Scientific Article

Diagnosis and treatment of dental trauma in a children's hospital

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Abstract

A comprehensive review of 487 emergency dental trauma visits seen at a children's hospital during a 3-year period was performed to investigate aspects of trauma care that have not been previously reported. Patient characteristics, diagnoses, and injury treatment were analyzed. General patient characteristics and diagnoses were consistent with other studies. Young children were often injured in falls within the home whereas older children were often injured in sports and activities outside the home. The emergency visit was the first contact with the dentist for 80% of children 3.5 years old and younger. Maxillary incisors accounted for 84% of primary tooth injuries: examination and extraction were common treatments. Maxillary incisors accounted for 87% of permanent tooth injuries: bandage restorations and splint placement were frequent treatments. An assistive restraint device was used most often for children 4 years and younger who required extractions. The restraint was used more frequently during clinic hours with support staff present than after hours with a sole provider. Hospital facilities were not essential for treatment of the patients in this study (Pediatr Dent 20:2 112–120, 1998).

Traumatic dental injuries are of interest to dental educators, clinicians, and coordinators of emergency health care services. Numerous studies focus on visits to emergency rooms and dental clinics for emergent dental problems. Many are all-inclusive, studying traumatic injuries as well as visits for infection and other causes.

Patient demographics such as sex, age, and time of visit have been well documented. Males exhibit a higher overall incidence of dental trauma than females.[1–18] It is unclear whether this dichotomy is present in the youngest age groups; several studies do not report statistically significant gender-based differences in injury rates in the primary dentition.[2, 7, 19] The mean age of children sustaining traumatic dental injuries has been reported to be 5.5 years or younger,[9, 11, 16, 18] with the majority of injuries occurring in 2 year olds.[6, 8, 14, 20] Some studies show a second, smaller increase in the frequency of traumatic injuries between the ages of 5 and 9.[6–8, 14, 15, 20]

Investigators have looked for a seasonal pattern of dental trauma but have reported conflicting results. Several studies have identified summer months as the busiest although the results were not statistically significant.[6, 12–15, 18, 20, 21] Late spring/early summer months (April through June) have been reported to have statistically significantly higher frequencies of traumatic emergencies.[9] Autumn[22, 23] and winter[11] have been reported as the busiest months by others.

Dental emergencies with traumatic and nontraumatic causes follow a pattern during the week. Most visits occur on weekends,[6, 18] and midweek has the lowest frequency.[18] Battenhouse[20] found 35% of emergency visits to be during nonclinic hours. Schwartz[19] reported a similar frequency (39%) of emergency trauma visits occur during nonclinic hours. In studies with samples of after-hours patients presenting with all types of emergencies, most weekday emergency visits arise between 5 p.m. and midnight.[6, 18, 24] On weekends, the highest numbers of patient visits are in the afternoon.[6, 24] Studies involving only traumatic injuries report similar time-of-day findings.[9, 19]

Maxillary central incisors are the most commonly injured teeth in both primary and permanent dentitions.[1, 4, 6, 7, 12, 13, 16–19, 21] In the primary dentition, the most common type of injury is displacement of the tooth: avulsion, luxation, intrusion, or extrusion.[3, 7, 8, 11, 12, 16, 19, 22] Crown or root fractures are more frequent in the permanent dentition.[3, 7, 12, 19, 22]

Soft-tissue injuries have been reported in almost half of dental trauma patients.[7, 14–16, 22] The most common soft-tissue injury is lip laceration[6, 7, 14, 20] and soft-tissue injuries appeared to motivate early attendance for care.[7] Sae-Lim[16] reported that 45% of injuries to the dentition had concurrent soft-tissue injuries, and usually multiple teeth were injured.

The incidence of facial fractures in children is low, with mandibular fractures the most common.[16, 25–27] Mandibular fractures in children occur most often as condylar fractures, followed by body fractures.[26, 27] Facial fractures occur most often in older children, frequently as a result of traffic accidents.[27]

Falls are the most common source of dentoalveolar trauma in children.[5-9, 12, 14, 15, 17, 21, 22] The majority of falls take place within the home.[4, 5, 8, 14, 17] Bhat et al.[3] reported that nearly 70% of children 5 and younger either fell from furniture, on floors and stairs, or in bathtubs or showers. The study found 60% of children 5 and older experienced injuries associated with either sports and play or bicycles and other wheeled vechicles.[3]

Few investigators have reported the racial composition of their sample. Two studies have described sample trauma populations with similar racial demographics as the population surrounding the study sites.[8, 16]

The types of emergency treatment for dental trauma have been infrequently reported. Common procedures for treatment of dental trauma have been reported to be exam alone, extraction, composite bandage, suturing, and splinting.[18] In a study of subluxation injuries of primary teeth, 90% were either extracted or examined.[5]

Some factors associated with traumatic dental injuries are poorly understood. Timing of visits may be skewed in favor of after hours because many studies include patients outside of regular clinic hours, inflating the number of evening visits.[6, 18, 24] The frequencies of various soft-tissue injuries correlated to particular hard-tissue diagnoses are unclear. Many authors have suggested reduction of risk factors in the child's environment but identifying specific risk factors has been difficult.[3, 7, 14, 16, 20]

To assist health care planners, clinicians, and dental educators in the prevention, diagnosis, and emergency treatment of traumatic dental injuries, this study set out to further clarify the pattern of dental trauma in the areas of:

1. patient characteristics
2. time of visit
3. interval between traumatic event and presentation for emergency care
4. cause of injury
5. combination injuries of hard and soft tissues
6. emergency treatment performed
7. behavior-management techniques used in emergency settings.

Methods

Children's Hospital and Medical Center, Seattle, Washington, is a 208-bed, tertiary-care pediatric teaching hospital. Patients are treated in the dental clinic by attending dentists, pediatric dentistry graduate students, or general practice residents. Clinic hours are Monday through Friday from 9 a.m. to 5 p.m. Emergency patients presenting outside of clinic hours come to the hospital through the emergency room and are treated by a pediatric dentistry graduate student, a general practice resident, or an oral and maxillofacial surgery resident with attending dental staff back-up.

A comprehensive review of all emergency dental records from 1992–1994 was completed. Emergencies both during and outside clinic hours were included. From the 958 emergency records, 487 were for dental trauma and subsequently included in this study. Demographic information including age, race, gender, time of visit, and day of week was collected, as well as specific information regarding the injury including diagnosis, treatment, location, cause of injury, and other related information such as use of restraint devices and medications prescribed. The initial record data extraction was performed by a single dentist-examiner (SML) familiar with our study procedures. Complicated cases were jointly reviewed with a participating dentist.

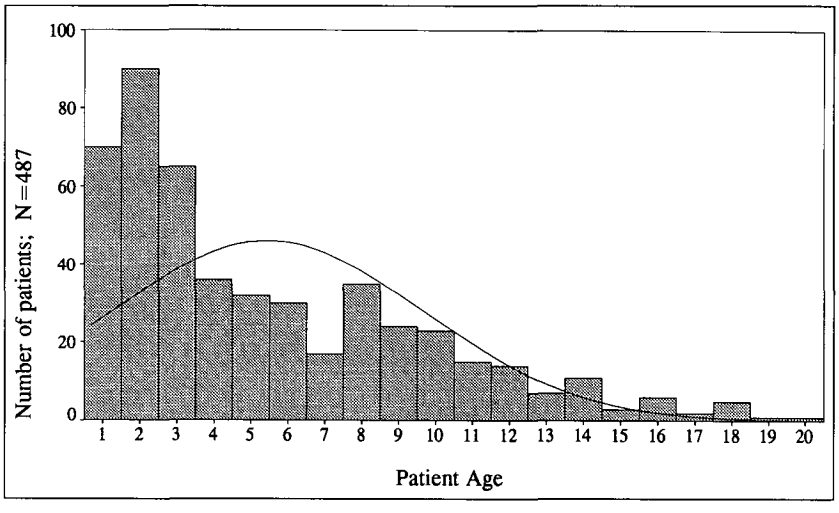

Fig 1. Patient age ranged from 8.5 months to 20 years (N = 487). High-frequency age clusters surrounded age 2 and to a lesser degree age 8.

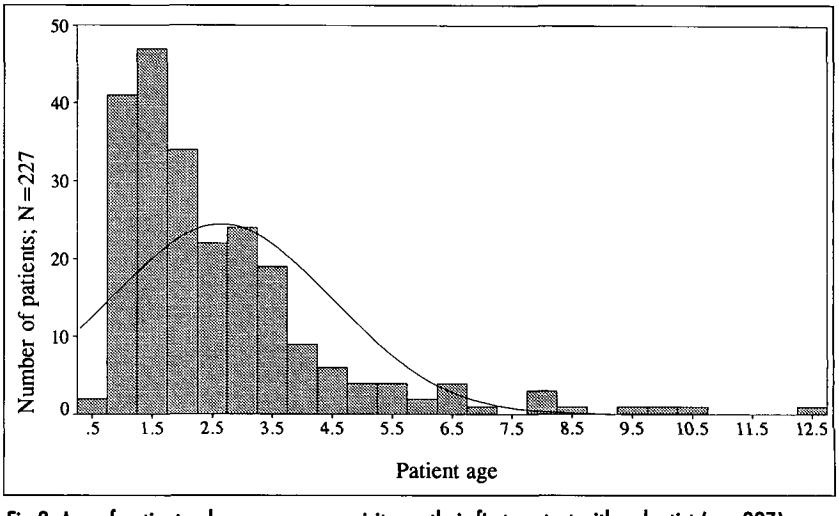

Fig 2. Age of patients whose emergency visit was their first contact with a dentist (N = 227).

Data was entered into a data base program (Microsoft® Access) designed for this project. Statistical Package for the Social Sciences (SPSS) was used for analysis. As a check of examiner reliability for cause of injury and diagnosis determination from the emergency record, 6% of cases were randomly selected for re-examination; a 92% agreement rate was determined. For all other categories of data, accuracy ranged from 98 to 100%.

Results

Patient characteristics

The 487 patients seen with trauma were evenly distributed over the 3-year study period (165 in 1994; 153 in 1993; 169 in 1992). In all, 181 were female and 306 were male (χ^2=32.08, $P \leq 0.001$). The disparity between sexes remained statistically significant in all age groups.

Patient age ranged from 8.5 months to 20 years, 2 months. The mean age was 4.0 years. Highest frequency clusters surrounded age 2 and to a lesser degree, age eight (Fig 1). Of the children seen during clinic hours, 125/199 were 4 years old and younger; after clinic hours, 131/288 were 4 years old and younger.

Caucasians accounted for 329 patients. A majority of patients (414) reported a medical history which was noncontributory to dental care. Asthma was the medical condition most often cited (23). Four patients required antibiotic prophylaxis prior to treatment for prevention of subacute bacterial endocarditis (SBE).

In 227 patients, the emergency visit was the first contact with a dentist, and of those children, 189/227 were 3.5 years of age and younger (Fig 2). Twenty of the 487 patients were regular patients of the hospital dental clinic or its community satellite clinic.

There was consistent seasonal variation in patient volume through the study period. When patients of all ages were considered, March through September was significantly busier than October through February (χ^2 = 23.87, DF = 11, P = 0.0133). There was no significant seasonal variation for children younger than 5 (χ^2 = 9.25, DF = 11, P =.5987). Children 5 and older exhibited a statistically significant seasonal variation during March through September (χ^2 = 19.67, DF = 11, P = 0.0501) (Fig 3).

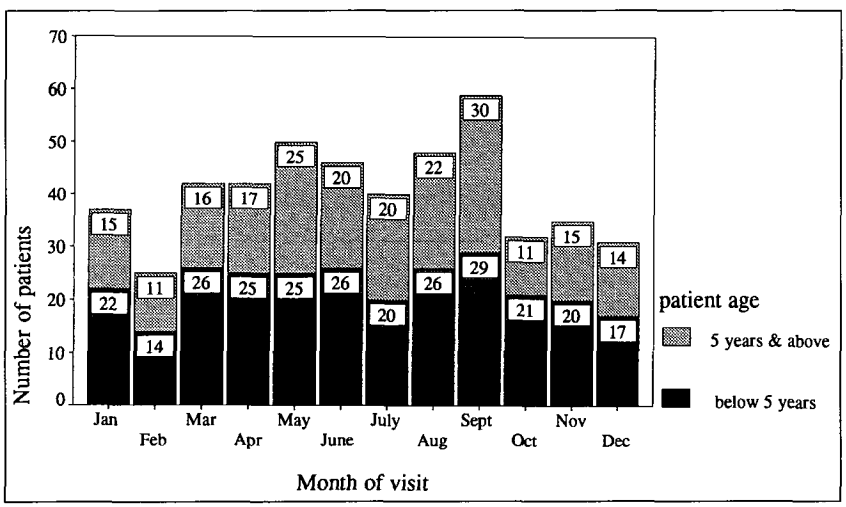

Fig 3. Overall, March through September was significantly busier than October through February (P = 0.0133). No significant seasonal variation was found in children younger than 5 years of age. Children 5 years and older exhibited a statistically significant seasonal variation (P = 0.0501).

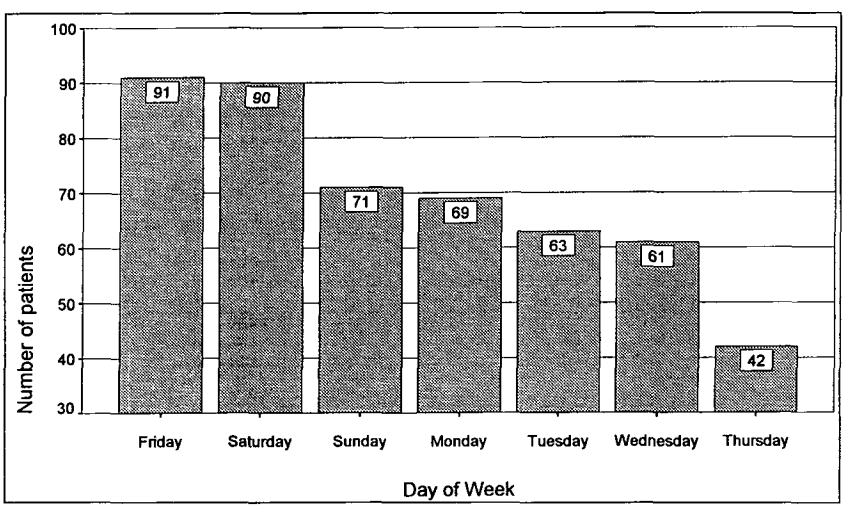

Fig 4. Distribution of frequency of emergency visits during the week.

Friday was the busiest day and the number of patient visits steadily declined to Thursday (Fig 4). Hour of visit was available for 420 patients; the remaining 67 patients were known to have visited during clinic hours because of the registration process. In all, 199 children presented during clinic hours. Of the 288 who came after hours, 188 presented between 5 p.m. and midnight. Considering only the patients presenting on Saturday and Sunday, 65/160 presented between 5 p.m. and midnight. The time of day with the highest visit frequency was 1 p.m.; a second peak occurred at 7 p.m. The frequency of visits during clinic hours was highest at noon and 1 p.m. Visits on weekends were fairly constant between 11 a.m. and 10 p.m.

Time of presentation to the dental clinic following injury was grouped into five categories: < 2 h (112); 2–6 h (169); 6–12 h (11); >12 h (125); and unknown (70/487). Injuries which presented most frequently in the < 2-h group were luxation with displacement

(20/112), laceration (20/112), and avulsion (16/112), which accounted for 24%, 30%, and 42% of total luxations, lacerations and avulsions, respectively. In the >12-h group, the frequencies decreased to 35/196 luxations, 21/155 lacerations, and 15/88 avulsions.

Diagnostic data

For the 487 patients, 1056 specific diagnoses were recorded. These diagnoses included 562 primary teeth, 276 permanent teeth, one supernumerary tooth, 193 soft-tissue and 24 bony injuries. Two hundred and four patients had injury to one tooth only. Injury to two teeth was experienced by 157 patients, injury to three teeth was experienced by 44 patients, and injury to four teeth was experienced by 27 patients. Thirteen patients experienced injury to five or more teeth. Forty-two patients escaped injury to teeth, and 32 patients presented with soft-tissue trauma only.

Lateral luxation, intrusion, and avulsion accounted for 286/562 injuries to primary teeth (Table 1). Maxillary incisors were involved in 470 primary tooth injuries. Central incisors accounted for 373 and lateral incisors for 97 of injured primary teeth (Fig 5).

The most frequent injuries to permanent teeth were Ellis class II crown fracture (72/276), luxation (41/276), and avulsion (33/276). Of 276 permanent teeth, 206 maxillary central incisors and 33 maxillary lateral incisors received trauma. A total of 239/276 of all permanent tooth injuries were to maxillary incisors (Fig 6).

Laceration was the most common soft-tissue diagnosis (155/193). The maxillary labial gingiva (50) and the upper lip (38) were sites of the most frequent soft tissue injuries (Table 2).

Of the 24 bony injuries, five were fractures and 19 were trauma without fracture. The five fractures had the following locations: two condylar fractures, one body fracture, one maxillary fracture, and one fractured nose. Sixteen patients experienced trauma to the temporomandibular joint without fracture, and three had mandibular trauma with no fracture.

A combination of hard- and soft-tissue injuries was experienced by 107 patients. Seventy-six experienced soft-tissue injuries with tooth displacement. Soft-tissue injury with either crown and/or root fracture or concussion injuries were recorded for 27 patients. Four were associated with bony fractures.

Treatment

Examination was the sole treatment in 262/562 injuries to primary teeth and in 86/276 injured permanent teeth. Injured primary teeth were extracted 240 times. For children who had injured permanent teeth, bandage restorations were placed on 79/276 and splints on 76/276. Only 3/276 injured permanent teeth were extracted (Table 3).

Facial fractures required immediate intervention beyond examination and follow-up care. No patient required admission to the hospital for management of traumatic injuries. Of the 14 segmental alveolar fractures that occurred in the primary dentition, three were examined only, seven repositioned, and four treated with extraction. All four segmental alveolar fractures in the permanent dentition were splinted.

Sutures were placed in 96/217 recorded soft-tissue injuries. For gingival lacerations and lip lacerations, 32/56 and 31/51, respectively, were sutured. Soft-tissue injuries were examined with no other treatment per-

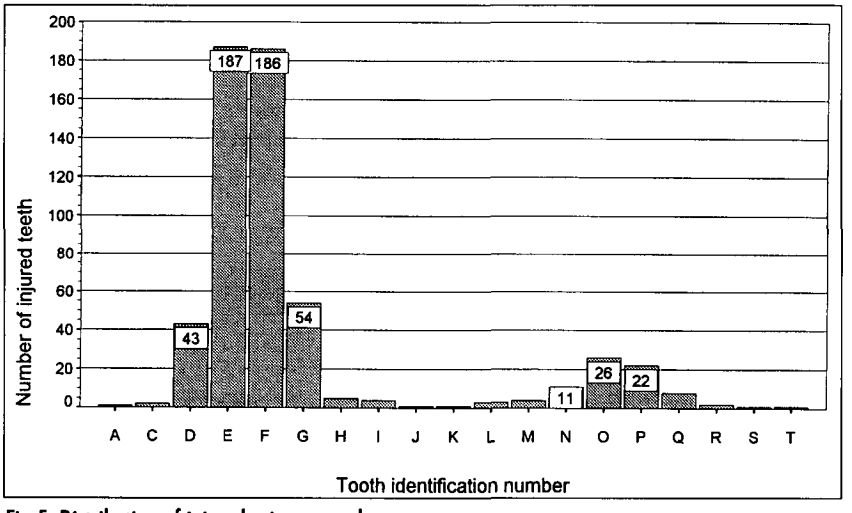

Fig 5. Distribution of injured primary teeth.

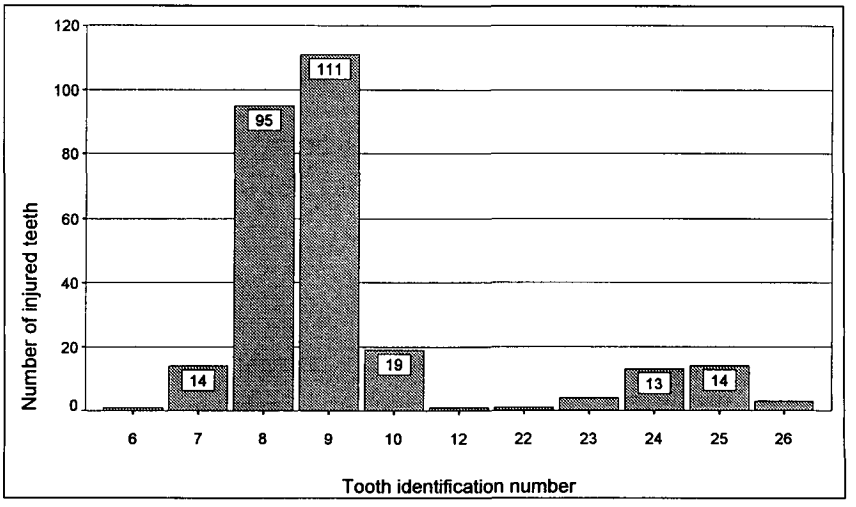

Fig 6. Distribution of injured permanent teeth.

TABLE 1. FREQUENCY OF INJURIES

Diagnosis	*% of Injured Primary Teeth*	*Patient (N)*	*% of Injured Permanent Teeth*	*Patient (N)*
Segmental alveolar fracture	3	14	1.0	4
Avulsion	10	55	12	33
Caries	3	14	0	0
Craze lines	0.4	2	3	9
Crown fracture–enamel	6	35	8	23
Crown fracture–dentin	4	21	26	72
Crown fracture–pulp	8	44	6	17
Extrusion	7	39	7	19
Facial bony plate fracture	4	22	3	8
Intrusion	14	76	3	8
Luxation	27	155	15	41
Root fracture–apical	0.5	3	0	0
Root fracture–coronal	0.2	1	0.4	1
Root fracture–middle	1.4	8	0.7	2
Root fracture–vertical	2	9	0.7	2
Subluxation	11	64	13	37
Total:	100	562	100	276

formed in 89/217 of cases. Tongue lacerations were sutured 9/10 times.

Radiographs were exposed for 347/487 patients. Of the other 140, 126 were younger than 4. Periapical radiographs were exposed most often (327) followed by panoramic radiographs (27), occlusal (15), lateral occlusal (8), facial series (3), chest film (3), and anterior/posterior view (1).

An assistive restraint device (Papoose Board™, Olympic Medical Corp, Seattle, WA) was used on 99 of the 487 patients. Children 4 and younger accounted for 89/99 children requiring the use of the papoose board (PB). During clinic hours, the PB was used with 56/199 patients, while after hours it was used with 43/288 patients. Eighty-one children received primary tooth extractions with the restraint, accounting for 114/240 primary teeth extracted. The PB was used for primary tooth extraction during clinic hours 61% of the time (63 extractions, 44 children) and for 38% of after-hours primary tooth extractions (51 extractions, 37 children). One after-hours patient was reappointed due to unmanageable behavior. Attending dental staff in the emergency room used the PB at 24/102 patient visits for which they provided care. Residents used the PB at 75/487 patient visits for which they provided care.

Most patients received no prescription medication (440/487). Antibiotics and analgesics were prescribed equally (34 prescriptions each). Amoxicillin was the most often prescribed antibiotic (19). Other antibiotics prescribed were penicillin (both oral and IV) (9), cephalosporins (4), and erythromycin (2). Antibiotics were prescribed for 18/155 patients with lacerations, 11/196 patients with luxations with displacement, and 10/88 patients with avulsions. Antibiotics prescribed for SBE prophylaxis were not included in the analysis. Acetaminophen with codeine was prescribed most often for analgesia (25/34).

Follow-up at the hospital dental clinic was provided for 82 patients: 11/18 patients with segmental alveolar fractures; 26/88 with avulsions; 8/24 with bony injuries; 30/84 with intrusions; 50/155 with lacerations; and 33/196 with luxations with displacement.

The general practice resident or pediatric dentistry graduate student provided care for 370 of the 487 patient visits. Attending pediatric dentists provided care for 102 patients, and the oral and maxillofacial surgery service was involved with 23 patients. During clinic hours the pediatric dental attendings treated 96/202 patients. Patients may have been treated by more than one clinician, particularly those whose injuries were managed by the oral and maxillofacial service.

Cause of injury

The most frequent cause of injury was unspecified falls (87/487). An almost equal number of patients presented after falls on floors, pavement, or decks (85/487). Falls on furniture made up 55/487 patients seen, 47% of which were falls from coffee tables and furniture of similar vertical height. Forty-six children were injured in falls from bicycles (Table 4).

The source of injury varied in relation to age and type of injury sustained. Of children injured in falls to the ground (on floors, etc.), on stairs, furniture, beds, or unspecified, 184/227 were 6 or younger. Children older than 6 hurt themselves on bikes (35/46 of total bicycle injuries) and playing sports (22/22 of total sports injuries). Patient age did not correlate with the number of injuries sustained on playground equipment or contact between children (person vs. person).

TABLE 2. SOFT-TISSUE DIAGNOSES AND LOCATION OF INJURIES

	Abrasion	*Bruise*	*Laceration*	*Puncture Wound*	*Swelling*
Cheek	2	0	3	0	0
Chin	7	0	10	0	0
Commisure	7	0	4	0	0
Forehead	1	0	2	0	0
Frenum	1	0	18	0	0
Gingiva–labial mandible	0	0	8	0	0
Gingiva–labial maxilla	1	5	44		
Gingiva–lingual mandible	0	0	2	0	0
Gingiva–palate	0	0	2	0	0
Lower lip	5	1	23	1	
Mandible	5	1	23	1	1
Nose	2	0	0	0	1
Soft palate	2	0	1	0	0
Tongue	0	0	10	0	0
Upper lip	6	2	28	0	
Total:	39	9	178	2	4

TABLE 3. TREATMENT PROVIDED

Treatment	*Primary*	*Permanent*	*Soft Tissue*	*Total*
"Bandage" restoration	18	79	0	97
Cvek pulpotomy	0	6	0	6
Debride/clean	0	0	29	29
Exam only	262	86	89	437
Extraction	240	3	0	244*
Open and broach	0	10	0	10
Parent refused treatment	3	3	0	6
Reposition	34	9	3	46
Reposition and splint	0	66	0	66
Smooth or plasty	5	4	0	9
Splint	0	10	0	10
Sutures (assuming debridement)	0	0	96	96

*The supernumery tooth was extracted

The most common sources for hard- and soft-tissue combination injuries were falls on floors/pavement/decks (22/107), from bicycles (21), unspecified falls (12), and from playground equipment (11). An attempt was made to find a pattern of common injuries received by children who shared sources of trauma but none was found.

Bicycle accidents caused 20% of injuries involving three or more teeth. The most common diagnoses for children experiencing bicycle accidents were: laceration (26/152), Ellis class II crown fractures (26), and luxation with displacement (25). The majority of bicycle accidents occurred between May and September. Information about helmet use was collected but the data were incomplete and inconclusive.

Discussion

The majority of children sustaining dental injuries were young. The emergency visit was the first contact with the dentist for 80% of children 3.5 years and younger. While it is recommended that children have their initial visit to the dentist at 1 year of age, most have not. Families of injured children who have not yet established regular dental care often turn to the hospital for emergency dental treatment. Most emergency patients (60%) were treated after clinic hours, although a greater proportion of young children were treated during clinic hours than not.

The children presenting for care were healthy, and most had injuries which did not require hospital facilities to treat. Boys were injured more frequently across all age groups; including the toddler years when many injuries are attributed to developing motor coordination, rather than generalized risk-taking or increased participation in sports. The racial composition of the patients seen was consistent with 1990 census data from the city of Seattle.

This study found a constant baseline of injuries occurring year-round in young children, with an increase in injuries experienced by older children during the summer months. Treatment of injuries sustained by older children tended to be more involved, such as the placement of splints or bandage restorations.

It was hypothesized that children presenting to the dental clinic shortly following injury would present

TABLE 4. CAUSE OF INJURY

Cause	*Patient*	*% of Patients*	*Most Common Injury (% of diagnoses)*
Auto accident	5	1	–
Auto–fell in and around vehicle	2	0.5	–
Abuse	1	0.2	–
Bed	17	3	Luxation (26%)
Bike	46	9	Class II dentin fx (21%) Laceration (21%) Luxation (16%)
Children's vehicles	6	1	
Coffee table or other furniture of same vertical height	26	5	Luxation (20%) Intrusion (16%)
Fall–unspecified	86	18	Intrusion (15%) Luxation (14%) Class II dentin fx (14%)
Fell on floor/ pavement/deck	85	17	Laceration (16%) Luxation (14%)
Fell on stairs	23	5	Avulsion (19%) Luxation (15%)
Other furniture	29	6	Luxation (29%) Laceration (19%)
Person vs. person	31	6	Luxation (36%)
Playground equipment	32	7	Laceration (19%)
Pool	1	0.2	–
Sports–baseball	14	3	–
Sports–basketball	5	1	–
Sports–football	2	4	–
Sports–soccer	1	0.2	–
Skating	4	0.8	–
Toys	9	2	–
Wheelchair falls	1	0.2	–
Shopping cart	3	0.6	–
Bathtub	9	2	–
Tree (fell out of)	3	0.6	–
Railing	3	0.6	–
Fireplace/windowsill (same vertical height)	6	1	–
Other	11	2	–
Unknown	26	5	–
Total:	487	100	–

with increased injury severity. Avulsion, laceration, and luxation with displacement were the most frequent injuries presenting in the <2-h group and, their frequencies decreased by half when compared to the >12-h group. It appeared that avulsed or severely displaced teeth—injuries that could interfere with occlusion—as well as bleeding, influenced early attendance for care.

Differences in injuries sustained between the primary and permanent dentitions were illustrated by this study. Primary teeth were commonly displaced from the socket and permanent teeth were often fractured (crown and/or root). Many authors have speculated that young bone tends to flex, resulting in displacement rather than fracture of the primary tooth.[1, 5, 7–9, 22, 23] These results are complicated by differing sources of trauma between age groups. Differences were found between source of trauma and patient age, but the relationship between source of trauma and injury sustained was unclear. Until that relationship is defined, the debate as to whether a specific mechanism of fall creates a force more likely to fracture rather than displace teeth vs. the influence of the composition of the supporting dental tissues will continue.

Several studies report lip laceration as the most common soft-tissue injury to the orofacial area.[6, 7, 14, 20] Our study found that laceration of the maxillary gingiva was more frequent. The emergency room triages children with lip lacerations and no intraoral injuries to either the plastic surgery service or emergency room physicians. We also report low numbers of facial fractures and admissions. Seattle has a regional trauma center (Harborview Medical Center) where severe trauma is triaged from the field. Accordingly, one would expect few facial fractures and admissions for dental trauma at the Children's Hospital.

Few have studied the relationship between hard- and soft-tissue

injuries. Three times as many soft-tissue injuries were found with injuries that displaced teeth compared to concussion injuries and crown and/or root fractures. The occurrence of soft-tissue injuries was 3.6 times greater in patients with multiple tooth injuries when compared to patients with single tooth injuries. The most severe injuries were experienced by children on playground equipment or in bicycle accidents. It seems reasonable to assume that the force experienced in these accidents is greater than that experienced in the typical toddler tumble.

Children in bicycle accidents experienced both a high number of injuries and an increase in injury severity. While helmet and mouthguard use have enjoyed increasing acceptance and wear by children,[28, 29] mouthguard use is more common in organized sports activities.[28, 30, 31] The prevalence of mouthguard use with bicycle riding is unknown but presumed to be low. Many injuries, both bicycle and nonbicycle related, may have been prevented with the use of a mouthguard.

A focused effort should be made to educate dental students and practicing dentists about the treatment of dental trauma. Extraction of primary teeth, placement of composite or glass ionomer "bandage" restorations, bonding splints, and suturing oral lacerations accounted for almost 50% of total treatments. Examinations alone added another 40% of total treatment performed in this study.

While radiographs are indicated for most patients presenting with trauma, they are not always possible. Ninety-three teeth were managed (beyond exam) without radiographs in the 3-year study period. The alternative diagnostic skills that are often necessary when treating the very young patient who has sustained trauma should be included in the emergency curriculum of dental schools.

It was surprising that the assistive restraint device (PB) was used more during regular clinic hours with full support staff present than after hours, when the resident on call was typically the sole care provider. The restraint was used more often by experienced attending pediatric dentists than by residents. The younger age of the patients treated by the attending dentists explains only part of this disparity. The majority of on-call residents have had little or no experience using the PB prior to their rotation at the hospital. The residents may be overly optimistic about the child's ability to cooperate, uncomfortable obtaining consent for use of the restraint, or have personal objections to physical restraint of children.

Understanding sources of dental trauma will help with the development of more effective prevention measures. Most falls in young children occur in the home. As parents childproof their homes with traditional measures, they could also address the risks posed by furniture. Closer parental supervision would also decrease a child's risk of injury both in and out of the home.

Dental injuries resulting from child abuse were reported only once in this study. This is reflective of the nature of the hospital's emergency services and its documentation of patient visits. Children suffering severe trauma following abuse are routed to the regional trauma center rather than Children's Hospital and Medical Center. Minor dental trauma resulting from abuse may have been attributed to falls. Details about the fall may have not been pursued by the provider if the injuries were consistent with routine dental trauma.

This study was limited by the nature of the sample. Information was extracted from records completed by 32 different providers. The records were complete but varied in degree of detail. As a result, superficial lacerations, bruises, and abrasions were not recorded in this study. Terminology and definitions varied between dentists and required careful reading by the records abstractor; interpretation errors were possible. Standardization of data collection is vital to the success of future multicenter studies.

Some dental injuries may have presented to the emergency room and never been seen by the dental staff. During the triage process they may have been missed altogether, or deferred due to more severe trauma or illness.

When assessing the intraexaminer reliability of the records abstractor, the errors made were consistent. The distinction between the determination of the cause of trauma from an unspecified fall vs. an unknown source was sometimes difficult to ascertain. It was also difficult to distinguish when severe subluxations or intrusions became luxation with displacement.

It would be beneficial to further explore several areas relating to dental trauma. While the overwhelming majority of injuries were straightforward and could have been treated in a private dental practice, parents and caregivers decided to seek care at the hospital. Accessing emergency dental treatment through a hospital is costly. Measures of parental decision-making regarding their choice of emergent dental care would allow insight on how to better manage health care resources. To understand the impact of dental trauma, detailed information about children treated in hospitals and private practice is necessary. The increased use of computer technology offers the opportunity for future prospective, multicenter studies.

Conclusions

1. Across all age groups, males show a higher frequency of dental trauma than females.
2. The highest frequency clusters of patient visits were grouped at age 2, and to a lesser degree age 8. Sixty-four percent of children seen were 6 and younger.
3. Young children show no significant seasonal variation in injury rate. Older children showed increased visits during the summer months. Fridays had the highest frequency of patient visits.

Sixty-nine percent of dental trauma emergency visits occured after regular clinic hours.

4. Primary teeth were injured more often than permanent teeth. Maxillary central incisors were most commonly injured. Lateral luxation, intrusion, and avulsion accounted for half of the injuries to primary teeth. Crown fracture, luxation, and avulsion were the most common injuries to permanent teeth.
5. Laceration of the maxillary gingiva was the most common soft-tissue injury.
6. Examination only and extraction were the most common treatments performed in the primary dentition. Common treatments in the permanent dentition included bandage restorations and placement of splints.
7. An assistive restraint device was used most frequently by experienced pediatric dentists during clinic hours for children requiring extractions. The restraint was used less often by dental residents providing after-hours care.
8. Young children were most often injured within the home. Falls on furniture accounted for 11% of injury sources in young children, and should be pointed out to parents as a risk factor. Older children were often injured outside the home, and many injuries could have been prevented with mouthguard use.

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