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CASE STUDY

Root canal retreatment followed by apicoectomy and direct restoration with intracanal retention on overfilling obturation

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ABSTRACT

The success of endodontic treatment depends on proper shaping, disinfection, and obturation of the root canals. The filling material must adequately occupy the root canal space without extending the anatomical apex. Overfilling occurs when the filling material extrudes into the periapical tissues beyond the apex, which negatively affects the long-term prognosis. Endodontic overfilling cases can be addressed through surgical treatments aimed at preserving the tooth. This case report aims to inform to highlight endodontic surgery as an effective treatment for cases of failed root canal treatment due to overfilling of the obturation material. A 27-year-old male patient came to the Dental Conservation clinic at RSGM Prof. Soedomo with a chief complaint of the left maxillary lateral incisor, which had undergone discoloration and caused discomfort during chewing. The tooth had undergone root canal treatment two years prior. Periapical radiographic examination revealed that tooth 22 had been treated with overfilling obturation material and there was widening of the periodontal membrane in the periapical area. Root canal retreatment was performed using the crown-down preparation technique, followed by single-cone obturation with a bioceramic sealer. At the subsequent visit, an apicoectomy was performed, involving flap opening, alveolar bone exposure, removal of granulation tissue, and resection of 3 mm of the tooth apex. Retrograde filling with Mineral Trioxide Aggregate (MTA) was applied, followed by bone grafting and membrane placement. The area was sutured and covered with a periodontal dressing. The final restoration was completed using direct composite resin with intracanal retention. At the one-week follow-up, the patient reported no complaints. In conclusion, apicoectomy is an effective solution for overfilling cases. This case report demonstrates that surgery combined with retreatment can preserve the tooth and restore its function.

Keywords: apicoectomy; direct restoration; intracanal retention; overfilling; retreatment

INTRODUCTION

The main goal of endodontic treatment is to eliminate endodontic microbial biofilm, which can cause inflammatory reactions in the periapical tissues, through disinfection and sealing of the root canal. Therefore, successful endodontic treatment depends on mechanical preparation, adequate and effective irrigation, and obturation of the 3-dimensional root canal system.[1]

The most commonly used root canal obturation material is gutta-percha. Ideally, the root canal filling material should fit precisely within the root canal. However, overfilling gutta-percha still occurs, especially in cases of incompletely sealed root canals, resorption, or over instrumentation of the root canals.[2] Overfilling of gutta-percha results in a lower success rate of endodontic treatment, estimated at 76%, compared to the generally reported success rates of 85-95%.[3] Overfilling of gutta-percha can induce foreign body reaction and inflammatory response, leading to several complications, such as pain, swelling, granuloma, paresthesia, periapical lesions, and ultimately, failure of endodontic treatment.[4]

Failure of endodontic treatment due to gutta-percha overfilling can be treated by non-surgical methods, surgery, or a combination of both.[5] Endodontic surgery is a popular procedure

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that improves tooth survival when conventional endodontic treatment alone is insufficient. It is indicated in cases of significant overfilling of obturation material resulting in symptomatic periradicular pathology, periradicular cysts with epithelial-lined cavities that do not heal after non-surgical treatment, persistent periradicular pathology, and correction of deficiencies in previous treatments.[3]

Additionally, curettage plays a crucial role in debriding pathological periapical tissue, removing extraradicular infections, foreign bodies, or cystic tissue.[6] The primary objective of endodontic surgery is to eliminate necrotic tissue from the root canals, thoroughly debride them, and seal cavities or defects to reduce microorganisms in the periradicular tissue, thus creating an environment conducive to periodontal tissue regeneration. This goal is achieved through apex resection treatment, apex cavity preparation, and bacteria-tight closure of the apical end of the root canal system with retrograde filling. In addition, curettage plays an important role in debriding periapical pathologic tissue, removing extraradicular infection, foreign body, or cystic tissue.[6] The aim of this case report is to describe root canal retreatment followed by apicoectomy and direct restoration with intracanal retention in a case of overfilling.

METHODS

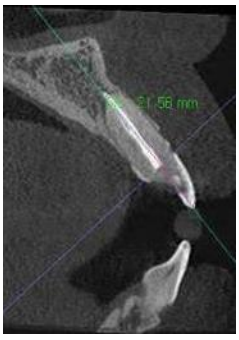
A 27-year-old male patient came to the Dental Conservation Clinic at RSGM Prof. Soedomo with a complaint of discoloration in the old filling of his upper left front tooth, requesting a replacement. He also reported discomfort while chewing. The tooth had undergone root canal treatment two years prior and was restored with a tooth-colored filling. The patient wants the tooth to be retreated to restore comfort while chewing and to match the filling to the original tooth color. The patient had no history of systemic disease or allergies.

On examination, tooth 22 exhibited had tooth-colored fillings on the mesial surface, cervical caries, and a positive response to percussion tests

(A)

(B)

(C)



(D)

Figure 1. (A) The clinical condition of tooth 22 showed a tooth-colored restoration and caries on the cervical part; (B) Periapical radiograph showed overfilling of the obturation material and thickening of the periodontal ligament; CBCT showed overfilling obturation material; (C) CBCT coronal view; (D) CBCT sagittal view

(A) (B)

Figure 2. (A) Cavity access for retreatment; (B) Post-retreatment periapical radiographs showed that there was still gutta percha that had not been collected

(Figure 1A). A periapical radiographic examination revealed that tooth 22 had been treated with a root canal with overfilling of the obturation material widening of the periodontal membrane in the periapical area (Figure 1B). Cone beam computed tomography (CBCT) examination in the coronal plan and sagittal views showed radiopaque material resembling root canal obturation material extending beyond the length of the root canal of tooth 22 (Figure 1C and 1D).

The final diagnosis for tooth 22 was previously treated with symptomatic apical periodontitis. The treatment plan included retreatment, apicoectomy, and direct composite resin restoration with intracanal retention.

Visit I (Dental retreatment 22)

After signing the informed consent form, the retreatment was initiated. The working area was isolated using a rubber dam. The access cavity was opened with an endo access bur (Dentsply) to penetrate the gutta-percha and widened using a non-cutting ended fissure bur (Diamendo, Dentsply) (Figure 2A). The gutta-percha was removed using a solvent (Citrol, Biodinamica), and a rotary retreatment file (NIC-Retreatment File, MDI Dental). Once the gutta-percha was removed, a periapical radiograph was taken to confirm the removal of the obturation material (Figure 2B).

The next step involved re-measuring the working length, assisted by periapical radiographs and confirmed using an electronic apex locator (Tri Auto ZX2, Morita). The root canal was then prepared to a working length of 21 mm using the crown-down technique with M3-Pro Gold files (UDG Dental Group) and irrigated repeatedly with 2.5% sodium hypochlorite (NaOCl). After completing the root canal preparation, the canals were irrigated with 2.5% NaOCl solution and 17% ethylene diamine tetraacetate (EDTA) solution (Smear Clear, SybronEndo) for 1 minute by disinfection with 2% chlorhexidine digluconate (CHX) (Cavity Cleanser, Bisco) for 30 seconds. Saline solution was used as an intermediate irrigation solution. The root canals were then dried using paper points, and intracanal medication was administrated using calcium hydroxide gel (Calcigel, Prevest Denpro) and covered with a temporary restoration (Caviton, GC).

Visit II (Root canal obturation)

The second visit was conducted one week after the first. The patient reported no complaints, including no pains. Objective examination showed that the provisional restoration was still intact, with no signs of leakage or fistulas. Percussion, palpation, and mobility examinations were negative.

The working area was isolated using a rubber dam. The temporary restoration was removed with a scaler and excavator, and the intracanal calcium hydroxide medicament was removed with 2.5% NaOCl irrigation. The root canal was re-cleaned

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Figure 3. The post-obturation periapical radiograph showed hermetic results and there was sealer extrusion.

using a #25 K-File according to the working length and re-irrigated with 2.5% NaOCl and saline. Next, the root canals were irrigated with 17% EDTA solution for 1 minute, and then dried with paper points. Obturation was performed using a single cone obturation technique with a bioceramic sealer (Ceraseal). The cavity was cleaned, and an orifice barrier was applied using resin-modified glass ionomer cement (RMGIC) (Fuji II LC, GC) before sealing with a temporary restoration (Caviton, GC). A periapical radiograph was taken to confirm the results of the root canal obturation (Figure 3).

Visit III (Apicoectomy)

The third visit was conducted two weeks after the second. The patient reported no complaints, including no pain. Objective examination showed that the provisional restoration was still intact, with no signs of leakage or fistulas. Percussion, palpation, and mobility examinations were negative. Prior to surgery, laboratory tests, including blood sugar levels and a complete blood count, were conducted, and the results were normal.

The surgical area was prepared by placing a surgical drape in the oral area followed by disinfection of the operative field with povidone-iodine. Infiltration anesthesia was administered to the anterior superior alveolar nerve with the injection point at the mucobuccal fold of tooth 22 and to the palatal nerve at the incisor papilla, using 1 cc of Articaine HCl 1:100.000 (Orabloc, Phapros) for each injection site.

A semilunar flap design was made on the labial side of tooth 22, with the incision point determined using a periodontal probe based on radiographic measurements (Figure 4A).. The incision was made using a #15C surgical blade (Swann-Morton) (Figure 4B), and the flap was elevated with a raspatory to expose the bone (Figure 4C). The alveolar bone was removed using a No.6 round bur on a low-speed handpiece, irrigated with sterile saline or NaCl until the root apex was visible (Figures 4D and 4E). Gutta-percha was observed protruding from the root end. The periapical area of tooth 22 was curetted to remove pathological tissue and foreign bodies (Figure 4F). The remaining granulation tissue on the root surface was cleaned with an ultrasonic scaler.

Approximately 3 mm of the root apex of tooth 22 was resected to eliminate apical ramifications. The resection was performed at a 45° labial-facing angle for better visibility and access, using a taper micro-diamond bur on a high-speed handpiece. The area was continuously irrigated with NaCl during the procedure. Retrograde instrumentation was then performed with an ultrasonic tip (Start-X, Dentsply), followed by apex surface finishing. A Class I cavity, 3 mm deep, was prepared with a round diamond bur for retrograde filling. Mineral trioxide aggregate (MTA) was placed into the retrograde cavity using an MTA carrier (Nexton) and compacted with a plugger (Figure 4G). A moist cotton pellet was placed over the MTA and left for 45 minutes to allow the initial setting. The surgical area was irrigated using NaCl until clean. An allograft bone graft (FDBA, Batan Research Tissue Bank) was applied to the curetted area, ensuring solid coverage to promote new bone growth (Figure 4H). A collagen membrane (Pericardium membrane, Batan Research Tissue Bank) was placed over the bone graft until it is completely covered (Figure 4I). The flap was repositioned and sutured using non-absorbable monofilament 4-0 nylon thread (Daclon USP 4/0 EP 1.5) (Figure 4J). The surgical area was cleaned with sterile gauze and was

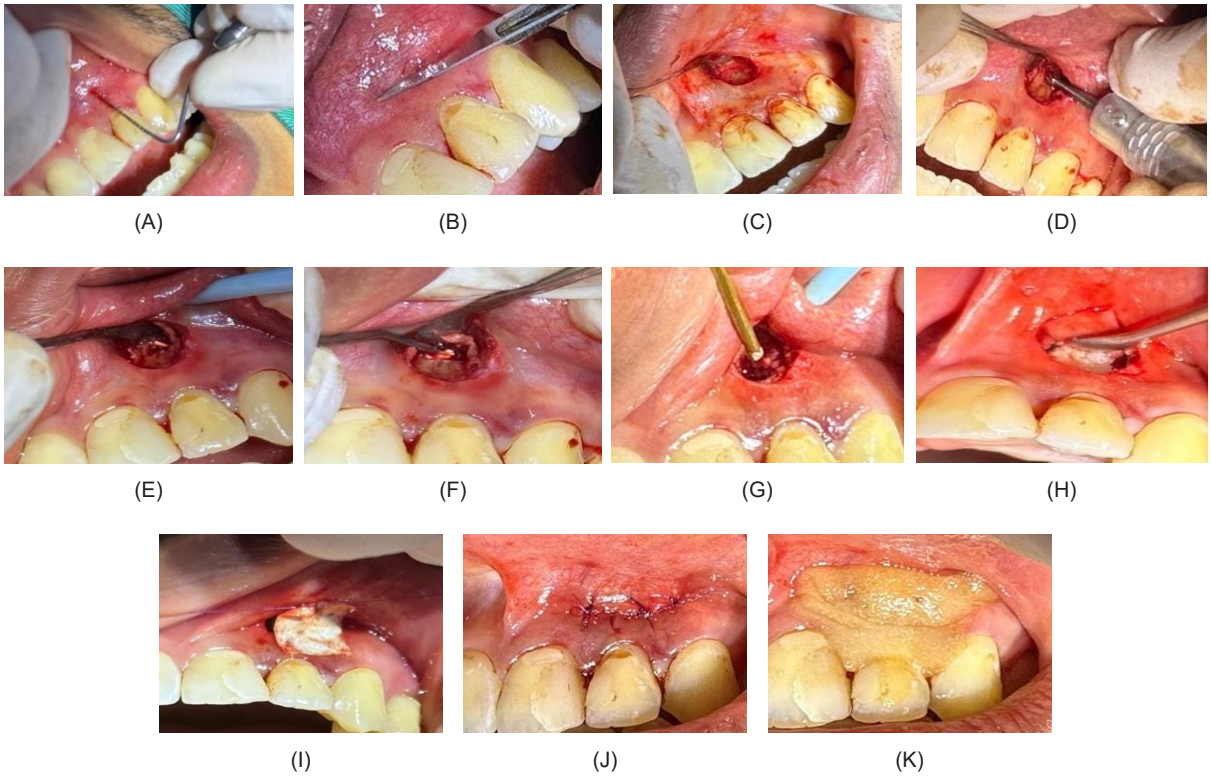

Figure 4. (A) Determining the location of the incision with a periodontal probe; (B) Semilunar incision using a blade; (C) Separation of the mucoperiosteum from the bone using a mucoperiosteal elevator; (D) Labial bone preparation with bone burs; (E) The Apex is exposed; (F) Curettage of pathological tissue and foreign bodies with a curettage; (G) MTA applications with MTA carriers; (H) Application of bone graft with a bone carrier; (I) Collagen membrane application; (J) Repositioning and suturing; (K) Periodontal dressing application

covered with a periodontal dressing (Reso-Pac, Hager & Werken) (Figure 4K). The application of periodontal dressing serves as a protector of the postoperative wound area, as flap retention, and protection from secondary wounds. The patient was prescribed antibiotics, analgesics, and anti-inflammatories and was instructed to maintain good oral hygiene. A follow-up appointment was scheduled for seven days postoperatively.

Visit IV (Control after 7 days apicoectomy)

The patient stated that he had no complaints of pain. Objective examination showed that the provisional restoration was still in good condition, with no leaks or fistulas. Percussion, palpation, and mobility examinations were negative. In addition, the periodontal dressing remained well attached. Upon opening the periodontal dressing, it was observed that the suturing was still intact, the surgical wound was closed, and there were no signs of inflammation or bleeding in the surgical area. The stitches were removed, and the area was irrigated with NaCl. Next, a periapical radiograph was taken (Figure 5). The radiograph showed signs of improvement, with a radiopaque area in the periapical region representing the bone graft material, as well as visible root shortening following the apicoectomy.

Visit V (Tooth restoration)

The fifth visit was conducted one month after the fourth. The patient stated that he had no complaints (no pain during the visit). Objective examination revealed that the provisional restoration was still in good condition, with no leaks or fistulas. Percussion, palpation, and mobility examinations were negative. The work area was isolated using a rubber dam (Figure 6A). A temporary restoration was removed using scalers and excavators.

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Figure 5. Post-apicoectomy periapical radiographic results

Old restorations were cleaned using round diamond burs, and unsupported enamel was removed with fissure diamond burs. The cavity was then prepared to create a bevel at the edge of the cavosurface using a flame-shaped micro preparation bur at an angle of 45° to the cavity (Figure 6B). The RMGIC barrier was cleaned using a round diamond bur. Next, the gutta-percha was reduced by 5 mm below the orifice to create space for intracanal retention using a Peeso reamer (Figure 6C). The results were confirmed using the installed K-File, followed by irrigation and disinfection with saline and 2% chlorhexidine digluconate.

The prepared cavity was etched with 37% phosphoric acid (DenFil Etchant-37 syringe, Vericom), left for 15 seconds on the enamel, and 10 seconds on the prepared dentine. It was then rinsed with a water syringe and the moist surface of the cavity was condition with cotton pellets moistened with sterile distilled water that has been squeezed out. A thin layer of universal bond (Optibond, Kerr) was applied using a microbrush, which was placed at the base of the cavity and spread throughout. The bond was left for 20 seconds and then gently air-dried with a three-way syringe for 2 seconds, keeping the syringe above the cavity. Curing was then performed using a light cure for 10 seconds. A bulk-fill composite resin (SDR, Dentsply) was applied as intracanal retention to cover the pulp base and cured with a light cure unit with a small tip (VRN, VAFU) for 20 seconds. In the palatal cavity, composite resin (Z350 XT, 3M ESPE) A3.5 dentine and A3 enamel were applied using the layering technique in 2 mm increments with a plastic instrument (Figure 6D). Each layer was cured with a light cure unit for 20 seconds.

The rubber dam was removed, and the occlusion was checked using articulating paper. Finishing was performed using a fine finishing

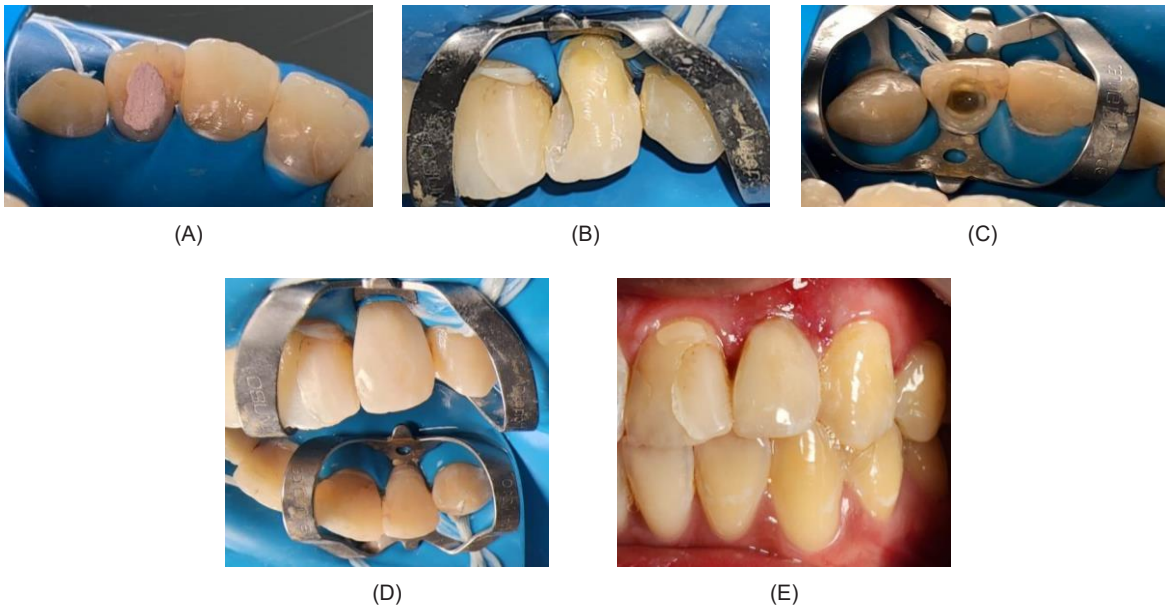

Figure 6. (A) Installing a rubber dam; (B) Preparation results; (C) Results of reduced gutta-percha as intracanal retention; (D) The result of the restoration from palatal view; (E) The result of the restoration from labial view

diamond bur, followed by polishing with a diamond-impregnated disc (Diacomp Twist, EVE).

Visit VI (Control after 7 days of restoration)

Subjective examination showed no complaints. Objective examination revealed no fistula, no gingival inflammation around the restoration, and no food impaction. Percussion, palpation, and mobility were negative.

DISCUSSION

One of the iatrogenic complications is the overfilling of obturation material, which negatively affects the prognosis of treated teeth. A better prognosis for root canal treatment can be achieved when the obturation material does not extend beyond the apical foramen and remains 1 mm below the apex on radiographic examination.[7] Another study demonstrated a better prognosis when the obturation material reached between 0 and 2 mm below the apex on radiographs.[8]

Gutta-percha is the most commonly used material for root canal obturation. It is biologically inert and resilient. Pure gutta-percha is considered biocompatible, with no reported effect on the frequency of chromosomal aberrations in vitro studies. Gutta-percha typically consists of 20% gutta-percha with zinc oxide (ZnO) 60-70% being the main component to provide radiocapacity. Commercially available gutta-percha can be cytotoxic due to added particularly zinc (Zn), which can leak into surrounding soft tissue. Cytotoxicity has been reported when analyzed using scanning electron microscopy (SEM), which can induce periradicular inflammation or necrosis of the periodontal ligament.[9]

Extruded gutta-percha analyzed with SEM has shown the presence of biofilm, which supports bacterial growth, resists host defenses, and is responsible for foreign body reactions. Overfilling can lead to apical periodontitis caused by the transport of bacteria beyond the apex, foreign body reactions, and painful symptoms from irritative stimuli. Therefore, overfilling should be avoided to prevent both short-term and long-term treatment failure.[9]

Orthograde retreatment is an option for cases of failed endodontic treatment. However, persistent clinical symptoms or non-healing lesions often necessitate endodontic surgery.[9] In this case, extruded gutta-percha required surgical intervention because orthograde retreatment could not completely remove the material. Endodontic surgery has the advantage of fully repairing the root canal system and eliminating bacteria.[6] Endodontic surgery is considered the last resort-treatment that has evolved in recent years and increased the ability of physicians to achieve more predictable clinical outcomes with success rates exceeding 90%.[9]

One of the most frequently performed endodontic surgeries is apicoectomy. Apicoectomy or root resection involves the removal of infected soft tissue, root resection, retrograde root filling, and the application of graft material to stimulate new bone formation at the site of the defect.[10]

The main cause of periapical lesions is leakage of the apical seal, which allows microorganisms and toxins to be released. Removing the infected periapical tissue only addresses the effect of the leak, but not the cause. Therefore, the elimination of the periradicular lesion alone may result in the recurrence of the lesion if the apex is not resected.[11] Studies have shown that 3 mm of apical resection and 3 mm of apex preparation during apicoectomy can reduce apical ramifications and 93% of lateral canals by 98%, thereby reducing the risk of re-infection and treatment failure.[12]

Apical closure with proper root-end filling significantly increases the success of the surgical intervention.[13] A literature review indicated a higher success rate in follow-up studies using MTA as a root end filling material.[6] This is due to MTA's beneficial biological properties such as its biocompatibility with the periradicular tissue, ability to stimulate osteogenesis and cementum deposition, antibacterial activity, and better edge adaptation and sealing propertis when compared to other materials. In addition, MTA is dimensionally stable, resistant to dissolution, radiopaque, hydrophilic, and can be used in areas with blood.[3]

In this case, the patient experienced bone loss, so a bone graft was applied to accelerate bone healing and induce host cells to regenarate the missing bone. The process of bone formation or osteogenesis involves osteoblast cells or progenitor cells in the graft material. Osteoinduction refers to the bone graft material's ability to stimulate the formation of a scaffold for host stem cells to grow. During osteoinduction, many growth factors influence the transformation of host stem cells into osteoblast. Growth factors that play a role in this process include platelet-derived growth factors (PDGFs), fibroblast growth factors (FGFs), and transforming growth factor-β (TGFs- β). These factors are crucial in the formation of new bones, occurring in direct parallel with the interconnections between bones.[14]

When selecting a bone graft material, important considerations include biocompatibility, bioreceptivity, sterility, structural integrity, adequate porosity for new blood vessel growth, compressive strength, cost, and ease of manipulation.[9]

The process of bone healing using bone grafts typically takes 19-20 weeks.[15] Therefore, the use of membrane barrier is necessary. Research has shown that using a resorbable membrane barrier has been over 24 months results in good bone formation and no patient complaints. During the 14 days postoperatively, the periosteal tissue has not yet shown regenerative action on the bone until trabeculae begin forming from the endosteal tissue, resulting in a difference in healing rates between the gingival soft tissue and the alveolar bone.[16]

In this case, root canal obturation was performed using a bioceramic sealer. Bioceramic sealers create an alkaline environment by raising the pH, which prevents bacterial proliferation and stimulates the regeneration of periodontal and endodontic tissues through the release of calcium ions (Ca^{2+}).[17]

Adequate final restoration after root canal treatment is essential, as many cases of post-root canal treatment are caused by inadequate restorations. This failure is typically due to microleakage. The selection of the final restoration depends on the amount of remaining tooth structure. In this case, a direct composite restoration was chosen because a significant amount of tooth structure remained. Composite resin was selected for its color and translucency, which closely resemble natural tooth structure, resulting in good aesthetics. Additionally, composite resin restorations are minimally invasive, requiring little tooth structure removal, thus preserving strength. They are also easy to apply, require fewer steps, minimize visits, and are cost-effective.[18]

In this case, intracanal retention was enhanced using bulk-fill composite resin, which forms retention and provides resistance to tipping or lateral forces. Bulk-fill composite resin was chosen for its many advantages, including low polymerization shrinkage, higher light transmission, the ability to be applied in layers up to 5 mm thick, and suitability for cavities with a high C-factor.[19]

CONCLUSION

Periapical gutta-percha overfilling is one of the complications that may occur during root canal treatment. If resolved, it can cause long-term foreign body reactions and lead to the formation of lesions in the periapical area. Endodontic surgery can be an effective a treatment option when conventional root canal treatment proves insufficient. Proper case and material selection, along with adequate operator skills, can significantly enhance the success of endodontic treatment.

CONFLICT OF INTEREST

The authors declare no competing interests.

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