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Is it Necessary to Incorporate Traumatic Dental Injury Course into the Medical Education Curriculum: A Systematic Review

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Abstract

This study addresses the theoretical and practical knowledge gap concerning traumatic dental injuries (TDI) within the medical education curriculum and among medical practitioners. The significance of addressing this gap is heightened by the fact that many TDI cases present to hospital emergency departments, where physicians often lack sufficient knowledge and experience in TDI management. Studies indicate significant deficiencies in educational programs in this regard, which consequently limit the capacity for emergency intervention. Therefore, the authors propose the integration of dental trauma education into the medical curriculum, expanding it to encompass both theoretical knowledge and practical applications. Diversified teaching methodologies are recommended to transmit this topic to medical students, including simulation-based learning, online courses, and interdisciplinary collaborations. It is believed that these approaches will increase students' learning effectiveness and enable them to make more competent interventions in emergencies. As a result, integrating dental trauma education into the medical curriculum is expected to improve the quality of patient care in emergency medicine by enhancing clinicians' clinical skills. The need for integrating this topic into the curriculum underscores the necessity of enriching medical education with a multidisciplinary approach.

Keywords:Dental trauma, medical curriculum, dental anatomy

INTRODUCTION

Traumatic dental injury (TDI) is characterized by damage caused when kinetic energy is abruptly transferred to the teeth, soft tissues, and supporting structures.[1] Traumatic dental injury could result from direct or indirect impact (falls, road traffic accidents, cycling, sports accidents, assaults). The extent of damage depends on factors such as the energy of the impact, flexibility and shape of the impacting object, direction of impact, and response of the tissues surrounding the tooth. These injuries could occur in the primary and permanent dentition for diverse reasons.[2]

The most frequent cause of TDI was falls (31.7% to 64.2%), followed by sports activities (up to 40.2%), cycling accidents (up to 19.5%), road traffic accidents (up to 7.8%), and physical violence (up to 6.6%). While traumas due to falls and impacts are more frequent in the 0-6 age group due to increased independent movements, accidents during play and sports injuries are more frequent in the 7-15 age group. In the 21-25 age group, physical violence is the most frequent cause of dental injury.[3-5]

The available data on the prevalence of TDI are variable. Although oral trauma is generally uncommon, it accounts for 5% of all body injuries in all age groups compared to approximately 17% in the 0-6 age group. Traumatic dental injuries are more common in the permanent dentition (58.6%) than in the primary dentition (36.8%).[6,7] The majority of TDIs in the permanent dentition occur in the upper anterior teeth. Maxillary incisors (66.7%) were the most commonly affected teeth, followed by the lateral incisors (17.4%). The incidence of TDI peaks at 9-10 years of age, and TDI is more common in the permanent dentition of boys than girls.[8-10]

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Traumatic dental injury can cause dental fractures, complete detachment from the socket (avulsion), displacement within the socket (luxation), and damage to the bone and soft tissue. There are many classifications of TDI in the literature, with Andreasen's classification being the most widely used.[11,12] Andreasen classified TDIs on the basis of groups: tooth structure, supporting bone, periodontal tissue, and soft tissue injuries. These groups are subdivided into 7 types of tooth fracture, 6 types of luxation, 8 types of supporting bone injury, and 3 types of oral mucosal or gingival injury.[11,12]

Treatment rates for dental trauma are low on the worldwide level compared to the number of dental trauma cases. This is thought to be related to the fact that uncomplicated enamel-dentine injuries are not perceived as requiring emergency treatment.[13] However, pulp necrosis could occur in teeth exposed to injuries causing complicated or uncomplicated crown/root fractures.[14] Pulp survival rates for complicated crown fracture injuries range from 63% to 94%, whereas the pulp usually survives (75.8%) when these injuries are properly treated.[15] The consequences of TDI on the tooth and surrounding tissues are more severe in avulsion or intrusion cases.[14] Various types and degrees of root resorption can be observed in such injuries.[14] The treatment method chosen and the time elapsed after the injury have a significant impact on the treatment outcome and can influence the healing process. The outcome of dental trauma depends on the type of injury, the time elapsed before emergency treatment, and the competence of the treatment. Therefore, immediate and correct intervention in TDI cases is considered important for the prognosis of treatment.[15]

Most patients exposed to TDI apply to emergency departments of hospitals for various reasons (inability to reach dental professionals). Therefore, it is important that physicians are able to provide adequate and appropriate emergency care to stabilize dental injuries and increase the survival rate of the injured tooth.[16] Numerous studies have evaluated the outcomes of dental emergencies in emergency departments of hospitals. These studies highlight the lack of knowledge and skills among physicians and their dissatisfaction with the level of knowledge about dental trauma. A study conducted in the United Kingdom in 2012 shows that a large proportion of emergency physicians do not feel competent to manage TDIs. These findings suggest that medical doctors' lack of confidence and knowledge in dealing with TDI affects their ability to provide appropriate care to dental trauma patients. This is thought to be due to a lack of focus on dental terminology and trauma, or a lack of emphasis on these topics in medical education programmes.[17]

RESEARCH NEEDS

The researchers present numerous reports demonstrating the lack of dental trauma courses in the medical curriculum. Abu-Dawoud et al.[18] reported that 96.6% of the doctors in their study received no dental trauma training during their medical education. Similarly, Skapetis et al.[19] reported that 76% of the doctors in their study received no training in dental trauma. Several studies have shown that information regarding dental trauma is unavailable or incomplete in many medical schools and that management protocols for TDI are inadequate.[18,19]

To address this concern and enable clinicians to more effectively manage the diagnostic and therapeutic process, researchers recommend the inclusion of dental trauma training in the medical curriculum. Several studies have suggested that integrating dental anatomy and trauma into medical education will provide physicians with the necessary basic knowledge and management skills.[20] The aim of this article is to review the requirements, possible benefits, and methods of integrating TDI and dental anatomy into the medical curriculum.

RESEARCH METHODS

The database used for the review is PubMed. The search covers sources published between 2014 and 2024. The keywords used in the search are "dental trauma," "medical curriculum," "doctors," and "online education." These keywords were used in different combinations and with appropriate Boolean operators (AND, OR). The types of publications included were original articles and reviews. Only studies published in English were included. Information from the selected studies was collated to include basic information such as author(s), year of publication, study design, results, and conclusions. The content of the studies was summarized and categorized by topic. The data collected were grouped around key themes and concepts, and an overall assessment was made. The data were discussed in relation to existing information in the literature.

Inclusion Criteria

- Studies investigating the knowledge of physicians about dental trauma
- Studies discussing what physicians need to know about dental trauma
- Studies on the integration of dental trauma education into the medical curriculum
- Studies on the benefits of integrating dental trauma education into the medical curriculum
- Studies published in English
- Full-text articles

Exclusion Criteria

- Knowledge and competencies of dentists regarding dental trauma
- The place of dental trauma in the dental curriculum
- Management of dental trauma by non-health professionals
- Treatment protocols for dental trauma

RESULTS

A combination of proposed keywords yielded 1157 articles of potential interest. After removing duplicates and studies not meeting the inclusion criteria, 27 papers underwent full-text assessment. A preferred reporting items for systematic reviews and meta-analyses (PRISMA) flowchart detailing the inclusion and exclusion of studies at primary and secondary levels is depicted in Figure 1.[21] Finally, 17 studies were included in the systematic review for analysis based on the established criteria (Figure 1).

Physicians' Current Knowledge of Traumatic Dental Injury Management

The level of physicians' knowledge of TDI reported in the literature suggests that it is currently insufficient to manage TDI cases effectively, with most physicians reporting minimal education, training, and experience in TDI management. According to some studies, 75% of physicians have no experience in TDI management;[18] 75% have seen a traumatic dental injury and not intervened;[22] 68% have seen at least one dental trauma case during their career;[23] and 45.5% of physicians have never seen a dental trauma case (Table 1).[24]

In a survey including 427 emergency physicians, 256 (59.95%) reported having no or inadequate knowledge of dental trauma management, and 266 (71.12%) reported having no skills in this area. Approximately 76% of participants indicated they lacked knowledge of dental practices. The same study found that only 7.28% of participants knew the correct procedure for replanting an avulsed tooth (Table 1).[25]

Previous studies show that although clinicians have sufficient knowledge and skills to manage soft tissue injuries, major facial trauma, and maxillomandibular fractures, they lack sufficient anatomical and clinical knowledge to manage crown-root fractures, root fractures, dislocation injuries, and replantation of avulsed teeth (Table 2).[17,26]

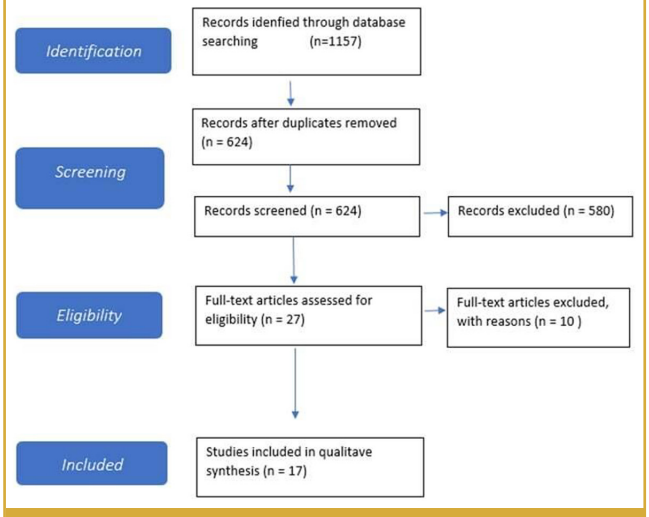

Figure 1. PRISMA 2009 flow diagram.[21]

Table 1. Summary of Survey Studies' Findings on TDI Among Physicians

Findings	Reference
75% of physicians have no experience in TDI management	18
75% of physicians have seen a traumatic dental injury and not intervened	22
68% of physicians have seen at least one dental trauma case during their career	23
45.5% of physicians have never seen a dental trauma case	24
59.95% emergency physicians reported having no or inadequate knowledge of dental trauma management	25
71.12% emergency physicians reported having no skills in this area	25
76% of participants indicated they lacked knowledge of dental practices.	25
7.28% of participants knew the correct procedure for replanting an avulsed tooth	25
95% of physicians are dissatisfied with their knowledge of dental trauma.	22

Competencies Expected of Clinicians in the Traumatic Dental Injury Management Process

Clinicians must be capable of assessing various types of dental injuries based on the clinical information gathered during consultations. Therefore, knowledge of the Andreasen TDI classification, which is widely used by dentists, is considered useful in assessing patients' emergencies and referring them to dentists. Dentists' awareness of advanced imaging techniques, such as cone beam computed tomography (CBCT), can greatly enhance their diagnostic skills. Cone beam computed tomography provides detailed 3D images of teeth and surrounding structures, allowing for a more accurate assessment of complex dental injuries such as root fractures and luxations. This technology not only supports the Andreasen TDI classification in practice but also helps to plan precise surgical interventions when necessary. In addition, understanding the use of such imaging techniques helps clinicians to discuss cases more effectively with dental specialists, improving interdisciplinary communication and patient care outcomes.[27]

According to the studies, it is important for dentists to have basic anatomical knowledge of teeth and surrounding tissues. According to the authors, dentists should know the difference between primary and permanent teeth and that each tooth is made up of enamel, dentin, pulp, and cementum. They should also learn that the gums are soft tissues firmly attached to the alveolar bone or tooth by periodontal ligament fibers. When there is a visible injury to the gums and oral mucosa, such as bleeding of varying degrees, healthcare professionals should know that these soft tissue tears must be properly closed with stitches. In addition, medical

Table 2. Doctors' Competencies and Deficiencies According to Each Dental İnjury Classification

Injury Classification	Competencies	Deficiencies	References
Injuries to the tooth structure	Physicians reported inadequate knowledge of the appropriate treatment for dental fractures with and without pulp exposure. Physicians' knowledge of dental anatomy and crown fractures was inadequate.		16,22,26
Injuries to the supporting bone	Physicians reported inadequate knowledge in managing crown-root fractures and root fracture cases.	Physicians reported adequate knowledge in managing major facial trauma, and maxillomandibular fractures.	17,26
Injuries to the periodontal tissues	Physicians reported inadequate knowledge of managing luxation and avulsion injuries.	Physicians reported adequate knowledge of the concept of replanting an avulsed tooth.	12,16,17, 18,22,24
Injuries to the soft tissues		Physicians felt they had adequate knowledge of suturing facial lacerations and managing oral mucosa lacerations.	17,26

practitioners are considered to have an important role and responsibility in repositioning a displaced tooth and splinting teeth before referring the patient to a dentist for further treatment.[28]

With regard to the effective management of TDIs, Yeng et al[29] identified the most important areas of knowledge needed by practitioners. These areas include how to diagnose and manage different types of luxation injuries, awareness of their important role and responsibilities in repositioning a dislocated tooth, understanding the concept of preservation of an avulsed tooth and the importance of emergency replantation in managing the process, awareness of the need for rapid closure of soft tissue lacerations with sutures, and familiarity with basic dental anatomy and terminology used in dental trauma management.[29]

Integration of Dental Trauma Education into the Medical Curriculum and Potential Benefits

The literature review reveals that there is a clear lack of knowledge and confidence in dental anatomy and trauma management among medical students. It is recognized that there is a theoretical and clinical knowledge gap in the curriculum. To overcome this knowledge gap and to increase medical students' awareness of dental trauma management, the authors propose the integration of dental trauma education into the medical curriculum. The approach of integrating dental trauma education into the medical curriculum should aim not only to provide medical students with theoretical knowledge but also to improve their emergency response skills.[20,30]

The results of the literature review by Yeng et al.[29] suggest that the inclusion of dental trauma in medical education would be beneficial and could improve the quality of patient care. If medical practitioners can stabilize fractured teeth, the injured tooth will usually remain pain-free until the patient reaches the dentist. Similarly, if dentists can reposition and splint horizontal root fractures and alveolar bone fractures, the incidence of healing complications will be reduced. If clinicians can restore displaced teeth to their normal position as soon as possible, pulpal and periodontal healing can be facilitated. Furthermore, if clinicians can reposition an avulsed tooth within 5 minutes, the long-term survival rate and periodontal healing of the tooth will be much better.[30,31]

Campaigns to educate medical students about dental trauma and to teach dental trauma in dental schools are thought to be effective in the proper assessment and management of emergency treatment of TDI. Educational campaigns may include clinical practice in the assessment and management of dental trauma, formal lectures that provide a theoretical foundation, or interdisciplinary seminars such as joint clinical sessions and conferences between medical and dental schools.[18,32] Such collaborations can enrich the educational environment by facilitating the sharing of resources and expertise and provide a more comprehensive education in dental trauma. In this way, medical students can benefit from hands-on training in state-of-the-art dental facilities and interaction with experienced dentists, thereby gaining a deeper understanding and experience of dental anatomy and trauma management.[33]

Although the results of the studies suggest that increasing doctors' knowledge and skills in dental trauma can have a long-term positive impact on patients, the authors note that it is difficult for doctors to gain sufficient clinical experience in managing the TDI process due to the unpredictability of events, the large number of different types of injuries, and the relatively small number of cases presented.[26] Therefore, doctors are not expected to be competent in all aspects of TDI management but are considered to have a duty to manage the situation appropriately. The authors believe that it is the duty of the physician to accurately assess the severity of the TDI, stabilize the acute situation, and provide appropriate emergency treatment before referring the patient to the dentist.[16]

Determining the Educational Approach

Given that each student has a unique learning style, it is a fact that educators can develop and use different teaching approaches to ensure that the subject is fully covered. Previous studies show that students learn the subject more easily if they have sufficient learning resources, the learning environment is conducive, and the subject is presented in an interesting and meaningful way.[34,35]

When planning a new topic in the medical curriculum, educators need to consider several important issues. In relation to TDI, these include determining the most appropriate pedagogical approach (traditional lectures, case discussions, or online modules, etc.) and planning at which stage of the curriculum dental anatomy, terminology and tooth numbering system should be incorporated.[20]

The authors agree that it is appropriate to provide dental trauma education to medical students during their undergraduate training and concurrently with their clinical training. It is expected that final-year students will benefit more from this training as they are considered to have a stronger foundation and broader knowledge base. The critical question is which learning theory and teaching method is most appropriate for introducing a new TDI topic. A review of randomized controlled trials comparing traditional and online learning methods shows that contemporary online learning outcomes are similar to traditional learning outcomes in terms of knowledge base, skill levels, attitudes, and satisfaction. However, online courses are seen as a convenient way for students to access course materials during busy university schedules.[4,22,36]

Tay Yengi et al[37] presented a study on the design and development of an online dental trauma education course for final-year medical students. The online course was designed for final-year medical students so that the learning of TDI runs parallel to the emergency medicine education process. The course utilizes a constructivist perspective, and students are expected to construct their own understanding. The online dental trauma course is delivered through an applied e-learning model and consists of 4 modules. These modules aim to provide students with a basic knowledge of dental trauma and emergency response skills. In general, these 4 modules consist of teaching dental anatomy and terminology, assessment and management of various TDI cases, management of dental and periodontal injuries, and management of bone and soft tissue injuries.[37,38]

Online courses offer a wide range of learning opportunities for medical students by providing a flexible learning environment.[39] Online educational platforms have the ability to provide interactive learning tools and visuals. In particular, tools such as 3D models, animation, and virtual reality can engage students and increase learning effectiveness.[40]

Research indicates that the utilization of diversified learning methods assists students in comprehending and applying knowledge more effectively.[41] Particularly, simulation-based training provides practical experience to students in managing urgent medical conditions such as dental trauma, thereby enhancing the applicability of theoretical knowledge in clinical settings.[40-42]

The importance of identifying learning outcomes is emphasized to strengthen both theoretical and clinical skills. It is suggested that regular testing and practical assessments post-education can help bridge the gap between knowledge and its application in emergency care. Institutions like the World Health Organization (WHO) and various dental associations have developed guidelines that may be integrated into medical curricula to standardize learning outcomes and enhance future practitioners' competence in managing dental injuries. The authors propose using these guidelines to educate medical students about dental trauma.[43-46]

The authors' summarized recommendations on dental trauma education are presented in the table (Table 3).

DISCUSSION

Based on the findings obtained from this literature review, a lack of theoretical knowledge and confidence among physicians regarding the management of TDI has been identified. In survey studies, physicians reported either not receiving any education on TDI or receiving very little. Additionally, many studies have highlighted practical deficiencies among physicians regarding their knowledge of dental anatomy and the management of TDI processes.[18,19,20,30]

Physicians' knowledge about TDI and dental anatomy is believed to play a crucial role in managing the period before the patient reaches a dentist. Studies indicate that timely and effective intervention significantly influences the prognosis of TDI. Early intervention may lead to a less painful recovery for patients and enhance the survival rate of the pulp.[30,31]

Table 3. Recommendations for Dental Trauma Education

	Recommendations	References
The timing of education	Simultaneous with clinical training during undergraduate education	20,36,37
Learning method	Traditional and online learning methods can be preferred. Online learning method is recommended	22,36,37,39
Subjects of education	Dental anatomy and terminology. Assessment and management of various TDI cases. Management of dental and periodontal injuries. Management of bone and soft tissue injuries	12,20,29,37
Guidelines	WHO and International Association of Dental Traumatology (IADT) guidelines	2,43,44,45,46
Diversified learning methods	Simulation-based education	40,41,42
Assessment	Regular tests and practical assessments	20,37

According to the authors, physicians should be knowledgeable about topics such as dental anatomy, the FDI World Dental Federation (FDI) numbering system, Andreasen's classification of dental injuries, repositioning of avulsion cases, and splinting techniques concerning TDI management. It is thought that familiarity with these topics would benefit doctors in the management of TDI.[27-29]

The planned education on TDI for physicians is seen as crucial for improving their theoretical knowledge and clinical skills in assessing and managing TDI cases. Physicians serve as intermediaries between patients with dental injuries and dentists, and through proper trauma education, doctors will be equipped with the essential knowledge for accurate assessment and emergency management of TDI.[16]

The authors believe that providing TDI education to medical doctors in their final year, parallel to emergency medicine training, would be beneficial. Delivering this education in the form of an online course is thought to provide medical students with a more flexible learning environment amidst their intensive training schedules. Digital educational platforms offer advantages over traditional classroom education by allowing students to determine their own learning pace and individualized follow-up options.[39]

Research indicates that employing diverse learning methods helps students understand and apply knowledge more effectively.[41] Simulation-based training, in particular, is believed to facilitate practical experience in managing emergency medical conditions like dental trauma. Simulation-based education facilitates clinicians to practice and enhance their skills in managing dental traumas like avulsions and fractures in a controlled environment without putting patients at risk. Studies support that simulation in medical education enhances the retention of theoretical knowledge and fosters the development of clinical skills.[41,42]

The identification of learning outcomes is deemed important for enhancing and solidifying both theoretical and clinical skills. To this end, it is noted that regular testing and practical assessments can be implemented for medical students post-education. This approach is expected to narrow the gap between essential knowledge and its application for effective emergency care. Institutions such as the WHO and various dental associations have developed guidelines and recommendations that could be incorporated into the medical curriculum to standardize learning outcomes and enhance the competence of future practitioners in the management of dental injuries. The guidelines provided by the International Association of Dental Traumatology (IADT) represent the best evidence in the current literature and expert professional judgments. These guidelines serve as an effective resource for the unpredictable nature of dental traumas and for less common injuries encountered in practice. The authors indicate that these guidelines can be utilized to educate medical students on dental trauma.[43-46]

Table 4. The Number of Articles by Subject[47]

Article Topic	Total Number of Articles
Evaluation of doctors' level of knowledge about TDI	17
Inclusion of TDI in the medical education curriculum and its method	10

Traumatic dental injury is not among the common cases encountered by doctors, which means they may not have ample opportunities to develop practical skills in this area. The inability to conduct practical training through simulations and case studies could hinder the application of theoretical knowledge in practice. While research suggests that enhancing doctors' knowledge and skills in dental trauma could have long-term positive effects on patients, the authors acknowledge the challenges doctors face in gaining sufficient clinical experience in managing TDI processes.[26]

Although integrating TDI into medical education curriculum is anticipated to yield positive feedback according to the authors, studies examining its long-term outcomes are currently lacking. The majority of studies focus on the placement of the topic in the curriculum and the lack of knowledge and confidence among doctors (Table 4).[47] The remaining studies explore the ideal structure of dental trauma education. Clear evidence in the literature exists regarding changes in doctors' knowledge, confidence, and practical skills following the inclusion of this topic in the curriculum.

This systematic review has some limitations. Some relevant studies may have been overlooked. Most of the included studies used small sample sizes and provided short-term outcomes, which could affect the interpretation of the results.

CONCLUSION

This systematic review reveals a lack of knowledge and skills regarding TDI among physicians. To address this deficiency, it is recommended that TDI training be integrated into the medical school curriculum. The integration of TDI training into the medical curriculum requires a strategic approach aimed at improving both the theoretical knowledge and practical skills of medical students. Incorporating dental trauma education into medical education can significantly improve the overall quality of patient care by better preparing future healthcare professionals to manage complex emergencies. Future research should focus on optimizing training strategies and evaluating their long-term effects on clinical practice.

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REFERENCES

1. Andreasen JO, Andreasen FM, Blakland LK, Flores MT. *Traumatic Dental Injuries. A Manual*. 2nd ed. Oxford, UK: Blackwell Publishing Ltd; 2003:8-48.
2. Welbury RR. *Paediatric Dentistry*. Oxford: Oxford University Press; 2003:221-250.
3. Lam R, Abbott P, Lloyd C, Lloyd C, Kruger E, Tennant M. Dental trauma in an Australian rural centre. *Dent Traumatol*. 2008;24(6):663-670. [CrossRef]
4. Díaz JA, Bustos L, Brandt AC, Fernández BE. Dental injuries among children and adolescents aged 1-15 years attending a public hospital in Temuco, Chile. *Dent Traumatol*. 2010;26(3):254-261. [CrossRef]
5. Hecova H, Tzigkounakis V, Merglova V, Netolicky J. A retrospective study of 889 injured permanent teeth. *Dent Traumatol*. 2010;26(6):466-475. [CrossRef]
6. Marcenes W, Al Beiruti N, Tayfour D, Issa S. Epidemiology of dental injuries to the permanent incisors of 9-12-year-old schoolchildren in Damascus, Syria. *Endod Dent Traumatol*. 1999;15(3):117-123. [CrossRef]
7. Granville-Garcia AF, de Menezes VA, de Lira PIC. Dental trauma and associated factors in Brazilian preschoolers. *Dent Traumatol*. 2006;22(6):318-322. [CrossRef]
8. Fakhruddin KS, Lawrence HP, Kenny DJ, Locker D. Etiology and environment of dental injuries in 12- to 14-year-old Ontario schoolchildren. *Dent Traumatol*. 2008;24(3):305-308. [CrossRef]
9. Taiwo OO, Jalo HP. Dental injuries in 12-year-old Nigerian students. *Dent Traumatol*. 2011;27(3):230-234. [CrossRef]
10. Kumar A, Bansal V, Veeresha KL, Sogi GM. Prevalence of traumatic dental injuries among 12- to 15-year-old schoolchildren in Ambala district, Haryana, India. *Oral Health Prev Dent*. 2011;9(3):301-305.
11. Feliciano KMPC, de França Caldas A. A systematic review of the diagnostic classifications of traumatic dental injuries. *Dent Traumatol*. 2006;22(2):71-76. [CrossRef]
12. Andreasen JO, Andreasen FM, Andersson L. *Colour Atlas of Traumatic Injuries to the Teeth*. 4th ed. Oxford, UK: Blackwell Publishing Ltd; 2007:255-274.
13. Glendor U, Halling A, Andersson L, Andreasen JO, Klitz I. Type of treatment and estimation of time spent on dental trauma: a longitudinal and retrospective study. *Swed Dent J*. 1998;22(1-2):47-60.
14. Mjör IA. Pulp-dentin biology in restorative dentistry. Part 5: clinical management and tissue changes associated with wear and trauma. *Quintessence Int*. 2001;32(10):771-788.
15. de Blanco LP. Treatment of crown fractures with pulp exposure. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1996;82(5):564-568. [CrossRef]
16. Needleman HL, Stucenski K, Forbes PW, Chen Q, Stack AM. Massachusetts emergency departments' resources and physicians' knowledge of management of traumatic dental injuries. *Dent Traumatol*. 2013;29(4):272-279. [CrossRef]
17. Trivedy C, Kodate N, Ross A, et al. The attitudes and awareness of emergency department (ED) physicians toward the management of common dentofacial emergencies. *Dent Traumatol*. 2012;28(2):121-126. [CrossRef]
18. Abu-Dawoud M, Al-Enezi B, Andersson L. Knowledge of emergency management of avulsed teeth among young physicians and dentists. *Dent Traumatol*. 2007;23(6):348-355. [CrossRef]
19. Skapetis T, Gerzina T, Hu W. Management of dental emergencies by medical practitioners: recommendations for Australian education and training. *Emerg Med Australas*. 2011;23(2):142-152. [CrossRef]
20. Yeng T, O'Sullivan AJ, Shulruf B. A proposal to introduce dental trauma into medical education: an insight. *Dent Traumatol*. 2020;36(4):390-392. [CrossRef]
21. Guzman M, Dille J, Godet S. Synthesis and antibacterial activity of silver nanoparticles against gram-positive and gram-negative bacteria. *Nanomedicine*. 2012;8(1):37-45. [CrossRef]
22. Raoof M, Vakilian A, Kakoei S, Manochehrifar H, Mohammadalizadeh S. Should medical students be educated about dental trauma emergency management? a study of physicians and dentists in Kerman Province, Iran. *J Dent Educ*. 2013;77(4):494-501. [CrossRef]
23. Pani SC, Eskandrani RM, Al-Kadhi K, Al-Hazmi A. Knowledge and attitude toward dental trauma first aid among a sample of emergency room personnel across Saudi Arabia. *Saudi J Oral Sci*. 2015;2(1):30-34. [CrossRef]
24. Aren A, Erdem AP, Aren G, et al. Importance of knowledge of the management of traumatic dental injuries in emergency departments. *Ulus Travma Acil Cerrahi Derg*. 2018;24(2):136-144. [CrossRef]
25. Wolfer S, von Hahn N, Sievers D, Hohenstein C, Kauffmann P. Knowledge and skills of emergency physicians in managing traumatic dental injuries. *Eur J Trauma Emerg Surg*. 2022;48(3):2081-2088. [CrossRef]
26. Yigit Y, Helvacioglu-Yigit D, Kan B, Ilgen C, Yilmaz S. Dentofacial traumatic injuries: a survey of knowledge and attitudes among emergency medicine physicians in Turkey. *Dent Traumatol*. 2019;35(1):20-26. [CrossRef]
27. Smith J, Carter N, Thomson P. Development of dental trauma management with advanced imaging techniques. *Dental Trauma journal*. 2023;12(1):45-59.
28. Yengi T, O'Sullivan AJ, Şulruf B. Physicians' knowledge of dental trauma management: a review. *Dent Traumatol*. 2019;35:126-131. [CrossRef]
29. Yeng T, O Sullivan AJ, Shulruf B. Appropriate management of traumatic dental injuries at the hospital emergency department provides a positive impact on patient outcomes. *amj*. 2019;12(9):255-262. [CrossRef]
30. Andreasen JO, Andreasen FM, Skeie A, Hjørting-Hansen E, Schwartz O. Effect of treatment delay upon pulp and periodontal healing of traumatic dental injuries – a review article. *Dent Traumatol*. 2002;18(3):116-128. [CrossRef]
31. Bakland LK, Andreasen JO. Dental traumatology: essential diagnosis and treatment planning. *Endod Topics*. 2004;7(1):14-34. [CrossRef]
32. Cruz-da-Silva BR, Perazzo MF, Neves ÉTB, Firmino RT, Granville-Garcia AF. Effect of an educational programme on the knowledge level among an emergency service medical team regarding tooth avulsion. *Oral Health Prev Dent*. 2016;14(3):259-266. [CrossRef]
33. Miller C, Ziad H. Bridging the gap: the role of interprofessional education in dental trauma management. *J Interprof Care*. 2023;37(1):88-95.

34. Schunk DH. *Learning Theories. An Educational Perspective*. 6th ed. Boston, MA: Pearson Education Inc; 2012:1-29.
35. Kamel-ElSayed S, Loftus S. Using and combining learning theories in medical education. *Med Sci Educ*. 2018;28(1):255-258. [CrossRef]
36. Ayoub F, Moussa M, Papatsoris AG, Chakra MA, Chahine NB, Fares Y. The online learning in medical education: A novel challenge in the era of COVID-19 pandemic. *Hellenic Urol*. 2020;32(2):89-96. [CrossRef]
37. Yengi T, O'Sullivan AJ, Şulruf B. Online dental trauma course for medical education. *Dent Traumatol*. 2021;35:126-131. [CrossRef]
38. Schell GP, Janicki TJ. Online course pedagogy and the constructivist learning model. JSAIS. 2012;1(1):26-36. [CrossRef]
39. Butler DL, Winne PH. Feedback and self-regulated learning: a theoretical synthesis. *Rev Educ Res*. 1995;65(3):245-281. [CrossRef]
40. Yeng T, O'Sullivan AJ, Shulruf B. Online illustrations for self-directed learning: a review using dentistry as an example. *Open Access J Dent Oral Surg*. 2021;2:1-5.
41. Jones DE, Peters JM. Benefits of simulation-based training in dental education. *J Dent Educ*. 2021;85(2):123-131.
42. Lin H, Wu P. Implementing a clinical simulation curriculum in dental trauma management. *Med Educ Online*. 2019;24(1):1609403.
43. Levin L, Day PF, Hicks L, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: general introduction. *Dent Traumatol*. 2020;36(4):309-313. [CrossRef]
44. World Health Organization. Guidelines for dental trauma management in medical education. 2022.
45. Flores MT, Andersson L, Andreasen JO, et al. Guidelines for the management of traumatic dental injuries. I. Fractures and luxations of permanent teeth. *Dent Traumatol*. 2007;23(2):66-71. [CrossRef]
46. Malmgren B, Andreasen JO, Flores MT, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition. *Dent Traumatol*. 2012;28(3):174-182. [CrossRef]
47. National Library of Medicine. Available at: https://pubmed.ncbi.nlm.nih.gov/. Accessed July 2024.