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Dental trauma in an Australian rural centre

Raymond Lam[1], Paul Abbott[1], Christopher Lloyd[2], Carmel Lloyd[2], Estie Kruger[3], Marc Tennant[3]

[1]School of Dentistry, The University of Western Australia, Nedlands; [2]Private Dental Practice, Bunbury; [3]Centre for Rural and Remote Oral Health, The University of Western Australia, Nedlands, WA, Australia

Correspondence to: Prof. Paul V. Abbott, School of Dentistry, The University of Western Australia, 17 Monash Avenue, Nedlands, WA 6009, Australia
Tel.: 61 8 9346 7665
Fax: 61 8 9346 7666
e-mail: paul.v.abbott@uwa.edu.au

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Abstract – *Background/Aim*: There is little epidemiological research regarding dental trauma in Australia. Previous research has largely focused on specific sub-populations with data not necessarily applicable to a general rural Australian population. Studies from other countries have presented variable data and the relevance of their findings to the Australian setting is questionable. The aim of this study was to investigate the prevalence, causes and presentation of dental trauma in a large rural centre in Australia. *Materials and methods*: A retrospective analysis was performed of the dental records of 323 consecutive patients who had attended a private general dental practice in Bunbury, Western Australia following an injury to their teeth and/or mouths during the period from May 2000 to December 2005 (inclusive). Injuries were classified using the Andreasen system (1994). Data analysis was carried out using SPSS software and Chi-Square tests were performed with the level of significance set at 5%. *Results*: There were 528 teeth injured and eight patients had only soft tissue injuries. Males (68.1%) significantly outnumbered females (31.9%) and the ages ranged from 10 months to 78 years. The highest number of injuries occurred in children and adolescents, specifically the 0- to 4-year age group followed by the 5- to 9-year age and 10- to 14-year age groups. Trauma was most frequently the result of falls, accidents while playing and participating in sports activities. *Conclusions*: The maxillary central incisors were the most commonly injured teeth in both the primary and permanent dentitions. Uncomplicated crown fractures were the most common injury followed by luxations and subluxations. No significant differences in frequency were reported for the different days of the week, the different months or seasons of the year. Only one-third of the patients presented for dental treatment within 24 h of the injury while the remainder delayed seeking treatment for varying times up to 1 year.

Dental trauma is an injury to the teeth and/or oral cavity. It is usually sudden, circumstantial, unexpected, accidental and often requires emergency attention. Although dental trauma is more common among children and teenagers, it can occur in any age group and is not confined to individuals of poor health. Costs to the injured person and to the community can be substantial (1). Currently, there is a paucity of epidemiological data in the field of dental trauma in Australia and the limited information available has mainly focused on specific sub-populations (1–6). Internationally, research in dental trauma has been more substantial (7–20), but its applicability and relevance to Australia can be questioned.

The factors that influence the prevalence of dental trauma may be complex, culture specific and multifactorial. They include access and availability of dental and/or hospital treatment, the type of local work and industries, and the risk of each type of sport or recreational activity. Many factors lead to a great variation in the literature with regards to the cause, severity and prevalence of dental trauma in different locations (1–20). Existing studies regarding the incidence and causes of dental trauma have been reported from many different countries and communities with obvious biases towards their social, sporting and cultural activities as causes of dental trauma (1–20). Even within Australia, there may be significant variations between communities but this can not currently be confirmed nor quantified because of the lack of data. A better knowledge and understanding of the factors unique to this country could not only assist academic staff in preparing dental students and in developing continuing professional development curricula, but would also enable the local dental practitioners to better plan the emergency services for their community equipped with information that reflects the patterns of health at that location.

The aim of this study was to examine the pattern and characteristics of dental trauma, including the type, causes and incidence in Bunbury, a large rural centre in Western Australia. Bunbury is the second most populated location in Western Australia with a resident population of over 30 000 people and a large 'feeder' population from surrounding farming areas and smaller towns. According to the Rural, Remote and Metropolitan Classification released by the Australian Government's Department of Health and Ageing, Bunbury is considered to be a large rural centre. However, Bunbury lacks the dental facilities, both in terms of access and specialization, that are housed in the major teaching

hospitals in Perth, the capital city of Western Australia. The lack of dental facilities includes specialist endodontists, paediatric dentists, oral and maxillofacial surgeons and specific after-hours emergency clinics. Hence, the onus of managing dental trauma in Bunbury falls primarily on private general dentists within the town.

Materials and methods

A retrospective analysis of dental records from a private general dental practice in Bunbury was undertaken. These records concerned 323 consecutive patients who had suffered an injury to their teeth and/or mouths over a 66-month period from May 2000 to December 2005 (inclusive) and who had presented to the dental practice for management of their injury/injuries during this period. The patients were examined by dentists within the practice, with most of them being examined by one of the two practice principals.

Approval from the University of Western Australia's Human Research Ethics Committee was granted to examine the de-identified patient records. The data were categorized according to the patient's age and gender, the cause, type and date of the injury, the tooth injured and the time delay in seeking dental treatment.

The Andreasen classification of traumatic injuries to the teeth (21) was used and teeth were designated according to the FDI system. Data analysis was carried out using SPSS software (SPSS for Windows, version 16.0, SPSS Inc., Chicago, IL, USA). Chi-square tests were used, where appropriate, to investigate the association between the various factors relating to the causes and characteristics of dental trauma. The level of significance was set at 5% (i.e. $P < 0.05$).

Results

The age of the patients at the time of the injury ranged from 10 months to 78 years. Males significantly outnumbered females (220 males (68.1% of all patients), 103 females (31.9%), $\chi^2 = 37$, $P < 0.001$), with the male to female ratio being 2.1:1. The mean ages were 11.6 years for the females and 14.1 years for the males. Approximately, 92% of the patients were < 34 years old and the majority of injuries occurred in infants, young children and adolescents, especially the 0- to 4-, 5- to 9- and 10- to 14-year age groups (Fig. 1).

The most common injuries were uncomplicated crown fractures (31.5%), subluxations (16.4%) and lateral luxations (13.2%). When analysed according to primary or permanent dentition, a similar result was obtained with uncomplicated crown fractures, subluxations and lateral luxations being the most common injuries (Table 1). More injuries were sustained in the permanent dentition compared with the primary dentition by a factor of 2.3.

Overall, 528 injured teeth were managed in 323 patients (average 1.7 teeth per patient, range 1–6 teeth per patient) during the period of this study. Of these, 159 (30.2%) were primary teeth and 368 (69.8%) were permanent teeth. Most patients presented with one (55.3%) or two (24.3%) injured teeth with 3 (9.3%), 4 (5.1%), 5 (2.3%) and 6 (0.3%) teeth being much less frequent. No statistical difference was observed between gender and the number of injured teeth ($\chi^2 = 70$, $P > 0.07$).

The date on which the injury occurred was analysed according to the day of the week, the month of the year and the season. Accidents on the days leading up to and immediately after the weekend (Thursdays, 16%; Fridays, 20%; Mondays, 17%) were slightly more common than on other days of the week (ranged from 9% on Sundays to 14% on Wednesdays) but the differences were not significant ($P > 0.7$). Similarly, when grouped into months, February and August recorded the highest frequencies but there were no significant differences between all the months (range 6–11%). There were also no significant differences between the number of injuries in each of the four seasons of the year ($P = 0.2$) and no statistical difference between gender and the incidence of trauma by seasons ($P > 0.07$).

There were statistically significant differences in the causes of injuries between the primary and permanent dentitions (Fig. 2). Falls accounted for over half of the injuries in the primary dentition followed by accidents while playing. However, in the permanent dentition there was a greater range of causes with sports and accidents while playing predominating. A significant association was noted between age and the cause of the injury

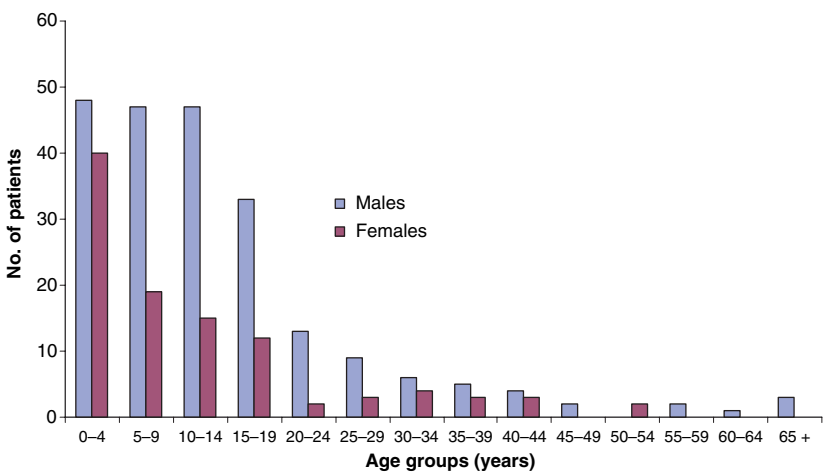

Fig. 1. Distribution of the patients according to age and gender.

Table 1. Frequency of dental injury according to the type of dentition

	Primary dentition		Permanent dentition		All teeth	
Injury type	*n*	%	*n*	%	*n*	%
UC/R#	0	0	2	0.5	2	0.2
RESTN	3	1.9	9	2.4	12	2.3
ROOT#	3	1.9	13	3.5	16	3.0
CC/R#	7	4.4	17	4.6	24	4.6
CC#	2	1.3	26	7.1	28	5.3
UCC#	18	11.3	151	41.0	169	32.0
INT LUX	18	11.3	3	0.8	21	4.0
CONC	5	3.1	25	6.8	30	5.7
AVULSION	13	8.1	19	5.2	32	6.1
EXT LUX	18	11.3	17	4.6	35	6.6
LAT LUX	36	22.5	35	9.5	71	13.5
SUBLUX	37	23.1	51	13.9	88	16.7
Total	160	100	368	100	528	100

UC/R#, Uncomplicated crown:root fracture; RESTN, Restoration fracture; ROOT#, Root fracture; CC/R#, Complicated crown:root fracture; CC#, Complicated crown fracture; UCC#, Uncomplicated crown fracture; INT LUX, Intrusive Luxation; CONC, Concussion; AVULSION, Avulsion; EXT LUX, Extrusive Luxation; LAT LUX, Lateral Luxation; SUBLUX, Subluxation.

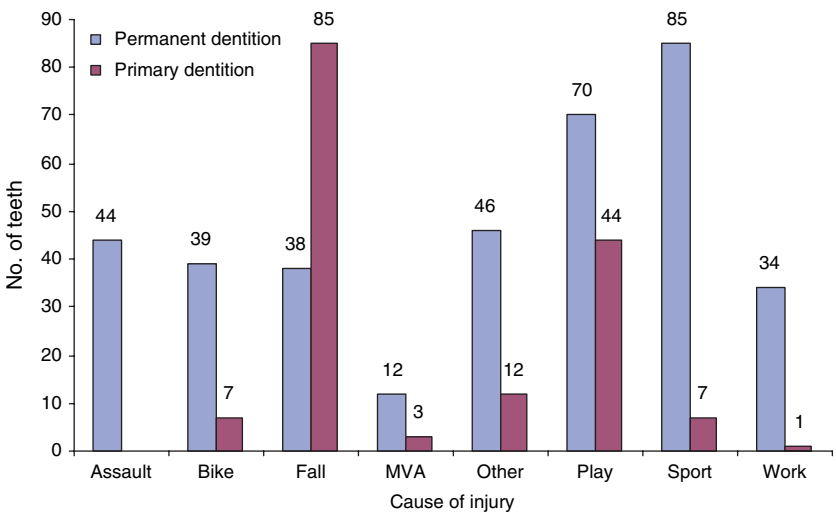

Fig. 2. The causes of injury in the primary and permanent dentitions. (MVA, Motor vehicle accident).

($P < 0.001$). In the 0-to 4-year age group, the predominant causes of dental trauma were falls (65%) and accidents while playing (18%). In the 5- to 9-year age group, falls and accidents while playing predominated, but the number of falls reduced (18%) and accidents while playing increased (52%). Sporting injures were first recorded in this group, representing 10% of the injuries. The number of injuries resulting from falls decreased as age increased and simultaneously, the number of accidents while playing and during sporting activities increased to a maximum in the 20- to 24-year age group. Sporting injuries were the most common injuries in the 15- to 19-year group (42%) and in the 25- to 29-year group (27%). Injuries from assaults had their highest frequencies in the 20-to 24-year age groups (25%) and 25- to 29-year (27%) age groups. Overall, the most common activities at the time of the accident were falls (24%), playing (21%), and participating in sport (18%). These activities collectively accounted for 63% of all injuries. Males outnumbered females in all categories of cause except feinting, accidents, and leisure activities (Table 2). A fall was the most common cause of injuries for females (36.9%) while playing was the most common cause in males (23.6%).

Table 2. Cause of dental trauma according to gender

	Gender		
	Male *n* (%)	Female *n* (%)	Total *n* (%)
Assault	19 (8.6)	3 (2.9)	22 (6.8)
Bike	18 (8.2)	7 (6.8)	25 (7.7)
Fall	45 (20.5)	38 (36.9)	83 (25.7)
Motor vehicle accident	5 (2.3)	2 (1.9)	7 (2.2)
Other	23 (10.4)	18 (17.5)	41 (12.7)
Play	52 (23.6)	22 (21.4)	74 (22.9)
Sport	42 (19.1)	9 (8.7)	51 (15.8)
Work	16 (7.3)	4 (3.9)	20 (6.2)
Total	220 (68.1)	103 (31.9)	323 (100)

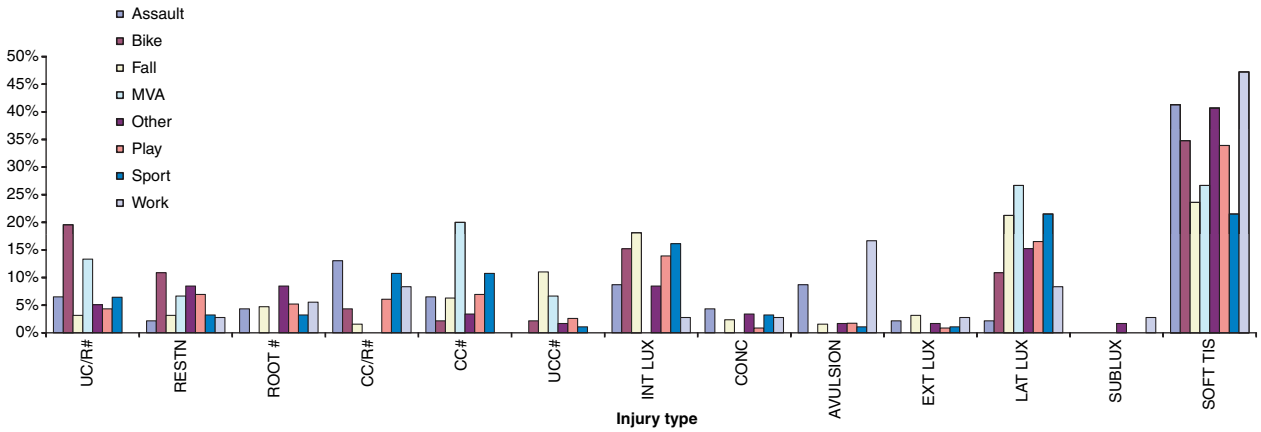

Fig. 3. Cause of injury according to the type of injury. (UC/R#, Uncomplicated crown:root fracture; RESTN, Restoration fracture; ROOT #, Root fracture; CC/R# Complicated crown:root fracture; CC# Complicated crown fracture; UCC#, Uncomplicated crown fracture; INT LUX, Intrusive Luxation; CONC, Concussion; AVULSION, Avulsion; EXT LUX, Extrusive Luxation; LAT LUX, Lateral Luxation; SUBLUX, Subluxation; SOFT TIS, Soft tissue injury only).

There were 116 soft tissue injures; 108 of these occurred concurrently with other injuries and the other eight cases only had injuries to the soft tissues.

Figure 3 shows the association between the causes of injuries and the resultant injuries to the teeth and soft tissues. The most frequently injured teeth were the maxillary central incisors in both the primary and permanent dentition. In the primary dentition, the three most commonly injured teeth were the maxillary central incisors (74.2%), maxillary lateral incisors (15.7%) and maxillary canines (3.1%). Similarly, in the permanent dentition, the most commonly injured teeth were the maxillary central incisors (62.8%), followed by maxillary lateral incisors (18.5%), mandibular central incisors (9.7%) and mandibular lateral incisors (4.6%). Collectively, maxillary central incisors accounted for 66.2% of all teeth injured. Table 3 shows the proportion of traumatized teeth by gender and tooth type.

Injury to the anterior teeth significantly outnumbered injury to the posterior teeth in all categories – male, female and total sample ($P < 0.001$). The majority of the injured teeth were in the maxillary arch (461 teeth,

Table 3. Injured tooth types according to gender and dentition

	Gender				
	Males		Females		
Tooth	*n* (%)	Total %	*n* (%)	Total %	Total *n* (%)
Permanent maxillary teeth					
Central incisor	164 (43.5)	31.1	67 (44.7)	12.7	231 (43.8)
Lateral incisor	51 (13.5)	9.7	17 (11.3)	3.2	68 (12.9)
Canine	2 (0.5)	0.4	3 (2.0)	0.6	5 (0.9)
First premolar	0 (0)	0	3 (2.0)	0.6	3 (0.6)
Second premolar	0 (0)	0	2 (1.3)	0.4	2 (0.4)
First molar	1 (0.3)	0.2	0 (0)	0	1 (0.2)
Permanent mandibular teeth					
Central incisor	34 (9.0)	6.5	2 (1.3)	0.4	36 (6.8)
Lateral incisor	16 (4.2)	3.0	1 (0.7)	0.2	17 (3.2)
Canine	2 (0.5)	0.4	0 (0)	0	2 (0.4)
Second premolar	0 (0)	0	1 (0.7)	0.2	1 (0.2)
Second molar	2 (0.5)	0.4	0 (0)	0	2 (0.4)
Primary maxillary teeth					
Central incisor	78 (20.7)	14.8	40 (26.7)	7.6	118 (22.4)
Lateral incisor	15 (4.0)	2.8	10 (6.7)	1.9	25 (4.7)
Canine	4 (1.1)	0.8	1 (0.7)	0.2	5 (0.9)
First molar	2 (0.5)	0.4	0 (0)	0	2 (0.4)
Second molar	1 (0.3)	0.2	0 (0)	0	1 (0.2)
Primary mandibular teeth					
Central incisor	2 (0.5)	0.4	1 (0.7)	0.2	3 (0.6)
Lateral incisor	1 (0.3)	0.2	1 (0.7)	0.2	2 (0.4)
Canine	1 (0.3)	0.2	0 (0)	0	1 (0.2)
Second molar	1 (0.3)	0.2	1 (0.7)	0.2	2 (0.4)
Total	377 (100)	71.5	150 (100)	28.5	527 (100)

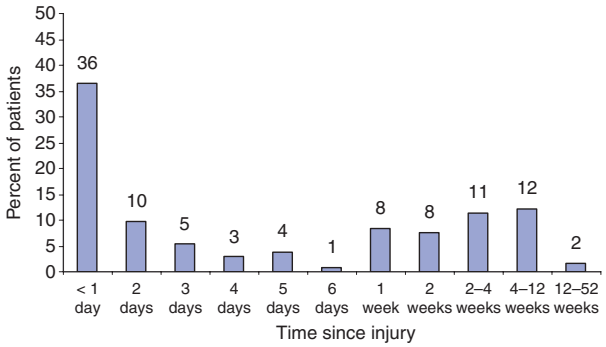

Fig. 4. Time delay between the accident and seeking dental treatment.

87.5%). Most of the injuries occurred to the anterior teeth (maxilla 452 teeth, 85.8%; mandible 61 teeth, 11.6%) with only 14 posterior teeth being damaged (maxilla nine teeth, 1.7%; mandible five teeth, 0.9%). When further subcategorized into gender, no significant changes were noted and the proportions were similar ($P < 0.001$).

The period of time that had elapsed from when the injury occurred until when the patient presented to the surgery (i.e. the time delay) was recorded for each patient (Fig. 4). These data are reliant on the individual patient's recollection of the timing of the event. Just over one-third of the patients (36%) were seen within 24 h, that is, on the same day of the accident or overnight. Approximately one-third of the patients (31%) were seen within 1 week but the remainder (33%) delayed seeking treatment for weeks, months or even up to 1 year.

Discussion

This study examined the data obtained from patients who presented to a general dental practice in Bunbury, Western Australia following an injury to their teeth and/or mouths. There was no data available concerning those patients who did not present to this particular practice or those who did not seek any dental treatment at all. The details of the injuries, such as the time and cause, will depend on the patients' (or their parents') recollections of the events and consequently the accuracy will often depend on factors such as the severity of the condition, the time from the injury to treatment and the patient's maturity, especially when children are concerned. Despite these limitations, this study is likely to reflect the prevalence and pattern of dental trauma in Bunbury. The particular dental practice that participated in this study has an affiliation with the regional hospital where patients presenting to its emergency department with dental trauma are given contact details for the practice after triage assessment and medical treatment if required. Other patients in this study may have come from the practice's regular pool of patients, by referral from existing patients, or they may have accessed the practice via its after-hours emergency contact telephone service.

The number of males in this study significantly outnumbered females which is consistent with many Australian (2–6) and international studies (8, 10, 12–16). The predominance of males to females in this study (2.1:1) is within the range of many other studies, which have reported ratios ranging from 1.3 to 3.3:1.0 (2–11, 17–19, 22). Many factors may influence the male:female ratio such as the social, cultural, geographical and sporting characteristics of the cohort of patients. The ratio will also be dependent on the time and field of analysis, for example, Liew and Daly (4) focused on anterior teeth requiring after-hours treatment in Sydney, Australia and recorded a high male:female ratio of 2.6:1 and a high incidence of 18- to 23-year old males compared with other Australian studies (1, 22). More men in this age group participate in sport and night time social activities which appeared to result in more injuries because of assaults (4). Many studies also support the premise that more men than women usually engage in sports that are more aggressive in nature (4–6, 10). In contrast, Grimm et al. (9) analysed injuries among schoolchildren in Brazil and reported a male:female ratio of 1.58:1. The younger cohort of subjects, the different culture and the different geographical location in this latter study are likely to reflect the different activities and sports in which the children participate and all of these factors contribute to the different gender balance reported. The current study encompasses a range of patients over an extended time period and is believed to be representative of the entire local population.

In this study, the age of patients suffering trauma ranged from 10 months to 78 years. Comparisons of age group characteristics between studies are difficult to perform because of the diversity of age groupings used by the various researchers. In this study, the highest frequency of trauma occurred in the 0- to 4-year age group followed by the 5- to 9- and 10- to 14-year groups. Although the 5- to 9-year age group was prominent, other Australian studies have reported higher frequencies in the 6- to 11-year age group (1, 3, 22). The differences may be explained by a combination of factors including local characteristics, study methodology, time and source of data. The State's School Dental Service may have been an alternative contact for the school age child during school and clinic hours (2) rather than a private dental practice. The younger age groups (0–4 and 5–9 years) were probably well represented in this study because of the nature of the dental practice studied. The practice is known to be a family-oriented practice with a practitioner experienced and confident in dealing with the younger age groups. It is located close to several schools and the dentists are available to treat patients who are injured outside normal working hours. In addition, there is no children's hospital in Bunbury and the general hospital does not have a dental clinic. Hence, children who have had dental trauma are generally referred from the general hospital to private dental practitioners for management of any dental and oral injuries.

Differences in the reported frequencies of trauma in Australian studies may also be partly because of variations in the methodologies used in the various studies. Davis and Knott (3) conducted a study in 1984 based on survey forms sent to members of the Australian Society of Endodontology and they reported that the group most

at risk of dental trauma was primary school children aged from 6 to 12 years (3). Martin et al. (6) restricted their study to patients who presented for after-hours treatment of anterior teeth in Sydney and Western Newcastle. They reported that the most frequent age groups were the 6- to 11- and 12- to 17-year groups. They acknowledged that timing was likely to have had a significant influence on the frequency of presentation for treatment for a particular age group with more severe injuries, more teeth injured and predominantly older aged groups presenting for treatment after hours than during normal working hours (6). A more recent study by Wood and Freer (22) in south east Queensland in 1998 found the highest frequency of trauma occurred in the 6- to 10 year age group.

There may be some subjectivity and variations associated with assessing and classifying the causes of injuries. There is no standard classification of the causes of dental and oral injuries and therefore reports will depend on the individual clinician who records the incident and such descriptions may be interchangeable among different clinicians. In this study, an attempt was made to use a classification that was simple and that could be related to other studies. Unusual or uncommon causes were grouped as 'other' in order to simplify the results.

The most common causes of trauma in this study were playing, falls and sports. This is consistent with almost all literature reviewed. It is interesting to note the significant differences between the causes of injury between the primary and permanent dentitions which has not been previously reported. The high number of dental injuries arising from accidents with bicycles was also noted in this study.

Seasonal differences have been reported to be significant in some studies (17, 21, 23–25) but with varying effects which may be related to the geographical location and the type of sports or other activities that are common in each location. One study reported more injuries in winter (21), others have reported increased frequencies in summer (23–25) while another study from Brazil (17) reported more injuries in the months of October (spring) and March (summer). The study by Wood and Freer (22) in Queensland, Australia reported more trauma occurred from July (winter) to October (spring) but the current study showed no statistically significant differences between the seasons, although slightly more injuries occurred in February (summer) and August (winter). These months were closely followed by March (autumn) and October (spring).

The association between age and the cause of dental trauma can be explained by the typical age-related activities and the physical abilities of those in each age group. In this study, the predominant causes of dental trauma among the 0- to 4-year age group were falls (65%) and accidents while playing (18%). This may be because the reflexes and motor co-ordination are still developing in this age group. It is typical for children in this age group to sit up, crawl and stagger before being able to maintain a 'fully controlled walk'. Falls and accidents while playing were still prominent in the 5- to 9-year age group but when compared with the 0- to 4-year age group, the number of injuries caused by falls had markedly reduced (to 16%) and accidents while playing had increased considerably (to 52%). The number of injuries resulting from falls generally decreased as age increased, and simultaneously, accidents while playing and caused by sporting injuries increased with a peak in the 20- to 24- and 25- to 29-year age groups. Sporting injures were first recorded in the 5- to 9-year age group (10% of the injuries in this group) and were highest in the 15- to 19-year group (42%). Injuries resulting from assaults were highest in the 20- to 24 (25%)- and 25- to 29 (27%)-year age groups – this finding is likely to be related to activities with high risk of trauma such as drinking and socializing that are more common in these age groups.

Uncomplicated crown fractures were the most common type of injury in this study (31.5%). This is in agreement with many studies (2-4, 18,-19, 22) but differs from some other studies (6, 8, 17). Luxations and subluxations were also common.

In this study, trauma most commonly affected the maxillary central incisors, a result similar to many other national (2, 4–6, 22) and international studies (8–11, 26). This is to be expected because maxillary central incisors are the most protrusive teeth and therefore they are more likely to be struck by an object or they may hit the ground first when the victim accidentally falls over. Permanent maxillary central incisors are also the first teeth to erupt, usually at around 5–6 years of age which means that they will be present when the child begins to play sport and participate in playground activities at school.

The number of patients presenting to the private dental practice in this study with injuries sustained in motor vehicle accidents was low (2.2%). This is likely to be because patients in this group probably presented to the local hospital's emergency department with more serious concurrent body injuries in which case they would either be admitted to the hospital and therefore be unable to seek private dental treatment, or alternatively, they may have been transferred to a major teaching hospital in the capital city of Perth if the injuries were severe.

There was a wide range of time delays for patients to seek dental treatment following their injury but the reasons for their delayed presentations were not recorded. Only one-third of the patients presented within 24 h while another third presented within a week. The others took varying periods of time to seek treatment ranging from 2 weeks to one year. This type of data has not often been reported in previous studies so it is interesting to speculate as to why many patients delayed seeking help for long periods of time after their injury had occurred. There may be many reasons for these delays such as patients may have been waiting for long periods for assessment or medical treatment at the local hospital; they may not have been aware of the availability of an after-hours service; they may not have had any pain or other symptoms; or they may have given low priority to their dental injuries. Some delays may be attributed to the unavailability of the dentists because of sickness, holidays, travel or other commitments.

The type or level of prevention undertaken by each patient (e.g. mouthguards, seatbelts, protective gear, oral health promotion, etc) was not recorded in the patient

records that were analysed in this study. Including a question about hobbies and/or sporting activities in the patient's medical/dental questionnaire may alert dentists to the need to advise some patients about the risks of a particular sport and the appropriate preventive action that may reduce the incidence and consequences of trauma to the teeth and mouth. In order to effectively provide this type of advice, future studies need to specifically address the major sports and activities played in the location being studied since many studies have consistently shown that the increase in dental trauma over the last decade has been attributed to greater participation in sporting activities (20, 27, 28).

Future studies could also analyse the treatment provided, the number of appointments and the prognosis of the treatment in order to provide more information about the effects of trauma and its management. More local studies are needed to enhance the understanding of the epidemiology of dental trauma in Australia. Knowledge of the common types of injuries that occur in a community would allow the dentists in that area to better manage their practice for the provision of emergency services. This should include educating patients about the need to seek immediate dental treatment for any oral and dental injuries in order to reduce the long-term consequences of the injuries.

Conclusions

Males presented with dental injuries more than females and most injuries occurred in children and adolescents. The most frequent cause of injures were falls, accidents while playing and while participating in sport. The most commonly injured tooth was the maxillary central incisor in both the primary and permanent dentitions. Uncomplicated crown fractures were the most common injury although luxations and subluxations were also common. The frequency of trauma was not affected by the day of the week, the month or season of the year. Many patients delayed seeking dental treatment for their injuries.

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Conflict of interest

The authors declare that they have no conflict of interest with respect to the submitted work. None of the authors have had any institutional, private or corporate financial support for the work within the manuscript apart from that listed above.

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