locking plate as a temporary fixation for treatment of infected bone defects: A new method of stabilization. J Orthop Surg Res 2020;15:44.
14. Vaishya R, Chauhan M, Vaish A. Bone cement. J Clin Orthop Trauma 2013;4:157-63.
15. Kühn KD. Properties of bone cement: What is bone cement. In: The Well-Cemented Total Hip Arthroplasty. Heidelberg: Springer Medizin Verlag; 2005. p. 52-9.
16. Frutos G, Pastor JY, Martínez N, Virto MR, Torrado S. Influence of lactose addition to gentamicin-loaded acrylic bone cement on the kinetics of release of the antibiotic and the cement properties. Acta Biomater 2010;6:804-11.
17. Badr AE. Marginal adaptation and cytotoxicity of bone cement compared with amalgam and mineral trioxide aggregate as root-end filling materials. J Endod 2010;36:1056-60.