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Dental and maxillofacial skeletal injuries seen at the University of Otago School of Dentistry, New Zealand 2000-2004

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Abstract – An epidemiological study of dental and facial trauma injuries was performed on patient presentations to the University of Otago School of Dentistry during the period 2000–2004. A total of 1287 patients were seen for dental injuries with 3473 tooth injuries. The mean age was 17.48 ± 13.13 years (range: 2–86), the highest number of injuries occurred in the 16–25 year group with a male to female ratio of 2.01:1. Uncomplicated crown fractures were the most common injury that required treatment and the variables of age, gender, tooth type, type of injury, cause of injury, location where injury occurred were similar to other studies. Falls, accidental contact, assault and motor vehicle accidents attributed to >60% of the causes of trauma and to more serious injuries. Dental injuries sustained during sporting activities reflected the potential for high impact contact and the pattern of injury suggested that preventative measures had a positive outcome in limiting the number and degree of complexity of injuries. The emergence of skateboard injuries was a feature of this study. Non-sport causes attributed to the majority of facial fractures while rugby union was the most common sport associated with bone fractures. This study shows that dental and facial injury rates and patterns in a New Zealand region are similar to other populations.

The consequences of dental trauma may span the lifetime of an individual and place a rehabilitation and financial burden on the individual and/or community. Although the literature supports the notion that the types of dental injury that occur are similar over different populations (1), it is important for individual communities to analyse data from their own regions so that specific recommendations on prevention, management and funding can be targeted to the needs of the population.

New Zealand has a government run insurance system, the Accident Compensation Corporation (ACC), for all injuries incurred by the population that is primarily funded by company and personal taxation. In spite of this widespread collection of injury data for the New Zealand population, little has been in a usable format for determining prevalence of injury in the population (2–7). As such this study reports on the frequency and pattern of dental injury over a 5-year period of patients admitted to New Zealand's only School of Dentistry as a reflection of dental injury in the New Zealand community.

Materials and methods

The records of patients admitted to the University of Otago School of Dentistry who had suffered a dental injury in the period 2000–2004 were analysed and various aspects of the injury were recorded (Table 1). Ethical approval was gained from the University of Otago Human Ethics Committee.

Standard injury types were recorded, with slight modification due to variations in descriptions in the data where a complicated crown fracture was considered to involve enamel and dentine with pulp exposure, and subluxation and luxation injuries were grouped together and defined as an injury with identified disruption to the periodontal ligament. Data analysis were undertaken using the SPSS statistical software program, including frequency distribution and cross-tabulation. Chi-squared tests were used to compare qualitative data and determine statistical significance at a level of $P < 0.05$.

Results

A total of 1287 patients were seen for a dental injury, which comprises 3473 injuries in this patient pool, with 746 patients (58%) receiving multiple injuries. The mean age was 17.48 ± 13.13 years (range: 2–86) with a male to female ratio of 2.01:1. Fig. 1 shows the overall number of dental injuries for age groups, with the highest number occurring in the 16–25 year group.

Deciduous tooth injury

There were 653 deciduous tooth injuries representing 18.8% of all dental injuries. The male to female ratio was 1.58:1 with the greatest number of injuries occurring in the first 5 years of age (Fig. 2). There was no difference in the tooth type injured at any age ($P < 0.05$) with the

Table 1. Data collected from patient's files

Age at time of injury
Gender
Deciduous tooth type
Permanent tooth type
Type of dental injury
Soft tissue laceration
Bone fracture
Cause of injury
Location when occurred
Month when occurred

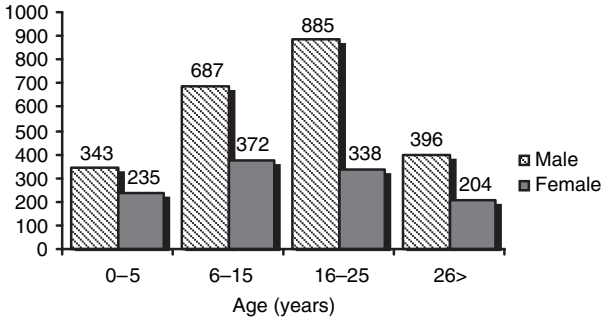

Fig. 1. Distribution of dental injuries according to age.

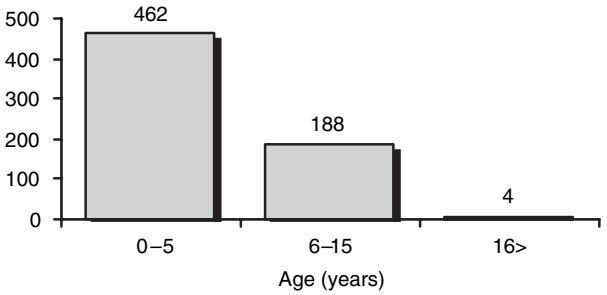

Fig. 2. Distribution of deciduous tooth injuries according to age.

upper and lower incisors being the most commonly injured (Table 2). The male to female ratio for maxillary tooth injury was 1.19:1 while a reverse trend was seen for the mandibular teeth of 0.74:1.

The distribution of injuries associated with the deciduous dentition is shown in Table 3. Concussion (51%), subluxation (27%) and uncomplicated crown fractures (11%) were the most common injuries. Table 4 shows the causes of injury associated with the deciduous dentition with falls being the major source of trauma and the upper incisors most commonly involved. The majority of the injuries occurred at home (Table 5).

Table 3. The type and number of injuries of the deciduous dentition and the frequency found in the upper and lower incisors

Injury	Total, *n* (%)	Upper incisors, *n* (%)	Lower incisors, *n* (%)
Concussion	336 (51)	243 (72)	58 (17)
Subluxation/luxation	182 (27)	151 (83)	18 (10)
Uncomplicated crown fracture	73 (11)	54 (75)	7 (10)
Intrusion	11 (1.7)	11 (100)	–
Complicated crown fracture	4 (0.6)	3 (75)	–
Extrusion	4 (0.6)	4 (100)	–
Root fracture	1 (0.15)	1 (100)	–
Enamel crack	–	–	–
Avulsion	42 (6.4)	32 (76)	7 (16)

Table 4. Cause of injuries to deciduous teeth and its relationship to trauma of the upper and lower deciduous incisors

Cause	Total, *n* (%)	Upper incisors, *n* (%)	Lower incisors, *n* (%)
Fall	425 (69)	346 (59)	51 (9)
Accidental contact	107 (16)	78 (73)	21 (19)
Road bike	28 (4.3)	21 (75)	2 (7)
Softball/baseball	9 (1.4)	4 (44.4)	4 (44.4)
Mountain bike	8 (1.2)	3 (37)	1 (12.5)
Assault	7 (12)	–	3 (43)
Seizure	6 (0.9)	2 (33)	4 (66)
Soccer	5 (0.7)	5 (100)	–
Motor vehicle accident	5 (0.7)	4 (80)	–
Cricket	4 (0.6)	4 (100)	–
Swimming	3 (0.45)	3 (100)	–
Skateboard	1 (0.1)	1 (100)	–
Hockey	1 (0.1)	1 (100)	–
Other	44 (7)	32 (69)	4 (9)

Permanent tooth injury

There were 2039 injuries associated with permanent teeth with a male to female ratio of 1.9:1, and the highest injury occurrence in the 16–25 year group (Fig. 3). The upper permanent incisors were the most common teeth injured (Table 6). There was no difference between tooth type injury and gender ($P < 0.05$), with males having the greater number of injuries.

Table 7 shows the type of injury associated with the permanent dentition with concussion and uncomplicated crown fracture being highest. Falls, accidental contact, assault and road accidents were the most frequent non-sport cause of injury, while rugby union football was the most frequent sport involved in permanent tooth injury (Table 8). Accidents in the home or on the road were the

Table 2. Number of injuries per deciduous tooth

Tooth	55	54	53	52	51	61	62	63	64	65
Number of injuries, *n* = 539 (82%)	1	2	16	95	150	151	105	17	1	1
Tooth	85	84	83	82	81	71	72	73	74	75
Number of injuries, *n* = 114 (18%)	1	1	10	21	25	25	20	9	1	1

Table 5. Location when injuries to deciduous teeth occurred

Location	Home	School	Playground	Road	Swimming pool	Other
Total, *n* (%)	445 (68)	89 (14)	51 (8)	39 (6)	4 (0.6)	25 (4)

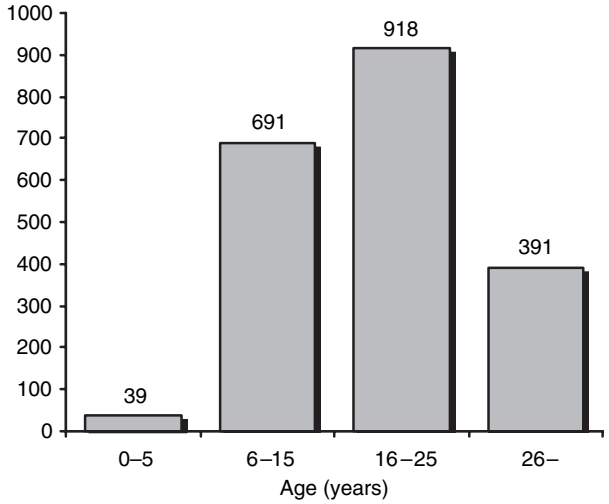

Fig. 3. Distribution of permanent tooth injuries according to age.

most frequent locations for permanent tooth injury (Table 9).

Bone fracture injuries

Over the period there were 230 cases with bone fractures to the facial skeleton (Table 10) with the majority of bone fractures occurring in the 16–25 year group (Fig. 4) and a male to female ratio of 4:1.

Rugby union football was the most common sport associated with bone fractures and assaults being the most common cause of non-sport bone fracture injuries (Table 11). Incidents occurring on the roads was the most common location for bone fractures (Table 12).

The distribution of injuries per month showed peaks associated with organized sport seasons while other causes generally showed a consistent trend over the year data (Fig. 5).

Discussion

Epidemiological research involves the collection and interpretation of data and provides relevant information for clinicians, institutions and government bodies on issues related to the population's health, disease or injury status. Meaningful results depend on a number of variables including sample size and accuracy of data.

Table 7. The type and number of injuries to the permanent dentition and the frequency found in the upper and lower incisors

Injury	Total, *n* (%)	Upper incisors, *n* (%)	Lower incisors, *n* (%)
Concussion	1088 (53)	680 (62)	192 (17)
Uncomplicated crown fracture	578 (28)	377 (65)	112 (19)
Subluxation/luxation	216 (10)	143 (66)	59 (27)
Complicated crown fracture	64 (3)	44 (69)	9 (14)
Avulsion	64 (3)	50 (78)	8 (12)
Root fracture	21 (1)	18 (86)	3 (14)
Intrusion	4 (0.2)	4 (100)	
Enamel crack	3 (0.1)	3 (100)	–
Extrusion	1 (0.05)	1 (100)	

Table 8. Cause of injuries to permanent teeth and its relationship to trauma to upper and lower incisors

Cause	Total, *n* (%)	Upper incisors, *n* (%)	Lower incisors, *n* (%)
Fall	429 (21)	290 (68)	72 (17)
Accidental contact	361 (18)	236 (65)	62 (17)
Assault	340 (17)	189 (56)	66 (19)
Motor vehicle accident	145 (7)	79 (54)	26 (18)
Road bike	145 (7)	123 (85)	15 (10)
Rugby union	129 (6)	66 (51)	30 (23)
Skateboard	44 (2)	26 (59)	10 (23)
Swimming	37 (2)	29 (78)	5 (13)
Seizure	25 (1.2)	17 (68)	4 (16)
Horse riding	25 (1.2)	7 (28)	14 (56)
Cricket	24 (1)	15 (62)	4 (16)
Softball/baseball	20 (1)	8 (40)	8 (40)
Hockey	20 (1)	12 (60)	8 (40)
Soccer	15 (0.7)	8 (53)	4 (26)
Mountain bike	14 (0.7)	6 (43)	3 (21)
Basketball	8 (0.4)	4 (50)	4 (50)
Netball	6 (0.3)	3 (50)	–
Dog bite	4 (0.2)	4 (100)	–
Other	248 (12)		

This study was based on a large sample size and as such will accurately reflect the type and prevalence of trauma commonly seen within the Otago region and the country as a whole. Recording of data can be influenced by a number of factors such as conforming to a reporting system, e.g. an insurance system and the environment it is recorded in, while data recording may not be exact

Table 6. Number of injuries per permanent tooth

Tooth	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Number of injuries, *n* = 1532 (75%)	4	6	13	9	11	59	226	401	422	237	66	22	21	21	14	–
Tooth	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Number of injuries, *n* = 507 (25%)	3	8	8	4	5	20	81	108	108	74	16	8	8	15	8	3

Table 9. Location when injuries to permanent teeth occurred

Location	Home	School	Playground	Road	Swimming pool	Work	Other
Total, *n* (%)	565 (28)	135 (7)	388 (19)	574 (28)	54 (3)	54 (3)	269 (13)

Table 10. Number of fractures of the facial skeleton

	Gender		
Bone fracture	M	F	Total, *n* (%)
Zygoma	53	11	64 (28)
Mandible	51	2	53 (23)
Orbit	35	11	46 (20)
Nasal bone	19	3	22 (10)
Maxilla	14	3	17 (7)
Alveolar	9	5	14 (6)
TMJ	8	6	14 (6)

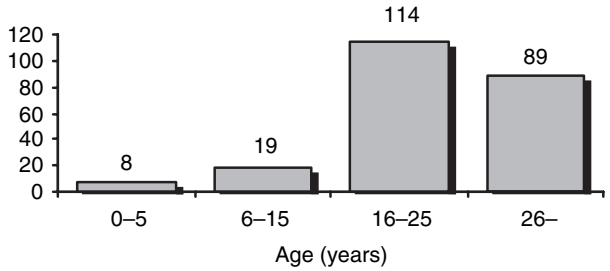

Fig. 4. Distribution of fractures of the facial skeleton according to age.

with some aspects of an injury not being recorded. During the data gathering for this study it became evident that a complicated crown fracture should be defined as an injury involving enamel and dentine with pulp exposure and that minor luxation injuries and subluxation injuries be grouped together. Such an approach may limit comparison with other studies; however, the dental injury trends seen in this study with respect to age, gender, tooth type, type of injury, cause of injury, location where injury occurred were similar to other populations (1).

The data presented in Tables 3 and 7 show that concussion dental injuries were the most common injuries reported. However, it is very likely that the number of these injuries was overestimated due to the reporting nature required for future treatment requirements under ACC, in that successful future claims are more likely to be accepted if a recording is made at the time of injury. In contrast, the number of enamel crack injuries is likely to have been under reported due to clinicians primarily reporting a more substantive concurrent injury, e.g. luxation. Excluding these injuries it is clear that uncomplicated crown fracture is the most prevalent injury for both deciduous and permanent teeth followed by subluxation/luxation injuries and that non-sport-related cause is the most common cause of injury (Tables 3 and 7).

In broad terms injury prevention may be approached by education, changes to the environment (e.g. use of safety devices) or enforcement usually through regulation or legislation. In New Zealand, government and professional bodies commonly use all these approaches to minimize injury to the population as a whole and also to target specific activities such as sport. Rugby union is regarded as the national sport in New Zealand and injury prevention measures are rigorously enforced such as the compulsory wearing of mouth guards for school-aged players. The study showed that only 6% of dental injuries were attributed to rugby union (Table 8) and that the severity of the injuries were such that they could be easily managed and have a good prognosis, e.g. uncomplicated crown fracture (Table 13). This suggests that prevention measures have a positive influence on the number and severity of rugby union-related dental

Table 11. Cause of fractures of the facial skeleton

	Fracture							
Cause	Alveolar	Mandible	TMJ	Maxilla	Zygoma	Orbit	Nasal bone	*n* (%)
Assault	1	24	3	4	22	14	7	75 (32)
Motor vehicle accident	1	4		7	6	10	5	33 (14)
Fall	7	2	2	1	12	6	1	31 (13)
Rugby union	1	8	2	1	10	5	1	29 (12)
Accidental contact		5		1	4	5	4	19 (4)
Road bike	1	3	4	2	3	1	1	15 (6)
Cricket		1	1			3	1	6 (3)
Hockey	1				2	1	1	5 (2)
Horse riding			1	1				2 (0.8)
Soccer					2			2 (0.8)
Mountain bike		1						1 (0.4)
Dog bite	1							1 (0.4)
Other	1	5	1		3	1	1	12 (0.5)
n	14	53	14	17	64	46	22	230

Table 12. Location when fractures to the facial skeleton occurred

Location	Fracture							
	Alveolar	Mandible	TMJ	Maxilla	Zygoma	Orbit	Nasal bone	*n* (%)
Road	3	22	4	11	23	24	11	98 (43)
Playground/park	3	12	3	1	15	10	3	47 (20)
Home	7	2	2	1	8	4	4	28 (12)
Work		1			1	2	1	5 (2)
School			1	1				2 (0.8)
Swimming pool		1						1 (0.4)
Other	1	15	4	3	17	6	3	49 (21)
n	14	53	14	17	64	46	22	230

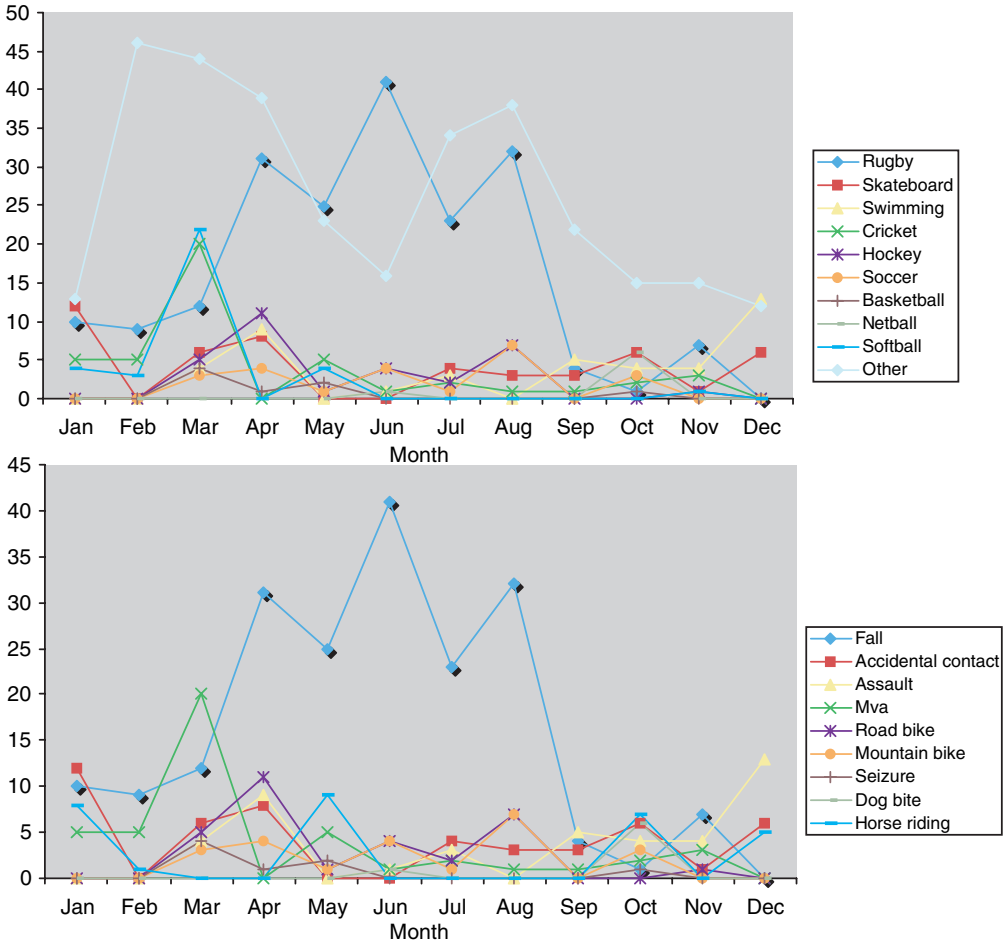

Fig. 5. Distribution of causes of injury per month.

injuries. Indeed, Table 13 demonstrates that sport activity did not account for the more complicated injuries, e.g. avulsion or intrusion, rather non-sporting activities accounted for the majority of these injuries, which is consistent with the preventive nature of wearing mouth guards during sport thereby minimizing the effect of high velocity impact.

The sports identified reflect those most commonly played in the Otago region and New Zealand as a whole and are consistent with those identified in a previous study (5). Similarities in ranking, based on the number of injuries per sport, between the studies can be seen, e.g. swimming injuries were ranked highly just below rugby union while other sports show differences, for example, basketball was third behind rugby union in the previous study (5) and eighth behind rugby union in the present study. Such differences can be explained in terms that the early study (5) used national data and more accurately reflects the regional variation that occurs over the country as a whole. A major difference between this and the previous study (5) is the emergence of skateboard-related injuries. In this study, skateboarding was

Table 13. Type of dental injury relative to cause of injury

Cause	Dental injury							
	Uncomplicated crown fracture	Subluxation/ luxation	Complicated crown fracture	Avulsion	Root fracture	Intrusion	Total	Extrusion
Fall	147	161	16	28	3	11	2	368
Accidental contact	103	67	14	8	1	1	2	196
Assault	100	29	8	16	7	–	–	160
Motor vehicle accident	59	22	5	17	1	–	–	104
Road bike	57	28	1	10	2	2	1	101
Rugby union	35	20	8	2	3	–	–	68
Skateboard	14	3	1	3	–	–	–	21
Swimming	12	–	–	3	–	–	–	15
Seizure	5	6	3	1	–	–	–	15
Horse riding	–	4	–	–	–	–	–	4
Cricket	7	5	5	–	–	–	–	17
Softball/baseball	1	3	–	2	–	–	–	6
Hockey	6	3	1	4	1	1	–	16
Soccer	4	7	1	–	–	–	–	12
Mountain bike	14	5	1	2	–	–	–	22
Basketball	2	2	–	–	–	–	–	4
Netball	2	–	–	–	–	–	–	2
Dog bite	1	–	–	–	–	–	–	1
Other	58	30	3	11	4	–	–	106
Total	627	395	67	107	22	15	5	1238

the second ranked sporting activity behind rugby union and it did not feature in the top 10 sports in the previous study (5). This reflects the increased uptake of skateboarding in New Zealand, which is almost exclusively related to children and young adults.

There are few regulatory safety requirements associated with skateboarding, and compounded by the high prevalence of recreational skateboarding activity and the use of skateboards on open roads may explain the high number of dental injuries. This result provides clear evidence that educative, environment and regulatory preventive measures should be targeted to skateboarding activities in New Zealand.

The data presented in Table 13 gives some insight into what type of dental injury can be expected with the common causes of dental injury and confirms that the degree of injury is related to impact energy, e.g. hockey attributed to only 1% of all injuries (Table 8) but of those injuries a relatively high number were complicated injuries (avulsion, root fracture, intrusion) even though mouth guards are compulsory for the sport. It is important for patients and institutions to have some idea of the potential ongoing dental and financial requirements subsequent to dental trauma. The data seen in Figs 1 and 3 suggest that overall sporting injuries should have minimal ongoing dental and financial cost, while the greater range and complexity of injuries seen with interpersonal violence and traffic accidents indicate that a greater dental and financial burden to an individual and to institutions is expected with these causes and suggest that ongoing preventive measures should be directed to these areas.

The type of fractures of the facial skeleton and related factors reported in this study confirms previous reports in New Zealand (4, 6, 7). Assault and motor vehicle accidents attributed to almost half of the fractures (Table 11) and alcohol consumption is frequently associated with these causes (7–9). Recently concern has been expressed about the increase in hospitalized injuries from alcohol-related traffic accidents in New Zealand. Kypri et al. (10) have shown that since the legal drinking age in New Zealand was lowered in 1999 from 20 to 18 years the number of traffic-related injuries increased for 15–17 (male 14%; female 24%) and 18–19 year olds (male 12%; female 51%). Although the present study did not compare time periods the 2000–2004 data probably reflects this trend. This area warrants close attention and preventive measures implemented.

Conclusion

This study shows that dental and facial skeleton injury rates and patterns in a New Zealand region are similar to other populations. The evidence suggests that preventive measures introduced to sporting activities have a positive outcome while specific causes of trauma, such as skateboarding and motor vehicle accidents, warrant further investigation in order to develop prevention strategies.

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