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CASE STUDY

Apicoectomy and root canal treatment of a maxillary right central incisor with discoloration, class IV ellis fracture, and radicular cyst

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ABSTRACT

In cases of pulp necrosis, infection products can spread into the periapical tissues, triggering an inflammatory response that stimulates the proliferation of the epithelial cell rests of Malassez. As the epithelial mass enlarges, the central cells—farther from the nutritional supply, undergo necrosis, leading to fluid accumulation. The cyst continues to expand due to cyst wall proliferation and increased hydrostatic pressure in the lumen. This pressure causes the accumulated fluid to spread and compress the epithelial lining of the fibrous capsule. This report presents the successful management of a radicular cyst in the maxillary anterior region through apicoectomy. The patient, who sustained a traumatic injury and fractured the tooth at the age of 10, later experienced pain and gingival swelling. Clinical examination revealed a Class IV Ellis fracture and discoloration of tooth 11. Radiographic evaluation showed a well-defined, rounded radiolucency approximately 20 mm in diameter in the periapical region of teeth 11 and 12, extending toward tooth 13. The treatment plan included disinfection and healing enhancement (DHE), root canal therapy, apicoectomy, and intracoronal bleaching. Apicoectomy proved to be a reliable treatment with a favorable prognosis for anterior teeth.

Keywords: apicoectomy; intracoronal bleaching; radicular cyst

INTRODUCTION

Radicular cysts are classified as inflammatory odontogenic cysts, typically resulting from the activation and proliferation of epithelial rests of Malassez following dental caries or trauma. These cysts commonly develop at the apex or along the lateral side of the root.[1] Periradicular cysts are more frequently observed in the anterior maxilla, likely due to trauma and the presence of residual epithelial cells. They generally exhibit a slow and infiltrative growth pattern and are often asymptomatic unless acute inflammation occurs. Such lesions are frequently detected incidentally during routine radiographic evaluations.[2]

A definitive diagnosis of a cyst requires histopathological confirmation. For large periapical lesions, surgical endodontic treatment is often recommended, as conventional root canal therapy in non-vital teeth with extensive lesions has a relatively high failure rate.[3] A retrospective study indicated that enucleation followed by apicoectomy is the preferred treatment for radicular cysts.[1] When no alternative treatment can preserve the tooth, endodontic surgery should be pursued. Successful outcomes require the clinician to have a comprehensive understanding of surgical procedures and anatomical structures. Cone-beam computed tomography (CBCT) is a valuable diagnostic tool that can aid in preoperative planning and surgical execution.[4]

Apicoectomy (also referred to as root-end resection or root amputation) involves the removal of the apical portion of the root to eliminate infection, granulation tissue, or cystic lesions, while preserving most of the root structure. The three essential steps of periradicular surgery include: (1) surgical debridement of pathological tissue, (2) resection of the root apex, and (3) retrograde root

canal obturation.[5] In apicoectomy, approximately 3 mm of the root apex is removed to eliminate apical ramifications and lateral canals, thereby reducing the risk of reinfection and treatment failure. In this case, mineral trioxide aggregate (MTA) was selected as the retrograde filling material due to its superior sealing ability, biocompatibility, suitability for use in moist environments, and capacity to reinforce weakened roots.[4]

Currently, dental aesthetics, particularly related to the smile, are becoming increasingly important, as they can have significant psychological and social impacts on an individual's appearance. Tooth discoloration can be especially noticeable when it affects only a single tooth, as it often appears darker than the adjacent teeth. Non-vital tooth discoloration can result from several factors, one of which is dental trauma that leads to pulp necrosis. Such trauma commonly affects the dentoalveolar area and can cause damage to both hard and soft tissues. A frequent outcome of pulp necrosis due to trauma is tooth discoloration.

Internal bleaching is a minimally invasive and effective treatment for discolored teeth that have undergone endodontic treatment, especially when the clinical crown remains structurally intact. This technique is simple, conservative, and widely used. Among various internal bleaching techniques, the walking bleach method is the most commonly applied. In this technique, a bleaching agent, typically 35% hydrogen peroxide, is placed in the pulp chamber and left for a specific period, with periodic evaluations until the desired shade is achieved.[1] The aim of treatment in this case is to perform an apicoectomy to remove the radicular cyst and then restore the tooth's natural color using internal bleaching, followed by final restoration with composite resin.

METHODS

A male patient presented to RSGM Prof. Soedomo seeking restoration for his upper right anterior tooth. At the age of 10, the patient had sustained dental trauma after a fall, fracturing the tooth. Years later, he experienced recurrent pain and gingival swelling. The tooth had previously undergone three restorations, all of which failed, and had never received root canal treatment.

Clinical examination revealed good oral hygiene, symmetrical facial features, and no lymphadenopathy. Tooth 11 showed palatal exposure, a Class IV Ellis fracture, cavitation, and discoloration. Vitality testing was negative, with positive responses to percussion and palpation. Radiographic examination showed a well-defined, rounded radiolucent lesion (20 mm in diameter) in the periapical area of teeth 11 and 12, extending toward tooth 13. The apices of teeth 11 and 12 were located within the lesion. An oblique line was also noted on the incisal edge of tooth 11.

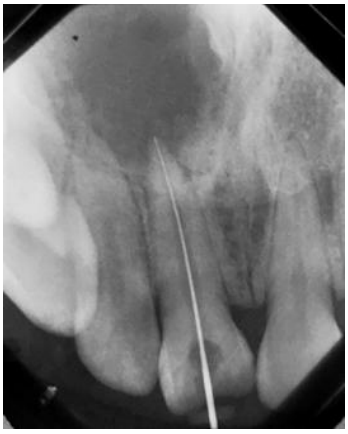
The diagnosis was a Class IV Ellis fracture of tooth 11 with an associated periapical lesion consistent with a radicular cyst. The proposed treatment included root canal therapy using the step-back technique, followed by apicoectomy and retrograde filling with MTA, enucleation of the cyst, internal bleaching using the walking bleach technique, and final restoration with Class IV resin composite.

The prognosis was favorable, considering the restorability of the remaining crown, intact supporting tissues, good oral hygiene, the absence of systemic disease, and the patient's cooperative attitude and high motivation for dental care. Informed consent was obtained.

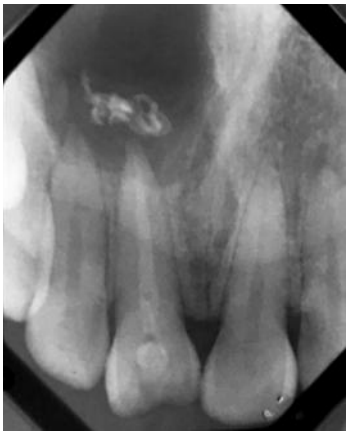
The treatment procedure and potential risks were explained to the patient, and written informed consent was obtained. Tooth 11 was isolated with a rubber dam. Access to the pulp chamber was created on the palatal surface using a round diamond bur, followed by refinement with an endo-access bur. A smooth broach was used to check canal straightness, and the pulp chamber was irrigated with 2.5% NaOCl.

Root canal negotiation was performed using a #10 K-file to two-thirds of the root canal length with watch-winding movements, followed by irrigation using 2.5% sodium hypochlorite (NaOCl). The estimated working length was initially determined by tracing the diagnostic radiograph. Subsequently, a #15 K-file was inserted according to the estimated

length. The working length was then confirmed using an electronic apex locator, revealing a length of 21 mm for tooth 11. After determining the initial apical file, root canal preparation was carried out using the step-back technique. The canal was medicated with a calcium hydroxide dressing.



(A)



(B)

Figure 1. A. measurement of working length 11. B. radiograph after dressing

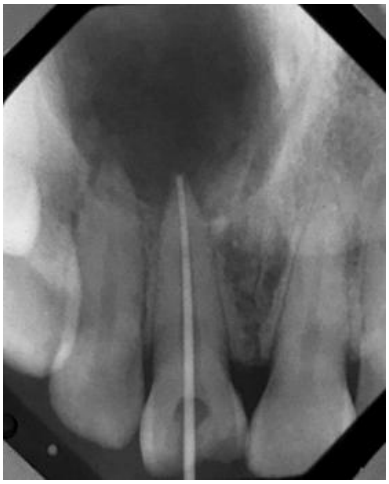


Figure 2. gutta percha trial

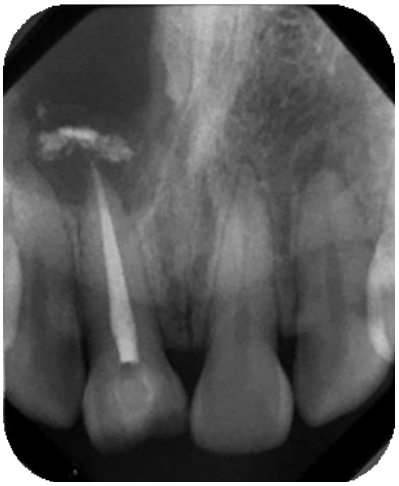
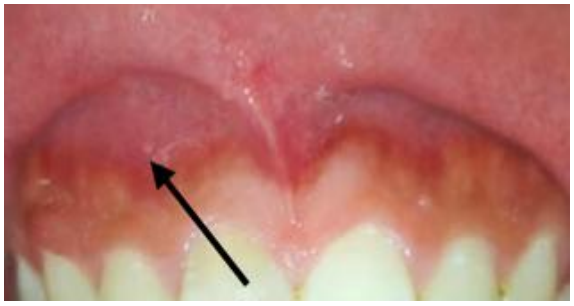
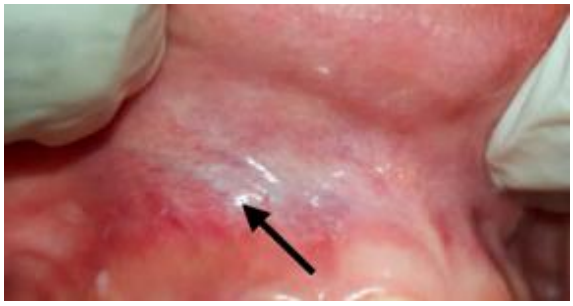


Figure 3. Radiograph of tooth 11 after obturation



(A)



(B)

Figure 4. Clinical Intraoral shows there is swelling around the vestibule of tooth 11

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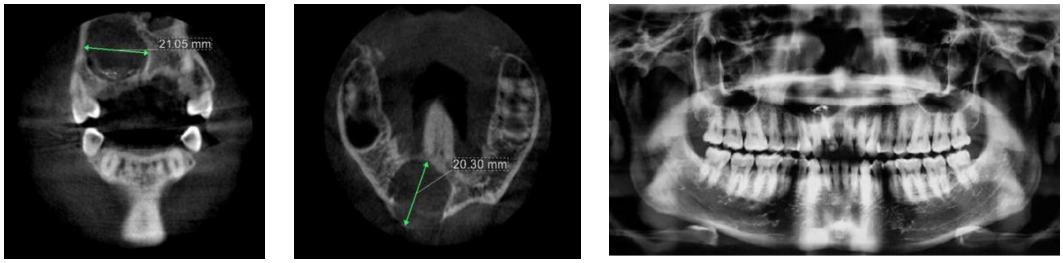
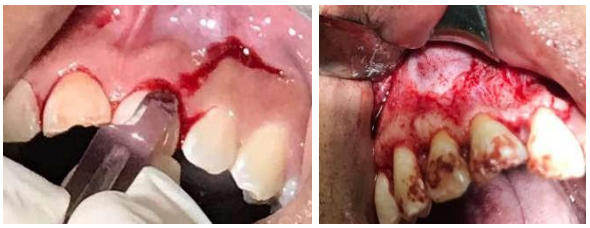


(A) (B) (C)

Figure 5. (A) CBCT from axial, (B) CBCT from sagittal, (C) radiograph panoramic

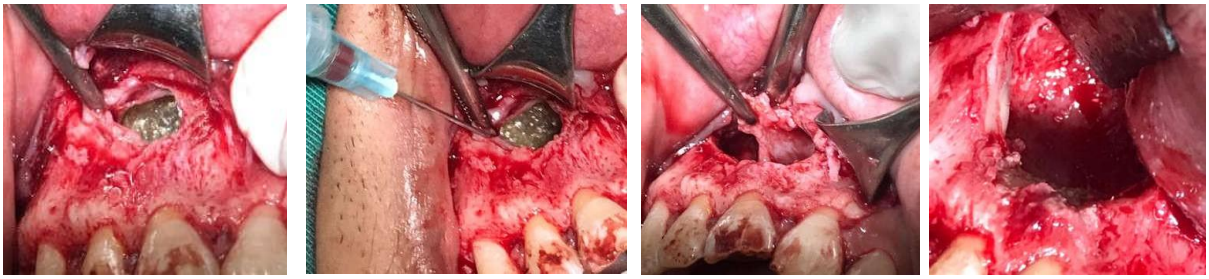
(A) (B)

Figure 6. (A) Infraorbital anesthesia. (B) Anesthetic infiltration in the palatal area



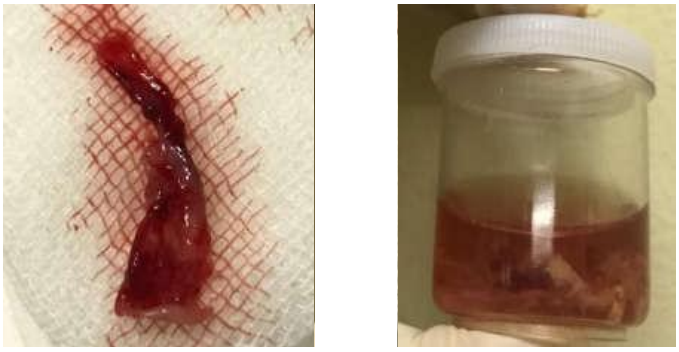
(A) (B)

Figure 7. (A) Incision and flap using blade #15. (B) Flap opened with raspatorium



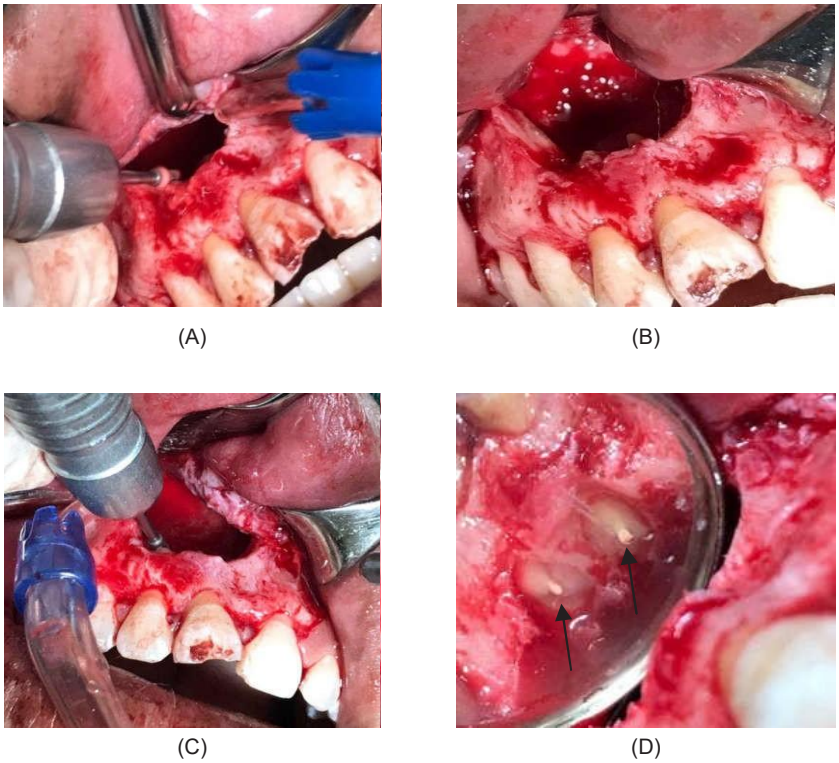
(A) (B) (C) (D)

Figure 8. (A) The cyst cavity has been opened, B) Yellowish cyst fluid is visible, (C) Removal of the cyst capsule, (D) The cyst capsule has been removed as indicated by the visible bone base



(A) (B)

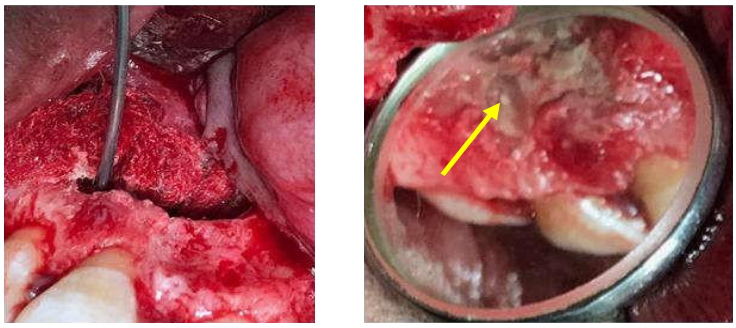
Figure 9. (A) Cyst capsule, (B) Stored in 10% formalin solution



(A) (B)

(C) (D)

Figure 10. (A) Sharp bone edges are smoothed with a bone bur and bone file; (B) Apicoectomy of teeth 11 and 12; (C) Apices of teeth 11 and 12 resected by 3 mm; (D) Gutta-percha obturation material visible at the cut apex (black arrow)



(A) (B)

Figure 11. (A) MTA placement into the cavity using a Micro Apical Placement (MAP) system; B. Retrograde MTA fill visible at the apex (yellow arrow)

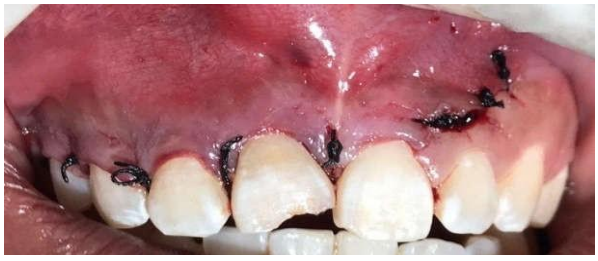


Figure 12. Interrupted suturing

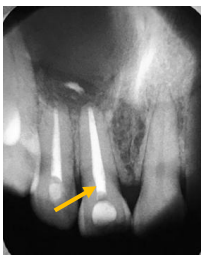


Figure 13. Periapical radiograph of tooth 11

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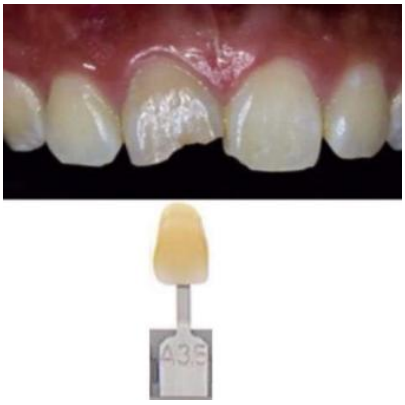


Figure 14. Initial tooth shade of tooth 11 recorded as A3.5 using the Vitapan Classical guide

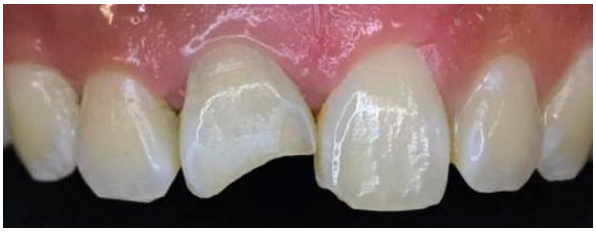
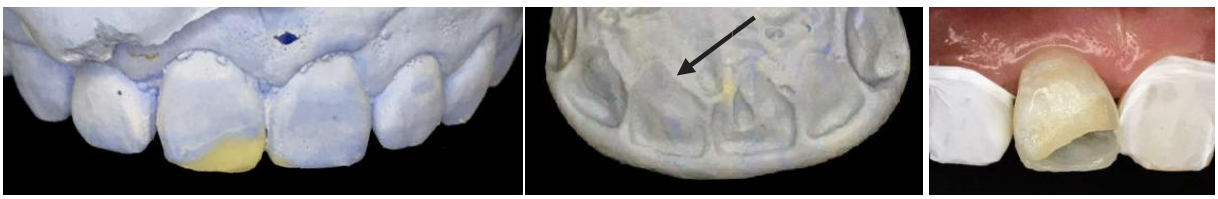


Figure 15. Class IV cavity preparation in tooth 11

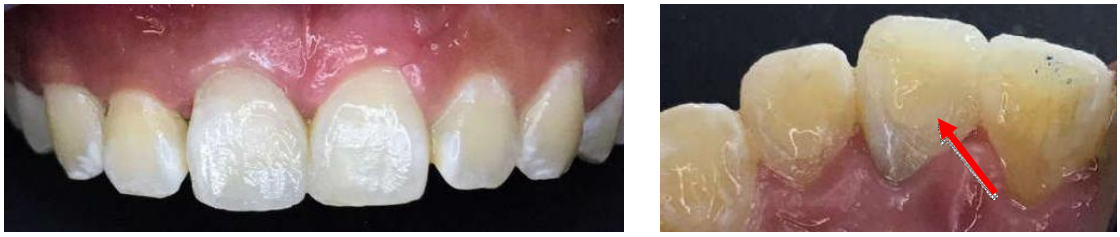
At the second visit, obturation was initiated by fitting a #50 gutta-percha master apical cone (MAC) to a length of 21 mm, followed by a trial radiograph. Irrigation was performed using 2.5% NaOCl, 17% EDTA, and 2% chlorhexidine digluconate as the final rinse, then the canal was dried with paper points. The gutta-percha was inserted to the working length, confirming adequate "tug-back." Prior to use, the gutta-percha was disinfected by immersion in 2% chlorhexidine digluconate for one minute and then dried. The sealer was introduced into the canal using a lentulo spiral, which was rotated slowly in a coronal direction. Lateral condensation obturation was performed. The MAC gutta-percha was compacted with the largest hand spreader that could reach within 2 mm of the working length. Additional gutta-percha points were added based on the hand spreader size and color. Condensation and filling continued until the canal could not accommodate further material. The gutta-percha was trimmed to 2 mm below the canal orifice. Coronal sealing was done using glass ionomer cement, followed by a temporary restoration.

At the third visit, the patient received a detailed explanation regarding the planned surgical procedure, which included cyst enucleation, apicoectomy, and retrograde filling. The patient consented to the treatment and signed the



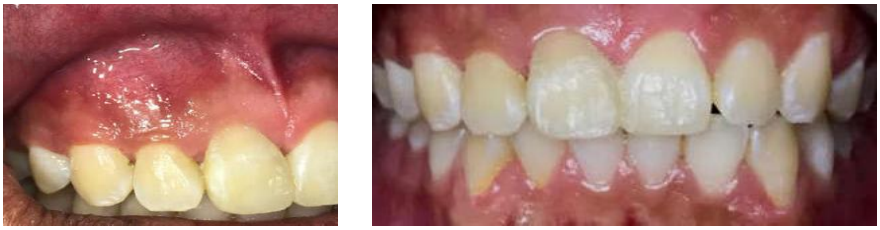
(A) (B) (C)

Figure 16. (A) Mock up of tooth 11, (B) Palatal guide for restoration of tooth 11 (black arrow), (C) Restoration of the palatal part of tooth 11



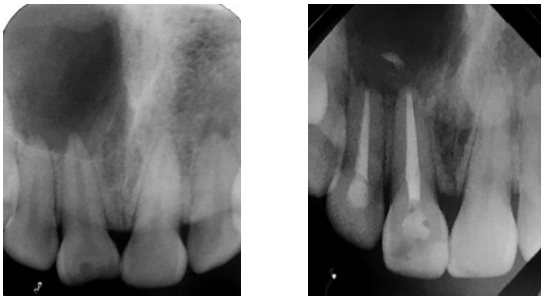
(A) (B)

Figure 17. (A) Results of class IV cavity restoration tooth 11 from labial part, (B) palatal part (red arrow).



(A) (B)

Figure 18. 1.5 months after surgery, the restoration of tooth 11 is good, there is no discoloration on the labial side



(A) (B)

Figure 19. (A) Preoperative periapical radiograph; (B) Periapical radiograph after 1.5 month

informed consent form. Vital signs, including blood pressure, pulse, temperature, and respiration, were recorded and found to be within normal limits. The patient appeared in good general health.

All surgical personnel wore sterile gowns, gloves, and masks. The operative field was draped, and the area was disinfected using 10% povidone-iodine solution. Aseptic technique was maintained throughout. Local anesthesia was administered via supraperiosteal infiltration targeting the infraorbital nerve. The injection site was approximately 2 cm inferior to the infraorbital margin, with the needle directed at the apex of the maxillary anterior teeth. An additional palatal injection was made at the incisive foramen.

A full-thickness mucoperiosteal flap was elevated following a triangular incision starting from the mesial aspect of tooth 21 (oblique incision) and extending distally to tooth 14. Flap reflection was carried out using a periosteal elevator (raspatorium). Thin overlying bone was carefully removed to expose the cyst without perforating the capsule. The cystic lesion was enucleated using the raspatorium with the instrument tip directed toward the bone. Complete removal was confirmed when the bony base of the cavity was visible and clean.

The excised lesion tissue was preserved in a 10% formalin solution and sent for histopathological examination. The edges of the remaining bone were smoothed using a round bone bur at low speed under continuous saline irrigation. The apices of teeth 11 and 12 were resected approximately 3 mm using a fissure-shaped bur.

A retrograde cavity was prepared at the apical end using a diamond round bur. The surgical site was irrigated with 0.9% sodium chloride (NaCl). Mineral trioxide aggregate (MTA) was prepared on a glass slab by mixing MTA powder and distilled water in a 3:1 ratio until a homogeneous paste was formed. The MTA was loaded into a Micro Apical Placement (MAP) system and delivered into the retrograde cavity, followed by gentle condensation. Any excess MTA extruded into the surrounding tissue was removed. A Denker drain packed with antibiotic-soaked gauze was placed, and hemostasis was achieved. The intraoral flap was repositioned and secured with interrupted sutures.

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Postoperatively, the patient was prescribed oral medications including Amoxicillin 500 mg, Methylprednisolone 8 mg, and Mefenamic Acid 500 mg. The patient was instructed to return two days after surgery for drain removal. Postoperative instructions included avoiding excessive lip movement and speaking on the first day, applying cold compresses to the facial area adjacent to the surgical site, and avoiding brushing over the surgical area (mouthwash may be used instead). A soft diet was recommended for three days. Smoking was prohibited during the healing period, and the patient was advised to take all medications as prescribed and return after one week for suture removal. At the one-week follow-up, the sutures remained intact, the labial mucosa had healed well, and no signs of inflammation were observed.

In the subsequent treatment phase, intracoronal bleaching was performed. Gutta-percha within the root canal was reduced by 2 mm from the cervical margin using a Peeso reamer. The depth of reduction was confirmed with a periodontal probe. The pulp chamber walls were treated with dentin conditioner for 15 seconds, rinsed with distilled water, and gently air-dried. A cervical barrier was created using resin-modified glass ionomer cement (Fuji II LC, GC) to a thickness of 3 mm above the gutta-percha, followed by light curing for 20 seconds. A periapical radiograph was taken to verify the location and thickness of the barrier. Tooth shade was determined using the Vitapan Classical shade guide, and the initial color of tooth 11 was recorded as A3.5.

For intracoronal bleaching, 35% hydrogen peroxide (Opalescence Endo, Ultradent) was placed in the pulp chamber and pressed against the labial wall. The chamber was then sealed with cotton, followed by temporary restoration using Caviton (GC) and glass ionomer cement (Fuji II, GC). At the following visit, the tooth was permanently restored using a direct composite technique. A palatal silicone guide was used for proper contouring. Packable composite resin in shade A2 was applied with a plastic instrument along the guide to the designated mark, which had been previously created by scoring with a probe before etching and bonding of tooth 11. Final occlusal adjustments were performed using articulating paper to eliminate any premature contacts or sharp areas.

DISCUSSION

The formation of periapical lesions is a defensive mechanism by the body to limit the spread of bacteria, necrotic tissue, and toxins to surrounding structures. Therapeutic options for managing large periapical lesions include non-surgical root canal treatment or endodontic surgery. According to the World Health Organization (WHO), a radicular cyst is an odontogenic cyst of inflammatory origin associated with non-vital teeth.[6] Radicular cysts are typically characterized as fluid-filled cavities arising from epithelial remnants—specifically, the epithelial rests of Malassez—within the periodontal ligament. These cysts commonly develop as a result of inflammation, often following pulp necrosis, which may be caused by trauma.[7]

Radicular cysts can increase in size and lead to significant destruction of the periradicular periodontal tissues and the surrounding jawbone.[8] Although they are often asymptomatic, such lesions are frequently identified during routine radiographic examinations. When cystic lesions become acutely symptomatic, manifesting as swelling, pain, or tooth mobility, surgical intervention, such as apicoectomy, may be warranted. One of the key factors influencing the success of surgical treatment is the selection of an appropriate root-end filling material. In this case, mineral trioxide aggregate (MTA) was used as a retrograde filling material. The choice of an ideal root-end filling material plays a crucial role in the overall outcome of surgical endodontic procedures.[7]

The primary objective of apicoectomy is to promote periapical tissue regeneration and to establish an effective seal between the root canal system and the periradicular tissues. This is achieved by resecting the root apex and sealing the root canal terminus to prevent microbial leakage.[9] Apical resection or apicoectomy is generally performed for two main reasons: the removal of a diseased root apex and to gain access

for retrograde filling. Resection of a necrotic or infected apex facilitates healing of the surrounding tissues. In both scenarios, one of the most critical considerations is the closure of the resected root end. Failure to adequately seal this site may result in persistent infection.[10]

Endodontic surgery may be contraindicated in cases where the proximity to sensitive anatomical structures poses a risk of temporary or permanent damage during the procedure. These structures may include the nasal cavity or maxillary sinuses. Additionally, systemic conditions such as congenital bleeding disorders may preclude surgical intervention. Certain cardiovascular diseases may also contraindicate the use of vasoconstrictors in local anesthetics, significantly impairing hemostasis during surgery.[11]

Recent studies suggest that the success rate of apical surgery is influenced by several factors, including tooth location, the histological or radiological severity of periapical inflammation, the quality of prior root canal treatment, and the presence of preoperative symptoms such as pain or clinical signs of inflammation. Tooth type has been shown to significantly affect surgical outcomes. Anterior teeth demonstrate the highest success rates, followed by premolars and maxillary molars, while mandibular molars show the lowest success rate (71.4%). This discrepancy may be attributed to the more challenging surgical access and reduced visibility in posterior regions, as well as the complex root canal anatomy of mandibular molars.[12]

Two primary surgical approaches for managing cystic lesions are marsupialization (or decompression) and enucleation. The key difference lies in the technique: marsupialization involves creating a large bony window into the cyst, allowing a gradual reduction in size. This method, commonly used for odontogenic cysts, establishes a pouch that connects the oral and cystic cavities, enabling peripheral bone regeneration by relieving the internal hydrostatic pressure.[13]

Mineral trioxide aggregate (MTA) is widely regarded as the gold standard for root-end filling materials. Numerous clinical studies have reported high success rates with MTA.[14] In the present case, MTA was used as the apical filling material. MTA has demonstrated the ability to prevent apical leakage, including leakage by Staphylococcus epidermidis. Furthermore, MTA promotes hard tissue formation and the regeneration of new cementum. The success of bone regeneration following periapical surgery depends on several factors, including primary wound closure, angiogenesis to establish a blood supply, and wound stability.[7] Generally, MTA is favored for its biocompatibility, bioactivity, and its ability to stimulate the differentiation and migration of hard tissue-forming cells. A biological seal is formed on the MTA surface through the development of hydroxyapatite (or carbonated apatite).[15]

Tooth discoloration resulting from pulp necrosis is a common indication for bleaching treatment after apicoectomy. Pulp necrosis can cause discoloration due to the breakdown of pulp tissue, which produces colored by-products that penetrate the dentinal tubules.[16] Intracoronal bleaching, often performed using the walking bleach technique, is a widely accepted method for whitening non-vital teeth. After the bleaching procedure, the material must be removed from the pulp chamber and the area thoroughly rinsed. The mechanism of hydrogen peroxide bleaching involves oxidation. As a low-molecular-weight and highly reactive compound, hydrogen peroxide diffuses through dentin and reacts with organic molecules, breaking down the conjugated double bonds in chromogenic compounds.[17]

CONCLUSION

In this case, the apicoectomy procedure was successful, supported by favorable anatomical conditions of the root and surrounding periodontal structures. A correct diagnosis, an accurate prognosis, and an appropriate treatment plan are critical determinants of a successful surgical outcome.

CONFLICT OF INTEREST

The author(s) declare that they have no conflict of Interests.

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