

Clinical treatment of avulsed tooth, data from literature

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Abstract

Background: The most dangerous outcome of a tooth avulsion, independent of the tooth's "kind" or "position" inside the oral cavity, is destruction of periodontal ligament and pulpal necrosis. Very few live cells with the capacity to heal the damaged ligament, are left on the surface of the tooth. In actuality, the patient is not accountable for and is not even able to handle the injuries caused by the tooth colliding with the alveolus, or the cement colliding with the alveolar walls. Even if these blemishes are minor, the cement is harmed. **Methods:** The primary focus of this research is to collect data that has previously been released on the therapy protocol for avulsed teeth and the features of the variables which influence the effective completion of re-implantation in line with the previously established procedures. There are 20 publications that require to be examined in more detail. They will be classified initially based on the approach that was employed for assessing the results and then by their year of publication of the article.

Results: Apexification is believed to be important in 12% of cases if it pertains to a re-implanted tooth's prognosis. A component that was not truly included in the timetable for putting out the re-implantation procedure. The results show that fifteen percent of the prognostic of re-implanted teeth can be attributed to vitality of alveolar bone. The eventual fate of a tooth which has been reimplanted remains unaltered by bone vitality. The one element related to this process is alveolar bone, that is always essential. There's an absolute lack of information concerning the pulp vitality factor considering that we are talking about re-implanted teeth, not luxated teeth, and every single re-implanted tooth has an indication for endodontic treatment.

Conclusions: The loss of periodontal ligament's normal physiological metabolism and the morphology of the cells which make up the ligament, decrease if periodontal ligament dried up. All of these factors depend on the speed at which the re-implantation procedure continues, preferably in the first fifteen to twenty minutes after avulsion. The nurse or emergency doctor performing this procedure must be familiar with re-implantation or receive medical care for this. If not, a dentist has to give this information over the phone as soon as possible. The tooth "needs" to be washed and carefully placed in the empty alveolus, paying care to keep the shape of both elements, the tooth and the alveolus.

Keywords: Avulsion; Clinical Treatment; Carrier Solution; Periodontium; Calcium Hydroxide.

1. Introduction

The most serious consequence of avulsion of a tooth, regardless of type of tooth and its positioning in the oral cavity, is damage to periodontal ligament and pulpal necrosis. [1], [2] After the detachment of the periodontal ligament, very few living cells remain on the surface of the tooth with the ability to regenerate the damaged ligament. In fact, injuries due to the collision of the tooth against the alveolus, that is, cement against the walls of the alveolus, are something that does not depend on the patient and cannot even be controlled by him. [3-5] These damages may be small but harmful to cement. In addition to traumatic injuries, we are faced with the fact that avulsion also causes "drying" of periodontal ligament. The more reduced the level of drying of the periodontal ligament, the better the prognosis of re-implantation. [1], [5-8] Moisture and the level of its preservation in the periodontal tissues of the avulsed tooth affect the vitality of the remaining cells of the periodontal ligament on the surface of avulsed tooth. At the site of the accident for the avulsed tooth, the primary care is to minimize the possible necrosis of the periodontal ligament of the avulsed tooth. [3], [6], [9] Impact trauma to the periodontal ligament is the element that cannot be overlooked and cannot be controlled in the fact that we can minimize it.

The element that can be controlled has to do with the preservation of moisture for the avulsed tooth, thereby reducing the possibility of necrosis of the periodontal ligament. The most important question is how to transport the avulsed tooth to the nearest dental clinic for re-implantation. [9-13].

Attention is always focused on periodontal ligament, while pulp tissue should not be thought of at the accident site or in the initial stages of treatment, but only in the later stages of the treatment of the tooth after re-implantation. [14-16] Reduction of drying of periodontal ligament reduces the loss of the normal physiological metabolism of the periodontal ligament and the morphology of its constituent cells. And all these elements depend on the speed with which the re-implantation procedure takes place, preferably within the first 15-20 minutes after avulsion. [3], [7], [17-20].

This procedure must be performed by the nurse or emergency doctor who must know or be treated for re-implantation; if not, this information must be given as soon as possible by a dentist over the phone. From the doctor, care must be taken that the tooth is clean and placed

very carefully in the empty alveolus, respecting the shape of both the tooth and the alveolus. [21-25] If this cannot happen, or if there are doubts about the re-implantation performed by the doctor, then the avulsed tooth should be placed in a place or in a suitable transport environment to the dental office. [26], [27] If the therapy starts at the optimal time, the pulp is necrotic and free of bacterial content. Calcium hydroxide is changed every 3 months for a period of 6-24 months. The creation of the lamina dura is the radiographic sign that indicates the moment when the canal or root of the re-implanted tooth must be definitively filled. Calcium hydroxide changes the pH of the dentin to alkaline, which makes the dentin resistant to the effect of resorbing cells and promotes the formation of hard tissue. Changing the calcium hydroxide should be done no more often than once every 3 months. [27-31].

2. Methods

The purpose of this study is to analyze how the clinical approach is according to published sources of literature on the emergency treatment with re-implantation of avulsed teeth, based on the collection of data in the different types of applied studies, especially knowing the aesthetic and functional importance of an avulsed permanent tooth to be restored with re-implantation as soon as possible after dental trauma.

The 10-year period of inclusion criteria of the articles selected for this study is to reflect the trend of scientific research on re-implantation protocol, regardless of the development and evolving technology of materials or transport environments of the extracted tooth from the scene to the closest dental clinic. This selection over the years is due to the large number of case-report articles about treatment of avulsed teeth, which also reflects the frequency of dental traumas.

The electronic search was carried out in PubMed page using the keywords according to the following steps:

Stage 1: application of keywords: dental avulsion and case report

Stage 2: applying inclusion and non-inclusion criteria to articles in further analysis.

Time search interval is 10 years; articles published in PubMed about avulsion and re-implantation of avulsed teeth. From a total of 31 articles, through the first stage of selecting articles of interest in accordance with the purpose of our study, 11 articles are outside this purpose. [24], [25], [27], [32], [50].

The non-inclusion criteria are as follows:

- 1) Procedural treatment of hard and soft tissues after dental trauma with tooth avulsion, but not with re-implantation procedure of the avulsed tooth—4 articles [25], [45], [49], [50].
- 2) Procedural treatment of hard and soft tissues after dental trauma but not with avulsion (intrusion, suction)-3 articles [27], [32], [33].
- 3) Avulsion of dental impression but not of a specific tooth—2 articles [39], [43].
- 4) Specific procedure about complications after re-implantation of avulsed tooth (ankylosis) 2 articles [24], [48].

20 articles remain to be further analyzed, which will first be classified depending on the way of analyzing the data in the review or in vitro categorization, and then depending on the year of publication of the article.

The selected criteria are: abstract and full text, English language, and publications within the time interval of about 10 years. The period was chosen due to the fact that the evolution of ideas on this treatment of this local pathology and the control, possible or not, that the patient himself exercises over this phenomenon have been in significant exploration and evolution for decades, as presented in the already published literature. From a total of 31 articles, through the second stage of selecting articles of interest in accordance with the purpose of our study, 11 articles are excluded. [24], [25], [27], [32], [33], [39], [43], [45], [48], [49], [50].

3. Results

Articles selected in accordance with the purpose of the study will be classified based on the information they convey, depending on the type of publication presented. Table 1 shows data of selected articles classified from the perspective of frequency of dental traumas associated with tooth avulsion based on the classification according to age and gender of patients.

Table 1: This Table Shows the Distribution of Articles Based on Gender and Age of the Patient Where Dental Trauma Occurred Accompanied by Tooth Avulsion, Among the Case-Report Type Articles Included in the Study.

Age Gender	Pre-adolescence	Adolescence	Adult	Total of articles
Male	6 articles [11], [17],[19], [23], [25], [27] – 30%	4 articles [7], [18], [21], [22] – 20%	4 articles [1], [4], [9], [28] – 20%	14 articles– 70%
Female	2 articles [3], [16] – 10%	2 articles [10], [15] – 10%	2 articles [2], [12] – 10%	6 articles – 30%
Total	8 articles – 40%	6 articles - 30%	6 articles – 30%	20 articles – 100%

Figure 1 Shows the Data from Table 1 Graphically.

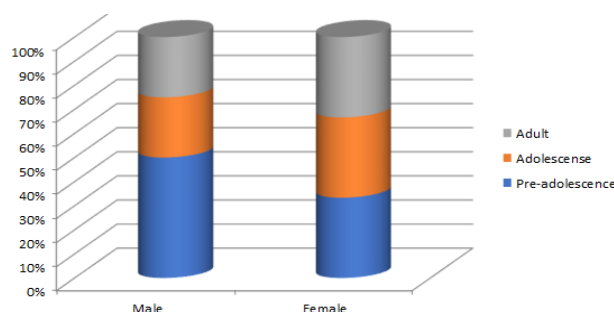


Fig. 1: Distribution of Articles Based on the Gender and Age of Patients Where Dental Trauma Occurred Accompanied by Tooth Avulsion, Among the Case-Report Type Articles Included in the Study.

Figure 2 shows data from Table 1, but also emphasizes the fact that what part of the whole is affected not only by gender but also by age.

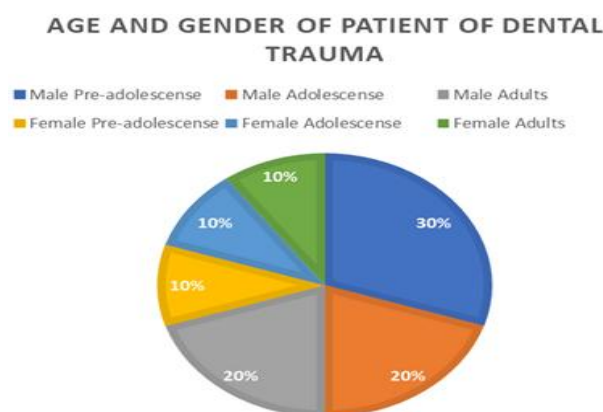


Fig. 2: Distribution of Articles Depending on the Age When the Dental Trauma Accompanied by Tooth Avulsion Occurred, Specifically According to the Gender of the Patient.

Table 2 shows data collected based on reason for dental trauma and age of the patient.

Table 2: Presentation of Data Collected from Articles Selected for this Study, Based on Reason of Dental Trauma and Patient Age

Age of patient Reason of trauma	Pre-adolescence		Adolescence		Adult		Total
	M	F	M	F	M	F	
Sports					2 articles [1], [4]		2 – 10%
Epileptic seizure	1 article [28]				1 article [2]		2 – 10%
Blow	1 article [19]	1 article [3]	2 articles [18], [21]				4 – 20%
Crash	1 article [27]	1 article [16]	1 article [7]	2 articles [10], [15]			5 – 25%
Accident	4 articles [11], [17], [23], [25]				1 article [9]	1 article [12]	6 – 30%
Extraction			1 [22]				1 – 5%
Total	7 articles	2 articles	4 articles	2 articles	3 articles	2 articles	20 – 100%

Figure 3 shows the data from Table 2 schematically with the aim of understanding the frequency of reasons for dental trauma resulting in avulsion.

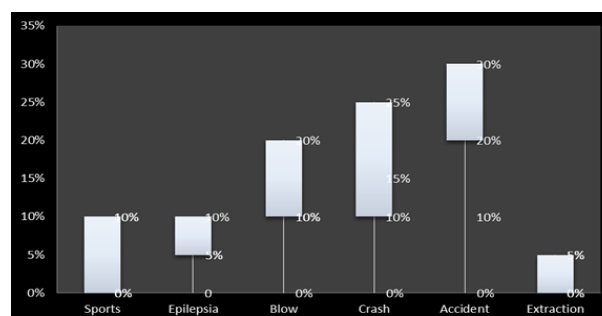


Fig. 3: Reasons for Dental Trauma with the Frequency of Their Occurrence According to the Data in Table 2

Table 3 shows the collected data based on time spent outside the alveolus for the avulsed tooth, depending on the type of avulsed tooth classified by its position in the alveolus.

Table 3: Positioning of Avulsed Tooth in the Arch, Respectively in Maxilla and in Mandible, and the Extra-Alveolar Time Limit Based on Data Collected in Literature

Evaporated teeth Time limit	Maxilla	Mandibula	Total
0-10 minutes	4%	1%	11%
10-20 minutes	7%	3%	21%
20-30 minutes	15%	16%	32%
30-40 minutes	12%	11%	23%
40-50 minutes	14%	15%	29%
50 min -	1%	0%	1%
Total	53%	47%	100%

Figure 4 shows results of table 3 with the aim of seeing the differences in clinical success of an avulsed tooth classified according to its positioning in the arch, respectively maxilla: mandible and extra-alveolar limit time.

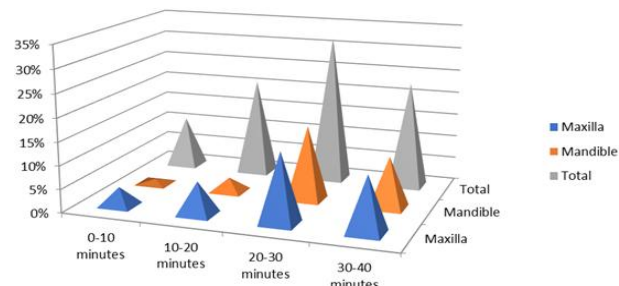


Fig. 4: In This Graph, Data from Table 3 are Shown Based on Results for the Extra-Alveolar Time Limit When It Is Highly Indicated to Perform the Re-Implantation Procedure and Type of Avulsed Tooth.

Table 4 shows collected data about the importance of the extra-alveolar limit time of the avulsed tooth and the factor that most affects the clinical life of an avulsed tooth and re-implanted afterwards.

Table 4: Processed Data Based on the Factor That Most Affects the Clinical Lifespan of the Avulsed Tooth and Treated with Re-Implantation Against the Extra-Alveolar Limit Time of the Same Avulsed Tooth

"Success" factor Time limit	Pulp vitality	Vitality of ligament	Bone vitality	Apexification	Total
0-10 minutes		5%			5%
10-20 minutes	4%	4%		1%	10%
20-30 minutes	5%	19%	4%	2%	31%
30-40 minutes	3 – 4%	12%	3%	4%	23%
40-50 minutes		14%	7%	5%	30%
Total	16%	55%	15%	12%	100%

Data from Table 4 are presented graphically in Figure 5.

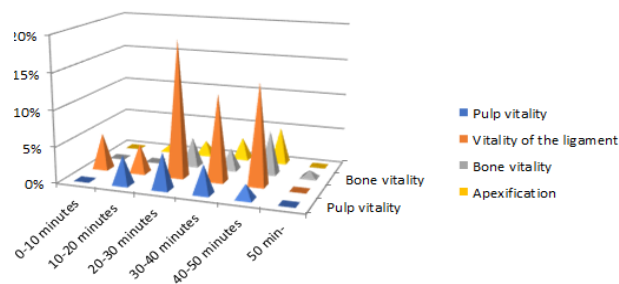


Fig. 5: Graphic Presentation of Data from Table 4 Based on Factors That Affect More the Clinical Life of the Avulsed Tooth Treated with Re-Implantation.

Table 5 shows collected data based on previous interventions of re-implantation of an avulsed tooth, depending on complications presented post-procedure of re-implantation.

Table 5: Data Collected from Case-Report Articles, Based on Classification of Dental Interventions Performed After Re-Implantation of an Avulsed Tooth as A Result of Post-Re-Implantation Complications

Dental intervention Positioning of avulsed tooth	Surgery	Prosthetic	Orthodontics	Total
Maxilla	3 articles – 15%	1 articles – 5%	1 article – 5%	5 – 25%
Mandible	4 articles – 20%	2 articles – 10%	-	6 – 30%
Total	7 articles – 35%	3 articles – 15%	1 article – 5%	11 – 53%

Figure 6 shows data from table 5.

Dental intervention after re-implantation

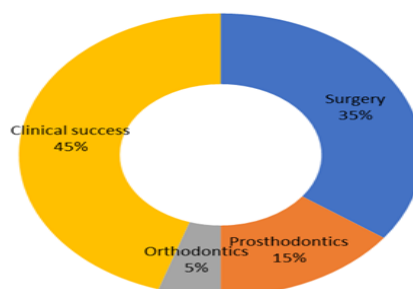


Fig. 6: Dental Interventions Divided According to Specialties Identified for Solving Complications After Re-Implantation of an Avulsed Tooth.

4. Discussions

From data in Table 2, it is clear that among the reasons for the appearance of dental trauma resulting in tooth avulsion, the most frequent is a car accident in 30% of cases, followed by a fall in 25% and sudden blows in 20% of cases. Sports, epileptic seizures, and dental extraction are presented in a lower percentage.

Based on division by gender, it can be said that male gender appears with a higher frequency in the occurrence of dental accidents resulting in avulsion.

The importance of apexification as a factor in the prognosis of a re-implanted tooth is estimated at 12% an element that actually should not have been related to the time limit for performing the re-implantation procedure. For the vitality of alveolar bone as a factor, the results show that the evaluation of this factor in the prognosis of a reimplanted tooth reaches 15%. Bone vitality does not affect the prognosis of the re-implanted tooth. [1], [5], [8].

The only element that is not related in this process is alveolar bone, because it is always vital. For the pulp vitality factor, we are talking about a re-implanted tooth, not a luxated tooth. A total lack of information is noted since every re-implanted tooth has an indication of performing the endodontic procedure of root canal treatment. [12], [17].

From the data in Table 2, it is shown that the highest percentage has to do with the main factor of periodontal ligament vitality. In total, this value is about 55%. Related to the limit duration for the immediate treatment of re-implantation, which is 20-30 minutes, the values are divided into 19%. Combining the data of Table 3 and Table 4 brings the golden ratio of clinical success to a relatively small value of about 19%. This data shows once again that theoretically the clinical elements can be related to each other; practically, this does not happen. From data in table 5, the tendency of studies to see the role of an avulsed and re-implanted tooth as something that is part of the oral cavity and to be maintained and treated with re-implantation is very well observed in the value of 53%. From the studies carried out in case-report cases of re-implantation of an avulsed tooth, it is concluded that the need for surgical intervention for post-implantation complications is reached in 35% of clinical cases, where the most pronounced is the partial osteotomy of a dental area, accompanied by the application of cell-rich fibrin for even better clinical dental results. [7], [9], [14], [18], [21].

Based on data in table 5, it is clearly shown that the application of prosthetic interventions not for functional clinical complications but for aesthetic complications of the avulsed tooth goes to 15% of cases, mainly with the placement of veneers in incisor teeth avulsed and re-implanted with clinical success. [1], [9], [28] Orthodontic interventions are those that also accompany surgical intervention due to ankylosing of the re-implanted tooth, occupying a reduced percentage of 5%. [18]

Traumatic dental injuries resulting in avulsion of a tooth are frequent, especially in children of pre-adolescent age and in mixed dentition, as a result of sudden and unavoidable impacts based on the motor skills of age. [19] Maxillary incisor teeth are more often prey to avulsion than the mandibular incisor teeth; thus, the dental damage of not immediately replacing a maxillary incisor tooth that affects the phonetics and bone development of the jaws of the individual who suffers dental trauma resulting in avulsion is high. [21] About the extra-alveolar limit time of the avulsed tooth, it is more important the environment where the tooth is kept than the duration; despite the latter, the attempt to re-place the tooth in the alveolus is indicated. [22] Vitality and preservation of teeth are very important. The vitality of the periodontal ligament is more important since the vitality of the pulp of an avulsed tooth is not discussed. It can be lost, and the re-implanted tooth should be treated with endodontic procedures according to the treatment protocol of a re-implanted tooth. [2]. [6]. [12], [22] Follow-up of cases with avulsed teeth and treated with re-implantation, according to studies included in this analysis about this topic, has brought positive results in the 3, 6, 9, 12-month periodical controls, but also for long-term positive results, like after 5 years or after 10 years. [2], [4], [9], [12], [17], [22], [24].

5. Conclusions

Incisor teeth are more "prey" of avulsion as a result of dental traumas originating from sports, accidental hits, falls, car accidents, or even as an unintentional result of dental extractions, but with higher vulnerability in the maxilla than in the mandible. The pre-adolescent age is more prone to avulsion of teeth and the male gender as well, regardless of age classification, in the frequency of occurrence of dental trauma. Theoretical formation and staying in touch with the latest information about the evolution of instruments and materials that help in re-implantation as quickly as possible and within pre-determined dental protocols is an added professional skill for every dentist, regardless of specialty. Every avulsed and re-implanted tooth must be prone to post-re-implantation complications, but if the indications and realization of the steps of the predetermined re-implantation protocol of an avulsed tooth are carefully followed, the possibility of appearing these complications is significantly reduced.

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