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Case Report

Management of Severe External Inflammatory Root Resorption in Replanted Maxillary Incisors Following Delayed Endodontic Intervention: A Case Report

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Abstract

Background and Aim: Avulsion with replantation of permanent teeth carries a high risk of external inflammatory root resorption (EIRR). This case report outlines the management of severe EIRR in replanted maxillary incisors after delayed endodontic care and an extended period of splinting.
Case Presentation: A 16-year-old male presented with a 3-month history of anterior maxillary pain and swelling. Six months earlier, teeth 21 and 22 (FDI) had been avulsed in a road traffic accident, replanted after more than one hour, and stabilized with a flexible splint for six months. Radiographic examination revealed severe EIRR in both teeth and an acute apical abscess at tooth 22. Endodontic treatment was completed over three visits via an intracanal calcium hydroxide (CH) dressing, followed by obturation with a calcium–silicate–based bioceramic (Cold-Ceramic). At the 14-month follow-up, radiographs demonstrated complete periapical healing with replacement resorption. The teeth remained functional and asymptomatic.
Conclusion: When endodontic treatment is initiated late, the staged use of CH may aid in the resolution of apical pathology and help maintain function in replanted teeth with EIRR. Extended splinting may be related to replacement resorption; therefore, stabilization should be flexible and time-limited.
Key Words: Tooth avulsion, Tooth replantation, Root resorption, Endodontics, Calcium hydroxide, Bioceramics

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Introduction

Dental avulsion is the complete displacement of a tooth from its socket and is one of the most severe dental injuries, with marked effects on aesthetics, function, and well-being in children and adolescents (1). Although uncommon, it accounts for 0.5% to 16% of dental traumas. Maxillary central incisors are most often involved, with a peak between 7 and 14 years of age (2). When feasible, replantation is preferred because it restores appearance and function and helps maintain quality of life (3).

Healing after replantation proceeds through distinct pathways. Periodontal ligament (PDL) healing is the desired outcome and supports long-term retention (4). If the PDL becomes necrotic, bone may replace the root structure through a process of replacement resorption. Bacterial contamination of a necrotic canal may initiate external inflammatory root resorption (EIRR), a complication that is more likely after delayed replantation or unsuitable storage of the avulsed tooth (5-8). EIRR occurs in approximately 30% of replanted teeth (9).

The prognosis depends on PDL cell survival, cementoblast integrity, and pulp status (5, 10). Immediate replantation or placement in an appropriate storage medium preserves PDL cells and reduces the risk of ankylosis and resorption (11, 12). Pulp necrosis is common and usually requires prompt endodontic therapy, whereas immature

teeth may revascularize (13, 14). Risk is modified by the root development stage, extra-alveolar time, and timing of care, and delayed endodontic treatment is associated with more severe EIRR (15, 16).

The International Association of Dental Traumatology (IADT) recommends initiating root canal treatment within 7–10 days after replantation to limit inflammatory resorption (17). Calcium hydroxide (CH) is widely used as an intracanal medicament. Its high pH and antimicrobial activity can arrest resorption and support repair (18). Once severe resorption develops, management is difficult, and the prognosis remains guarded, which often necessitates coordinated care and long-term follow-up (1).

This report presents severe EIRR in replanted maxillary incisors managed successfully despite delayed endodontic intervention. The evidence for such outcomes is limited. The aim is to outline key diagnostic findings, a practical treatment sequence, and follow-up strategies for advanced resorptive change.

Materials and Methods

Patient information

A 16-year-old male presented to the Department of Endodontics, AJA Dental School, with a three-month history of pain and swelling in the anterior maxilla. Six months earlier, teeth 21 and 22 had been avulsed in a motor vehicle accident. The extraoral dry time exceeded 60 minutes, and the teeth were stored in gauze before replantation. At the time of injury, tetanus immunization and antibiotic administration were not documented. The avulsed teeth were kept dry for several hours and then replanted and splinted at another clinic. Prereplantation root surface management was not recorded. The patient was healthy and had no relevant family history. He remained symptomatic when he sought care. The medication history from the emergency visit was unavailable, and hospital records could not be retrieved.

Clinical and radiographic findings

Intraoral examination revealed a flexible splint from teeth 13 to 23 that had been in place for six months (Figure 1a). The splint consisted of a 0.7 mm stainless steel wire and composite resin. The splint was removed at the first visit. Both replanted teeth exhibited Grade 2 mobility according to Miller's mobility index. Tooth 21 responded differently to sensibility testing, and tooth 22 was tender to percussion. Palpation caused discomfort at tooth 21 and pain at tooth 22. A buccal sinus tract was present at 22. Thermal and electric pulp tests were negative for both teeth, indicating pulp necrosis. Cold testing was performed with a cold spray, and EPT used Digitest 2 with adjacent teeth as controls.

Periapical radiographs revealed severe EIRR at 21 and 22, with adjacent bone loss (Figure 1b). Apical resorption was advanced at both roots. The sinus tract tracing at tooth 22 was localized to the apex, which was consistent with an acute apical abscess (Figure 1c). Periodontal probing revealed normal sulcular depths at tooth 21 (1–2 mm). At tooth 22, a 14 mm periodontal pocket was detected at the mid-buccal surface, with moderate bleeding on probing.

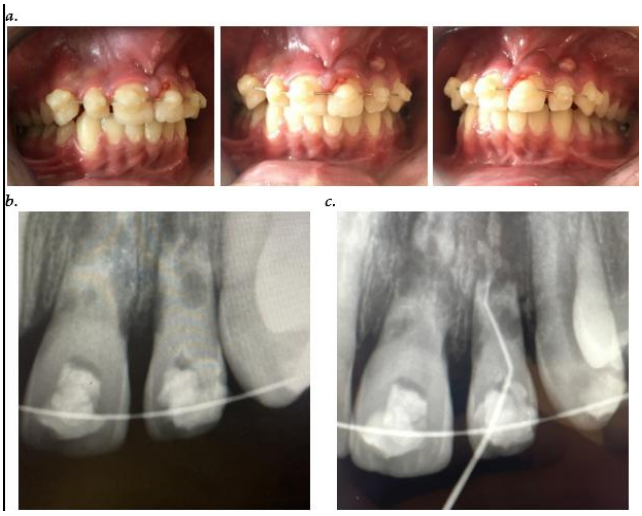

Figure 1. Baseline clinical and radiographic findings. (*a*) Clinical view showing a flexible splint from tooth 13 to tooth 23 that had remained in place for six months. No endodontic treatment had been initiated. (*b*) Preoperative periapical radiographs showing severe EIRR in teeth 21 and 22 with adjacent bone loss. (*c*) Gutta-percha tracing of a deep buccal periodontal pocket at tooth 22.

Diagnostic assessment

External inflammatory root resorption was

diagnosed for teeth 21 and 22. Evidence included radiographic loss of root structure, negative pulp sensibility results, and clinical signs of infection. Both teeth showed pulp necrosis. The periapical diagnosis was chronic apical periodontitis for tooth 21 and an acute apical abscess arising from a chronic lesion for tooth 22. The likely etiology was bacterial contamination, resulting from delayed endodontic treatment and prolonged splinting.

Therapeutic intervention

After discussion of risks and prognosis, written informed consent was obtained. Local anesthesia was administered with 2% lidocaine containing 1:80,000 epinephrine. The teeth were isolated with a rubber dam to maintain asepsis. Access cavities were prepared under sterile saline irrigation. The Working length was established using an electronic apex locator and verified radiographically, measuring 15 mm for tooth 21 and 14 mm for tooth 22 with size 20 K-files (MANI®, Tochigi, Japan) (Figure 2a).

Canal preparation followed a conservative step-back technique with hand files, then rotary nickel–titanium instruments (HAMERZ E_FLEX GOLD). The objective was to preserve remaining dentin in roots compromised by inflammatory resorption and reduce unnecessary removal of dentin, which is linked to lower fracture resistance in endodontically treated teeth (19).

Each canal was irrigated with 20 mL of 1.5% sodium hypochlorite (NaOCl). A moderate NaOCl concentration was selected to balance disinfection with preservation of dentin structure, as higher concentrations can weaken root dentin. A final rinse with 17% EDTA removed the smear layer and enhanced medicament penetration, followed by saline to eliminate residual irrigant (20).

CH paste (Golchadent, Iran) was placed as the intracanal medicament. The access cavities were sealed with 3–4 mm of self-cured glass ionomer cement over a resin-bonded base (GC Fuji, Japan) (Figure 2b). CH was used to increase intracanal pH, inhibit clastic activity, and control infection, supporting arrest of external inflammatory root resorption (21).

At the three-week review, symptoms had lessened, but mild discomfort persisted. The canals were re-irrigated, and the CH dressing was renewed to maintain antibacterial and antiresorptive action. This protocol follows trauma guidelines recommending CH placement for several weeks with replacement as needed. The teeth were resealed (22).

Three weeks later, the patient was asymptomatic, and mobility had decreased. After cleaning and irrigation, obturation was completed with a cold-ceramic bioceramic putty placed to working length (Figure 2c). Cold-ceramic was selected for its biocompatibility, dimensional stability, and ability to adapt within irregular resorptive defects. Its alkaline calcium-silicate composition favors sealing and tissue repair. Post-obturation radiographs showed dense, void-free fills (23).

Analgesia consisted of 400 mg ibuprofen. No antibiotics were prescribed because there were no systemic signs of infection, and adequate drainage and debridement had been achieved, consistent with endodontic stewardship principles (24).

Definitive restoration was planned for one month later. In the interim, the access cavities were restored with type II glass ionomer cement to maintain coronal seal and permit follow-up evaluation (Figure 2d).

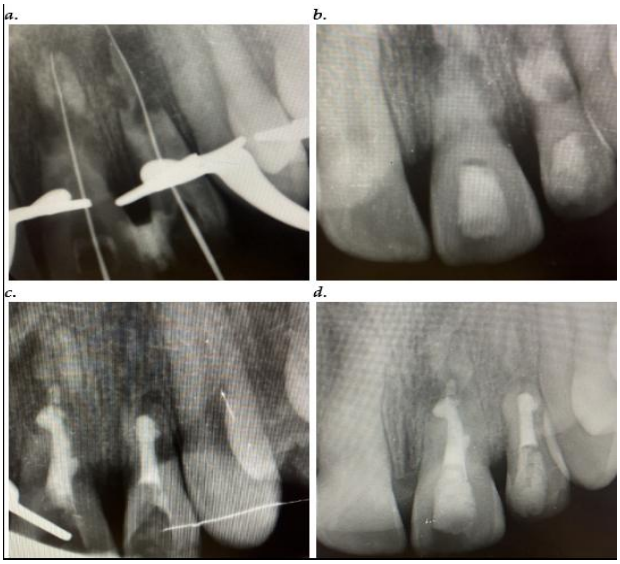

Figure 2. Endodontic treatment steps. (*a*) Working length determination. (*b*) Placement of the CH as the intracanal medicament. (*c*) Postobturation with a bioceramic material (Cold-Ceramic). (*d*) Access cavities sealed with glass ionomer cement.

Follow-up and outcomes

At three months, both teeth were stable with no mobility. The patient was advised to avoid hard foods, maintain excellent oral hygiene, and discontinue nail biting. Reviews at three, six, and twelve months revealed no complications.

At fourteen months, the patient remained asymptomatic. Radiographs revealed replacement resorption with complete periapical healing and hard tissue formation around both roots (Figure 3b). Intraoral examination revealed healthy soft tissues and stable function (Figure 3d). The patient's function was restored, and the patient was satisfied with the aesthetic results. The sinus tract had resolved, and both teeth produced a metallic sound on percussion.

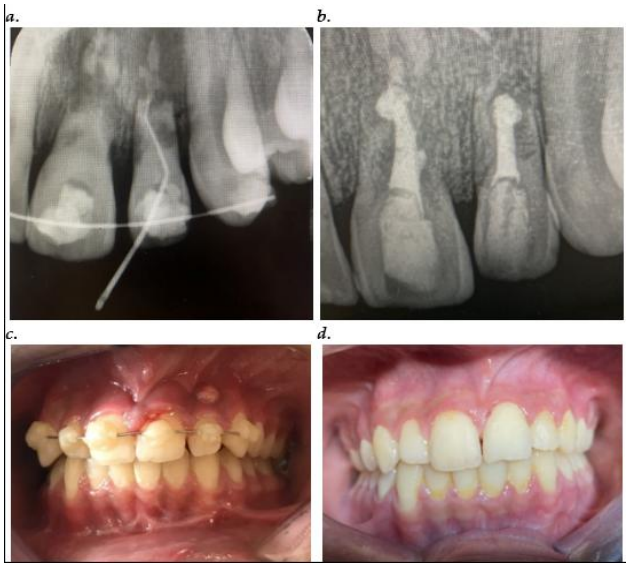

Figure 3. Clinical and radiographic follow-up. (*a*) Pretreatment periapical radiograph. (*b*) Fourteen-month follow-up radiograph showing replacement resorption with complete periapical healing. (*c*) Intraoral view at baseline with the splint in place. (*d*) A 14-month follow-up revealed healthy tissues and stable teeth

Patient education and maintenance

The patient and his parents were counseled regarding the uncertain long-term prognosis. They were instructed to avoid excessive biting forces, maintain meticulous oral hygiene, and attend annual reviews.

Discussion

This case involved severe EIRR affecting two replanted maxillary incisors after delayed endodontic care and prolonged splinting. Staged CH medication followed by bioceramic obturation coincided with the resolution of symptoms, periapical healing, and a stable radiographic appearance at 14 months.

EIRR develops when bacterial products from a necrotic canal reach injured periodontal tissues through dentinal tubules or cemental defects, which activate clastic cells and lead to root loss (7, 8). CH offers disinfection and an antiresorptive effect. Renewal maintains an alkaline environment until clinical stability returns (18). We completed obturation with a bioceramic material to secure a seal and biocompatibility in roots with irregular resorptive defects (25).

Current guidance recommends initiating root canal treatment 7 to 10 days after replantation to limit inflammatory resorption (17). Delays in endodontic therapy and extended splinting are associated with greater periodontal ligament necrosis and higher resorption risk (5, 6, 15, 16, 26). When treatment begins late, thorough chemical disinfection with CH can still arrest EIRR and allow recovery (27). In this patient, CH was renewed until pain and the sinus tract resolved, then obturation was completed.

This case differs from published reports in several significant ways. Most documented cases involve younger patients and earlier treatment, whereas this 16-year-old presented after a prolonged extraoral period, delayed initiation of endodontic therapy, and six months of splinting, factors known to increase the likelihood of replacement resorption. As reported by Di Giorgio et al. and Asgary et al., intracanal disinfection with CH, followed by calcium–silicate obturation, led to the resolution of apical pathology and preservation of function (28-30). In those cases, however, treatment began sooner and splinting was shorter, and replacement resorption was less evident. Reports describing delayed replantation with adjunctive root surface or intracanal procedures show inconsistent outcomes but generally involve early disinfection rather than intervention months after injury (31, 32).

The six-month splint likely increased periodontal

damage and favored replacement resorption. Shorter, flexible splinting tends to support physiologic healing and reduce ankylosis risk (33). After long extraoral times, replacement resorption is common. In growing patients, it may progress slowly yet still permit a period of function (34).

Close follow-up is essential. Examinations should include percussion tone, probing depths, mobility, symptoms, and serial radiographs (1). In this case, at 14 months, the periapical tissues appeared healed, and function was stable, with no radiographic progression of EIRR.

This report has clear limits. It is a single case without a comparator, so causality cannot be proven (35). The follow-up interval is modest, and replacement resorption may continue for years after trauma (36). Periapical radiographs can underestimate early or three-dimensional defects. Cone-beam computed tomography (CBCT) could have provided a more precise volumetric assessment (37, 38). Bioceramic materials vary in formulation and handling, and alternative obturation strategies such as mineral trioxide aggregate or thermoplasticized gutta-percha with a bioceramic sealer might perform differently, but this cannot be tested here (39). Patient factors such as systemic health, bone remodeling, and root form also limit generalizability (35).

Alternative or adjunctive approaches deserve consideration in selected scenarios. Advanced or inaccessible lesions may need surgical management, such as root surface treatment or retrograde filling (40). Regenerative protocols remain experimental in traumatized, resorbing teeth, but could be explored in tightly defined cases (41). Adjunctive measures, including topical corticosteroids, have been proposed for resorption control and may warrant study (42).

When optimal immediate care is missed, a salvage strategy is still possible. Eliminate intraradicular infection with CH, delay obturation until clinical stability is achieved, then use a bioceramic material, and monitor the patient closely. Early endodontic intervention remains the preferred course of action. Future work should include longer follow-up periods, volumetric imaging, and comparative designs to clarify which interventions truly alter the trajectory of EIRR and replacement resorption.

Conclusion

Severe EIRR in replanted incisors can be controlled when intraradicular infection is eliminated and when obturation is deferred until the tooth is clinically stable. In this case, CH dressing followed by bioceramic obturation relieved symptoms and restored function despite delayed care and prolonged splinting. At 14 months, the periapical tissues had healed, and replacement resorption was present without any clinical symptoms.

Statement

The authors utilized a commercial grammar and style tool (Grammarly) to refine their wording, enhance clarity, and verify spelling and grammar. All the authors approved the final manuscript.

References

1. Muller DD, Bissinger R, Reymus M, Bucher K, Hickel R, Kuhnisch J. Survival and complication analyses of avulsed and replanted permanent teeth. Sci Rep. 2020;10(1):2841.

2. Çalışkan S, Delikan E, Kızılaslan S, Özbek Ö. Knowledge of dental avulsion among emergency physicians: A survey study. The Journal of Pediatric Research. 2021.

3. Korkut E, Terlemez A, Çelebi H, Şener Y. Multidisciplinary treatment of avulsed teeth case report and 6 years follow-up. Journal of Pediatric Dentistry/May-Aug. 2016;4(2):43.

4. Qin M. [Replantation and delayed replantation of avulsed young permanent teeth]. Zhonghua Kou Qiang Yi Xue Za Zhi. 2013;48(6):321-4.

5. Poornima P, Kotari S, Sasalawad SS, Nagaveni N, Roshan N, Subba Reddy V. Save cells before tooth replantation: A review. Int J Contemp Dent Med Rev. 2015;2015:1-7.

6. Giannetti L, Spinas E, Murri Dello Diago A. Tooth avulsion with extra oral time in less than 60 minutes: two different therapeutic protocols with 13-year follow-up. J Biol Regul Homeost Agents. 2019;33(2):629-31.

7. Wu JY, Li X, Wang CL, Ye L, Yang J. [Research progress on the pathogenesis of inflammatory external root resorption]. Hua Xi Kou Qiang Yi Xue Za Zhi. 2019; 37(6): 656-9.

8. Abbott PV. Prevention and management of external inflammatory resorption following trauma to teeth. Aust Dent J. 2016;61 Suppl 1:82-94.

9. Kaufman AY, Kahler B. Arrest and Repair of Inflammatory Root Resorption After an Endodontic Regeneration Procedure - A Hypothesis and Case Report. J Endod. 2024;50(12):1743-51.
10. Esper HR, Panzarini SR, Poi WR, Sonoda CK, Casatti CA. Mechanical removal of necrotic periodontal ligament by either Robinson bristle brush with pumice or scalpel blade. Histomorphometric analysis and scanning electron microscopy. Dent Traumatol. 2007;23(6):333-9.
11. Krasner P, Person P. Preserving avulsed teeth for replantation. J Am Dent Assoc. 1992;123(11):80-8.
12. Blomlof L, Lindskog S, Andersson L, Hedstrom KG, Hammarstrom L. Storage of experimentally avulsed teeth in milk prior to replantation. J Dent Res. 1983;62(8):912-6.
13. Di Fiore PM, Hartwell GR. Dental pulp revascularization in a replanted avulsed immature maxillary permanent central incisor. Eur Endod J. 2017;2(1):1-6.
14. Andreasen JO. Pulp and periodontal tissue repair - regeneration or tissue metaplasia after dental trauma. A review. Dent Traumatol. 2012;28(1):19-24.
15. Marao HF, Panzarini SR, Aranega AM, Sonoda CK, Poi WR, Esteves JC, et al. Periapical tissue reactions to calcium hydroxide and MTA after external root resorption as a sequela of delayed tooth replantation. Dent Traumatol. 2012;28(4):306-13.
16. Kolli NKR, Challa R, Karthik A, Nuvvula S. Delayed replantation of avulsed tooth with 4½ days extraoral time with 18 months follow up. Journal of Dr YSR University of Health Sciences. 2017;6(2):136-9.
17. Hinckfuss SE, Messer LB. An evidence-based assessment of the clinical guidelines for replanted avulsed teeth. Part I: Timing of pulp extirpation. Dent Traumatol. 2009;25(1):32-42.
18. Mohammadi Z, Dummer PM. Properties and applications of calcium hydroxide in endodontics and dental traumatology. Int Endod J. 2011;44(8):697-730.
19. Usta SN, Silva E, Falakaloglu S, Gundogar M. Does minimally invasive canal preparation provide higher fracture resistance of endodontically treated teeth? A systematic review of in vitro studies. Restor Dent Endod. 2023;48(4):e34.
20. Xu H, Ye Z, Zhang A, Lin F, Fu J, Fok ASL. Effects of concentration of sodium hypochlorite as an endodontic irrigant on the mechanical and structural properties of root dentine: A laboratory study. Int Endod J. 2022; 55 (10):1091-102.
21. Jahromi MZ, Motamedi MRK. Effect of calcium hydroxide on inflammatory root resorption and ankylosis in replanted teeth compared with other intracanal materials: a review. Restorative dentistry & endodontics. 2019;44(3).
22. Boukpessi T, Cottreel L, Galler KM. External Inflammatory Root Resorption in Traumatized Immature Incisors: MTA Plug or Revitalization? A Case Series. Children (Basel). 2023;10(7):1236.
23. Modaresi J, Hemati HR. The cold ceramic material. Dent Res J (Isfahan). 2018;15(2):85-8.
24. Fouad AF, Byrne B, Diogenes A, Sedgley C, Cha B. AAE guidance on the use of systemic antibiotics in endodontics, AAE position statement. 2017. 2020.
25. Dong X, Xu X. Bioceramics in Endodontics: Updates and Future Perspectives. Bioengineering (Basel). 2023; 10(3): 354.
26. de Lima ERC, da Silva Toledo GC, de Araújo Silva TR, de Menezes Torres LM, de Vasconcelos RA, Nicácio DCSP. Reimplante dentário após trauma de avulsão: Relato de caso clínico. Research, Society and Development. 2021; 10 (8):e4910816967-e.
27. Barbosa-Ribeiro M, Arruda-Vasconcelos R, de-Jesus-Soares A, Zaia AA, Ferraz CCR, de Almeida JFA, et al. Effectiveness of calcium hydroxide-based intracanal medication on infectious/inflammatory contents in teeth with post-treatment apical periodontitis. Clin Oral Investig. 2019;23(6):2759-66.
28. Di Giorgio G, Salucci A, Sfasciotti GL, Iaculli F, Bossu M. External Root Resorption Management of an Avulsed and Reimplanted Central Incisor: A Case Report. Dent J (Basel). 2021;9(6):72.
29. Asgary S, Nosrat A, Seifi A. Management of inflammatory external root resorption by using calcium-enriched mixture cement: a case report. J Endod. 2011;37(3):411-3.
30. Chalakkal P, Thomas AM, Akkara F, Fernandes KS. Delayed Replantation after Endodontic and Fluoride Treatment: A 5-Year Follow-up. Int J Clin Pediatr Dent. 2011;4(3):228-31.
31. Balakrishnan P, Srinivasan D, Eagappan S. Management of avulsion-induced external root resorption of permanent maxillary left central and lateral incisors-a one-year follow-up case report. Trends in Pediatrics. 2024;5(2):43-7.
32. Fouad AF, Abbott PV, Tsilingaridis G, Cohenca N, Lauridsen E, Bourguignon C, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol. 2020;36(4):331-42.
33. Levin L, Day PF, Hicks L, O'Connell A, Fouad AF, Bourguignon C, et al. International Association of Dental

Traumatology guidelines for the management of traumatic dental injuries: General introduction. Dent Traumatol. 2020;36(4):309-13.
34. Filippi A, Pohl Y, von Arx T. Treatment of replacement resorption by intentional replantation, resection of the ankylosed sites, and Emdogain--results of a 6-year survey. Dent Traumatol. 2006;22(6):307-11.
35. Jackevicius C. The Value of Case Reports. Can J Hosp Pharm. 2018;71(6):345-6.
36. Gul A, Lauridsen E, Gerds TA, Andersson L. Risk of ankylosis of avulsed teeth immediately replanted or stored under favorable storage conditions before replantation: A long-term clinical study. Dent Traumatol. 2024;40(2):137-43.
37. Pereira SA, Corte-Real A, Melo A, Magalhaes L, Lavado N, Santos JM. Diagnostic Accuracy of Cone Beam Computed Tomography and Periapical Radiography for Detecting Apical Root Resorption in Retention Phase of Orthodontic Patients: A Cross-Sectional Study. J Clin Med. 2024; 13(5): 1248.
38. Gadzhula N, Povsheniuk A, Cherepakha O. Diagnosis of internal root resorption: clinical manifestations and radiological features. 2024.
39. Prasad Kumara P, Cooper PR, Cathro P, Gould M, Dias G, Ratnayake J. Bioceramics in Endodontics: Limitations and Future Innovations-A Review. Dent J (Basel). 2025; 13 (4):157.
40. Ghafoor R, Tabassum S, Hameed MH. Management of extensive external apical root resorption leading to root perforation. BMJ Case Rep. 2017;2017:bcr-2017-220234.
41. Dadpe AM, Shah DY, Natanasabapathy V, Sureshbabu NM, Hindlekar AN, Modi K. Regenerative Endodontic Procedures in Teeth with Root Resorption: A Systematic Review. Eur Endod J. 2023; 8(3):170-86.
42. Zou X, Zheng X, Liang Y, Zhang C, Fan B, Liang J, et al. Expert consensus on irrigation and intracanal medication in root canal therapy. Int J Oral Sci. 2024; 16(1):23.