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Microsurgical Repair of a Lateral Root Perforation in a Replanted Premolar with Five Years of Follow-up

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Abstract

Recurrent disease in a replanted tooth may remain amenable to treatment when the lesion is localized, and its cause is accessible. This report describes microsurgical repair of a mesial mid-root perforation in a previously replanted maxillary left second premolar. A 32-year-old woman was referred after recurrence of a sinus tract and a lateral radiolucency. According to the referral history, the perforation had occurred during cast post preparation. The tooth had subsequently been inadvertently extracted during an attempt to remove the restoration, repaired extraorally with amalgam, and replanted. Cone-beam computed tomography (CBCT) identified a lesion adjacent to the perforation without a visible fracture line, root resorption, or apical radiolucency. Microsurgical treatment comprised flap elevation, removal of granulation tissue and the previous amalgam repair, and sealing of the perforation with a bioceramic putty. An allograft and collagen membrane were placed before flap closure. Histopathological examination confirmed granulation tissue. At one- and five-year follow-up, the tooth remained functional and asymptomatic, with clinically normal periodontal probing and tooth mobility, no metallic percussion tone, and apparent resolution of the lateral lesion on periapical radiographs. No follow-up CBCT was available to confirm complete three-dimensional osseous healing. This case suggests that targeted microsurgical repair may preserve a selected replanted tooth with recurrent perforation-associated disease. The outcome did not establish the superiority of a particular repair material or the independent benefit of regenerative adjuncts.

Keywords: Bioceramics; Microsurgery; Root Canal Therapy; Tooth Replantation; Treatment Outcome

Introduction

Root perforation creates a communication between the root canal system and the surrounding periodontal tissues and can compromise retention of an otherwise restorable tooth. Management requires assessment of the defect, adjacent periodontal support, existing restoration, and feasibility of access [1]. Clinical evidence supports repair rather than automatic extraction: a systematic review reported a pooled success rate of 72.5% for nonsurgical perforation repair, although outcomes varied and pre-existing radiolucency was an unfavorable prognostic factor [2, 3].

When orthograde access is impractical or potentially damaging, microsurgical access may permit inspection and repair of a localized root defect. Contemporary surgical endodontics combines magnification, controlled tissue management, and suitable repair biomaterials [4, 5]. Favorable outcomes reported for endodontic microsurgery support its role in tooth preservation, but they should not be extrapolated directly to lateral perforation repair. For example, a long-term meta-analysis reported pooled success estimates of 91.3% for randomized trials and 78.4% for prospective cohort studies; these estimates concerned apical surgery in different study populations [6].

Replantation adds another layer of complexity because tooth retention and periodontal healing are distinct outcomes. A prospective study of intentional replantation evaluated both endpoints and excluded teeth with preoperative periodontal and root defects, limiting its direct applicability to a perforated tooth [7]. Recurrence of a localized lesion after replantation therefore warrants reassessment of its cause and the remaining treatment options. This report describes microsurgical repair of a recurrent lateral lesion associated with a previously amalgam-repaired perforation in a replanted maxillary premolar, with clinical and

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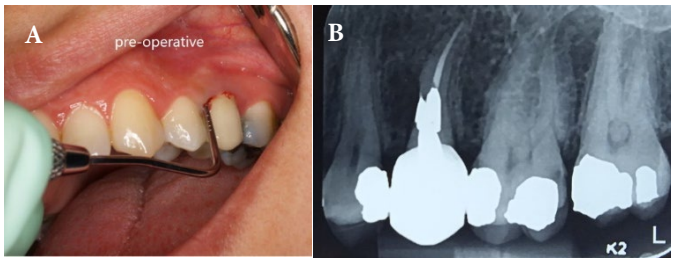


Figure 1. *A*) Pre-operative photograph; *B*) Pre-operative radiograph

radiographic follow-up over five years. The clinical contribution is the use of localized surgical repair after recurrence following an earlier extraoral repair and replantation, rather than the introduction of a new repair material or regenerative technique.

Case Presentation

A 32-year-old woman was referred by her general dentist for evaluation of a recurrent lateral radiolucency associated with a previously replanted maxillary left second premolar. Her medical history was unremarkable. The tooth had a full-coverage crown, was not tender to percussion or palpation, and had clinically normal periodontal probing and tooth mobility. No periodontal pocketing was recorded, and the coronal seal was clinically satisfactory. The patient reported no pain. A recurrent sinus tract was documented in the referral history. Periapical radiography showed a mesial mid-root radiolucency corresponding to a perforation reportedly created during cast post preparation (Figs. 1A & 1B).

According to the history provided, the tooth had undergone root canal treatment and amalgam core restoration approximately five years before the present microsurgical procedure (Figs. 2A & 2B). Two years later, a cusp fracture prompted preparation for a cast post and crown. A mid-root perforation occurred during post-space preparation and was reportedly left unrepaired when the restoration was completed (Figs. 2C & 2D). A sinus tract developed approximately one year later. During an attempt to remove the crown and post for perforation repair, the tooth was inadvertently extracted with the crown still in place. The perforation was repaired extraorally with amalgam, and the tooth was replanted (Fig. 2E). A one-week course of antibiotics was prescribed, and the clinical signs and symptoms initially subsided. Approximately two years after replantation, the sinus tract recurred, and the patient was referred for specialist assessment and the present microsurgical procedure (Fig. 1).

The clinical timeline, reconstructed from the reported intervals, was as follows: approximately five years before microsurgery, root canal treatment and amalgam core restoration; three years before microsurgery, post-space perforation and crown placement; two years before microsurgery, sinus tract development, inadvertent extraction, extraoral amalgam repair, and replantation; at baseline, recurrent sinus tract and microsurgical perforation repair; one week later, suture removal; and one and five years later, clinical and periapical radiographic recalls. The earlier replantation was performed by another clinician. The patient recalled that the tooth was replanted within less than 20 min of extraction; this is a patient-reported estimate, not a recorded extraoral time. Exact calendar dates, storage conditions, root handling, stabilization, and detailed preparation and placement of the earlier amalgam repair could not be retrieved.

Cone-beam computed tomography (CBCT) demonstrated a mesial root perforation with an adjacent osseous lesion (Figs. 3A & 3B). No fracture line, root resorption, or apical radiolucency was visible on the available scan. The working diagnosis was recurrent inflammatory disease associated with the previously repaired lateral perforation in a root canal-treated tooth. This interpretation was supported by the spatial correspondence between the known perforation and lateral lesion, the history of recurrence after extraoral perforation repair, a clinically satisfactory coronal seal, and the absence of periodontal pocketing or communication with the gingival sulcus. Sinus tract tracing was not performed because the treating clinician considered the CBCT localization sufficient for planning access; consequently, no tract-tracing evidence was available to independently confirm the source. These findings did not exclude persistent intraradicular infection. Orthograde access would have required management of the existing crown and cast post; the previous removal attempt had resulted in inadvertent extraction. Surgical access was selected to permit direct inspection, debridement, and replacement of the external repair while avoiding another restoration-removal attempt. This choice targeted the localized defect despite uncertainty about the complete microbial source. Treatment options, including extraction and implant replacement, were discussed. The patient, who was a dentist, expressed a preference for retaining the tooth. The risks and benefits were explained, and informed consent for treatment was obtained.

The defect was located on the mesial mid-root surface. The distance between the coronal margin of the osseous lesion and the alveolar crest was 1.9 mm. This measurement describes the intervening crestal bone, not the perforation diameter. The perforation measured approximately 3 mm. The extent of the associated osseous lesion is illustrated in the preoperative CBCT images (Figs. 3A & 3B). Measurements on the preoperative CBCT were 4.79×7.59 mm in the displayed axial section and 6.45×7.96 mm in the displayed coronal section. These are section-specific dimensions, not three orthogonal maximum

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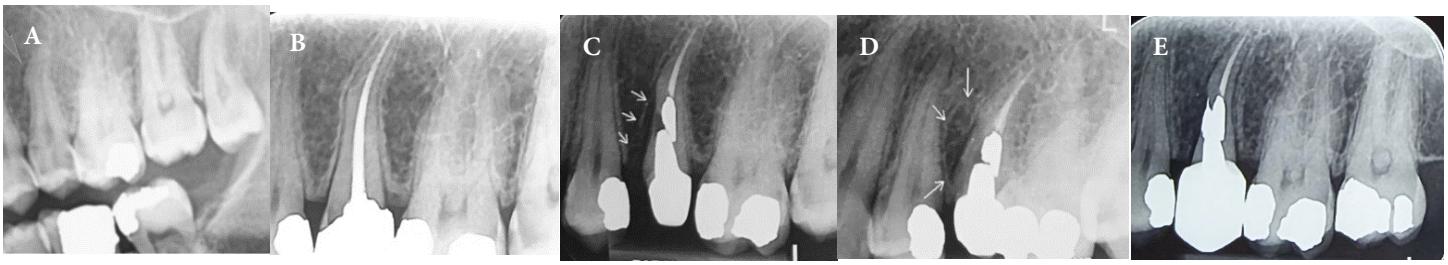


Figure 2. *A*) Initial radiograph; *B*) Endodontic treatment and amalgam buildup of second left maxillary premolar; *C, D*) Lateral root perforation; *E*) Replantation following inadvertent extraction of the tooth and sealing the perforation with amalgam

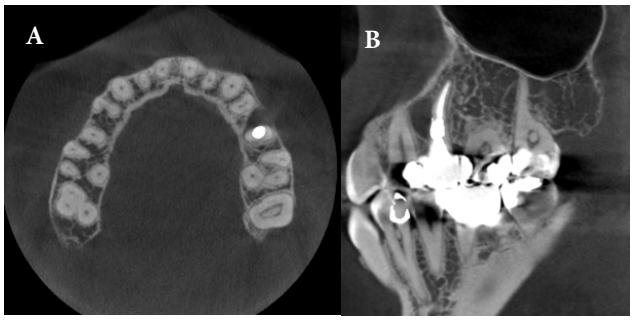


Figure 3. Cone-beam computed tomography; *A*) Axial view; *B*) Sagittal view

dimensions. Loss of the buccal cortical plate overlying the defect was confirmed by direct observation during surgery. The number and integrity of all remaining bony walls could not be reliably established, precluding a definitive wall-based classification. No periodontal pocketing or communication between the defect and the gingival sulcus was detected.

Microsurgical procedure and follow-up

The procedure was performed by an endodontist using an operating microscope (Global, Saint Louis, MO, USA). Local anesthesia was administered by infiltration with two cartridges of 2% lidocaine containing 1:100,000 epinephrine (DarouPakhsh, Tehran, Iran). A 0.12% chlorhexidine mouth rinse (Irannajo Co., Iran) was used. A triangular sulcular full-thickness mucoperiosteal flap was elevated. Loss of the buccal cortical plate overlying the osseous defect was directly observed. Granulation tissue was removed and submitted for histopathological examination. The exposed root surface was stained with methylene blue and inspected under the operating microscope; no crack or fracture line was observed (Fig. 4A).

The previous amalgam repair was removed with ultrasonic tips (ACTEON, Mérignac, France) (Fig. 4B). Hemostasis was achieved with epinephrine-impregnated cotton pellets. The perforation cavity was dried with paper points and sealed with a bioceramic putty (One-Fil, MEDICLUS, Cheongju, Korea) (Fig. 4C). The osseous defect was filled with a bone allograft and covered with a collagen membrane (both from Kish Tissue Regeneration Corporation, Iran) (Fig. 4D). The allograft was intended to support space maintenance within the defect, and the membrane to limit soft-tissue and epithelial migration given the loss of the buccal cortical plate and the 1.9-mm distance between the lesion and alveolar crest. These were treatment aims rather than demonstrated regenerative effects. The flap was repositioned and sutured with 5-0 polyglycolic acid sutures, and an immediate postoperative periapical radiograph was obtained (Fig. 4E).

Postoperative care included ibuprofen for analgesia and chlorhexidine mouth rinse for one week. Sutures were removed after one week, when the patient was asymptomatic. Histopathological examination confirmed granulation tissue. At the one- and five-year recalls, the tooth remained functional and asymptomatic, with no tenderness to percussion or palpation. The clinical records described normal periodontal probing without periodontal pockets; exact site-specific probing depths were not recorded. Tooth mobility was described qualitatively as normal at baseline and at both recalls. Numerical clinical attachment levels and mobility grades were not available in the records supplied for this report. Periapical radiographs were reported to show apparent resolution of the lateral radiolucency and re-establishment of a periodontal ligament space (Figs. 5A & 5B). No follow-up CBCT was available. The treating clinician confirmed that a metallic percussion tone was absent at all follow-up examinations, including the one- and five-year recalls. This is a reported clinical observation; a separately documented standardized assessment of ankylosis was not available. Table 1 summarizes the available longitudinal findings.

Discussion

The principal observation in this case was preservation of a previously replanted premolar after microsurgical treatment of recurrent disease localized to a lateral root perforation. The tooth remained functional and clinically asymptomatic at five years, with clinically normal probing and mobility, no metallic percussion tone, and apparent resolution of the lesion on periapical radiographs. Its significance lies in the treatment sequence: a previous attempt at extraoral repair and replantation

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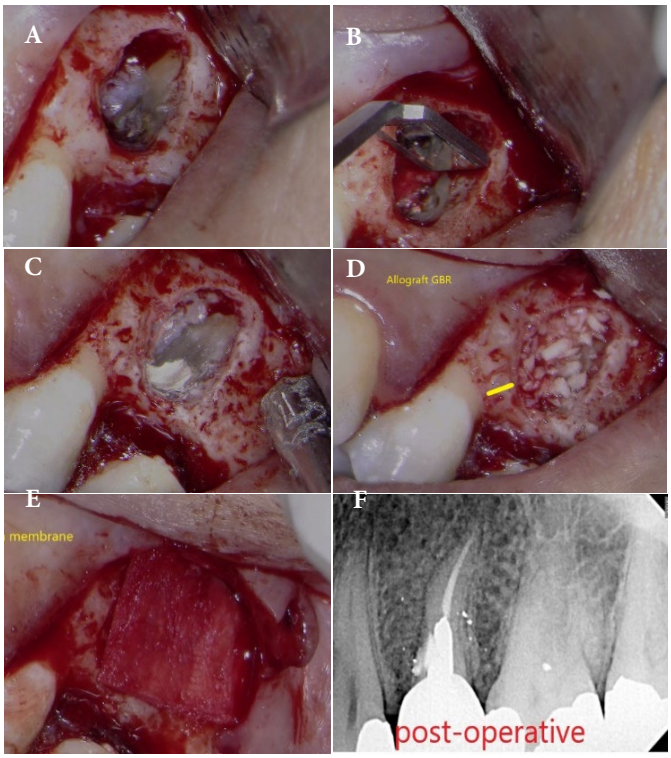


Figure 4. *A*) Flap elevation and granulation tissue curettage; *B*) Removing amalgam and inspection; *C*) sealing the perforated site; *D & E*) GBR; *F*) post-operative periapical radiograph

had not provided lasting disease resolution, yet a subsequent targeted intervention was associated with clinical stability and radiographic improvement. This experience supports reassessment of a retained tooth before extraction when a potentially treatable local cause can be identified. It does not establish a general success rate for surgery after replantation.

Comparable reports help define the limited contribution of this case. Zhang *et al.* [8] described a post-space lateral perforation in a maxillary central incisor treated by MTA repair, bone grafting, and intentional replantation, with a five-year follow-up. In that report, replantation provided access to the defect; here, the tooth had already been replanted, and recurrent disease was treated through a flap without further extraction. Córdova-Malca *et al.* [9] reported micro-resurgery for recurrent perforation associated with a radicular cyst, with grafting, platelet-rich fibrin, and two-year radiographic and CBCT assessment. Their case addressed recurrence after previous surgery, whereas the present intervention addressed recurrence after extraoral repair and replantation. Thus, the contribution is a distinct treatment sequence with five-year tooth retention, not proof of a novel material, a superior technique, or the first reported application. The lack of follow-up CBCT also makes the anatomical healing evidence less complete than in the latter report.

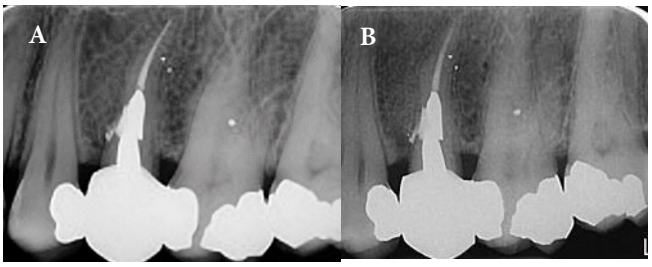


Figure 5. *A*) One-year follow-up; *B*) 5-year follow-up

Related recent reports further clarify the treatment alternatives; researchers described late disease in a mandibular second molar with a strip perforation, treated by intentional replantation with mid-root resection and CEM root-end filling [10].

Although the title refers to a ten-year clinical course, the reported follow-up after replantation was one year. Here, flap access was used after recurrence in a tooth that had already been replanted, with five years of follow-up after microsurgical repair. Saberi *et al.* [11] reported endodontic and surgical treatment of a miniscrew-induced root perforation with a favorable 24-month outcome. That report supports surgical access as an option for an iatrogenic root defect, but did not involve a previously replanted tooth. These comparisons support the clinical relevance of the present treatment sequence without establishing superiority or novelty of the repair technique.

Accurate characterization of the preceding intervention is important. The history describes inadvertent extraction during attempted restoration removal, followed by extraoral repair and replantation, rather than a planned intentional replantation procedure. Furthermore, recurrence of a perforation-associated lesion is not synonymous with complete failure of periodontal healing after replantation. Intentional replantation research distinguishes retained teeth from teeth that have healed without complications [7]. In the present case, clinically normal probing and mobility, absence of sulcular communication, and absence of visible resorption on the preoperative CBCT supported consideration of further tooth-preserving treatment. The treating clinician confirmed absence of metallic percussion tone at both recalls. This clinical observation supports a favorable assessment but does not conclusively exclude focal ankylosis. The term "replanted tooth with recurrent perforation-associated disease" therefore describes the available evidence more precisely than an unqualified label of failed intentional replantation.

The diagnostic findings directed treatment toward the lateral root surface. The lesion corresponded to the known perforation, the coronal seal was clinically satisfactory, and no

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periodontal pocketing or sulcular communication was detected. No apical radiolucency was visible. Intraoperative methylene-blue-assisted inspection under the operating microscope revealed no crack or fracture line on the exposed surface. These findings supported a localized perforation-associated process and made a visible root fracture less likely, but did not establish that the canal system was free of infection or exclude an undetected fine fracture. Sinus tract tracing was not performed, so anatomical localization relied on CBCT and surgical inspection. A satisfactory coronal seal and absence of apical radiolucency cannot independently exclude persistent intraradicular infection. The diagnosis was therefore a clinical inference, and local repair addressed an accessible potential source while preserving the crown and post. The favorable subsequent course is consistent with that decision but does not retrospectively prove an exclusively extraradicular cause. Histological identification of granulation tissue supported inflammation without identifying its microbial source.

A microsurgical approach provided access to the external defect and existing repair without repeating extraction. This was particularly relevant because the previous attempt to remove the crown and post had resulted in inadvertent tooth removal. The rationale is consistent with the broader role of surgical endodontics when conventional access is problematic [4, 12]. Nevertheless, this intervention should be described as microsurgical perforation repair, because no apicoectomy or root-end preparation was documented. Published success estimates for apical microsurgery [6] cannot be used as the expected prognosis for this combination of a lateral perforation, previous replantation, and an established osseous lesion.

Although research on mineral trioxide aggregate (MTA) and related Portland cements has addressed their composition, clinical applications, and biological responses, including a canine pulp-capping study in which calcium chloride addition did not significantly improve histological outcomes, selection of repair biomaterials should be guided by evidence specific to root perforation management [13-15]. Mente *et al.* [16] reported healing in 86% of 64 examined teeth after perforation repair with MTA, providing clinical support for retaining selected perforated teeth. This evidence is relevant to the treatment principle, but does not directly validate the product or surgical sequence used here. In an Iranian Endodontic Journal retrospective series, de Melo *et al.* reported successful outcomes in 69.8% of 53 MTA-treated perforations, with a mean follow-up of six years [17]. That series used coronal access and provides context for long-term perforation repair, rather than an outcome estimate for surgery in a previously replanted tooth. Likewise, Safi *et al.* found no statistically significant difference between MTA and EndoSequence root repair material in a randomized trial of apical microsurgery [18]. That trial evaluated a different premixed material, a different defect location, and a different procedure. It therefore offers contextual support for the clinical use of calcium silicate repair materials without demonstrating equivalence among all bioceramic products or superiority of One-File in lateral perforations.

Table 1. Available findings before surgery and at follow-ups

Finding	Baseline	One year	Five years
Symptoms and function	No pain or percussion/palpation tenderness; recurrent sinus tract in referral history	Functional; no percussion/palpation tenderness	Functional; no percussion/palpation tenderness
Periodontal probing	Normal; no pockets; exact depths not recorded	Normal; no pockets; exact depths not recorded	Normal; no pockets; exact depths not recorded
Tooth mobility	Qualitatively normal; numerical grade unavailable	Qualitatively normal; numerical grade unavailable	Qualitatively normal; numerical grade unavailable
Imaging	Lateral lesion; CBCT showed no visible fracture, resorption, or apical lesion	Periapical radiograph: reported apparent lesion resolution and PDL space	Periapical radiograph: reported apparent lesion resolution and PDL space
CBCT assessment	Preoperative CBCT available	No follow-up CBCT	No follow-up CBCT
Clinical signs of ankylosis	Not separately reported at baseline	No metallic percussion tone (clinician confirmed)	No metallic percussion tone (clinician confirmed)
Clinical attachment level	Numerical values unavailable	Numerical values unavailable	Numerical values unavailable

PDL, periodontal ligament; CAL, clinical attachment level. Normal probing and mobility are qualitative findings. Exact site-specific probing depths were not recorded; numerical CAL values and mobility grades were not available in the supplied records. Absence of metallic percussion tone at both recalls was confirmed by the treating clinician. These observations and the periapical images do not conclusively exclude focal ankylosis or small resorptive lesions, and do not establish complete three-dimensional osseous healing.

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The recurrence after the initial amalgam repair cannot be attributed to amalgam alone. Inadequate adaptation, residual contamination, the extent of the defect, or other local factors are possible explanations, but none was demonstrated in this case. The second intervention combined removal of the previous repair, debridement, renewed sealing, and placement of regenerative adjuncts. Consequently, improvement cannot be isolated to substitution of the filling material. A more defensible interpretation is that correction of a localized, previously treated defect was followed by a favorable outcome. This avoids converting a single clinical observation into a comparative claim about material performance.

The allograft and collagen membrane were additional components of treatment. Their intended role was to support repair within the osseous defect, but the present case cannot determine whether either component was necessary. A systematic review of guided tissue regeneration in endodontic surgery found an overall trend toward improved outcomes that was not statistically significant [19]. Those studies concerned surgical endodontic lesions rather than this specific post-replantation perforation scenario. The perforation measured approximately 3 mm. The associated osseous lesion measured approximately 4.8×7.6 mm in the displayed axial section and 6.5×8.0 mm in the displayed coronal section. These measurements describe the selected sections rather than the complete three-dimensional extent of the lesion. Loss of the buccal cortical plate was directly observed during surgery, although the number and integrity of all remaining bony walls were not established. Radiographic lesion resolution also cannot establish histological regeneration of cementum, periodontal ligament, and bone. The observed loss of the buccal cortical plate, together with the 1.9-mm distance between the lesion and the alveolar crest, provided a clinical rationale for attempting space maintenance and exclusion of migrating soft tissue. No periodontal pocketing or communication with the gingival sulcus was detected. The adjuncts were used to support space maintenance and tissue exclusion in a defect close to the crest, rather than to treat a demonstrated apicomarginal communication. Although buccal cortical loss was confirmed, incomplete characterization of the other walls prevents a definitive wall-based classification and limits assessment of how the residual anatomy influenced prognosis. This case cannot establish whether grafting was indispensable.

The five-year recall is a strength because it extends assessment beyond initial symptom resolution and exceeds the approximately two-year interval preceding recurrence after replantation [20]. Clinical function, percussion and palpation findings, probing, and imaging should be interpreted together. The reported radiographic improvement is encouraging, but two-dimensional imaging does not demonstrate complete three-dimensional healing. In the trial by Safi *et al.* [18] estimated success differed between periapical and CBCT evaluation, illustrating the influence of the assessment method. This does not imply that routine additional CBCT is required in an asymptomatic patient; the outcome here remains based on the clinical and periapical radiographic assessments described. A metallic percussion tone was absent at both recalls according to the treating clinician. However, this finding and the available two-dimensional images cannot conclusively exclude focal ankylosis, residual buccolingual osseous defects, or small resorptive lesions. Accordingly, the outcome is described as tooth retention with favorable clinical findings and apparent radiographic healing, rather than confirmed complete osseous regeneration.

Several limitations constrain interpretation. This is a single case without a comparator. The earlier replantation was performed by another clinician, and the reported interval of less than 20 min before replantation is based on patient recall rather than a contemporaneous timing record. Storage conditions, root handling, stabilization, and detailed technique of the earlier amalgam repair could not be retrieved. The perforation diameter was approximately 3 mm, and the lesion-to-crest distance was 1.9 mm. Section-specific CBCT dimensions were available, and buccal cortical loss was confirmed intraoperatively; however, three orthogonal maximum lesion dimensions and the number and integrity of all residual bony walls were not established. The records described normal probing without periodontal pockets, but exact probing depths were not recorded; numerical clinical attachment levels and mobility grades were not available in the supplied records. Absence of metallic percussion tone at all recalls was confirmed by the treating clinician, but a separately documented standardized ankylosis assessment was unavailable. Follow-up periapical imaging cannot conclusively exclude focal ankylosis or small resorptive lesions, and no follow-up CBCT was available to assess complete three-dimensional osseous healing. Persistent intraradicular infection could not be definitively excluded. Concurrent interventions prevent attribution of healing to the putty, graft, or membrane independently. Longer observation would be needed to characterize durability beyond five years. The report therefore illustrates technical feasibility in a selected patient, without establishing a reproducible rescue protocol.

Conclusion

Microsurgical removal of a previous amalgam repair and resealing of a lateral root perforation with bioceramic putty, combined with an allograft and collagen membrane, was followed by tooth retention and favorable reported clinical findings and apparent healing on periapical radiographs over

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five years in this replanted premolar. A history of replantation with recurrent localized disease need not automatically preclude further tooth-preserving treatment. Careful diagnosis and assessment of restorability and periodontal support remain essential. Periodontal probing and tooth mobility were clinically normal, and no metallic percussion tone was observed at the one- and five-year recalls. The absence of follow-up CBCT limits confirmation of complete three-dimensional osseous healing and conclusive exclusion of focal ankylosis or small resorptive lesions. This single case does not establish material superiority, the necessity of regenerative adjuncts, or predictable outcomes in other patients.

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Conflict of Interest
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Author Contributions
Conceptualization: ASH; Methodology: ASH/RS; Formal Analysis and Investigation: ASH/FS; Writing-Original draft preparation: ASH/RS/FS; Writing-review and editing: ASH/RS/FS; Supervision: ASH. All authors read and approved the final manuscript.

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