CASE REPORT

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Endodontic Management of a Periapical Lesion Induced by an Orthodontic Mini-Screw: A Case Report

Ortodontik Mini Vida Tedavisi Sebebiyle Gelişen Periapikal Lezyon: Vaka Sunumu

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ABSTRACT

Introduction: Orthodontic mini-screws are commonly used materials in orthodontic treatment because they can provide stable anchorage. Nevertheless, if placed close to the root apex, they can cause complications including pulpal injury, perforation, root resorption, and periapical irritation.

Case Report: This case study presents the non-surgical endodontic treatment of a periapical lesion that developed as a result of mini-screw placement near the root apex of a mandibular right canine during orthodontic therapy. Thorough anamnesis, clinical, and radiological examinations revealed a sinus tract and a radiolucent area in the periapical region. A routine root canal treatment was planned after all treatment modalities were explained to the patient. The sinus tract healed during follow-up, and complete radiographic healing of the lesion was apparent at 48 months.

Conclusion: This case report demonstrates that mini-screws placed near the root apex during orthodontic treatment can cause complications, but these issues can be resolved effectively with conservative endodontic techniques.

Keywords: *Root canal therapy, Orthodontic anchorage procedure, Orthodontic tooth movement, Periapical disease,*

ÖZET

Giriş: Ortodontik mini vidalar, stabil ankraj sağlayabilmeleri nedeniyle ortodontik tedavilerde yaygın olarak kullanılan materyallerdir. Bununla birlikte, kök apeksine yakın yerleştirildiklerinde pulpal hasar, perforasyon, kök rezorpsiyonu ve periapikal irritasyon gibi komplikasyonlara neden olabilirler.

Olgu Sunumu: Bu olgu sunumu, ortodontik tedavi sırasında mandibular sağ kanin dişin kök apeksine yakın yerleştirilen mini vida sonucu gelişen periapikal lezyonun cerrahi olmayan endodontik tedavisini sunmaktadır. Ayrıntılı anamnez, klinik ve radyolojik muayenede periapikal bölgede bir sinüs traktı ve radyolusent bir alan saptanmıştır. Tüm tedavi seçenekleri hastaya açıklandıktan sonra rutin bir kök kanal tedavisi planlanmıştır. Takip sürecinde sinüs traktı iyileşmiş ve lezyonun radyografik iyileşmesi 48. ayda tamamen belirgin hale gelmiştir.

Sonuç: Bu olgu sunumu, ortodontik tedavi sırasında kök apeksine yakın yerleştirilen mini vidaların komplikasyonlara yol açabileceğini, ancak bu problemlerin konservatif endodontik tekniklerle etkili bir şekilde çözülebileceğini göstermektedir.

Anahtar Kelimeler: *Kök Kanal Tedavisi,Ortodontik ankraj teknikleri, Ortodontik diş hareketi, Periapikal hastalık,*

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Introduction

Selecting optimal anchorage techniques is crucial for the success of orthodontic treatments. Due to the limitations of conventional methods, such as fixed appliances, orthodontic mini-screws—which are widely recognized for their ability to provide stable anchorage—have become increasingly common in modern orthodontics.[1,2] Because these screws are relatively simple to insert, do not require invasive surgery, and can be removed when required, they are especially preferred in interradicular cortical bone regions. However, anatomical and clinical factors, such as screw length, patient age, oral hygiene status, insertion angle, and—most importantly—the distance from the dental roots, all affect their success rate.[1,3]

The root surfaces may sustain mechanical trauma when mini-screws are positioned excessively close to the root structure. Inflammatory reactions triggered by this trauma may ultimately lead to complications such as pulp necrosis, external root resorption, root perforation, and periapical inflammation.[4,5] Younger patients are particularly susceptible to faster progression of root resorption due to their active bone remodeling processes. The literature reports that after an observation period of approximately three to six months, iatrogenic root damage caused by orthodontic mini-screws has occasionally been observed to heal spontaneously without the need for any intervention.[6,7] However, endodontic or surgical intervention may be required for the affected tooth if symptoms persist during the follow-up period or if no signs of radiographic healing are observed.[4,8,9] One of the more technically advanced imaging methods, cone-beam computed tomography (CBCT), offers useful diagnostic data for the early identification of such issues,[8] however, these complications typically only become noticeable after the emergence of clinical symptoms like sinus tract formation, pain, or radiolucency.[10]

Non-surgical root canal treatment protocols remain the primary option for managing periapical lesions from an endodontic approach. In this situation, calcium hydroxide's [$Ca(OH)_2$] high pH (~12.5) effectively eradicates anaerobic bacteria and encourages the formation of hard tissue in apical tissues, which prevents the resorption process from progressing.[11,12] Furthermore, it has been proven to suppress any remaining microorganisms within the root canal system and stimulate the healing of the surrounding periapical tissues when used as an interappointment medicament.[13,14]

This case report presents the non-surgical endodontic management of a chronic periapical lesion associated with the placement of an orthodontic mini-screw in close proximity to the root apex of a mandibular right canine during orthodontic treatment. Clinically, a sinus tract and a well-defined periapical radiolucency were noted. Differential diagnoses such as periodontal lesions and vertical root fractures were ruled out based on clinical examinations and radiographic findings, leading to a final diagnosis of chronic apical periodontitis. Given the lesion's size, the severity of clinical symptoms, and the extent of infection; a conservative approach involving non-surgical root canal treatment was deemed the most appropriate course of action.

Case Report

An 18-year-old systemically healthy male patient presented to Department of Endodontics, Faculty of Dentistry, Başkent University, in 2021. His complaint was a sinus tract in the right mandibular canine's buccal mucosa (Figure 1). Patient's dental history revealed that his fixed orthodontic treatment was completed in 2020, which performed with orthodontic mini-screws in the area of the mandibular canines (Figure 2).

Figure 1. Intraoral sinus tract

During clinical examination, a sinus tract was observed on the vestibular mucosa in the right mandibular canine area. The tooth exhibited no coronal restoration. The tooth revealed no signs of pain to percussion or palpation. Pulp vitality assessments, including both cold (Endo-Frost, Roeko, Langenau, Germany) and electric pulp tests (Parkell Inc, Edgewood, NY), showed negative responses. Periodontal examination of the affected canine and adjacent teeth revealed normal findings, including physiological probing depths, with no signs of mobility or attachment loss.

A panoramic radiograph obtained during orthodontic treatment and the initial periapical radiograph at presentation showed that the orthodontic mini-screws had been placed in close proximity to the root apex of the right mandibular canine (Figure 2).

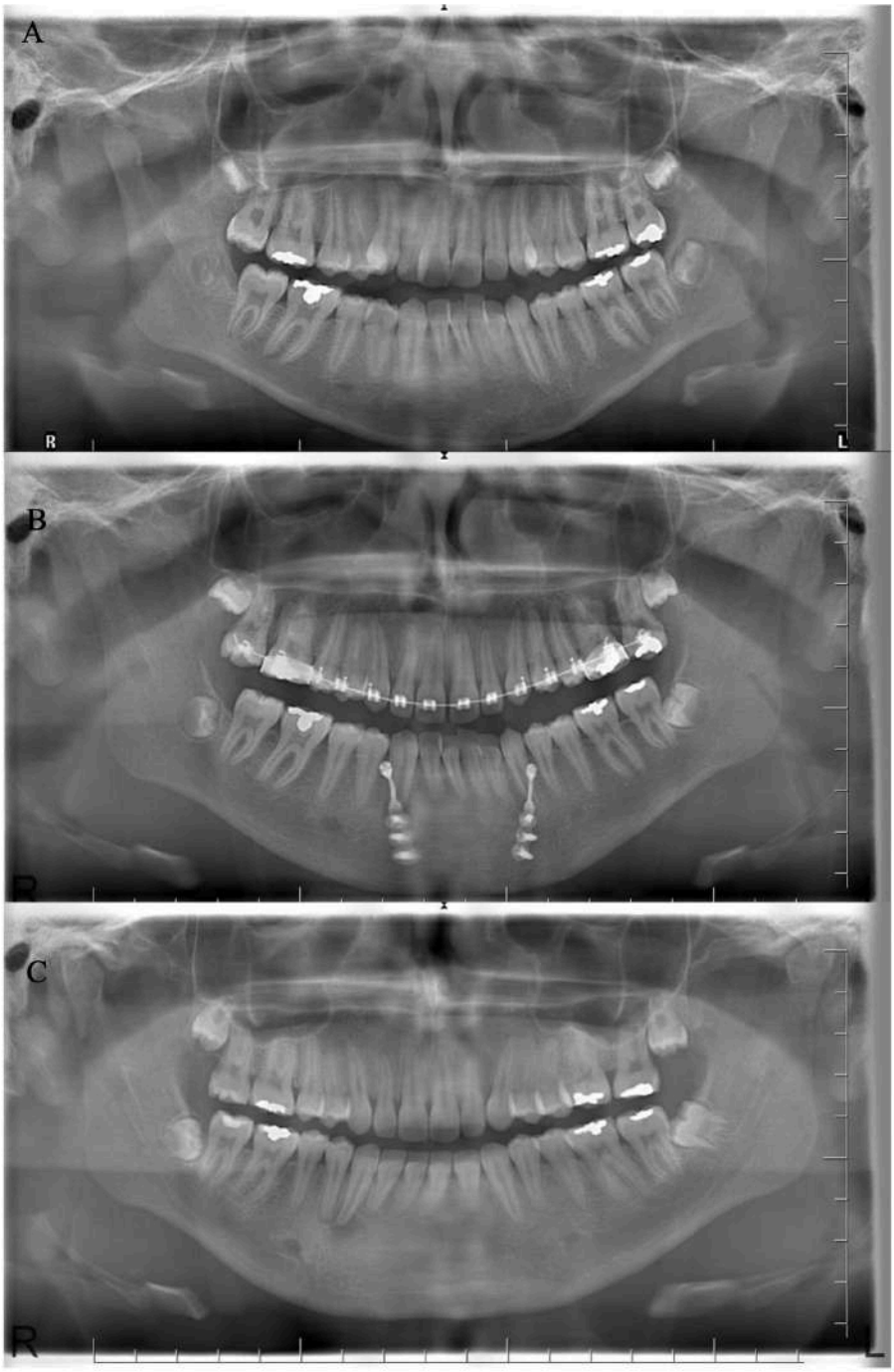

Figure 2. Panoramic Radiographs A. Initial (02/2016) B. During orthodontic treatment (06/2018) C. After orthodontic treatment (12/2020)

On the initial periapical radiograph, a well-defined periapical radiolucency surrounding the apex was detected (Figure 3). The lesion was assigned a Periapical Index (PAI) score of 4, indicating a well-defined radiolucent area. Additionally, radiopaque lines were observed (Figure 3). The structural integrity of the lamina dura was obviously affected. Clinical and radiographic assessments of the adjacent teeth, supported by pulp sensibility testing and periodontal examination, confirmed that they were vital and not involved in the pathological process. Written informed consent was obtained from the patient for the endodontic treatment and the publication of this case report with an assurance of anonymity.

Figure 3. Post-orthodontic periapical radiograph (03/2021)

A routine root canal treatment was planned for the tooth with necrotic pulp. Following a local anesthetic (articaine HCl with epinephrine 1:100,000), an access cavity was prepared under rubber dam isolation. The working length was determined with an electronic apex locator and then confirmed with periapical radiography (Figure 4). The canal was prepared using the ProTaper Next rotary file system (X1–X3; Dentsply Maillefer, Switzerland) and nickel-titanium hand files (#70).

Figure 4. Working length determination (03/2021)

A syringe was used to irrigate the canal with 2 mL of a 2.5% sodium hypochlorite (NaOCl) solution (Microvem, Istanbul, Turkey) between each file. For the final irrigation, 5 mL of 17% EDTA (Microvem, Istanbul, Turkey) was used for one minute, followed by distilled water. Manual dynamic activation was performed using a well-fitting master gutta-percha cone to enhance the efficacy of the irrigants. $Ca(OH)_2$ (Calsin, Merkez Kimya, Turkey) was placed into the canal as an intracanal medicament to suppress residual microorganisms and prevent the progression of root resorption. Then, the access cavity was sealed with a temporary restorative material (Cavit, Meta Biomed, Cheongju, Korea).

At the two-week follow-up visit, the sinus tract on the vestibular mucosa was reported to have successfully healed; no edema or pain was observed in the affected area. The intracanal medication was removed by irrigating with 5 mL of 2.5% NaOCl and 5 mL of 17% EDTA,

accompanied by manual dynamic activation. The root canal was dried with sterile paper points and was obturated with gutta-percha (70.02) (Sure Dent Corporation, Gyeonggi-do, Korea) and AH Plus sealer (Dentsply Maillefer, Switzerland) via the cold lateral compaction technique (Figure 5).

Figure 5. Root canal obturation (03/2021)

Finally, the tooth was restored with composite resin (Filtek Z250, 3M ESPE, St Paul, MN) (Figure 6). During the patient's regular follow-up appointments, no symptoms were mentioned. At the 48-month follow-up examination of the patient, the tooth was healthy and the periapical radiograph showed healing of the periapical lesion (Figure 7).

Figure 6. A post-operative radiograph (03/2021)

Figure 7. 48 months follow up (03/2025)

A notable radiographic finding in this case was the presence of two thin, ring-like radiopacities adjacent to the root apex. These findings persisted with the same morphology after obturation and throughout the 48-month follow-up period. Neither the radiographic healing process nor the clinical course was impacted by these findings.

Conclusion

The use of mini-screws during orthodontic treatment provides control over tooth movement by providing stable anchorage; nevertheless, proximity to or contact with tooth roots during placement may lead to complications.

Incorrect angulation or placement of mini-screws too close to the root surface could damage the cementum and dentin, leading to various types of root resorption. Brudvik and Rygh[5] state that when cementum surfaces exposed to such damage experience osteoclastic activity, inflammatory root resorption occurs. According to the literature, inflammation damages the pulp tissue and causes internal root resorption which is a progressive process. However, after cementum damage, external inflammatory root resorption appears in the periodontal ligament and typically takes place in the apical or lateral regions of the root.[15,16] This mechanism is frequently observed in cases involving external damage, particularly those caused by orthodontic mini-screws.[17]

Additionally, external surface resorption caused by damage to the cementum and periodontal ligament is typically a temporary, superficial form that resolves spontaneously following trauma.[15] If the inflammation process persists, a progressive variant known as replacement resorption may develop, in which bone tissue gradually replaces the cementum. This reparative process causes ankylosis, since the root structure is replaced by bone.[17,18]

The growth of periapical inflammation, particularly after pulp vitality has been lost, might result in the development of sinus tracts and apical lesions[3,4] In this case, the patient's asymptomatic clinical condition at referral supported the diagnosis of chronic apical periodontitis. One of the report's limitations was the absence of CBCT imaging. Despite this limitation, the proximity of the mini-screw to the root apex was apparent on periapical radiographs. According to standard radiography findings, external inflammatory root resorption was considered as the most likely diagnosis.[8]

The removal of pulp tissue, elimination of bacterial contamination, and complete disinfection of the root canal system provide the primary therapeutic approach for periapical lesions associated with root resorption.[9,19] For this purpose, it has been shown that an irrigation protocol combining 2.5% sodium hypochlorite (NaOCl) with 17% ethylenediaminetetraacetic acid (EDTA) is exceptionally efficient in getting eliminating both organic and inorganic debris.[20] The use of EDTA as a final irrigant has been shown to improve the sealer's adaptation to the dentinal walls by effectively clearing the smear layer.[21]

As an intracanal medication, $Ca(OH)_2$ is regarded for its antibacterial characteristics as well as its ability to promote periapical healing and slow down the resorption process.[22] In this case, the application of $Ca(OH)_2$ at the first visit contributed to the complete closure of the sinus tract and a quick clinical improvement. Similar clinical findings have been reported in other cases, where symptoms such as sinus tract, pain, and tenderness resolved within as little as 1 to 4 weeks. For instance, a 2022 systematic review by Alghamdi and Alkhatib demonstrated a significant reduction in these symptoms following the use of $Ca(OH)_2$ in periapical lesions.[23] Furthermore, another review that was published in 2024 confirmed that intracanal calcium hydroxide is useful for accelerating symptomatic healing, particularly when there are large periapical lesions.[24]

Epoxy resin-based root canal sealers are commonly preferred by endodontists due to their ability to establish an optimal interface with dentin, exhibit low solubility, and effectively prevent apical microleakage.[25,26] Especially, AH Plus Sealer is considered a reliable material for root canal obturation, and is commonly used by many endodontists in clinical practice. Due to its effective apical sealing ability, limiting the penetration of irritants into the periapical area, it is deemed as the gold standard for epoxy resin-based root canal sealers.[20]

AH Plus root canal sealer and gutta-percha cones were used to complete the root canal obturation, and long-term follow-up revealed complete healing of the periapical lesion. Based on its high dimensional stability, strong

dentin adhesion, and low solubility, AH Plus, an epoxy resin-based sealer, is accepted as a consistent material in endodontics. Because of these qualities, it has been regarded as the "gold standard" in many research studies.[27] Additionally, AH Plus promotes the formation of a three-dimensional, hermetic seal by decreasing microleakage, which significantly improves the long-term success of the treatment.[28]

According to all the available data, AH Plus remains an effective root canal sealer in clinical practice due to its long-term dependability and physical durability. However, bioceramic sealers have shown significant advantages, particularly in moist environments, due to their increased biocompatibility and ability to promote the formation of hard tissue.[29,30]

In recent years, bioceramic-based root canal sealers have received a lot of attention due to their remarkable hydrophilic nature, ability to stimulate hard tissue growth, and exceptional biocompatibility.[31] For instance, in retrospective clinical studies, bioceramic (calcium silicate-based) sealers demonstrated a 100% success rate after 11.9 months of follow-up, whereas epoxy resin-based sealers reported a 93.8% success rate under the same conditions.[32] Furthermore, *in vitro* studies demonstrate no statistically significant differences between AH Plus and bioceramic sealers in terms of their apical sealing performance.[29]

A significant feature of this case is the successful non-surgical endodontic treatment of a pathology caused by an orthodontic mini-screw, with demonstrated long-term healing over a 48-month follow-up period. Research studies analyzing the prevalence of mini-screw complications have revealed that when the screw is placed less than 1 mm from the root, the risk of root resorption increases significantly.[2,33] Therefore, before placement, orthodontists must carry out detailed radiographic planning and carefully determine the distance between the mini-screw and nearby tooth roots.[34]

A notable radiographic finding in this case was the presence of two thin, ring-like radiopacities adjacent to the root apex. Orthodontic mini-screws placed close to tooth roots have been associated with tooth-related complications, including iatrogenic root injury and subsequent periradicular pathology.[2,35] These radiopacities may represent metallic micro-fragments related to mini-screw insertion/removal, as mechanical complications (including screw fracture) are reported more frequently in situations of high bone density and root proximity.[35] However, because periapical radiographs depict three-dimensional structures in two dimensions, they may be insufficient to determine the exact nature of radiopaque findings or the full extent of iatrogenic root damage.[36] In the present case, the stability of these radiopacities on serial radiographs, the absence of symptoms, and the favorable radiographic healing suggested that they were clinically inert; therefore, no additional invasive confirmation was pursued.

In conclusion, the overall result of orthodontic therapy is significantly affected by the contact between orthodontic mini-screws and surrounding structures. This case demonstrates how non-surgical endodontic treatment can effectively manage a periapical lesion brought on by the placement of a mini-screw near the root apex. Long-term follow-up increases this approach's effectiveness and endurance. In this case, the thin apical radiopacities remained with consistent morphology throughout the follow-up period; they were asymptomatic and did not affect the healing process, thus no further intervention was necessary. In particular circumstances, a conservative treatment approach combined with an early diagnosis may produce desirable outcomes without surgical intervention.

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Ethical Approval and Informed Consent
For this case report, institutional ethical approval was not required as per the national guidelines for case reports. However, written informed consent was obtained from the patient for the endodontic treatment and the publication of this case report, including any associated images, with an assurance of anonymity.

Conflict of Interest
The authors declare that they have no conflict of interest related to this study.

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Idea/Concept: D.I Design: D.I, C.G.C Control/ Supervision: D.I, C.G.C Literature Review: D.I. Data Collection and/or Processing: D.I Analysis and/or Interpretation: K.G, C.G.C Writing the Article: D.I Critical Review:K.G.

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