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Original Article

Knowledge of dental students and professionals about the management of traumatic dental injuries: A critical literature review

Marcela Baraúna Magno[1], Patrícia Nadelman[1], Matheus Melo Pithon[2,3], Lucianne Cople Maia[3,*]

[1] PhD Student, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

[2] Professor, Southwest Bahia State University UESB, Jequié, Bahia, Brazil.

[3] Professor, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

Corresponding author:
Dr Lucianne Cople Maia.
Rua Rodolpho Paulo Rocco, 325.
Cidade Universitária, Rio de Janeiro – RJ. Brazil. CEP: 21941-913.
E-mail: rorefa@terra.com.br
ORCID ID: 0000-0003-1026-9401

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Knowledge about the diagnosis and treatment of traumatic dental injuries (TDIs) is extremely important in improving the prognosis of such cases. **Aim:** To evaluate the knowledge of dental students and professionals about the management of TDIs, and the factors that influence this knowledge, through a literature review. **Methods:** An electronic search was performed in the PubMed database, with no language or date restrictions. Studies that evaluated the knowledge of dental students or professionals about the management of TDIs were considered eligible. **Results:** From a total of 1902 retrieved papers, 36 full-texts were assessed for eligibility, and 31 were included in this review. All studies evaluated TDI knowledge through questionnaires; 15 of them only concerned tooth avulsion. In general, knowledge about TDI treatment, both in deciduous and permanent dentition, was considered to be low or moderate. Individual factors (age and gender), professional factors (postgraduate degree, qualification time and place of work), and previous TDI knowledge (attendance frequency, previous education and self-judgment about the knowledge) influenced the knowledge and the frequency of correct answers. **Conclusion:** Dentistry student and professional knowledge about TDIs is not satisfactory.

Keywords: Tooth injuries. Knowledge. Review.

Introduction

Traumatic dental injuries (TDIs) are considered to be a public health problem due to their increasing prevalence, high frequency in young age groups,[1] length and cost of treatment procedures,[2] and their impact on an individual's daily life.[3] TDI prevalence was estimated 17.5% in the population, but can vary form 6.1% to 36.6% based on geographical area.[1] TDIs can vary from a simple concussion and enamel crack to considerable damage involving structures surrounding the tooth. Also, their treatment can be conservative, involving only preservation without intervention, or can be more radical, comprising tooth replantation in the socket or prosthetic rehabilitation.[4-6]

In most TDI cases, immediate and proper treatment can minimize the patient's emotional distress, and improve the prognosis.[7] Following that, the dentist's knowledge regarding the management of TDIs plays an essential role in the prognosis of the traumatized tooth because early intervention can enhance the regenerative capacity of traumatized teeth.[8] Hence, dentists should be familiar with the different types of TDIs, involving teeth and the supporting tissues, and should also be aware that immediate and appropriate treatment, together with long-term follow up, lead to a favorable prognosis for the traumatized tooth.[4-6] In this context, the International Association for Dental Traumatology[9] has published a series of guidelines for the management of TDIs in deciduous and permanent teeth to help dentists and other healthcare professionals to make the correct decisions regarding the different types of TDIs.[4-6]

The treatment of TDIs is part of general dental practice[10], and a dentist's knowledge about TDIs is critical because inadequate management of traumatized teeth can result in serious consequences for the immediate outcome, and the long-term prognosis, general health, and psychosocial well-being of the patient.[11] Therefore, this study aimed to evaluate, through a literature review, the knowledge of dental students and professionals about the management of TDIs, as well as to discuss the factors that have positively influenced their knowledge.

Materials and Methods

An electronic search was performed in the PubMed database, up to September 2018, using MeSH terms and free terms related to 'knowledge', 'tooth injuries', and 'dentistry'. The search was limited to the title and abstract fields. The Boolean operators 'AND' and 'OR' were applied in order to combine the terms. No restrictions were placed on the publication language or publication date. The search strategy is described in Figure 1.

One author (M.B.M.) evaluated the titles and abstracts of all identified articles provided by the electronic database to see which studies met the inclusion criteria of the literature review. The predefined inclusion criteria were observational studies that evaluated the knowledge of dental students or professionals about the management of TDIs. Studies not related to TDI, case reports, literature review papers, and articles that evaluated the knowledge about management of TDIs in non-dental students or professionals were excluded. The titles and abstracts were read and evaluated for

#1 Knowledge[mesh terms] OR Knowledge[tiab] OR Management[tiab] OR awareness[tiab]
#2 Tooth Injuries[mh] OR Tooth Avulsion[mh] OR Tooth Movement[mh] OR Tooth Fractures[mh] OR Teeth injur*[tiab] OR dental injur*[tiab] OR dental trauma[tiab] OR traumatic injur*[tiab] OR Teeth avulsion[tiab] OR Exarticulation[tiab] OR Dental dislocation[tiab] OR Tooth Movement[tiab] OR teeth extrusion[tiab] OR lateral luxation[tiab] OR Tooth Fractur*[tiab] OR crown fractur*[tiab] OR root fractur*[tiab]
3 Dentistry[mesh terms] OR dentist*[tiab] OR endodontics[mesh terms] OR endodontic*[tiab] OR Orthodontics[mesh terms] OR Orthodonti*[tiab] OR Pediatric Dentistry[mesh terms] OR "Pediatric Dentistry"[tiab] OR Pedodontics[tiab] OR Periodontics[mesh terms] OR Periodontics[tiab] OR Prosthodontics[mesh terms] OR "Prosthetic Dentistry"[tiab] OR Public Health Dentistry[mesh terms] OR "Public Health Dentistry"[tiab] OR Surgery, Oral[mesh terms] OR "Maxillofacial Surgery"[tiab] OR dental students[tiab]

Final search strategy: #1 AND #2 AND #3

Figure 1. Pubmed search strategy.

eligibility. When insufficient information was present in the title and abstract, the full texts of the potential papers were retrieved.

For each included study, the knowledge level was categorized based on the following criteria:

- **Excellent**, when the percentage of correct answers ranged from 100% to 90%;
- **Good**, when the percentage of correct answers ranged from <90% to 70%;
- **Moderate**, when the percentage of correct answers ranged from <70% to 50%;
- **Low**, when the percentage of correct answers ranged from <50% to 25%; and
- **Very low**, when the percentage of correct answers were lower than 25%.

The characteristics, such as authors, year and country of origin, sample size and features of the studied population, TDI type, method of evaluation, scale type and validation of the data collection instrument, and results of the selected studies, were tabulated and descriptively presented.

The factors that positively influenced knowledge about TDI management were organized in a model with three key domains: **(1) individual factors:** gender and age; **(2) dental student/professional factors:** presented, or not, postgraduate degree, qualification time, and place of work; and **(3) previous TDI knowledge:** frequency of TDI attendance, receipt of previous education about TDI, and self-judgment on TDI treatment knowledge. The key domains model included several factors that significantly influenced ($p<0.05$) the dental students' and professionals' knowledge about TDIs, and also presented the total number of participants evaluated for each factor. The factors reported in the included studies that significantly ($p<0.05$) influenced one or more TDI answers were collected, organized, and discussed.

Results

The database search identified 1902 articles. After title and abstract screening, 1866 articles not related to this review's topic were excluded: 717 are case reports, 261 are literature review, 125 evaluate knowledge of other health professionals or

lay people, 751 are not related to knowledge about TDI management and 12 are in vitro studies. Thus, 36 full-text studies were assessed in order to verify their eligibility. Among them, four studies were excluded because they were not performed with dentists or dental students, and two further studies were excluded as they did not evaluate knowledge about TDI management. Finally, 30 studies were included in the present review.

The numbers of included participants ranged from 18 to 693 dentists, dental students, dental hygienists and dental assistants. Twenty-six studies evaluated dentists' knowledge,[7, 12-37] and five studies evaluated undergraduate dental students' knowledge.[22, 38-41] Among these 31 studies, 15 evaluated only knowledge about tooth avulsion.[7, 13, 14, 16, 18, 21, 23, 25, 29, 32, 33, 37, 38, 40, 41]

Concerning the applied questionnaires, the number of questions ranged from four to 28, some of them describing imaginary cases of TDI, with or without images, while the others were composed of direct questions without images. Only four studies[12, 22, 26, 41] used previously validated questionnaires.

Seven studies evaluated knowledge about TDIs in deciduous and permanent dentition,[14-16, 22, 29, 32, 37] 19 evaluated knowledge about TDIs only in permanent dentition,[7, 12, 13, 18-21, 23, 25, 27, 28, 30, 31, 33-36, 39, 41] and only one study evaluated TDI knowledge in deciduous dentition.[26] Three studies did not specify the type of dentition included in the questionnaires.[24, 38, 40]

The level of knowledge varied from excellent to low in the included studies. While only one study presented an excellent level of TDI management knowledge (90% or more correct answers)[29], five studies presented a good level of TDI management knowledge (<90% to 70% correct answers),[19, 20, 28, 35, 41] 22 studies presented a moderate level of TDI management knowledge (<70% to 50% correct answers),[7, 12-19, 22, 23, 25, 30, 32-34, 36-41] five studies presented a low level of TDI management knowledge (<50% to 25% correct answers),[12, 21, 26, 27, 39] and two studies presented a very low level of TDI management knowledge (<25% correct answers).[24, 31]

The characteristics of the selected studies are listed in Table 1.

A diagram of the model of the factors that influenced knowledge about TDIs is shown in Figure 2.

Discussion

Literature reviews are secondary studies and may have several formats. The present literature review aimed to present a global view of the knowledge of dental students and/or professionals about TDI treatment. As no control / comparison group was adopted, the systematic review format could not be performed[42] and, consequently, there was no methodological analysis of included studies. This factor, along with the search strategy had been performed in only one database (PubMed) are limitations of this study.

This study has assessed, through a literature review, the knowledge of dental students and professionals concerning the treatment of TDIs. Thirty-one studies that evaluated the comprehension of dental students and/or professionals about TDI treatment were

Table 1. Description of included studies.

Author, year. Coutry	Sample size	Population	TDI evaluated	Method of question	Questionnaire	Scale type	Validation	Results
Akhlaghi et al., 2014. Iran	241	Dentists	Fracture, luxation and avulsion in permanent dentition	Imaginary TDI cases	14-item multiple choice questions	Scores 0-4 were considered as poor knowledge, scores 5-8, 9-11 and 12-14 were taken as moderate, good and excellent knowledge, respectively.	Yes	The level of knowledge was low and moderate for TDI management (73.2% of people responded between 35% to 57% of correct answered questions).
AlJazairy et al., 2015. Saudi Arabia	470	Dentists	Avulsion in permanent dentition	Only questions	19-item modified version of Westphalen et al.	Scoring system that assigned one point for each correct answer and zero points for wrong answers, with a maximum possible score of ten points.	No	The level of knowledge was moderate for avulsion management (60% of correct answered questions).
Al-Shamiri et al., 2018. Saudi Arabia	307	Undergraduate dental students	Avulsion	NR	17-item modified version of Al-Obaid and Fujita et al. versions.	NR	No	The level of knowledge was moderate for avulsion management (66.9% of correct answered questions).
AlZoub et al., 2015. London	70	Undergraduate dental students	Fractures and luxation in permanent dentition	NR	NR	NR	No	The level of confidence was low (2.41) and the level of knowledge was moderate for TDI (64% of correct answered questions).
Baginska and Wilczynska-Borawska 2012. Poland	133	Dentist	Avulsion in deciduous and permanent dentition	Questions without images	12-item questionnaire	The respondents get 1 point for each correct answer and the maximum number of points was 11.	No	The level of knowledge was moderate for avulsion management (52.7% of correct answered questions).
Çinar et al. 2013. Turkey	154	Dentists	Fractures, luxation and avulsion in deciduous and permanent dentition	Questions without images	12-item multiple choice questions	NR	No	The level of knowledge was moderate for all TDI (57% of correct answered questions for luxation, 60.8% for fractures and 51% for avulsion).
Cohenca et al. 2006. United States	202	General dentists, specialists, dental hygienists and dental assistants	Avulsion in deciduous and permanent dentition	Questions without images	12-item multiple choice questions	NR	No	The level of knowledge was moderate for avulsion management (59.5% of correct answered questions).

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França et al. 2007. Brazil	108	Dentists	Fracture, luxation and avulsion in permanent dentition	Questions without images	5-item multiple choice questions	NR	No	The level of knowledge was moderate for avulsion management (50.3% of correct answered questions).
Frujeri and Costa 2009. Brazil	100	Dentists	Avulsion in permanent dentition	Questions without images	12-item multiple choice questions	NR	No	The level of knowledge was moderate for TDI management for general dentists (60%of correct answer could not be calculated)
Fujita et al. 2014. Japan	121	Undergraduate dental students	Avulsion	Imaginary TDI cases	Modification questionnaire of Al-Obaia et al. (Multiple choice questions to hypothetically clinical situations)	NR	No	The level of knowledge was moderate for avulsion management (64.8% of correct answered questions).
Hu et al. 2006. Brazil	300	General dentists (n=230) and endodontists (n=70)	Fracture, avulsion and TDI consequences in permanent dentition	Imaginary TDI cases	10-item multiple choice questions to hypothetically clinical situations	NR	No	The level of knowledge was moderate for TDI management for general dentists (mean of correct answered questions was 6.4) and good for endodontists (mean of correct answered questions was 7.7).
Jain et al., 2018. India	88	Undergraduate dental students	Avulsion in permanent dentition	Imaginary TDI cases	23-item multiple choice questions	NR	Yes	The level of knowledge was moderate for males TDI management (mean of correct answered questions was 15.5) and good for females (mean of correct answered questions was 16.5).
Kostopoulou and Duggal 2005. UK	693	General dentists practioners (n=612) and community dental offices (n=81)	Crown fractures and avulsion of young permanent dentition	Questions without images	8-item multiple choice questions	NR	No	The level of knowledge was good for TDI management for general dentists practioners (74.8% of correct answered questions) and for community dental offices (76.8% of correct answered questions).
Krsastl et al. 2009. Switzerland	181	Dentists	Fracture, luxation and avulsion in permanent dentition	Imaginary TDI cases	8-item multiple choice questions	NR	No	The level of knowledge was low for TDI management for general dentists (40.7% of correct answered questions).

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Limbu et al. 2014. Nepal	121	Undergraduate dental students	Avulsion in deciduous and permanent dentition	Questions without images	Previous valeted questionnaire	NR	Yes	The level of knowledge was moderate for TDI management for general dentists (63.7% of correct answered questions).
Menezes et al., 2015. Brazil	74	Dentists	Avulsion in permanent dentition	Questions without images	5-item multiple choice questions	NR	No	The level of knowledge was moderate for TDI management (54.2% of correct answered questions).
Pedrini et al. 2011. Brazil	693	Dentists	Luxation	Questions with images	5-item multiple choice questions	NR	No	The level of knowledge was very low for TDI management (23.7% of correct answered questions).
Qazi et al. 2009. Pakistan	148	Dentists (n=48) and bachelor in dental surgery (n=100)	Avulsion in permanent dentition	Questions without images	NR	NR	No	The level of knowledge was moderate for TDI management (69.8% of correct answered questions).
Ravikumar et al. 2018 India	100	Dentists	Fracture, luxation and avulsion in deciduous dentition	Imaginary TDI cases	15-item multiple choice questions (5-pint Likert scale)	NR	Yes	The level of knowledge was low for TDI management (46.7% of correct answered questions).
Re et al. 2014. Italy	500	Dentists	Fracture, luxation and avulsion in permanent dentition	Imaginary TDI cases	9-item multiple choice questions	NR	No	The level of knowledge was low for TDI management (46% of correct answered questions).
Skaare et al. 2015. Norway	164	Dentists	Fractures and avulsion in permanent dentition	Imaginary TDI cases	28-item multiple choice questions	NR	No	According the author, the level of knowledge was good (75.4% of correct answered could not be calculated).
Stokes et al. 1992. New Zeland	18	Dentists	Avulsion in deciduous and permanent dentition	NR	12-item multiple choice questions of Raphael and Gregory	NR		The level of knowledge was excellent for TDI management (91.5% of correct answered could not be calculated).
Tondelli et al. 2008. Brazil	105	Orthodontists	Luxation and avulsion	Questions without images	4-item multiple choice questions	NR	No	The level of knowledge was moderate for TDI management (62.8% of correct answered questions).

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Trabert et al. 2009. Brazil	85	Dentists	Fracture and avulsion in permanent dentition	Questions without images	4-item multiple choice questions	NR	No	The level of knowledge was very low for TDI management (12.3% of correct answered questions).
Upadhyay et al. 2012. Nepall	102	Dentists	Avulsion in deciduous and permanent dentition	Questions without images	10-item multiple choice questions	NR	No	The level of knowledge was moderate for TDI management (50% of correct answered questions).
de Vasconcellos et al. 2009. Brazil	264	Dentists (except endodontists and buccomaxillofacial surgery)	Avulsion in permanent dentition	Questions without images	21-item multiple choice questions	NR	No	The level of knowledge was moderate for TDI management (62% of correct answered questions).
Westphalen et al. 2007. Brazil	250	Dentists (except endodontists and buccomaxillofacial surgery)	Avulsion in permanent dentition	Questions without images	9-item multiple choice questions	NR	No	The level of knowledge was moderate for TDI management (58.8% of correct answered questions).
Yeng and Parashos 2008. Australia	371	Dentists	Fractures, luxation and avulsion in permanent dentition	Questions without images	19-item multiple choice questions (6-pint Likert scale)	NR	No	According the author, dentists demonstrated moderate knowledge for management of TDI.
Zadik et al. 2009. Israel	54	Dentists	Fracture, luxation and avulsion in permanent dentition	Questions without images	11-item multiple choice questions	NR	No	The level of knowledge was good for TDI management (71.7% of correct answered questions).
Zaleckienė et al. 2018. Lithuania	582	Dentists	Fractures, luxation and avulsion in permanent dentition	Imaginary TDI cases	13-item multiple choice questions	Theoretical range was from 0 "no knowledge" to 13 "excellent knowledge"	No	The level of knowledge was moderate for TDI management (mean of correct answered questions was 7.6)
Zhao and Gong 2010. China	258	Dentists	Avulsion on deciduous and permanent dentition	Questions without images	9-item multiple choice questions	NR	No	The level of knowledge was moderate for avulsion management (60% of correct answered questions).

NR Not report.

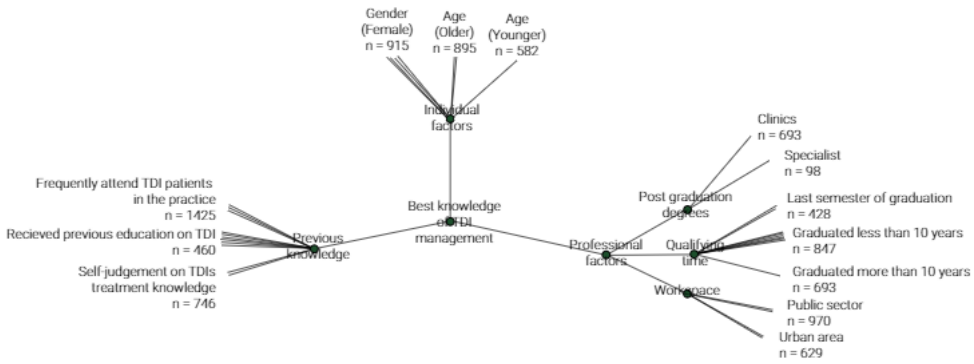

Figure 2. The diagram of the model of the factors that influenced in knowledge about TDIs.

included. In addition, during the study selection process, a large number of studies were encountered that evaluated the knowledge of other professionals and lay people about TDI treatment. The fact that this subject has been widely researched in scientific society is related to its relevance and importance due to its high prevalence and the need for immediate treatment; however, the studies did not shown encouraging results. In general, knowledge about TDI treatment, regardless of the type of teeth (deciduous or permanent), was considered to be low to moderate. This may indicate that dental students and professionals can moderately well handle TDI cases on a day-to-day basis, whilst they may present certain difficulties in some activities related to such work.

Regarding the type of TDI, avulsion was considered to be one of the most complicated and serious traumas, with a prevalence of 16% in both types of dentition.[43] In addition, there was an urgent need for treatment of this specific TDI,[5] and this fact may explain why a significant number of the included studies – almost half of them (15 of the 31) – exclusively evaluated knowledge about the treatment of dental avulsion. In relation to the evaluation of this knowledge, the studies assessed the management of avulsed permanent teeth, including extra-oral period, storage media, stage of root development, and splinting. Most of these showed that avulsion treatment knowledge is moderate. This may indicate that dental students and professionals can moderately well handle tooth avulsion cases on a day-to-day basis, although they may present certain difficulties in some activities related to such work.

The present review also showed that individual and professional factors, as well as previous knowledge about TDI, influenced TDI treatment knowledge. Among the individual factors, professional age and gender were considered to be influential elements in the knowledge, and among the professional factors, the workspace, qualification time, and postgraduate degree were shown to be knowledge influencers.

Regarding professional age, three studies[16,20,31] reported that older people (≤35 years[16,31] or between 40-59.9 years[20]) had better knowledge about certain TDI aspects. Hypothetically, being older would mean having more general experience and likely having dealt with TDI situations previously and, consequently, knowing how to proceed in TDI situations. On the other hand, one study[36] reported that younger people were associated with a higher prevalence of correct answers. This association could be related to

the fact that younger dentists participate, more frequently, in different postgraduate education courses, where contemporary TDI knowledge can be acquired. Studies that included postgraduate dental students reported that the majority of this population was below 35 years.[44, 45]

Concerning the gender of the professionals, previous studies that evaluated memory indicated significant gender differences, and female superiority in short- and long-term memory tests, when compared to males in the same age range,[46-48] while none study report male superiority. So, based on these previous studies, it could be raise the hypothesis that the female superiority in TDI knowledge could be related to this gender-related ability and, in this way, women could be retaining information for longer than men.

With regard to the workspace, according to some authors, professionals that worked in public departments[13, 27] and urban areas[34, 37] presented a higher knowledge level, while none study report particular clinics and rural area better knowledge. This finding may indicate a deficiency in the diffusion and dissemination of knowledge in rural areas, where access to continuing education programs are more limited.[49] Certain factors, such as speed of spreading knowledge and conference opportunities in urban and suburban areas, may have contributed to this difference in knowledge among dentists. Besides that, dentists that work in public hospitals may be exposed to the diagnosis and treatment of TDIs more frequently and, in this sense, they could be better prepared to deal with such emergencies.

Regarding the qualification time, the same argument used concerning previous TDI education could be applied to the association between better knowledge and professionals who graduated less than 10 years ago, or students in the last semesters of graduation. Unsurprisingly, students at a higher academic level presented better knowledge when compared to those at lower academic levels[38, 40]. With regard to undergraduate students, this result was expected, and could be explained by students at higher academic levels having already been exposed to a greater amount of clinical cases compared to those at lower academic levels. Concerning the professionals, this result indicated that the knowledge can be time-dependent since six studies[7, 14, 17, 21, 26, 31] reported greater knowledge of professionals graduated less than 10 years while only 1 study[20] reported greater knowledge of trained professionals over 10 years.. This means that TDI knowledge acquired at the undergraduate and/or postgraduate level may not be retained throughout the dentist's career, and could be forgotten or become outdated over the years. Both situations highlight the importance of continuous education, and the development of tools that can help the practitioner in their clinical decisions regarding TDI management.

Additionally, the relationship between being a postgraduate or a general dentist versus knowledge about TDI management should be evaluated with caution, since only three studies compared the knowledge of a few dental specialties directly to the knowledge of general practitioners, and these found contradictory results.[19, 24, 25] Both evaluated specialties (endodontics and the Bachelor's in Dental Surgery) presented the topic of diagnosis and treatment of some TDIs in their program contents; however, studies evaluating other specialties should be performed in order to assess the influence of different postgraduate courses in TDI knowledge.

Relating to previous knowledge, people who reported having received previous education in TDIs[12, 16, 19, 20, 22, 39], who frequently attend TDI patients,[12, 19, 22] and who thought they had sufficient knowledge about TDIs[28, 36] presented a higher prevalence of correct answers. None study reported better knowledge of professionals that didn't had previous education in TDI, didn't attended TDI cases or thought they had insufficient knowledge about TDI. This finding is in accordance with previous studies, which have demonstrated that different educational interventions (such as lectures, folders, and mobile learning apps) were related to lay person, dentistry professional and student knowledge increase in relation to certain aspects of oral health.[50-52] The association between a good knowledge self-assessment and real-world good knowledge is important, and needs to be further explored, since inaccurate self-assessment leads to an unrealistic perception of a dentist's competence in treating TDIs, and may cause iatrogeny during the trauma treatment.

This review has shown that a limited number of dentists, in general, would not provide the quality emergency management and treatment necessary to enhance the survival time of teeth exposed to TDI. This insufficient knowledge could generate none, or postponement, of patient TDI treatment (who many times need immediate care) and sequelae on traumatized tooth, or their successor. This is a compelling reason to encourage continuing education programs to constantly reinforce the emergency and preventive procedures for TDIs. In addition, the development of tools, including the content of different approved TDI guidelines, should be undertaken. Leaflets, tutorials, or mobile apps – in local languages – could be developed, disclosed, and distributed in a way that would reach both urban and rural areas. A reduction in the number of accidents, and their adverse effects, with the aid of tools for teaching and knowledge transmission, would have a positive impact on the social costs of the treatment of victims of TDIs.

It is possible to conclude, from this review of the literature, that dental students and professionals presented, in general, a moderate to low level of knowledge about TDI treatment. Individual factors, such as gender and age, professional factors, and previous knowledge about TDIs, influenced the level of knowledge.

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