CASE SERIES

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Endodontic treatment of teeth with periapical lesions: Case series

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In this case series, radiographic images of healing lesions resulting from non-surgical root canal treatments and follow-up of periapical lesions caused by traumatic occlusion, untreated trauma injuries, inadequate root canal treatment, and pulp necrosis with deep caries and internal resorption are presented. The treatment of four cases consisting of mandibular and maxillary incisors, molars, and premolars with a lesion was completed by filling the root canals after opening the access cavity, applying biomechanical preparation, and canal medication with calcium hydroxide. The symptoms of the patients were evaluated with control examinations; lesion healing was followed by periapical radiographs taken from the patients. As a result of clinical and radiographic evaluations, it was observed that the lesions were greatly reduced, and bone formation occurred. Periapical lesions can be healed by performing conservative root canal treatment in line with correct procedures, even without surgical procedures.

Keywords: Calcium hydroxide; periapical lesion; root canal treatment; trauma.

Introduction

Periapical lesions occur as a result of the progression of apical periodontitis, which may result from the apical reaching of microorganisms and their products in the pulp infected by the presence of deep caries, irritant agents, host defense system reactions, acute, and chronic trauma (1). Acute trauma may be the cause of periapical lesions, usually encountered in anterior teeth in young patients. Traumatic occlusion, on the other hand, is the etiology of pulp necrosis and inflammation in the periapical tissues, which occurs as a result of continuous and invariable force. Such long-term irritations cause periapical lesions and cysts in the apical region. If left untreated, necrotic and infected pulp causes inflammatory lesions in the periapical tissues to grow over time and cause structural changes in the bone (2). Periapical lesions can also be seen after root canal treatment is completed with insufficient irrigation and incomplete filling. In studies on root canal-treated teeth, the rate of apical periodontitis was shown to be between 16-61% (3). The treatment prognosis of periapical lesions is correlated with the success of root canal treatment and evaluated with radiographic controls. The same size of the lesion or its reduction in size on the radiographs taken suggests that the treatment was successful. Periapical lesions have been classified in many ways according to their clinical, histopathological, and radiographic features (4). Ørstavik developed a scoring system called the Periapical Index Scoring System (PAI) that provides

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Table 1. Periapical Index Scoring System

Periapical Index Scoring (PAI)	Features
Score 1	A normal periapical structure
Score 2	Small changes in bone structure
Score 3	Changes in bone structure with some mineral loss
Score 4	Periodontitis with well-defined radiolucent areas
Score 5	Severe apical periodontitis with exacerbating features

the main resource for epidemiological studies. Today, the (PAI), with a scale of 1 to 5, is used in the evaluation of endodontic treatment results on radiographs (5) (Table 1). In many studies, the (PAI) was used when evaluating apical periodontitis (6). In the treatment of periapical lesions, non-surgical root canal treatment, apical surgery, and extraction can be used (7). During non-surgical root canal treatment of periapical lesions, various irrigation solutions, intracanal medicaments, and temporary filling materials are used between sessions. Calcium hydroxide ($Ca(OH)_2$), which stimulates hard tissue formation and has antibacterial activity, is generally used as an intracanal medicament in the treatment of infected root canals and periapical lesions (8).

*Informed consent form was obtained from the patients before starting the treatment.

Case 1

A 25-year-old female patient was reported to the Endodontics Department, Faculty of Dentistry, with a pain complaint in the anterior mandibular teeth. The patient had no systemic disease. In the clinical examination, pain was observed in the percussion examination of teeth 31 and 41, but no swelling or fistula was observed in the gingiva. In radiological examination, a prominent radiolucent area was observed in the apical regions of teeth 31 and 41, and the PAI index was 4 (Fig. 1a). As a result of the clinical examination, the patient was diagnosed with chronic apical periodontitis caused by traumatic occlusion. Root canal treatment was initiated in the teeth that tested negative in the vitality test (C-Pulse Pulp Tester Digital Vitalometer, Coxo, China) after obtaining the informed consent form from the patient in the same session. The apical foramen was reached with an electronic apex locator (Propex Pixi, Maillefer, Dentsply Sirona, Ballaigues, Switzerland) when the second yellow bar flashed, and the working length was measured. Chemomechanical preparation was performed by the ProTaper Next X3 (Dentsply Maillefer, Ballaigues, Switzerland) file under copious irrigation of 5 mL 2.5% sodium hypoclorite with a 27 gauge needle, and manual dynamic activation was done. $Ca(OH)_2$ was applied as an intracanal medicament. The cavity was closed with temporary filling material (Cavit, 3M ESPE, Germany). The biting and chewing surfaces of the teeth were ground down to achieve proper balance and alignment. In the second session (two weeks later), the patient's complaints had resolved. Temporary filling material was removed. Chemomechanical preparation was performed again to remove $Ca(OH)_2$ from the canal

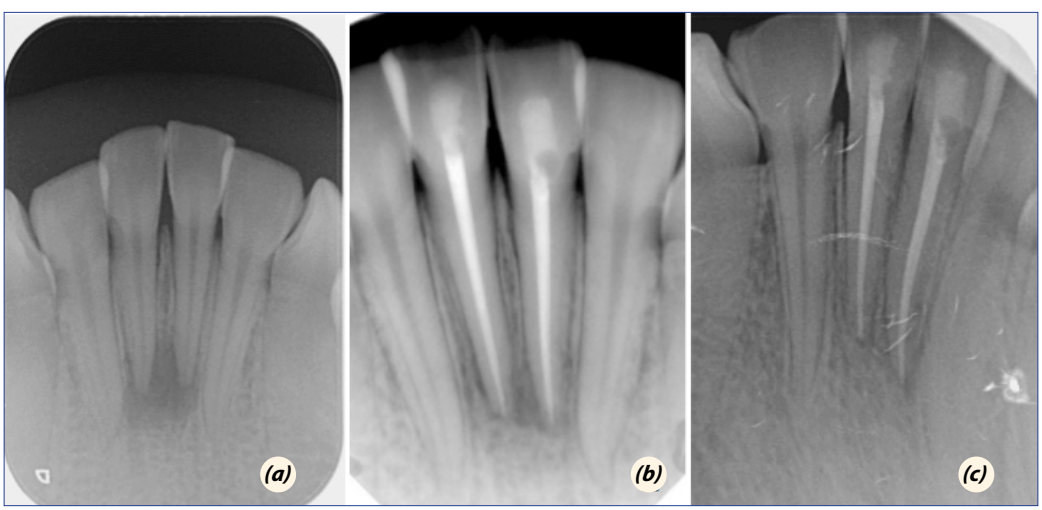

Fig. 1. **(a)** Diagnostic periapical radiograph taken on radiographic examination- **(b)** Periapical radiograph after 6 months- **(c)** Periapical radiograph after 1 year.

walls. The final irrigation procedure was performed with 5 mL 2.5% NaOCl, 17% ethylenediaminetetraacetic acid (EDTA) (Endo-Solution; PPH Cerkamed), 5 mL 2.5% NaOCl, distilled water, 2% chlorhexidine (CHX) (Calasept, Nordiska) respectively, and canals dried with paper points. Root canal treatment was completed with the single cone technique (X3 gutta-percha) and root canal sealer (Dia-Proseal, epoxy resin sealer, Diadent, Burnaby, Canada). The access cavity was restored with resin composite (Palfique Estelite Paste, Tokuyama, Tokyo, Japan). Control radiographs taken at regular intervals showed that the lesion was healing. At 6-month (Fig. 1b) and 1-year follow-up radiographs, it was determined that the PAI index decreased to 2 (Fig. 1c).

Case 2

A 32-year-old female patient was reported to the Endodontics Department, Faculty of Dentistry, with complaints of a fistula and discoloration in the right first anterior maxillary tooth. The patient had no systemic disease. In her dental history, it was noted that she had experienced trauma at the age of 9 years. In her clinical examination, discoloration, swelling, and a fistula were observed in tooth number 11, but no pain was observed on percussion. In the radiological examination, severe bone loss, a prominent radiolucent area, and apical incomplete closure of tooth 11 were observed. The PAI index was evaluated as 5. The consent form was obtained from the patient. Root canal treatment was started in the same session for tooth 11 (Fig. 2a). The apical foramen was reached with an electronic apex locator (Propex Pixi, Maillefer, Dentsply Sirona, Ballaigues, Switzerland) when the second yellow bar flashed, and the working length was measured. Due to intracanal drainage, irrigation was performed with distilled water, and an appointment was made again 2 days later. Intracanal drainage continued for 6 sessions. After the drainage stopped, the canal was irrigated with 5 mL 2.5% NaOCl with a 27 gauge needle and prepared with the step back technique up to 70# K file (MAF= 50). Manual dynamic activation was done. $Ca(OH)_2$ treatment was applied as a medicament to provide apexification. The cavity was closed with temporary filling material (Cavit, 3M ESPE, Germany). A new appointment was scheduled, but the patient did not attend her appointment for 10 months. When the patient returned to the clinic 10 months later, it was seen that the apexification was completed and the lesion had healed on the radiograph (Fig. 2b). The patient's complaints had resolved. Temporary filling material was removed. Chemomechanical preparation was performed again to remove $Ca(OH)_2$ from the canal walls. The final irrigation procedure was performed with 5 mL 2.5% NaOCl, 17% (EDTA) (Endo-Solution; PPH Cerkamed, Wojciech Pawlowski), 5 mL 2.5% NaOCl, distilled water, and 2% (CHX) (Calasept, Nordiska Dental, Ängelholm, Sweden) respectively, and canals dried with paper points. Root canal treatment was completed with the lateral condensation technique and root canal sealer (Dia-Proseal, epoxy resin sealer, Diadent, Burnaby, Canada). The access cavity was restored with resin composite (Palfique Estelite Paste, Tokuyama, Tokyo, Japan). At the 1-year follow-up radiograph, it was determined that the PAI index had decreased to 1 (Fig. 2c).

Case 3

A 35-year-old female patient was reported to the Endodontics Department, Faculty of Dentistry, with a severe

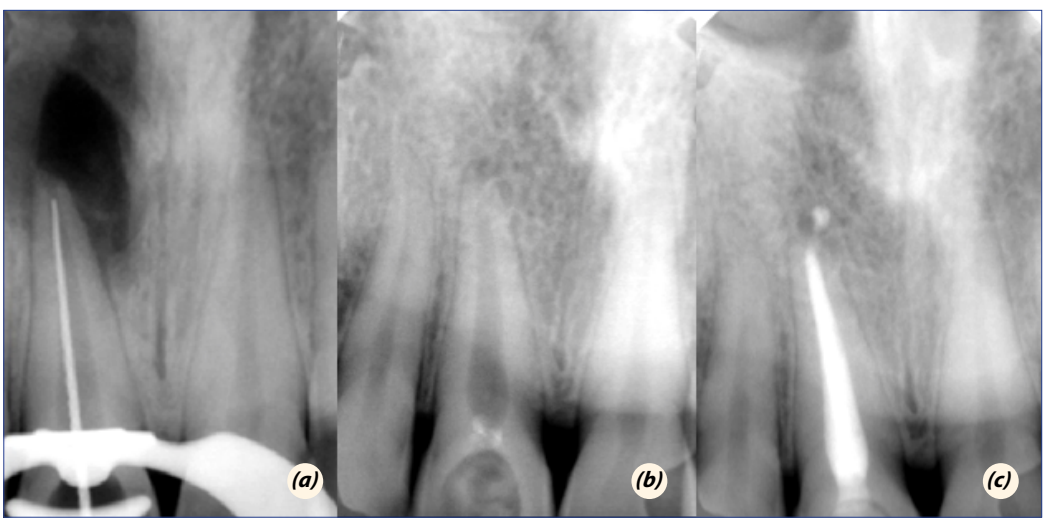

Fig. 2. **(a)** Working length determination radiography - **(b)** Radiograph with temporary filling after 10 months **(c)** 1-year follow-up radiograph.

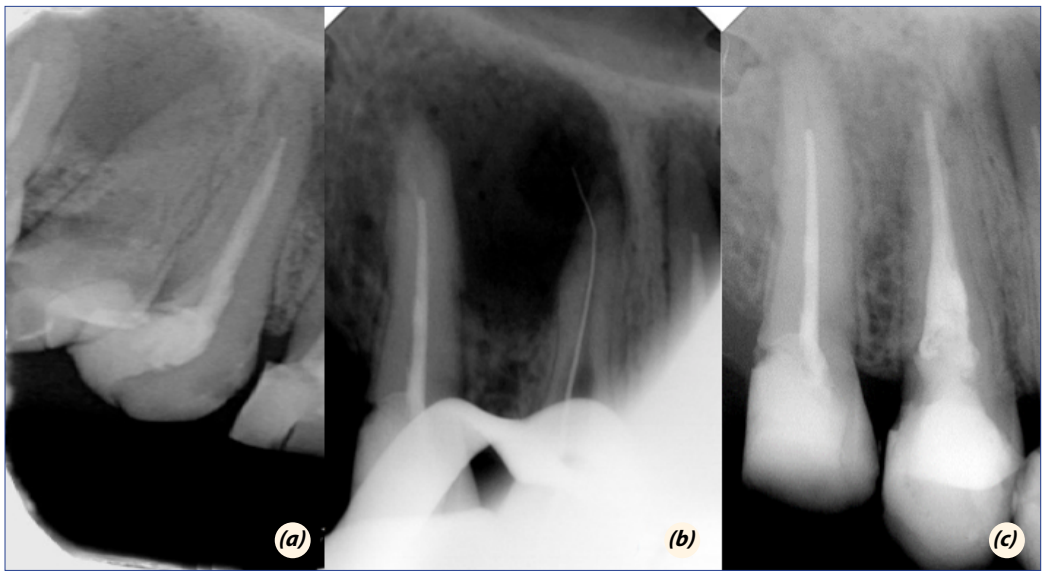

Fig. 3. **(a)** Diagnostic periapical radiograph taken on radiographic examination– **(b)** Working length determination radiography - **(c)** 6 month follow-up radiograph.

pain complaint in the right first maxillary premolar tooth. The patient had no systemic disease. In the clinical examination, secondary caries, palatal swelling, pain on percussion, and palpation were observed in tooth 14. Radiological examination revealed a prominent radiolucent area and internal resorption (Fig. 3a). The PAI index was 5. After obtaining an informed consent form from the patient, root canal treatment was started in the first session, and abscess drainage was provided (Fig. 3b). The apical foramen was reached with an electronic apex locator (Propex Pixi, Maillefer, Dentsply Sirona, Ballaigues, Switzerland) when the second yellow bar flashed, and the working length was measured. Due to intracanal drainage, irrigation was performed with distilled water, and an appointment was made again 2 days later. Intracanal drainage continued for 5 sessions. After the drainage stopped, the canal was irrigated with 5 mL 2.5% NaOCl, manual dynamic activation was done, and it was prepared with the step back technique up to 60# K file (MAF= 45). $Ca(OH)_2$ was applied as an intracanal medicament. The cavity was closed with temporary filling material (Cavit, 3M ESPE, Germany). One month later, during her second session, the final irrigation procedure was performed with 5 mL 2.5% NaOCl, 17% ethylenediaminetetraacetic acid (EDTA) (Endo-Solution; PPH Cerkamed, Wojciech Pawlowski), 5 mL 2.5% NaOCl, distilled water, and 2% chlorhexidine (CHX) (Calasept, Nordiska Dental, Ängelholm, Sweden) respectively, and canals dried with paper points. Root canal treatment was completed with the hybrid technique (lateral condensation technique and thermoplastic injection technique) and root canal sealer (MTA Fillapex; Angelus, Londrina, Paraná) due to internal resorption. The access cavity was restored with resin composite (Palfique Estelite Paste, Tokuyama, Tokyo, Japan). Control radiographs taken 6 months later showed that the lesion had largely healed. It was determined that the PAI index decreased to 2 (Fig. 3c).

Case 4

A 17-year-old female patient was reported to the Endodontics Department, Faculty of Dentistry, with severe pain complaints in the left first maxillary molar tooth. The patient had no systemic disease. Root canal treatment was applied to tooth 36 with the diagnosis of primary acute apical periodontitis 2 years ago, but it was determined that the patient had complaints of pain again. While no swelling and fistula were observed in the clinical examination, it was noted that there was pain on percussion and chewing. Radiological examination revealed a prominent radiolucent area at the apex, and the PAI index was 5 (Fig. 4a). Retreatment was planned for the patient. The informed consent form was obtained. After the removal of the previous root canal filling with ProTaper Universal retreatment files D1-D3 (Dentsply Maillefer, Ballaigues, Switzerland), the apical foramen was reached with an electronic apex locator (Propex Pixi, Maillefer, Dentsply Sirona, Ballaigues, Switzerland) when the second yellow bar flashed, and the working length was measured. Chemomechanical preparation was performed by the ProTaper Next X3, and X4 (Dentsply Maillefer, Ballaigues, Switzerland) file under copious irrigation of 5 mL 2.5% NaOCl with a 27 gauge needle, and manual dynamic activation was done. Intraca-

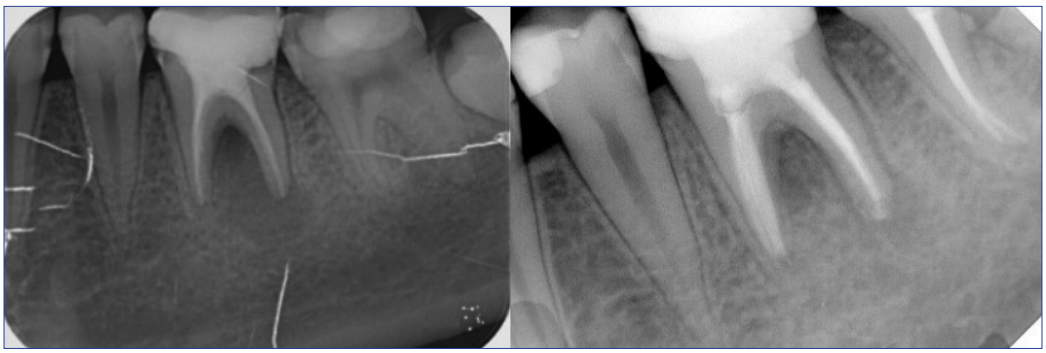

Fig. 4. **(a)** Diagnostic periapical radiograph taken on radiographic examination– **(b)** 6 month follow-up radiograph.

nal medicament $Ca(OH)_2$ treatment was applied, and the cavity was closed with temporary filling material (Cavit, 3M ESPE, Germany) for 3 weeks. In the second session, the patient's complaints had resolved. Temporary filling material was removed. Chemomechanical preparation was performed again to remove $Ca(OH)_2$ from the canal walls. The final irrigation procedure was performed with 5 mL 2.5% NaOCl, 17% EDTA (Endo-Solution; PPH Cerkamed), 5 mL 2.5% NaOCl, distilled water and 2% CHX (Calasept, Nordiska) respectively, and the canals dried with a paper point. Root canal treatment was completed with the single cone technique (X3, X4 gutta-percha) and root canal sealer (Dia-Proseal, epoxy resin sealer, Diadent, Burnaby, Canada). The access cavity was restored with resin composite (Palfique Estelite Paste, Tokuyama, Tokyo, Japan). In the control radiograph taken 6 months later, the lesion was largely healed, and the PAI index decreased to 2 (Fig. 4b).

Discussion

Periapical lesions occur following the inflammation in the defense system of the periapical tissues, caused by intracanal infection after apical periodontitis, trauma, and inadequate root canal treatment. In the treatment of teeth with periapical lesions, surgical methods such as apical resection, as well as root canal treatment and non-surgical methods, are applied. In recent years, conservative treatment options have come before surgical interventions in the treatment procedures of teeth with periapical lesions (9). In the non-surgical treatment of periapical lesions, it is stated that such lesions are healed by eliminating the existing infection in the root canals (10). Nair et al. (11) showed that the size of periapical lesions decreased by up to 90% in the radiographic evaluation after root canal treatment. In some case reports, it has been stated that full recovery can be achieved in the treatment of large periapical lesions with root canal treatments performed using antibiotics, $Ca(OH)_2$ medication, and decompression (12). Sjögren et al. (13) stated that there was no significant difference in healing between lesions larger than 5 mm (87%) and smaller (83%).

Drainage, aspiration, and irrigation are very important in the conservative treatment of large periapical lesions. It has been reported that symptoms decrease when direct and immediate drainage is provided in localized swellings or abscesses (14). After intracanal abscess drainage stops, effective irrigation is required to destroy microorganisms. To ensure optimum disinfection, studies recommend washing the root canals with EDTA and NaOCl and then using CHX, a bisguanide agent with a wide antimicrobial spectrum that is effective against anaerobics. Although various irrigation activation techniques have been recommended in many studies and case series, activation was performed within clinical possibilities in this case series (15, 16). In addition, $Ca(OH)_2$ is a frequently used intracanal medicament in non-surgical root canal treatment procedures. In most case reports, it has been stated that the application of $Ca(OH)_2$ as an $Ca(OH)_2$ intracanal medicament after adequate preparation and irrigation effectively destroys bacteria, accelerates healing, and ensures the disappearance of lesions. Many studies have reported that $Ca(OH)_2$ acts in inducing mineralization in destroyed tissues and activation of alkaline phosphatase (17). It is also preferred in treatments of internal resorption to maintain antibacterial effectiveness and disinfect inaccessible areas (18). In the case series we prepared, $Ca(OH)_2$ was preferred as a medicament.

After medication treatment; in this case series, as recommended in the literature, single cone technique was preferred for filling narrow canals, cold lateral condensation technique for wide canals, and a hybrid technique consisting of lateral condensation and thermoplastic injection techniques for canals with internal resorption. As for the root canal sealer, epoxy resin-based root canal sealer was chosen in cases other than resorption, while MTA Fillapex (Angelus, Londrina, Paraná), which has an mineral trioxide aggregate formulation as it has good marginal adaptation and sealing properties (19-21).

The success of endodontic treatment is evaluated depending on the asymptomatic teeth and mucosa in the post-treatment clinical examination, the healing of the periapical lesion with the formation of a trabecular structure, increasing density, and the functional use of the tooth. In many case series, periapical healing is determined by evaluating changes in the PAI index, which is determined to provide standardization (22-24). While PAI can be evaluated with periapical radiographs, it can also be preferred to be evaluated with cone beam computed tomography (CBCT) since it gives clearer results compared to periapical radiographs (25). However, concerns still remain regarding the use of CBCT due to its disadvantages such as high cost and radiation exposure (26). In the prepared case series, healing of periapical lesions was indicated by observing the formation of bone trabeculae and shrinkage of radiolucent areas in periapical radiographs, taking into account PAI values (Table 1) as applied in other studies (27,28).

In this case series, periapical radiographs were examined by evaluating PAI. Diagnosis, treatment planning, and postoperative follow-up of the patients were provided. In the follow-up appointments after the treatment, it was observed that the symptoms of the patients disappeared and the lesions healed and started to heal according to the cases. It is thought that all protocols applied at every stage of treatment contribute to the healing of periapical lesions.

Conclusion

In periapical lesion healing, the protocols applied at each stage of the treatment are of particular importance. The treatment of four cases consisting of mandibular and maxillary incisors, molars, and premolars with a lesion was achieved by opening the correct access cavity, drainage, chemomechanical preparation, irrigation activation, intracanal medicament with Ca(OH)2, and filling the root canals with canal sealer and gutta-percha. After all these procedures, it was observed that the periapical lesions healed.

Therefore, it should not be forgotten that non-surgical root canal treatment is a viable treatment choice in the treatment of teeth with periapical lesions.

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