International Journal Dental and Medical Sciences Research
Volume 6, Issue 4, July-Aug 2024 pp 422-426www.ijdmsrjournal.com ISSN: 2582-6018

Replantation of an avulsed permanent maxillary central and lateral incisor: A case report
Running title: Replantation of Avulsed Maxillary Incisors: A case report

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Submitted: 15-08-2024 Accepted: 25-08-2024

ABSTRACT: The success of the treatment of traumatized teeth revolves around the status of periodontium, extra-alveolar time period, choice of storage media and contamination of the avulsed tooth. Delay in the replantation increases the risk of dentoalveolar ankylosis and replacement root resorption.This case report highlights the management of an avulsed maxillary incisors by replantation after a lapse of 120 minutes which was preserved in milk. A 24-year oldpatient presented with an avulsed teeth 11 and 12 that was replanted and stabilised with splinting. Root canal therapy was initiated one week post-replantationand completed two weeks later followed by removal of the splint after 4 weeks. Follow up done till 12 months which showed slight root resorption in the apical zone of the tooth 12. Unfortunately, the patient failed to visit for further follow up. Replantation of avulsed teeth is the most accepted treatment approach considering esthetic and functionality.

Keywords: Avulsion, replantation, root canal treatment, root resorption, trauma

I. INTRODUCTION

A tooth avulsion is an overall rupture of the periodontal ligament, complete loss of connection between the tooth and the socket, and cemental injury.Permanent tooth avulsion is a very uncommon occurrence, accounting for 0.5% to 16% of all severe dental injuries. Because of their prominent position in the arch, maxillary incisors are most frequently affected[1].

The most crucial element for reattachment after tooth replantation is the viability of the periodontal ligament cells. In addition, other elements that affect the dental prognosis include extraoral duration, how the avulsed tooth is stored, and the maturity of the root.Prolonged extra-oral dry period beyond one hour is detrimental to PDL cell survival, and root resorption (inflammatory/replacement) is a possible consequence[2].

For an avulsed tooth, replantation is seen to be the best option because it retains the patient's appearance and function. When an avulsion is severe, the periodontal ligament becomes dehydrated and is unlikely to recover if it persists for longer than 60 minutes. Therefore, the best course of action at this time is to immediately replace any permanent teeth that have been avulsed.However, pulp necrosis, inflammatory resorption and ankylosis-related (replacement) resorption are possible side effects of replanting[3,4].A recent investigation has demonstrated the long-term success of replanted teeth that follow the International Association of Dental Traumatology (IADT) treatment criteria,

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Volume 6, Issue 4, July-Aug 2024 pp 422-426www.ijdmsrjournal.com ISSN: 2582-6018

despite the fact that few cases of replanted teeth have demonstrated a lower long-term survival rate[5, 6].

This case report demonstrates the thorough steps used to successfully replant two avulsed maxillary incisors, considering an extended extra-oral duration 120 minutes.

II. CASE REPORT

A 24-year-old female presented with a history of a fall and injuries to the anterior maxillary region sustained 2 hours prior. Throughout the examination, the patient was attentive and cooperative and had no notable medical history. Upon extraoral inspection, both the upper and lower lips were swollen and had minor abrasions. The right maxillary central (11) and lateral incisors (12) were not present during intraoral examination, and the adjacent area's marginal gingiva was lacerated (Figure 1A). In the vicinity of teeth 11 and 12, radiovisiography (RVG) showed an empty alveolar socket with an intact lamina dura; no damage or fracture was observed to the neighboring teeth or related alveolar structures (Figure 1B).

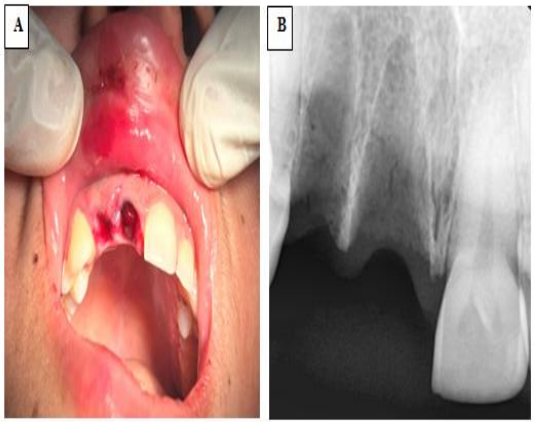

FIGURE 1: (A, B) Pre-operative clinical and radiographical images with avulsed socket 11 and 12

Two hours after the trauma, the patient reported, with the avulsed tooth preserved in milk. The patient was made aware of the potential risks associated with replacing an avulsed tooth that had undergone an extra-oral period of around 120 minutes, including replacement resorption/ankylosis, inflammatory resorption, and discoloration of the tooth. It was decided to reposition and replant teeth 11 and 12 after obtaining the patient's informed permission. The avulsed tooth was examined for cracks and deposition of debris on the root surface. Each of the teeth had a well-formed root with a closed apex and parts of the crown that were still intact. The avulsed teeth were held by the crown and the debris was then gently washed away with regular saline. Both the teeth were preserved in saline solution to keep the teeth hydrated (Figure 2A).

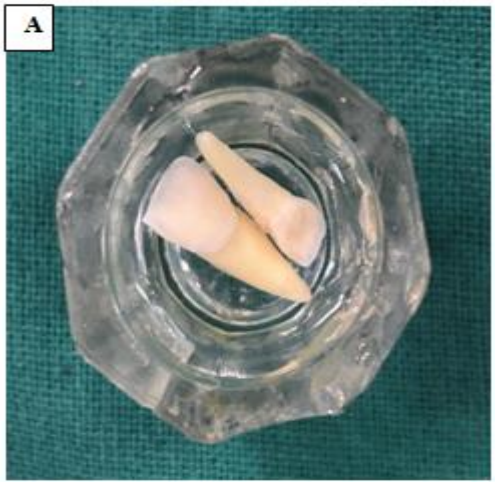

Figure 2(A): Avulsed tooth after debris removal

Under local anesthetic (2% lignocaine without vasoconstrictor), the tooth socket was carefully rinsed with saline and povidine iodine solution (Poviont Solution, Maxx Farmacia, India). With minimal digital pressure, the avulsed teeth were replaced into their sockets (Figure 2B).

Figure 2(B): Tooth 11, 12 repositioned into the socket

Following radiological confirmation, the replanted tooth was given stability in its socket utilizing splinting made of an orthodontic wire (0.4 mm stainless steel wire) bound with light-cure flowable composite resin (Ivoclar Tetric N-Flow Composite, Liechtenstein). The maxillary anterior teeth's labial and lingual surfaces were spot etched with 37% phosphoric acid for 20 seconds, subsequently rinsed and allowed to air dry. Following application, a bonding agent (One Coat 7.0 Universal,Coltene AG, Altstätten, Switzerland)

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was light cured for 20 seconds. Flowable composite was applied to the designated areas and then, a thin orthodontic wire was fixed in place and light cured (Figure 3). The patient was instructed to wear the splint for four weeks. Recommendations for maintaining good dental hygiene, a soft diet, and the necessity of using a mouthwash containing chlorhexidine were advised. For five days, a prophylactic antibiotic regimen consisting of 625 mg/day of amoxicillin trihydrate and potassium clavulanate was administered. It was also advised that the patient get a booster dosage of antitetanus.

Figure 3: Splinting of the avulsed tooth with orthodontic wire and composite resin

One weeks later, the replanted teeth 11 and 12 underwent root canal therapy. A periapical radiograph was used to determine the working length.The canals were prepared till 60/0.02 (Dentsply Maillefer, Ballaigues, Switzerland) by step back technique. Throughout this process, a solution of sodium hypochlorite and a normal saline were flushed through the canals to clean them. Calcium hydroxide dressing was placed inside the canals and the teeth was then temporarily sealed (Cavit G 3M ESPE, United States). After 2 weeks, as the patient was symptoms free, the intracanal medicament was flushed out with saline and the canals were obturated utilizing gutta-percha (Dentsply ISO Color Coded 2% Gutta Percha, Germany) and AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) with cold lateral compaction technique (Figure 4A).

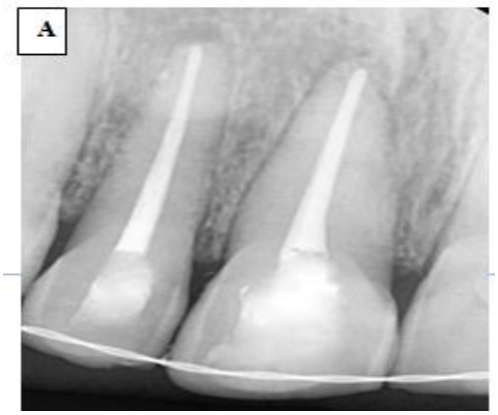

Fig 4A: Radiographic image after endodontic treatment

Four weeks after replantation, the splinting wire was removed and polished (Shofu Super-Snap Mini Kit CA, Japan) (Figure 4B).It was noted that the mobility of the replanted tooth had reduced to grade I.

Fig 4B: Post Operative clinical photograph after treatment completion

At 12 months follow-up, we observed minor root resorption at the apical zone of the avulsed tooth 12 (Figure 5). The patient failed to return for the follow-up appointment after 12 months, so no further observation could be done.

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Fig 5: Radiographic image after 12 months

III. DISCUSSION

Immediate replantation is considered the gold standard for treating an avulsed permanent tooth. This is because it helps preserve the alveolar socket's form, the tooth's functionality, and the vitality of the periodontal ligament cells. In this current case, despite the extended extra-oral dry time of 2 hours, teeth 11 and 12 were replanted immediately[7].

For a positive outcome in treating an avulsion injury, several factors play a key role: proper initial care, well-defined treatment strategies, and taking prompt action[6]. The critical factors influencing successful replantation include the patient's overall health, the development stage of the tooth root (maturity of root), material used to store the avulsed tooth (storage media), and the amount of time the tooth spends outside the mouth. Notably, the last two factors, storage medium and extra-oral time, hold the most significant influence on the outcome[8]. Out of all the methods available for storing an avulsed tooth, milk is the most widely used and recommended option. This is because milk is readily accessible and possesses properties that favor tooth survival. Milk has a suitable pH level, along with the right balance of substances that promote cell growth (growth factors), essential nutrients, and the appropriate concentration of particles dissolved in water (osmolarity)[9]. Additionally, as a secretion from mammary glands, milk contains epithelial growth factor (EGF), which can stimulate the multiplication and renewal of certain cell groups within the tooth (epithelial cell rests of Malassez)[10].

In this particular case, the patient had carried the avulsed tooth which was stored in milk and arrived at the dental department almost two hours after the injury. However, a delay in replanting the tooth can lead to necrosis of the periodontal ligament cells, potentially causing complications like inflammation-related or replacement root resorption. Research has shown that teeth with an immature apex have a higher possibilty of complications compared to fully developed teeth[11]. In this current case, the avulsed tooth had a fully formed root tip, which was a positive factor.

Splinting was crucial for keeping the tooth properly aligned and safeguarding the pulpal tissues as well as the tissues that support the tooth when the tooth is mobile and its functionality is compromised. The only resorption associated with a delayed replantation that was found was associated with ankylosis (replacement)[12].

It is generally accepted that two weeks is the optimal duration for maintaining a splint on a replanted tooth. This is due to research suggesting that over 60% of the supporting tissue's ability to hold the tooth in place (mechanical properties) recovers within two weeks of the injury. However, if the tooth sustained significant trauma or the splint isn't effectively keeping it in its correct position, an extended week of splinting might be required [5, 12].

According to the International Association of Dental Traumatology (IADT) guidelines, root canal treatment should be started within two weeks after replanting the tooth. This is because the dead pulp tissue (necrotic pulp) and the harmful substances it produces (toxins) could reach the supporting tissue of the tooth (periodontal ligament) through various pathways, potentially contributing to the process of root resorption[5,13]. Traditionally, root canal therapy was performed extra-orally before the tooth was replanted. However, current guidelines recommend doing this treatment intra-orally after replantation. This minimizes the amount of time the tooth spends outside the mouth (extra-oral time) and reduces the associated risks[8]. In this case, endodontic treatment was started two weeks after replanting the tooth. Then, an intracanal medicament containing calcium hydroxide was placed in the canals for two more weeks. Calcium hydroxide works by killing microorganisms (antimicrobial effects), hindering the enzymes produced by bacteria (inhibits bacterial enzymes), and stimulating the activity of certain enzymes in the tissue (like alkaline phosphatase) that can promote mineralization (mineralisation). Overall, this helps to thoroughly disinfect the canals and reduce the risk of a complication called root resorption that can sometimes occur after replantation[14]. While

current recommendations suggest using calcium hydroxide for a longer period of four weeks, studies have shown similar effectiveness with shorter durations, particularly when there are no signs of underlying pathology present[9, 10].

After replanting an avulsed tooth, close monitoring is crucial. Continuous follow-ups are required for patients at scheduled times of two weeks, four weeks, every six months for the first year, and thereafter once a year for a minimum of five years. During these visits, both clinical and radiographical examination need to be performed to assess the tooth's prognosis[15].

In this particular case, we were only able to document the patient's progress for 12 months because the patient did not report for their follow-up appointment after that time. It's important for patients to understand the favorable or unfavorable outcomes of any treatment, and to discuss all available treatment options with their dentist.

IV. CONCLUSION

After an avulsion, the preferred course of therapy is replantation. It not only satisfies the patient's functional and aesthetic concerns but also helps to maintain the surrounding bone. Despite the situation, replantation is always the ideal course of action since it preserves the bone's structure as it is crucial for future prosthetic rehabilitation (replacement with artificial tooth/teeth) if there might be any failure in the future.

Conflict of Interest Statement: Authors disclose no potential conflicts of interest
Funding: This work is not financiered
Ethics Statement: Not Applicable
Acknowledgements: NIL

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