

Empowering paramedics to save teeth: a comprehensive assessment of their knowledge and skills in managing dental traumas

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ABSTRACT

Aims: Dental traumas are prevalent injury types worldwide, and the time of the first intervention is crucial for a favorable prognosis. Paramedics are often the first to arrive at the scene of dental trauma. The significance of paramedics' knowledge of dental trauma cannot be overstated, yet studies on this subject are limited. This study aims to assess the level of dental trauma knowledge among paramedics.

Methods: A Google Forms link measuring dental trauma knowledge level consisting of 17 questions was sent to 1576 participants via WhatsApp. The forms were fully and consistently completed by 300 participants (19.3%). The data collected through Google Forms were imported into Microsoft Excel for statistical analysis. *Statistical Analysis:* The Mann-Whitney U test was used to determine whether there was a difference between the categories. The Kruskal-Wallis H test was used to determine whether there was a difference between the categories of the qualitative variable and more than two categories in the quantitative variable since average distribution as assumptions were not met. The statistical significance level was taken as 0.05.

Results: There are 300 paramedics, with 159 males and 141 females. 87% of the participants did not receive any training regarding dental trauma. According to 85.3% of paramedics, dental traumas are considered an emergency situation. The most important type of dental trauma is avulsion. Only 21.7% of paramedics knew reimplantation was possible, while 78.4% believed that a dentist should do it. Research shows that 38.4% of paramedics prefer using a sterile sponge when storing avulsed teeth, while 10.7% prefer milk. 82.7% of the paramedics reported lacking the knowledge to handle dental traumas, and 84% expressed interest in receiving training.

Conclusion: The research revealed that paramedics have insufficient knowledge regarding dental trauma. Most participants stated their preference not to intervene in cases of dental trauma. They believed that a dentist or emergency physician should handle it.

Keywords: Paramedic, avulsion, dental trauma, dentoalveolar trauma, hank's balanced salt solution, ambulance

INTRODUCTION

Traumatic dental injuries are common in children and adolescents and can affect teeth and periodontium.¹ TDIs are responsible for facial injuries in around 5% of all trauma cases.² This highlights the importance of seeking prompt treatment in such patients. Convenient and accurate intervention is crucial for a favorable prognosis of a traumatized tooth.¹ Treating injuries and restoring traumatized teeth can pose a difficult challenge for patients, caregivers, and dental practitioners.³ If treatment is delayed or incorrect, it can negatively impact the prognosis and result in tooth loss.⁴ This can cause problems

with appearance, functionality, finances, social interactions, and mental well-being.⁵

In cases of trauma, prompt intervention is crucial, and patients receive first aid at the accident scene, in ambulances, or in emergency service.³ In emergency services, the focus is on treating conditions that pose a risk to the overall health of the patient, which may result in injuries to the teeth and surrounding tissues being overlooked.⁶ As a result, numerous cases of dental trauma go untreated or receive incorrect

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treatment, resulting in further complications.^{3,7} Improper treatment of injuries can result in short or long-term absence from physical activities, school, or work. According to a previous study, patients who experience dental trauma often seek treatment at hospital emergency services because dental clinics operating during regular business hours may not always be convenient or accessible.³ Paramedics, nurses, and emergency physicians are typically the initial health professionals to attend to patients experiencing traumatic dento-alveolar injuries. It is crucial for health personnel, often the first responders in trauma cases, to possess a high level of knowledge and awareness about dental traumas to ensure proper care and treatment for patients.

This study aims to gather paramedics' opinions and first-hand encounters regarding dental injuries. It also seeks to evaluate their proficiency in dealing with such incidents and highlight the crucial role of their initial response in restoring affected teeth.

METHODS

The study was carried out with the permission of Afyonkarahisar Health Sciences University Faculty of Medicine Clinical Researches Ethics Committee (Date: 7.7.2023, Decision No: 2023/304). A study was carried out in Turkey from August 2022 until March 2023. Paramedics working in public or private hospitals were invited to participate in the research and respond to data collection forms sent via WhatsApp® (WhatsApp, Menlo Park).

Sample Size Determination

The number of paramedics in Istanbul was calculated using data from the Ministry of Health in Turkey. Currently, there are 3,290 paramedics employed in hospitals, health centers, and emergency aid stations affiliated with the Ministry of Health. It was calculated that a minimum of 329 paramedics from Turkey are needed with 95% confidence and 5% tolerance.⁸ During the study conducted in Istanbul city, 300 paramedics, which represents 9.2% of the total paramedics, were contacted.

The data collection form comprised two questions regarding demographic information and nineteen regarding knowledge and awareness of emergency dental injury treatment. These questions were previously used in similar studies found in literature and have undergone validity and reliability testing.

During the initial section of the questionnaire, participants were asked to provide their gender and age. Those who believed that Traumatic Dental Injuries were not an emergency were allowed to skip the questions in the third section and proceed to the other survey areas. Participants who responded affirmatively to the inquiry, "Can a dislodged tooth be reimplanted?" were guided to the 4th section, whereas those who replied negatively were redirected to the 6th section. The study in Türkiye involved sending out questions to 1576 individuals, but only 300 people completed all the questions and were included in the final results.

Statistical Analysis

The SPSS (Statistical Package for the Social Sciences package program version 21.0, IBM Corp., Armonk, N.Y., USA) program was used for data analysis. The Mann-Whitney U test was used to determine whether there was a difference between the qualitative variable and two categories in the quantitative variable since the assumptions of normal distribution were not met. The Kruskal-Wallis H test was used to determine whether there was a difference between the categories of the qualitative variable and more than two categories in the quantitative variable since average distribution assumptions were not met. The statistical significance level was taken as 0.05.

RESULTS

Out of the individuals who accessed the WhatsApp link and accurately completed the form, the response rate was 19.03%. Out of all the participants in the study, 159 (53.0%) were female, and 141 (47.0%) were male. 37.7% of participants were 18-25 years old, 31.7% were 25-30, 12.3% were 30-35, and 18.3% were over 35. When surveyed, 13.0% of individuals reported having received training on dental traumas. Of those individuals, 74.0% answered affirmatively, "Is a traumatic tooth injury considered an emergency?" If someone has a soft tissue injury in their mouth or face, like their lips, cheeks, or tongue, is it necessary to get treatment immediately? Of 300 respondents, 256 (85.3%) answered in the affirmative. On the other hand, only 70 people (23.3%) believed immediate treatment was necessary for a patient with a broken tooth who wasn't bleeding. During this survey, 25.3% of the participants favored searching for fragments of a broken tooth at the trauma scene. Additionally, 19.7% of the respondents believed that the broken parts of a tooth damaged due to trauma could be bonded. **Table 1** responds to the remaining inquiries in the research. Out of the total number of paramedics surveyed, only 65 (21.7%) believed that teeth that have been avulsed of their sockets could be reimplanted. Only 18.4% of the 65 people knew the ideal replantation time of 30 minutes. The correct storage solution for an avulsed tooth, milk, was only known by seven people (10.7%) until reimplantation. Only 21 out of all the participants (7%) correctly identified avulsion as an example of dental trauma that requires emergency attention. **Table 2** displays the correlation between the responses to the questions and the accuracy percentage of those responses. Did you receive any training or attend a course on Dental Trauma? Also, do you feel confident about your level of knowledge regarding oral and dental injuries? The percentage of correct answers provided for these questions differed significantly ($p=0.018$ and $p=0.028$, respectively). Experience in dental traumas correlates with higher accuracy in answering related questions. Those who answered yes had a $47.82 \pm 22.19\%$ correct answer rate, compared to the average of $38.91 \pm 18.62\%$. Would you say your knowledge of oral and dental injuries is adequate? Those who answered no to this question had a significantly higher percentage of correct answers than those who answered yes.

Table 1.

Variables		
Gender, n(%)	Woman	159 (53.0)
	Man	141 (47.0)
Age, n(%)	18-25	113 (37.7)
	25-30	95 (31.7)
	30-35	37 (12.3)
	>35	55 (18.3)
Have you encountered any cases of dental trauma in your professional career?	No	114 (38)
	Yes	186 (62)
Have you received any education or training regarding dental injuries? n (%)	No	261 (87.0)
	Yes	39 (13.0)
Is it necessary to seek emergency treatment for traumatic tooth injuries? n(%)	No	78 (26.0)
	Yes	222 (74.0)
Is it vital to seek medical attention immediately if someone experiences a soft tissue injury in their mouth or face, particularly in the lips, cheeks, or tongue? n(%)	No	44 (14.7)
	Yes	256 (85.3)
Is it necessary to seek urgent treatment if a patient has a broken tooth but no bleeding? n (%)	No	230 (76.7)
	Yes	70 (23.3)
Should fragments of a fractured tooth be searched upon arrival after trauma? n(%)	No	224 (74.7)
	Yes	76 (25.3)
Is it possible to reattachment the broken parts of a tooth damaged due to dental trauma? n(%)	No	241 (80.3)
	Yes	59 (19.7)
If a tooth is knocked out (avulsed), is it necessary to search for it at the accident scene? n(%)	No	230 (76.7)
	Yes	70 (23.3)
Is it possible to reimplant a tooth that has been displaced (avulsed)? n(%)	No	235 (78.3)
	Yes	65 (21.7)
What is the appropriate action for a knocked-out tooth (avulsed) that has come out of its socket? , n(%)	Emergency doctor, dentist	4 (6.2)
	Paramedic, emergency doctor, dentist	2 (3.1)
	Paramedic ambulance doctor, emergency doctor, dentist	6 (9.2)
	Dentist	51 (78.4)
	Victim or relative (if conscious)	2 (3.1)
Is it possible for a tooth reimplanted into its socket to heal once more? n(%)	No	7 (10.8)
	Yes	58 (89.2)
If your answer to the above question is yes, What is the ideal time to reimplant an avulsed tooth?	In the first 30 minutes	12 (18.4)
	Within 1 hour	12(18.4)
	Within 2 hours	7(10.7)
	Within 24 hours	19 (29.2)
	No Matter	15(23.7)
Where should the avulsed tooth be stored until it is reimplanted in its socket?	Sterile Sponge	25(38.4)
	Sterile Saline	20(30.7)
	Ice/Iced water	9(13.8)
	Milk	7(10.7)
	Saliva	4(6.15)
What kind of dental injury is considered an emergency?	Enamel fracture	5(1.6)
	Enamel-dentin fracture	5(1.6)
	Complicated enamel-dentin fracture	142 (47.3)
	Mobilized, bleeding tooth	43(14.3)
	Root fracture	13(4.3)
Do you feel confident in your understanding of oral-facial and dental injuries? n(%)	No	248 (82.7)
	Yes	52 (17.3)
Are you interested in receiving training regarding oro-facial and dental injuries? n(%)	No	48 (16.0)
	Yes	252 (84.0)
Correct Answer Percentage	Mean±SD	40,06±21.01
	Mean (min-max)	41,07 (0,00-100,00)

n: number

Table 2.

Variables		Correct Answer Percentage		
		Mean±SD	Mean(min-max)	p
Gender	Woman (n=159)	39.33±20.60	38.02 (0.00-100.00)	0.386a
	Man (n=141)	40.89±21.50	42.86 (0.00-90.00)	
Age	18-25 (n=113)	39.03±16.52	42.86 (0.00-70.00)	0.827b
	25-30 (n=95)	40.29±21.72	41.18 (0.00-100.00)	
	30-35 (n=37)	39.20±20.10	38.74 (0.00-80.00)	
	>35 (n=55)	42.33±19.86	42.83 (0.00-80.00)	
	Have you encountered any cases of dental trauma in your professional career?	No (n=114)	36.68±19.56	
Yes (n=186)	30.32±16.28	41.58 (0.00-90.00)		
Have you received any education or training regarding dental injuries?	No (n=261)	38.91±18.62	41.55 (0.00-90.00)	0.018a
	Yes (n=39)	47.82±22.19	50.00 (0.00-100.00)	
Do you feel confident in your understanding of oral-facial and dental injuries?	No (n=248)	40.96±18.87	42.86 (0.00-90.00)	0.028a
	Yes (n=52)	35.74±26.28	28.57 (0.00-100.00)	
Are you interested in receiving training regarding oro-facial	No (n=48)	35.64±21.69	28.57 (0.00-90.00)	0.088a
	Yes (n=252)	40.91±19.97	42.86 (0.00-100.00)	

a:Mann-Whitney U testi, b:Kruskal Wallis H testi, p<0,05

DISCUSSION

Dental avulsions are the most critical type of dental trauma. Still, they can be treated with early and correct intervention.⁹ Health professionals other than dentists need to increase their knowledge about avulsion.⁶ Although the dental trauma knowledge level of several groups, including doctors,⁶ teachers,¹⁰ and coaches,¹¹ has been assessed in scientific literature, only a few studies have evaluated the knowledge levels of paramedics and emergency medicine technicians.¹²⁻¹⁵ In this research, 62% of participants experienced dental trauma at least once in their careers, consistent with previous studies.^{3,6,16,17} However, insufficient information on dental trauma, avulsions, and maintenance was found, consistent with other studies.^{12,13} One of the main reasons for this situation is the lack of education and training on handling dental emergencies and traumas. 87% of participants reported never receiving dental trauma training, consistent with previous studies.^{13,14} Video and hands-on-course training on dental traumas should be provided with a way to measure effectiveness.¹⁸

Although dental injuries primarily affect children, adults are more likely to experience them due to severe maxillofacial trauma.¹² Paramedics, doctors, and nurses are mainly responsible for providing first aid in case of such injuries in emergency departments.^{6,14} Early, correct, and adequate first intervention is crucial in dental injury cases, as the emergency department often lacks a dentist.^{3,6} As the first healthcare professionals on the accident scene, paramedics require adequate knowledge of dental traumas and emergency interventions. According to previous studies, only 17.3% of paramedics feel confident enough to intervene in dental trauma patients despite it being a common injury.^{14,15} 74% of the participants consider traumatic dental injuries emergencies, but 25.3% would not search for broken tooth fragments at the accident scene.

Similar to a study conducted in Turkey, our study found that although 74% of participants acknowledged that traumatic dental injury is an emergency, only 23.3% believed that emergency intervention was necessary if there was no bleeding in a broken tooth.¹³ 85.3% of participants said bleeding in the orofacial area, particularly on the tongue, cheeks, and lips, warranted urgent intervention. It can be concluded that paramedics prioritize treating soft tissue bleeding over tooth fractures or avulsions.¹⁴

74.7% of participants said they wouldn't search for a broken tooth at an accident scene where dental trauma occurred. Similarly, 80.3% of respondents indicated that broken tooth fragments cannot be reattached. During the literature review, it was discovered that no prior research had been conducted on this topic. Hence, it is necessary to conduct more research on this topic to validate our findings.

The percentage of paramedics who would search for an avulsed tooth at the accident scene is 23.3%. The rate of paramedics who believe that reimplantation of avulsed teeth is possible is only 21.7%. The results of our study were consistent with previous studies conducted in Turkey¹³ and other countries.^{3,12,14} In contrast to our findings, a study conducted with paramedics and paramedic assistants in Germany revealed that 80% of the participants would search for avulsed teeth at the accident scene and consider the possibility of replantation.⁷ The researchers who conducted the study concluded that this difference is most likely related to the training the paramedics participating in the study received. In this study, 78.4% of respondents believed only dentists should reimplant avulsed teeth into their sockets. Previous studies^{3,14} and the International association of Dental Traumatology Guideline (IADT) have shown that this situation is invalid and incorrect.² Joybell et al.¹⁹ found that 80% of the paramedics in their study, who had less than three years of experience, could perform tooth replantation themselves. Shaul et al.¹⁴ found that only 6.8% of paramedics would attempt to replant avulsed teeth, similar to our study. According to the studies conducted by Diaz et al.,³ almost half (43.9%) of the participants believed that reimplanted teeth could cause infections. Additionally, 21.9% of the participants were concerned about the possibility of the replanted tooth being avulsed again. In comparison, 21.9% believed that replanted teeth could cause damage to neighboring teeth and should not be replanted. It is commonly believed that individuals who are hesitant to perform reimplantation may benefit from additional information.^{6,12,14,20}

The prognosis of dental avulsion injuries is positively affected by the time of reimplantation.¹ The avulsed tooth should be re-implanted into its socket as soon as possible for optimal healing. According to IADT, this period is defined as the first half hour.¹ In this research, only 18.4% of the 65 participants who believed in the possibility of replacing avulsed teeth correctly identified the optimal time for replantation as within the first 30 minutes. It has come to light that there is a significant deficiency of information regarding this matter. There is a lack of research measuring the knowledge of the ideal time for replantation. In Wolfer et al.'s⁷ research, 55.2%

of participants believed avulsed teeth should be reimplanted immediately. Our research in Turkey resulted in worse outcomes than the study in Germany due to lower knowledge levels. According to a survey by Wolfer et al.,⁷ only 56% of the participants received training on dental trauma.

Avulsed teeth should be replanted as soon as possible. If not, the cells of the periodontal ligament may start to lose their vitality.² One of the most critical factors determining the prognosis of replanted teeth after avulsion is the loss of viability of periodontal ligament cells.¹ If the avulsed teeth cannot be immediately replanted, they should be stored in a solution that can preserve the viability of the periodontal ligament cells when they are outside the alveolar socket. Although the latest 2020 IADT guideline recommends Hank's Balanced Salt Solution as the best dental storage solution, accessibility in society is limited.¹ It is important to note that cold milk is the most readily available solution for storing an avulsed tooth in any society worldwide.^{1,2} Correct answers are rarely obtained in studies with various professional groups about whether avulsed teeth should be stored in milk.^{6,10,11,21} In this research, only 2.3% of paramedics knew that milk could be used to store avulsed teeth. Only 10.7% of those who said their teeth could be replanted knew that avulsed teeth should be stored in milk. 38.4% of participants believed avulsed teeth could be stored in the sterile sponge, while 30.7% thought they could be stored in sterile saline. When these results were evaluated, it was sadly determined that all paramedics needed more knowledge. Aras et al.¹³ reported that only 5.7% of participants in their study believed that avulsed teeth could be preserved in milk compared to other studies on the subject. 52.7% of participants reported that teeth can be transported in sterile saline, while 28.5% said movement in the sterile sponge. In a Lewandowski et al.¹² research, only 4% of 138 paramedics knew avulsed teeth could be stored in milk. 42% said it could be stored in sterile saline, and 34% said it was a sterile sponge.

In research conducted by Joybell et al.,¹⁹ 10% of the 108 participating paramedics stated that avulsed teeth can be preserved in milk. The percentage of paramedics who believe it can be stored in sterile saline is only 14%. According to Lin et al.,¹⁴ 15.9% of the 44 emergency medical technicians in their study believed milk is a suitable storage medium for avulsed teeth. The percentage of participants who preferred storage in sterile saline solution was 38.6%. According to Diaz et al.'s³ study involving 82 participants and 43 paramedics, 42.7% of healthcare professionals recommended keeping avulsed teeth in sterile saline if they cannot be replanted within 30 minutes. Meanwhile, 8.5% of healthcare professionals suggested using a sterile sponge instead. Unfortunately, participants in this research were not provided with the option of milk. According to a study by Wolfer et al.⁷ involving 500 paramedics, only 10.8% believed that avulsed teeth could be stored in milk. The percentage of participants preferred storing it in sterile saline was 31.6%, while only 4.4% preferred storing it in a sterile sponge. In research of medical doctors in 545 emergency rooms, Kuru & Duruk⁶ found that 28% recommended milk, 72.3% recommended sterile saline, and 67.1% recommended sterile sponges for storing avulsed teeth.

The general conclusion from the above studies is that sufficient milk is not known as the ideal transport solution. Participants stated that avulsed teeth could be stored in sterile saline. It has been revealed that there is a significant lack of information on this subject. Paramedics and other healthcare professionals in the emergency department lack knowledge.^{3,6} There is a need for studies to determine the changes in the level of knowledge by providing training to the participants on this subject.

Paramedics in the study were asked to identify dental emergencies. At the end of the survey, 47.3% of participants believed that complicated fractures involving enamel and dentin required immediate attention. Additionally, 14.3% thought that bleeding teeth needed urgent intervention, while only 9.17% believed that avulsed teeth required the same level of urgency. In a study with 44 emergency medical technicians, Lin et al.¹⁴ found that 31.8% referred bleeding situations to a dentist, and only 6.8% would stop the bleeding first. Cruz-da-Silva et al.²⁰ found that 81% of participating paramedics were unfamiliar with dental avulsion. Joybell et al.¹⁹ found that 28% of paramedics surveyed considered dental injuries urgent enough to require ambulance intervention. According to the survey, 68% of the respondents reported being knowledgeable about dental injuries. Aras and Doğan¹³ found that only 74.5% of the 389 participating paramedics could stop bleeding in injuries they had previously treated. Although our results differ from these studies, it's evident that all participants lacked information.

In our study, only 17.3% of participants felt confident intervening with dental trauma patients. According to Wolfer et al.⁷ research, 88.4% of the 677 participants completed dental trauma training. 44% of the participants reported insufficient knowledge about managing dental trauma. Nearly half of paramedics said that their activity on dental trauma was inadequate, with 45.9% expressing dissatisfaction with the level of instruction provided. 50.6% of paramedics reported insufficient practical knowledge of dental trauma. Joybell et al.¹⁹ found that only 10% of 100 paramedic participants had received training on dental trauma. According to research, only 18% of paramedics have sufficient knowledge about dental concussions. Kuru&Duruk⁶ found that 93.4% of emergency medicine doctors consider dental trauma training necessary, but only 88.6% have received it. It is evident from this study that emergency medicine doctors are better trained to provide accurate information regarding dental traumas, consistent with previous studies.

In our study, 84% of respondents felt that their knowledge and education on dental trauma were insufficient and expressed a desire to receive further training on the subject. According to research conducted by Wolfer et al.,⁷ which involved 677 people, even though 88.4% of the participants had received training on dental trauma, 44% of them had inadequate knowledge regarding dental trauma. Furthermore, 68.8% of the participants desired to obtain more activity on the subject. 43.7% of the participants preferred hands-on course training, while 35.9% favored video training. In their research with 21 paramedics, Cruz-da-Silva et al.²⁰ found that 91.7% desired dental trauma training. Joybell et al.¹⁹ found that only 18%

of 100 paramedic participants felt their knowledge level was sufficient, while 66% expressed a desire for training on dental trauma.

It is important to note that this study has certain limitations. One of our significant limitations was our inability to access paramedic healthcare personnel. Delivering our questionnaire to constantly working paramedics and getting it filled out was challenging. It was found that a significant number of paramedics did not complete the questionnaire thoroughly or answered questions inconsistently. Because of these challenges, the study only included 300 paramedics. One limitation pertained to questions about avulsion. It was found that many participants provided multiple responses about the proper storage conditions for knocked-out teeth. The answers were examined individually and checked for consistency with the other questions. Participants who lacked knowledge or did not want to intervene in dental trauma were not asked about the post-avulsion treatment protocol. Some also declared their knowledge as insufficient. This research differs from the previously mentioned studies due to this particular situation. Participants in other studies were asked how to handle avulsed teeth before replantation, including washing and replantation. Our study had a limitation in that we only evaluated knowledge levels of dental trauma. It is possible to measure the increase in knowledge levels following the training. However, the challenges of delivering and consistently filling out the questionnaires caused a further decrease in the number of participants among paramedics.

CONCLUSIONS

The study conducted in Turkey revealed that nearly all paramedics have insufficient knowledge about dental traumas. Most participants stated that they preferred not to intervene in cases of dental trauma and believed that a dentist or emergency physician should handle it. However, as this situation is not common in practice and it is known to be the main factor leading to unsuccessful prognosis, paramedics should receive training on treating dental trauma. We believe that studies involving more participants will confirm our results on this subject.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Afyonkarahisar Health Sciences University Faculty of Medicine Clinical Researches Ethics Committee (Date:7.7.2023, Decision No: 2023/304).

Informed Consent

Because the study was designed survey study, no written informed consent form was obtained from participants.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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