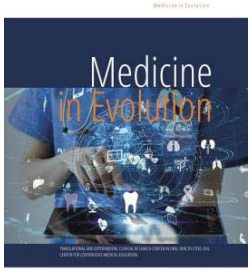
Factors influencing the success of replantation in periodontal trauma



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Abstract

Traumatic injuries to permanent teeth include crown and root fractures, subluxations, dislocations, and avulsions. The most common complications following replantation are pulp necrosis and root resorption. Treatment is often complex, time-consuming and requires multidisciplinary approaches, such as endodontic and periodontal treatments, surgical interventions, orthodontic movements, as well as aesthetic crown restoration.

The objectives of this study are to observe the factors that can intervene in the successful implementation of the treatment of a replantation, their consequences and the realization of the treatment plan, according to the case in order to minimize or even obtain a favorable result over a longer period of time.

Keywords: dental trauma, necrosis, root resorption, avulsion

INTRODUCTION

Dento-alveolar trauma (avulsions, dislocations, fractures) requires emergency treatment that consists in repositioning the fragments in their anatomical positions, immobilization or tooth extraction [1].

The importance of this theme is due to the polymorphism and variety of clinical forms under which the avulsion manifests itself, giving uniqueness to each case. The consequences of dento-cranio-facial trauma can be dramatic for the person involved, both from the perspective of physical, psychological and social impact. Beyond the acute nature, two important aspects give specificity to dento-periodontal trauma: the age of the patients and the multidisciplinarity of the therapeutic approach [2]. Primary care decisively influences the subsequent evolution of the affected structures and states the future therapeutic decisions [3].

Avulsion is a relatively uncommon type of trauma, that appears rarely, but most frequently between the ages of 7-14, with prevalence at the maxillary central incisors [4].

The average prevalence of dental and oral lesions reported in the literature ranged from 14% to 27% [5]. Males showed a higher prevalence than females, but this difference was only significant for the 12 and 14-year age groups. Avulsed teeth represent statistically 1% to 16% of all traumatic injuries in the permanent dentition [6].

The new therapeutic philosophy recommends the correct evaluation of the avulsed tooth based on the physiological state of the cells of the periodontal ligament, the stage of development of the apex and the duration of preservation in the extraoral environment.

According to Krasner, 10 aspects are taken into account [7].

In the case of the tooth with the apex fully developed:

1. If the extra-oral time is less than 15 minutes, replantation will be performed after a simple saline or Hanks solution rinse.

2. If the extra-oral time is less than 2 hours, without any preservation medium, replantation is preceded by a 30-minute immersion in Hanks' medium.

3. If the tooth is replanted after an extra-oral time of 6 hours, with an immediate immersion in a standard preservation medium (saliva, milk or physiological serum), it is recommended to perform a 30-minute immersion in Hanks medium, before performing replanting.

4. If the tooth is replanted after an extra-oral time of 24 hours, with preservation in Hanks medium, the replantation can be performed without special measures.

5. If the extra-oral time exceeds 2 hours without conservation measures and the periodontal ligament is destroyed, there is no possibility of healing without resorption. A specific protocol must be applied to cause an iatrogenic ankylosis:

a) curettage of the periodental ligament;

b) successive immersion in a solution of citric acid for 3 minutes, in a solution of stannous fluoride for 5 to 20 minutes, in a solution of doxycycline for 5 minutes;

c) endodontic treatment;

d) dental replantation. Immobilization is done for 4-8 weeks. They cannot exceed 2 months to avoid any risk of ankylosis. Endodontic treatment will be equally systematized, either before replantation or during the first months.

In the case of the tooth with an incompletely developed apex:

The eventuality of a pulpal revascularization modifies the therapeutic attitude. Immobilization will be limited to 3 weeks in order not to stop root development.

6. If the extra-oral time is less than 15 minutes, the tooth will be replanted after being immersed in a doxycycline solution for 5 minutes.

7. If the extra-oral time is less than 2 hours, without any conservation measure, it can be hoped that there is still a sufficient percentage of healthy periodental ligament, able to cover the denuded tooth surface. Replantation will be performed after a 30-minute immersion in Hanks medium and 5 minutes in a doxycycline solution.

8. If the tooth is replanted after an extra-oral time of 6 hours and was immediately immersed in a standard preservation medium (saliva, milk or saline), it will be immersed in Hanks solution for 30 minutes before replantation, then 5 minutes in a doxycycline solution.

9. If the tooth is replanted after an extra-oral time of 24 hours, with preservation in Hanks medium, the replantation is performed after a 5-minute immersion in doxycycline solution.

10. If the extraoral time has exceeded 2 hours, without preservation medium, the same protocol as for mature teeth will be applied.

Follow-up assessments should occur at 3 months, 6 months, and annually for at least 5 years. External resorption of the root, pulp complications of infectious origin of sub-epithelial origin or cervical, are considered reversible in most cases [8].

The working hypothesis of this study is based on the verification of the factors that lead to the success of the long-term treatment of dento-periodontal trauma, factors represented both by the emergency care provided in the minutes immediately following the trauma, and by the time elapsed until the patient receives treatment. The statistical analysis of the obtained results reveals the importance of the care of the affected structures and configures future therapeutic decisions.

Aim and objectives

The purpose of this study is to observe the factors that can influence the evolution of an oro-maxillo-facial trauma, considering the fact that this appears in patients between ages of 7 and 14, taking into account the fact that the development of the facial massif is not complete, the type of trauma, the medical history, the environment in which the fractured element was transported, the treatment performed and the course of healing until the final result - the success of replantation.

The objectives of this study are to observe the factors that can intervene in the successful implementation of the treatment of a replantation, their consequences and the realization of the treatment plan, according to the case to minimize or even obtain a favourable result over a longer period of time.

MATERIAL AND METHODS

The type of study performed is analytical, observational and prospective because it investigates relationships between exposure, risk factors and outcome.

The methods of data collection are direct and indirect, the direct ones through: observation; clinical/paraclinical examination; interview; and the indirect ones by: collecting individual data from the consultation form.

The subjects involved in the study are patients between the ages of 7 and 14, belonging to both sexes. A total of 8 participants and 10 avulsed teeth. They presented in a private practice, as an emergency following a dento-periodontal trauma, between 2020-2022, including the follow-ups.

The selection criteria for the study are patients presenting dento-periodontal trauma at the oro-maxillo-facial level that includes dislocation, avulsion or intrusion of at least one dental unit, implicitly lesions of the surrounding soft tissues.

The treatment of avulsed teeth is divided into 2 main stages:

1. emergency treatment that must be provided as soon as possible; and

2. definitive treatment based on a clinical follow-up and radiographic examination.

From a total of 10 teeth of which 8 were replanted and 2 of them showed an incompletely formed apex and an extra-oral time longer than one hour, kept in a dry environment, not being subjected to replantation.

The following protocol was applied to eligible cases:

1. Topical anesthesia Lidocaine 10%, spray, solution.
2. Loco-regional anesthesia using an anesthetic without vasoconstrictor, injectable solution. Local anesthesia will be performed by infiltration and anesthesia at the interincisive hole. Hemostasis with sterile compresses, if appropriate.
3. The alveolar wound will be cleaned by performing a gentle curettage and irrigation with 0.9% saline solution.
4. Inspection of the alveolar process, if a fracture of the alveolar process is found, the respective fragment is returned to the correct position by manual pressure.
5. Manual replantation will be performed, reocclusion of the dental units by manual pressure, followed by immobilization for 7-14 days, with semi-rigid fixation. Wire immobilization "in 8" (hippocratic ligature), 0.25mm orthodontic wire. Preferably, two teeth before and two after the fracture site will be anchored.
6. The teeth are etched using 37% phosphoric acid, conditioned with an adhesive, bonding system, then the wire is placed at the level of the tooth with a light-curing composite material.
7. Inspecting the soft tissues, dressing and suturing them in place, if necessary.
8. The traumatized tooth will be removed from occlusion for 2-3 weeks.
9. The patient is recommended a semi-liquid diet for 2-3 weeks, no sustained physical exertion and antibiotic therapy for 7 days.
10. Even if a degree of dental mobility persists when the immobilization is removed, it will not be prolonged, because it stimulates root resorption.
11. Institution of endodontic treatment 14 days after replantation.

RESULTS

Statistical analysis was performed in the Microsoft Excel Worksheet program. This tracked the percentage of successful healing of each individual tooth. All the factors that can influence the success of the replantation were noted, then a percentage was assigned to them that shows its importance for the study carried out, how it works and the healing capacity of each one (Table 1).

Table 1. Representative table of statistical analysis

Tooth no.	Apex	Percent A	Medium	Percent M	Time	Percent T	Necrosis	Percent N	Resorbtion	Percent R	Total percent/tooh
1	Imature	0%	Dry	0%	360 min	0%	Absent	0%	Absent	0%	**0%**
2	Imature	0%	Dry	0%	1200 min	0%	Absent	0%	Absent	0%	**0%**
3	Mature	20%	Wet	20%	40 min	20%	Absent	20%	Absent	20%	**100%**
4	Mature	20%	Wet	20%	25 min	20%	Absent	20%	Absent	20%	**100%**
5	Mature	20%	Wet	20%	70 min	20%	Absent	20%	Absent	20%	**100%**
6	Mature	20%	Wet	20%	90 min	10%	Present	5%	Absent	20%	**75%**
7	Mature	20%	Wet	20%	120 min	10%	Present	5%	Absent	20%	**75%**
8	Mature	20%	Wet	20%	200 min	10%	Present	5%	Present	10%	**65%**
9	Mature	20%	Dry	10%	30 min	20%	Absent	20%	Absent	20%	**90%**
10	Mature	20%	Dry	10%	170 min	10%	Present	5%	Present	10%	**55%**

Out of the total number of 10 avulsed teeth, 2 of them had an incompletely formed apex and did not undergo replantation treatment, so they were assigned a percentage of 0%. The remaining 8, showing a fully formed apex, were replanted, giving them a percentage of

20%, this representing the maximum percentage that can be attributed to each factor. Thus, the percentage M, attributed to the storage environment, taking into account the time elapsed since the accident, receives values of 10% for the dry environment and 20% for the wet one. The percentage T, representing the percentage attributed to the time factor was divided into 2 categories less than 60 minutes, receiving the maximum percentage and more than 60 minutes, receiving a percentage of 10%. For postoperative complications, pulp necrosis and root resorption were assigned percentages based on the healing capacity of each.

The rate of successful replanting was 66%.

6 teeth were kept in a wet environment (i.e. own saliva), and the other two out of a total of 8 were brought in a dry environment. The time interval from the moment of the accident to the arrival of the patient varies from 20 minutes, the shortest time to 7 hours, the longest time (Table 2).

Table 2. Extra-oral time and storage environment for the selected teeth

	EXTRA-ORAL TIME	*STORAGE ENVIRONMENT*	*NUMBER OF TEETH*
A	< 60 min	Saliva	2
BC	>60 min	Saliva	4
D	<60 min	Dry	1
	>60 min	Dry	1

After replantation, the most common complications were pulp necrosis and root resorption. Of the 8 replantation cases, 4 were successfully treated during the study period, respectively 2 years after the intervention, and 4 of them presented complications as follows (Table 3):

Table 3. Type of complication encountered in each case

Case no.	Resorbtion	Occurrence time	Necrosis	Occurrence time
A1	No		No	
A2	No		No	
B1	No		No	
B2	Yes	18 months	No	
B3	Yes	3 months	No	
B4	Yes	1 month	Yes	2 weeks
C1	No		No	
D1	Yes	6 months	Yes	1 weeks

Endodontic therapy was performed for each of the 8 replanted teeth 14 days after replantation, consisting of root canal instrumentation and its filling with calcium hydroxide paste. This aspect was beneficial due to the characteristics of calcium hydroxide, the incidence of resorption was low compared to previous scientific studies. Root canal filling with calcium hydroxide paste was done every 3 weeks.

The best results were obtained in those teeth that had an extra-oral time of less than 60 minutes, kept in the respective humid environment, the success of the replantation having a percentage of 100% (2 out of 2 teeth) with no complication in the next 2 years.

From the total of 4 teeth with an extra-oral time longer than 60 minutes, kept in a dry environment, a percentage of 50%, i.e. 2 out of 2 teeth presented 1 of the 2 complications followed, respectively, pulp necrosis. 25%, respectively 1 tooth presented 2 out of 2 complications, both pulp necrosis and root resorption. The tooth with the shortest period of exposure to the moist environment showed a 100% success rate.

Keeping it in the dry environment for a period that did not exceed 60 minutes achieved a 100% success rate. In this case, the tooth in question did not present any complications over a determined period of 2 years.

DISCUSSIONS

After replantation, the most common complications were pulp necrosis and root resorption. Of the 8 replantation cases, 4 were successfully crowned during the study period, respectively 2 years after the intervention, and 4 of them presented complications.

According to the studies carried out, the treatment plan in the case of avulsions is established according to the clinical case, the age of the patient, the maturity of the apex, the storage environment of the tooth, as well as the time elapsed from the time of the injury to the time of the patient's dispensary [9,10,11].

The objective of the paper is to observe the factors that influence the success of replantation, as well as to adapt the appropriate treatment plan to minimize possible complications. For a higher success rate, teeth showing incompletely formed apex, long extra-oral duration, and inadequate storage medium were excluded from the current study [12,13,14]. They presented a diminished capacity for pulpal revascularization, an increased percentage of the incidence of root resorption, as well as pulpal necrosis, due to the inability to form cells of the periodontal ligament, given the prolonged extra-oral time in a dry environment, unlike the scientific studies carried out to date, where the transport medium of the avulsed tooth recommended and used is the ideal preservation medium, Hanks or Eagle medium [15]. ViaSpan medium, which is used in organ transplantation, is also recommended [16]. Unlike other conservation medium, the proposed ones have a targeted mode of action. Undoubtedly, it targets and favours pulpal revascularization and reduces the risk of infection. On the other hand, they are preferred for the percentage of resorption and distant ankylosis [17,18].

The working protocol, according to the clinical studies carried out to date, places a high value on the preparation of the root before its repositioning in the alveolus. The work protocol used in the current study coincides with the one recommended in scientific studies, with the exception of preparing the root with antibiotic solutions, performing an immersion in 9% saline solution for 5 minutes before replanting the tooth in the alveolus [19].

Another difference is the initiation of endodontic treatment, where pulpal revascularization is attempted as the first step, if this does not occur, it is moved to the next step, the preparation of the root canal and filling it with calcium hydroxide paste. In the present case, endodontic therapy was instituted 14 days after replantation of the avulsed tooth, followed by testing the vitality of the neighboring teeth over a period of 6 months [20].

Antibiotics were administered systemically for a period of 7 days after replantation [21].

No tooth was replanted at the site of the accident.

CONCLUSIONS

Treatment of avulsed teeth with saline solution did not cause any consequences after replantation and thus replantation with full success occurred in 4 out of 10 cases.

Complications of replantation were pulp necrosis and root resorption with a total of 4 of 8 cases showing resorption, 2 of 8 cases showing pulp necrosis and 1 of 8 cases showing both necrosis and resorption.

The most important factors that influence the success of replantation are the time elapsed until the time of intervention and the conservation environment of the avulsed tooth as follows:

- Replanting in the shorter time frame of 60 minutes has the highest success rate.
- The correct treatment plan is crucial in the long-term preservation of the avulsed tooth.
- Of particular importance is the maturity level of the apex.
- Immobilization for longer than 14 days produces ankylosis of the tooth.
- Endodontic therapy performed 14 days after replantation prevents pulp inflammation.
- Evaluation of neighboring teeth is important to prevent infection of the traumatized area.
- Prolonged extra-oral time reveals a higher incidence of complications.
- The ideal storage medium, in the present case, is the moist one, which is the patient's saliva.
- Systemic drug treatment prevents infections.
  Removing the tooth from occlusion is essential for its fixation in the alveolus.

REFERENCES

1. Andreasen JO, Andreasen FM. Dental traumatology, quo vadis. Endod Dent Traumatol 1990; 6: 78– 80.
2. Al-Jundi SH. Type of treatment, prognosis, and estimation of time spent to manage dental trauma in late presentation cases at dental teaching hospital: a longitudinal and retrospective study. Dent Traumatol 2004; 20: 1– 5.
3. Andreasen JO, Borum MK, Jacobsen HL, Andreasen FM. Replantation of 400 avulsed permanent incisors. 4. Factors related to periodontal ligament healing. Endod Dent Traumatol 1995; 11: 76– 89.
4. Traebert J, Peres MA, Blank V, Boell Rda S, Pietruza JA. Prevalence of traumatic dental injury and associated factors among 12-year-old school children in Florianópolis, Brazil. Dent Traumatol 2003; 19: 15– 18.
5. Marcenes W, Al Beiruti N, Tayfour D, Issa S. Epidemiology of traumatic injuries to the permanent incisors of 9–12 year-old schoolchildren in Damascus, Syria. Endod Dent Traumatol 1999; 15: 117– 23.
6. Andreasen JO, Borum MK, Jacobsen HL, Andreasen FM. Replantation of 400 avulsed permanent incisors. 1. Diagnosis of healing complications. Endod Dent Traumatol 1995; 11: 51– 8.
7. Krasner, P., & Person, P. (1992). Preserving avulsed teeth for replantation. Journal of the American Dental Association (1939), 123(11), 80–88. https://doi.org/10.14219/jada.archive.1992.0300
8. Hammarstrom L, Blomlof L, Lindskog S. Dynamics of dentoalveolar ankylosis and associated root resorption. Endod Dent Traumatol 1989; 5: 163– 75.
9. Barrett EJ, Kenny DJ. Avulsed permanent teeth: a review of the literature and treatment guidelines. Endod Dent Traumatol 1997; 13: 153– 63.
10. Trope M. Clinical management of the avulsed tooth: present strategies and future directions. Dent Traumatol 2002; 18: 1– 11.
11. Flores MT, Andreasen JO, Bakland LK, Feiglin B, Gutmann JL, Oikarinen K, et al. Guidelines for the evaluation and management of traumatic dental injuries. Dent Traumatol 2001; 17: 193– 6.
12. Malhotra N, Cyriac R, Acharya S. Clinical implications of storage media in dentistry: a review. Endo (Lond Engl) 2010 Sep;4(3):179–188
13. Poi WR, Sonoda CK, Martins CM, Melo ME, Pellizzer EP, de Mendoncja MR, Panzarini SR. Storage media for avulsed teeth: a literature review. Braz Dent J. 2013 Sep-Oct;24(5):437–445

14. Bazmi BA, Singh AK, Kar S, Mubtasum H. Storage media for avulsed tooth - a review. Ind J Multidis Dent. 2013;3(3):741–749
15. Blomlof L. 1981. Milk and saliva as possible storage media for traumatically exarticuled teeth prior to replantation. Swed Dent J. 8:1–26
16. Trope M, Friedman S. Periodontal healing of replanted dog teeth stored in ViaSpan, milk, Hank's Balanced Salt Solution. Endod Dent Traumatol. 1992;8:183–188
17. Malmgren B, Malmgren O. Rate of infraposition of reimplanted ankylosed incisors related to age and growth in children and adolescents. Dent Traumatol. 2002;18(1):28–36.
18. Andersson L, Bodin I, Sorensen S. Progression of root resorption following replantation of human teeth after extended extraoral storage. Endod Dent Traumatol 1989; 5: 38– 47.
19. Oikarinen K. Tooth splinting: a review of the literature and consideration of the versatility of a wire-composite splint. Endod Dent Traumatol 1990; 6: 237– 50.
20. Krastl, G., Weiger, R., Filippi, A., Van Waes, H., Ebeleseder, K., Ree, M. et al. (2021) European Society of Endodontology position statement: endodontic management of traumatized permanent teeth. International Endodontic Journal, 54, 1473– 1481
21. Hammarstrom L, Blomlöf L, Feiglin B, Andersson L, Lindskog S. Replantation of the teeth and antibiotic treatment. Endod Dent Traumatol 1986; 2: 51–7