



**Research Article**

## **REVIEW ON STORAGE AND TRANSPORTATION PROCESS OF AVULSED PERMANENT TOOTH BEFORE RE-PLANTATION**

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### **ABSTRACT**

Avulsion of permanent tooth can be successfully re-plantation if it properly handle and transported in easily available media at the accidental site. After reviewing the whole literature it can be concluded that avulsed tooth should be hold from the crown and gently wash in a running tap water to preserve the periodontal ligament cells. Put the washed avulsed tooth in the mouth to protect the cells of periodontal ligament because saliva is a natural preservative media. The running tap water and saliva is easily available at the trauma site. The preservation of avulsed tooth for longer duration can be done in various preservatives in the hospital before planned re-plantation. Immediate re-plantation of avulsed permanent tooth is generally accepted as treatment of choice, which may successfully restore the aesthetics and functional value of the tooth (Venkataramana *et al.*, 2015). The prognosis of an avulsed tooth is essentially dependent on its extra-alveolar time, transfer media and the procedures performed at the time of re-implantation. In cases where these factors are unfavorable, pulp necrosis and degeneration of periodontal ligament (PDL) cells may ensue, resulting in inflammatory/replacement root resorption or ankylosis of the tooth, eventually leading to tooth loss (Andersson and Andreasen, 2012; Soares *et al.*, 2008). Immediate replantation is the treatment of choice for an avulsed permanent tooth, although it is not always possible to perform this treatment. Replantation success depends on the maintenance of PDL cell vitality (Pileggi *et al.*, 2002). Re-plantation of the avulsed tooth may be a promising treatment modality and can be achieved at a lower cost with higher success rate, if the people involved in the process have a sound knowledge about the various aspects of avulsed tooth re-implantation. If a tooth is maintained in a dry environment prior to re-implantation, irreversible damage to PDL cells can cause an inflammatory response on the root surface, which leads to ankylosis and eventual tooth loss. Hank's Balanced Salt Solution (HBSS), a tissue culture medium is recommended as the best storage medium for avulsed permanent tooth in order to maintain the viability and enabling in multiplication of the periodontal ligament cells. If HBSS is not available then cold milk, the patient's saliva and water can be used as a storage medium (American Association of Endodontics, 1995; Krasner and Person, 1992). Sigalas *et al.* (2004) reported that HBSS (tissue culture medium) was found to be superior among other storage media such as eye contact lens solution, water, milk and ice in maintaining the viability of PDL cells up to one hour. It is also observed that water had a most detrimental effect on PDL cells. Two percent milk preserved more viable cells than contact lens solution.

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### **INTRODUCTION**

Ten percent of human population has experienced some kind of dental trauma, of which 0.5 to 16% were of permanent teeth avulsion (Mori *et al.*, 2007; Anderson and Anderson, 2012). Dental trauma accounts to about 17% of the total body injuries in those aged between 0-6 years as compared to an average of 5% across all ages (Zaleckiene *et al.*, 2014).

Epidemiological data shows that about 50% of children have experienced dental trauma in their primary or permanent dentition throughout their school period (Qazi & Nasir, 2009). Dental injury never comes alone but damages surrounding soft tissue, periodontal tissues, which may results into luxation, tooth fracture, and tooth avulsion. The tooth luxation, avulsion and fracture of crown along with root and alveolar bone require immediate repositioning and stabilization with various degree of prognosis (Ferreira *et al.*, 2009). The root fractures have poor prognosis because they involve a combination of damage to the periodontal ligament, cementum, dentin, and

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pulp (Francisco *et al.*, 2015) whereas, crown fractures involving enamel and dentin have a favorable prognosis because the possibility of irreversible pulp necrosis and obliteration of root canal is minimum. Many a times such injuries have a negative impact on quality of life by affecting feeding, communication, social and psychological comfort (Natarajan and Gurunathan, 2013). It is the prime responsibility of dental professionals to retain avulsed permanent teeth so that the normal physiological and psychological functions of a affected patient can be retained.

Re-plantation of avulsed tooth presents a great challenge because of lack of awareness among common people as well as other professional physicians and surgeons with regard to its prompt and proper storage. The primary and principle challenge is to maintain the vitality of periodontal cells of avulsed tooth by keeping it in proper storage medium and after that search for proper treatment as a secondary challenge. Extra alveolar dry time and storage media used to transport the tooth, type of retention employed, time of endodontic intervention, oral hygiene status are among the critical factors for successful re-plantation and long term favorable outcomes (Hashim, 2012). Immediate re-plantation of avulsed permanent tooth is generally accepted as treatment of choice, which may successfully restore the aesthetics and functional value of the tooth (Venkataramana *et al.*, 2015). It has been reported that immediate re-plantation gives success rates of 85 % to 97% for healing of periodontal ligament depending on stage of root development. The length of extra-alveolar time and type of storage are significant factors that can affect long term survival of avulsed tooth. If there is more extra oral time of avulsed tooth then desiccation of root surface begin with high risk of loss of vitality of the periodontal ligament cells (Addo *et al.*, 2007 and Bazmi *et al.*, 2013). Prompt and appropriate management is necessary to improve the prognosis of an avulsed tooth re-plantation. Unfortunately, fifty percent of dental avulsion patients, could not get prompt and appropriate first aid treatment and loose avulsed teeth due to lack of knowledge among attending people and physicians (Hashim, 2012 and Raof *et al.*, 2013). Many patients after traumatic tooth avulsion have to approach medical doctors for treatment due to lack of awareness or unavailability of a dentist in rural India (Jyothi *et al.*, 2011). Emergency medical personnel have faced difficulties with diagnosis, investigation, management and appropriate referral of dental emergencies due to inadequate training and insufficient knowledge (Samaei *et al.*; 2015). To ensure proper and appropriate management of the avulsed tooth, it is essential that medical professionals should have sufficient knowledge on the emergency management and storage process of the avulsed teeth.

Pediatricians are the first hand clinicians to attend the children suffered from tooth avulsion. The pediatrician knowledge and attitude, prepare the base for the success of re-plantation procedure for referred dental experts (Hashim, 2012), especially for the population having limited access to dental experts. The criticality of time and knowledge of pediatricians is very crucial in the success of dental trauma management (Chanchala *et al.*, 2016). Pediatricians may be able to play an important role in improving the dental health of their patients by increasing their involvement in oral health management

during well-child care visits. However, it is doubtful to what degree pediatricians are knowledgeable about preventive oral health and to what extent they may already be participating in prevention and assessment (Lewis *et al.*, 2017). Various studies have draws the attention to the need of improving the knowledge base of general practitioners and pediatricians for the emergency management of traumatic teeth related injuries (Hatem *et al.*, 2015).

## DISCUSSION

Luxation injuries are considered most common type of traumatic dental injury (TDI) in primary dentition, while crown fracture occurs more commonly in permanent dentition. In 93.3 percent of the TDI's, the central incisors are affected and comprise 73 percent of all injuries. The prevalence of dental traumatic injuries is two times higher in boys as compared to girls (Dua and Sharma, 2012; Al-Majed, 2001 and Andersson, 2013) because the boys participate more in outdoor activities and sports (Brien, 1993, Andreasen *et al.*, 1995a; Andreasen *et al.*, 1995b). It has also been suggested that the avulsion of tooth is briefly favored by the malleability of the alveolar bone and thin structured PDL (Ravn, 1974).

The survival of avulsed tooth primarily depends upon its immediate management by the people present at the trauma site and afterward the knowledge, skill and aptitude of the physicians, who attend the patient at the first instance. The prognosis of an avulsed tooth is essentially dependent on its extra-alveolar time, transfer media and the procedures performed at the time of re-implantation. In cases where these factors are unfavorable, pulp necrosis and degeneration of periodontal ligament (PDL) cells may ensue, resulting in inflammatory/replacement root resorption or ankylosis of the tooth, eventually leading to tooth loss (Andersson and Andreasen, 2012; Soares *et al.*, 2008). Immediate replantation is the treatment of choice for an avulsed permanent tooth, although it is not always possible to perform this treatment. Replantation success depends on the maintenance of PDL cell vitality (Pileggi *et al.*, 2002). Re-plantation of the avulsed tooth may be a promising treatment modality and can be achieved at a lower cost with higher success rate, if the people involved in the process have a sound knowledge about the various aspects of avulsed tooth re-implantation.

International Association of Dental Traumatology (2012), published guidelines for the management of avulsed teeth and highlights the evidence-based approach to emergency care and is of great help for dentists, health-care professionals, and parents in decision-making (Andersson *et al.*, 2012). In case of an emergency involving avulsed tooth, parents of the affected child are the first people to attend and make decisions. Awareness and knowledge of parents in the handling of these emergency traumatic injuries involving avulsion of a tooth greatly influences the prognosis.

Surgeons in trauma centers are the first people to manage the emergency traumatic condition of head, neck and oral region. Usually while stabilizing the head injury little attention were paid to the dental injury except, bleeding control from avulsed tooth site. It is equally important to save the avulsed tooth along with head injury for total recovery from the trauma. A

patient cannot be categorized as totally recovered, if he/she has lost one or other tooth in a traumatic accident. Cortes *et al.* (2002) reported that dental trauma in children affected the child's ability to smile and laugh. Children with missing anterior teeth feel embarrassment and cannot maintain a normal healthy emotional state without being irritable. Such kids were reported to be less satisfied from their food, maintained a negative attitude towards tooth brushing, and felt less comfortable about smiling, laughing or showing their teeth, when socializing with people. Wong *et al.* (2016)<sup>[30]</sup> assessed the changes in the oral health related quality of life in preschool children, who lost tooth due to untreated dental caries and extraction afterward. He reported that such kids suffered from severe mental and psychological stress and were uncomfortable in taking initiative and socializing with people. Giannetti *et al.* (2007) assessed the changes in oral health related quality of life in school children who had a complete dislocation of the tooth out of socket and concluded that if patients got into tooth avulsion their quality of life is adversely affected.

Isha (2020) has evaluated the level of knowledge of 70 pediatricians working in Government and private hospitals in Karnal region, about various concepts involved transportation and preservation of avulsed tooth before re-implantation in children. All evaluated pediatricians were found well aware of tooth avulsion and 50% had already come across with the condition in their routine practice. The knowledge about various concepts involved in re-implantation of avulsed tooth was found varying significantly between individual to individual irrespective of experience of the subject. The right knowledge about the "Immediate management of permanent avulsed tooth by putting the avulsed tooth in its original socket and then refer to dentist" was found correct only in 28.57% pediatricians. Out of those 28.57% subjects who have answered correctly, 7.14% were found in practice for less than 10 years, 10% for 10 to 20 years, 4.28% for 20 to 30 years and 7.14% for above 30 years. 71.43% pediatricians were found with incorrect knowledge about the importance of immediate management of permanent avulsed tooth or extra-oral/ dry period of avulsed tooth for re-plantation. Among the pediatricians who answered incorrectly 16 22.86% opted as 'refer to the dentist immediately without doing anything', 34 48.57% as 'put the tooth in transport media and refer to the dentist. Similar finding were reported by Balaban *et al.* (2011)<sup>[32]</sup> in their study that 67.8 % pediatricians considered their knowledge on oral health as insufficient and need educative training. The prognosis of the avulsed tooth depends on, how the tooth is treated within the first few minutes and steps taken to preserve and replant the tooth. Parents or guardians of the child are the first ones to report such cases to dental professionals, so awareness and knowledge regarding the handling of avulsed tooth is extremely important. The study by Unal *et al.* (2014) revealed that in 65% of cases of tooth avulsion, the time from the injury to the arrival at a dental office exceeded 60 min. Ozer *et al.* (2012) concluded that the 90.7% of visiting parents at Ondokuz Mayıs University's Pediatric Dentistry Clinic, were having no knowledge about re-plantation of avulsed tooth in its socket where as 68.2% were found to have correct answers regarding the optimum time for which an avulsed tooth should be left out from the

mouth prior to re-implantation. Abhinav Prakash (2015) concluded that the prognosis of traumatized tooth often depends on the prompt and appropriate treatment given to patient by the people who are present at the site. Often these injuries occur in school environment and, therefore, the perception of school teachers towards this is crucial to the prognosis of tooth avulsion. The knowledge of school teachers towards immediate management of avulsed tooth is insufficient. Therefore, a teacher's orientation program towards management is highly suggested. Shetty (2009) reported that the primary school teachers in Bangalore city have rudimentary knowledge about emergency management of dental avulsion and suggested that the teachers and other individuals, who are involved in the supervision of children in schools, should compulsorily receive simple instructions in dental first-aid as children spend considerable duration of the active day time at school. Only 45 of the respondents were confident of putting the tooth back into its alveolar socket. Among the respondents 200 would seek the dentists help immediately and 180 would not mind the delay of 30 minutes. Most of the respondents would clean the dirty avulsed tooth in tap water and only 10 respondents would use milk for transporting the avulsed tooth. A great majority of the respondents were not satisfied with the knowledge on the "management of dental trauma" & most of them expressed desire for further information. Nikam *et al.* (2014) reported that the level of knowledge and attitude of parents and caregivers of children of age group 5-14 years about avulsed tooth management was fairly low and there was a need to provide the general population with information regarding emergency management of avulsed tooth. They further reported that 95% of the participants reported that their children experienced dental trauma at the age of 5-14 years, 65% said they preferred to place the avulsed tooth back into the child's mouth and 20% of the mother's said that they would discard the avulsed tooth and 95% of the participants felt the need of immediate dental consultation. Francisco *et al.* (2015) assessed the knowledge of teachers about dental trauma and revealed that 13% of teachers would replant the tooth in the socket, 7 % said they would put the tooth in some liquid and 58% would store in a piece of paper, cloth or clean container. Only 15 % correctly answered that they would replant the avulsed tooth and then refer to the dentist. They concluded that knowledge of teachers must be improved using educational campaigns. Fujita *et al.* (2014) reported in his survey study that 55.9% of sixth year dental students and 28.3% of first year dental students have low level of knowledge about the transportation of avulsed tooth to the dental clinics and indicated towards the need to provide adequate education in this regard. Child's own mouth and saliva or mouth and saliva of parents / any person present at the accidental site is the right media of immediate transportation of avulsed tooth, which is easily and freely available without any immunological reaction on avulsed tooth. It is very unfortunate that very few pediatricians were found to be well aware of this concept. A ten year boy can easily be advised to carry an avulsed tooth in his oral cavity. However, sometime accidental ingestion and / or propulsion of avulsed tooth from mouth due to nausea and vomiting may happen.

If the avulsed tooth cannot be re-implanted immediately, it should be stored in a proper medium. It is very crucial that the avulsed tooth is not left unattended to dry as cells on the root surface in the periodontal ligament will render unviable in such conditions. If a tooth is maintained in a dry environment prior to re-implantation, irreversible damage to PDL cells can cause an inflammatory response on the root surface, which leads to ankylosis and eventual tooth loss. Hank's Balanced Salt Solution (HBSS), a tissue culture medium is recommended as the best storage medium for avulsed permanent tooth in order to maintain the viability and enabling in multiplication of the periodontal ligament cells. If HBSS is not available then cold milk, the patient's saliva and water can be used as a storage medium (American Association of Endodontics, 1995; Krasner and Person, 1992). Sigalas *et al.* (2004) reported that HBSS (tissue culture medium) was found to be superior among other storage media such as eye contact lens solution, water, milk and ice in maintaining the viability of PDL cells up to one hour. It is also observed that water had a most detrimental effect on PDL cells. Two percent milk preserved more viable cells than contact lens solution. Knowledge of correct measures regarding storage media was found to vary considerably. For transport for an avulsed tooth, dry storage of the tooth will cause irreversible injury to the periodontal membrane, resulting in loss of the reimplanted tooth over time. However, storing the tooth in water is not recommended since the osmolality of water is too low (Blomlof, 1981a; Sigalas *et al.*, 2004). Milk has a favorable osmolality and composition for the viability of periodontal ligament cells and has therefore been recommended for temporary storage of avulsed teeth before reimplantation (Blomlof, 1981b; Sigalas *et al.*, 2004). Despite years of research showing that cell membranes will be destroyed if stored in normal saline, an alarming number of physicians (42.4%) thought that a tooth could be stored in such a medium. There seems to be an urgent need to educate the physicians and correct these misconceptions.

Dali *et al.* (2014) have also observed that fair knowledge and attitude of medical doctors working in Nobel medical college, Biratnagar, towards emergency management of avulsed tooth and need of educative program in their text. The study further revealed that 55.6% of medical doctors knew the correct meaning of avulsed tooth, only 41.3% had prior knowledge about management of an avulsed tooth, whereas 58.6% were unaware of its management and 58.6% choose saline as best medium to preserve an avulsed tooth, 8.6% choose saliva, 4.3% choose milk. Hashim (2012) assessed that around 68% of the physicians referred the avulsed tooth immediately to the dentist, none of them attempted to put the tooth back into socket before referring to dentist. When asked about storage medium for avulsed tooth, 42.4% of the physician would advice normal saline and only 8% knew that milk can be used as better medium. A total of 83.2% of the respondents were unsatisfied with their knowledge regarding emergency management of dental trauma. About 96.8% of the physicians felt the need of educational programs in this regard. Talluri *et al.* (2014) found that 32.8% of the medical professional's referred the patient to the dentist in case of avulsion, 4.3% said that no treatment was required in cases of avulsion, 55%

suggested that saliva can be used as best storage medium, 37% preferred normal saline as storage medium whereas 6.9% preferred Povidone iodine lotion, 57% said that best time for re-implantation of avulsed tooth was within an hour 26% said within half an hour. They concluded that level of knowledge was inadequate and there was a need of appropriate training in this regard. Venkataramana *et al.* (2015) assessed the knowledge and attitude of medical professionals teaching staff, postgraduates and house surgeons working in a medical hospital in Khammam district in Telangana regarding management of an avulsed tooth. They reported that 64% were aware of the meaning of an avulsed tooth, 54% suggested saline as the best storage medium for transportation.

Al Jazairy *et al.* (2015) observed that 89.4% of the studied dentists were of the opinion that the extra oral period, storage medium and injury to the PDL are factors that may affect the outcome of replantation of the avulsed tooth, which is consistent with the results by Westphalen *et al.* (2007). The extra-alveolar period has been recognized as the most critical factor for optimal periodontal healing (Andreasen *et al.*, 1995a, b, c; Barrett and Kenny; 1997). Saline, Hank's balanced salt solution (HBSS), and milk are examples of osmolality-balanced media suitable for storing avulsed teeth (Andersson and Andreasen, 2012). The patient's saliva, although readily available at the site of trauma, contains bacteria and their by-products (Blomlöf, 1981a). Furthermore, several studies have reported that the vitality of PDL cells can be sustained for 30 min when immersed in the patient's saliva, but it decreases remarkably after 60 min (Andreasen *et al.*, 1995a, b; Blomlöf, 1981b; Andreasen, 1981). However, while milk may not be readily available at the site of trauma, storage of the avulsed tooth in milk at room temperature has been reported to preserve the viability of PDL cells for up to 60 min, whereas refrigerated milk preserves viability for an additional 45 min (Blomlöf *et al.*, 1981b; Lekic *et al.*, 1996), HBSS, on the other hand, was not included by some authors as an option in their questionnaire concerning storage medium due to its lack of availability at trauma sites (Krastl *et al.*, 2009). Physiological saline solution is more commonly available than HBSS but is less available than milk. The highest percentage of our respondents (45%) reported HBSS as the best storage medium, followed by the patient's saliva (26.1%) and milk (24.1%). This finding was not consistent with the results of previous studies, in which most of the participants reported the patient's saliva (Westphalen *et al.*, 2007) saline (Baginska and Wilczynska-Borawska, 2013, milk (Cohenca *et al.*, 2006; de Vasconcellos *et al.*, 2009; Yeng and Parashos, 2008) as the preferable or recommended storage medium.

Isha (2020) in her study on evaluation of first aid knowledge of pediatricians of Karnal district of Haryana, India observed that the proper handling of avulsed permanent tooth and its immediate gentle cleaning with the easily available tap water was found correct in 8% pediatricians (4% were having experience of <10 years and 4% > 10 to 20 years). Those 92% who answered incorrectly include 77% as wash with normal saline and 5% as scrub the tooth and clean it and 10% were found having no knowledge about the cleaning technique of avulsed permanent tooth. The IADT along with numerous

others sources state that after avulsion of a permanent tooth, the tooth should be handled only by crown, gently rinsed off with water to clean away debris, and re-implanted as soon as possible by anyone present at the scene (American Academy of Pediatric Dentistry, 2004; Zemon and Kenny, 2001; Flores *et al.*, 2007; Kenney *et al.*, 2003; Mc Tigue, 2000; Trope, 1996; Andreasen, 1995a, b). Handling of the avulsed tooth and carrying the same in proper medium maintaining its vitality dictates the prognosis of the tooth. Al Ghamdi *et al.* (2016) observed that the majority of the Saudi parent's choose washing the avulsed tooth under tap water, in contrast to the results obtained by other studies, where they preferred to scrub the tooth and clean it (Robertson and Noren, 2001; Raphael and Gregory, 1990; Namdev *et al.*, 2014; Shashikiran *et al.*, 2006). Talluri *et al.* (2014) studied that 64.7% of doctors would re-implant an avulsed tooth and follow this with an appropriate referral. Nasr *et al.* (2008) showed that 78% of doctors would re-implant an avulsed tooth and follow this with a referral to an appropriate medical professional (Nasr *et al.*, 2008). Talluri *et al.* (2014) observed that 100% of medical professionals expressed that they could account for avulsed teeth and 22.4% doctors stated that the appropriate treatment during the initial 30 minutes provides the best prognosis for traumatically avulsed teeth. Talluri *et al.* (2014) revealed that 59.5% of the studied doctors had no recollection of any training in the management of dental injuries. This was similar to the study done by Nasr *et al.* (2008) and agrees with Patel and Driscoll's (Harrison, 2014) with only 6% of senior house officers had training in dental management as part of their undergraduate education. Lewis *et al.* (2016) studied the importance of re-implantation and observed that approximately 40% of the pediatricians were not sure of undertaking the tooth saving procedures and storing medium of avulsed tooth in a solution compatible with cell viability. More than half of the pediatricians were unaware of the most appropriate storage medium. Similar findings were observed in a study by Khandelwal *et al.* (2013).

However a non significant negative correlation between knowledge score and length of experience was observed in this study. Lewis *et al.* (2016) also observed a negative correlation indicating recently passed out pediatricians had better knowledge than the more experienced. Similar findings were noted in a study conducted by Khandelwal *et al.* (2013). This might be due to escalating incidence of orofacial trauma and increased awareness. Pithon *et al.* (2014) found poor level of knowledge of primary school teachers in the public school network of North-Eastern Brazil with respect to management of dental trauma and its relationship with prognosis. Glendor Ulf (2009) reviewed from different countries and groups of people but the result seem to be consistent, i.e. that a large part of the education process of professional caregivers and lay people regarding dental trauma care had failed. Too much hope seems to be on lay people to handle difficult cases such as tooth avulsion. His reports revealed that education of caregivers and lay people was a field where much remains to be explored. Mori *et al.* (2007) concluded that the efficacy of campaign on avulsed tooth management was found positive and the respondents possessed all required adequate knowledge thus promoting implementation of more such educative campaigns in other schools. Natarajan and

Gurunathan (2013) observed that the level of knowledge among physical education teachers in Chennai regarding tooth avulsion and its emergency management was insufficient and recommended the need of implementing educative programs. Lewis, *et al.* (2017) assessed pediatricians' knowledge, attitudes, and professional experience regarding oral health. Pediatricians may be able to play an important role in improving the dental health of their patients who have difficulty obtaining access to professional dental care. However, it is unclear to what degree pediatricians are knowledgeable about preventive oral health and the extent to which they may already be participating in prevention and assessment. Also, little is known about the incidence of dental problems in pediatric practice, and whether pediatricians attitude act as barrier to their patients' receiving professional dental care. Finally, it is important to know how pediatricians value the promotion of oral health and whether they would be willing to take on additional activities aimed at its improvement. Pani *et al.* (2015) reported that the level of knowledge regarding traumatic dental injuries was highest among surgeons and lowest among emergency room technicians who are likely to be the first people to encounter such injuries. They further reported that the attitude towards management of traumatic dental injuries was most positive among nurses. Jyothi *et al.* (2011) observed through survey study that only 78.5% of the medical doctors working in Sri Siddhartha medical college, Tumkur, know the correct meaning of avulsed tooth and concluded that the knowledge of the medical doctors were having fair although none were found to provide accurate and appropriate first aid. Samaei *et al.* (2015) reported that the knowledge and confidence of Australian Emergency Physicians and college trainees in managing dental emergencies was varied and Interactive training sessions in dental emergency management were highly indicated. The response rate was observed as 13.6% and college members were proportionally represented by region. Fewer than half (42%) had received dental training. Sixty two percent passed a knowledge test. More than 60% incorrectly answered a question on dental fracture, periodontal abscess, tooth eruption dates and ulcerative gingivitis. Forty two percent incorrectly answered a question about Ludwig's angina. Eighty three percent were confident in the pharmacological management of toothache but only 26% were confident in recognizing periodontal diseases. Interactive workshops were preferred by most (93%). Khandelwal (2013) observed that 90% of physicians and Paediatric surgeons practicing in Indore area have accepted that they had no knowledge of dental trauma management and 93% of the practicing doctors were interested in attending an education program in this regard. Blakytyn *et al.* (2001) observed that majority of primary school teachers possessed a rudimentary knowledge of the emergency management of dental avulsion & further suggested to issue dental first aid instructions to them. Bhandary *et al.* (2014) observed the need of training in the management of dental trauma as part of their training program for physical education teachers regarding dental trauma and its management in Karnataka state of India.

The pediatricians' knowledge about tooth trauma management and familiarity with basic oral health-related research were limited, particularly the research in the last decade (Koranyi *et*

*al.*, 1991; Sanchez *et al.*, 1997; Gift *et al.*, 1984). Pediatricians can expand their involvement in oral health prevention, but they can never replace the care that dental professionals can provide. Time pressure, lack of accurate knowledge and inadequate staffing will make it difficult for pediatricians to devote the attention to oral health that all children deserve. Physicians' knowledge regarding tooth avulsion was found insufficient and only 18.8% refer pediatric patients to pediatric dentist (Ulusoy *et al.*, 2012). There was no correlation between knowledge score and level of dental education received in medical school and / or residency (Sezer *et al.*, 2013). In Kuwait, 16.7% physicians had received information about tooth avulsion (Abu-Dawoud, 2007). Holan and Shmueli (2003) found that 55% of the physicians in their study had never received any information related to dental trauma. Hashim (2012) highlighted that only 19.2% of the physicians had received training on managing avulsed teeth and the rest never had any educative program in this regard. The majorities 97.6% of the respondents was not satisfied with their level of knowledge and believe that they need further education. McCann *et al.* (2005) observed that physicians and medical undergraduates in the United Kingdom were inadequately educated about dental trauma case and there is an urgent need to provide more courses on dental trauma management for physicians and pediatricians. Kahabuka *et al.* (2003) conducted a cross-sectional study to evaluate the influence of two different modes of delivering guidelines to school teachers regarding emergency treatment in traumatic dental injuries in Tanzania, East Africa. A total of 539 randomly selected primary school teachers were included in the study. The study reported significant differences among level of knowledge regarding emergency first aid management of avulsed tooth between the study group and the control group indicating that the efficacy of the educative programs was found to be positive. Only 15 % correctly answered that they would replant the avulsed tooth and then refer to the dentist. They concluded that knowledge of teachers must be improved using educational campaigns. Andersson *et al.* (2006) stated that knowledge of the correct first-aid measures is crucial to successful re-plantation. He conducted a study to assess the present knowledge level of emergency measures for tooth avulsion in Kuwaiti school children, and to design and test an interview form with structured standardized questions. The results of the interviews showed that 30.3% of the children had been exposed to dental trauma in the past. Among children 7-9 years of age, 25% had conventional information on general first aid as compared with 75% in children aged 10 years and older. Children 10 years and older, in general, had a high knowledge level regarding general principles of managing injuries. Irrespective of age group, there was generally a low knowledge level regarding tooth avulsion, re-plantation, extra-alveolar time and storage media. The survey concluded that first-aid knowledge in Kuwaiti school children is low on avulsion and re-plantation of teeth in spite of a high knowledge level in case of emergency management of bodily injuries which should be augmented through intervention programs. Al-Asfour *et al.* (2008) assessed the knowledge level of emergency measures for tooth avulsion in Kuwaiti school teachers. A total of 85 teachers at two intermediate schools were included in this

study and their knowledge was assessed using a closed ended questionnaire. They observed that school teachers can play a crucial role in improving the prognosis of avulsed permanent teeth of school children. Many avulsed permanent teeth in school children can be saved by re-plantation if school teachers learn what to do when a tooth is avulsed. A lecture followed by discussion proved to be a successful and efficient way of intervention to improve the knowledge level of teachers so that appropriate dental first-aid measures can be achieved. Meintyre *et al.* (2008) conducted a survey to assess the knowledge, practice and experience regarding traumatic dental injuries (TDIs) among a sample of elementary school personnel in U.S.A. Assessment was performed using a demographic questionnaire and a newly developed traumatic dental injury survey instrument. Results revealed a wide distribution of responses. Overall, dental trauma knowledge among this group was poor. The majority of respondents were not well-versed regarding traumatic dental injuries. Hence, education and management are required among all elementary school staff members to enhance the prognosis of these accidents when they occur. Tzigkounakis and Merglova (2008) evaluated the knowledge of primary school teachers in Pilsen, Czech Republic to provide first aid during tooth avulsion. A questionnaire about avulsion of permanent teeth was prepared. They concluded that prevention of tooth injuries was very important, as they may result even in tooth loss. This stresses an attempt to properly inform and educate sport trainers and primary school teachers about providing first aid in such situations. Additionally, this effort should be intensive and continuous. Zakirulla *et al.* (2011) studied the knowledge and attitudes regarding emergency management of dental trauma, first aid for avulsed tooth and influence of dental education among school teachers in Abha city, Saudi Arabia. Results concluded that majority of school staff had little knowledge related to handling of traumatic dental injuries and emergency management in school children. Majority of school teachers were eager to have knowledge regarding dental trauma through continuous dental education programs and workshops. Additionally, the study recommended that first aid training increases knowledge about dental trauma and should be included in the course curriculum of teacher trainee. Ozer *et al.* (2012) examined the parental knowledge and attitudes about avulsed permanent teeth and their emergency treatment in children with the questionnaire of 289 parents of children aged 6-12 years receiving care at Ondokuz Mayıs University Pediatric Dentistry Clinic, Turkey. Results concluded that parental level of knowledge about the emergency treatment of avulsion in children is inadequate and that educational campaigns are necessary to improve proper emergency management. Further, authors concluded that there is a statistically significant effect on the number of correct responses regarding appropriate management of avulsed injuries. Namdev *et al.* (2014) conducted a survey in order to evaluate the awareness level of a sample of Indian (Rohtak, Haryana) parents in the management of dental trauma. This study indicated a low level of knowledge regarding tooth avulsion and re-plantation procedures to be followed in emergency. The residing area and age of parent did not affect the knowledge and awareness of parents. Moreover, well-educated parents also had very little or no information about

dental trauma first-aid. The study concluded that Educational programs to improve the knowledge and awareness among the parents have to be implemented, dental injury prevention and management should be recognized as a major public health issue and adequate resources to be allocated for research in this area. Prakash (2015) assessed the perception of teachers towards traumatic tooth avulsion and its management. A total of 131 teachers from different schools of Durg district, Chattisgarh were included in this study. He concluded that the prognosis of traumatized tooth often depends on the prompt and appropriate treatment given to patient by the people who are present at the site. Often these injuries occur in school environment and, therefore, the perception of school teacher towards these is crucial to the prognosis of tooth avulsion. The knowledge of school teachers towards immediate management of avulsed tooth and medium for storage and transport of avulsed tooth is insufficient. Therefore, a teacher's orientation program towards management of TDI's is highly warranted. Meka *et al.* (2015) investigated the knowledge of emergency management of oro-facial trauma among the physical education students from the University College of physical education located in Khamman, South India. They concluded that 55.43% had received first aid training and 84.31% of the study population reported inclusion of dental injury management during their training. Majority of students (53.61%) opted for antiseptic lotion for storage and transport of avulsed tooth. Prasanna *et al.* (2011) reported that traumatic dental injuries including avulsed tooth is a terrible and overlooked problem among school children. Awareness about avulsed tooth emergency management among school teachers is an important concept for long-term success and to prevent future consequences since school teachers commonly supervise the physical activity of the children. The study was performed by administering a self-designed questionnaire on a sample of 300 primary school teachers. Sixty-eight percent of the school teachers (government, semi-aided and aided schools) admitted the possibility of an avulsed tooth to be replanted and thirty-two percent had no idea on tooth replantation and only twenty-three percent of the teachers knew the procedures taken in cases of avulsed teeth. Seventy-seven percent of all teachers did not feel the possibility of tooth replantation. There is poor knowledge in the management of avulsed teeth among the school teachers of Davangere city, Karnataka. They do not feel capable of replanting an avulsed tooth. Krishnan *et al.* (2016) conducted a cross-sectional descriptive study and employed a questionnaire type survey instrument across 3 public and 2 private Sydney primary schools to assess the knowledge of Australian school teachers in their initial management of traumatic dental injuries (TDIs). Furthermore, the study aims to explore any differences in knowledge between primary school teachers working in public versus private metropolitan schools. Results reveal that among the Primary schools in Sydney knowledge of management of TDIs were relatively low amongst sampled teachers with comparable levels of knowledge found between private and public school groups. Additionally, Knowledge gaps were demonstrated amongst Sydney primary school teachers in the initial management of TDIs and found to be consistent with previously published literature. Ghamdi *et al.* (2016) conducted a study to assess Knowledge and attitude of Saudi

Arabian parents with regards to emergency management of dental trauma. They observed that sixty one percent of the parents reported dental trauma in their children and 67.2% of them were not aware of the steps to be followed in tooth avulsion. The percentage for the source of information for avulsed tooth management was either a dentist (38.8%) or the internet (34.5%). 73.8% of the parents were unaware of the fact that permanent avulsed tooth can be replanted. 56.3% parents said that they would discard the knocked out tooth. This survey reflected the lack of awareness and adequate knowledge regarding the avulsed tooth. The study highlighted the facts that there is an imperative need for educating the parents. They are among the first people to deal with tooth avulsion injuries in children. Dela Cruz *et al.* (2004) recommend that physicians provide preventive dentistry services, including dental screening and referral. This study is the first to inspect characteristics of medical providers that influence their referral to a dentist of children who are at risk for dental disease. A cross-sectional survey was undertaken to evaluate a pediatric preventive dentistry program targeted toward Medicaid-eligible children in North Carolina. Patient characteristics (tooth decay status, insurance status, immigrant status, English speaking), practice characteristics (setting, number of providers, patient volume, busyness), practice environment (perceived and actual availability of dentists), and other provider characteristics (gender, type, practice experience, board certification, training in oral health during or after professional education, hours worked, teaching of residents, preventive behaviors) were assessed and used as control variables. Nearly 78% of 169 primary care clinicians who participated in the survey reported that they were likely to refer children who had signs of early decay or high risk for future disease. Zhao and Gong (2010) conducted a survey and documented that there is a high frequency of dental trauma cases in China, where tooth avulsion is one of the most serious scenarios. The knowledge of how to take care of an avulsion is of great importance. The results revealed an uneven pattern of knowledge between urban and suburban dentists regarding the emergency management of avulsed teeth. The study highlighted Chinese dentists' need for long-term education in order to enhance current knowledge in emergency management of avulsed teeth.

Nammalwar and Rangeeth (2012) studied the knowledge and attitude of the pediatricians and family physicians about pediatric dentistry. A questionnaire was administered to 400 pediatricians and 400 family physicians practicing in Chennai city. The level of knowledge was found to be unsatisfactory. The study suggested the incorporation of dental lecture into CME programs and recognition of pediatric dentistry by providing referral to needy patients. Halawany *et al.* (2014) conducted a study to evaluate the level of knowledge regarding tooth avulsion and its management in a group of dental assistant's in Riyadh, Saudi Arabia. They reported that the level of knowledge among the participants was fair and strongly correlated with their educational qualifications. Re Dino *et al.* (2014) conducted a cross-sectional study to evaluate the degree of knowledge in the management of different scenarios of dental trauma in a population of Italian dentists. They reported that 75% of the participants answered correctly to the questions regarding crown fracture and



extrusive luxation injuries, only 40% had correct knowledge regarding duration and type of splinting following avulsion. 60% of participants incorrectly choose immediate invasive therapies for horizontal middle –root fracture. They concluded that level of knowledge in the group of dentists was considered heterogeneous whereas lack of knowledge was identified in fields like type and duration of splinting following avulsion and root fracture and thus educative programs in this regard should be launched. Limbu *et al.* (2014) conducted a cross-sectional survey to assess the knowledge and attitude of dental interns of Nepal regarding management of tooth avulsion and also to evaluate the need for further education. They reported that the level of knowledge was very inadequate regarding re-implantation of avulsed tooth and the type of splinting required and various critical factors in the outcome of replanted tooth. They suggested that there was a need of the adequate educative programs. Al Jazairy *et al.* (2015) stated that there is a lack of enough information on dentists' knowledge about tooth avulsion and its management in Saudi Arabia. The study figured out the level of knowledge about permanent tooth Avulsion and its management among dentists working in Riyadh, Saudi Arabia. The surveyed dentists were found to have a moderate knowledge of avulsion and its management, although a relative lack of knowledge was observed regarding the length of time of follow-up after reimplantation. Nabil and Zubair (2015) conducted a survey to investigate the knowledge of general dentists about emergency management of dental avulsion in Yemen. The test Sample comprising of 272 general dental practitioners was surveyed using a set of self administered, close ended questionnaire. The results suggested that the level of knowledge on the management of dental avulsion was inadequate and warranted a need of educative programs.

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