



## Restorative and Endodontic Management of Avulsed Teeth and Complications Associated with It: A Narrative Review

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### ABSTRACT

Avulsion of permanent teeth is one of the rarest and most devastating dental injuries, accounting for 0.5% to 16% of all traumatic injuries. Because of their exposed location in the dental arch, the maxillary central incisors are the teeth most often afflicted, and the younger population is the most affected. Even with proper tooth replantation treatment, external root resorption (inflammatory/replacement) incidence is still significant. On the other hand, if several criteria are adhered to, the disease may advance slowly and eventually have a favorable prognosis. To assess the restorative and endodontic management options of avulsed teeth and list the complications associated with it. A narrative literature review from 2017 to 2023 was performed using PubMed, Medline, and ScienceDirect databases. The keywords used were "restorative management", "endodontic management", and "teeth avulsion". The treatment of trauma and avulsed teeth in patients can be multidisciplinary and take into account the endodontic approach, the existing bone capacity, and the pubertal growth stage in the case of adolescents.

**Key words:** Avulsed teeth, Restorative management, Endodontic management, Permanent teeth

### INTRODUCTION

#### Dental avulsions and their frequency

A severe traumatic dental injury is a tooth avulsion (a complete luxation, extrusion, or avulsion). It is a kind of dental trauma when the tooth is entirely forced out of the alveolar bone socket [1].

#### Studying epidemiology and population

Avulsion of permanent teeth is one of the rarest and most devastating dental injuries, accounting for 0.5% to 16% of all traumatic injuries. Because of their exposed location in the dental arch, the maxillary central incisors are the teeth most often afflicted, and the younger population is the most affected [1].

#### Complications and risk factors

After avulsion and dental replantation, infection, and root resorption are always possible. These events might impact the prognosis of the affected teeth and the treatment's success and survival rate [2].

#### Implications of dental avulsion

In addition, the effects of a dental avulsion vary from patient to patient and may include issues with the person's quality of life, psychological issues, social issues, and treatment expenses.

#### **Treatment with periodontal ligament cells**

The alveolar-dental ligament rupturing causes most periodontal ligament cells that remain on the root surface after a tooth avulsion. Hydrating these cells is necessary to prevent resorption, promote healing, and preserve the tooth's durability. On the other hand, inflammatory resorption happens when the extraoral duration lengthens and leaves the periodontal ligament dry [2].

#### **Factors influencing prognosis and resorption**

Even with proper tooth replantation treatment, external root resorption (inflammatory/replacement) incidence is still significant. On the other hand, if several criteria are adhered to, the disease may advance slowly and eventually have a favorable prognosis.

#### **The evolution of inflammatory and replacement resorption natural history**

After all, determining the appropriate prognosis for the replanted tooth depends on understanding the natural history of inflammatory and replacement resorption.

#### **Various factors influencing the replanted avulsed teeth management**

The incidence of external root resorption (inflammatory/replacement) might be considerable for patients with so-called accurate replantation, ranging from 59% to 80%. The impact of dry storage, crucial to the survival of periodontal ligament cells and may cause inflammatory resorption, has been the subject of several investigations [3].

#### **Best storage media and its effect**

Additionally, it has been shown that periodontal ligament cells may withstand a drying duration of 10 to 15 minutes. However, if the drying time is greater than 60 minutes, there may be very little chance that these cells will survive, which raises the risk of early resorption. Milk is still the ideal, well-balanced storage medium as a result. Since it maintains the periodontal ligament cells for many hours and retains them in excellent health till replantation, it is the most significant medium. A balanced solution of salt and saliva might also produce the same suggestive effects that milk has [4].

#### **Dental development and age**

An immature tooth develops more problems and has a shorter survival probability than a mature tooth, according to the parameters related to avulsion injuries.

#### **Affecting factors for root resorption**

This aspect was advantageous in past clinical research, with three teeth having closed apices. According to different research, a patient's age may significantly predict how root resorption in teeth with prolonged additional oral time would evolve. It is also true that patients between the ages of 17 and 39 exhibit more excellent rates than younger patients between the ages of 8 and 16 at the time of the avulsion trauma [4].

#### **Timing and extirpation of pulp**

Additionally, recent research demonstrates that the pulpectomy time is associated with the chance of having severe inflammatory resorption. To lower the chance of early difficulties, pulp extirpation after replanting has to be done as soon as possible. In past research, the intracanal calcium hydroxide was inserted three months before the obturation canals, and the pulpectomy was performed one week following the replantation. The most contentious part of caring for teeth that have been restored has changed several times throughout the years. Endodontic therapy, consisting of biomechanical preparation, obturation with gutta-percha, and sealer, was carried out extraoral before replantation in both clinical and experimental trials. These days, recommendations suggest doing endodontic therapy intraorally as it may cut down on several risk factors and extra time [5].

#### **Duration of dry time and risk of ankylosis**

According to a previously published clinical investigation on replanted teeth, the risk of ankylosis increases with longer dry times, and this risk is much more significant in mature teeth with closed apices than in immature teeth. Furthermore, it has been shown

that the incidence of internal and exterior root resorption—whether replacement or inflammatory—varies after dental avulsion and replantation. It was discovered that replacement root resorption is the most prevalent kind of root resorption, followed by inflammatory external root resorption, surface root resorption, and the least common type, internal root resorption [5].

### **Materials and Methods**

A narrative literature review from 2017 to 2023 was performed using PubMed, Medline, and ScienceDirect databases. The keywords used were "restorative management", "endodontic management", and "teeth avulsion".

### **Inclusion criteria**

- Case-control and randomized control studies
- Published between 2017 and 2023
- English language of publication
- In vivo (humans)

### **Exclusion criteria**

- Systematic reviews meta-analyses or expert opinions or narrative reviews
- Out of the specified time range
- Language other than English
- In vitro

### **Results and Discussion**

Replanting has been deemed contraindicated by periodontal disease. However, according to several studies, periodontitis is no longer a strict no-no for dental replantation. Compared to teeth with additional pockets and patients over 40, teeth with one periodontal pocket >6 mm in patients under 40 had a 2.5- and 2.6-fold decreased chance of failure. When having teeth replanted, these variables need to be closely monitored. Delay in replantation does not ultimately preserve bone volume since the bone vanishes along with the tooth, according to other research. The buccal contour of the alveolar bone in the maxilla's front part depends upon teeth with a viable periodontal ligament. The young patient in the past case study had stable periodontitis that was effectively treated, and since then, the maintenance phase of periodontal treatment has been carried out. Thus, the circumstances for the replantation of the three teeth were favorable. One may use the lack of bleeding and inflammation upon probing to predict periodontal stability [6].

### **The prognosis for permanently implanted avulsed teeth**

Avulsed permanent teeth that are replanted have varying prognoses. These include the degree of root growth, the extent of damage to the root surface, the extra-alveolar dry time, and the storage media used before replanting.

### **Affecting clinical success factors**

The endodontic therapy, antibiotic prescription, patient age, splinting type, and replantation duration are some variables that might affect the clinical outcome of tooth replantation. Positive results have been reported, with some teeth surviving more than 30 years. But tooth loss may also result from problems such as ankylosis and root resorption. A healing environment and tissue regeneration may be enhanced by efficient infection control.

Viability and Storage Medium Research indicates that using milk as a storage medium helps keep periodontal ligament cells viable, which improves the prognosis. Three replanted teeth in one example, exhibited no symptoms of ankylosis or root resorption over three years [7].

### **Factors affecting the prognosis**

The kind and timing of therapy, pulp removal within 7–14 days, replantation contraindications, and root development are some variables affecting an avulsed tooth's prognosis. Success rates may be increased using a suitable storage medium and replanting

immediately. Another important factor is patient compliance with follow-up visits and post-replantation treatment. To sum up, tooth avulsion is a severe dental injury with a vague prognosis [8]

### **The effect of tooth avulsion on replantation**

A tooth avulsion is the total extraction of a tooth from its socket due to unintentional or purposeful trauma. Replanting teeth is a crucial step in a successful course of therapy that is impacted by several variables. Some of these aspects include the extra-alveolar period, tooth storage, kind of retention employed, endodontic intervention timing, prescription medications, dental cleanliness, and overall health. Avulsion is a common occurrence during sports, school, and leisure activities. It is best treated quickly for a positive outcome [9].

### **The difficulties of treating tooth avulsion**

Despite being common, there needs to be more awareness of tooth avulsion care among the general public, educators, athletes, and medical professionals. The study aimed to assess how education affects various professional groups, emphasizing knowledge, prevention, and emergency treatment of avulsed teeth. Five different professional groups participated in the research, which was carried out in Brasília, DF, Brazil: pediatricians, primary school teachers, bank workers, dentistry experts, and physical education specialists. Participants were evaluated using a questionnaire given to them both before and after the presentation. Using the Wilcoxon test, analysis of the 479 returned questionnaires showed statistically significant changes in professional groups' performance after informational sessions ( $P < 0.0001$ ) [9].

### **Problems with replanted permanent avulsed anterior tooth**

Replantation of the avulsed permanent anterior teeth often results in complications. The two main side effects that are clinically significant are inflammatory root resorption and pulpal necrosis.

### **Necrosis of the pulpals**

The most frequent pulp consequence, necrosis, occurs when avulsion causes a vessel to rupture. The pulp suffers from infarction and coagulation necrosis, often resulting in microbial contamination. Bacterial exposure over time may lead to infection, which can stop pulp revascularization and result in complete pulp necrosis. Pulpal necrosis may be seen as soon as two weeks after replanting and continue for up to two years [10].

### **Inflammatory root resorption**

During trauma, mechanical injury is a direct cause of the formation of inflammatory root resorption. Dentinal tubules are exposed to the surrounding periodontal ligament and bone when the cementum is lost. Bacterial contamination and untreated pulpal necrosis both aggravate and contribute to the inflammatory process of root resorption. This problem, which affects around 23% of replanted avulsed permanent anterior teeth, may be identified eight months after the initial tooth extraction. To increase their knowledge and help patients suffering from dental trauma, experts in various areas must have a thorough grasp of tooth avulsion and how to treat it [10].

### **Handling of intricacies**

Its failure and early loss may be lessened with prompt and appropriate care of the problems of replanting an avulsed permanent anterior tooth. Inflammatory Root Resorption and Pulp Necrosis to avoid the complications of pulpal necrosis, replanted mature avulsed permanent anterior teeth should have their pulp extracted as soon as possible. Inaction on the dentist's part will result in an unchecked infection and the development of inflammatory resorption, which will ultimately cause tooth loss. The pulp's revascularization is possible in a transplanted immature avulsed permanent front tooth. During follow-ups, it has to be closely observed. If there are radiographic and clinical indications of inflammatory root resorption, immediate root canal therapy is recommended. The restored tooth should be examined for any indications of new infections after root canal therapy.

### **Avulsion of tooth and interim restorations**

Most permanent anterior tooth avulsion cases happen in children and teenagers when facial development is not fully developed. As a result, before receiving more permanent treatment, patients may need to wear non-invasive interim restorations throughout

this growing phase. The available temporary restorations include metal FDPs that are resin-bonded and detachable retainers. Ceramic FDPs glued with resin Composite resin-bonded restorations reinforced with fibers After 4.5 years, 73% of resin-bonded FDPs and composite resin-bonded restorations still exist. When using premolars to replace maxillary incisors, the success rate of tooth auto transplantation may be pretty high (i.e., 100% at 4.8 years). Implant placement should wait until the skeletal development is finished. Consequently, this is a significant drawback when considering cosmetic treatment with implants as a management option for children's and teenagers' failed replanted avulsed permanent anterior teeth. Consequently, the treatment approach for anterior permanent tooth loss resulting from avulsion or a failed attempt to replant an avulsed permanent anterior tooth should consider the patient's age [11].

#### **Avulsion of the tooth among adults: Prevalence**

Among persons eighteen years of age and older, the incidence of tooth avulsion varied from 5% to 15%. With a decline in age, the frequency of people experiencing tooth avulsions rises. Research indicates that adults between the ages of 18 and 30 report the fewest tooth avulsions (15%) as compared to children (68%), adolescents (17%), and young adults (17%). Little children's comparatively strong alveolar bone offers little defense against extrusive pressures. In 2017, the National Oral Health Survey of Schoolchildren revealed that the prevalence of traumatized anterior teeth among children under 16 was 7.2%. This figure is less than what previous studies have shown. Of the 12-year-olds with traumatized anterior teeth, 84.5% were left untreated. Avulsion of permanent teeth occurred between the ages of 10 and 13 years, with permanent maxillary incisors accounting for most occurrences, according to local retrospective research conducted between 2001 and 2006. Different age groups have different causes of traumatic dental injury [12].

#### **Adolescent trauma associated with Sports**

Car accidents are the most common source of damage to anterior teeth in late teens and young adults. In contrast, sports-related accidents are the leading reason for anterior tooth trauma in adolescents. Among young children, motor vehicle accidents accounted for 57% of the cases of tooth avulsion, followed by falls at 40% and being struck by an item at 3%. The Paediatric Dental Specialist received referrals for almost 80% of the patients from the nearby hospital's Accident and Emergency Department. One of the frequent effects of domestic abuse in women, children, adolescents, and older people of both genders has also been documented to be avulsion. Avulsion of the tooth and other traumatic dental injuries were more common in males than in girls. Boys are often more gregarious and drawn to physically demanding outdoor activities than females. Children with insufficient lip covering, an overjet of more than 5 mm, and Class II Division 1 malocclusion had a considerably more significant risk of severe dental injury [13, 14].

#### **Managing avulsed permanent anterior teeth is difficult**

Handling permanently impacted anterior teeth might be upsetting, especially in emergencies. Healthcare and public officials seem to be ignorant about how to handle avulsed permanent anterior teeth, which leads to improper handling and treatment, delays in seeking treatment, and unjustified implications for the avulsed tooth's prognosis. Therefore, creating efficient interventional techniques is crucial to preventing or lessening the detrimental impacts of tooth avulsion on social and psychological issues, quality of life, and the high expense of treatment for patients and healthcare providers alike [15].

#### **Difficulties in replacing root resorption or managing ankylosis**

The care of replacement root resorption or ankylosed replanted avulsed permanent anterior teeth needs to be better supported by high-quality research, which presents a significant barrier to clinical practice. Its care is complex and requires multidisciplinary planning for both short- and long-term therapy. In developing youngsters, tooth ankylosis often results in an eruption failure that causes infra-occlusion. It causes space loss, neighboring tooth tilting, and poor aesthetics by interfering with the development of local alveolar growth. Replacement root resorption may proceed quickly in young children, mainly if discovered before age ten [14].

#### **Dental ankylosis in elderly individuals**

Conversely, tooth ankylosis in older adults is a desirable result. This age group has reached skeletal maturity, and replacement resorption is progressing slowly. Small amounts of infra-occlusion may raise only a few aesthetic issues. The tooth that has been

ankylosed may endure for many years until the whole root is replaced by bone. The crown may eventually fall out on its own or need surgery.

### Management points to remember

Clinicians should base their treatment strategy for ankylosed, replanted, avulsed permanent anterior teeth on their experience, expertise, and the desires and viewpoints of their patients. The following are the interventions of replanted, avulsed, ankylosed permanent anterior teeth:

Dental autotransplantation; crown decoration; surgical luxation or purposeful luxation; distraction osteogenesis in orthodontic therapy; surgical osteotomy and distraction osteogenesis; and minor crown changes using composite build-up

The most often carried out treatments among all the approaches above are decoration and tooth autotransplantation. Conversely, specific methods are unique and may not be repeated because of how the examples are presented [15].

### Treatment of permanent anterior teeth that are avulsed

When a suitable donor is available, tooth autotransplantation in healthy, developing children and adolescents may be considered a substitute for ankylosed, replanted, avulsed permanent anterior teeth. The most often used donor tooth in autotransplantation is the premolar. Before executing premolar autotransplantation, orthodontic consulting must be included in the treatment planning as part of a multidisciplinary team approach. The 10-year survival rate of autotransplant teeth with incomplete root development was 96.3% (CI 89.8 – 98.7%) in a meta-analysis, whereas the weighted annual success rate was 96.6% (CI 97.8 – 94.8%). It was discovered that the incidence of problems, including pulp necrosis, root resorption, and ankylosis, was minimal [16, 17].

### Conclusion

The treatment of trauma and avulsed teeth in patients can be multidisciplinary and take into account the endodontic approach, the existing bone capacity, and the pubertal growth stage in the case of adolescents. Autotransplantation, even though it offers somewhat great success rates, needs repeated follow-up and control of possible complications, such as inflammatory resorption. When interdisciplinary management is executed in a way in which the outcome is expected, the overall results are biologically favorable, aesthetic, and functional.

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