Long Term Outcome of Avulsed Immature Mandibular Incisor with Progressive External Root Resorption: 9 Years Follow-Up

Lina Mickeviciene[1], Vestina Ciruliene[1], Greta Lodiene[1]

[1]Clinic of Dental and Oral Pathology Faculty of Odontology, Lithuanian University of Health Sciences, Kaunas, Lithuania.

Corresponding Author:
Lina Mickeviciene
Clinic of Dental and Oral Pathology Faculty of Odontology
Lithuanian University of Health Sciences
Eivenių g. 2, Kaunas
Lithuania
Phone: +37068476540
E-mail: linamickeviciene25@gmail.com

ABSTRACT

Background: Avulsion of permanent teeth is the most common in young permanent dentition. Replantation of immature teeth after avulsion represents a major challenge in terms of treatment management and long–term prognosis. This case report describes 9 years of follow-up for an avulsed and replanted immature mandibular lateral incisor with progressive external root resorption.
Methods: A 7-year-old patient following an accident in which his mandibular left central incisor was avulsed and replanted within one hour after being stored in a physiological storage medium. However, radiographic examination conducted six weeks after the dental injury revealed inflammatory root resorption of the replanted tooth #31. To address root resorption, endodontic treatment was performed involving the use of calcium hydroxide as an intracanal medication for a short period of time, followed by root canal obturation with mineral trioxide aggregate placed below the crestal bone margin.
Results: Three months later the root resorption had progressed. Consequently, a decision was made to perform periodontal surgery. While the long-term follow-up revealed that the inflammatory root resorption had damaged half of the root, the tooth remained functional and aesthetically favourable.
Conclusions: Despite the challenges associated with replantation of an immature tooth following avulsion, this case demonstrated favourable outcomes. The tooth maintained its functionality, exhibited favourable aesthetic, and the dimensions of the alveolar ridge were preserved, allowing for the physiological expansion of the dental arch.

Keywords: etiology; mandible; root resorption; tooth avulsion; tooth injuries; tooth replantation.

Accepted for publication: 13 June 2023
To cite this article:
Mickeviciene L, Ciruliene V, Lodiene G.
Long Term Outcome of Avulsed Immature Mandibular Incisor with Progressive External Root Resorption: 9 Years Follow-Up
J Oral Maxillofac Res 2023;14(2):e5
URL: http://www.ejomr.org/JOMR/archives/2023/2/e5/v14n2e5.pdf
doi: 10.5037/jomr.2003.14205

INTRODUCTION

Avulsion of permanent teeth is prevalent in young individuals, with a reported prevalence of up to 10% [1,2]. The resilience of the alveolar bone and incomplete root development make young permanent dentition more susceptible to avulsion [1]. Immediate replantation, followed by appropriate management, is crucial for successful outcomes. However, external root resorption is a significant complication associated with avulsion, particularly in adolescents, due to the wider dentinal tubules, facilitating microbial invasion and accelerating the resorption process [3]. This usually appears 3 weeks after the replantation in young patients [3]. The International Association of Dental Traumatology (IADT) emphasizes the importance of long-term follow-up for dental trauma cases, with extended follow-up periods of up to 5 years due to the delayed onset of certain complications [4,5]. Common dental trauma cases are with the multiple dental injuries. Some of them can be mild, while others can be more severe. Andreasen and Pedersen [6] studied the development of pulp necrosis following dental trauma. It was found that pulp necrosis in mild injuries could appear within 3 months or even later.

This case report describes 9 years of follow-up for an avulsed and replanted immature mandibular lateral incisor with progressive external root resorption.

CASE DESCRIPTION AND RESULTS

A 7-year-old boy was referred to an endodontist at a private practice (Kaunas, Lithuania) on September 4th, 2012, for the following treatment. The patient had an accident and received emergency treatment for an avulsed mandibular left-central incisor. Following injury, the tooth was preserved by placing it in the mother's mouth under the tongue for less than 60 min before replantation. After the replantation the tooth #31 was stabilized using a flexible wire-composite splint for two weeks.

At the two-week follow-up visit, the patient did not report any complaints, but the tooth #31 exhibited slight mobility (Figure 1). Cold and electro odontometric tests, which are used to assess pulp sensitivity, were negative. One month later, additional tests including pulp sensitivity, percussion and palpation were performed and yielded negative results. A periapical radiograph (X-ray) showed a slight radiolucent area on the external surface of the tooth root (Figure 2). Based on these findings, root canal treatment was initiated under dental microscope and rubber dam isolation. An endodontic access cavity was prepared using a round diamond high-speed bur with water cooling. The necrotic pulp tissue was removed and the root canal was thoroughly irrigated with a copious amount of 2.5% sodium hypochlorite and passive ultrasonic activation. For short-term intracanal medication, calcium hydroxide paste (UltraCal™ - Ultradent Products, Inc.; South Jordon, Utah, USA) was used. After four weeks, the tooth was reopened and the canal was irrigated with 2.5% sodium hypochlorite. A final irrigation with 17% ethylenediaminetetraacetic acid (EDTA) was performed. The root canal was then dried with paper points and obturated with mineral trioxide aggregate (ProRoot® MTA, Densply - Sirona; Charlotte, North Carolina, USA) placed below the crestal bone margin (Figure 3). The access cavity of the tooth was restored with composite resin.

Three months later, during the follow-up visit, the patient had no complains, the tooth was not mobile.

Figure 1. Avulsed tooth (tooth #31) two weeks after replantation.

Figure 2. Avulsed tooth (tooth #31) four weeks after replantation. Periapical radiograph showed a slight area of radiolucency involving the external root walls of the tooth - radiological signs of external inflammatory root resorption.

The sinus tract was observed on the buccal side of the gingiva and the radiograph confirmed the progression of the external root resorption (Figure 4). This factor and the Concilium of orthodontist, surgeon and endodontist led to the periodontal surgery decision in order to remove the inflamed granulation tissue and biofilm and maintain the tooth in the dental arch. A mucoperiosteal flap was raised and the inflammatory tissue was removed using curettes and ultrasonic tips.

The patient was followed regularly performing clinical and radiographic examination (Figures 5 to 9). During each control visit, maxillary and mandibular incisors were evaluated. The patient had no complains, clinically there were no symptoms, but periapical radiographs revealed the pulp canal obliteration process (Figure 10 to 14) and disrupted development of the roots (Figure 11 to 14). Seven years after the tooth #31 injury, the sinus tract next to the tooth appeared again, and periodontal surgery was repeated. Nine years after dental trauma, half of the root resorption was detected radiographically with root canal filling resorption as well. The tooth crown was slightly discoloured, but the tooth was still functional preserving the alveolar ridge with favourable aesthetics for the patient.

DISCUSSION

This case report focuses on the preservation of tooth #31 to maintain dental arch space and prevent bone loss. As the jaw grows vertically, teeth continue to erupt, and the intermolar width increases to expand the perimeter of the dental arch [7,8]. It is important to note that during dental arch expansion, the buccal-lingual dimension of the alveolar ridge remains relatively constant, and the teeth stay centred within the ridge [9]. This consistency is achieved through controlled activities at the four surfaces of the alveolar ridge. Specifically, new bone is added to the buccal surface and lingual bundle bone, while resorption removes the lingual surface and the buccal bundle bone. These processes allow the posterior teeth to move buccally relative to the mid-sagittal plane of the head while remaining centred between the buccal and lingual alveolar plates.

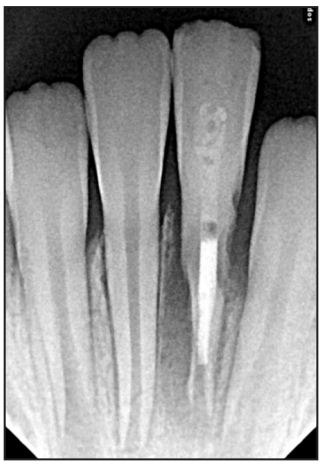

Figure 3. Avulsed tooth (tooth #31) two months after replantation.

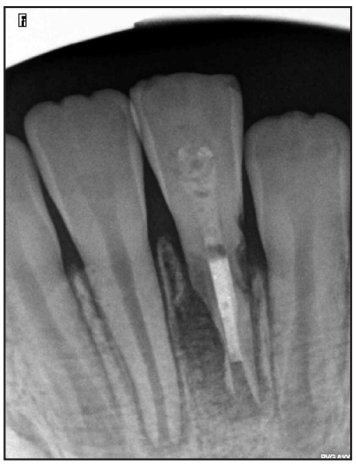

Figure 4. Avulsed tooth (tooth #31) three months after replantation.

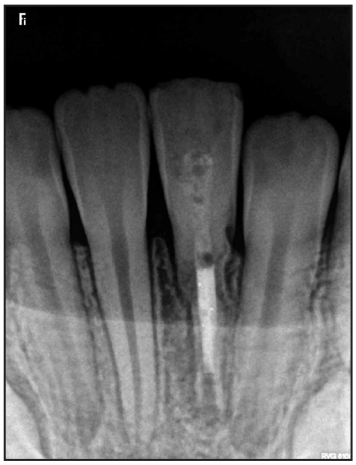

Figure 5. Follow-up after 10 months.

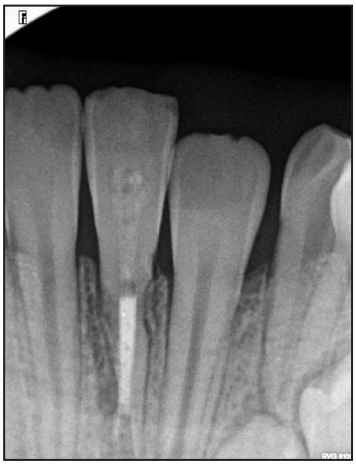

Figure 6. Follow-up after 14 months.

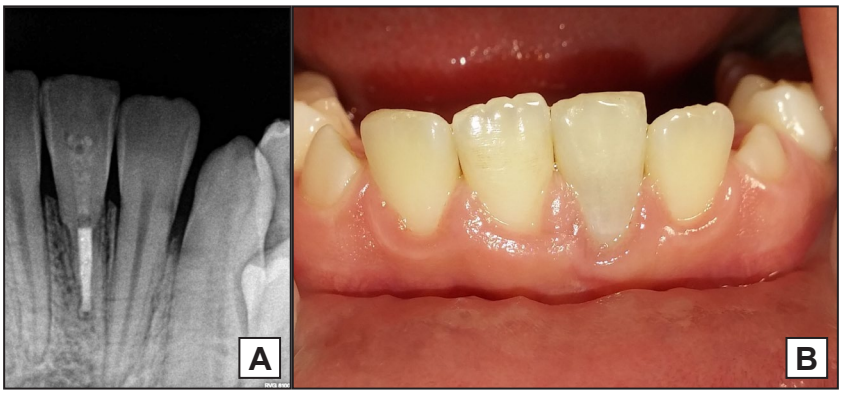

Figure 7. Follow-up after 3.5 years. A = periapical radiograph; B = intraoral photograph.

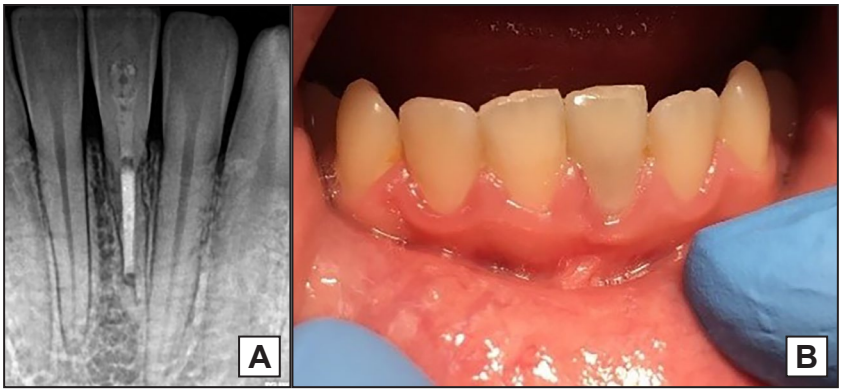

Figure 8. Follow-up after 5 years. A = periapical radiograph; B = intraoral photograph.

Figure 9. Follow-up after 9 years. A = periapical radiograph; B = intraoral photograph.

Figure 10. Periapical radiograph of maxillary incisors 3 months after dental trauma.

Figure 11. Periapical radiograph of maxillary incisors 10 months after dental trauma.

Figure 12. Periapical radiograph of maxillary incisors 3.5 years after dental trauma.

Figure 13. Periapical radiograph of maxillary incisors 5 years after dental trauma.

In adolescents, the extraction or loss can result in a substantial reduction in the buccal-lingual alveolar dimension [9,10]. These negative changes disrupt the movement of posterior teeth and can also affect the dental arch perimeter. Additionally, Sillman et al. [11] reported that intercanine and intermolar widths continue to increase until the age of 13 years and then decrease in individuals under 16 years of age. Tooth loss in growing individuals may lead to imbalances in mesial-distal size and dental arch length [12], as well as a loss of anterior space if primary incisors are lost before the eruption of primary canines. Intercanine distance is important for maintaining dental arch stability [13] and preventing occlusal damage. While dental implants are possible solution for tooth loss at growing ages [14], there are age limitations due to changes in alveolar bone dimensions. Implant placement is generally recommended after the age of 10 to avoid growth-related complications, and the risk of complications is lower in patients over 15 years of age [14].

Approximately 4 to 24% of traumatized teeth develop pulpal obliteration, characterized by the loss of pulp space radiographically and a yellow discoloration of the clinical crown [15]. Upper central and lateral incisors are most commonly affected by trauma [16]. Routine pulp sensibility tests may be unreliable for teeth with pulp canal obliteration, and regular control visits are important to monitor the condition [15]. In this case, pulp canal obliteration was diagnosed on the upper central incisor 10 months after trauma (Figure 11). The main hypothesis for canal calcification is accelerated dentin deposition associated with the loss of neural control over odontoblastic secretory activity [17]. Up to 75% of teeth with pulp canal obliterations are symptom-free and require no treatment other than radiographic monitoring because routine pulp sensibility tests are unreliable [15,16]. Consequently, it is very important

Figure 14. Periapical radiographs of maxillary incisors 9 years after dental trauma.

clinically and radiographically to examine the antagonists and adjacent teeth during follow-up visits.

Dental traumatic injuries can also impact root development. In this case, the upper left incisor's root lengthening was arrested. Rule and Winter [18] had stated that root growth is only possible where the cells of the Hertwig root sheath (HERS) have retained their specialized functions. The HERS provides a source of undifferentiated cells that could give rise to further hard tissue formation. In addition, it may protect against the ingrowth of periodontal ligament cells into the root canal, which would result in intracanal bone formation and arrest of root development [19,20]. The HERS plays a crucial role in root growth, and its damage during trauma can disrupt root development.

Mineral trioxide aggregates (MTA) are commonly used in endodontic treatments but can cause tooth discoloration over time [21]. Blood contamination and constitution within MTA have been identified as major causes of tooth discoloration. Haemoglobin and haematin molecules within the blood deepen the tooth colour after clinical therapy [22].

External root resorption is a rapid complication of avulsed teeth, particularly in children [4]. Recent literature has presented alternative interventions when tooth loss is unavoidable. Alternative interventions, such as guided bone regeneration techniques and bone replacement materials, are being explored to preserve the alveolar ridge in cases where tooth loss in unavoidable [23-25]. In this specific case, despite external root resorption, tooth #31 was saved for nine years after trauma, preserving the dimensions of the alveolar ridge and maintaining the physiological expansion of the dental arch. The overall goal was not only to treat a single tooth but to consider the tooth as part of a dentoalveolar system and observe its impact on craniofacial development.

CONCLUSIONS

Despite the challenges associated with replantation of an immature tooth following avulsion, this case demonstrated favourable outcome. The tooth maintained its functionality, exhibited favourable aesthetic, and the dimensions of the alveolar ridge were preserved, allowing for the physiological expansion of the dental arch.

ACKNOWLEDGMENTS AND DISCLOSURE STATEMENTS

The authors provided ethical approval for this case study. Published with consent of the patient. Conflict of interest - none declared.

REFERENCES

1. Andreasen JO, Andreasen FM, Andersson L. Textbook and color atlas of traumatic injuries to the teeth. 4th ed. Oxford, UK: Wiley-Blackwell; 2018. [doi: https://doi.org/10.1038/bdj.2007.1053]
2. Glendor U, Halling A, Andersson L, Eilert-Petersson E. Incidence of traumatic tooth injuries in children and adolescents in the county of Västmanland, Sweden. Swed Dent J. 1996;20(1-2):15-28. [Medline: 8738905]
3. Andersson L, Bodin I, Sörensen S. Progression of root resorption following replantation of human teeth after extended extraoral storage. Endod Dent Traumatol. 1989 Feb;5(1):38-47. [Medline: 2598883] [doi: 10.1111/j.1600-9657.1989.tb00335.x]
4. Fouad AF, Abbott PV, Tsilingaridis G, Cohenca N, Lauridsen E, Bourguignon C, O'Connell A, Flores MT, Day PF, Hicks L, Andreasen JO, Cehreli ZC, Harlamb S, Kahler B, Oginni A, Semper M, Levin L. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol. 2020 Aug;36(4):331-342. [Medline: 32460393] [doi: 10.1111/edt.12573]
5. Andersson L, Andreasen JO, Day P, Heithersay G, Trope M, Diangelis AJ, Kenny DJ, Sigurdsson A, Bourguignon C, Flores MT, Hicks ML, Lenzi AR, Malmgren B, Moule AJ, Tsukiboshi M; International Association of Dental Traumatology. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol. 2012 Apr;28(2):88-96. [Medline: 22409417] [doi: 10.1111/j.1600-9657.2012.01125.x]
6. Andreasen FM, Pedersen BV. Prognosis of luxated permanent teeth--the development of pulp necrosis. Endod Dent Traumatol. 1985 Dec;1(6):207-20. [Medline: 3867505] [doi: 10.1111/j.1600-9657.1985.tb00583.x]
7. Bishara SE, Jakobsen JR, Treder J, Nowak A. Arch width changes from 6 weeks to 45 years of age. Am J Orthod Dentofacial Orthop. 1997 Apr;111(4):401-9. [Medline: 9109585] [doi: 10.1016/S0889-5406(97)80022-4]
8. Liu SS, Buschang PH. How does tooth eruption relate to vertical mandibular growth displacement? Am J Orthod Dentofacial Orthop. 2011 Jun;139(6):745-51. [Medline: 21640880] [doi: 10.1016/j.ajodo.2010.03.029]
9. Sun Z, Herring SW, Tee BC, Gales J. Alveolar ridge reduction after tooth extraction in adolescents: an animal study. Arch Oral Biol. 2013 Jul;58(7):813-25. [Medline: 23380583] [PMC free article: 3665758] [doi: 10.1016/j.archoralbio.2012.12.013]
10. Rodd HD, Malhotra R, O'Brien CH, Elcock C, Davidson LE, North S. Change in supporting tissue following loss of a permanent maxillary incisor in children. Dent Traumatol. 2007 Dec;23(6):328-32. [Medline: 17991231] [doi: 10.1111/j.1600-9657.2006.00466.x]
11. Sillman JH. Dimensional changes of the dental arches: longitudinal study from birth to 25 years. Am J Orthod. 1964;50(11):824-42. [doi: 10.1016/0002-9416(64)90040-5]
12. Ferguson DJ. Chapter 25 - Growth of the face and dental arches. In: Dean JA, Avery DR, McDonald RE., editors. McDonald and Avery Dentistry for the Child and Adolescent (9th edition). St. Louis: Mosby; 2011. p.510-24. [doi: 10.1016/B978-0-323-05724-0.50029-1]
13. Holan G, Needleman HL. Premature loss of primary anterior teeth due to trauma--potential short- and long-term sequelae. Dent Traumatol. 2014 Apr;30(2):100-6. [Medline: 24138100] [doi: 10.1111/edt.12081]
14. Bohner L, Hanisch M, Kleinheinz J, Jung S. Dental implants in growing patients: a systematic review. Br J Oral Maxillofac Surg. 2019 Jun;57(5):397-406. [Medline: 31076220] [doi: 10.1016/j.bjoms.2019.04.011]

15. McCabe PS, Dummer PM. Pulp canal obliteration: an endodontic diagnosis and treatment challenge. Int Endod J. 2012 Feb;45(2):177-97. [Medline: 21999441] [doi: 10.1111/j.1365-2591.2011.01963.x]
16. Vinagre A, Castanheira C, Messias A, Palma PJ, Ramos JC. Management of Pulp Canal Obliteration-Systematic Review of Case Reports. Medicina (Kaunas). 2021 Nov 12;57(11):1237. [Medline: 34833455] [PMC free article: 8625069] [doi: 10.3390/medicina57111237]
17. Bastos JV, Côrtes MIS. Pulp canal obliteration after traumatic injuries in permanent teeth - scientific fact or fiction? Braz Oral Res. 2018 Oct 18;32(suppl 1):e75. [Medline: 30365616] [doi: 10.1590/1807-3107bor-2018.vol32.0075]
18. Rule DC, Winter GB. Root growth and apical repair subsequent to pulpal necrosis in children. Br Dent J. 1966 Jun 21;120(12):586-90. [Medline: 5221182]
19. Andreasen JO, Borum MK, Andreasen FM. Replantation of 400 avulsed permanent incisors. 3. Factors related to root growth. Endod Dent Traumatol. 1995 Apr;11(2):69-75. [Medline: 7641621] [doi: 10.1111/j.1600-9657.1995.tb00463.x]
20. Diaz JA, Nuñez J, Camilla M. Uncommon disturbance of root development after tooth replantation. Five-years follow-up period case report. Int J Odontostomat. 2016 Dec;10(3):491-8. [doi: 10.4067/S0718-381X2016000300017]
21. Khalilak Z, Esnaashari E, Saati K, Bineshmarvasti D, Yousefshahi H, Nobakht M. An in Vitro Comparison of Coronal Discolouration Caused by White Mineral Trioxide Aggregate, Theracal, Calcium-Enriched Mixture and Biodentine. Eur Endod J. 2022 Mar;7(1):47-51. [Medline: 35353066] [PMC free article: 9035861] [doi: 10.14744/eej.2020.83584]
22. Lin HN, Wang LC, Chen MS, Chang PJ, Lin PY, Fang A, Chen CY, Lee PY, Lin CK. Discoloration Improvement by Mechanically-Milled Binary Oxides as Radiopacifier for Mineral Trioxide Aggregates. Materials (Basel). 2022 Nov 10;15(22):7934. [Medline: 36431419] [PMC free article: 9695230] [doi: 10.3390/ma15227934]
23. Ashman A. Ridge preservation: important buzzwords in dentistry. Gen Dent. 2000 May-Jun;48(3):304-12. [Medline: 11199597]
24. Bartee BK. Extraction site reconstruction for alveolar ridge preservation. Part 1: rationale and materials selection. J Oral Implantol. 2001;27(4):187-93. [Medline: 12500877] [doi: 10.1563/1548-1336(2001)0272.3.CO;2]
25. Stanley HR, Hall MB, Clark AE, King CJ 3rd, Hench LL, Berte JJ. Using 45S5 bioglass cones as endosseous ridge maintenance implants to prevent alveolar ridge resorption: a 5-year evaluation. Int J Oral Maxillofac Implants. 1997 Jan-Feb;12(1):95-105. [Medline: 9048461]

To cite this article:
Mickeviciene L, Ciruliene V, Lodiene G.
Long Term Outcome of Avulsed Immature Mandibular Incisor with Progressive External Root Resorption: 9 Years Follow-Up
J Oral Maxillofac Res 2023;14(2):e5
URL: http://www.ejomr.org/JOMR/archives/2023/2/e5/v14n2e5.pdf
doi: 10.5037/jomr.2003.14205