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Traumatic orodental injuries and the development of an orodental injury surveillance system: a pilot study in Victoria, Australia

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Abstract – Traumatic orodental injuries are common dental public health problems that have complex aetiology and significant impact on those affected. It is important to understand the frequency, pattern and causes of traumatic orodental injuries so that appropriate and effective treatment services are made available and injury prevention interventions are designed and implemented. The aims of this study were to measure the frequency, causes and patterns of traumatic orodental injuries in patients of all ages treated at the Royal Dental Hospital of Melbourne in Victoria, Australia, over a 12-month period and to investigate the feasibility of establishing an orodental injury surveillance system. For which, a retrospective audit of 304 patient records was undertaken and injury surveillance data were extracted and analysed. Males represented 67% of cases. Three-quarters of all cases were aged less than 24 years. The most frequent cause of orodental injury was falls from less than 1 m or being struck by or colliding with a person or object. Injuries occurred most commonly around the home, on the road, street or footpath, the sports ground and places for recreation and were most often associated with leisure and sports activities. Orodental injuries sustained in one traumatic incident were often multiple and serious. Many severe orodental trauma injury cases present at this public dental hospital are expensive to treat, require long-term management and may be preventable. The findings from this study have led to the development and planned implementation of an enhanced electronic orodental injury structured history form that incorporates the collection of key injury surveillance data. These prospective data are to be combined with injury surveillance data that are routinely collected by all Victorian public hospital emergency departments in order to improve understanding of the nature of orodental injuries impacting Victorian communities and assist with appropriate service planning and the design of orodental injury prevention interventions.

Traumatic orodental injuries are common dental public health problems that have complex aetiology and significant impact on those affected. They can be painful, distressing, disfiguring, permanent and expensive to treat, and often require long-term management (1, 2). It is important to understand the frequency, pattern and causes of traumatic orodental injuries, so that appropriate and effective treatment services are made available and injury prevention interventions can be designed and implemented.

Previous studies have reported a wide range of prevalence levels in different population groups. These differences may be partly because of methodological differences such as the definition of injury used, method of data collection, the type of dentition studied (primary or secondary), targeted age groups, geographical differences and behavioural diversity of the study groups. Some examples of orodental injury prevalence figures in children include: 10.3% of orthodontic candidates in Germany (3); 23.3% of a group of 12-year-old schoolchildren in Brazil (4); 18.9% in another 12-year-old group of schoolchildren in Brazil (5); 29.6% of 9 to 13-year-old schoolchildren in Israel (6); 14.2% of children attending a university teaching clinic in Jordan (7); and 17.4% of 10-year-old schoolchildren in a catchment area in Spain (8). A review of orodental trauma studies up to the year 2000, reported prevalence levels between 6% and 34% (9).

A consistent finding in most orodental trauma studies is that males experience more orodental trauma in the permanent dentition than females. The male:female ratio ranges from 1.6 to 3.3:1 (2, 4, 6–15). The most commonly

reported causes of traumatic orodental injuries are falls and collisions with people or objects (2, 5–9, 11–13, 15, 16). Previous research indicates that most traumatic orodental injuries occur in the home, school and on streets/roadways and in places for sport and recreation (5–7, 9, 10, 13, 14, 16), associated with leisure activities, sports and traffic incidents and assaults (2, 5, 9–11, 13, 14).

Most studies have focused on specific sub-populations such as schoolchildren, children attending hospital emergency departments or within localized geographical areas. Data have predominantly been collected retrospectively utilizing cross-sectional surveys or prospectively from hospital attendees. Retrospective studies are weakened by the effect of recall bias, that is, a subject may not be able to accurately recall the time, place, cause and nature of the injury sustained, particularly if there is a delay in reporting. Prospective studies avoid recall bias by collecting data as the trauma events occur. An effective method of systematically collecting injury data is to utilize injury surveillance systems (17).

Currently there is no international orodental injury data collection standard or tool that enables prospective and timely surveillance (18). An optimal injury surveillance system should collect the minimum data that are required to establish the nature of injury, time and location where injury occurred, cause and mechanism of injury, activity being undertaken when injured, human intent, use of protective equipment, description of the event, diagnosis of injury and discharge status.

In Australia, the Victorian government health department (Department of Human Services) collects demographical, clinical and administrative data from 37 public hospital emergency departments (that operate 24 h/day) across Victoria and collates them into a dataset called the Victorian Emergency Minimum Dataset (VEMD). An injury surveillance data subset exists within the VEMD for collation of injury information.

However, the state's only public dental hospital, the Royal Dental Hospital of Melbourne (RDHM), is not required to contribute data to the VEMD as it does not meet the criteria of offering a 24-hour-a-day emergency service. The resultant under-reporting of orodental injuries affects the interpretation of the prevalence, patterns and causes of orodental injuries sustained by the Victorian population.

The aims of this pilot study were to measure the frequency, causes and patterns of traumatic orodental injuries in patients of all ages treated at the RDHM over a 12-month period and to investigate the feasibility of establishing an orodental injury surveillance system within the RDHM that could provide reliable data to the VEMD.

Setting

The RDHM is located in the capital city of Victoria, Melbourne and is operated by the Dental Health Services Victoria (DHSV). In addition to generalist and specialist oral health services, it provides a limited-hours emergency service/primary care unit (ES/PCU) every day of the year that is subsidized for all the people who hold a government issued healthcare card or pensioner concession card, and full fee-paying services for other members of the public.

This pilot study was undertaken as a collaborative project between Monash University Accident Research Centre and DHSV.

Materials and methods

Definition of orodental injury used: the physical damage to a structure in the oral and/or dental region of the head caused by intolerable levels of energy (Table 1).

At the time of this pilot study the computerized record system at the RDHM did not contain any form of coding that would enable trauma cases to be identified. However, when new patients attended the RDHM with traumatic injuries a specific paper-based patient file was created and recorded on a ledger system that was kept within the RDHM records department. A retrospective audit of all new patient records created, from 1 December 2004 to 30 November 2005, was performed to identify traumatic orodental injury patients.

Injury surveillance data variables: age, gender, activity when injured, description of main injury, external injury cause, nature of main injury, human intent, place where injury occurred, description of injury event and discharge status (17) were extracted and orodental injury was classified according to the World Health Organization classification system (19) (Table 2). De-identified data were entered into SPSS version 12.0 for analysis. Data extraction and analysis were undertaken by one researcher (Tham).

Ethics approvals for this pilot study were granted by DHSV and Monash University Human Research Ethics Committees.

Results

The ES/PCU record ledgers identified 304 eligible traumatic orodental injury cases among first-time patients (n = 6938) presenting for emergency treatment from 1 December 2004 to 30 November 2005. The total number of patients treated in ES/PCU in that period was 13 228.

Table 1. Orodental injury examples

Orodental injury	Possible location	Type of injury
Laceration of oral soft tissue	Lips	Laceration
	Tongue	
	Cheek	
	Hard and soft palate	
	Floor of mouth	
	Gingivae	
Dental injury	Crown: Enamel ± dentine	Crown fracture with or without pulpal involvement
	Root	Root fracture
	Periodontal ligament	Concussion
		Luxation
		Avulsion
Jaw injury	Mandible	Dislocation
	Maxilla	Fracture

Table 2. World Health Organization classification system for orodental traumatic injury (19)

Classification of orodental trauma [Includes primary(deciduous) and permanent teeth]
Fracture of enamel of tooth only (enamel chipping)
Fracture of crown without pulpal involvement
Fracture of crown with pulpal involvement
Fracture of root of tooth
Fracture of crown and root of tooth
Fracture of tooth, unspecified
Luxation of tooth
Intrusion or extrusion of tooth
Avulsion of tooth (exarticulation)
Other injuries including superficial injury (laceration) of lip and oral cavity

Patient demographics

Males represented 67.1% of orodental injury cases. Three-quarters of patients seen were aged less than 24 years (76%). The largest group was those aged 5–9 years (22%), followed by those aged 10–14 years (16.8%). Those aged 0–4 years and 15–19 years were of the same proportion (14.5%) (Fig. 1).

Cause, place of occurrence and activity and intent

A high proportion of records examined (295, 97%) contained information that described the cause of injury. The most frequent cause of orodental injury was falls from 1 m level or less (42.4%), followed by being struck by or colliding with a person (22.4%). The proportion of orodental injury presentations caused by striking or colliding with either a person or an object was 42.4% (Table 3).

Falls commonly occurred, around the home (57%), places for recreation (10%) and school and daycare centres (8%). Children aged less than 15 years of age accounted for 70% of all fall-related injuries.

Of the 68 orodental injury cases caused by striking or colliding with a person, 67.6% were intentional, that is, they were related to assaults or fights. There were 36 orodental injury cases caused by striking or colliding with an object, of which 94.4% were unintentional; they were mostly related to sports and recreational activities. Objects involved included: trampolines, balls (basketball, cricket, football, and rugby), slides, skateboards, snowboards and goal posts.

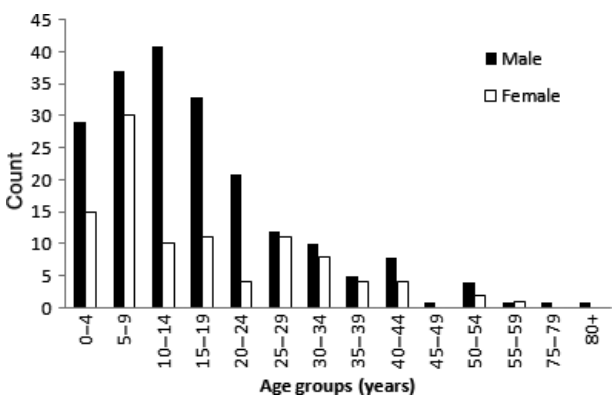

Fig. 1. Frequency of orodental injury cases by age group and gender, RDHM, 1 December 2004 to 30 November 2005 (n = 304).

Table 3. Cause, place of occurrence and activity undertaken at time of orodental injury, RDHM, 1 December 2004 – 30 November 2005

	n (%)
Cause (n = 304)	
Fall ≤ less than 1 m	129 (42.4)
Struck by or collision with person	68 (22.4)
Struck by or collision with object	36 (11.8)
Unspecified strike by collision with person or object	25 (8.2)
Pedal cyclist	19 (6.3)
Other transport	8 (2.6)
Falls > 1 m	2 (0.7)
Machinery	2 (0.7)
Motor vehicle driver	2 (0.7)
Horse, other animal related	1 (0.3)
Motor-cycle driver	1 (0.3)
Other specified	2 (0.7)
Unspecified	9 (3.0)
Place of occurrence (n = 304)	
Home	123 (40.5)
Road, street, footpath or highway	41 (13.5)
Athletics and sports areas	40 (13.2)
Place for recreation	32 (10.5)
Trade or service area	22 (7.2)
Unspecified place	22 (7.2)
School, day care, public area	13 (4.3)
Farm	4 (1.3)
Industrial/construction area	3 (1.0)
Residential institution	2 (0.7)
Other specified place	2 (0.7)
Activity (n = 304)	
Unspecified	115 (37.8)
Leisure	96 (31.6)
Sports	41 (13.5)
Vital activity: resting, eating, sleeping	33 (10.9)
Education	7 (2.3)
Working for income	7 (1.3)
Other work	5 (1.6)

The most common transport-related cause of orodental injuries was falls from bicycles on roads, in recreational areas and around the home. Three-quarters of injured persons were aged less than 25 years (74%). Only one motor cycle-related and two motor car-related injuries were recorded. Other forms of transport related to orodental injuries were scooters and skateboards, and one case involved a tractor.

Most records (280, 92%) contained information describing the location where the orodental injury occurred. The most common location of injury was the home (40.5%) followed by on the road, street, footpath or highway (13.5%) and in places of sport and recreation (13.2%) (Table 3). Within the home, orodental injuries most often occurred in the bedroom, bathroom and lounge room.

Children aged less than 15 years comprised 72% of the orodental injury cases that occurred in the home. Adults aged between 15 and 25 years accounted for half

of orodental injury cases that occurred in the sports area and 41% of injuries that occurred on roadways.

Thirty-eight per cent of records provided no information on the specific activity being undertaken at the time of injury. The majority of reported activities were leisure related (31.6%) followed by sports activities (13.5%) and vital activities (10.9%) (Table 3). The leisure activities being undertaken at the time of injury included jumping on trampolines, skateboarding, playing in playgrounds and riding bicycles. The sports most often involved were football, cricket, basketball, netball and hockey. Orodental injuries reported during vital activities included those resulting from falling off chairs, out of beds, whilst bathing, and as a result of fainting and having epileptic seizures.

The majority of injuries were unintentional (81.9%). The remaining cases were as a result of intentional assaults (16.1%) except for one case where the intent was unspecified (1.9%). A high proportion of presentations because of assault were males (87.8%) aged between 10 and 49 years. The females who presented with orodental injuries because of assault were aged between 25 and 55 years.

Only one record documented whether protective equipment, such as a mouthguard, was being worn at the time of the injury.

Orodental injuries sustained

If multiple injuries were sustained in one traumatic episode, the four most serious orodental injuries were recorded. Half of the patients (51.6%) that presented had sustained only one orodental injury, 25% had sustained two, 12.5% had sustained three and 8% had sustained four or more injuries in one traumatic episode. Over the 12-month study period a total of 529 injuries were recorded for 304 patients.

The most common orodental injury recorded was dental luxation (27%) followed by fracture of crown without pulpal involvement (22.7%), fracture of crown with pulpal involvement (20.1%) and avulsion of tooth (13.5%) (Table 4). Of the 167 dental luxation injuries, only seven injuries (4.2%) were recorded as subluxations, the remainder were lateral luxations.

Young people, aged less than 19 years, reported the highest frequencies of crown fractures with or without pulpal involvement (16.1% and 14.8% respectively) and dental luxation (18.4%). Avulsion injury frequency was highest in children aged less than 4 years, forming 26.8% of orodental injuries in this age group.

The RDHM examined and treated the majority of these traumatic orodental injury patients; however four children aged less than 2 years were referred to the Royal Children's Hospital for treatment of complex orodental injuries, such as complicated crown fractures, avulsions, crown/root fractures and lateral luxations.

Table 4. Types of orodental injuries sustained, RDHM, 1 December 2004 – 30 November 2005

Orodental injuries (n = 529)	n (%)
Dental luxation	167 (31.6)
Fracture of crown without pulp involvement	119 (22.5)
Fracture of crown with pulp involvement	79 (14.9)
Avulsion	59 (11.2)
Enamel fracture	40 (7.6)
Soft tissue laceration	29 (5.5)
Intrusion or extrusion	21 (4.0)
Fracture of crown and root	8 (1.5)
Root fracture	7 (1.3)

Discussion

This pilot study found that the major cause for orodental injuries was falls from height at or less than 1 m followed by being struck by or colliding with a person or object which is a consistent finding with previous studies on the aetiology of orodental injuries (2, 5–13, 15, 16). Also consistent with previous studies, the home was the most common location where these injuries were sustained (2, 6, 7, 13, 16). It is more difficult to identify the next most common locations of orodental injury reported in the literature because previous studies used different classification systems. Other findings consistent with this study were that most orodental injuries were unintentional and that males were disproportionately more likely to have an orodental injury than females, in all age groups, especially in the 10- to 24-year-olds (4, 9–13, 20).

The most common activities being undertaken at the time of the orodental injury in this study were recreational and sports activities, in agreement with previous studies (2, 5, 6, 10, 14). However, more than one-third of patient records examined lacked any information in relation to this variable. This study noted that the structured history form that was completed by RDHM clinicians lacked questions on the type of activity being undertaken at the time of injury and this information was derived from the brief descriptive narrative of the injury event. It is important for surveillance data to be collected at the time of examination as missing information impacts the ability to identify potential risk factors for orodental injury and develop appropriate intervention or injury prevention programmes.

This study found that those aged less than 19 years sustained the highest number and the most serious orodental injuries: avulsion, fracture of crown with or without pulpal involvement and luxations. Most of these injuries were sustained during leisure and sports activities undertaken around the home, on the street and in sports and recreation areas.

The RDHM treated at least 304 new orodental injury cases in 2005. This was an underestimation of the total number of orodental injury cases because at the time of the pilot study there was no way of identifying traumatic injury cases in the RDHM electronic patient data system. The hand-written daily ledger only identified traumatic orodental injury cases if the patient was presenting to RDHM for the first time, so return patients with orodental injuries were not able to be identified. It was impossible, therefore, to determine any differences (demographic and injury related characteristics) that may have existed between first-time patients presenting with injuries and return patients.

The limitations of examining a small sample of patient records with incomplete descriptions of the injury events that led to the orodental injury meant that no firm recommendations can be made in relation to population-based prevention strategies or interventions. Enhanced orodental injury surveillance, in particular the recording of informative free text data detailing the circumstances of the injury, would provide essential information to inform the development and targeting of population-based prevention initiatives.

The high-level severity of many orodental injury cases presenting to RDHM requires a service that is responsive, appropriately skilled and able to provide follow-up care for eligible clients. In the case of ineligible clients, appropriate discharge planning and advice needs to be given to improve the prognosis of the orodental injury. The findings from this study have led to the development and planned implementation of an enhanced electronic structured history form for orodental injuries (Fig. 2) that includes the collection of orodental injury surveillance data (Figs 3–7 demonstrate the drop-down menus), that is to be completed by all RDHM clinicians treating orodental injury cases at the time of entering their clinical notes into the electronic patient record. The aim of this comprehensive form is to improve the quality of orodental injury treatment records, treatment services, referral and ongoing management (21). As many of the demographic variables are routinely collected, six additional injury surveillance variables are required: cause of injury (Fig. 3), activity (Fig. 4), products involved (Fig. 5), place of injury (Fig. 6), intent (Fig. 7) and a brief text narrative describing the mechanism and circumstances of the injury. The RDHM will contribute these standardized orodental injury surveillance data

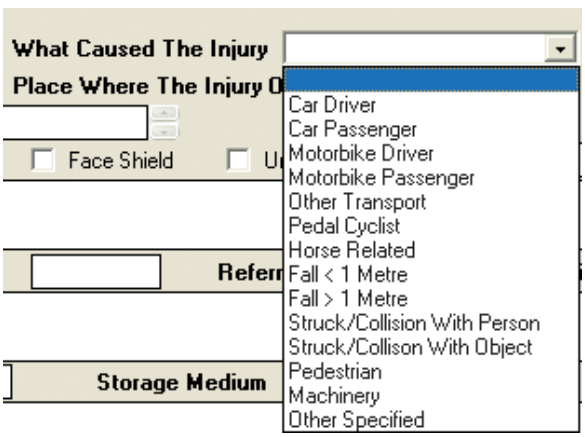

Fig. 3. Injury surveillance data variable – cause of injury.

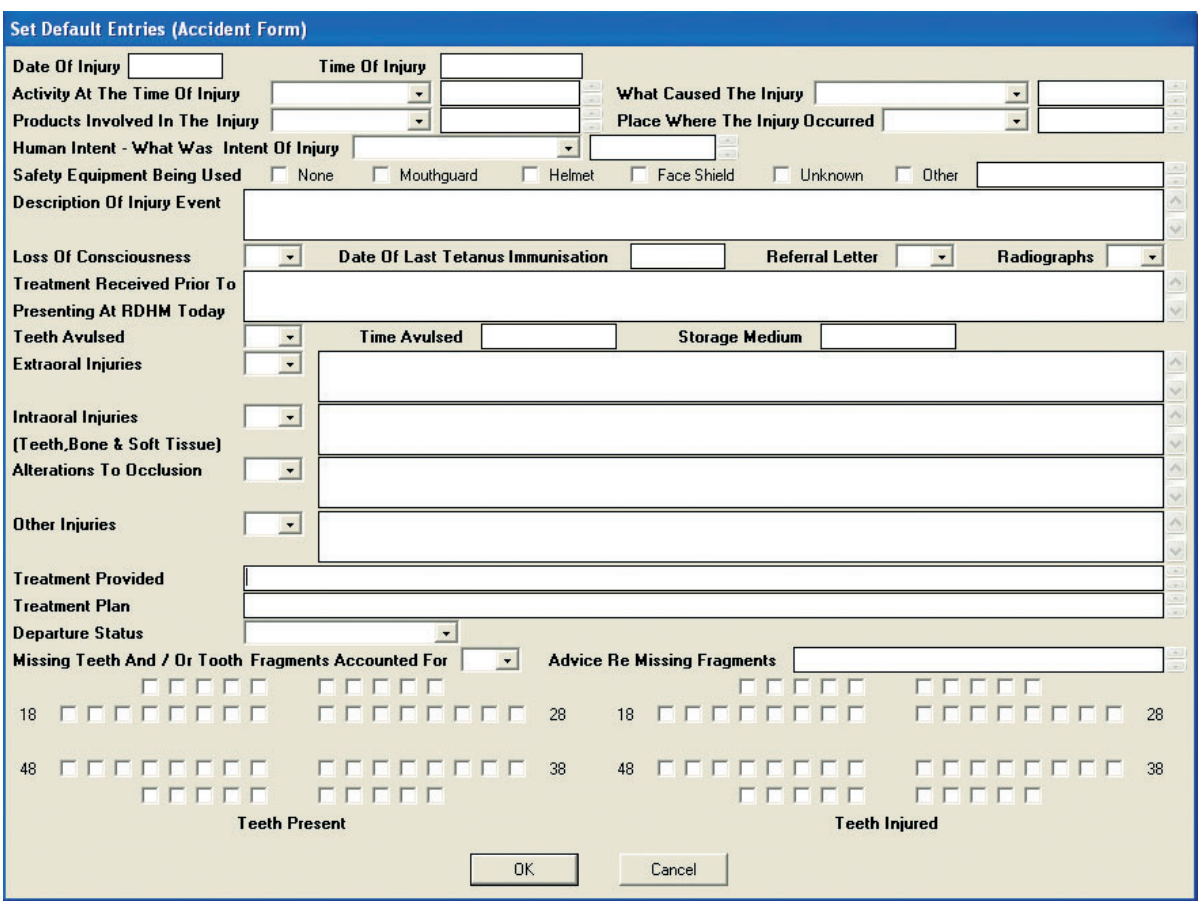

Fig. 2. Electronic structured history form for orodental injuries, RDHM.

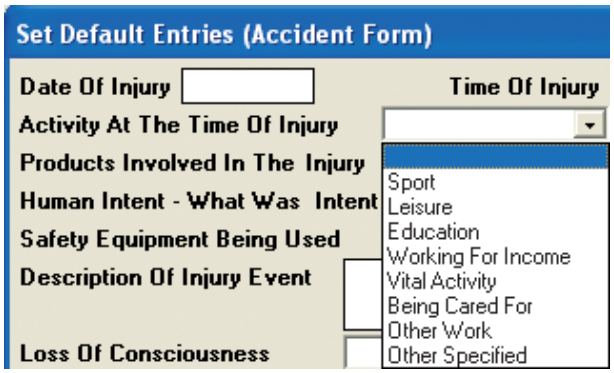

Fig. 4. Injury surveillance data variable – activity at time of injury.

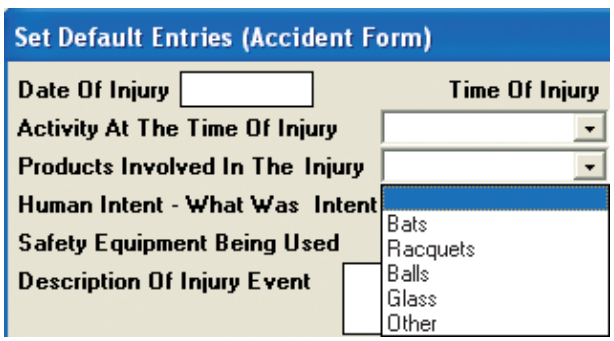

Fig. 5. Injury surveillance data variable – products involved in injury.

directly to the VEMD and the RDHM orodental injury surveillance system will be monitored and evaluated with the aim of contributing towards the further development and implementation of standardized orodental injury surveillance systems.

Conclusion

Many orodental injuries are serious and require expensive and long-term management, but currently it is not possible to accurately measure the financial, psychological and physical costs of orodental injury in Victoria as systematic and consistent data collections of orodental injuries are lacking. Currently it is also not possible to develop population-based orodental injury prevention

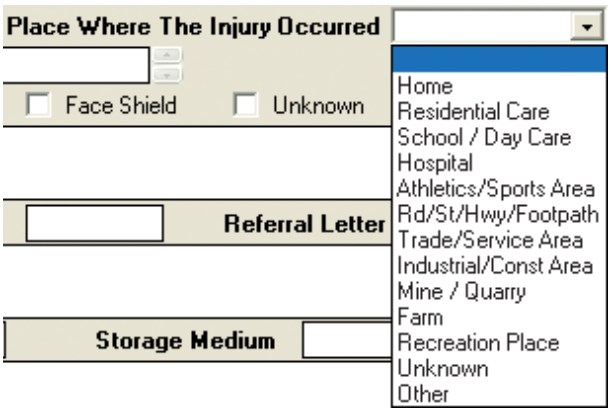

Fig. 6. Injury surveillance data variable – place where injury occurred.

interventions beyond the recommendation of mouthguard wear in contact sports. The findings from this study support the recommendation of the use of structured history forms to prompt clinicians to obtain comprehensive injury data for clinical and surveillance purposes. The benefits of an orodental injury surveillance system include improved understanding of the epidemiology of orodental injuries across populations; the potential to implement targeted preventive programmes and to develop educational programmes at the undergraduate and graduate levels through continuing professional development programmes and the provision of timely and comprehensive information to assist oral health services planning. The possible outcomes are lower orodental injury incidence; improved clinical management and long-term prognosis; and reduced financial, physical and psychological costs associated with orodental injuries.

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Conflict of interest statement

The authors acknowledge the contribution of the Department of Human Services, Victorian Public Health Training Scheme for funding Rachel Tham's salary at

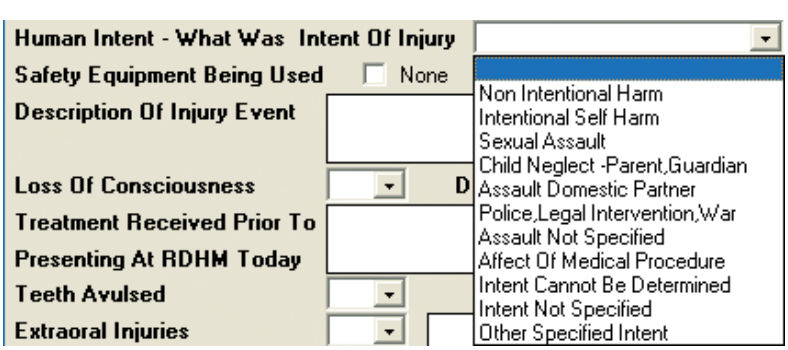

Fig. 7. Injury surveillance data variable – human intent.

the time that the study was conducted. The authors have no competing interests.

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