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# Reimplantation of primary tooth – case report

## CASE REPORT

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**Abstract** – This article reports a clinical case of a primary tooth avulsion followed by dental reimplantation and endodontic treatment according to the protocol established by the Federal University of Santa Catarina for the treatment of traumatized primary teeth. A patient, 2 years and 6 months of age, MR, suffered the avulsion of tooth 61 because of a fall at school. The child was given dental assistance within 30 min, and the avulsed tooth was stored in milk during the period. After radiographic examination, the tooth was reimplanted and splinted. This procedure was performed after having obtained the mother's permission. Endodontic treatment was implemented a few days after the reimplantation because of the pulp necrosis that originated from a neurovascular bundle rupture. The endodontic treatment consisted of calcium hydroxide manipulated using glycol propylene dressings. After 12 months of treatment, the avulsed tooth presented the absence of periapical bone rarefaction in addition to a dry root canal, presenting ideal conditions for a definitive obturation. The obturation was applied using ZOE. The follow-up procedures on the obturated tooth were performed until the total eruption of the succeeding permanent tooth had been achieved, with no sequelae. Reimplantation, followed by endodontic treatment performed according to biological principles, has proven to be a good option for avulsed primary teeth.

Avulsion is considered to be the most severe dental trauma, because of the fact that the force incurred upon the tooth is strong enough to completely remove it from the alveolus, generating a lesion in the periodontal ligament and the rupture of the neurovascular bundle.

The avulsion of primary teeth is the second type of trauma, occurring after the intrusion associated with alterations in the permanent succeeding teeth (1–4). Such alterations may include hypoplasia, affecting only the enamel or the enamel and the dentine, hypocalcification, or even dilacerations of the crown or succeeding tooth root (5).

The existing proximity between the root apex of the primary tooth and the germen of the succeeding tooth explains the risk of developmental disturbances in the permanent tooth. In addition, this points toward the fact that most alterations are located in the buccal face (4). However, in cases of avulsions, the alterations are related to the direction and the force of impact, which frequently occurs in the region of the labial filter (6).

Avulsion, even of permanent or primary teeth, represents a challenge to the clinicians, especially the pedodontist. Beyond the difficulties that the trauma itself originates, when it occurs in a primary tooth, the pedodontist becomes hesitant because of the young age of the child and, in most cases, decides not to execute the treatment (7).

It was only after the studies of Andreasen (8) that the reimplantation of avulsed permanent teeth was widely divulged and its clinical results scientifically confirmed. Following adequate protocols for the realization of treatments, with due support from previous dental literature, it is possible to keep the permanent teeth reimplanted in the oral cavity for a long period of time. However, in many cases, its loss is inevitable. Nevertheless, the maintenance of the permanent tooth, even if for limited periods, brings benefits to the adolescent or the adult who has suffered such a trauma.

When the avulsion affects a primary tooth, many authors counter-indicate the reimplantation (6–12), based on the risk of damaging the succeeding permanent tooth germen because of the pressure exerted to push the coagulum against the follicle or based on the risk of contaminating the alveolus, thus causing additional infections and/or inflammations (13, 14). The ankylose and/or lack of cooperation of the child during the treatment also constitute counter-indications because of the reimplantation of primary teeth (15).

Because of the concerns demonstrated by some parents related to the early loss of primary teeth (7), the dental reimplantation of these teeth has been recommended by some authors. The literature demonstrated that an avulsed primary tooth incisor can be preserved without causing damage to the developing permanent successor (16–22). The tooth should be reimplanted immediately or be kept in a suitable solution, such as a physiologic saline solution or milk, to maintain the viability of the cells on the root (7). The reasons for temporarily retaining the primary anterior teeth until the permanent teeth erupt are related to speech development, physiological aspects of chewing, and psychological effects on the child.

Similar to what occurs when considering the reimplantation of avulsed permanent teeth, for a primary tooth to be reimplanted, it must follow protocols with precise indications, so as to guarantee a greater benefit for the children.

Before the dental reimplantation procedure can be chosen, some critical aspects must be evaluated to determine whether or not the procedure is indeed recommended for this tooth: the strategic value of the primary tooth in the oral cavity, integrity of the alveolar bone, the period of time the tooth was kept out of the alveolus, the contamination level of the location where the tooth fell, storage means of the tooth while out of the alveolus, the presence of contiguous teeth to splint, and nutritious or non-nutritious habits in the child's routine that may affect the stability of the reimplanted tooth. In addition, the avulsed primary tooth requires, necessarily, the realization of a subsequent endodontic treatment to avoid the apical consequences of pulp necrosis.

This article reports a clinical case of a primary tooth avulsion, followed by dental reimplantation and endodontic treatment according to the Federal University of Santa Catarina (UFSC) protocol of treatment of traumatized primary teeth. The reported case carried out clinical and radiographic follow-up procedures preceding the complete eruption of the succeeding permanent tooth.

## Case report

The patient MR, 2 years and 6 months of age, was taken to the Pediatric Dentistry Clinic of the UFSC after the avulsion of the left upper incisor, occurring because of a fall at school (Fig. 1). The girl was assisted in less than 30 min and, during this time, the tooth was stored in milk.

Periapical radiography of the region of the incisor confirmed the total avulsion of the tooth. No root fracture of the contiguous teeth or of the bone tissue was detected (Fig. 2).

During clinical examination, a small gingival laceration, restricted only to the left upper incisor area, was detected.

According to the UFSC protocol for the treatment of traumatized primary teeth, the tooth was recommended for dental reimplantation. That is, the tooth had spent less than 30 min out of the alveolus (18) and was hydrated because it was properly stored in milk, the alveolar bone tissue was not damaged, and the tooth presented a strategic value since the child was only 2 years and 6 months of age.

The mother was informed about the advantages and disadvantages, risks and benefits, of a dental reimplantation as well as about the necessity of subsequent endodontic treatment. After the explanation, the mother gave her consent for the reimplantation of the avulsed tooth.

Following the protocol, the alveolus was irrigated with sterile physiologic saline, aimed at removing the coagulum present within the alveolus. The avulsed tooth, up to that moment stored in milk, was washed with sterile physiologic saline and introduced in the alveolus with intermittent and light movements. In contrast to the findings of some authors (6–8), no application of strength during the reimplant was necessary.

After having been repositioned, the tooth was splinted using a fixed 0.5 steel wire and a composed resin flow in the buccal face of the right and left central and lateral incisors and canines, maintaining the tooth in its correct position (Fig. 3).

The child returned to the UFSC Pediatric Dentistry Clinic to begin the endodontic treatment of the reimplanted tooth. Upon examination, the gingival tissue presented a healing process, and, during the anamnesis, it was verified that the child did not use a pacifier but was fed with a bottle twice a day. The mother was instructed to discontinue the habit.

For the endodontic treatment, another periapical radiography was performed, with radiographic devices revealing an image compatible to the beginning of a pathologic root resorption in the apical region (Fig. 4). The child was laid on a 'Macri' (child stretcher), where the endodontic access with relative isolation (cotton rolls and saliva remover) was maintained. The mother was present during the entire procedure.

After performing the endodontic assessments, the pulp necrosis of the reimplanted tooth was confirmed (visually), because of the rupture of the neurovascular bundle. This, in fact, explained why no anesthesia was applied to the region.

*Fig. 1.* Avulsion of the left upper incisor.

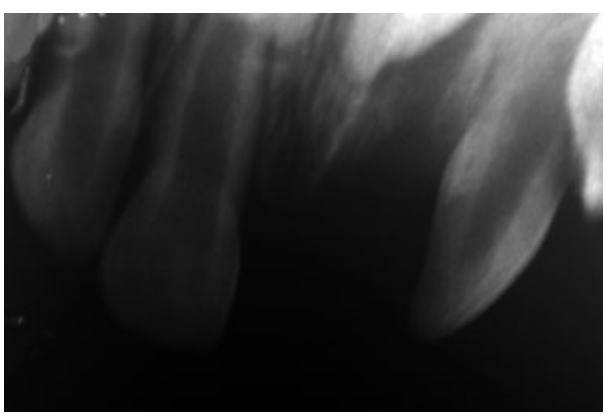

*Fig. 2.* Periapical radiograph after avulsion.

*Fig. 3.* Splint maintaining the tooth in its correct position.

*Fig. 4.* Pathological root resorption of the left upper incisor.

In order to measure the exploratory work length (EWL), the UFSC technique recommends the measurement of the distance comprehended between the incisal face of the tooth and the point of reference, which may include: (a) root apex, (b) physiologic or pathologic root resorption, or (c) imaginary line tangent to the germen of the permanent tooth. Based on these reference points, in the present case, the distance between the incisal face and the imaginary line tangent to the permanent tooth was measured. The root work length (RWL) of 11 mm was obtained. As the RWL is an imprecise measurement, 2 mm were subtracted and the Flexo-File (Dentsply, York, PA, USA) #15 was calibrated as the length of the work for exploration (EWL = RWL – 2 mm), in other words, a length of 9 mm.

The root canal was emptied, removing the pulp tissue during the biomechanical preparation procedure. The instrumentation was carried out with the first series of Flexo-File (#15 to #40), taking into consideration the caliber of the anatomic canal, calibrated according to the EWL. The biomechanical preparation was carried out with permanent irrigation and aspiration with 1% NaOCl (Iodontosul®, Porto Alegre, Brazil).

After instrumentation, the canal was dried and filled with calcium hydroxide (Riedel de Haën®, Seelze, Germany) manipulated with propylene glycol (Delaware®, Porto Alegre, Brazil) in the proportion of 0.4 mg of powder to 0.2 ml of liquid. The mixture formed a dense consistency, where most of the calcium hydroxide was aggregated to the propylene glycol. The paste was taken to the root canal by means of a spiral lentulo, calibrated according to the EWL. Immediately afterwards, a radiograph was taken to confirm the presence of a dressing. The presence of the calcium hydroxide mixture can be observed through the radiography because it presents a radiopacity similar to that of dentine. The pulp chamber was cleaned, and the tooth was temporarily sealed with restorative glass ionomer (Vidrion R; SS White®, Rio de Janeiro, Brazil).

Once a month, the child returned to the Pediatric Dentistry Clinic and was submitted to a controlled radiographic examination. If the radiography indicated the presence of the calcium hydroxide in the root canal (especially in the apical third), the exchange was not performed. Otherwise, a new dressing was applied, following the same procedures described above.

The behavior of the child, because of her age, was, at first, quite uncooperative. However, when she completed 3 years of age, her behavior changed considerably, in a favorable manner, every time the calcium hydroxide had to be changed. At this age, the child began to receive the treatment in the dentist's chair.

Because of the behavioral improvement, a radiographic examination of the tooth's work length was performed to verify the modeling work length (MWL). In this examination, it could be observed that the apical portion (the 2 mm not instrumented) was resorbed and substituted for the bone tissue. Thus, the MWL was maintained at 9 mm (Fig. 5).

After 12 months of clinical radiographic control (six dressing changes), the absence of periapical bone rarefaction and a dry canal were observed, conditions considered ideal for performing a root canal obturation.

The material used in the obturation was ZOE, manipulated into a more fluid form, introduced in the canal by a Flexo-File #30 and a spiral lentulo calibrated to MWL – 1 mm (8 mm). A periapical radiograph was taken, which showed the presence of ZOE in the entire canal (Fig. 6).

The pulp chamber was sealed with restorative glass ionomer (Vidrion R; SS White®) using a Centrix (3M®,

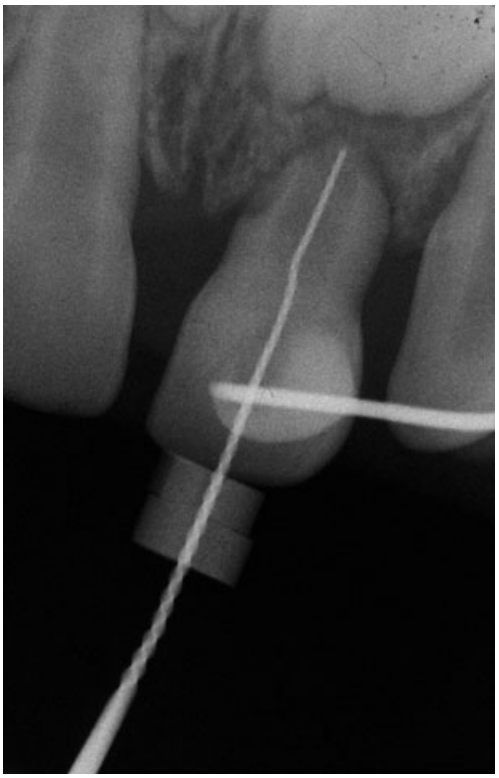

*Fig. 5.* Measuring the tooth's root length.

*Fig. 6.* Obturation of the root canal.

St Paul, MN, USA) syringe. During the subsequent consultation, the superficial layer of the restorative glass ionomer was removed, and the tooth was restored with composite resin.

*Fig. 7.* Frontal view after obturation of the left upper incisor.

*Fig. 8.* Physiological root resorption of the right and left upper incisor.

During the endodontic treatment of the left upper incisor, a color change in the right upper incisor (it had changed to yellow) was observed. Further radiographic examination verified the pulp canal/chamber obliteration.

After the obturation of the tooth, following the UFSC protocol for the treatment of traumatized primary teeth, the right and left upper incisors underwent a clinical and radiographic follow-up procedure every 6 months. After 16 months, the control radiographic examination showed the physiologic resorption of the right and left upper incisors (Figs 7 and 8). Over this period, the right and left lower incisors and the right and left lower first molars had already begun to erupt in the oral cavity.

*Fig. 9.* Right and left permanent upper incisor without alteration.

During the follow-up period, the eruption of the right and left upper permanent incisors was verified. They presented clinical and radiographic aspects compatible with the normal process with no esthetic alteration (Fig. 9).

## Discussion

Nowadays, all protocols for the treatment for traumatized primary teeth are based on the reports of clinical cases, expert opinions, and review articles (15). However, the elected treatment proposed in the literature for trauma cases is the extraction of the tooth, because of the absence of protocols, the non-cooperative behavior of the child, or the risk of developmental disturbances in the succeeding permanent tooth.

Recently, a longitudinal study of trauma cases in primary teeth, assisted by the same protocol (UFSC protocol), was carried out (23, 24). This protocol determined: (a) the intervals between the follow-up period for consultations regarding the traumatized tooth, (b) recommendations on when to begin the endodontic treatment, (c) endodontic treatment using calcium hydroxide dressings (much in the same way as used in the treatment of traumatized permanent teeth), and (d) follow-up consultations with the patient until the eruption of the succeeding permanent teeth has occurred.

The report of the aforementioned case followed the UFSC protocol for the treatment of traumatized primary teeth, which, when recommended, prescribes the reimplantation of the primary avulsed tooth. Other authors, such as Kinoshita et al. (25), Mueller & Whitsett (21), Weiger & Heuchert (22), and Zamon (26), concur on this fact. After the reimplantation, the UFSC protocol recommends for endodontic treatment, including periodic changes of the calcium hydroxide dressing, canal obturation, and subsequent follow-up procedures.

Nevertheless, most case reports presented in dental literature counter-indicate the reimplantation procedure, as it is believed that such treatment may damage the permanent successors (6, 8, 9, 11, 12). According to some authors, there are three moments during an avulsion in which the permanent successors may be affected: (a) at the moment of the trauma (27), (b) during the dental reimplant (8, 9, 15, 28), and (c) because of the maintenance of the infection and/or inflammation of the traumatized primary tooth (29, 30).

Before the primary avulsed traumatized tooth reimplantation can be recommended, the UFSC protocol demands that some key factors be considered, such as: (a) the strategic value of the primary tooth, that is, the time the tooth will be present in the dental arch before the natural physiologic exfoliation; (b) the period of time the tooth was kept out of the alveolus (maximum 30 min); (c) the storage means of the avulsed tooth (wet); (d) the contamination level of the location where the tooth fell; (e) the presence of contiguous teeth to splint; and (f) the presence of nutritious or non-nutritious habits in the child's routine, which may affect the stability of the reimplanted tooth. When these factors are associated, the reimplantation is recommended. Similar to that proposed for permanent teeth, the sooner the tooth is reimplanted, the better the outcome (18).

When an avulsed tooth is reimplanted, in the areas where there is periodontal ligament necrosis (15), the juxtaposition of the bone tissue against the root cement (ankylosis) occurs. From this moment on, the renovation of the bone tissue occurs, through the physiological process, where the dental root is substituted by the bone tissue (replacement by root resorption). Although the replacement by root resorption consists of a pathological process, there is no effective treatment, even when it affects the permanent teeth.

Another consequence resulting from the trauma is pulp necrosis (15). Cases of avulsion occur because of the neurovascular bundle rupture when the tooth is expelled from the alveolus. The maintenance of a tooth affected by necrosis will cause an inflammatory process in the patient, which may result in an inflammatory root resorption, thus affecting the apical bone tissue as well. The maintenance of the inflammation may develop an abscess with or without a fistula. The inflammatory root resorption after the reimplantation may be avoided or treated using endodontic procedures, that is, by the removal of the necrosis in the pulp tissue, which is the inflammatory reaction agent. The presence of an inflammatory process in the root apex will not bring immediate damage to the permanent successor unless it is maintained for several months (31).

Warning signs of failure in the reimplantation of the primary teeth, as described in the literature, include: crown color alteration, dental mobility, and periapical bone rarefaction associated or not with external root resorption (20). All of these factors are associated with the reimplantation of the primary tooth, which does not undergo endodontic treatment. On the other hand, the success of a dental reimplantation is associated with the time the tooth was kept out of the alveolus, the storage means, and the contamination absence (31). The stage of the root development may also be considered, as it is associated with these factors. Teeth that present the clinical signals of physiological root resorption are not recommended for reimplantation, as they do not present the strategic value (proximity to the eruption period of the permanent successors).

Some authors affirm that, because of the close relation between the root of the primary tooth and the germen of

the succeeding permanent tooth, at the moment of reimplantation during the dental repositioning process, the coagulum is pressed against the germen in formation (8, 9, 15, 28), which may in turn cause damage to the permanent tooth.

It is important to point out that 30 min is the maximum indicated time for reimplantation of an avulsed primary tooth, as the formed coagulum within the alveolus is still fluid. This is the ideal condition for the removal of the clot through irrigation with sterile saline solution before reimplantation. Another important procedure to be observed during the dental repositioning in the alveolus is that related to the movements that must be executed in the apical direction, in a cadenced and gradual form, in order to proportion the necessary time for the dispersion of some pressure through the *Havers'* system of the alveolar bone. There is also a tendency of the tooth to return to its original position. Even if some pressure is exerted during the reimplantation, a cephalometry study showed that there is a barrier of approximately 3 mm, most commonly made up of fibered tissue, between the primary tooth and the permanent successor, which guarantees the integrity of the germen (32–34).

Although Andreasen (8) gave mention to ankylosis as a prolonged retention factor of the reimplanted primary tooth, which may in fact lead to a counter-indication of the reimplantation procedure (8), this factor was not found in any other case containing such characteristics.

The consequences levied on the succeeding permanent tooth, derived from the trauma in the primary tooth (4), may vary because of the change in the crown color (associated or not with hypoplasia), crown dilaceration, odontoma, duplication or radicular dilaceration, partial or total paralyzation of the tooth's radicular development or of the entire tooth, ectopic eruption, early or delayed eruption, and/or the impact on the tooth (35).

The alteration will occur if the trauma in the primary tooth happens before the age of 5, that is, between stages 3 and 6 of *Nolla* (36). Thus, the severity in the alteration of the succeeding permanent tooth is closely related to the age of the child (germen mineralization level) at the moment of the trauma (4).

No case of primary tooth avulsion, followed by reimplantation associated with a sequelae in the permanent tooth, was found in the literature. Specific case studies, however, relate the alterations in the permanent tooth to the moment of the trauma and not to the treatment (2, 27, 37–41).

The present clinical case shows that the reimplantation of the primary tooth can be performed in a safe manner so long as the biological principles are respected and the professional dominates the technique of conditioning and counts on the unconditional collaboration of the family during the entire procedure and follow-up process. The failures described in previous literature are related specifically to an incorrect case selection, to a precarious endodontic treatment, or to the lack of an endodontic intervention. It is important to point out that, irregardless of the treatment performed, the follow-up procedure should be extended until the eruption of the permanent succeeding tooth has occurred.

The behavior of the child, over time, was used as a factor to counter-indicate dental treatments of medium or high complexity. The point that differentiates pediatric dentistry from other areas of dentistry is the capacity and training that the professional may have acquired to execute correct biological treatments on uncooperative patients.

At the moment of decision-making for the reimplantation of a primary tooth, it is necessary to take into consideration not only the technical indications, but also the importance of such an act to the child and to the family, explaining the treatment options, risks, and benefits of each option.

It is important to observe that the younger the child is, the worse his/her behavior will be, thus increasing the importance of maintaining the traumatized tooth in the oral cavity. Even if during the first consultations the child's behavior is not cooperative (common in children under 3 years of age), there is still a high probability that the child will improve his/her conduct during the treatment, making use of adequate protocols quite possible.

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