

Management of Complex Endodontic Failure in Maxillary Anterior Teeth Using Bioceramic Material: A Two-Year Follow-up

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ABSTRACT

This case report presents the successful management of a complex endodontic failure involving three maxillary anterior teeth in a 25-year female. The patient, who experienced persistent symptoms following substandard root canal treatment, was treated with a combination of non-surgical and surgical endodontic treatment using bioceramic material. The perforation in UR1 was repaired, and root-end closure was achieved, leading to significant healing and symptom resolution. After a two-year follow-up, the patient showed favourable outcomes, including decreased periapical radiolucency and no clinical symptoms. This case highlights the effective use of bioceramic material in complex endodontic cases, especially in resource-limited settings.

Key Words: *Bioceramic materials, endodontic failure, perforation repair.*

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INTRODUCTION

Endodontic failures are common problems in dentistry that need accurate evaluation and a cost-effective approach to treatment. Problems such as under-obturation, iatrogenic errors during the procedure, and periapical pathology can affect the success of endodontic treatment.¹ Retaining damaged teeth through appropriate treatment not only maintains / retains the natural dentition but also leads to better chewing and appearance, which patients greatly appreciate.

Advanced diagnostic tools and biomaterials have broadened the management of complex endodontic cases. In low- and middle-income countries such as Pakistan, where access to advanced imaging technologies is restricted, clinicians must depend on a blend of clinical judgement and traditional radiographic interpretation, alongside careful utilisation of resources to enhance the outcomes. Bioceramic materials are recognised for their biocompatibility, sealing properties, and ability to facilitate periapical healing.²

This case report examines the management of a complex endodontic failure affecting three maxillary anterior teeth in a young adult female with orthograde and surgical procedures.

The report highlights the significance of precise diagnosis, the application of bioceramic material for repair, and a thorough treatment strategy to attain a successful long-term outcome.

CASE REPORT

A 25-year female patient, who was a banker by profession, presented with persistent bleeding from her upper front tooth for one week, accompanied by a foul odour. The patient reported no significant medical history. She had sustained facial trauma three years earlier after falling down a staircase but had not sought dental care at the time. Subsequently, she underwent root canal treatment for her upper right central, lateral, and canine teeth (UR1, UR2, and UR3) two years prior, performed by a general dental surgeon due to persistent pain in the same region.

The patient experienced recurring swelling in the vestibule, pain, and bleeding from UR3. An examination by another general dentist revealed significant complications, and extraction of the three teeth was advised. However, the patient sought a second opinion from the author at the teaching dental institute, expressing an unwillingness to lose her teeth.

Clinical examination revealed greyish discolouration of UR1, UR2, and UR3, along with tenderness at their apices. Palpation and percussion tests were markedly positive for UR3 and UR2 and negative for UR1. Blood oozed from UR3 during palpation, and bleeding on probing was noted for UR3, UR2, and UR1. Endo ice (cold test) and electric pulp testing (EPT) showed no response for UR3, UR2, and UR1, indicating necrotic pulps, whereas adjacent teeth UL1, UL2, and UL3 responded positively, confirming vitality. Probing depths varied, with mesial

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and distal measurements reaching 6 mm for UR2 and UR1, while UR3 had probing depths of less than 3 mm (Figure 1A, B).

Radiographic analysis showed a large periapical radiolucency involving the three teeth, inadequate obturation in UR1, and an extruded gutta-percha cone in UR2. Additionally, a mesial perforation was observed in UR3, and external resorption was noted on the distal aspect of UR1. Based on these findings, a diagnosis of substandard endodontic treatment with associated perforation, external resorption, and periapical pathology was made (Figure 1C, D).

The patient was presented with two treatment options: Obtaining a limited field-of-view cone beam computed tomography (CBCT) for detailed assessment or proceeding with blind exploratory surgery with an uncertain prognosis. Due to the unavailability of CBCT, the patient opted for the latter, providing informed consent after being briefed on potential risks.

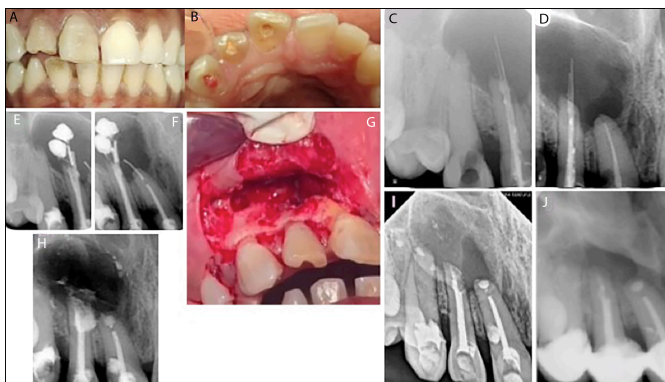


Figure 1: (A) Frontal view in occlusion showing discoloured UR1, UR2, and UR3 with unilateral open bite on the right side. (B) Maxillary occlusal view, access opening in UR1, UR2, and UR3 with pus discharge from UR3. (C, D): Preoperative periapical radiographs, (E, F): Post-obturation and perforation repair periapical radiographs. (G) Intraoperative surgical site view showing cervical resorption and osteotomy site. (H) Immediate postapical surgery periapical radiograph. (I) Periapical radiograph after four months apical surgery. (J) Periapical radiograph after two years with teeth restored with metal ceramic crowns.

During the second visit, access refinement was performed on all three teeth. The perforation in UR3 was repaired using bioceramic putty, and the canals in UR1 and UR2 were biomechanically prepared with hand files. In UR3, the canal was initially identified under magnification using dental loupes (Zumax Medical Co., Ltd.), but canal negotiation was unsuccessful. After a failed attempt, the perforation was repaired with bioceramic putty (Endosequence Bioceramic Root Repair Material, Brasseler USA) from the access opening, with a sectional matrix placed to prevent extrusion. Gutta-percha removal from UR1 resulted in breakage of the cone, which was left *in situ*, and the canal was obturated. UR1 and UR2 were obturated after biomechanical preparation using ISO hand files in a single visit, followed by cold lateral compaction and provisionally restored with glass ionomer (GC International, Europe). The patient was scheduled for periapical surgical exploration after 24 hours (Figure 1E, F).

During the third visit, infraorbital block local anaesthesia (2% Lidocaine with 100,000 Epinephrine) was administered, and a full mucoperiosteal flap was raised with an intracervical incision, revealing an eggshell-thin bone structure. External resorption was observed on the distal aspect of UR1 after flap raising, which was sealed with an bioceramic putty following cavity preparation. The periapical lesion was curetted using a large surgical spoon excavator, and root-end closure was achieved using bioceramic putty. The flap was sutured back with 3/0 silk sutures and was left in place for seven days to promote healing. Postoperative medications included Augmentin 625 mg (1 + 1), Metronidazole 400 mg (1 + 1), Synflex 550 mg (1 + 1), Xynosine Nasal Spray (S.O.S.) in case sinusitis developed, and a chlorhexidine mouth rinse to support healing and prevent infection (Figure 1G, H).

During the fourth visit, the patient returned for a follow-up. The surgical site exhibited satisfactory healing without signs of inflammation, although slight tenderness on palpation persisted. The patient was asymptomatic otherwise and was advised to proceed with definitive crown restoration to address discolouration and prevent external cervical resorption associated with internal bleaching.

She presented four months after surgery to get a definitive restoration. On clinical examination, probing depth remained unchanged, but bleeding on probing was absent, and the patient was otherwise asymptomatic. A periapical radiograph was obtained that showed a decrease in the radiolucency and resorption of the bioceramic material in UR2. The treatment plan was updated to proceed with crown preparation (Figure 1I).

On the sixth visit, porcelain fused to metal crowns was placed on the affected teeth. The patient was asked to return for a radiographic evaluation after two years. At the two-year follow-up, the patient was asymptomatic, and the radiograph showed a decrease in the periapical radiolucency, categorising the lesion as incomplete healing (scar tissue) according to Rud *et al.*'s criteria.³ No further intervention was required at that time (Figure 1J).

DISCUSSION

This case underscores the intricate challenges associated with the management of endodontic failures, particularly in the context of perforation, external resorption, and periapical pathology.

Exploratory surgery in the maxilla carries inherent risks due to the proximity of vital anatomical landmarks. Involvement or accidental perforation of the maxillary sinus poses additional risks, including sinusitis or the formation of an oroantral fistula.⁴ This patient's postoperative course included measures such as antibiotic coverage and a nasal spray to mitigate such complications, underscoring the importance of preemptive strategies in high-risk cases.

Bleeding is another significant consideration, as the maxilla is highly vascularised. Injury to major arteries, such as the greater

palatine artery or branches of the maxillary artery, can lead to excessive haemorrhage.⁵ In this case, careful surgical planning and atraumatic technique minimised the risk of excessive bleeding.

Structural issues, such as excessive bone removal or inadvertent weakening of the maxilla, could result in fractures or long-term instability.⁶ Therefore, in this case, the precise use of surgical tools and bioceramic material preserved the structural integrity of the roots, as evidenced by the patient's stable condition at follow-up.

The psychological impact of such an invasive procedure cannot be overlooked. Patient anxiety, discomfort, or dissatisfaction with outcomes must be addressed through effective communication and comprehensive preoperative counselling. The patient's reluctance to extract her teeth was a key factor influencing the treatment plan, highlighting the need for patient-centred care. The decision to proceed with exploratory surgery without CBCT imaging underscores the challenges of managing dental cases in resource-limited settings. While CBCT could have provided a more detailed assessment of the lesion and anatomical complexities, the surgical approach allowed for direct visualisation and repair of the defects. The choice of bioceramic material for perforation repair and root-end closure was supported by their superior sealing ability, biocompatibility, and resistance to microbial infiltration.²

The inability to negotiate the canal in UR3 poses a potential risk for long-term treatment success. Incomplete negotiation can lead to inadequate debridement and obturation, thereby leaving behind residual micro-organisms that may eventually cause persistent or recurrent periapical infection.⁷ Although UR3 remains asymptomatic in the short term, this technical shortfall could compromise its long-term prognosis by allowing for a latent infection that might later manifest clinically. In contrast, the observed resorption of the bioceramic material in UR2—while notable—has been reported in the literature as a controlled process. Studies indicate that moderate resorption of calcium silicate-based materials can be part of the natural healing response, with the resorbed material gradually replaced by new hard tissue, which may even enhance the biological seal at the repair site.⁸ However, if the resorption were excessive, it could undermine the integrity of the repair, resulting in compromised sealing ability and structural support. In summary, while the gradual resorption in UR2 appears to be within acceptable limits and is accompanied by favourable clinical and radiographic signs of healing, the failure to negotiate the canal in UR3 remains a concern that necessitates careful long-term monitoring to ensure that it does not lead to future complications.

The management of external resorption in UR1 with bioceramic putty demonstrated the utility of this material in addressing challenging conditions. The decision to retain the broken gutta-percha cone in UR1 reflects a pragmatic approach to minimise further damage, although this may predispose the tooth to future complications; however, no complications were observed on the two-year follow-up.

Endodontic failures involving perforations and external resorption are well-documented in the literature.⁹ However, this case is notable for its multifaceted complications, including inadequate obturation, extruded filling material, and delayed treatment after trauma. Previous studies have emphasised the importance of immediate trauma management to reduce long-term sequelae such as external resorption and persistent periapical pathology. Unlike cases where CBCT imaging-guided treatment, this case relied solely on clinical and two-dimensional radiographic assessments, which limited preoperative planning but still achieved favourable outcomes.

Bioceramic materials have been increasingly recommended in endodontic and surgical cases due to their excellent sealing properties and biocompatibility.^{2,10} Several clinical reports have demonstrated the successful use of bioceramic materials in managing complex endodontic complications similar to this case. For example, Toubes *et al.* described the management of lateral root perforations in maxillary incisors using Bio-C repair, with favourable healing and symptom resolution at one-year follow-up.⁷ Similarly, Alhilou reported the effective sealing of perforating internal root resorption using a bioceramic sealer via a single-cone technique, further supporting the clinical utility of these materials in challenging cases.¹¹ Bioceramics exert their beneficial effects through a hydration reaction in which calcium silicate particles interact with tissue fluids to form a calcium silicate hydrate gel and calcium hydroxide. The released calcium hydroxide subsequently reacts with phosphate ions present in periapical tissues to yield hydroxyapatite, establishing a chemical bond with dentin and promoting biomineralisation. Additionally, the elevated pH during setting creates an antibacterial environment that further facilitates tissue healing.¹² These combined biological and physicochemical properties render bioceramic materials a promising alternative for the repair of complex endodontic defects.

Alternative treatment options for this case included intentional replantation and extraction followed by implant placement. Although intentional replantation has been reported as a viable alternative in managing endodontic failures, it is associated with risks such as periodontal ligament damage, external root resorption, and ankylosis—particularly when complex root anatomies are present or when extraoral time is extended beyond the recommended limit.¹³ Extraction with subsequent implant placement, while offering high success rates, may compromise natural proprioception and aesthetic outcomes, in addition to requiring more invasive surgical intervention and higher costs, with potential complications such as peri-implantitis.¹⁴ Given the patient's strong preference to preserve her natural dentition and the promising clinical and radiographic outcomes achieved with bioceramic repair, we elected to pursue a conservative treatment approach rather than these alternative options.

This case adds to the evidence supporting their use in managing complex endodontic failures. However, the observed resorption of bioceramic material in UR2 raises questions about its

long-term stability, warranting further investigation. Bioceramic materials have been increasingly recommended in endodontic and surgical cases due to their excellent sealing properties and biocompatibility.^{2,10} This case adds to the evidence supporting their use in managing complex endodontic failures. However, the observed resorption of bioceramic material in UR2 raises questions about its long-term stability, warranting further investigation.

PATIENT'S CONSENT:

The patient provided written informed consent.

COMPETING INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

SS: Treated the patient, including both orthograde and surgical interventions, collected clinical data and ensured proper follow-up over two years. Drafted the initial manuscript and provided clinical insight.

PR: Assisted in the surgical phase of the treatment and performed bioceramic material application, reviewed the clinical data and provided detailed input on the technical aspects of the intervention. Contributed to the revision of the manuscript for technical accuracy.

MMA: Analysed radiographic data and monitored healing over the two-year follow-up period, provided insights into the radiological, and clinical outcomes in resource-limited settings. Contributed significantly to the discussion section of the manuscript.

FAK: Provided supervision throughout the case management, writing and publication process, critically revised the manuscript for intellectual content, grammar, and coherence, and ensured adherence to journal submission requirements and ethical standards.

All authors approved the final version of the manuscript to be published.

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