

Managing Pediatric Dental Trauma in a Hospital Emergency Department

Jonathan M. Mitchell, DMD, PhD

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Barbara Sheller, DDS, MSD, *Co-Chair*

Elizabeth Velan, DMD, MSD, *Co-Chair*

JoAnna Scott, PhD

Derya Caglar, MD

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DEDICATION

I dedicate this thesis to my wife, Hong, and two children, Nolan and Jenson, for their unconditional love and support. I appreciate all the sacrifices that they have made over the past two years. Thank you.

INTRODUCTION

Over the past several decades, a shift has taken place in the role of the hospital emergency department (ED) from a place that primarily treats significant trauma and other medical emergencies to a source of primary care. In 2007, half of ED visits were for emergent or urgent care (Niska et al, 2010). For uninsured patients or those with limited access to care, EDs are now the “provider of last resort for millions of patients” (Institute of Medicine, 2006). This change has also occurred in dentistry, most significantly for patients of low socioeconomic status including a disproportionate number of minorities (Pettinato et al, 2000). This demographic is more likely to be uninsured or have Medicaid, which decreases access to dental care (Mouradian et al, 2000; Slifkin et al, 2004). Patients without a dental home are more likely to seek treatment for dental emergencies at an ED (Cohen and Manski, 2006).

In the United States, ED visits increased 23.9% from 1997 to 2007 (Tang et al, 2010). Referred to as the “safety net of the safety net,” EDs have become inundated with underserved patients, many of whom present with non-urgent needs (Institute of Medicine, 2006). Studies focusing on ED wait times have shown that low acuity patients have longer wait times compared to patients with urgent symptoms, particularly at high-volume community or teaching hospitals (Canada Institute for Health Information, 2007; Tang et al, 2010). Overcrowded waiting rooms may delay treatment, increase the length of ED stay, and adversely impact the quality of care (McCarthy et al, 2009; Schull et al, 2004).

Numerous studies have examined the implications of treating dental emergencies in hospital EDs. Simple dental trauma results in thousands of ED visits every year. In contrast to a dental clinic where definitive care can be provided, hospital EDs are not optimal for treating minor dental trauma. In the United States, \$2 trillion is spent per year on health care or \$7,000 per person (American Medical Association, 2010). One of the strategies of the American Medical Association (AMA) to contain health care costs is to make care delivery more efficient by reducing unnecessary treatment and directing care to cost-effective sites (American Medical Association, 2010).

Dental emergencies are exacerbating the problem of overcrowded EDs (Schafermeyer and Asplin, 2003; Schneider et al, 2003). From 1997 to 2000, there were over 700,000 annual dental-related visits to hospital EDs in the United States (Lewis et al, 2003). Utilization of hospital EDs for dental-related emergencies is increasing nationwide as demonstrated by a California study reporting a 12% increase in ED dental visits from 2005 to 2007 (California Healthcare Foundation, 2009) and a similar study in Houston that showed a 121% increase from 1997 to 2001 (Ladrillo, 2006). A 2005 study of 6,431 patients presenting to hospital EDs in Nevada, had total associated costs of \$3.9 million. A 2010 study of five urban hospital EDs in Minnesota, reported over 10,000 ED visits for dental-related problems with total charges approaching \$5 million in one year (Davis, et al. 2010). In New York state, dental treatment costs at EDs and ambulatory surgery facilities increased from \$18.5 to \$31.3 million from 2004 to 2008 (Nagarkar, 2012). The majority of these charges were billed to public programs (Davis, et al. 2010; Nagarkar, 2012).

According to the American Society of Oral Surgeons (ASOS), emergency dental care is the “management or treatment of hemorrhage, upper airway impairment, trauma, acute infection, or acute inflammation involving the teeth and dentoalveolar processes which threatens the person’s life or substantially impairs the functioning of such structures” (DeLuke, 1976). These types of emergencies rely upon urgent care and may require advanced life support. Most dental-related emergencies that present to hospital EDs do not meet the ASOS definition.

Unless a hospital ED has dental providers, treatment of dental emergencies will be less definitive than care by a dentist (Graham et al, 2000; DeLuke, 1976). A 1999 study calculated that the cost per-visit in an ED was three to four times more than comparable treatment in an outpatient clinic (Thompson and Glick, 1999). ED medical services are not essential for appropriate management of most dental emergencies. When patients utilize more than one ED seeking dental emergency treatment this further compounds inefficiencies and consumption of resources (Sheller et al, 1997; Rowley et al, 2006).

Five studies of dental emergencies presenting to Seattle Children’s Hospital (SCH) have been published. In a review of 1,482 cases of after-hours dental emergencies presenting between

1982 and 1991, dental trauma comprised 60% of total visits, compared to caries (35%) and other (5%) (Zeng et al, 1994). Demographic differences were found between caries and trauma patients: Caucasians were twice as likely to present with dental trauma, non-Caucasians were more likely to present with caries-emergencies. Mean age of trauma patients was 5.5 years compared to 7.5 years for caries. Trauma patients were more likely to have private pay insurance (56% private, 29% none, and 15% Medicaid) compared to caries patients (35% private, 33% none, and 32% Medicaid).

In a study describing 487 patients presenting with trauma-related emergencies during clinic (59%) and after-hours (41%) between 1992 and 1994, patient characteristics, diagnoses, and treatment were analyzed (Lombardi et al, 1998). The emergency visit was the first experience with a dentist for 227 patients; 187 of first visit patients were 3.5 years or younger. Patient ethnicity was consistent with the previous study. Payer source was not reported. Most children had dental injuries that did not require hospital facilities for optimal treatment.

In a study of 2,683 dental emergencies from 1995 to 2003, 51% were trauma-related (Rowley et al, 2006). Most traumas involved tooth injuries (88%), primarily to maxillary incisors. Similar to previous SCH studies, there were ethnic differences: 55% of Caucasians presented for dental trauma compared to African-Americans (45%), Asians (35%), and Hispanics (38%). Trauma patients were usually younger than caries emergency patients. Medicaid was the most frequent payer (32%). Thirty-nine percent of trauma patients presented to the ED because no dentist was available. Twenty-eight percent of trauma patients had no dental home. Trauma patients came more frequently after hours and 11% were referred from another ED.

All services provided by the ED falls under the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). JCAHO pain standards were established in January 1, 2001 stating that, "patients have the right to appropriate assessment and management of pain" and consider pain to be the "fifth vital sign" to be assessed with temperature, pulse, respiration, and blood pressure (Phillips, 2000; JCAHO, 2012). A five level triage scale is used in the ED at SCH (Shelton 2009; Travers 2009; Christ 2010).

PURPOSE

The purpose of this study was three-fold: 1) examine the types of dental traumas presenting to an emergency department (ED) of an urban children's hospital, 2) describe the medical and dental services provided to these patients, 3) quantify treatment and wait times in the ED for dental trauma emergencies including the impact of pain score and level of triage acuity on time variables measured.

METHODS

The records of 265 after-hours dental trauma patients receiving emergency dental treatment at Seattle Children's Hospital (SCH) from January 1, 2008 through December 31, 2010, were analyzed in this Institutional Review Board-approved study. SCH is a 245-bed tertiary-care pediatric teaching hospital located in Seattle, Washington (King County), providing care from birth to age 21 years. After clinic hours (weekdays 5:00 PM to 8:00 AM; weekends/holidays all day), patients either call the hospital or present directly to the ED. Phone calls are triaged by an on-call pediatric dentistry resident who directs the patient to the ED as needed.

Patients presenting to the ED are initially triaged by a pediatric nurse (Figure 1). A triage score is assigned from 1 to 5, with lower numbers indicating a more acute problem. Pain is scored from 0 to 10 using a standardized scale with higher numbers indicating more severe pain. For purposes of this study, pain was categorized as low (0-3), moderate (4-6), or severe (7-10). Following the nursing assessment, ED patients are evaluated by a medical resident or fellow then by an ED attending. Patients are referred as indicated to the on-call dental residents. A problem-focused dental examination and acutely needed treatment is provided for emergency patients. All emergencies are treated by pediatric dental residents with an attending pediatric dentist available as needed.

Dental trauma type was classified as soft tissue, primary dentition, or permanent dentition. In the case of multiple injuries, the most severe injury determined the classification category. For example, an avulsed permanent incisor with gingival laceration was categorized as permanent tooth injury. All variables recorded for this study are listed in Appendix 1.

Data for this study came from the following sources: electronic medical record (Computerized Information System (CIS)), Epic Hyperspace™, paper medical record (hard chart), and an electronic SCH Department of Dentistry After-Hours Patient Log. Dental radiographs are stored with a copy of the dental treatment notes within the Department of Dentistry. Data extraction and entry was performed by a single dentist examiner. This study was conducted

under committee guidance as partial requirement for the Master's of Science in Dentistry Degree at the University of Washington.

Data was entered into a database program (Microsoft Excel®). Analysis was conducted with STATA Version 11.1 (StataCorp LP, College Station, TX). Descriptive statistics were calculated, including the mean and standard deviation for quantitative measures and frequency and percent for categorical variables. Comparisons were made between emergency types (primary tooth injury and permanent tooth injury) and between patient groups using analysis of variance or t test to compare group means and using a chi-square test to compare group frequencies.

RESULTS

A total of 265 patients with dental trauma (141 primary tooth injuries and 124 permanent tooth injuries) presented over the study period. Selected patient characteristics are displayed in Table 1. Mean patient age (7.1 ± 4.7 years), gender (Male 60%; Female 40%), ethnicity, payer status, and cause of injury are consistent with previous SCH studies (Lombardi et al, 1998; Rowley et al, 2006). Most patients were self-referred (78.9%). Of the 44 patients referred from other hospital EDs, 34 had trauma to permanent teeth. All ten patients referred by a dentist, had primary dental injuries (6 luxations, 3 complicated crown fractures, and 1 uncomplicated crown fracture).

Ten percent of patients had a dental home at SCH or one of its partner institutions (University of Washington and Odessa Brown Dental Clinic). Of all patients, 37.4% had no dental home; the mean age for these patients was 5.1 ± 4.2 years (Table 2). Differences in payer status were found between patients with primary versus permanent dental trauma. Nearly all patients with primary dental trauma had some form of dental insurance (91.6%) compared to 57.2% of patients with permanent dental trauma with dental insurance.

Medical and dental services provided

Of the 29% of patients who were given medications in the ED, the majority received analgesics (57.9% non-narcotics vs. 30.5% narcotics) (Table 4). There were no statistically significant differences between analgesic administration for primary and permanent dental traumas. Other services such as non-dental radiographs, extraoral sutures, or laboratory testing were rarely provided (Figure 3). For the 11 patients who received non-dental radiographic imaging, 8 involved bike or skateboard accidents (3 patients were wearing helmets).

Medications were prescribed for 64.5% of patients to be filled after discharge from the ED; prescription types were: 28.5% non-narcotic analgesics, 17.9% chlorhexidine, 14.1% narcotic analgesics, and 12.6% antibiotics (Table 5). Prescription patterns for primary versus permanent dental traumas differed significantly with more prescriptions for permanent traumas for narcotics ($p=0.016$), chlorhexidine ($p=0.023$), and antibiotics ($p<0.001$). Thirty-three percent

of prescriptions were for other commonly used pediatric medications including asthma controllers.

Dental treatment ranged in complexity from an examination to tooth reimplantation, splinting, and intraoral sutures (Table 6). Significant differences were found between primary and permanent dental traumas for most treatment categories, reflecting recommended trauma management by the American Academy of Pediatric Dentistry (American Academy of Pediatric Dentistry. Guidelines on Management of Acute Dental Trauma, 2009). Forty-six out of 265 patients (10.9%) received nitrous oxide anxiolysis and 13 patients (4.9%) were sedated for the dental procedure by an ED physician.

Triage level

Triage scores were recorded for 263 of 265 patients (Table 3). Two-hundred and sixteen were triaged with level 3 or 4 type injuries, evenly distributed for both primary and permanent dental injuries. Forty-four patients were triaged at a higher acuity level (triage 2) and none were triaged at the highest level (triage 1). As triage acuity increased, indicative of a more severe dental injury, there was an increase in wait time for MD, dental treatment time, and overall length of stay (Table 3 and Figure 4). Comparing patients with triage score 4 to those with triage score 2, increased times were 25 minutes for physician wait time, 5 minutes for dental treatment, and 40 minutes overall length of stay.

Pain score

Pain scores (low, moderate, or severe) were recorded for 215 of 265 patients (Table 4). Patient gender was not associated with pain score. Patients reporting moderate or severe pain were significantly older than those with low pain; low (5.8 ± 4.4 years), moderate (8.2 ± 4.7 years, low vs. moderate $p=0.004$), severe (9.6 ± 4.7 , low vs. severe $p<0.001$). No significant age differences were found between moderate and severe pain groups. As pain level increased, there was a trend towards analgesic administration in the ED and/or prescription (Figure 2).

As pain level increased, the overall length of stay in the ED also increased; a difference of 58 minutes (low vs. severe) for primary dental injuries and 21 minutes (low vs. severe) for permanent dental injuries (Table 4). For high pain levels, the mean wait time to MD for primary dental injuries was 85.6 ± 46.2 minutes compared to 47.8 ± 40.2 for permanent dental injuries. Dental treatment time was not significantly associated with pain scores. However, for the small number of children with primary dental trauma and severe pain, treatment time was increased.

ED wait and treatment times

The average time between dental injury and check-in time at the ED exceeded 2 hours (Table 7). The mean overall length of stay in the ED was nearly 3 hours, with no significant differences between primary and permanent dental traumas. Time was spent waiting for providers and receiving medical and dental services. The overall mean wait time for a physician evaluation (Time to MD) was 50.9 ± 39.1 minutes and patients with primary dental injuries waited a mean of 10 minutes longer than those with permanent dental injuries ($p < 0.05$). Time receiving dental treatment differed significantly between primary (49.0 ± 23.8 minutes) and permanent (61.6 ± 29.7 minutes) dental traumas ($p < 0.001$). Administration of medications ($p < 0.001$) or prescriptions ($p < 0.001$) significantly increased overall length of stay for both dental injury types; a mean of 40 minutes for medications administered and 35 minutes for prescriptions.

DISCUSSION

A hospital ED is not the optimum environment for treating routine dental trauma; care is time-consuming, expensive, and may not be definitive. Our findings confirm previous reports from this institution and others regarding patient demographics, injury types, and dental treatment (Lombardi et al, 1998; Rowley et al, 2006). To our knowledge, this is the first study to examine the broader implications of receiving care for dental trauma in a hospital ED. If the majority of time patients spend in the ED is not used receiving dental services, then what other services or activities account for the time spent?

Since 2001, the AAPD has advocated establishment of a dental home by age 12 months for all children (AAPD Policy on Dental Home, 2011). One of the reasons for establishing a dental home at an early age is to secure a resource for emergency services. Over one-third of patients in this study lacked a dental home; this was not limited to the youngest children. In a previous study at this institution, Lombardi and co-authors found that the emergency dental visit was the first appointment for most children younger than age three and under, similar to our results (Lombardi et al, 1998). Despite educational measures encouraging the public and healthcare providers to establish a dental home by age one year, this study indicates that additional efforts are needed. Surprisingly, most of the dentally homeless patients in this study had private insurance; financial resources for dental care were not presumed to be the primary barrier. Nearly all dental traumas require timely follow-up, which is problematic for those patients without a dental home. In a 2011 study of permanent tooth injuries, few patients returned for recommended follow-up (Gustafson et al, 2011).

Hospital EDs follow JCAHO protocols including pain scores for each emergency patient (Phillips, 2000; JCAHO, 2012). In this study, pain scores were correlated with an increase in overall length of stay including longer wait times for medical providers and the overall length of stay in the ED. Although counterintuitive, wait times for an evaluation by an ED physician were longer with high pain dental injuries. This may be explained by the complexity of the injury requiring extensive monitoring and stabilization as well as ancillary medical services including radiographic imaging or extraoral sutures prior to treatment of their dental injury. Not

surprisingly, a high pain score was associated with longer dental treatment times for injuries to primary teeth. This may be explained both by the complexity of the injury and lack of patient cooperation in some young patients. Interestingly, few patients received nitrous oxide during their dental treatment, most likely due to equipment challenges with a mobile nitrous oxide system.

As pain score increased, both medications administered in the ED and prescriptions for analgesics increased. However, in the group with the highest levels of pain, administration of analgesics in the ED occurred less than 50% of the time and analgesic prescriptions slightly more than half the time. This suggests that the dental treatment was expected to alleviate or eliminate the pain. The benefit of analgesic medication is accompanied by an increased amount of time waiting for the medication to be ordered or the prescription to be written, clearly illustrated by our results. Receiving analgesic medication in the ED added an average of 40 minutes, and receiving a prescription added an average of 35 minutes to the overall length of stay (Figure 5). The majority of analgesic prescriptions were for medications readily available over the counter, compounding time inefficiency with increased cost. An additional time burden exceeding one hour for patients receiving both analgesic administration and prescription is significant both to families and overloaded EDs. Families discharged with a prescription faced additional waiting time in the pharmacy. Just over a third of patients received prescriptions for other medications not related to their dental injury (e.g. albuterol, multivitamins); it is possible that many of these patients did not have a medical home.

A more acute triage score correlated with an increase in all time variables. For more complex dental injuries, necessary medical management including the need for ancillary services, administration of medications, and additional periods of monitoring increased wait times and overall length of stay. Accordingly, with a more complex dental injury it is not surprising that the dental treatment time is longer.

In this study, the mean time elapsed from the dental injury to checking in at the ED exceeded two hours. Timely care for dental trauma is associated with improved outcomes for some injuries such as avulsions (Andreasen et al, 2002; Flores et al, 2007; AAPD Guidelines on

Management of Acute Dental Trauma, 2009). Resources need to be in place so that patients can reimplant and/or reposition teeth thereby improving long-term outcomes. Although the majority of patients have had a medical screening by age 1, physicians are not adequately trained or equipped to manage a dental injury. A 2012 study in the United Kingdom showed that only a small number of ED physicians felt confident in managing common dental traumas (Trivedy et al, 2012). Educating parents, teachers, and coaches in the appropriate initial management of dental injuries is critical. Multiple studies report that parents and teachers have low knowledge levels for managing dental trauma (Vergotine and Koerber, 2010; Hashim, 2011).

Although appropriate and timely dental treatment is essential, preventing dental injuries is of the utmost importance. As seen in this and previous studies, falls were the most common cause of dental injury. Over half of all injuries to primary teeth trauma involved a fall indoors. In particular, a coffee table in the home presents as a unique hazard for young children still developing coordination skills (Agostini et al, 2001; Cho et al, 2010). Although bicycle and sports-related injuries comprised a small percentage of total dental injuries, the majority involved permanent tooth trauma. In this study, bicycle or scooter injuries when the patient was not wearing a helmet resulted in more severe dental injuries (luxations and avulsions) compared to when a helmet was worn (data not shown). The wearing of protective equipment including mouthguards is promoted by both the AAPD and Academy for Sports Dentistry (ASD) to minimize sports-related injuries (AAPD Policy on Prevention of Sports-related Orofacial Injuries, 2009; Academy of Sports Dentistry, 2012).

Although the “dental home” concept was adopted more than ten years ago, this study shows that many children still do not have a dental home by age one year. If families have a dentist to contact following a dental trauma, many patients would receive care in an office setting minimizing time and expense. The economic implications of managing dental traumas in an ED are unfavorable for patients and third party payers. It is the interest of the insurance industry to minimize cost of care. Both medical and dental insurance vendors may wish to commit resources to educational efforts promoting the dental home.

Although the authors of this study have extensive experience with hospitals and EDs, we were surprised that only one-third of time spent by dental trauma patients was used receiving dental services (Figure 6). This study demonstrates the need to improve efficiencies in the ED by reducing overall wait and treatment times. One option may involve fast tracking medically stable patients; this would be optimal for time-sensitive dental injuries such as permanent tooth avulsions (Andreasen et al, 2002).

Limitations of this study are differences in the quality of record keeping among multiple medical and dental providers, subjectivity of pain scores in young patients, inconsistency in triage scores, and missing data including pain scores and some time parameters. In the current climate of healthcare reform, and the quest for effective and cost efficient care this study illustrates multiple opportunities to improve care for patients with dental trauma in the domains of dental home, fast tracking within the ED, and minimizing the delay between injury and accessing services.

FIGURES

Figure 1. Patient flow in ED for pediatric dental trauma

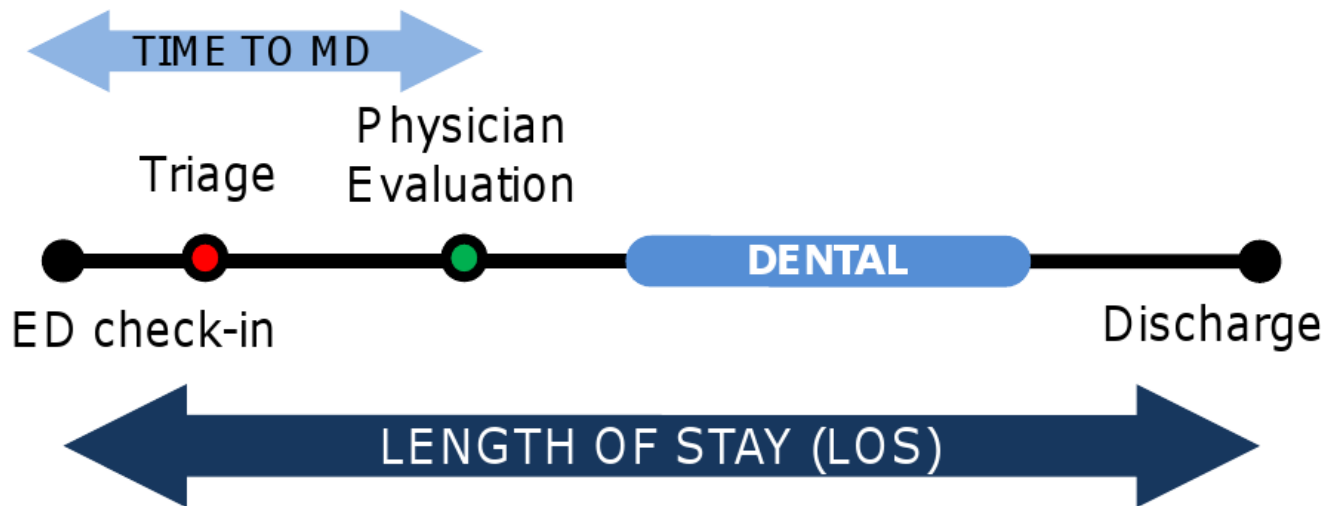
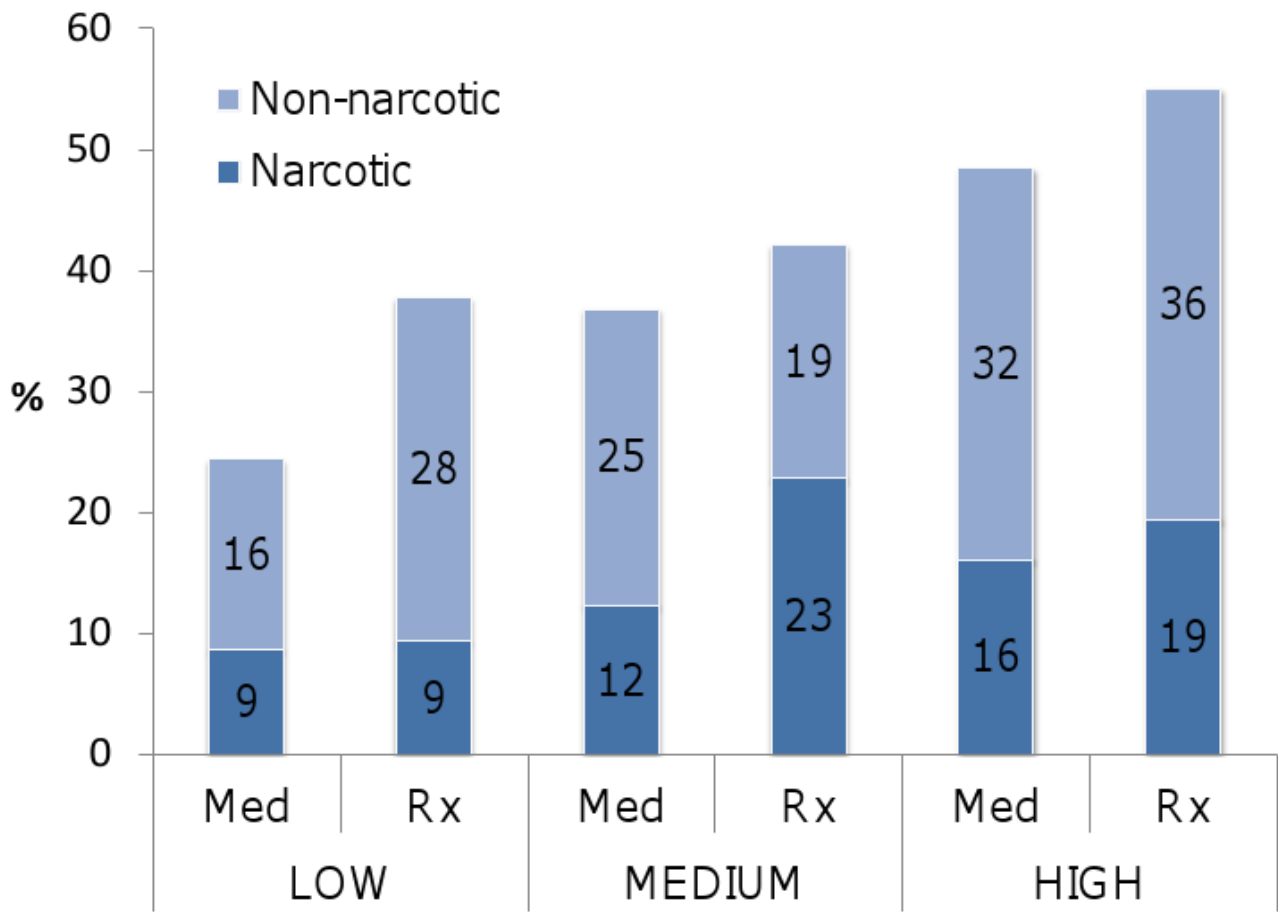


Figure 2. Relationship between pain level and type of pain management



Key: Medication administered in ED (Med); Prescription written (Rx); Pain scores: Low (0-3), Medium (4-6), High (7-10)

Figure 3. Medical services provided for dental trauma patients in the ED

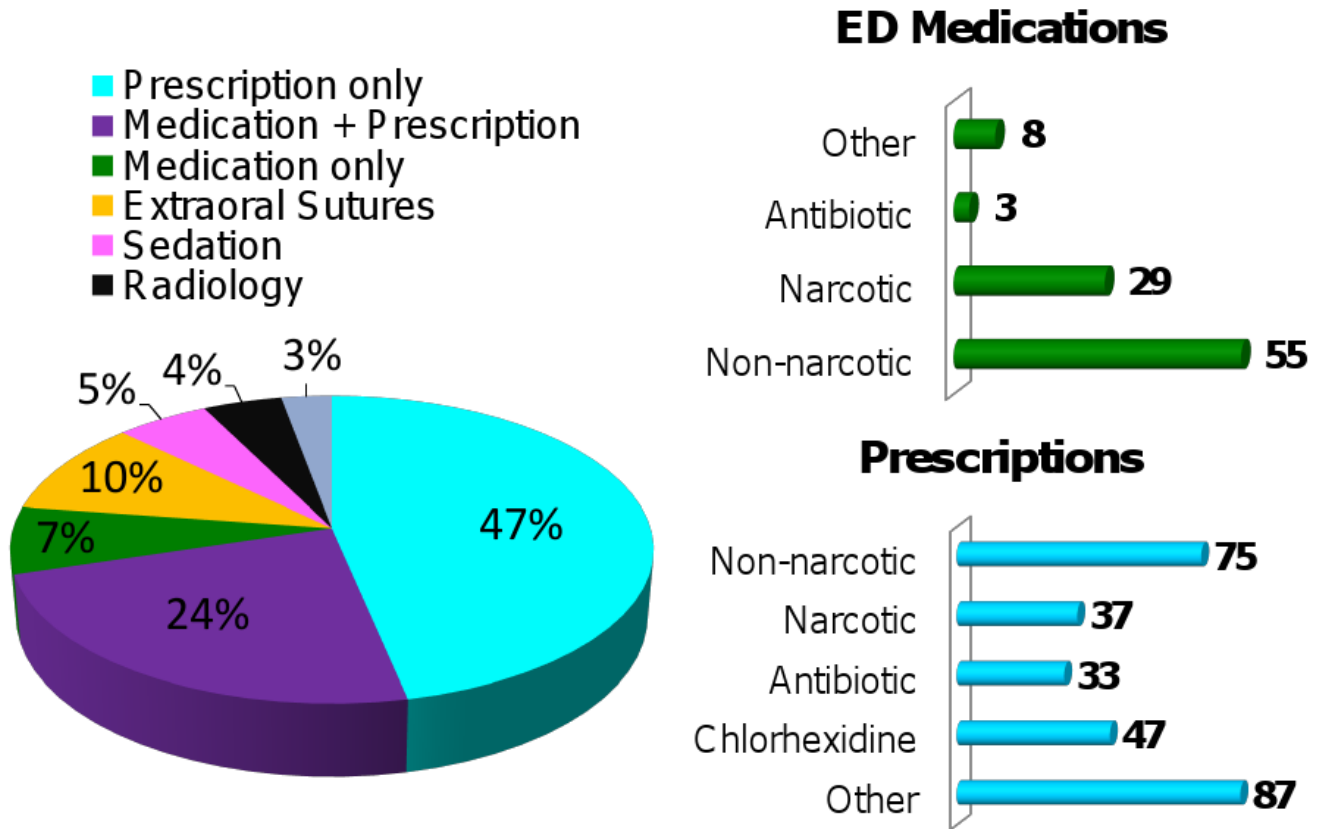


Figure 4. Relationship of triage score to ED treatment and wait times for dental trauma patients

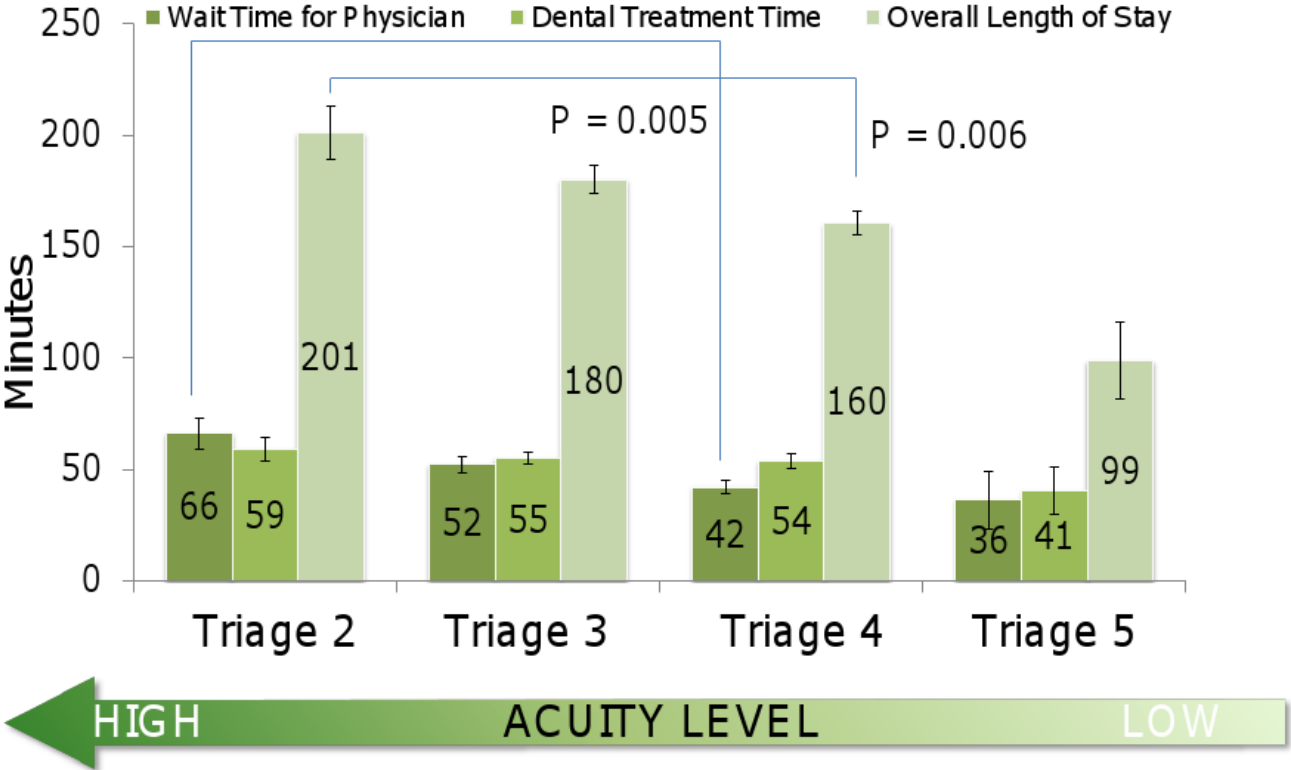


Figure 5. Impact of medications or prescriptions on overall length of stay in ED

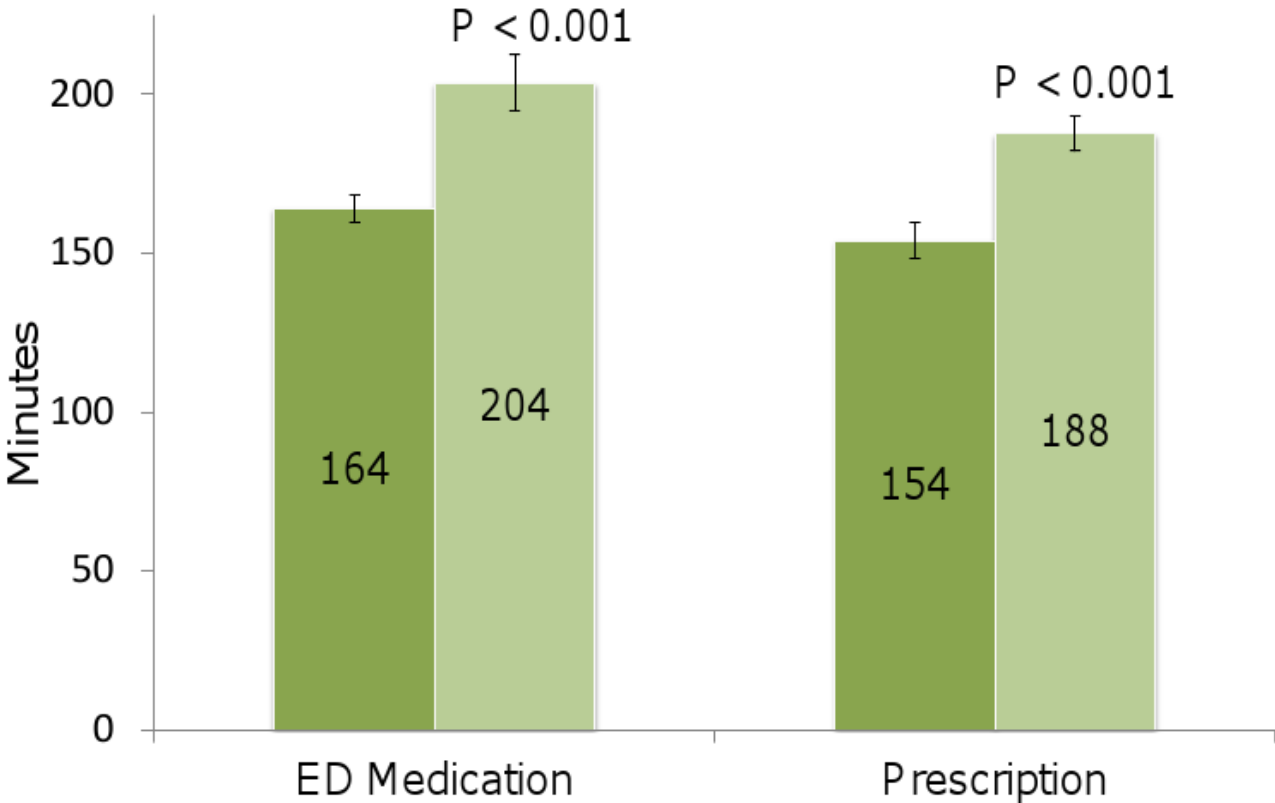
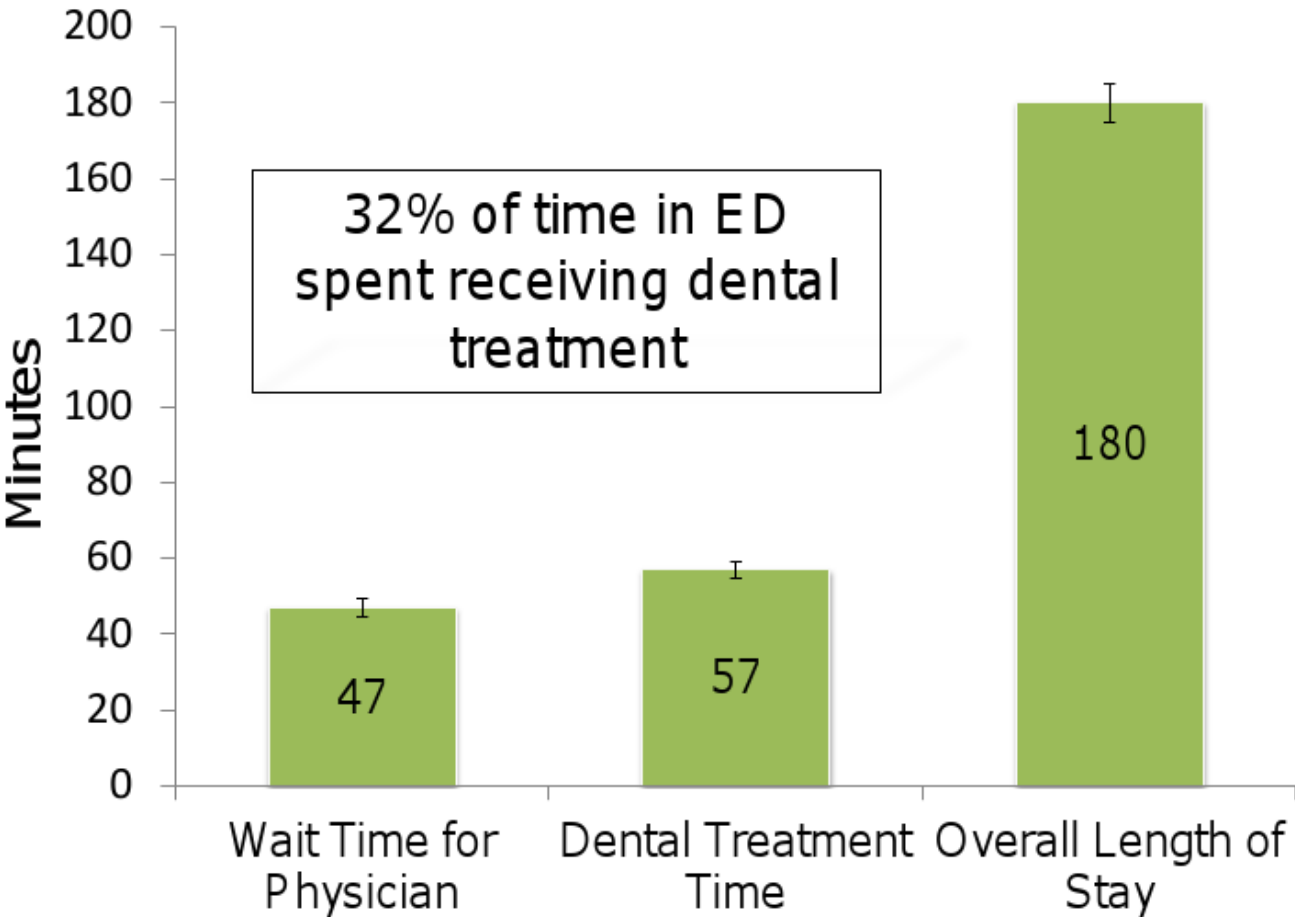


Figure 6. Wait and treatment times for dental trauma patients presenting to a hospital ED



TABLES

Table 1. Demographics and cause of injury in patients presenting with dental trauma to a hospital emergency department (ED)

		All Patients N=265	Primary Trauma N=141	Permanent Trauma N=124
Age (years)	Mean ± (SD)	7.1 ± (4.7)	3.0 ± (1.7)	10.9 ± (3.3)
	Median, Range	6.3, 0.1-21.6	3.2, 0.7-8.1	10.7, 6.0-21.6
		N (%)	N (%)	N (%)
Gender	Male	158 (60)	80 (57)	75 (63)
	Female	107 (40)	61 (43)	46 (37)
Ethnicity	Caucasian	166 (63)	91 (65)	75 (61)
	African American	42 (16)	22 (16)	20 (16)
	Hispanic	19 (7)	8 (6)	11 (9)
	Asian	19 (7)	11 (8)	8 (7)
	Other	11 (4)	6 (4)	5 (4)
	Unknown	8 (3)	3 (2)	5 (4)
Interpreter	Yes	31 (12)	17 (12)	14 (11)
	No	234 (88)	124 (88)	110 (89)
Payer Status	Private	139 (53)	83 (59)	56 (45)
	Medicaid	41 (16)	21 (15)	20 (16)
	Medicaid + Private	38 (14)	21 (15)	17 (14)
	Self Pay	36 (14)	14 (10)	22 (18)
	Charity	11 (4)	2 (1)	9 (7)
Dental Home	Private	120 (45)	53 (38)	67 (54)
	UW/Seattle	28 (11)	4 (3)	24 (19)
	Children's	14 (5)	11 (8)	3 (2)
	Community clinic	99 (37)	71 (50)	28 (23)
	None	4 (2)	2 (2)	2 (1)
Referral Source	Self-referral	209 (79)	119 (84)	90 (73)
	Hospital	44 (17)	10 (7)	34 (27)
	Dentist	10 (4)	10 (7)	0 (0)
	Physician	2 (1)	2 (1)	0 (0)
Zip Code by County	King	204 (77)	113 (80)	91 (73)
	Snohomish	45 (17)	20 (14)	25 (20)
	Pierce	7 (3)	4 (3)	3 (2)
	Other	9 (3)	4 (3)	5 (4)
Cause of Injury	Fall indoors	93 (35)	72 (51)	21 (17)
	Fall outdoors	62 (24)	41 (29)	21 (17)
	Bicycle/scooter	34 (13)	9 (6)	25 (20)
	Athletics	17 (6)	1 (1)	16 (13)
	Other	62 (24)	16 (11)	46 (37)
	Unknown	3 (1)	3 (2)	0 (0)

Table 2. Demographics for patients with no dental home presenting to an ED with dental trauma

		All Patients N=99	Primary Trauma N=71	Permanent Trauma N=28
Age (years)	Mean ± (SD)	5.1 ± (4.2)	2.8 ± (1.5)	10.8 ± (3.3)
	Median, Range	3.3, 0.7-20.6	2.5, 0.7-6.8	10.7, 0.7-20.6
		N (%)	N (%)	N (%)
Gender	Male	54 (55)	37 (52)	17 (61)
	Female	45 (46)	34 (48)	11 (39)
Ethnicity	Caucasian	61 (62)	47 (66)	14 (50)
	African American	14 (14)	9 (13)	5 (18)
	Hispanic	11 (11)	3 (4)	8 (29)
	Asian	8 (8)	8 (11)	0 (0)
	Other	3 (4)	3 (4)	0 (0)
	Unknown	2 (2)	1 (1)	1 (4)
Interpreter	Yes	14 (14)	8 (11)	6 (21)
	No	85 (86)	63 (89)	22 (79)
Payer Status	Private	50 (51)	45 (63)	5 (18)
	Medicaid	15 (15)	10 (14)	5 (18)
	Medicaid + Private	16 (16)	10 (14)	6 (21)
	Self Pay	12 (12)	5 (7)	7 (25)
	Charity	6 (6)	1 (1)	5 (18)
Referral Source	Self-referral	84 (85)	65 (92)	19 (68)
	Hospital	13 (13)	4 (6)	9 (32)
	Dentist	1 (1)	1 (1)	0 (0)
	Physician	1 (1)	1 (1)	0 (0)
Zip Code by County	King	77 (78)	56 (79)	21 (75)
	Snohomish	18 (18)	13 (18)	5 (18)
	Pierce	3 (3)	2 (3)	1 (4)
	Other	1 (1)	0 (0)	1 (4)

Table 3. Relationship of triage score to wait and treatment times in an ED

	All Patients N=263	Primary Trauma N=139	Permanent Trauma N=124	Time to Physician, minutes Mean ± (SD)	Dental Treatment Time, minutes Mean ± (SD)	Overall LOS, minutes Mean ± (SD)
Triage Score						
2	44 (17)	21 (15)	23 (19)	66.4 ± (47.0) N=43	58.5 ± (29.7) N=34	201.1 ± (80.7) N=44
3	131 (50)	74 (53)	57 (46)	52.0 ± (41.2) N=130	54.8 ± (27.3) N=91	179.6 ± (70.5) N=131
4	85 (32)	42 (30)	43 (35)	41.9 ± (28.3) N=83	53.7 ± (27.0) N=68	160.3 ± (49.4) N=85
5	3 (1)	2 (1)	1 (1)	36.3 ± (22.5) N=3	40.5 ± (14.8) N=2	98.7 ± (30.0) N=3

Table 4. Relationship of pain score to treatment times and medical interventions for patients presenting to an ED with dental trauma

	All Patients N=215	Low (0-3) N=127	Moderate (4-6) N=57	Severe (7-10) N=31
	N (%)	N (%)	N (%)	N (%)
Age				
Mean ± (SD)	7.0 ± (4.7)	5.8 ± (4.4)	8.2 ± (4.7)	9.6 ± (4.7)
Median, Range	6.7, 0.7-21.6	4.9, 0.8-17.5	8.9, 1.2-18.9	9.5, 0.7-21.6
Gender				
Male	130 (60)	75 (59)	37 (65)	18 (58)
Female	86 (40)	53 (41)	20 (35)	13 (42)
Triage Score				
2	36 (17)	17 (13)	12 (21)	7 (23)
3	105 (49)	57 (45)	30 (53)	18 (58)
4	71 (33)	50 (39)	15 (26)	6 (19)
5	3 (1)	3 (3)	0 (0)	0 (0)
Medications in ED				
Narcotic	23 (11)	11 (9)	7 (12)	5 (16)
Non-narcotic	44 (21)	20 (16)	14 (25)	10 (32)
Prescriptions				
Narcotic	31 (14)	12 (9)	13 (23)	6 (19)
Non-narcotic	58 (27)	36 (28)	11 (19)	11 (35)
Wait and treatment times in ED, minutes ± (SD)				
Wait time for physician	50.7 ± (41.0)	49.9 ± (42.3)	49.4 ± (35.1)	56.4 ± (46.2)
Primary trauma	50.7 ± (46.4)	55.2 ± (47.1)	54.5 ± (40.5)	85.6 ± (56.7)
Permanent trauma	44.5 ± (34.1)	42.7 ± (33.8)	45.1 ± (29.9)	47.8 ± (40.2)
Dental treatment time	55.4 ± (25.9)	54.8 ± (27.4)	53.3 ± (22.5)	61.0 ± (26.8)
Primary trauma	48.7 ± (22.2)	48.7 ± (20.3)	44.1 ± (21.2)	63.7 ± (36.1)
Permanent trauma	61.9 ± (27.7)	63.7 ± (33.6)	60.7 ± (21.1)	60.1 ± (24.4)
Overall length of stay in ED	169.0 ± (58.2)	161.6 ± (54.6)	171.3 ± (61.0)	195.3 ± (61.2)
Primary trauma	162.5 ± (58.0)	157.2 ± (53.2)	162.3 ± (67.1)	218.4 ± (49.2)
Permanent trauma	175.3 ± (58.0)	167.6 ± (56.5)	178.4 ± (55.9)	188.6 ± (63.6)

Table 5. Medical services provided to pediatric patients presenting to an ED with dental trauma

	All Patients N=265 N (%)	Primary Trauma N=141 N (%)	Permanent Trauma N=124 N (%)	P-value
MEDICATIONS ADMINISTERED				
Non-narcotic	55 (21)	28 (20)	27 (7)	0.677
Narcotic	29 (11)	12 (9)	17 (7)	0.169
Antibiotic	3 (1)	2 (2)	1 (4)	0.644
Other	8 (8)	3 (3)	5 (4)	0.361
PRESCRIPTIONS				
Non-narcotic	75 (29)	43 (31)	32 (26)	0.282
Narcotic	37 (14)	13 (9)	24 (19)	0.016
Chlorhexidine	47 (18)	8 (6)	39 (31)	0.023
Antibiotic	33 (13)	11 (8)	22 (18)	<0.001
Other	87 (33)	49 (36)	38 (31)	0.334
ADJUNCT SERVICES				
Sedation	13 (5)	10 (7)	3 (2)	0.084
Extraoral sutures	24 (9)	15 (11)	9 (7)	0.360
Radiology	11 (4)	3 (2)	8 (7)	0.078
Laboratory services	3 (1)	0 (0)	2 (2)	
Diagnostic	4(2)	1 (1)	3 (2)	

Table 6. Dental services provided to pediatric patients presenting to an ED with dental trauma

	All Patients N=265	Primary Trauma N=141	Permanent Trauma N=124	P-value
	N (%)	N (%)	N (%)	
DENTAL SERVICES				
Intraoral radiographs	230 (87)	110 (78)	120 (97)	<0.001
Extraction	85 (32)	80 (57)	5 (4)	<0.001
Indirect pulp capping	58 (22)	4 (3)	54 (44)	<0.001
Exam only	53 (20)	40 (28)	13 (11)	<0.001
Splint	39 (15)	0 (0)	39 (32)	<0.001
Intraoral sutures	34 (13)	24 (17)	10 (8)	0.033
Nitrous oxide	29 (11)	17 (12)	12 (10)	
Pulpotomy	22 (8)	0 (0)	22 (18)	<0.001
Reimplant tooth	6 (2)	0 (0)	6 (5)	0.007
Reposition tooth	5 (2)	2 (1)	3 (2)	0.540
Other	6 (2)	4 (3)	2 (2)	0.517

Table 7. Wait and treatment times for patients presenting to an ED with dental injury, mean times±(SD)

	All Patients	Primary Trauma	Permanent Trauma	P-value
Time of injury to check-in	129.4 ± (129.7)	129.5 ± (149.9)	129.3 ± (109.4)	0.989
Wait time for physician	50.9 ± (39.1)	55.4 ± (42.9)	45.8 ± (33.7)	0.048
Dental treatment time	54.9 ± (27.4)	49.0 ± (23.8)	61.6 ± (29.7)	0.001
Overall length of stay in ED	176.0 ± (67.6)	172.1 ± (68.7)	175.9 ± (67.6)	0.319

Table 8. Impact of administration of medications and prescriptions on overall length of stay in the ED for dental trauma patients, mean times \pm (SD)

	All Patients	P-value	Primary Trauma	P-value	Permanent Trauma	P-value
ED MEDICATION						
Yes	203.5 \pm (83.3)	<0.001	205.0 \pm (84.3)	<0.001	205.7 \pm (76.8)	0.006
No	164.1 \pm (56.1)		155.4 \pm (52.3)		167.4 \pm (56.4)	
PRESCRIPTION						
Yes	187.5 \pm (71.0)	<0.001	186.0 \pm (72.9)	<0.001	189.6 \pm (70.0)	0.014
No	153.8 \pm (54.7)		151.8 \pm (57.0)		157.8 \pm (50.9)	

Table 9. Patients characteristics for triage level 2 dental traumas presenting to a hospital ED

		All Patients N=44	Primary Trauma N=21	Permanent Trauma N=23
Age (years)	Mean±(SD)	7.3 ± (3.9)	3.7 ± (1.8)	10.4 ± (2.2)
	Median, Range	6.8, 0.8-14.0	3.0, 0.8-7.9	10.0, 6.0-14.0
		N (%)	N (%)	N (%)
Referral Source	Self-referral	31 (71)	18 (86)	13 (57)
	Hospital	11 (25)	1 (5)	10 (44)
	Dentist	0 (0)	0 (0)	0 (0)
	Physician	2 (5)	2 (10)	0 (0)
Cause of Injury	Fall indoors	9 (21)	8 (38)	1 (4)
	Fall outdoors	10 (23)	7 (33)	3 (13)
	Bicycle/scooter	8 (18)	2 (9)	6 (26)
	Athletics	2 (5)	1 (5)	1 (4)
	Other	14 (32)	2 (10)	12 (52)
	Unknown	1 (2)	1 (5)	0 (0)
Dental Injury Types	Avulsion	13 (30)	5 (24)	8 (35)
	Luxation	14 (32)	7 (33)	7 (30)
	Complicated crown fracture	6 (14)	1 (4)	5 (22)
	Other	11 (25)	8 (38)	3 (13)
Medical Services	Extraoral sutures	7 (16)	4 (19)	3 (13)
	Sedation	4 (9)	4 (19)	0 (0)
	Radiology	4 (9)	0 (0)	4 (17)
	Laboratory services	1 (2)	0 (0)	1 (4)
	Diagnostic	2 (5)	0 (0)	2 (9)

Table 10. Types of dental injuries presenting to SCH ED (2008-2010)

	Primary Trauma N=141	Permanent Trauma N=124
	N (%)	N (%)
Luxation	72 (51)	31 (25)
Lateral	35 (25)	12 (10)
Extrusion	17 (12)	13 (10)
Intrusion	20 (14)	6 (5)
Crown fracture	23 (16)	68 (55)
Uncomplicated	8 (6)	45 (36)
Complicated	15 (11)	23 (19)
Avulsion	14 (10)	17 (14)
Subluxation	12 (9)	2 (2)
Soft tissue	13 (9)	5 (4)
Concussion	1 (1)	0 (0)
Alveolar fracture	5 (4)	1 (1)
Root fracture	1 (1)	0 (0)

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APPENDIX 1. Data recorded from each patient and emergency record.

- Medical Record Number
- Date and time of service
- Date of birth
- Ethnicity
- Gender
- Zip code
- Interpreter status
- Payer
- ER triage acuity: 1, 2, 3, 4
- Pain score: 1-10
- Medical services provided: medical radiography, diagnostic imaging, laboratory tests, extraoral sutures, sedation, medications, and prescriptions
- Dental treatment provided

Temporal data (see Figure 1 for timeline):

- Time of injury
- Arrival time at ER (Check-in)
- Triage time in ER
- Time to physician examination
- Dental treatment time
- Discharge time