

Management of Periapical Lesion and Discoloration with Periapical Microsurgery Followed up by Internal-External Bleaching and Direct Composite Restoration: One-Year Clinical Evaluation

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Background: Endodontic treatment outcomes may change over time. Factors such as compromised coronal seal and inadequate obturation can lead to canal reinfection and often periapical infection, thus developing into periapical lesions. Biofilm occupying the surface of the root tip can cause failure of conventional endodontic treatment or retreatment. Healing is achievable depending on the success of efforts to eradicate the biofilm layer from the site. Tooth discoloration after a root canal treatment can also be concerning, with several causes and treatment options. One of the minimally invasive aesthetic treatment options for discolored anterior teeth is dental bleaching or direct composite veneers.

Case Report: A 22-year-old patient experienced pain in the right maxillary lateral and central incisors with a history of trauma at the age of six. Both teeth have undergone root canal treatment at the age of ten years. Clinically, the teeth were discolored with visible old composite restorations. Radiological finding shows radiolucency in the periapical and compromised apical structure. Endodontic retreatment and periapical microsurgery were performed to remove the periapical lesion, followed by internal-external bleaching and direct composite veneer to restore the aesthetics.

Results: The procedure was successful, and a one-year follow-up recall revealed bone regeneration around their apices and esthetic outcomes that satisfied the patient.

Conclusion: The technique described is an excellent approach in conserving the tooth with periapical lesions and compromised apical structure due to root resorption and internally stained teeth.

Keywords: periapical lesion, periapical microsurgery, tooth discoloration, internal-external bleaching, direct composite veneer

Introduction

Results of endodontic treatment may change over time. Long-term success of root canal treatment is inevitably related to complex multifactors.¹ Compromised coronal seal and inadequate obturation create a higher risk of root canal reinfection and may reach the periapical tissue. Microorganism causing root canal infections that have reached the periapical area can develop biofilms on the surface of the tip of the root, turning into periapical pathogens.² Notably, biofilms are resistant to antibiotic therapy and immune response.³ Biofilm that occupies the surface on the root tip can cause failure of conventional endodontic treatment or retreatment. Healing such a case depends on the success of eradicating the biofilm layer from the site.⁴

Treatment procedures to clean biofilms and pathological tissues in the periapical area can be carried out with a surgical endodontic treatment approach.⁵ The treatment stages involved biomechanical preparation of root canals and irrigation, followed by root canal disinfection and root canal filling, after which the root tips and pathological tissue were removed. Removal of

biofilm and pathological tissue will promote a faster healing process of periapical lesions.⁶ Histologically, there are three types of periapical tissue healing after surgery: (1) periodontal tissue remodeling with or without inflammation, (2) fibrous scarring, ankylosis, and inflammation to varying degrees, and (3) periapical inflammation of varying severity without scar tissue formation.⁷

Healing categories are defined as complete healing, incomplete healing (scar tissue formation), uncertain healing, and unsatisfactory healing, occur when histological findings are correlated with two-dimensional radiological examinations. To obtain more accurate evaluation results, it is necessary to visualize anatomical features in three dimensions with CBCT examination. In addition to these advantages, CBCT examination can be used to evaluate bone defects as well as their healing process.⁸

Guided tissue regeneration (GTR) technique has been proposed to complement endodontic surgery as a way to promote bone healing.⁹ Membrane barriers and bone grafting materials are used to prevent epithelial and gingival connective tissue from proliferating to the bone defect adjacent to the apical surface, giving the time required for periodontal ligament and alveolar bone cells to differentiate, proliferate, and migrate into the bone defect, promoting tissue repair.¹⁰

This case report describes the management of periapical lesions, a compromised apical structure, and internal staining/discoloration with a microsurgical approach adopting the guided tissue regeneration principle to teeth that had undergone a primary root canal treatment twelve years earlier. The internal-external bleaching and direct composite restoration were performed afterward to improve the aesthetics.

Case Presentation

A 22-year-old female patient was referred to the Department of Conservative Dentistry RSGM Universitas Padjadjaran, Bandung, Indonesia, complaining of sudden throbbing pain in the right front upper teeth a few days prior. She had a history of falling when she was six years old, and her right front maxillary teeth hit the floor, but she never felt pain until she reached ten years old. The teeth have had root canal treatment at the age of ten years. There are no exacerbating factors of pain in the patient's teeth. History of systemic diseases and drug allergies were denied.

Extra oral examination showed a symmetrical face, no abnormalities on lips and temporomandibular joints, sub-mandibular lymph nodes were not palpable and painless. Oral hygiene was good. Intra-oral examination exhibited a yellow-stained maxillary right lateral incisor with a composite restoration on the palatal as shown in Figure 1a and b. Pulp vitality /Cold test (-), percussion (+), palpation (-), tooth mobility (-). The maxillary right central incisor revealed brown-yellowish staining with a composite restoration that partially covered the labial and palatal surfaces. Pulp vitality/Cold test (-), percussion (+), palpation (-), tooth mobility (-). The patient agrees that this case report is to be published for scientific and educational purposes. In addition, the patient has received both written and verbal informed consent which she signed for the paper given.

A radioopaque area in the root canal up to the apical third of the maxillary right lateral incisor was seen on the radiological examination. There was a significant alteration in the periodontal area, confirmed by the widening structure of the periodontal membrane at the apical, other than that, lamina dura was seen severed at the apical, and there was a radiolucent in the periapical as well as a compromised apical structure due to resorption. The maxillary right central incisor showed a radioopaque area in the root canal, as well as a widening structure of the periodontal membrane at the

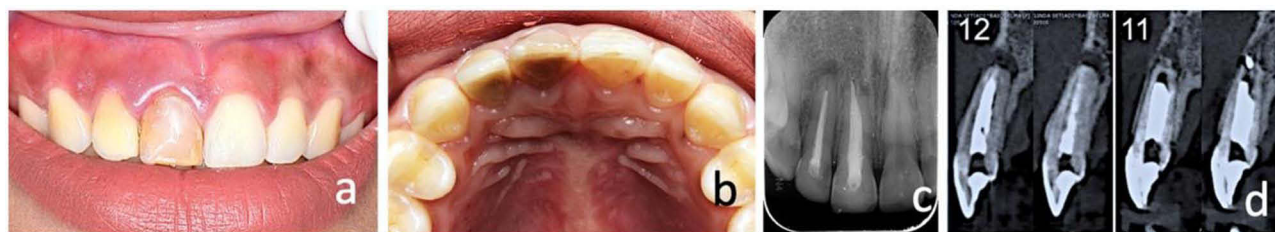


Figure 1 (a) The Intraoral photograph showed a slightly inflamed gingiva on the maxillary right lateral and right central incisor; a yellowish stain on the maxillary right lateral incisor; and a brown-yellowish stain on the maxillary right central incisor. (b) Discolored composite restorations with marginal staining on palatal surfaces. (c) Pre-op periapical x-ray showed lesions in periradicular regions. (d) Sagittal slices CBCT assessment shows a diffuse radiolucency surrounding the root tips of the maxillary right lateral and right central incisor and an unfilled one-third apical of the maxillary right central incisor.

apical, followed by a severed lamina dura at the apical region. A radiolucent area in the periapical accompanied by a compromised apical structure was also seen from the radiograph. (Figure 1c). Sagittal slices of CBCT (Vatech, Korea) assessment portrayed a diffuse radiolucency surrounding the root tips of the maxillary right lateral incisor and maxillary right central incisor (Figure 1d). Diagnosis: Previously treated, symptomatic apical periodontitis on the maxillary right lateral incisor and right central incisor.

Case management, specifically root canal retreatment, was performed on the maxillary right lateral incisor and right central incisor. A rubber dam (Coltene, US) was placed, and the access cavity was re-opened. Root canal filling material was removed with gutta-percha remover (MANI, Japan). Root canals were prepared with Protaper hand file up to F4 size (Dentsply, US); irrigation was done with EDTA 17% (Onemed, Indonesia) and NaOCl 5% (Onemed, Indonesia). Medicament application of Metapaste calcium hydroxide paste (Meta Biomed, Korea) was undergone for four weeks. Root canal filling with gutta-percha cone F4 size (Dentsply, US) and bioceramic sealer Endoseal MTA (Maruchi, Japan) was performed at the second visit.

Apex resection was performed under dental operating microscope magnification (semorr, China) with local anesthesia of 2% lidocaine with epinephrine 1:100,000 (Phapros, Indonesia). Ochsenbein-Luebke flap opening with no. 15c blade encompassed from distal of maxillary right canine to maxillary left central incisor was completed (Figure 2a). Osteotomy and root end resection were executed using a Piezotome bone cutting tip (NSK, Japan) (Figure 2b). Pathological lesions were removed and sent to the lab for histopathological analysis (Figure 2c). Retrograde preparation was performed using apical surgery tip AS6D (ACTEON, France) (Figure 2d). Inspection of retrograde preparation was conducted using micromirror (ACTEON, France) (Figure 2e), then filled with Bio MTA (Cerkamed, Poland) (Figure 2f). The bone defect was filled with Xenograft bone graft material (BATAN, Indonesia), covered with pericardium membrane (BATAN, Indonesia), the flap was repositioned and sutured with nylon monofilament no 6 (Mani, Japan) (Figure 2g). Immediately after suturing (Figure 2h). Periopack (GC, Japan) was placed to cover and protect the wound after suturing (Figure 2i). CBCT (Vatech, Korea) assessment one week post-op. shows bone defect after surgical removal of the lesions (Figure 3a). The sutures were removed at 1-week control, and the patient did not complain of swelling and pain. The edges of the flap were already noticeably filled with connective tissue (Figure 3b).

Internal-external bleaching was carried out two weeks after surgery to correct the shade of the maxillary right lateral incisor and maxillary right central incisor. Temporary fillings were cleaned up to 3 mm below the cemento-enamel junction. A barrier with IRM (Dentsply, US) material was placed on the root canal orifice that covered the root canal corresponding to the cemento-enamel junction height and overlapped with the coronal part of the cemento-enamel junction. Optragate (Vivadent, Germany) was placed to protect the lip mucosa. Vitamin E (Darya Varia Laboratories, Indonesia) was applied to the mucosa around teeth, followed by the application of gingival barrier (OpalDam Ultradent, US) to protect the mucosa so as not to come into contact with bleaching material (Figure 4a). Opalescence boost bleaching agent with 40% hydrogen peroxide (Ultradent, US) was activated by mixing base and catalyst components then applied to the labial surface and pulp cavity of the maxillary right lateral incisor and maxillary right central incisor (Figure 4b). After contact time of 20 minutes, the bleaching gel was thoroughly cleaned. Tooth color was assessed (Figure 4c). CPP ACP gel (GC, Japan) was applied to tooth the maxillary right lateral incisor. Bleaching gel was reapplied on the maxillary right central incisor for 20 minutes; then, the material was cleaned, followed by CPP ACP gel application.

The restoration stage was carried out two weeks after bleaching. A rubber dam was placed for optimum isolation of the working field (Figure 5a). The procedure involved cleaning the IRM barrier from root canal orifices of the maxillary right lateral incisor and maxillary right central incisor, cleaning the pulp cavity, and filling with packable glass ionomer restoration. The access cavity was restored with direct composite. The maxillary right central incisor was also restored with direct composite veneers to match the shade of adjacent teeth. Application of 35% phosphoric acid etch for twenty seconds after intra-enamel preparation (Figure 5b). Following application of BeautiBond Xtreme (Shofu, Japan) and light-cured for 10 seconds with Elipar DeepCure-L LED curing light (3M, US), an A2O Beautifil II shade (Shofu, Japan) was applied to cover the remaining stained the right central incisor and light cured for 10 seconds. A beautiful translucent (T) enamel shade (Shofu, Japan) was applied to cover the labial surface and carved to recreate the morphology and light cured for ten seconds (Figure 5c). Shaping and finishing the restoration with Soflex polishing disc (3M, US) to recreate

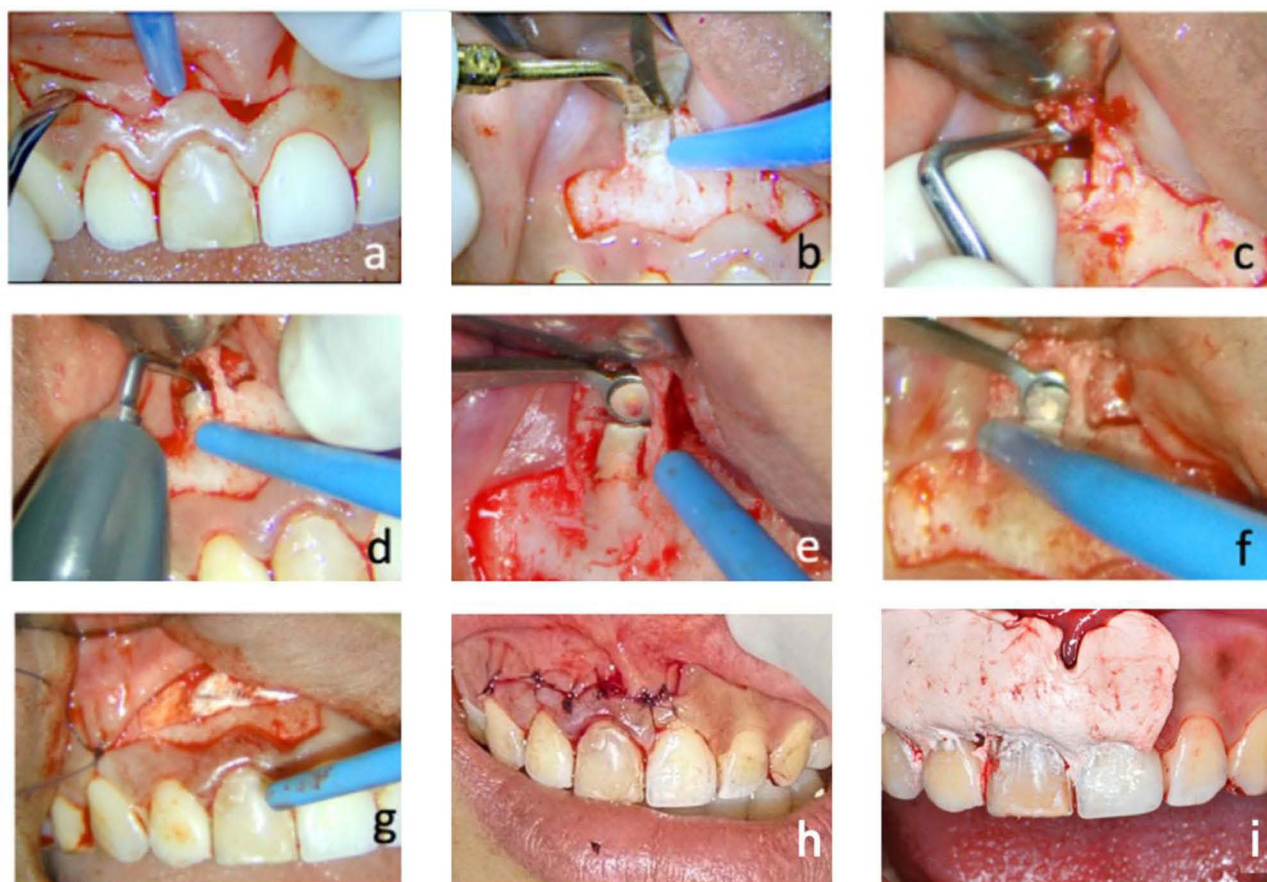


Figure 2 (a) Ochsenein Luebke flap design. (b) Osteotomy with bone window technique prepared with piezotome bone cutting tip. (c) Periapical tissue removal for pathology assessment. (d) Apical cavity preparation using apical surgery ultrasonic tip. (e) Inspection of the apical preparation with micromirror. (f) Filling the retrograde preparation with BioMTA. (g) Flap repositioning and suturing after bone graft and membrane placement. (h) immediately after suturing (i) Periopack placement.

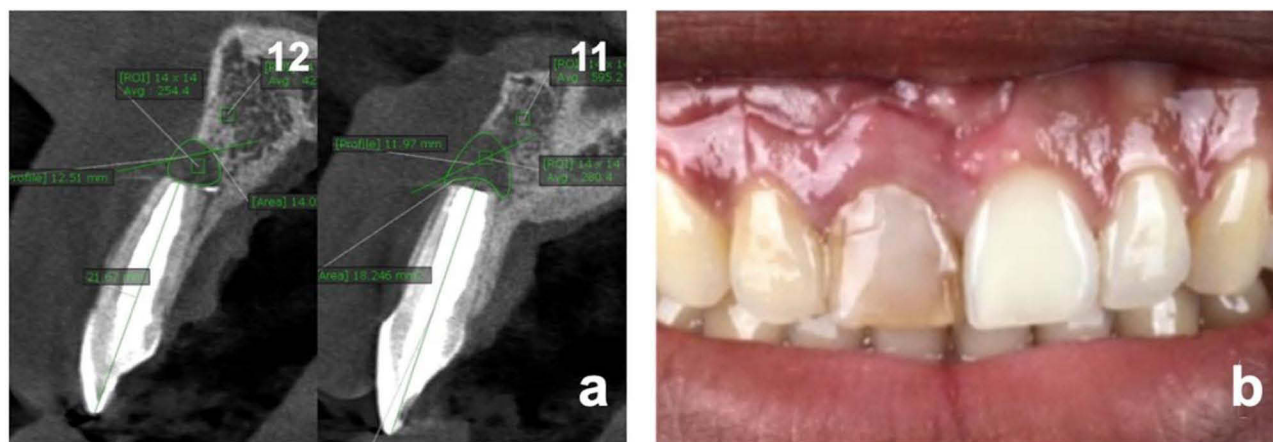


Figure 3 One week post-op. (a) Sagittal slices CBCT assessment shows bone defect after surgical removal of the lesions on #12, #11 (b) The sutures were removed at 1-week control, and the edges of the flap were already noticeably filled with connective tissue.



Figure 4 (a) Gingival barrier placement after application of vitamin E and optragate in place. (b) Internal-external bleaching with hydrogen peroxide 40% gel. (c) Lighter shade after bleaching the maxillary right lateral incisor and right central incisor.

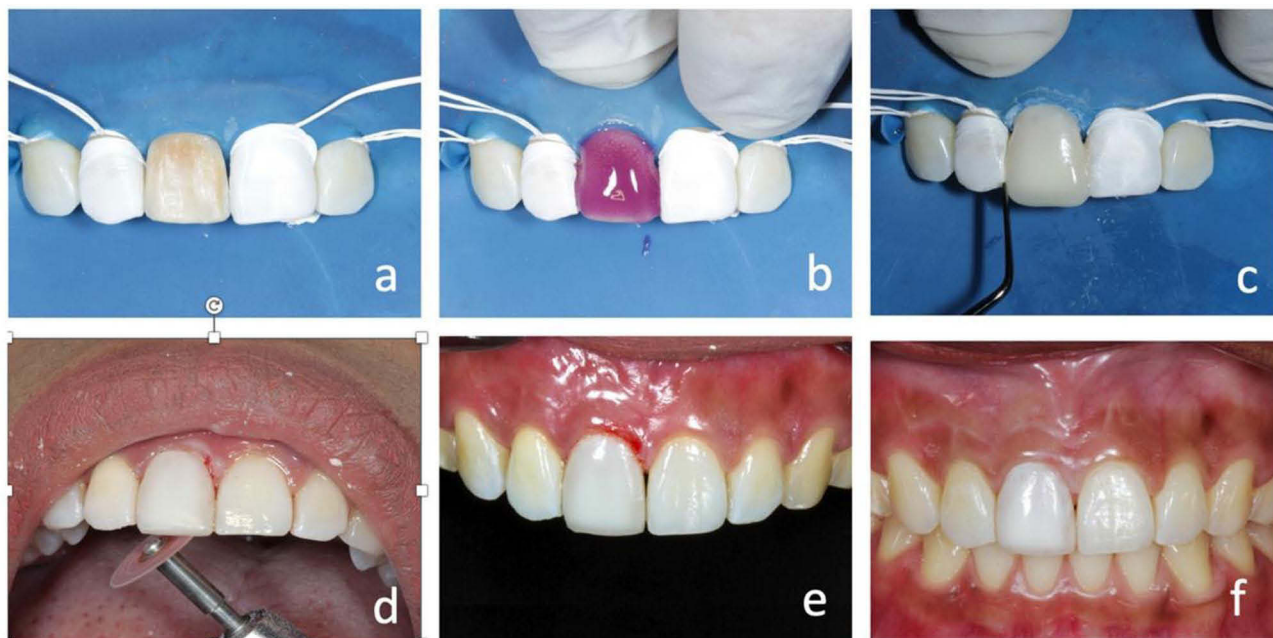


Figure 5 (a) Anterior teeth are isolated with a rubber dam, and the adjacent tooth is covered with PTFE tape. (b) Application of 35% phosphoric acid etch for twenty seconds. (c) Placement and carving of the direct composite veneer before light curing. (d) Shaping and finishing the direct composite veneer. (e) Direct composite veneer immediately after polishing. (f) six weeks post-op.

the luster of labial surface (Figure 5d). Note the shade resemblance of direct composite veneer with the rest of dentition immediately after polishing (Figure 5e) and six-week post-op (Figure 5f).

One year follow-up recall revealed aesthetic outcome that satisfied the patient (Figure 6a). Periapical x-ray evaluation showed healing of periapical lesion (Figure 6b), and bone regeneration around their apices on CBCT assessment (Figure 6c).

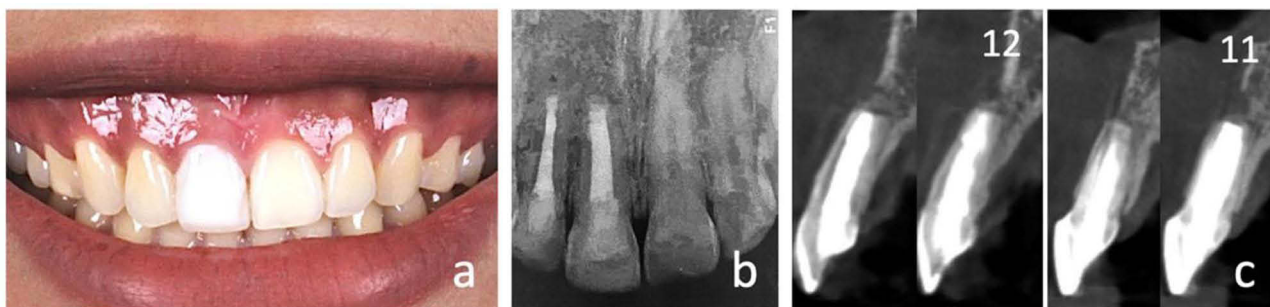


Figure 6 (a) One-year clinical evaluation. (b) Periapical x-ray photo shows healing of periapical lesions (c) Sagittal slices CBCT assessment show bone deposition surrounding the root tips of #12, 11.

Discussion

Pathological changes in the periapical area are not always caused by the presence of microorganisms in the periapex. Infected teeth with remaining vital pulp tissue at the apical area may induce periapical lesions.¹¹ Metabolic waste and toxins from bacteria that infect the root canal can diffuse and reach the periapical area, hence triggering an inflammatory process.¹²

The inflammatory process is a physiological response to harmful stimuli. The response of periapical tissue to inflammation affects the periodontal ligament and spongy bone. The process begins with a neurovascular response that gives rise to hyperemia, vascular congestion, periodontal ligament edema, and extravasation of neutrophils. The integrity of bone in the periapical area depends on the balance between bone resorption activity by osteoclasts and bone deposition by osteoblasts. Osteoclasts originate from the group of macrophage monocytes present in the bone marrow pulled by the chemo-attractant to emigrate from the peripheral circulation into the bone. Activation of osteoclasts then triggers bone resorption in the periapical region.^{12,13}

This case report discusses the management of symptomatic apical periodontitis in previously treated teeth. The long-term success of root canal treatment depends on such factors as (a) medical status, patient age, gender, or ethnic group; (b) operator skill and experience; and (c) tooth health condition and integrity of the tooth structure, pulp or periodontium; (d) quality of the RCT, such as inadequate obturation, short root canal fill or overfill; and (e) post-operative, mainly related to the quality of the coronal seal.¹ Failure of the long-term success of primary root canal treatment, in this case, is made possible by the quality of the coronal seal that has begun to be compromised, allowing reinfection into the root canal, which eventually reaches the periapical area. This causes an inflammatory reaction of the periapex, triggering the activation of osteoclasts that cause the resorption process and damage the integrity of the root tips and periapical tissue.

In the anterior region, it was important to carefully consider the most appropriate flap design to choose from. A submarginal rectangular ochsenbein Luebke flap was chosen in order to conserve the natural gingival line and allow the flap to reposition effortlessly. The use of piezotome in the hard tissue preparation is minimally invasive and reduces the level of trauma to the connective tissue, which translates to less inflammation during the healing process.¹⁴ Ultrasonic apical surgery tip was used to prepare the apical cavity in order to conserve as much healthy apical tissue as possible, which conventional rotary cutting instruments are incapable of.⁷ The use of these tools certainly requires magnification and adequate illumination, so that the process of identifying anatomical structures, pathological tissues and instrumentation can be more accurately done.¹⁵

Root end filling with bioMTA attempts to ensure an optimal apical sealing ability and biocompatibility with bioactive materials to support the healing process. Periapical defects filled with bone-graft material and covered by pericardium membrane are to ensure the optimum healing process of the bone defect filled with new bone formation instead of connective tissue.⁷ The flap was repositioned and sutured with no 6 nylon monofilaments to avoid debris retention and suppress inflammation potentials, leading to a faster healing process. Pathological examination reveals the periapical tissue is fibro-collagen connective tissue scattered with mononuclear inflammatory cells and PMN and no sign of malignancy. It translated that the lesion was a non-specific infection with no sign of malignancy.

Discoloration of the maxillary right lateral incisor and maxillary right central incisor were treated with internal-external bleaching using hydrogen peroxide 40%. Barrier application overlapping the coronal section to the cementoenamel junction aimed to limit the bleaching material applied to the pulp cavity only in contact with the dentin covered with enamel, not seeping through the dentin tubules to the cementum which has the potential to cause external resorption.¹⁶ The maxillary right lateral incisor was restored with direct composite restoration on the palatal access cavity preparation. A direct composite veneer and palatal access cavity restoration was performed on the maxillary right central incisor to achieve aesthetic harmony with the rest of the dentition. Nevertheless, further research is needed on a larger scale to determine the advantages of using bone grafts and membranes for guided tissue regeneration techniques compared to other periapical surgical methods.

Conclusion

The technique described is an excellent approach to conserving the tooth with periapical lesions and compromised apical structures due to root resorption and internally stained teeth. A piezotome device is superior in precision for osteotomy and produces less debris and less trauma compared to rotary instrumentation. Adopting the modern microsurgical technique, which minimizes the size of bone opening and less trauma to the soft tissue, may induce a faster healing process. Using bone grafts and

membranes as guided tissue regeneration can help ensure that bone defects will be filled with hard tissue. Internal-external bleaching is an effective treatment for cases of internally stained teeth involving dentin and enamel, and direct composite is a reasonable choice for the restoration of this case.

Acknowledgment

Approval was given from Universitas Padjadjaran as part of research and study program.

Disclosure

The authors report no conflicts of interest in this work.

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