Retrospective study on 696 cases of traumatic dental injuries of primary dentition in Xi'an, China



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Abstract

Aim The aim of the present study was to explore the epidemiological characteristics and treatment of traumatic dental injuries of primary dentition (TDI-p) in Xi'an, China.

Materials and methods Data of children with TDI-p admitted between January 2018 and December 2019 at the Department of Pediatric Dentistry, Xi'an Jiaotong University Stomatology Hospital were retrospectively analysed. The epidemiological distribution characteristics and related treatment information of TDI-p were described.

Results A total of 696 children (male-to-female ratio, 1.7: 1) with 1241 traumatised primary teeth were analysed. The peak period of TDI-p was 2 to 3 years of age (24.7%). TDI-p often involves a single tooth (46.3%), and the maxillary central incisors (75.4%) were the most frequently affected. About 57.6% of patients sought dental treatment within 1 day to 1 week after injury. Among the various types of teeth injuries, concussion (16.9%), subluxation (13.2%), and root fracture (13.3%) were the most common types of TDI-p. In addition, combined traumas mainly manifested as enamel-dentin fracture combined with a concussion (35.3%) or subluxation (23.3%). The recurrence rate of TDI-p was 3.3%. Observation (42.6%) and extraction (28.2%) were the most common ways to deal with TDI-p. About 46.6% of the children received treatment under physical restraints or general anaesthesia. About 3.3% of the guardians had a negative attitude towards the treatment plan or behavioural management of TDI-p.

Conclusion Compared with permanent dentition, TDI-p has its particularities, such as type of trauma, treatment procedure, and behavioural management. More attention should be paid to TDI-p by both dentists and guardians.

KEYWORDS Traumatic dental injuries; Primary dentition; Retrospective study; Pediatric dentistry.

Introduction

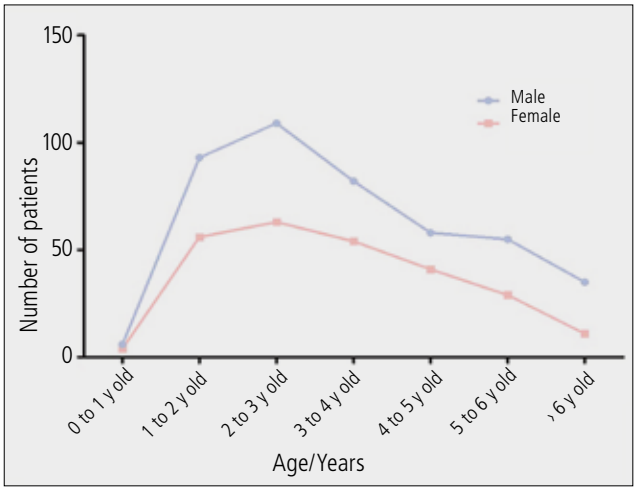
Traumatic dental injuries (TDIs) have been considered a dental public health problem worldwide, and there has been an upward trend in recent years [Glendor, 2008]. TDIs have a negative impact on the oral health-related quality of life of patients, including aesthetics, function, and psychology [Borges et al., 2017]. In addition, traumatic dental injuries of the primary dentition (TDI-p) may adversely affect the development and eruption of permanent successors [Tewari et al., 2018].

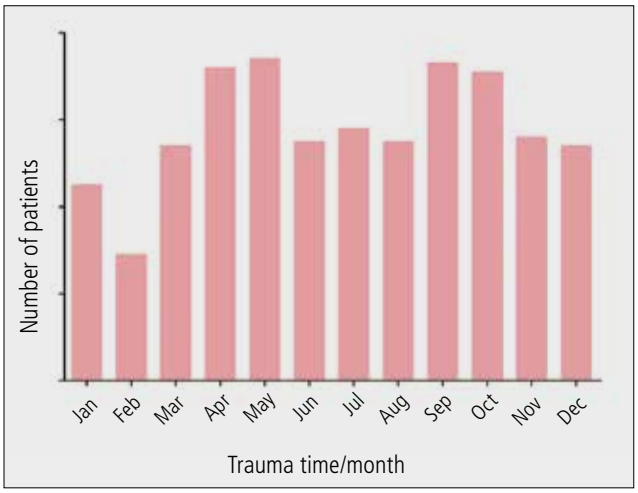
A meta-analysis of 102 primary studies showed that more than one billion living people have had TDIs, which was a neglected condition and could rank 5th if it was included in the list of the world's most frequent acute/chronic diseases and injuries [Petti et al., 2018]. Compared with permanent dentition, the prevalence of TDI-p is even higher [de Paula Barros et al., 2019], ranging from 6.2% [Shekhar and Mohan, 2011] to 76.1% [Bhayya and Shyagali, 2013] according to different studies worldwide. However, TDI-p has not received enough attention from both guardians and scholars, and neither developed nor developing countries can fully meet the needs of the treatment of TDI-p [Oliveira et al., 2007]. Some parents and dentists ignore the severity of TDI-p, they are confused about how to deal with TDI-p and even think it is not necessary to provide treatment [Ravikumar et al., 2017-Odersjö et al., 2018]. Furthermore, a recent bibliometric study indicated that only a low percentage of articles focus on TDI-p worldwide [Liu et al., 2020]. Despite the large number of dental trauma patients in China, few studies have focused on the clinical characteristics of TDI-p [Gong et al., 2011] .

Therefore, the aim of this retrospective study was to analyse the clinical data of TDI-p, describing the epidemiological distribution characteristics and treatment of TDI-p, enriching the related epidemiological database, and providing a reference for the prevention and treatment of TDI-p.

Materials and methods

This retrospective study was based on data collected from an electronic medical records system at Xi'an Jiaotong University Stomatology Hospital, which is a famous teaching stomatology hospital in northwest China. According to the medical ethics committee of Xi'an Jiaotong University, no ethical approval was required for this retrospective study, since it was not human subject research and no personal privacy were involved.





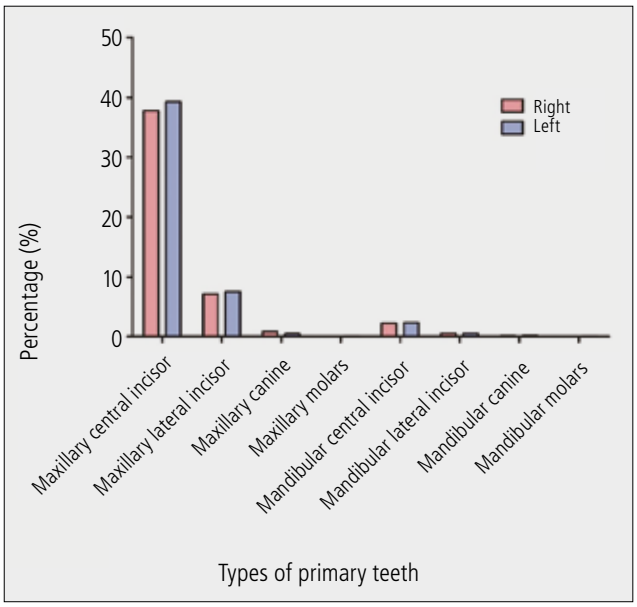


FIG. 1 Number of patients with traumatic dental injuries of primary dentition (TDI-p) according to age and gender (n = 696).
FIG. 2 Number of patients with traumatic dental injuries of primary dentition (TDI-p) related to time of the year (n = 696).
FIG. 3 The percentage distribution of traumatised primary teeth localization (n = 1241).

As routine practice for dental trauma in the Department of Pediatric Dentistry, on their first visit, all the guardians signed the informed consent, including diagnosis, treatment plan, possible prognosis, agreeing or denying the treatment, and permitted access to their child's dental records for research purposes.
We examined the medical records of children who were admitted to Xi'an Jiaotong University Stomatology Hospital with a chief complaint of dental trauma from January 2018 to December 2019. All cases of TDI-p were included. Cases of permanent dentition trauma and/or cases with incomplete information were excluded. For patients diagnosed with TDIs involving both permanent and primary teeth, only information on traumatic primary teeth was recorded.
The characteristics of TDI-p were categorised according to the following aspects: i) age and sex; ii) seasonal variation of trauma; iii) number and localisation of traumatised primary teeth; iv) type of trauma, according to Andreasen's classification [Malmgren et al., 2017], TDI-p can be represented as hard dental tissue injuries (enamel fracture, enamel-dentin fracture, complicated crown fracture, uncomplicated crown-root fracture, complicated crown-root fracture, and root fracture), periodontal tissue injuries (concussion, subluxation, extrusive luxation, lateral luxation, intrusive and avulsion), and bone tissue and soft tissue injuries. Furthermore, some traumatised teeth were combined traumas, which affected not only hard dental tissues but also periodontal tissues; v) recurrence, meaning a child suffered from TDI-p more than one time at different dates; vi) the time elapsed between TDI-p and the sought treatment; vii) initial treatment, such as observation, extraction, pulpectomy, repositioning, restoration, and others; viii) behavioural management, including verbal management (tell-show-do, voice control, positive reinforcement, and/or others), physical management (physical restraints), and pharmacologic management (general anaesthesia); ix) guardians acceptance of treatment.
The required information was recorded in Microsoft Excel 2019 (Microsoft, Redmond, WA, USA). Measurement data were presented as mean ± standard deviation, while count data were presented as rate and proportion. Descriptive statistics were used to show the characteristics of individuals and their dentition. For all statistical evaluations, the Chi-square test was used to compare the distribution of children's gender in different age groups, and the Kruskal-Wallis-rank-sum test was used to analyze the factors that may be related to the time elapsed between TDI-p and sought of treatment. The level of significance was set at 0.05.

Results

From January 2018 to December 2019, 1743 cases were diagnosed with TDIs at the Department of Pediatric Dentistry, Xi'an Jiaotong University Stomatology Hospital. According to the inclusion and exclusion criteria mentioned above, 696 cases of TDI-p were finally included in the present study, accounting for 39.9% of the total trauma cases.
Of the 696 children, 438 (62.9%) were boys and 258 (37.1%) were girls. Children with TDI-p were aged from 0.5 to 10 years with an average of 3.1 ± 1.4 years. Forty-six children were over 6 years old. A total of 457 (65.7%) cases appeared between 1 and 4 years of age, with a peak in the age interval of 2 to 3 years. The number of male patients surpassed that of female patients in every age grade (Fig. 1), with no significant difference (χ^2=4.921, P>0.05).

	enamel dentin fracture	uncomplicated crown-root fracture	root fracture	total
Concussion	41	1	4	46
Subluxation	27	1	6	34
Extrusive luxation	5	1	7	13
Lateral luxation	7	0	4	11
Intrusive	6	1	5	12
Total	86	4	26	116

TABLE 1 The distribution of combined traumas of primary teeth.

In different seasons, the percentages of TDI-p were as follows: spring (March, April, and May) (n=200; 28.7%), autumn (September, October, and November) (n=190; 27.3%), summer (June, July, and August) (n=174; 25.0%), and winter (December, January, and February) (n=132; 19.0%). Most TDI-p occurred in the months of April (n=72; 10.3%), May (n=74; 10.6%), September (n=73; 10.5%), and October (n=71; 10.2%), and the fewest number of injuries occurred in January (n=45; 6.5%) and February (n=29; 4.2%) (Fig. 2).

There were 1241 traumatised primary teeth among the 696 children. The number of traumatised primary teeth per child ranged from 01 to 07 teeth, with an average of 1.8 ± 0.9 teeth. A total of 322 (46.3%) children had TDI-p on a single tooth, 266 (38.2%) had on two teeth, 51 (7.3%) had on three teeth, and 53 (7.6%) had on four teeth, and only 04 (0.6%) had TDI-p. The most frequently affected primary teeth were the maxillary central incisors (n=936; 75.4%), followed by maxillary lateral incisors (n=198; 16.0%) and mandibular central incisors (n=65; 5.2%). It was 15 times higher in the maxillary than in the mandible, while the left and right sides were equally likely to be injured (Fig. 3).

Of all injured 1,241 primary teeth, 1,125 (90.7%) were suffered by single type of trauma, and combined traumas were found in 116 teeth (9.3%). 428 (34.5%) teeth had varying degrees of hard dental tissue injuries, 697 (56.2%) teeth appeared as periodontal tissue injuries. Moreover, 07 children and 45 children had not only teeth injuries but also supported bone tissue injuries and soft tissue injuries, respectively. Among the single type of traumas, the most common hard dental tissue injuries to the primary teeth were root fracture (n=150; 13.3%) and complicated crown-root fracture (n=115; 10.2%), while concussion (n=194; 17.2%) and subluxation (n=148; 13.2%) were commonly observed in periodontal tissue injuries (Fig. 4). Among the combined traumas, 41 (3.3%) primary teeth showed concussion combined with enamel dentin fracture, and 27 (2.2%) were subluxated combined with enamel dentin fracture (Table 1).

A total of 673 (96.7%) children had TDI-p only once, whereas 23 (3.3%) children had suffered from TDI-p twice. The shortest interval between the first and second TDI-p was 3 days, and the longest interval was 14 months.

The time elapsed between TDI-p and sought treatment ranging from 20 minutes to 6 months. Only 192 (27.6%) children had access to medical care within 24 hours; of these, 38 (5.5%) children received treatment within 2 hours or less. The majority of children (n=401; 57.6%) received treatment within 01 to 7 days after TDI-p (Fig. 5). The Kruskal-Wallis rank- sum

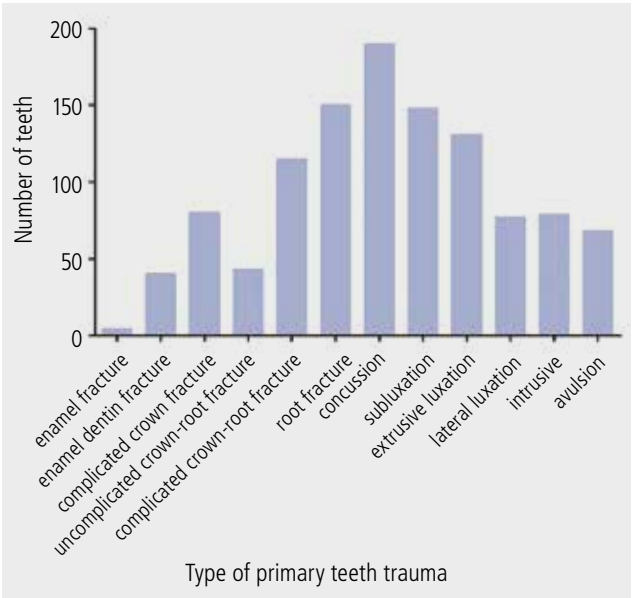
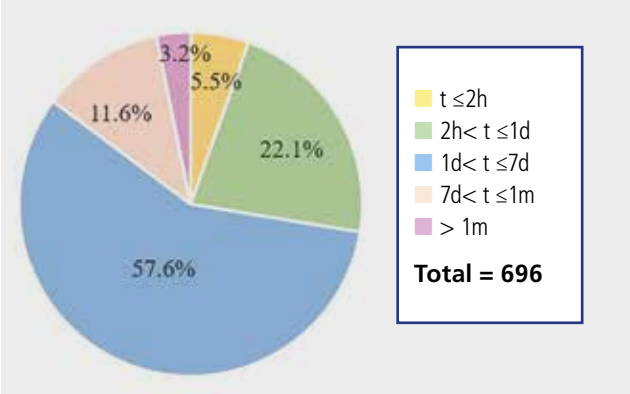
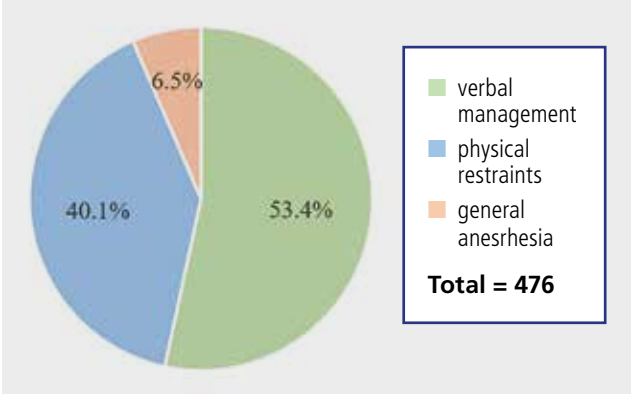


FIG. 4 The distribution of type of primary teeth trauma (n = 1124).

FIG. 5 The time elapsed between traumatic dental injuries of primary dentition (TDI-p) and sought treatment. FIG. 6 Behaviour management of treated children with primary teeth trauma.





Treatment procedure	Number of teeth	% of Total
Observation	528	42.5%
Extraction	366	29.5%
Pulpectomy	146	11.8%
Repositioning and splint	159	12.8%
Only extract the fragment	40	3.2%
Extract the fragment+ Pulpectomy	22	1.8%
Pulpotomy	12	1.0%
Indirect pulp capping	10	0.8%
Restoration	12	1.0%
Polish the sharp edges	5	0.4%

TABLE 2 Initial treatment of primary teeth trauma.

test showed the time elapsed between TDI-p and sought treatment was related to the age of the child (H=18.742, P <0.01) and the number of traumatised teeth (H=26.853, P <0.001). That is to say, the younger the child or the more teeth are traumatised, the shorter the time elapsed between TDI-p and seeking treatment.

Treatment depends mainly on diagnosis. Observation was the most prevalent treatment for TDI-p (n=528; 42.5%), followed by tooth extraction (n=366; 29.5%). In contrast, pulpotomy (n=12; 1.0%), restoration (n=12; 1.0%), indirect pulp capping (n=10; 0.8%), and sharp edges polishing (n=5; 0.4%) were at much lower percentages. A tooth may receive more than one treatment procedure (Table 2).

In addition to the observed cases, 476 children received at least one treatment procedure. Among them, 254 (53.4%) children could cooperate with the treatment in the outpatient clinic with verbal management. A total of 191 (40.1%) children received treatment under physical restraints and 31 (6.5%) children were treated under general anaesthesia (Fig. 6).

Most parents (n=656, 94.3%) accepted the treatment plan formulated by dentists. Among the 528 traumatised primary teeth of the 295 children treated as "observation", 91 (17.2%) teeth out of 40 (13.6%) were children whose guardians did not accept treatment (such as tooth extraction, repositioning, and splint), or the means of behavioral management (like physical restraints and general anaesthesia), therefore only "observation" measures could be taken.

Discussion and conclusion

In the current study, we retrospectively evaluated the epidemiological characteristics and treatments of TDI-p in a specialised stomatology hospital in Xi'an, China. Previous studies that focused mostly on permanent teeth showed higher incidences of TDIs in males because males prefer more violent sports or activities than females [Lam, 2016]. In terms of TDI-p, we found a male-to-female ratio of 1.7:1, which is in accordance with the results of studies conducted in other countries or regions [Skaare and Jacobsen, 2005;Choi et al., 2010].

Permanent TDIs occur frequently in children aged 9 to 10 years, at the age when they spend most of their daily time in school [Alhaddad et al., 2019].

In the present study, we found that the peak period of TDI-p was 02–03 years. Children aged 02 to 03 years can walk independently and the attention of caregivers to these children may decrease. In China, many children are accompanied by grandparents before kindergarten. The relatively slow action of grandparents is also a possible reason for the high rates of TDI-p during that period. Interestingly, it might precisely be the reason for the relatively low recurrence rate of TDI-p in China. Compared with the results of de Amorim Lde et al. [2011] and de Paula Barros et al. [2019], the recurrence of TDI-p was 16.9% and 26.3%, respectively, which were much higher than the 3.3% we indicated. It might be that the children's first trauma attracted the attention of guardians and enhanced their awareness of preventing re-trauma. Another possible reason might be the observation time. In theory, the longer the observation time, the higher the recurrence rate of TDI-p can be collected. Thus, in our subsequent study, we will continue to focus on TDI-p.

The occurrence of TDIs shows seasonal fluctuations. A study in Turkey found that TDIs occurred more often in the summer [Altun et al., 2009]. A study in South Korea reported that TDI-p occurred more often in late spring [Choi et al., 2010], and a study in Brazil reported that the occurrence of TDI-p is similar in the four seasons but slightly higher in spring and summer [de Amorim Lde et al., 2011]. These mild differences were related to cultures, educational patterns, and geographical climate. For example, the one-child policy that China has implemented for many years and recently abolished may cause the overprotection of children. In the cold winter, many young children were prohibited from skiing, skating, and outdoor activities that parents considered relatively dangerous. In contrast, the climate is pleasant in spring and autumn, and more outdoor activities may lead to an increase in TDI-p.

Sometimes, TDIs involve a single tooth, and multiple tooth injuries may occur during accidents, sports, and other severe traumas. Our study found that the proportion of single teeth involved in TDI-p was 46.3%, which was lower than that of permanent teeth [Zaleckienė et al., 2020]. Children with TDI-p are very young and have insufficient self-protection, which may worsen the outcome of the trauma. Due to the high elasticity of the alveolar bone and the short root of primary teeth, periodontal tissue injuries occur more frequently than dental hard tissue injuries in TDI-p, which is consistent with previous studies [de Paula Barros et al., 2019;Ng et al., 2020]. However, we found that root fracture is the most common type of hard tissue injury, rather than enamel fracture, as shown by other studies [Choi et al., 2010; Djemal and Singh, 2016]. There might be three reasons: (1) in this study, only the data from

one hospital was collected but not a general investigation or random sample; therefore, selection bias may have existed. This is also one of the limitations of this study; (2) nowadays, the guardians pay more attention to the dental trauma in children. Some guardians not only focus on the integrity of primary teeth after trauma, but also on tooth looseness and displacement, which helps in spotting root fractures; (3) the popularity of imaging examination has also increased the detection rate of root fractures. In China, more guardians would accept the imaging examination for children after dental trauma. Root fractures of primary teeth often occur in the middle or apical 1/3 of the root [Day et al., 2020]. For the apical 1/3 root fracture in primary teeth, normally with slight looseness, parents should be instructed to make child avoid chewing with the affected teeth for 2–3 weeks without other treatments. The fragment in apical fractures is often physiologically absorbed. Pulpectomy should be performed if at the follow ups at 3 and 6 month after injury there are signs or symptoms of pulp infection. For the middle root fracture in primary teeth, the extremely loose coronal fragment should be extracted, avoiding the loss of extremely loose fragment that could be accidentally aspirated by the child. If the child cooperates well and there is no severe displacement of coronal fragment, repositioning and splint for 4 weeks could be considered [Day et al., 2020]. However, the effect of this kind of treatment is not stable. For some patient, the traumatic primary teeth might be still loose after the removal of fixation, which would cause early loss of the traumatic primary teeth [Cho et al., 2018]. Additionally, we observed that 9.3% of injured teeth showed combined traumas. The most common combined traumas were concussion or subluxation combined with enamel-dentin fracture, which is in line with the results of previous studies [de Amorim Lde et al., 2011; Mahmoodi et al., 2015].

The length of time elapsed between TDI-p and seeking treatment may affect the diagnosis, treatment solution, and prognosis of the injured tooth. Regarding the 24-hour consultation rate after TDI-p, the results in developed countries were better than those in developing countries. The 24-hour consultation rate after TDI-p was as high as 97% in Australia [Ng et al., 2020] and 62.8% in South Korea [Choi et al., 2010]. In the present study, the 24-hour consultation rate after TDI-p was only 27.6%. We found that the time elapsed between TDIs and seeking treatment depended on the child's age and the number of traumatised teeth. Another study in China indicated that the type of urban or rural residence also affects the elapsed time after injury [Zhang et al., 2014].

Compared with permanent dentition trauma, the treatment of TDI-p has its particularity. Our clinical data in the past two years show that observation and extraction were the most prevalent types of initial treatments, which was related to the type of trauma, age, and degree of cooperation among children. It is not difficult to understand that for primary teeth with slight injuries, conservative approaches are more appropriate [Cunha et al., 2007], and for severely injured primary teeth with poor prognosis, tooth extraction might be the preferred treatment option in order to reduce the adverse effects on the inherited permanent teeth [Day et al., 2020]. Of course, we should also do our best to preserve the injured primary teeth. For example, the 2007 guidelines recommended extraction for primary teeth with crown-root fractures [Flores et al., 2007], while restoration was recommended by the 2012 guidelines only if the fracture involved a small part of the cementum and the remaining stable fragment is large enough [Malmgren et al., 2012]. The latest guidelines published in 2020 showed that endodontic treatment or extraction of the entire tooth is recommended, depending on the extent of the fracture [Day et al., 2020]. Moreover, it is interesting to note that primary teeth with crown fractures were common in our investigation, yet only a few children received pulpotomy and pulp capping treatment. On the one hand, it may be the low rate of prompt consultation. On the other hand, the principle of asepsis in pulpotomy requires the cooperation of the patient, which is always a difficult task in the treatment of young children with TDI-p.

Therefore, behavioural management techniques, including pharmacologic and non-pharmacologic methods, are particularly important in the treatment of TDI-p. In the present study, 53.4% of children with TDI-p who received clinical treatment were treated with verbal management. In addition, 40.1% and 6.5% of children needed to cooperate with treatment under physical restraints and general anaesthesia, respectively. The methods of behavioural management were suggested by the dentist and finally decided by the guardians, based on different awareness and acceptance [Al Zoubi et al., 2019]. Pharmacologic behavioral management techniques are safe and effective in some TDI-p cases [Yee et al., 2020]. However, compared with non-pharmacologic behavioural management techniques, general anaesthesia is costly, and some guardians are worried about anaesthetic accidents and potential side effects [Al Zoubi et al., 2019]. It should be noted that the choice of guardians may affect the outcome of treatment or prognosis of traumatised teeth [Gong et al., 2011]. We also found that 40 children (13.6%) with TDI-p refused the initial treatment solutions. It may be that parents are worried about a series of adverse reactions during and after the treatment procedures, or cannot bear their children being restrained, anaesthetised or their tooth extracted, and so on. At the same time, it may be closely related to guardians' cognition of TDI-p and behavioral management. This reminds us of improving communication when dealing with TDI-p.

The limitations of this study must be considered. First, the study was affected by time span and research methods, the cases, and information that could be collected were limited. Second, this study only focused on the initial diagnosis and treatment but lacked follow-ups, such as the long-term success rate of various treatments, and the impact of TDI-p on the successor permanent teeth. Third, our study is a single-center study, and multi-center data will make the results more objective.

Despite the limitations of this study, it can be concluded that TDI-p has its particularities, such as type of trauma, treatment procedure, and behavioral management. More attention should be paid to TDI-p by both dentists and guardians. Most of the epidemiological characteristics of TDI-p in Xi'an are consistent with previous studies, except for a high proportion of root fractures. Tooth extraction is a common treatment for severe TDI-p, and physical restraints and general anaesthesia could be performed if necessary.

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Conflict of interest

The authors declare that they have no conflict of interest concerning this article.

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