Nonfatal Sport-Related Craniofacial Fractures: Characteristics, Mechanisms, and Demographic Data in the Pediatric Population

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Background: Few reports exist on sport-related craniofacial fracture injuries in the pediatric population. Most patients with craniofacial injuries are adults, and most studies on pediatric sport injuries do not focus specifically on craniofacial fractures. The authors' goal was to provide a retrospective, descriptive review of the common mechanisms of sport-related craniofacial injuries in the pediatric population, identifying the characteristics of these injuries and providing a description of the demographics of this population.
Methods: The study population included children between the ages of 0 and 18 years who were seen in the emergency department at Children's Hospital of Pittsburgh of the University of Pittsburgh Medical Center between 2000 and 2005. Of the 1508 patients identified, 167 had injuries caused by sport-related trauma (10.6 percent).
Results: After evaluation in the emergency department, 45.5 percent were hospitalized, and 15.0 percent of these were admitted to the intensive care unit. The peak incidence of sport-related injuries occurred between the ages of 13 and 15 years (40.7 percent). Nasal (35.9 percent), orbital (33.5 percent), and skull fractures (30.5 percent) were most common, whereas fractures of the maxilla (12.6 percent), mandible (7.2 percent), zygomaticomaxillary complex (4.2 percent), and naso-orbitoethmoid complex (1.2 percent) were observed less frequently. Baseball and softball were most frequently associated with the craniofacial injuries (44.3 percent), whereas basketball (7.2 percent) and football (3.0 percent) were associated with fewer injuries. The most common mechanisms of injury were throwing, catching, or hitting a ball (34.1 percent) and collision with other players (24.5 percent).
Conclusion: These data may allow targeted or sport-specific craniofacial fracture injury prevention strategies. (*Plast. Reconstr. Surg.* 131: 1339, 2013.)

Participation in sports carries an increased risk of injury in the pediatric population, and sport-related injury is one of the leading causes of childhood injury.[1] An estimated 30 million children participate in sport-related activities annually, and the incidence of sport-related injury is 4 million.[1] Craniofacial injury is the second most common sport-related injury and is involved in up to 20 percent of all pediatric sport-related injuries in the United States.[2–9] Children are more likely to be hit in the face during player-to-player contact or player-to-object contact, or by falling while playing sports.

Available literature on sport-related injury in the pediatric population focuses on epidemiology, mechanism, management, and injury prevention strategies. There is a paucity of studies that focus on pediatric craniofacial fractures. Our literature search revealed no studies specifically related to sport-associated craniofacial fractures in children.

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Received for publication November 5, 2012; accepted December 5, 2012.

DOI: 10.1097/PRS.0b013e31828bd191

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

The goal of this study was to investigate the demographics, common mechanisms of sport-related craniofacial injuries, and the site and fracture patterns sustained during common sport activities in the pediatric population.

PATIENTS AND METHODS

Patients presenting to a level I regional trauma center and children's hospital emergency department were identified based on inclusion/exclusion criteria, as approved by the institutional review board. Inclusion criteria included the following: age between 0 and 18 years and treatment in the pediatric emergency department for facial and/or skull fractures between the years 2000 and 2005. Results were further refined to include patients with sport-related injury only. Data collected included demographic data, fracture type, sport type, mechanism of trauma, trauma site (anatomical location of impact), location of injury (e.g., school, home), Glasgow Coma Scale score, severity of trauma (trauma level), and fracture pattern. This study was conducted under the approval of the Institutional Review Board of the Children's Hospital of Pittsburgh at the University of Pittsburgh Medical Center.

Statistical Analysis

Descriptive analysis (mean, median, and cross-tabulation) was used to describe demographics of sport-related injury, number of participants injured in each sport type, and mechanism of trauma. To determine whether the severity of trauma was different by sport, a 3 × 2 chi-square test for each sport using Fisher's exact correction was performed. Chi-square test, Fisher's exact test, and correlation analyses were performed.

RESULTS

Demographics for All Sports

Of the initial cohort of 1508 patients with craniofacial fractures, 167 had a sport-related injury (10.6 percent). After treatment in the emergency department, 45.5 percent of patients with sport-related injury required hospitalization, of whom 15.0 percent were admitted to the intensive care unit and 31.1 percent required surgery for craniofacial injury (Table 1). Seventeen children experienced loss of consciousness (10.2 percent). The mean ± SD lowest recorded Glasgow Coma Scale score was 14.6 ± 1.8 (range, 3 to 15). There were no cases of mortality.

Of those injured, 80.8 percent were boys and 19.2 percent were girls (male-to-female ratio, 4.21:1). The peak incidence of sport-related injury occurred between the ages of 13 and 15 years (40.6 percent), followed by the 10- to 12-year-old age range (23.4 percent), whereas injuries in 6- to

Table 1. All Sport-Related Pediatric Craniofacial Injuries

	No. (%)	Average Age in Years (range)	No. Admitted to Hospital (%)	No. of Admissions Sent to ICU (%)*	Average Lowest Recorded GCS Score (range)	Average LOS in Days (range)	No. Requiring Surgery (%)
All sports	167	13 (6–18)	80 (45.5)	12 (15.0)	14.6 (3–15)	1.6 (0–18)	52 (31.1)
Baseball/softball	74 (44.3)	12.7 (6–17)	27 (36.5)	2 (7.4)	14.9 (9–15)	1.1 (0–18)	19 (25.7)
Skateboarding	14 (8.4)	13.8 (8–17)	14 (100)	3 (21.4)	13.5 (3–15)	4.5 (1–15)	3 (21.4)
Soccer	13 (7.8)	14.7 (7–17)	7 (53.8)	2 (28.6)	14.8 (14–15)	1.9 (0–9)	7 (53.8)
Basketball	12 (7.2)	15.0 (10–17)	0	0	15	0.3 (0–1)	3 (25.0)
Skiing/snowboarding	9 (5.4)	13.4 (11–15)	6 (66.7)	1 (16.7)	14.9 (14–15)	2.3 (0–10)	3 (33.0)
Horseback	8 (4.8)	15.1 (10–17)	7 (87.5)	2 (28.6)	12.0 (3–15)	0.3 (0–1)	2 (25.0)
Golf	6 (3.6)	8.7 (6–10)	4 (66.7)	0	15	1.3 (0–3)	2 (33.3)
Street hockey	6 (3.6)	12.5 (7–16)	4 (66.7)	0	15	1.2 (0–3)	2 (33.3)
Football	5 (3.0)	15.2 (13–16)	3 (60)	1 (33.3)	13.0 (5–15)	3.2 (0–6)	3 (60.0)
Rollerblading	5 (3.0)	11.8 (7–16)	5 (100)	1 (20.0)	14.6 (13–15)	3.2 (2–5)	2 (40.0)
Wrestling	4 (2.4)	13.4 (8–17)	0	0	15	0.75 (0–2)	2 (50.0)
Ice skating	2 (1.2)	12.0 (9–14)	0	0	15	0.5 (0–1)	0 (0)
Bike riding	1 (0.6)	14.4	1	0	15	2	0
BMX	1 (0.6)	16.6	1	0	15	2	0
Cheerleading	1 (0.6)	17.6	0	0	15	0	1
Gymnastics	1 (0.6)	13	0	0	15	0	1
Karate	1 (0.6)	14.8	0	0	15	0	1
Lacrosse	1 (0.6)	12.7	0	0	15	0	0
Swimming	1 (0.6)	13.4	0	0	15	0	1
Track	1 (0.6)	16.3	0	0	15	0	0
Roller hockey	1 (0.6)	13.1	1	0	15	0	0

ICU, intensive care unit; GCS, Glasgow Coma Scale; LOS, length of stay; BMX, bicycle motocross.
*Percentage of admitted patients who were sent to the intensive care unit.

Table 2. Fracture Distribution for All Sports

	Skull (%)	Orbit (%)	Naso-Orbitoethmoid (%)	Maxillary (%)	Zygomatico-maxillary Complex (%)	Nasal (%)	Mandible (%)
All sports	51 (30.5)	56 (33.5)	2 (1.2)	21 (12.6)	7 (4.2)	60 (35.9)	12 (7.2)
Baseball	16 (21.6)	31 (41.9)	1 (1.4)	13 (17.6)	3 (4.1)	30 (40.5)	2 (2.7)
Skateboarding	10 (71.4)	5 (35.7)	0	1 (7.1)	0	0	1 (7.1)
Soccer	3 (21.3)	2 (15.4)	0	2 (15.4)	1 (7.7)	6 (46.2)	2 (15.4)
Basketball	0	2 (16.7)	0	0	0	9 (75.0)	0
Skiing/snowboarding	2 (22.2)	6 (66.7)	1 (11.1)	2 (22.2)	1 (11.1)	4 (44.4)	0
Horseback	5 (62.5)	5 (62.5)	0	1 (12.5)	1 (12.5)	0	0
Golf	4 (66.7)	0	0	1 (16.7)	0	2 (33.3)	0
Street hockey	3 (50.0)	1 (16.7)	0	0	0	0	3 (50.0)
Football	1 (20.0)	1 (20.0)	0	0	1 (20.0)	1 (20.0)	2 (40.0)
Rollerblading	3 (60.0)	0	0	1 (20.0)	0	0	1 (20.0)
Wrestling	0	2 (50.0)	0	0	0	2 (50.0)	0
Skating	1 (50.0)	0	0	0	0	1 (50.0)	0
Bike riding	1	0	0	0	0	0	0
BMX	1	0	0	0	0	0	0
Cheerleading	0	0	0	0	0	1 (100.0)	0
Gymnastics	0	0	0	0	0	1 (100.0)	0
Karate	0	0	0	0	0	1 (100.0)	0
Lacrosse	0	1 (50.0)	0	0	0	1 (50.0)	0
Swimming	0	0	0	0	0	1 (100.0)	0
Track	0	0	0	0	0	0	1 (100.0)
Roller hockey	1 (100.0)	0	0	0	0	0	0

BMX, bicycle motocross.

9-year olds (18.0 percent) and 16- to 18-year-olds (18.0 percent) were least frequent. There were no sport-related injuries in children younger than 6 years. One hundred fifty children were Caucasian (89.8 percent), 11 were African American (6.6 percent), one was Hispanic, and one was other. Ethnicity was unavailable in four cases.

Pattern of Injury for All Sports

The patterns of fracture distribution are listed in Table 2. Dentoalveolar involvement was relatively uncommon (5.4 percent).

Cause of Injury for All Sports

Being hit by a ball was the most common cause of injury (44.9 percent) and occurred most frequently when the patients were throwing, catching, or hitting the ball themselves (34.1 percent) (Table 3). Less frequently, players were "collateral damage," such as being struck by a teammate's misthrown ball (10.8 percent). Falls were the fourth most common cause of injury (18.6 percent). Several children were kicked by a horse when horseback riding, and one child practicing karate kneed himself in the face. Information regarding cause was insufficient in four cases.

Injury by Sport

Baseball and softball were associated with the most craniofacial fractures (44.3 percent). Basketball and football were associated with fewer injuries (7.2 percent and 3.0 percent, respectively) (Table 1).

Regarding specific fracture patterns, soccer was strongly correlated with dentoalveolar and maxillary fracture ($\varphi = 0.171$, $p = 0.031$; $\varphi = 0.193$, $p = 0.015$, respectively). Skateboarding had a strong correlation with dental crown fracture and skull fracture ($\varphi = 0.164$, $p = 0.039$; $\varphi = 0.273$, $p < 0.001$, respectively). Horseback riding had a strong correlation with skull trauma ($\varphi = 0.158$, $p = 0.047$). Basketball had a negative correlation with skull trauma ($\varphi = -0.191$, $p = 0.016$).

Cause of Injury for Baseball/Softball

Trends were evident when examining cause of injury by sport type (Table 4); 70.3 percent of all baseball/softball injuries were related

Table 3. Cause of Injury for All Sports

Cause of Injury	No. (%)
Hit by ball	75 (44.9)
Throwing, catching, or hitting	57 (34.1)
Collateral damage*	18 (10.8)
Collision with another individual	41 (24.5)
Fall	31 (18.6)
Struck by car	5 (3.0)
Collision with object	4 (2.4)
Insufficient information	4 (2.4)
Collision with sporting equipment	3 (1.8)
Kicked by horse	3 (1.8)
Collision with self	1 (0.6)

*Collateral damage, when a player was struck by a ball accidentally, such as by a teammate's misthrown ball.

Table 4. Cause of Injury by Sport

Cause of Injury by Sport	No. (%)
Baseball/softball	
Catching: struck by ball	52 (70.3)
Collateral damage	9 (12.2)
Collision with another player	5 (6.8)
Throwing/hitting: struck by ball	4 (5.4)
Insufficient information	3 (4.1)
Hit by sporting equipment	1 (1.4)
Basketball	
Collision with another player	12 (100.0)
Football	
Collision with another player	5 (100.0)
Golf	
Collateral damage	6 (100.0)
Horseback riding	
Fall	5 (62.5)
Kicked by horse	3 (37.5)
Ice skating	
Fall	2 (100.0)
Rollerblading	
Fall	4 (80.0)
Struck by car	1 (20.0)
Skateboarding	
Fall	11 (78.6)
Struck by car	3 (21.4)
Skiing/snowboarding	
Fall	4 (44.4)
Collision with object	4 (44.4)
Collision with another player	1 (11.1)
Soccer	
Collision with another player	12 (92.3)
Collateral damage	1 (7.7)
Street hockey	
Collision with another player	3 (50.0)
Blocking: struck by puck	2 (33.3)
Collateral damage	1 (16.7)
Wrestling	
Collision with another player	3 (75.0)
Insufficient information	1 (25.0)

to the patient's attempt to catch a ball. Most frequently, this involved a line drive (40.5 percent of all baseball/softball injuries), followed by fly balls, where the child either misjudged the ball's trajectory or was blinded by the sun (18.1 percent of all baseball/softball injuries). Being hit by another player's bat (8.1 percent) was less common, whereas 5.4 percent of patients had collided with another player, either when they and another player ran to the same ball, or when sliding to a base. The few batting-related injuries occurred when players were batting and the ball struck them in the face (4.1 percent). Several injuries were related to inattention: one accidental/bystander injury occurred when an unsuspecting child was hit by a foul ball, and two occurred when the unsuspecting child was hit by a teammate's bat (4.1 percent).

Cause of Injury for Other Sports

All injuries in basketball and football, and most in soccer, were caused by collision with another player, whereas all injuries in golf were caused by the child being hit by another player's golf club. Interestingly, all injuries incurred while skiing or snowboarding, and the large majority of those incurred while skateboarding, were in children who had not worn helmets (Table 5). Horseback riders, meanwhile, were more likely to be wearing helmets at the time of injury.

Table 5. History of Protective Equipment for Selected Sports

Protective Equipment	No. (%)*
Skateboarding	
Helmet	1 (7.1)
No helmet	13 (92.9)
Skiing/snowboarding	
Helmet	0 (0)
No helmet	5 (100)
Other†	4
Horseback riding	
Helmet	3 (75.0)
No helmet	1 (25.0)
Other†	4

*Based on known helmet-wearing status.
†Insufficient information.

Initial Injury Severity Level

Regarding all sport-related injuries, 4.4 percent were trauma level 1 injuries (unstable airway or vital signs, or spinal cord injury), 30.4 percent were level 2 trauma (multiple system, stable), and 65.2 percent were level 3 trauma (unisystem injury) (Table 6). Using a Kendall tau-b analysis to determine association between specific sports and trauma level, higher or more severe trauma level was associated with horseback riding ($\tau = 0.272$, $p = 0.021$) and skateboarding ($\tau = 0.314$, $p = 0.002$). For horseback riding, level 1 trauma was 28.6 percent, level 2 trauma was 57.1 percent, and level 3 trauma was 14.3 percent (chi-square = 11.158, $p = 0.003$). For skateboarding, level 1 trauma was 14.3 percent, level 2 trauma was 64.3 percent, and level 3 trauma was 21.4 percent (chi-square = 13.591, $p = 0.001$). Average Glasgow Coma Scale score was lowest for horseback riding (12.0; range, 3 to 15), whereas the average Glasgow Coma Scale score for skateboarding was 13.5 (range, 3 to 15).

DISCUSSION

Overall Incidence of Pediatric Sport-Related Injury

In the United States, it is estimated that between 30 and 54 million children aged between

Table 6. Trauma Level/Glasgow Coma Scale Score by Sport*

Sport	GCS Score (range)	Average Trauma Level (range)	Trauma Level (%)		
			1	2	3
All sports	14.6 (3–15)	2.60 (1–3)	6 (4.4)	45 (30.4)	93 (65.2)
Baseball/softball	14.9 (9–15)	2.8 (1–3)	1 (1.6)	13 (21.7)	46 (76.7)
Basketball	15 (15)	3 (3)	0	0	10 (100.0)
Bike riding	15 (15)	2 (2)	0	0	1 (100.0)
BMX	15 (15)	3 (3)	0	0	1 (100.0)
Cheerleading	15 (15)	3 (3)	0	0	1 (100.0)
Football	13 (5–15)	2.5 (1–3)	1 (25.0)	0	3 (75.0)
Golf	15 (15)	2.3 (2–3)	0	4 (66.7)	2 (33.3)
Gymnastics	15 (15)	3 (3)	0	0	1 (100.0)
Horseback riding	12 (3–15)	1.9 (1–3)	2 (28.6)	4 (57.1)	1 (14.3)
Ice skating	15 (15)	3 (3)	0	0	2 (100.0)
Karate	15 (15)	3 (3)	0	0	1 (100.0)
Lacrosse	15 (15)	3 (3)	0	0	1 (100.0)
Rollerblading	14.6 (13–15)	3 (3)	0	4 (80.0)	1 (20.0)
Roller hockey	15 (15)	3 (3)	0	0	1 (100.0)
Skateboarding	13.5 (3–15)	2 (1–3)	2 (14.3)	9 (64.3)	3 (21.4)
Skiing/snowboarding	14.9 (14–15)	2.4 (2–3)	0	5 (55.6)	4 (44.4)
Soccer	14.8 (14–15)	2.5 (2–3)	0	4 (50.0)	4 (50.0)
Street hockey	15 (15)	2.8 (2–3)	0	2 (33.3)	4 (66.7)
Swimming	15 (15)	3 (3)	0	0	1 (100.0)
Track	15 (15)	3 (3)	0	0	1 (100.0)
Wrestling	15 (15)	3 (3)	0	0	4 (100.0)

GCS, Glasgow Coma Scale; BMX, bicycle motocross.
*Trauma level was unknown for 23 patients.

6 and 18 years participate in sports each year.[1,10] Participation in athletic activity translates into significant health benefits but is not without risk: over 4 million pediatric sport-related injuries occur each year.[1] Although there are reports in the literature regarding pediatric sport-related injuries, none focuses specifically on pediatric sport-related craniofacial fractures, which constitute 9 to 20 percent of pediatric sport-related injuries in the United States,[2–9] and approximately one-third of pediatric facial fractures occur secondary to sports participation.[11] The frequency of craniofacial fracture sport-related injuries in children and adolescents underscores the importance of recognizing and minimizing sport-related craniofacial trauma. In this study, we reviewed all craniofacial fracture sport-related injuries over 5 years at a major children's hospital emergency department and trauma center. Of all sports, baseball and softball together were associated with the most craniofacial fractures. Basketball and football, despite being more popular among children than baseball and softball,[12] were associated with fewer injuries. Overall, nasal, orbital, and skull fractures were most common.

Demographics

Consistent with other pediatric sport-related injuries, the majority of craniofacial fracture sport-related injury occurred in boys and within the 13- to 15-year-old age group.[6,7,11,13–17] Boys have been attributed with engaging in more aggressive, risk-taking behavior, leading to an increased incidence of injury in comparison with girls.[2,18–23] Regarding age, the flexibility of facial bone, lack of pneumatization of the paranasal sinus, and prominent buccal fat pad reduce the incidence of facial fracture before 13 years of age.[2,21] Later, during the growth spurt period, children are particularly prone to injury because of the discrepancy between bone matrix formation and bone mineralization, which diminish bone strength and render bones especially vulnerable to external forces.[1,24] In addition, it is within this 13- to 15-year-old age group that children first begin to participate in a greater number of contact sports, and are under less adult supervision.[13] As participants learn sports at a more competitive level, decreased balance and coordination increases their propensity to injury.[1] In contrast with other pediatric craniofacial fracture studies that have found orbital or mandibular fractures to be most common,[3,13,19,25–29] including a study published by our institution that included craniofacial fractures of all causes,[13] fractures of the nasal bone were the most common craniofacial sport-related injury; this is consistent with the growth and increasing prominence of the midface during this age, in relation to the most common cause of injury (being hit by a ball).[13,30,31]

Cause of Injury and Prevention

Overall, being hit by a ball was the most common cause of injury, followed by collision with another individual, and falls. However, the cause of injury tended to differ between sports. Baseball and softball injuries were frequently skill related, being mostly caused by a failed attempt to catch a ball. All injuries in basketball and football were secondary to collision with another player. For football players, most injuries were caused by collisions with others' helmets after a purposeful hit during play. In contrast, for basketball players, the majority of patients were injured accidentally after colliding with another player's elbow or chin. Soccer injuries were also incurred because of accidental collision with another player, either in head-on-head collision, or by knee or foot to face. All golf injuries were attributable to inattention—in all but one case, the patient stood too close to another player who was swinging a golf club or had hit themselves with the golf club, whereas the remaining case occurred when the patient was struck by a ball hit from 15 feet away. For several other sports—horseback riding, ice skating, and rollerblading—the majority of injuries were secondary to falls.

Approaches to reducing sports injuries overall may also reduce craniofacial injuries. Children injured during golf were on average the youngest group; this finding is consistent with others who have found that pediatric golf injuries occur most often in younger children.[32–35] Golf injuries most often occur in the home, with the most common mechanism of injury being "struck by a golf club," stressing the importance of supervision for younger children playing this sport.[34] For organized sports, it has been shown that avoiding multiple practices in a day decreases injury[36]; similarly, it is important to allow appropriate time for rest, recovery, and sleep.[37] Observance of rules and "fair play" by sports participants should be fostered as a strategy for reducing the frequency of injury.[36,38,39] Players newly learning a sport are especially prone to injury because of slower reaction times, reduced ball-handling accuracy, less coordination, and fear of the ball.[39,40] Special care should be taken during this period in coaching players, and prevention programs may be effective in educating coaches and players in mindful and defensive play, thereby reducing accidental injuries.[41–43] This approach, which has been used in soccer, has been especially effective in low-skill teams.[41]

Protective equipment is implemented for many sports.[38,44] There is already strong evidence to support helmet use for skateboarding, skiing/snowboarding, and horseback riding.[45–48] Our data are consistent with support of helmet use; in only one of 14 skateboarding accidents was a helmet worn, with the majority of injuries involving skull fractures; similarly, no skiers/snowboarders had recorded use of a helmet. Data were available on four of the eight horseback sport-related injury; three of the four had worn helmets. One-third of pediatric horse-related injuries involve an unmounted child, and helmet use is important when in the proximity of a horse, regardless of activity.[49] In addition, although helmet use provided protection from cranial injury, a number of patients presented with facial fractures, suggesting the potential use for face guards in addition to helmets, which has been suggested for horseback riding.[50]

Nasal protectors have been offered as potential adjunctive protective equipment for basketball and soccer.[51] Rigid protection offers resistance to deformation (decelerating force of impact), and flexibility in the device deforms to distribute and absorb energy, in addition to increasing comfort.[51] For soccer, which had a significant correlation with dentoalveolar fracture, use of protective mouth guards may be of special consideration.[52] Although data are available regarding the mechanical advantages of additional protective gear, a limitation remains that studies have yet to prove their clinical efficacy.

Several equipment modifications have been accepted as reducing injuries in baseball and softball. In this study of craniofacial fractures in the pediatric population, and in other studies surveying players of all ages and injury types, the majority of baseball/softball injuries result from impact with the ball.[53–55] It has been shown that low-impact, softer balls—those approved by National Operating Committee on Standards for Athletic Equipment youth softballs and baseballs—reduce injuries, and should be used in the younger population.[37,53,54] Consistent with the findings in this study, baseball and softball are a primary cause of sport-related craniofacial fractures across age groups.[37,56,57] In addition to focusing on a safe playing environment, motor and technical skill, and mindful and defensive game play,[43] helmets for batters and faceguards for catchers are well-accepted components of game play across skill levels. Despite the fact that only players in these positions routinely wear facial protective gear, the majority of pediatric craniofacial fractures related to baseball and softball occur when players are in defensive,

field positions.[58] Considering that face guards are effective protective equipment in preventing facial fractures, and that the majority of fractures in baseball/softball players reported here occurred in field positions, our strongest recommendation for injury prevention may be further consideration of face protective equipment for players fielding in baseball and softball.

Craniofacial Fracture Management

Overall, pediatric patients presenting with sport-related injury craniofacial fractures were not in a critical state: the average Glasgow Coma Scale score was 14.6, and only 12 of the 167 patients were admitted to the intensive care unit. More often than in adults, pediatric facial fractures may be treated conservatively because of the greater capacity for remodeling of bone in younger patients, although this may vary by institution and the surgeon's preference. For example, in a study published by Eggensperger-Wymann et al., 12 percent underwent closed reduction and only 13 percent underwent surgery.[2] Similar to the percentage of patients requiring surgery in this current reported population (31 percent), in our previous publication detailing craniofacial fractures resulting from all injuries, 36 percent underwent operative management.[13]

Contrary to a previous study regarding craniofacial fractures in our pediatric population, nasal fractures, not orbital fractures, were the most common sport-related fracture type. This may be because of the cause of injury in the study population, with the most injuries occurring as a result of collision with a baseball: projected forward in relation to adjacent structures, the nasal bone has an increased likelihood of damage. Even when not complex, fracture of the nasal bone may result in nasal deviation, dorsal hump, or obstructive breathing, treatment of which may involve septorhinoplasty at skeletal maturity.[4] This may be especially true regarding damage to the cartilaginous portion of the nasoseptovomeral region, which can result in significant growth disturbance, whereas isolated nasal bony fractures result in less growth disturbance, lessening the likelihood of need for later corrective surgery.[4,59] Orbital fractures were second most common and may often be treated nonoperatively.[4,60,61] Fractures of the skull, which were third most common, would be less of a concern regarding growth in the pediatric sport-related injury population, as these patients will have completed skull growth by 5 years of age.

Limitations

One limitation of this study is that the data include only children seen in our institution's emergency department, and do not include children who sought care in other settings such as outpatient clinics and other local emergency departments. Although the information presented in this article is detailed, some information—such as whether a supervisor was present or not during the sport activities; whether injury occurred during a competition, training, or recreational format; and whether protective equipment other than a helmet was worn by the child—is not available. The frequency of a sport's association with sport-related injury may be associated with its popularity,[62,63] and our data may be specific to the popularity of sports in our patient population.

CONCLUSIONS

This study represents all patients younger than 18 years who were seen at a high-volume, tertiary care center with a sport-related craniofacial fracture. As such, we add a significant amount of information to a thus far sparsely covered topic in the literature. These data provide a general risk estimation between sport-related injury and craniofacial fractures and may prove useful in developing future measures for prevention.

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