Report

Peer-reviewed paper: submitted November 2014; accepted May 2015

Trends in paediatric maxillofacial trauma presenting to Dunedin Hospital, 2006 to 2012

Jung TK, De Silva HL, Konthasingha PP, Tong DC

ABSTRACT

Objectives: The purpose of this study was to review the epidemiology, aetiology and management of maxillofacial injuries in the paediatric population seen in Dunedin, New Zealand from 2006 to 2012.

Materials and Methods: A retrospective descriptive analysis was conducted over a 7 year period. Data concerning demographics, injuries and management of patients between the ages of 0-17 years who presented to the oral and maxillofacial service in Dunedin were gathered and analysed.

Results: 340 incidents that excluded pure dental trauma were recorded. Falls were found to be the most common cause of injury; followed by contact with animate objects (other individuals and animals), contact with inanimate objects and road traffic accidents. Injuries in younger age groups were found to be caused by falls and contact with inanimate objects more often, receiving predominantly soft tissue injuries. In the older age group, a higher number of facial fractures were seen with a change in the most common causes to road traffic accidents and contact with animate objects. An increase in alcohol-related road traffic accidents was noted among females. For all injuries the male to female ratio was 2:1 which is similar to previous reports from New Zealand and overseas. For the sub group of facial fractures a much higher ratio of males were seen at a ratio of 8.5:1.

Conclusions: Causes of injury and anatomical location followed similar patterns to reports worldwide, along with a similar male to female ratio. Although the incidence of road traffic accident related facial injuries is relatively low, the high proportion of these accidents involving paediatric patients and alcohol is of concern.

INTRODUCTION

Maxillofacial injuries involve soft and hard tissue structures which include the face, lips, teeth and the facial bones. The most common causes of facial fractures among children include unintentional falls, sports injuries and road traffic accidents (Zimmerman et al. 2005). Road traffic accidents remain a significant cause of maxillofacial injuries despite an overall reduction in incidence attributed to changes in legislation, better vehicle safety standards and improved public awareness of road traffic safety.

Facial fractures in the paediatric population account for less than 15% of all facial fractures, with fractures in individuals below 5 years of age comprising only 0.6% to 1.4% of these (Gassner et al. 2004, Zimmerman et al. 2005). Although facial bone fractures form only a small proportion, the morbidity from these injuries have greater potential effects in young patients due to possible disturbances in growth and development of the facial skeleton (Kieser et al. 2002, Gassner et al. 2004). Injury to the maxillofacial region in young children especially to the nasal septum and mandibular condyles may lead to growth disturbances resulting in adverse outcomes. Even when managing paediatric facial fractures conservatively, making the correct diagnosis and undertaking regular monitoring and review are all fundamental principles of care (Proffit et al. 1980, Koltai and Rabkin 1996, Morris et al. 2012).

There has been limited research of paediatric maxillofacial fracture rates in New Zealand, but those that have been completed follow a similar trend to rates seen overseas, with reports of incidence ranging from 9.5 to 191.4 per 100,000 in children and adolescents (Kieser et al. 2002). The rates of fracture injuries in children is generally lower than adults and may be due to a number of factors including lower alcohol consumption, anatomical differences, and involvement in activities with less risk. In children less than 5 years of age the relatively small area of the face compared to the skull offers some protection in terms of facial injuries but not head injuries. However as facial growth and development increase, the incidence of facial bone injuries also increases (Zimmerman et al. 2005).

The aim of this study was to describe the trends in aetiology, epidemiology and management of maxillofacial injuries in the paediatric population presenting to a tertiary institution over a seven year period.

MATERIALS AND METHODS

This study reviewed patients who were managed by the oral and maxillofacial surgery service at Dunedin Hospital during a seven year period from 2006 to 2012.

A standardised data collection form was used to collect information on a total of 340 patients with head and neck injuries under the age of 18 years. Data was gathered regarding patient demographics (age, gender, ethnicity, socioeconomic status, referral source, medical history, dental history and history of previous trauma), place and cause of injury, type of injury, number of tissues involved, complications, and treatment provided. Incidents that did not have complete information recorded and those that were confined to purely dental trauma were excluded.

Injuries were recorded in two separate categories–those that presented within 24 hours of the accident and those that presented after 24 hours. This was to avoid missing potentially severe injuries that had a latent period before clinical signs of injury presented. When more than one anatomical site was involved in a single incident, only the most severe injury was counted in order to avoid the multiple injuries being interpreted as separate events. The deprivation status of each patient was collated using meshblock data to identify the deprivation score of households (Statistics New Zealand 2013). Deprivation scores range from 1 to 10, with a score of 1 indicating those that live in an area that is least deprived (highest socioeconomic status) and deprivation score 10 being those that are most deprived (lowest socioeconomic status).

The type and cause of injury were classified according to ICD-10 classification (ICD 10, S00 – S19 for injuries to the head and neck; ICD V01 – Y34 for external causes of morbidity and mortality); these categories were later condensed into broader categories to ensure statistical significance.

Statistical analysis was performed using IBM SPSS Statistics V21.0. Patient characteristics were analysed using descriptive statistics and comparisons were performed using Pearson's chi square test.

RESULTS

From January 2006 to December 2012, a total of 340 children and adolescents younger than 18 years of age were seen by the regional Oral and Maxillofacial Surgery service in Dunedin. Almost one third of maxillofacial injuries in the sample were due to unintentional falls (31.5%). Almost one quarter were due to contact with animate objects–other people or animals (23.5%), followed by injuries sustained from contact with inanimate objects (22.4%) and road traffic accidents (20.3%) – which also include bicycle accidents and accidents as a pedestrian. Unwitnessed causes and unspecified injuries comprise the remaining 2.3% (Figure 1).

Age and gender distribution

The age of patients at the time of injury ranged from 0 to 17 years, with a mean age (SD) of 8.75 ± 5.6 years. Eight percent were infants under the age of 2 years. Peak incidences were seen in children between the age of 3 and 5 years (early childhood) and those between 13 and 17 years of age (adolescence) making up over two thirds of the study population (34.8% and 34.5% respectively). A relatively smaller proportion of injuries (22.7%) involved children between 6 and 12 years of age (late childhood). Figure 2 summarises the age and gender distribution. There was just over a 2:1 ratio of boys (n = 231) compared with girls (n = 108) in the study population.

Yearly and monthly distribution

The annual numbers of patients seen showed two peaks in 2006 and 2008, and a general reduction in the number of incidents from 2008 onwards. The monthly distribution peaked in April (12.4%) with further peak incidences during February (10.6%), May (10%), and October (10.6%). The overall pattern showed an increased incidence during summer and early spring. The lowest figures were typically in July (5%) and December (5.3%).

Ethnicity and deprivation status of patients

The majority of patients were identified as New Zealand European (58.8%) whereas a relatively low number identified themselves as New Zealand Maori or Pacific Islanders (7.1% and 0.9% respectively). Approximately twenty percent (20.6%) did not state their ethnicity and 12.6% were recorded as "Other". The number of injuries for deprivation score by residential address were similar in all scores (approximately 10%) with the exception of those from deprivation score 1 (16%) and deprivation score 10 (4.5%). The deprivation score when cross-tabulated with time until presentation did not show any significant differences with the vast majority of patients presenting themselves for care within 24 hours (83.2%).

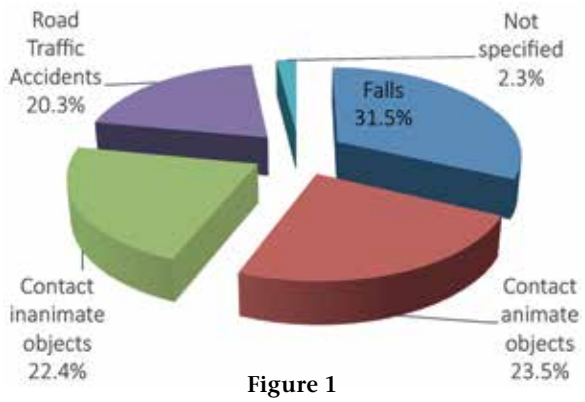

Figure 1

Source of referrals and location of event

Just over half of the incidents did not have the referral source stated (50.6%) however of the remainder, the majority were referred from medical practitioners (40.3%), followed by non-clinician referrals (6.2%). Referrals from general dental practitioners were less than one percent and the remaining two percent were unspecified. Almost one third of the injuries were sustained in a private setting (32.1%), followed by those in public transport areas (20.9%), sports fields (12.6%) and general public areas (9.7%) The location where the injury occurred could not be determined in almost a quarter of the records (24.7%) due to inadequate description or data.

Types of injury

Of the 340 patients, 39 patients received facial bone fractures (11.5%), 232 suffered from open soft tissue injuries (68.2%), 59 received superficial injuries (17.4%) and 5 received injuries to the temporomandibular joint (1.5%). Of the remaining patients that were referred to the department for evaluation, a maxillofacial injury could not be confirmed in three patients and injury was not stated in two patients.

Facial bone fractures

There were 39 facial bone fractures. The most common sites of injury were the mandible (58.9%) and midface (maxillary and zygoma) region (20.6%). Smaller numbers were seen in orbital

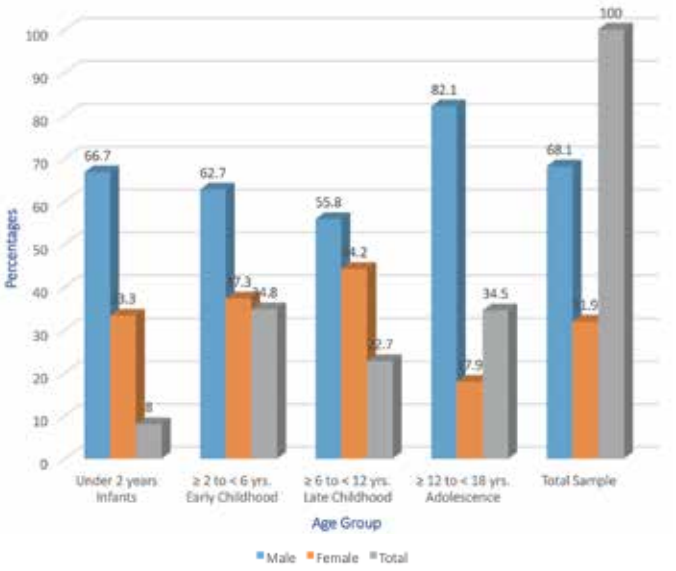

Figure 2

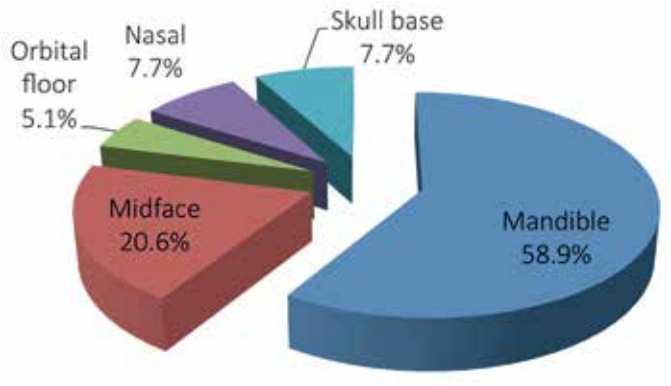

Figure 3

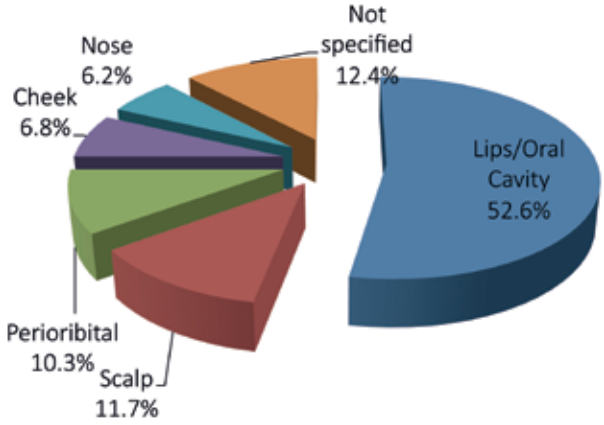

Figure 4

floor fractures (5.1%), nasal bone fractures (7.7%) and fractures of the cranium including skull base (7.7%) (Figure 3). The leading cause of injury was due to contact with animate objects (other individuals and animals) (56.4%), followed by road traffic accidents (17.9%). The highest incidence of facial bone fracture was seen among the adolescent age group (13 to 17 years) at 87.2%. A clear gender difference was also seen with almost 90% (87.2%) of fractures occurring in male patients giving a male to female ratio of 8.5:1.

Soft tissue injuries

Of the 291 soft tissue injuries recorded, over half involved the lips and oral cavity (52.6%). The next most common sites included the scalp (11.7%), peri-orbital region (10.3%), cheek and pre-auricular region (6.8%) and nose (6.2%) (Figure 4). One fifth (20.3%) of these injuries were classified as superficial wounds and did not require surgical closure. The remaining 80% were open wounds and required formal surgical closure. Falls were the leading cause of facial soft tissue injuries (35.7%) followed by contact with inanimate objects (23.7%) and road traffic accidents (21%). Two fifths (39.2%) of patients in early childhood sustained the most soft tissue injuries; patients in late childhood and adolescence showed similar proportions (a quarter each) and infants had the lowest proportion, less than ten percent. Males sustained almost twice as many facial soft tissue injuries compared to females.

Concomitant injuries

Of the total patients, over half received injury to more than one area of the maxillofacial region in a single incident (55%). Three percent of patients presented with focal neurological deficit involving the branches of the facial or trigeminal nerves.

Treatment provided

Two thirds of the patients required surgical intervention, with the majority of these involving open soft tissue wounds (92.4%). Definitive repair of bony injuries was performed in 7.6% of cases using open reduction with or without internal fixation. One fifth (19.7%) of the patients received active but non-surgical management. Almost four percent (3.8%) of patients required purely dental treatment only, having a concomitant superficial injury to facial soft tissue and dental injury. No treatment was indicated in 2.6% of patients. Treatment provided was not specified in 6.2% of the study population.

Motor vehicle accidents and alcohol involvement

Four wheeled motor vehicle accidents accounted for a relatively small number of injuries (5.3%). A higher proportion of males were involved overall (56%) however when alcohol was implicated (39.8% of incidents), a greater number of females (57.1%) were involved than males. Almost three quarters (71.4%) of those involved in alcohol related motor vehicle accidents were 17 years old with some individuals being as young as 15 years of age.

DISCUSSION

This study was a retrospective review of maxillofacial injuries in a paediatric population over a 7 year period between 2006 and 2012. A total of 340 incidents were reported with a greater proportion of males represented in a ratio of 2:1 between males and females–a similar ratio compared to other reports (Bamjee et al. 1996, Haug and Foss 2000, Munante-Cardenas et al. 2001, Gassner et al. 2004).

The limitations of this study include the small sample size, accuracy of information reported and whether or not the study population was representative of New Zealand given the low numbers of Maori and Pacific Island peoples compared to the North Island. However, this study provides an overview of paediatric maxillofacial trauma and highlights trends in terms of age, types of injury and representation between male and female patients.

There was no specific trend per year but the monthly distribution showed highest incidence in the summer season from February to May, peaking in April and early spring in October. These incidences coincide with warmer weather which may promote more outdoor activities and participation in sports (Shinya et al. 1993, Roccia et al. 2008). However the lowest monthly incidence was July which coincides with the rugby season, and one reason for the relatively small numbers may be due to less physicality in the game at this level (acknowledging that senior grades such as college First XV rugby teams are highly competitive).

Injuries were seen most often in patients whose residential address was in an area with a deprivation score of 1 (least deprived) compared to those living in deprivation score 10 areas. Perhaps individuals from more deprived families are less likely to present to medical services due to financial or educational barriers compared to least deprived families. In our study, most of the referrals were from medical practitioners (either hospital based or general practice), which is not unsurprising as patients are likely to seek a medical opinion in the first instance for

evaluation of a traumatic injury. Non-clinician referrals (self or parent referral) were surprisingly low, however it is acknowledged that approximately a half of the incidents in the study records did not have a referral source stated.

Children between 3 and 5 years of age had the highest overall incidence of maxillofacial injuries, accounting for over one third of the total in this study. The predominant injury and cause were facial soft tissue lacerations against inanimate objects such as chairs and coffee tables. It has been suggested that a combination of poorly developed motor skills, a relatively large and heavy head and the feet acting as a pivot point predisposes them to falls (Shinya et al. 1993, Zimmermann et al. 2005, Chan et al. 2011). Furthermore, their physical height is close to that of household furniture against which they fall and injure themselves. The second peak incidence was observed in adolescents, with a proportion similar to that of patients in early childhood (approximately one third). Soft tissue lacerations and facial fractures were more commonly seen in adolescents, predominantly due to contact with animate objects (such as interpersonal violence and sports) and road traffic accidents. Exposure to alcohol, interpersonal violence (with or without associated alcohol consumption) and access to motor vehicles at a relatively young age (the legal driving age in New Zealand begins at 16 years) may also be potential reasons for an increased incidence among this age group (Munante-Cardenas et al. 2001, Lee 2009). There were clear gender differences seen with an overwhelming ratio of 8.5: 1 males to females in terms of facial bone fractures. The tendency for males to be more active in contact sports and the higher involvement in interpersonal violence and motor vehicle accidents are thought to be contributory.

Eighteen road traffic accidents were due to four-wheeled motor vehicles with three incidents involving individuals under the legal driving age. Almost 40% of these road traffic accidents involved alcohol and a higher proportion of females were seen involved in alcohol related motor vehicle accidents (female to male ratio of 4:3).

The incidence of facial fractures among young people is still relatively low in comparison with adults and this may be due to increased elasticity of bone due to the physiologic composition of bone, less pneumatisation of the paranasal sinuses and the presence of the developing dentition (Shinya et al. 1993, Van Beek and Merkx 1999, Gassner et al. 2003, Zimmermann et al. 2005, Roccia et al. 2008, Lee 2009). Furthermore, differences in the magnitude of impact force due to lower body weight and physical strength may also be a factor in lowering the incidence among children (Munante-Cardenas et al. 2001, Morris et al. 2012). Over half of the fractures were treated conservatively due to minimal or no displacement and stable dental occlusion. The decision to treat a fracture with open reduction and internal fixation is not always straightforward, with due consideration given for potential growth disturbance, stage of dental development and the need for plate removal in the future.

CONCLUSION

There has been limited research on maxillofacial trauma in the paediatric population of New Zealand, and through this study we have provided much needed information regarding the trends of paediatric maxillofacial injuries in New Zealand. Findings of this study, regarding the cause and type of injury are consistent with past studies both within and outside of New Zealand. High risk groups include males and individuals in early childhood and adolescence. A greater insight has been gained from this study regarding alcohol consumption and motor vehicle accidents in the paediatric population. It is hoped that this study will form the basis of a larger national study with particular interest in the adolescent age group in relation to lowered drinking age and legal age of driving.

REFERENCES

Bamjee Y, Lownie JF, Cleaton-Jones E, Lownie MA (1996). Maxillofacial injuries in a group of South Africans under 18 years of age. *British Journal of Oral and Maxillofacial Surgery* 34:298-302.

Chan YM, Williams S, Davidson L, Drummond BK (2011) Orofacial and dental trauma of young children in Dunedin, New Zealand. *Dental Traumatology* 27: 199-202.

Gassner R, Tuli T, Hachl O, Rudisch A, Ulmer H (2003). Cranio-maxillofacial trauma : a 10 year review of 9543 cases with 21067 injuries. *Journal of Cranio-maxillofacial Surgery.* 31:51-61.

Haug RH, Foss J (2000). Maxillofacial injuries in the paediatric patient. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontics* 90:126-134.

Kieser J, Stephenson S, Liston PN, Tong DC, Langley JD (2002) Serious facial fractures in New Zealand from 1979 to 1998. *International Journal of Oral and Maxillofacial Surg*ery 31:206-209.

Koltai PJ, Rabkin D. (1996) Management of facial trauma in children. *Paediatric Clinics of North America* 43:1253-1275.

Lee KH (2009). Interpersonal violence and facial fractures. *Journal of Oral and Maxillofacial Surgery* 67:1878-1883.

Morris C, Kushner GM, Tiwana PS (2012). Facial skeletal trauma in growing patient. *Oral and Maxillofacial Surgery Clinics of North America* 24:351-364.

Munante-Cardenas JL, Olate S, Asprino L, de Albergaria Barbosa JR, de Moraes M, Moreira WF (2001). Pattern and treatment of facial trauma in paediatric and adolescent patients. *Journal of Craniofacial Surgery* 22:1251-1255.

Proffit WR, Vig KWL, Turvey TA (1980) Early fracture of the mandibular condyles: Frequently an unsuspected cause of growth disturbances. *American Journal of Orthodontics*. 78:1-24.

Roccia F, Diaspro A, Nasi A, Berrone S (2008). Management of sport-related maxillofacial injuries. *Journal of Craniofacial Surgery* 19:377-382.

Shinya K, Taira T, Sawada M, Isshiki N (1993). Facial injuries from falling: age-dependent characteristics. *Annals of Plastic Surgery* 30:417-423.

Statistics New Zealand (2013). http://www.stats.govt.nz/Census/2013-census/data-tables/meshblock-dataset.aspx

Van Beek GJ, Merkx CA (1999) Changes in the pattern of fractures of the maxillofacial skeleton. *International Journal of Oral and Maxillofacial Surgery* 28:424-428

Zimmermann CE, Troulis MJ, Kahan LB (2005) Paediatric facial fractures: recent advances in prevention, diagnosis and management. *International Journal of Oral and Maxillofacial Surgery* 34:823-833.

AUTHORS

TK Paul Jung BDS
Harsha L De Silva BDS, MS, FDSRCS, FFDRCSI
Priyangika P Konthasingha BDS, MSc, MD
Darryl C Tong BDS, MBChB, MSD, PhD (corresponding)