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VIRGINIA EMERGENCY DEPARTMENT PHYSICIAN KNOWLEDGE OF THE
EMERGENT TREATMENT OF AVULSED TEETH

A thesis submitted in partial fulfillment of the requirements for the degree of Masters of
Science in Dentistry at Virginia Commonwealth University.

by

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Table of Contents

	Page
Acknowledgements.....	ii
List of Tables	iv
List of Figures.....	v
Chapter	
1 Introduction.....	1
2 Materials and Methods.....	6
Design.....	6
Statistical Analysis	7
3 Results.....	8
4 Discussion.....	10
Conclusions	13
References.....	14
Appendices.....	25
A Survey Invitation Letter	25
B Avulsion Questionnaire	26

List of Tables

	Page
Table 1: Sources of Dental Services and Information for Virginia Physicians.	18
Table 2: Physicians' Responses on What Media to Store the Tooth in if Not Immediately Re-implanted.	19
Table 3: Further Dental Education Requested by Physicians.	20

List of Figures

	Page
Figure 1: When should a tooth be re-implanted?	21
Figure 2: What should a tooth be cleaned with prior to re-implantation?	22
Figure 3: Which teeth should be re-implanted?	23
Figure 4: Various storage media for teeth prior to re-implantation	24

Abstract

VIRGINIA EMERGENCY DEPARTMENT PHYSICIAN KNOWLEDGE OF THE EMERGENT TREATMENT OF AVULSED TEETH

By Joy Leatrice Barnes Phelps B.S., D.M.D.

A Thesis submitted in partial fulfillment of the requirements for the degree of Masters of
Science in Dentistry at Virginia Commonwealth University.

Virginia Commonwealth University, 2008

Major Director: Tegwyn Brickhouse D.D.S., Ph.D.
Assistant Professor, Department of Pediatric Dentistry

Purpose: The purpose of this study was to determine the knowledge and treatment protocols for physicians in Virginia emergency departments in regards to the emergent treatment of avulsed teeth.

Methods: Using a cross sectional survey design, an 8-item questionnaire regarding the treatment of avulsed teeth was emailed to 75 emergency department chairpersons in Virginia. After 30 days, a reminder paper copy of the questionnaire was mailed and an email reminder with the on-line link was sent. After 60 days the study was closed.

Comparisons were made using chi-square analysis based on percentages to test for significance.

Results: The response rate was 52 % (n = 39). There were no associations between physician knowledge of the treatment of avulsed teeth and whether there was a protocol for treatment, an in-house dental team, or an on-call dentist available.

Conclusion: Most of the physicians have some knowledge of the treatment of avulsed teeth; however further training would help ensure appropriate treatment.

Introduction

Often traumatic injuries of children present in the head and neck region. Dental/oral trauma has its highest incidence in the months of September and October with most injuries caused by falls and play accidents.¹⁻² A study of oral trauma in children by Meadow et al. found that 62% of injuries were due to falls, 13% from sports accidents and 8% from fighting between children. Most often, dental trauma occurs in toddlers as they are learning to ambulate. As they attempt to walk, they often stumble and have frequent falls which can injure their oral cavity.^{2,3} Thirty percent of children experience trauma to their primary teeth, while 22% of children experience trauma to permanent teeth, prior to age 14.² In the primary dentition, the peak incidence is between the ages of 2-4, whereas in the permanent dentition the peak is in the range of 8-10.² Trauma to teeth may include fractures to the crown or root, displacements/luxations and avulsions. Luxations are more common in the primary dentition and fractures predominate in the permanent dentition.¹ An avulsion is when a tooth is physically ejected from the bony socket. The most commonly avulsed teeth in children are the permanent maxillary central incisors, followed by the maxillary laterals and then the mandibular incisors.^{4,5} The frequency of avulsions is approximately 1 – 16% of all dental injuries.⁶

Avulsions of permanent teeth, without re-implantation, can have many effects on children and adolescents including loss of function, compromised esthetics, lowered self-esteem, and having to endure the long arduous process of fabricating a restoration to replace the tooth.² Cortes et al described that children with teeth that sustained trauma affected the child's ability to smile, laugh, show teeth without embarrassment, and maintain a normal emotional state without being irritable.⁷ In addition to the deleterious effects on the children, parents are also burdened by the time commitment needed to complete the treatment of trauma, loss of work and the monetary costs of the future prosthetic replacement of the tooth.

In order to avoid the negative consequences of tooth loss, the alternative is to provide the best possible protocol to maintain viability and long-term prognosis of the tooth. Numerous organizations have published guidelines and recommendations based on scientific evidence and treatment outcomes on how to successfully re-implant and save avulsed teeth. The American Academy of Pediatric Dentistry (AAPD), and the International Association for Dental Traumatology (IADT) guidelines suggest not to re-implant primary teeth because doing so may damage the developing permanent tooth.^{6,8,9} Some of the risks, outlined by Zamon and Kenny are that the primary tooth can cause deflection, hypoplastic and morphologic changes to the crown of the permanent tooth. The primary tooth may also form a dental abscess or undergo ankylosis.¹⁰

Permanent teeth have more complex guidelines and recommendations, however the AAPD, IADT, and the American Association of Endodontics (AAE) all assert that one of the most important factors in successful treatment is minimizing the time the tooth

is out of the socket.^{6,8,11,12} Avulsions require urgent treatment in order to increase the likelihood of a successful outcome.^{13,14} “Luxation injuries, particularly avulsions, dictate emergency treatment as positive outcomes diminish with time delay.”² As time progresses, the probability of regenerating or maintaining a viable periodontal ligament decreases.¹⁵ Moreover, the likelihood of replacement resorption and ankylosis increases. In a study by Andreasen and Hjørting, if a tooth is re-implanted within 30 minutes, 90% of the teeth show no radiographic root resorption at a 2 year follow up. However, if re-implanted more than 2 hours after the injury, root resorption is present radiographically in 95% of the teeth.¹⁶

The IADT along with numerous other sources state that after an avulsion of a permanent tooth, the tooth should be handled only by the crown, gently rinsed off with water to clean away debris, and re-implanted as soon as possible by anyone present at the scene.^{8,11,12,17-21} If it cannot be immediately re-implanted, another important factor in successful treatment outcome is the condition in which the tooth is kept until re-implantation can take place. It is important that the tooth not be allowed to dry as cells on the root surface in the periodontal ligament (PDL) will die. 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. After 60 minutes of dry time, survival of the PDL cells is unlikely.²² Various liquids have been studied to assess their effectiveness in maintaining the vitality of PDL cells. An article by Krasner and the AAE guidelines recommend Hank’s Balanced Salt Solution (HBSS) which is available over-the-counter.^{11,23} If HBSS is not present, cold

milk, the patient's saliva, and water are all superior to allowing the tooth to dry.^{8,15,24} In a study by Sigalas et al, HBSS, contact lens solutions, Gatorade®, water and milk were compared at room temperature and on ice to determine which solution better maintained the viability of PDL cells after one hour of exposure. This study found that HBSS was superior to the other liquids and that water had the most detrimental effect on PDL cells. Two percent milk followed by Gatorade® preserved more viable cells than contact lens solution only if the liquids are kept on ice.¹⁵

Another factor in successful treatment outcomes of re-implanted permanent teeth is the apical development; whether the apex of the tooth is open or closed. In a study by Barrett and Kenny, incisors with open apices exhibited a 4.2 times greater relative risk of failure than incisors with closed apices.²⁵ This finding was also supported in a study by Andreasen et al which found that 10 years post re-implantation, teeth with open apices had a lower survival.²¹

At the time of the avulsion, bystanders on the scene often do not re-implant the avulsed tooth. Their hesitance may be due to their lack of knowledge about what to do.²⁶ On the other hand, even with the knowledge present, other factors may impede their decision to act including the child's fear, not wanting to cause the child pain, and not wanting to be exposed to blood and bodily fluids. Instead of re-implanting the tooth, many kids are taken to the emergency room for treatment.

Some emergency rooms have an in-house dental team. However, most emergent treatment facilities do not have a dentist present at all times. Dentists may be available "on-call" and will go to the facility after being alerted that a dental trauma has taken

place. In the time interval between patient arrivals at a treatment facility and when a dentist arrives, or in the situation where a dentist is not available, physicians are likely the first medical personnel to evaluate these children. In light of the aforementioned guidelines recommending timely treatment of avulsed teeth, it is important that ER physicians be knowledgeable on the treatment protocols of avulsed teeth as they could have a huge impact on a successful treatment outcome. A study by Holan et al of emergency room physicians found that only 4% of the physicians surveyed would have performed an appropriate treatment that would have led to a successful treatment outcome. Moreover, 50% of this study's participants reported that they would not under any circumstance re-implant a permanent tooth.²⁷ In a similar study, findings revealed that recently graduated physicians "had low awareness about the emergency management of avulsed teeth and the possibility of saving them through simple replantation."²⁸ Twenty-five percent of the physicians thought there was no need to store a tooth that was not immediately re-implanted. In addition, 25% thought that the tooth could be stored dry. This study concluded that few of the physicians queried would provide the appropriate management of avulsed teeth.²⁸

The purpose of this study is to determine what knowledge physicians in Virginia emergency departments have regarding the avulsion of teeth and what the protocols are for the emergent treatment of avulsed teeth.

Materials and Methods

Design

This was a cross-sectional study design of emergency department chairmen. There was a sample of seventy-five emergency room physicians who were given the 8-item questionnaire to complete. The physicians were given the URL address of a one page questionnaire to complete. The survey was made available online and the Virginia College of Emergency Physicians contacted the physicians via email and informed them of the survey and the URL address. To increase the response rate, thirty days after the initial email, a reminder paper copy of the questionnaire was mailed to the physicians. They were given the option to complete the paper questionnaire and mail it in with a postage-paid envelope or access and complete the survey online. At thirty days, a second electronic mailing was conducted with an additional thirty days to reply. After the allotted sixty days, the study was closed and only data collected during that time period was incorporated for analysis.

The 8-item survey was self-administered online using Inquisite (version 7.0, Inquisite, Inc., Austin TX) or via paper survey. The survey was created based on a questionnaire used by Holan et al surveying physicians' knowledge of avulsed teeth. The survey asked whether the emergency department has an in-house dental team and/or an

on-call dentist and if so, what type of dentist. It also queried whether there was a set protocol for non-dentists in the treatment of avulsed teeth and what the physicians' knowledge was concerning which teeth should be re-implanted, in what time period and with what preparation of the tooth. This study was approved for Human Subjects by the Virginia Commonwealth University Institutional Review Board.

Statistical Analysis

Survey responses were evaluated to form descriptive statistics about emergency department's treatment protocols and physician knowledge of the treatment of avulsed teeth. Univariate distributions were obtained for each question. Since not all respondents answered each question, the denominator used to calculate the proportions was the total number of non-missing values. The response variables for survey items were compared according to whether or not the emergency department had an avulsion treatment protocol, an in-house dental team and an on-call dentist. These comparisons were made using chi-square analysis based on their percentages to test for significance. The level of significance was set at 0.05.

Results

Thirty-nine emergency department physicians completed the survey, yielding a response rate 52%. All of the participants who responded consented to participate in the study. Eighty-seven percent reported that their emergency department did not have an in-house dental team. Of the 13% that did have an in-house dental team, the ratio of type of dentist was 4:1 (oral surgeon : general dentist). Seventy-seven percent reported that they did not have an on-call dentist available. Of the 23% that did, the ratio of type of dentist was 5:3 (general dentist : oral surgeon). Eighty-five percent reported that they did not have a protocol for non-dentists in treating avulsed teeth (Table 1).

After an avulsion, if the tooth is not immediately re-implanted, 96% responded that the tooth should be placed in some form of liquid for storage (54% milk, 23% saliva, 8% Hank's Balanced Salt Solution, 8% Save-A-Tooth, 3% water) (Table 2). Ninety-five percent responded correctly that permanent teeth, not primary teeth should be re-implanted. Seventy-nine percent of the physicians responded that the tooth should be re-implanted immediately and most of them thought it could be saved if re-implanted within 2 hours (Figure 1). Seventy-four percent of respondents chose that the tooth should be cleaned prior to re-implantation and 67% of those respondents chose to clean it with water (Figure 2). There was no significant difference in physician knowledge of

the treatment of avulsed teeth based on whether or not the emergency department has a treatment protocol for non-dentists, an in-house dental team or an on-call dentist available (Figures 3 and 4).

Discussion

This survey gathered information about the sources of dental services and knowledge of emergency department physicians in Virginia. The findings of this survey showed that most emergency departments do not have a dental service available for dental emergencies; neither an in-house dental team nor an on-call dentist. In addition, most do not have a protocol for non-dentists in treating dental avulsions. Given the significance of timely treatment for this dental emergency, it is important that emergency department physicians be knowledgeable about the appropriate treatment for avulsed teeth. A study done by Holan et al found that only 4% of ER physicians would render the appropriate treatment for cases of dental avulsions, which would allow a dentist to follow up later and save the tooth.²⁸

This study found a higher level of avulsion treatment knowledge with 96% of the physicians aware that an avulsed tooth, that is not immediately re-implanted, should not be kept dry. As numerous studies have reported that a dry environment will lead to death of the PDL cells, this is a vital point for physicians to know. In this survey 54% reported that they would put the tooth in milk, which is an appropriate storage medium. However, a greater number of viable cells could be maintained if the milk is on ice; and other, more effective storage media exist including Hank's Balanced Salt Solution and Viaspan. If

more physicians were aware of these more effective media, they could stock these liquids in their emergency departments.

For the question “which teeth should be re-implanted after an avulsion”, fortunately, only a few respondents reported that they would re-implant primary teeth. Research has shown and treatment guidelines have established that doing so could damage the developing permanent tooth bud. Further education for physicians may be necessary to inform them of the consequences of re-implantation of primary teeth. Moreover, since the timing of permanent tooth re-implantation is integral to success, it is imperative that physicians realize the urgency with which they should attempt to re-implant the tooth.

Furthermore, teeth that are exposed to the extra-oral environment may have dirt or other contaminants on the root surface which could delay or prevent healing. Physicians should understand if they should and how to cleanse the tooth without damaging cells on the root surface. Seventy-four percent of participants in this survey responded that they would clean the tooth but only 70% of that subset answered correctly that they would rinse the tooth with water or an antibiotic. Twenty-nine percent of the respondents did not answer or answered they did not know with what they would clean the tooth.

In summary, their responses show that there are some voids in emergency physician knowledge of the emergent treatment of avulsed teeth. Given the frequency of this type of trauma, and the lack of dental services available in the emergency department, part of physician training should include information on dental trauma and/or more continuing education should be focused on this topic. Physicians who completed

the paper survey were also asked their opinion on what further dental information or education they would like on the topic. Their predominant interests are on dental emergencies in general and oral nerve blocks. These responses are shown in Table 3.

This study had some limitations that may weaken the strength of the results. Although 52% of the subjects responded to the survey, the responses to questions 1-3 were not normally distributed enough to make significant correlations. The responses to those questions were skewed such that most of the respondents did not have an in-house dental team, an on-call dentist, or a treatment protocol. To make an accurate comparison with this distribution of responses our sample size would need to be much larger. As a pilot study, this survey was limited to the department chairs of Virginia emergency departments. A follow up study could broaden the pool of participants by questioning all the emergency department physicians in Virginia. Also, there were no demographical questions asked in this survey; questions about respondents' age, gender, years of experience, and training. These variables could contribute to the responses of the physicians. Future studies could incorporate questions to gather more information about the physicians' demographics to allow for further analysis of the results.

Conclusions

- Most emergency departments in Virginia do not have an in-house dental team, an on-call dentist, or a protocol for treating avulsed teeth.
- Physician's knowledge is not associated with whether the emergency department has an in-house dental team, an on-call dentist available, or a treatment protocol.
- Most of the physicians have some knowledge of the appropriate treatment of avulsed teeth.
- More continuing education is needed to ensure proper treatment is provided for patients with this dental emergency.

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Literature Cited

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Table 1: Sources of Dental Services and Information for Virginia Physicians

	Yes	No
In-house dental team	5(13%)	34 (87%)
On-call dentist	9(23%)	30(77%)
Treatment protocol for non-dentists	6(15%)	33(85%)

Table 2: Physicians' Responses on What Media to Store the Tooth in if Not Immediately Re-implanted

	N	%
In a paper towel/napkin/gauze	1	3
In milk	21	54
In saliva	9	23
In water	1	3
In Hank's solution	3	8
In Tooth saver	3	8

Table 3: Further Dental Education Requested by Physicians

Avulsions, fractures, care of dry sockets and recent extractions
Dental nerve blocks
Avulsions
Abscesses
Dental emergencies
Use of emergency dental cement
How do most dentist deal with emergency patients in practice
Anything

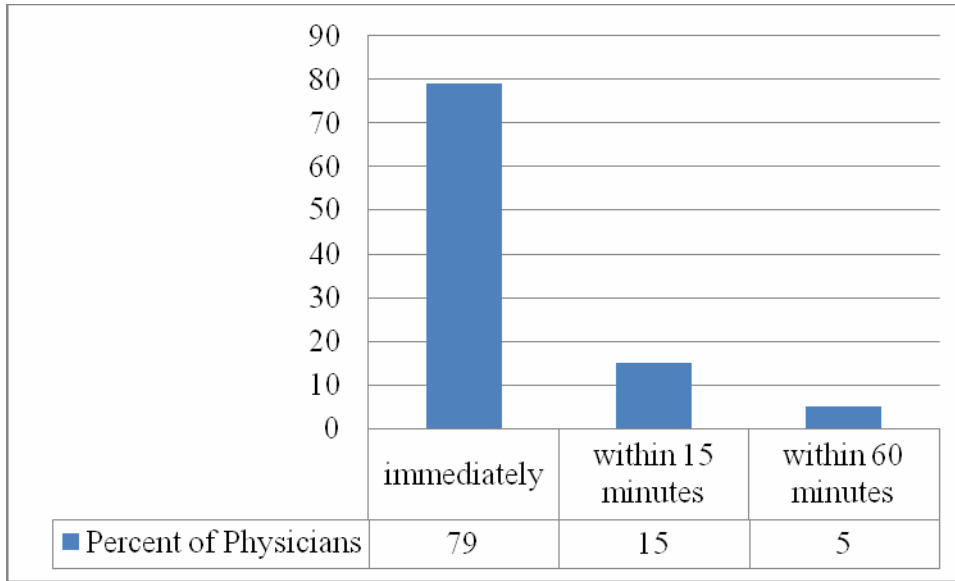


Figure 1: When should a tooth be re-implanted?

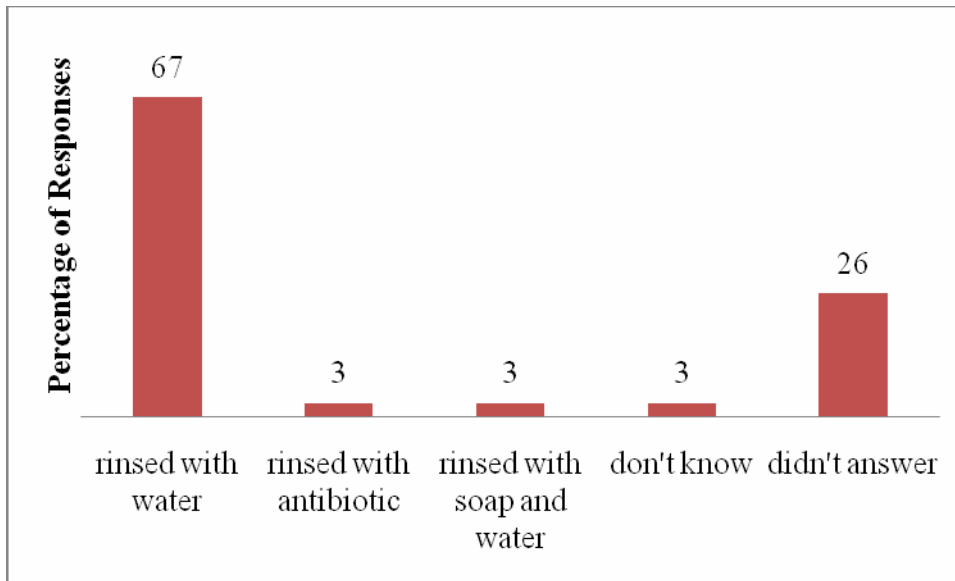


Figure 2: What should a tooth be cleaned with prior to re-implantation?

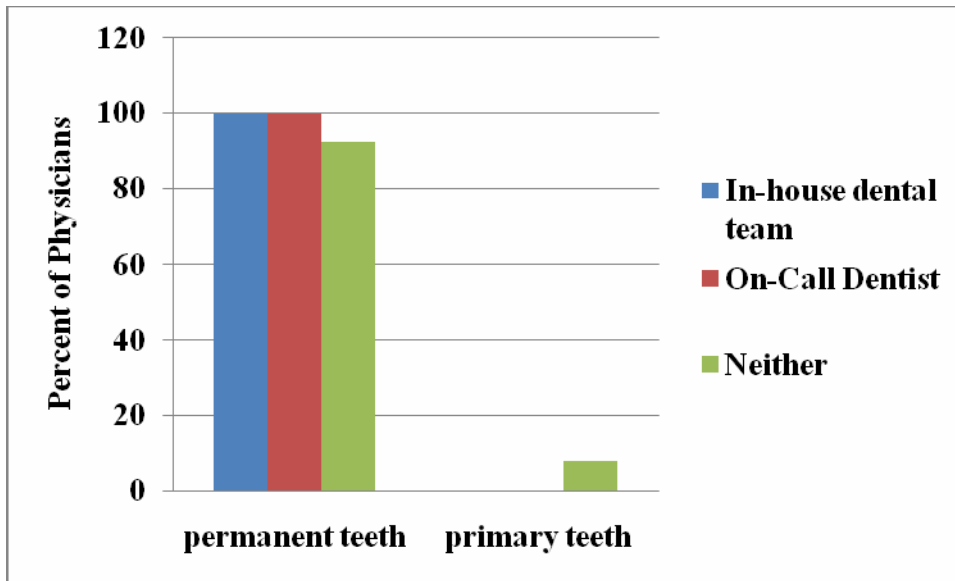


Figure 3: Which teeth should be re-implanted after an avulsion?

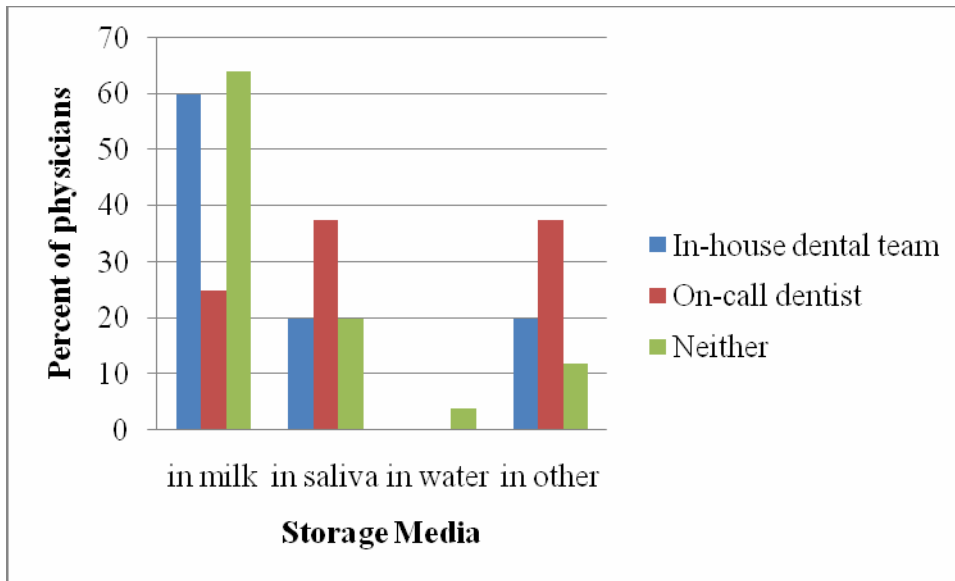


Figure 4: Various Storage Media for Teeth Prior to Re-implantation

APPENDIX A

Survey Invitation Letter

Dear Emergency Department Physician:

Virginia Commonwealth University is conducting a study to assess whether emergency departments have a protocol for the treatment of avulsed teeth and what knowledge the physicians in the emergency department have regarding avulsed teeth.

We are asking emergency medicine physicians in Virginia to complete a 5 minute, 8-item questionnaire. The information you provide will be used to assist us in identifying areas to include in future continuing education curriculum. Collected information will be aggregated to maintain confidentiality.

Please complete this on-line survey. There is no individual identifying information contained in the survey or in the process of completing the survey on-line. Your participation is critical to the success of this information-gathering effort. It is our goal to assure that the results reflect current information.

Please click the following link to start...

<https://survey.vcu.edu/surveys/XEWKF4>

Respectfully,

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APPENDIX B

Avulsion Questionnaire

1. Does your facility have an in-house dental team? Yes No

If yes, please state what types of dental providers? Choose all that apply

- General Dentist Oral Pathologist
 Pediatric Dentist Other Dental Specialist _____
 Oral Surgeon

2. Does your facility have an on-call dentist available? Yes No

If yes, please state whether the dentist is a general dentist or a specialist and what type. _____

3. Does your facility have a protocol for non-dentists in treating avulsed teeth?

- Yes No

4. After an avulsion takes place, if the tooth is not re-implanted, what is the best way to store the tooth? Choose one

- in a paper towel/napkin/gauze in saliva other _____
 in milk in water

5. Which teeth should be re-implanted after an avulsion? Choose one

- primary teeth none
 permanent teeth don't know

6. Check all the time periods from avulsion to re-implantation where the tooth can be saved.

- 15 min 2 hrs 1 day
 60 min 5 hrs don't know

7. How soon after a patient arrives to the emergency department should you re-implant the avulsed tooth?

- immediately within 60 min
 within 15 min within 2 hours

8. Before the tooth is re-implanted, should it be cleaned? Choose one

- Yes No Don't know

if yes, what it should be cleaned with? Choose all that apply

- rinsed with water rinsed with an antibiotic
 rinsed with alcohol don't know
 rinsed with soap and water

*** What type of dental education would be helpful to you as an emergency physician? _____

VITA

Joy Leatrice Barnes Phelps was born on April 19, 1980 in Norfolk, Virginia. She graduated from the North Carolina School of Science and Mathematics, Durham, North Carolina in 1998. She received a B.S. in Biological Sciences from North Carolina State University, Raleigh, North Carolina in 2002. Dr. Phelps received her Doctor of Dental Medicine from the Harvard School of Dental Medicine, Boston, Massachusetts in 2006.