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Avulsion and Replantation

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Department of Pedodontics and Preventive Dentistry
in Partial Fulfillment for the Bachelor of Dental Surgery.

By

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Certification of the Supervisor

I certify that this project entitled "**Avulsion and Replantation**" was prepared by the fifth-year student **Maryam Mowafak Mohammed** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the bachelor's degree in Dentistry.

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To **my father Mowafak**, my biggest inspiration and my strength, your guiding hand on my shoulder will remain with me forever.

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List of abbreviations

PDL	Periodontal ligament
HBSS	Hank's Balanced Salt Solution
Ni-Ti	Nickel titanium
CaOH	Calcium hydroxide

Introduction

Accidents involving anterior teeth are very common. The consequences may range from small tooth fractures to a complete dislocation of the tooth from its alveolus, characterizing a scenario of dental avulsion (**Grewal *et al.*, 2015**). It is noted that avulsion or exarticulation is regarded as one of the serious types of traumatic dental injuries (**Adnan S *et al.*, 2018**).

Immediate replantation is widely accepted as the most appropriate treatment for a traumatically avulsed permanent tooth; however, this is not most often feasible. It has been suggested to temporarily store avulsed teeth in a suitable storage medium (**Al-Asfour and Andersson 2008; Al-Asfour *et al.*, 2008; Vergotine and Govoni, 2010**).

The International Association of Dental Traumatology and American Academy of Pediatric Dentistry acknowledged that dental injuries could have improved outcomes if the public was aware of first aid measures and the need to seek immediate treatment. A number of studies have evaluated the knowledge of parents regarding immediate management of traumatized teeth and found the knowledge level to be low (**Zakirulla *et al.*, 2011**). Hence, it is important to improve their knowledge about the immediate and proper first-aid steps to be taken at the site of the accident (**Grewal *et al.*, 2015**).

The low level of awareness among general public and medical practitioners often leads to delay in seeking treatment which often leads to pain, severe symptoms, and poor prognosis. Pediatricians can play a significant role in identification of traumatic dental injuries, health advise, emergency care and referral to dentists (**Tewari *et al.*, 2019**).

Aims of the review

The aims of this review to known the cause and how to save tooth that avulsed by determine the factor that effect on appropriate treatment plane of avulsion tooth.

Chapter one: Review of literature

1.1 Definition of avulsion

Tooth avulsion implies total displacement of an intact tooth out of its socket, the frequency of tooth avulsions following traumatic injuries ranges from 0.5% to 16% in permanent dentition and from 7% to 13% in the primary dentition, it has been suggested that the avulsion of the tooth is briefly favored by the malleability of the alveolar bone and thin structured periodontal ligament (Kumar *et al.*, 2017).

1.1.1 Prevalence of avulsion tooth

Ten percent of the population, in general, has experienced some kind of dental trauma, of these, around 0.5-16% are reported cases of dental avulsion. Boys showed a higher prevalence of traumatic injuries as compared to girls in the ratio of 2:1. Because the peak age for avulsion of permanent incisors is between 7 and 9 years, most research has focused on parents and school teachers as the groups most commonly supervising children of this age (Castilho *et al.*, 2009).

The maxillary teeth in both primary and permanent are most affected by trauma, especially the central incisors due to its position (Kramer *et al.*, 2003, Granville-Garcia *et al.*, 2010). During the 9-year period, 5.87% of all traumatic dental injuries referred to our clinic consisted of avulsion injuries (Karayilmaz *et al.*, 2013).

1.1.2 Avulsion of primary teeth

The most frequent types of dental traumas in primary teeth are intrusion and avulsion (Carvalho *et al.*, 2010). Developmental disturbances in permanent teeth caused by trauma in their predecessors have a frequency that ranges from 12-74% (Sennhenn-Kirchner and Jacobs, 2006). This high frequency is due

mainly to the close anatomical relationship between the apices of primary teeth and their developmental permanent successors (**Diab and EIBadrawy, 2000**).

Avulsed primary teeth are not replanted, a high failure rate because of pulp necrosis, infection, possible damage to the permanent dentition is given as reasons (**de Carvalho Rocha and Cardoso, 2008**).



Figure (1-1) there is almost no indication for the replantation of an avulsed primary tooth. There is more risk of damage to the permanent tooth than there is benefit gained by replacing the tooth (**Cameron and Widmer, 2013**).

1.1.3 Avulsion of permanent teeth

Avulsion of the permanent incisor is the one of most serious emergencies in traumatology (**Andreasen et al., 2018**).The permanent anterior teeth apart from being an essential component of the aesthetic zone, is also essential for day to day communication, mastication and psychological and mental health of children, thus keeping this in mind, immediate replantation of an avulsed permanent tooth is often considered as the treatment of choice which can aid in enhanced self-confidence and improved self-perception of the children (**Shashikiran et al., 2006**).If cannot be replanted, the tooth should be placed in suitable storage medium (**Rao, 2012**). It represents frequent among the age group 8-11 years old At this age, the alveolar bone has limited resilience to

extrusive forces, the roots are shorter and thinner, and the ligament fibers are more flexible (**Oliveira et al., 2007**).

Upper central incisors are the most affected teeth, causing thereby aesthetic and functional disturbances, at the origin of inconveniences for the children and their families. (**Hassan, 2021**)

1.2 Causes of avulsion

Etiology of trauma may be categorized into the following:

1. Intentional injuries—child abuse and neglect.
2. Unintentional accidents such as road accidents, Sporting activities—contact sports, bicycle or horse riding, falls or collisions, inappropriate use of teeth and handicapped children.

Dental injury in young children is usually due to lack of motor coordination, i.e. during the first year of life as due to fall when the child learns to walk (**Andersson et al.,2018**).

1.3 Clinical and radiographic features

Clinically bleeding socket with missing tooth is seen as shown in (fig.1-2). While the Radiographic Features are

- Empty socket as show in (fig.1-3)
- Associated bone fractures.
- If the wound is recent then lamina dura is visible otherwise it is obliterated(**Dean, 2021**).



Figure(1-2) bleeding socket with missing tooth (**Marwah, 2018**).

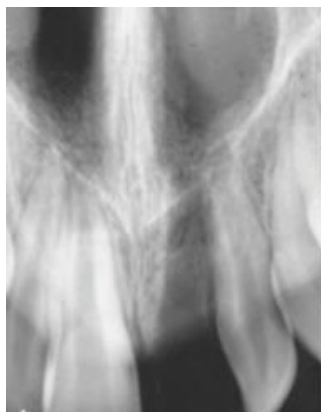


Figure (1-3), Radiograph of a patient who lost a central incisor as the result of trauma. Replantation was performed (**Dean, 2021**).

1.4 Storage media

An avulsed tooth is recommended to be immersed in a suitable storage media when immediate replantation cannot be conducted (**De Brier N *et al.*, 2020**). However, two key factors largely predict the prognosis of the replanted tooth, including

(a) the extra-oral time of the avulsed tooth and

(b) characteristics of storage media used to store the avulsed tooth prior to replantation (**Kinirons *et al.*, 2000**), and it is thus critically important to select an optimal media to preserve avulsed tooth at the suitable time. The search for a single, ideal storage medium that is capable of maintaining periodontal ligament

(PDL) and pulp cell viability, no or minimal microbial contamination, compatible physiological pH and osmolality, high availability, ready accessibility and low cost (**Gopikrishna *et al.*, 2008; Thomas *et al.*, 2008; Mori *et al.*, 2010**). Several media could be used to store the avulsed tooth till replantation such as:

1.4.1 Tap water

Tap water Has inadequate characteristics to be used as a storage medium for avulsed teeth because it has bacterial contamination, hypotonicity, and non-physiological pH and osmolality, which favors the PDL cells lysis (**Pearson *et al.*, 2003; Goswami *et al.*, 2011; Malhotra, 2011**)

Several studies have shown that cells stored in water did not maintain their morphology, with visible destruction and rapid cell death (**Hwang *et al.*, 2011; Thomas *et al.*, 2008; De Souza *et al.*, 2010**). In view of this, tap water should be used only to avoid tooth dehydration, but it is inadequate for conservation of avulsed teeth.

1.4.2 Saliva

Saliva similar to water, human saliva (buccal vestibule) is used as a storage medium due to its availability, but it has unfavorable characteristics, such as non-physiological pH and osmolality, high microbial contamination and hypotonicity (**Schwartz *et al.*, 2002; De Sousa *et al.*, 2008; Goswami *et al.*, 2011; Malhotra, 2011**).

Saliva is inefficient to maintain cell viability , but it is preferable to use it rather than keep the tooth in dry conditions because the effects of resorption become more severe with time (**Casaroto *et al.*, 2010**). Water and saliva are similar and cause a rapid lysis of the cell membrane, have pH and osmolality incompatible to the cells, in addition to being contaminated media, particularly

saliva, because the oral cavity hosts a wide resident and transient microbiota, these media for storage of avulsed teeth ultimately show a very poor efficacy and they were frequently used as negative availability, it is more convenient to use them for short periods than let the tooth dry out (**Poi *et al.*, 2013**).

1.4.3 Saline

Has physiological osmolality and pH, but it does not contain essential ions and glucose, which are fundamental for the cells (**Caglar *et al.*, 2010, Malhotra, 2011**), and for this reason has been suggested as an interim storage medium for up to 4 hours (**Pileggi *et al.*, 2002; Martin and Pileggi, 2004; Moreira-Neto *et al.*, 2009**), saline had a worse behavior compared with hank's balanced salt solution (HBSS) and milk concluded that water was worse than saline. Consequently, saline is not an adequate medium, but it may be employed for short periods of time (**Özan *et al.*, 2008**).

1.4.4 Milk

Has several favorable characteristics as a storage medium for avulsed teeth, as it is an isotonic liquid with an approximately neutral pH and physiological osmolality, has low or no bacterial content, contains growth factors and essential nutrients for cells, in addition to having a high availability mostly everywhere and low cost (**Goswami *et al.*, 2011, Malhotra, 2011**). Being a gland secretion, milk contains epithelial growth factor, which stimulates the proliferation and regeneration of epithelial cell rests of Malassez and activates the alveolar bone resorption.

This will ultimately contribute to isolate the bone tissue from the tooth and decrease the likelihood of ankylosis(**Consolaro, 2005**).

1.4.5 Hank's Balanced Salt Solution

Has been especially developed for cell maintenance and thus, theoretically, it allows a better conservation of tissues for long time periods. It has been widely employed as a reference solution in studies on dental avulsion as it has the ideal osmolality and pH for preserving the vitality of cells to PDL cells and provide conditions for cell proliferation, therefore can be indicated for use as storage media for avulsed teeth. It has demonstrated their excellent efficacy (**Sottovia *et al.*, 2010; Goswami *et al.*, 2011; Hwang *et al.*, 2011**), but their lack of availability and high cost make their routine use unviable, and thus these solutions are used in very special cases, such as laboratory studies (**Poi *et al.*, 2013**).

1.5 Replantation

Replantation refers to the insertion and temporary fixation(splinting) of completely or partially avulsed teeth that have resulted from traumatic injury, replantation restores occlusal function and esthetics shortly after injury (**Keklikoglu and Asci, 2006**).the success of replantation depends on:

- The vitality of the cells remaining on the root surface (**Puri *et al.*, 2011**).
- The length of extra oral dry time (**Singla *et al.*, 2010**).
- And the stage of root development (**Puri *et al.*, 2011**).

In replantation complete reestablishment of vitality of periodontal fibers is the prime objective. The reattachment of periodontal fibers and the formation of Sharpey fibrils occur about 2 weeks after replantation (**Keklikoglu and Asci, 2006**). If the tooth has been out of the mouth for under 30 minutes, the prognosis is therefore more favorable. Also, if the apical end of the tooth is

incompletely developed at the time of the injury, there is a greater chance of regaining pulp vitality after replantation (**Dean, 2021**).

Treatment is often complex, time-consuming, expensive and requires multidisciplinary approaches such as endodontic and periodontal treatment, surgery, orthodontic movements and esthetic coronal restoration (**Puri *et al.*, 2011**).

1.5.1 Techniques of replantation

If an evaluation of the socket area shows no evidence of alveolar fracture or severe soft-tissue injury, the tooth is intact, and only a few minutes have elapsed since the injury, the dentist should replant the tooth immediately. Under the conditions just described, every effort should be directed toward preserving a viable periodontal ligament (**Trope, 2002**).

If the tooth was cleanly avulsed, it can probably be replanted without local anesthetic, and obtaining the initial radiograph can also be delayed until the tooth is replaced in the socket and held with finger pressure. The minutes saved may contribute to a more successful replantation. If a clot is present in the socket, it will be displaced as the tooth is repositioned; the socket walls should not be scraped with an instrument. If the tooth does not slip back into position with relative ease when finger pressure is used, local anesthesia and a radiographic evaluation are indicated. Local anesthetic should also be administered when fractured and displaced alveolar bone must be repositioned before the tooth is replanted. Soft-tissue suturing may be delayed until the tooth has been replaced in the socket; however, the suturing should be performed to control hemorrhage before the tooth is stabilized with a bonded splint (**Dean, 2021**).



Figure(1-4) the avulsed tooth is replaced in the socket with gentle finger pressure (**Koch *et al.*, 2017**)

1.5.1.1 Prognosis of Replanted tooth

Factors that affecting the prognosis of replanted tooth are: (**Rao, 2012**)

- Maintenance of the periodontal ligament .
- A short time between tooth loss and replantation.
- Immaturity of the tooth to be replanted
- The undertaking of root canal therapy.

1.5.2 Splinting of a traumatized tooth

A splint has been defined as ‘an apparatus used to support, protect or immobilize teeth that have been loosened, replanted, fractured or subjected to certain endodontic surgical procedures (**McClanahan *et al.*, 2020**), the purpose of splinting is to stabilize the tooth in the arch in order to prevent further damage to the pulp and periodontal tissues. The term splint has been defined by the American Association of Endodontic (**Seo *et al.*, 2012**), as a ‘rigid or flexible device or compound used to support, protect or immobilize teeth that have been loosened, replanted, fractured or subjected to certain endodontic surgical procedures (**Malhotra *et al.*, 2011**), the Properties of an Ideal Splint are: (**Rao, 2012**)

1. Should be quick and easy to fabricate.
2. Should be atraumatic to the teeth and gingiva.
3. Should be adequately stable throughout the healing period.
4. Should have access to endodontic therapy if needed.
5. Should be as esthetically pleasing as possible.

1.5.3 Types of splints

There are many types of splints in current use:

a. Composite and wire splints

Most of modern teeth splinting methods require an acid etch technique. The devices are usually bonded to the labial surface of the teeth. The splints, which are one of the most widely used in dental practice, are wire-composite splints. The wires made from stainless steel suitable for this kind of splint are, for example, a rectangular orthodontic wire (0.41 mm x 0.41 mm), a multi-stranded flexible orthodontic wire or a ligature round wire with less than 0.4 mm in diameter. Nickel-titanium(Ni-Ti) wires are also used (**Sobczak-Zagalska and Emerich, 2020**).

b. Orthodontic brackets and wire splint

This splint involves orthodontic brackets bonded to the teeth with a resin-based orthodontic cement and connected with a light 0.014 NiTi flexible wire. (**Kahler et al., 2016**).The tooth to be splinted and the adjacent teeth on both the sides are fitted with brackets or bands. 0.3 mm soft wire is then braided from bracket to bracket to connect all the teeth. Care should be taken to avoid orthodontic force application on the teeth But this can be advantageous if simultaneous tooth movement and tooth repositioning is needed(**Rao, 2012**).

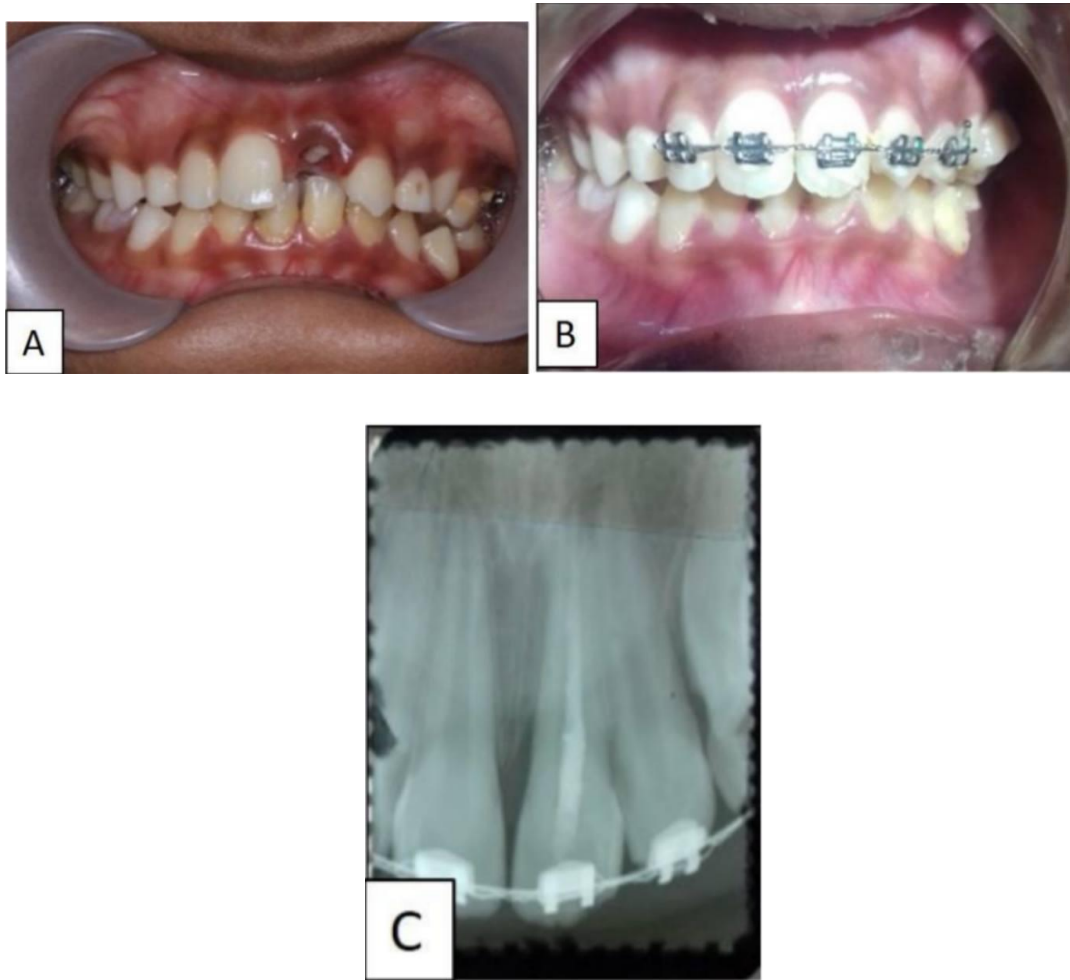


Figure (1-5) (a) Intra Oral Examination before treatment in the first case; (b) Intra Oral Examination after treatment using orthodontic appliance; (c) 3-month evaluation periapical radiographs (**Wahluyo *et al.*, 2018**).

c. The titanium trauma splint

Are specially designed to stabilize the teeth after repositioning or replantation titanium trauma splint , with its unique rhomboid mesh structure, is only 0.2 mm thick, it is easily adaptable to the dental arch, and rhomboid opening facilitates its application (**Sobczak-Zagalska and Emerich, 2020**)



Figure (1-6) the arch bar and ligature splint has been replaced with a titanium trauma splint. Gross gingival irritation caused by the arch bar splint is evident (Kahler *et al.*, 2016).

d. Acid etch composite resin splint

It consists of a thick band of composite resin that extends on the labial surface of the teeth required to be stabilized and onto at least one tooth on either side of the traumatized tooth. This splint is strong, easy to fabricate, more esthetic and provides access for root canal therapy (Rao, 2012).

1.6 Treatment of avulsed tooth

The choice of treatment is related to the maturity of the root (open or closed apex) and the condition of the periodontal ligament (PDL) cells. The condition of the PDL cells is dependent on the time out of the mouth and on the storage medium in which the avulsed tooth was kept. Minimizing the dry time is critical for survival of the PDL cells. After an extra-alveolar dry time of 30 minutes, most PDL cells are non-viable (Barbizam *et al.*, 2015), For this reason, information regarding the dry time of the tooth prior to replantation or prior to being placed in a storage medium is very important to obtain as part of the history. From a clinical point of view, it is important for the clinician to assess the condition of the PDL cells by classifying the avulsed tooth into one of the following three groups before commencing treatment (Fouad *et al.*, 2020) :

1. The PDL cells are most likely viable. The tooth has been replanted immediately or within a very short time (about 15 minutes) at the place of accident.
2. The PDL cells may be viable but compromised. The tooth has been kept in a storage medium (e.g. milk, HBSS (Save-a-Tooth or similar product), saliva or saline, and the total extra-oral dry time has been less than 60 minutes).
3. The PDL cells are likely to be non-viable. The total extra-oral dry time has been more than 60 minutes, regardless of the tooth having been stored in a medium or not.

1.6.1 Treatment of avulsed tooth with open apex

When immature teeth with open apices are avulsed, the ideal treatment objective is spontaneous revascularization of the pulp in addition to maintenance of PDL health. This would enable physiologic maturation of the immature root, including apexogenesis and root wall thickening. The tooth should be splinted for approximately 1 to 2 weeks. Success in these cases has been reported; therefore, dentists should await clinical or radiographic signs of necrosis before initiating regenerative endodontic therapy. When the splint is removed, the dentist may note that the tooth is quite mobile. This mobility is preferable to long-term rigid splinting because the latter has been correlated with an increased incidence of replacement resorption. The mobility of the tooth physiologically interrupts areas of incipient resorption/ankylosis on the PDL, allowing it to heal normally (**Nowak *et al.*, 2018**)

1.6.1.1 Extraoral dry time less than 60 minutes for open apex

The tooth has been kept in physiologic storage media or osmolality-balanced media (milk, saline, saliva, or Hanks' Balanced Salt Solution) and/or stored dry for less than 60 minutes(Dean, 2021).

The procedure is:

- Clean the root surface and apical foramen with a stream of saline.
- Topical application of antibiotics has been shown to enhance chances for revascularization of the pulp and can be considered if available (minocycline or doxycycline 1 mg per 20 mL saline for 5-minute soak).
- Administer local anesthesia.
- Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument.
- Irrigate the socket with saline.
- Replant the tooth slowly with slight digital pressure.
- Suture gingival lacerations, especially in the cervical area.
- Verify normal position of the replanted tooth clinically and radiographically.
- Apply a flexible like Composite and wire splints for up to 2 weeks.
- Administer systemic antibiotics.
- If the avulsed tooth has been in contact with soil and if tetanus coverage is uncertain, refer to physician for a tetanus booster.

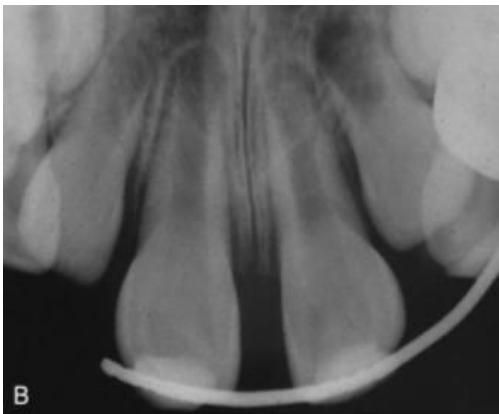
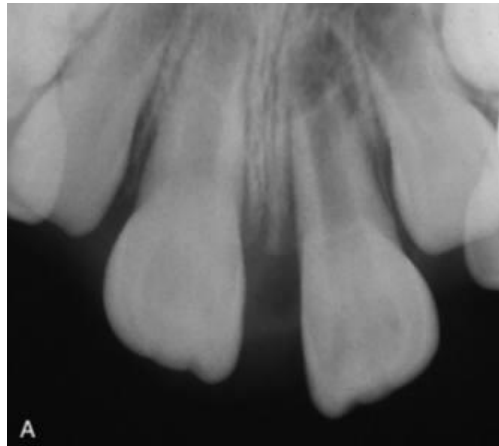


Figure (1-7) A, radiograph of an avulsed maxillary right central incisor, with incomplete root development. B, Radiograph of the avulsed central incisor showing that it is now at the desired position and has been stabilized with a section of 0.028-inch stainless steel wire.C, Splint in place at the end of the initial appointment (Dean, 2021).

1.6.1.2 Extraoral dry time more than 60 minutes for open apex

A tooth with a dry time in excess of 1 hour will have virtually no viable PDL cells on its root surface, It has been concluded that the ‘60-minute

mark' of dry time is the critical point at which PDL cell damage occurred (**Harlamb, 2016**). As a result, the management of the avulsed immature tooth with a dry time in excess of 1 hour is complex (**Malmgren *et al.*, 2006**). The revised International Association of Dental Traumatology confirmed the prognosis for such teeth is poor with resorption and ankylosis to be expected. However, replantation is recommended (delayed replantation) 'for aesthetic, functional and psychological reasons and to maintain alveolar contour (**Andreasen *et al.*, 2012**).

1.6.2 Treatment of avulsed tooth with closed apex

In mature teeth with closed apices, a splint that affords the tooth functional mobility should be applied for 7 to 14 days. The necrotic pulp should be extirpated and replaced with calcium hydroxide (CaOH) after 1 week to prevent the initiation of rapidly progressing root resorption. Importantly, root canal therapy should not be performed in the hand before replantation. This extends the extraoral period and places the PDL at greater risk to injury as a result of the additional manipulation of the tooth. The CaOH can be removed and a gutta-percha pulpectomy performed after 2 weeks. In those cases where the pulp was not removed within 2 to 3 weeks of the replantation, or when rapidly progressing resorption is evident radiographically, the CaOH should be maintained in the tooth until radiographic signs of healing are apparent (**Nowak *et al.*, 2018**).

1.6.2.1 Extraoral Dry Time less than 60 minute for closed apex (Dean, 2021)

The tooth has been kept in physiologic storage media or osmolality-balanced media (milk, saline, saliva, or Hanks' Balanced Salt Solution) and/or stored dry for less than 60 minutes.

The same procedure followed with the open apex:

Clean the area with water spray, saline, or chlorhexidine then Re-implant the tooth in the socket besides root canal treatment 7-10 days after replantation and before splint removal.

1.6.2.2 Extraoral Dry Time of more than 60 Minutes with Either Open or Closed Apex (Rao, 2012)

- Soaking is ineffective as all the cells might have died.
- Here the aim is to make the root resistant to resorption.
- The tooth may be soaked in citric acid for 5 minutes, then in 2% stannous fluoride for 5 minutes and then in doxycycline for 5 minutes before replanting it.

1.6.3 Endodontic Management of permanent Replanted Teeth

All replanted permanent teeth with complete apical root development should undergo a pulpectomy soon after re-plantation regardless of the length of time the tooth was out of the mouth. Even though a few reports of revitalization exist, the chances for revitalization are remote at best. Moreover, adverse reactions are virtually certain if degenerating pulp tissue is allowed to remain in the canals for more than a few days. The risk-benefit ratio for the patient favors pulpal extirpation (**Dean, 2021**), because replantation should be done as soon as possible after the injury, the dentist should not take time to extirpate the pulp before replantation, the pulp should be extirpated before the splint is removed, however, and preferably within 1 week after the injury (**Trope, 2002**). Thus, infection of the pulp space is believed to be established as early as 2–3 weeks

after replantation ,there is consensus that in mature teeth, early root canal treatment is mandatory (**Fouad *et al.*, 2020**).

It was recommended to schedule the initiation of root canal treatment to 7–10 days after replantation (**Andersson *et al.*, 2012**) if root canal treatment is initiated within 2 weeks post-replantation (**Fouad *et al.*, 2020**). Depending on the severity of periodontal damage caused during extraoral storage either periodontal healing or tooth ankylosis can be expected (**Kenny *et al.*, 2003, Lauridsen *et al.* 2019**), to increase the survival of teeth and achieve periodontal healing following replantation, immediate placement of alternative intracanal medicaments containing an antibiotic–corticosteroid paste, such as Ledermix has been proposed (**Trope, 2011**). In contrast to CaoH, Ledermix may be placed immediately or shortly following replantation (**Andersson *et al.*, 2012**).

Its main preventive mechanism against root resorption does not rely on an antibacterial effect, but on the direct inhibition of odontoclasts by detaching the resorbing cells from the root surface, although both the steroid (triamcinolone acetonide) and the tetracycline (demeclocycline hydrochloride) components in Ledermix have antiresorptive properties (**Krastl *et al.*, 2021**).

1.7 Systemic Antibiotics

Even though the value of systemic administration of antibiotics is highly questionable, the periodontal ligament of an avulsed tooth often becomes contaminated by bacteria from the oral cavity, the storage medium or the environment in which the avulsion occurred. Therefore, the use of systemic antibiotics after avulsion and replantation has been recommended to prevent infection-related reactions and to decrease the occurrence of inflammatory root resorption. Additionally, the patient’s medical status or concomitant injuries may warrant antibiotic coverage. In all cases, appropriate dosage for a patient’s age and weight should be calculated. Amoxicillin or penicillin remain the first

choices due to their effectiveness on oral flora and low incidence of side effects. Alternative antibiotics should be considered for patients with an allergy to penicillin. The effectiveness of tetracycline administered immediately after avulsion and replantation has been demonstrated in animal models (**Fouad *et al.*, 2020**). Specifically, doxycycline is an appropriate antibiotic to use because of its antimicrobial, anti-inflammatory and anti-resorptive effects. However, the risk of discoloration of permanent teeth must be considered before systemic administration of a tetracycline in young patients. Tetracycline or doxycycline are generally not recommended for patients under 12 years of age (**Andreasen *et al.*, 2006**).

1.8 Complications Following Avulsion

Several outcomes of early loss of primary incisors such as Loss of space can be expected if the injury occurred before eruption of the primary canines and in children with a crowded dentition. If primary incisors are lost before the child masters articulation, speech development may be affected (**Adewumi *et al.*, 2012**). However, articulation becomes normal after eruption of the permanent teeth. The impact to the primary incisor pushes the tooth into the surrounding tissues before the tooth is completely detached from the PDL and damages the permanent successors in 38% to 85% of cases. The younger the child is when injured, the higher the prevalence of damage to the permanent teeth (**Casamassimo *et al.*, 2012**). Delayed and ectopic eruption of permanent incisors in cases of avulsion of their primary predecessors have been described and attributed to lack of guidance, development of scar tissue, and deflection of the developing permanent tooth bud by the injured primary incisor (**Andreasen *et al.*, 2018**). Anatomic and histological deviations due to injuries to developing teeth can be classified as follows (**Marwah, 2018**):

- White or yellow brown discoloration of enamel.

- White or yellow brown discoloration of enamel with circular enamel hypoplasia.
- Crown dilacerations.
- Odontoma like malformation
- Root duplication.
- Vestibular root angulation.
- Lateral root angulation or dilacerations.
- Partial or complete arrest of root formation.
- Sequestration of permanent tooth germs.
- Disturbance in eruption.



Figure(1-8) Left maxillary primary central incisor 1 year after color change due to trauma (**Casamassimo *et al.*, 2012**).

Chapter two: Conclusion

- Dental injury prevention and management should be recognized as a major public health issue and, it is necessary to introduce programmers for parents to raise their level of awareness of avulsion specially avulsion of permanent teeth.
- Primary teeth that avulsed should not be replanted because it causes injury to permanent successors.
- The lower the age at the time of injury, the greater the risk of developmental disturbances in the permanent successors, discoloration was the most frequently seen developmental disturbance in the permanent successors.
- The replantation should be done as soon as possible ideally within minutes after trauma. If lay people do not feel comfortable to perform this procedure, they can place the tooth in a storage medium and consult the dentist immediately.
- The dentist must has the ability to communicate properly, using appropriate behavior-management techniques to win the child's confidence and to get the good prognosis to avulsion tooth.

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