

Peri-anaesthetic Dental Injury in Children: A Retrospective Audit in a Tertiary Paediatric Centre

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ABSTRACT

Introduction: Dental injury is one of the most common adverse events related to anaesthesia with a reported incidence of 0.04–0.1%. It is a frequent cause of anaesthesia-related medico-legal claim. To date, there is a lack of data in the literature on paediatric peri-operative dental injury. Accidental aspiration of the avulsed teeth into the bronchus is potentially life-threatening. Dental injury of permanent teeth in children also carries significant implications. The aim of this study is to determine the incidence, risk factors and outcomes of peri-anaesthetic dental injury in children following 80,811 general anaesthetics over a twelve-year period in our tertiary paediatric institution. This will aid in the prevention and management of peri-operative dental injury.

Methods: A retrospective audit of our department audit database for incidents of dental injury was conducted from 1 January 2000 to 30 June 2011.

Results: The incidence of dental injury was 42 out of 80,811 anaesthetics (0.05%). Incidence is highest in children aged 5–8 years old. The majority of dental injuries (83.3%) occurred during elective surgeries. Ninety-two per cent of the intubated patients had a grade 1 Cormack-Lehane larynx at laryngoscopy. Sixty-two per cent of the dental injuries occurred in patients with an inaccurate history. Six patients with dental injuries detected in the recovery had an inaccurate dental history.

Conclusion: The incidence of dental injury in our paediatric centre is 0.05% and is comparable to that widely reported in the adult population. An accurate pre-operative dental assessment and documentation in the anaesthesia record should be obtained by the attending anaesthesia team. History from the child is vital. Better communication, minimal handover between staff and continuing education are important measures. A high index of suspicion of injury and knowledge of the patient's dentition state are critical for early intervention and minimising adverse events when dental injury occurs.

Keywords: Dental injury, Peri-operative, Paediatric population, Anaesthesia, Retrospective audit

INTRODUCTION

Dental injury is one of the most common adverse events associated with anaesthesia. The reported incidence based on retrospective data varies from 0.04% to 0.1%^{1–3}. A prospective study by Chen *et al.* reported a much higher incidence of 12.1%⁴. Works on dental trauma have been largely reported in the adult population with a paucity of data in the paediatric population.

Peri-operative dental damage is also a frequent cause of patient complaint often with medico-legal consequences. It is the commonest reason for claims in a 20 year study by Cass⁵. Pulp necrosis is a common complication if a traumatised mobile permanent tooth is not treated properly.

Accidental aspiration of the avulsed tooth into the bronchus is a life-threatening complication. This risk is increased in the children as they have a high

incidence of loose and easily dislodged primary teeth. In addition, dental injury of permanent teeth in children and adults also carries significant implications in the immediate management.

The purpose of this study was to determine the incidence, risk factors and outcomes of peri-anaesthetic dental injury in children following 80,811 general anaesthetics over a 12-year period in our tertiary paediatric institution. This will aid in the management of peri-operative dental injury and minimise this recurrent problem.

MATERIALS AND METHODS

After obtaining Singhealth Institutional Review Board (IRB) approval, a retrospective audit of our department audit database for incidents of dental injury was conducted from 1 January 2000 to 30 June 2011. This database contains all adverse events reported from our department's 20-item anaesthesia audit documentation which is completed for every general anaesthetic care by the attending anaesthesia team. The patients with dental injury were identified and detailed information of each case was obtained from the patient's medical records.

Characteristics identified were: age, the emergency status of the procedure, accuracy of dental history and the type of airway intervention. Incidence of dental injury per annum was evaluated. The relationship between the accuracy of dental history obtained during pre-operative anaesthetic screening and incidence of dental injury was examined.

Definitions of the peri-anaesthetic dental injury were obtained from Handbook of Paediatric Dentistry⁶ as follows:

- Subluxation: Tooth is mobile but not displaced
- Luxation: Tooth is mobile with partial displacement of the tooth in the alveolar bone
- Avulsion: Complete displacement of tooth from its socket

For the purpose of this audit, luxation and subluxation were classified under "Mobile Teeth" (MT). Avulsion was classified as "Avulsed Teeth" (AT).

The definition of dental history was as follows:

- Accurate dental history: positive history of loose teeth and the loose teeth were correctly identified by caregiver or patient.
- Inaccurate dental history: undocumented or negative history of loose teeth and the loose teeth were incorrectly identified.

RESULTS

During the 12-year study period, there were 80,811 anaesthetics administered. A total of 42 cases of dental injury were reported. The incidence was one per 1924 anaesthetics (0.05%). Figure 1 illustrates the incidence of dental injury per annum. It ranged from 1.4 to 11.4 per 10,000 patients. The incidence of dental trauma did not drop below 6.2 per 10,000 patients for the last 3 years. Dental injury occurred in patients aged 2–15 years old with the highest frequency (69%) in children aged 5 to 8 years old.

The majority of dental injuries (83.3%) occurred during elective surgeries. A variety of airway devices were used in our patients with dental trauma (Fig. 2). Ninety-two per cent of the intubated patients had a grade 1 Cormack-Lehane larynx at laryngoscopy.

There is a relation between accuracy of pre-operative dental history and the incidence of dental injury and its immediate detection upon trauma. More patients with inaccurate dental history sustained dental injury (n=26) compared to those with accurate dental history (n=16). Sixty-two per cent (26/42) of the dental injuries occurred in patients with inaccurate dental history (Fig. 3).

In patients with accurate dental history, 14 out of the 16 dental injuries were detected prior to extubation and appropriate management instituted. In the remaining two patients, radiological imaging was required to locate the missing teeth. One patient's tooth was found in the stomach while the other remained unaccounted for (Table 1).

Patients with inaccurate dental history had more frequent adverse events. All six patients with dental injuries detected in the recovery room had an inaccurate dental history (Table 2). One patient coughed out the avulsed tooth during emergence in the recovery room. Two patients required a repeat anaesthetic for tooth removal and re-implantation.

Number per 10,000 patients

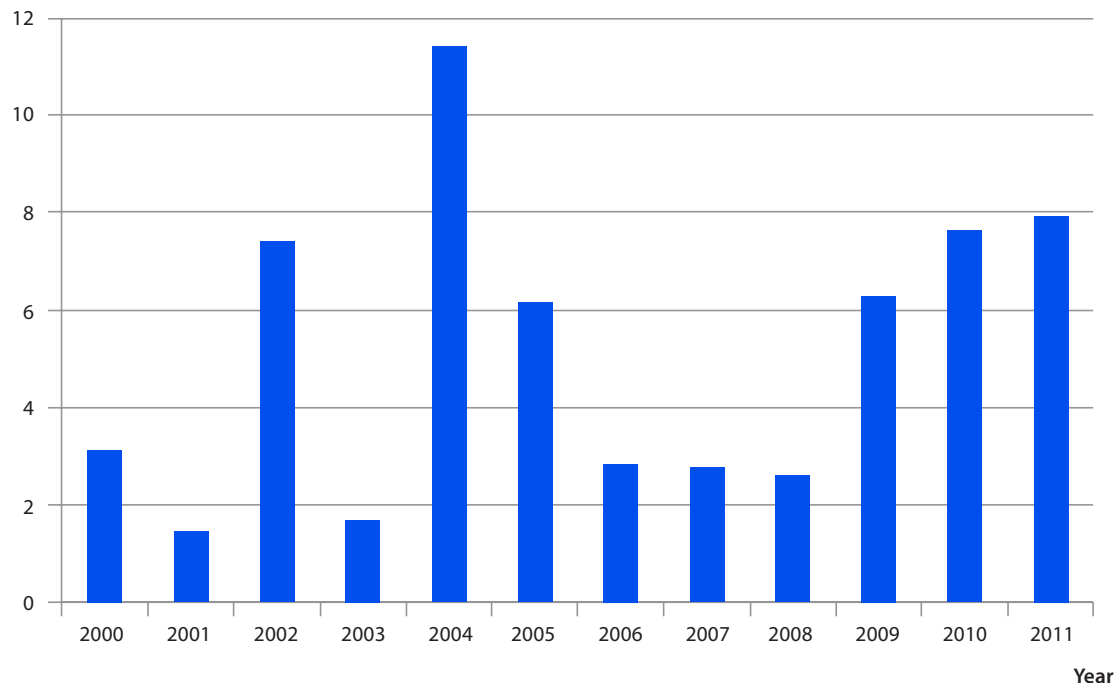


Fig. 1. Incidence of dental injury per annum

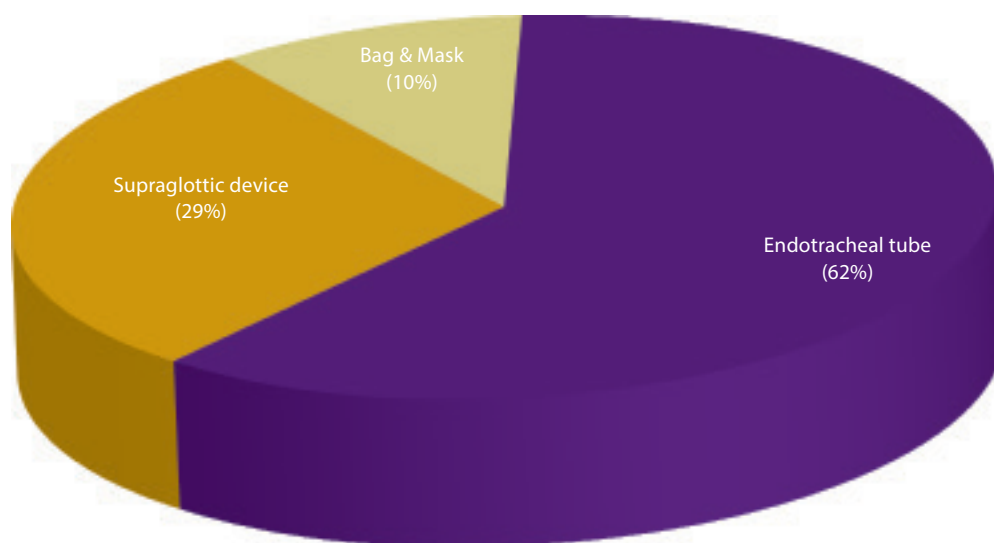


Fig. 2. Airway management in patients with dental injury.

Of the patients with inaccurate dental history, there were two six-year old patients with missing teeth who required radiological imaging (Table 2). One had a documented missing left upper incisor noted during the preoperative anaesthetic assessment for colonoscopy. He had another missing tooth with fresh blood stain seen on the gum after the procedure. His parents were unaware of the presence of a second loose tooth although the boy had indicated it to the anaesthetic nurse preoperatively. This was however not

communicated to the anaesthetist who had verified the dental history with the parents only. Radiography revealed a tooth in the stomach. The second patient with a negative history of loose teeth presented for incision and drainage of a chalazion. He underwent an uneventful general anaesthetic with laryngeal mask airway and was discovered to have a missing tooth by the parents just before discharge. His parents who brushed his teeth everyday were certain that a tooth had been dislodged. The anaesthetist did not check

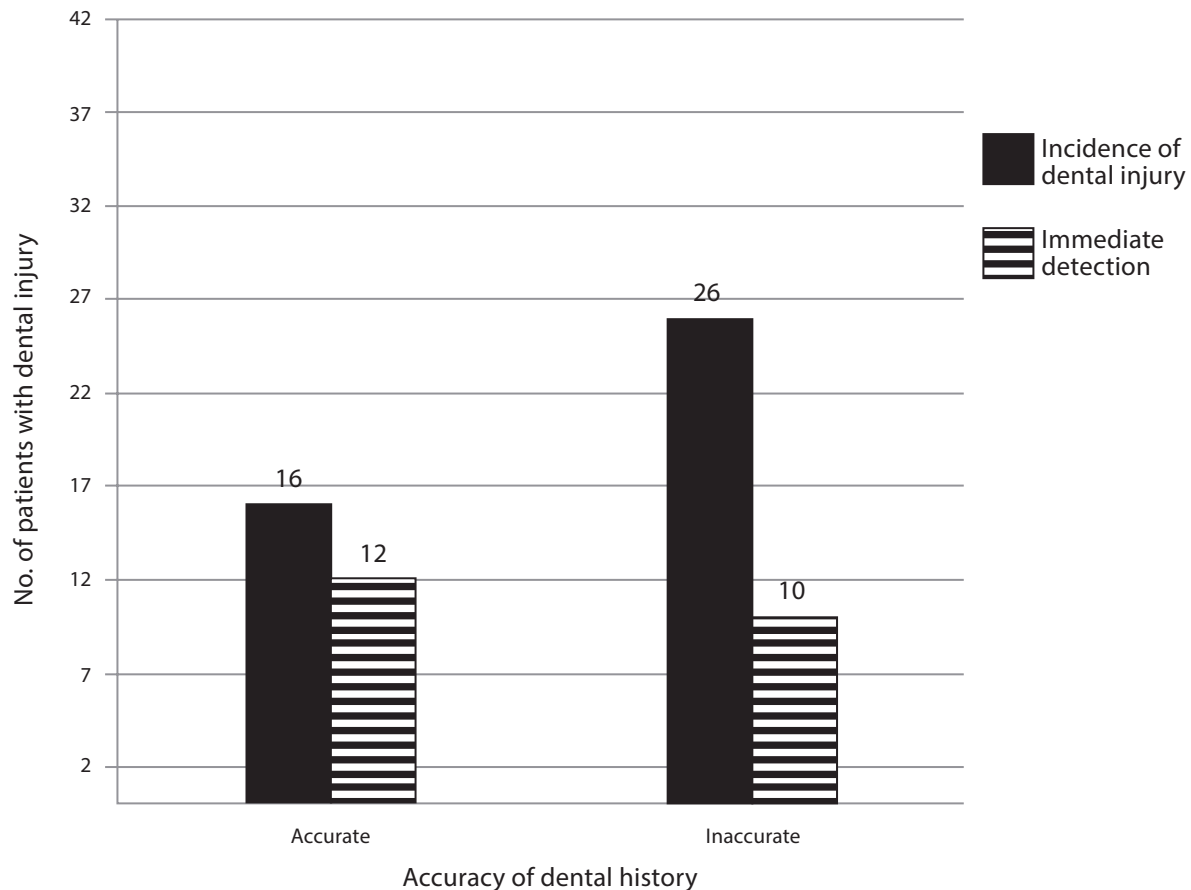


Fig. 3. Accuracy of preoperative dental history and its influence on the incidence and detection of dental injury.

for any missing tooth and/or gap prior to airway instrumentation, as it was not the routine practice.

DISCUSSION

The incidence of dental injury under general anaesthesia in our tertiary paediatric institution was one per 1924 anaesthetics (0.05%). This is comparable to the incidence in retrospective studies in the adult population. Newland *et al.*, in a case-control study of 161,687 anaesthetics performed over 14 years, reported an incidence of one per 2073 anaesthetics (0.04%)¹. Vallejo *et al.*, in a study involving 816,690 patients receiving anaesthesia in a large university hospital system, reported an incidence of dental injuries of 0.04%. They found that patients in the age group 18–65 years had a higher incidence of dental injuries of 0.05% compared to paediatric patients who had an incidence of 0.01%². To our knowledge, no one has reported on the incidence of dental trauma among paediatric population in a tertiary paediatric centre.

Our study showed that children aged 5–8 years were most frequently found to have dental injuries.

In our pilot study of 239 children aged 5–12 years, the incidence of loose teeth and interdental spaces was 28%. The highest incidence was in children 7–8 years old with an incidence of 50% and 31% respectively. Interdental spaces are present after the exfoliation of the primary teeth and prior to eruption of the permanent teeth. This is not surprising since the natural exfoliation of deciduous teeth usually commences at the age of 5–6 years. Primary teeth exhibit long slender roots that are less likely to withstand excessive physical forces. Hence, primary teeth are more vulnerable to dislodgement peri-operatively unlike permanent teeth. Children who fall within this period of “mixed dentition” (which occurs during the ages of 5 through 12 years) are more susceptible to tooth injury. There may be minimal blood in the tooth socket with avulsion due to shallow roots of decayed primary teeth. This can result in a delayed diagnosis of dental injury.

Emergency surgery and difficult intubation have been identified as factors associated with dental injury in previous adult studies^{3,4,8}. This is not the case in our paediatric cohort.

Table 1. Distribution of the 42 dental injuries.

| Description of dental injury and time of detection of MT or AT | Patients with accurate dental history n (%) | Patients with inaccurate dental history n (%) |
|--|--|--|
| MT (immediate detection and removed at induction) | 12 | 10 |
| AT (late detection and found just prior to extubation) | 2 | 4 |
| MT and AT (detected in recovery) | 0 | 6 |
| AT (detected via radiological imaging) | 2 | 6 |
| Total number | 16 (38%) | 26 (62%) |

AT: avulsed teeth. MT: mobile teeth.

Table 2. Dental history and adverse events

| Type of adverse event | Patients with accurate dental history (n) | Patients with inaccurate dental history (n) |
|--|---|---|
| Dental injury detected in recovery room | 0 | 6 |
| Patients requiring radiological imaging for detection of missing teeth | 2 | 6 |
| Ingestion of tooth (stomach) | 1 | 2 |

Our study demonstrated that an accurate and detailed knowledge of the patient's preoperative dentition is critical in minimising the incidence and severity of adverse events. Dental injury discovered in the recovery room was considered near-misses. In our study, all these patients had an inaccurate dental history. The case illustrations of two six-year old patients emphasise the importance of verification of the dental history with the child himself and to examine the presence of any interdental spaces pre-operatively. Although the effective radiation dose for a chest radiograph is minimal, the iatrogenic radiological exposure is unnecessary⁹ and radiological imaging for lost teeth can result in psychological distress for both child and parent.

Our institution has recognised the importance of preventing peri-anaesthetic dental injury and has implemented measures which include:

- Regular education and reminders for in-house anaesthetists and rotating residents are regularly informed at department meetings and morbidity rounds.
- A preoperative dental screening and discussion with the parents and the child during the pre-anaesthesia assessment for fitness for surgery.

iii. Incorporation of a dental diagram into our anaesthetic chart since 2010 to facilitate the documentation of loose tooth and interdental spaces by attending anaesthetist. This is done because there is a variable age of exfoliation of primary teeth and eruption of permanent teeth in children which may make documentation difficult. Dental charts using the Federation Dentaire Internationale system or Palmar notation are available for documentation but limitations exist¹⁰.

iv. Performance of pre-operative checks twice for any loose teeth by the anaesthesia nurse and the surgical nurse before a child is brought into the operating room. In addition, it has become the authors' practice to examine the patient's dentition for loose teeth and interdental spaces after anaesthetic induction.

Tooth aspiration can be life-threatening. Iatrogenic interventions such as bronchoscopy or gastroscopy require repeat general anaesthetic and can result in patient and parental anxiety as well as delayed hospital discharge. Boye *et al.* published a case report of spontaneous exhalation of an inhaled tooth in a three-year old girl after dental

extraction under general anaesthetic¹¹. Fortunately, none of our patients aspirated any tooth.

Early detection of avulsed permanent tooth increases the chances for its successful salvage. Immediate re-implantation gives the best prognosis. Re-implantation within 5 minutes results in a healing rate of 85–97%. Healing rarely occurs for re-implantation after 60 minutes. Established department guidelines ensure appropriate and rapid treatment for an avulsed tooth. We have adopted the following recommendations in our institution:

- The avulsed primary tooth does not require treatment. The return of the avulsed primary tooth into its original socket can damage the underlying erupting permanent tooth.
- If a permanent tooth is avulsed, hold it gently by the crown but avoid touching the root. Attempt to re-implant the tooth by holding the avulsed tooth in place and securing it to the neighbouring tooth with aluminium foil should be made by the anaesthetist. If one is unable to re-implant the tooth within 5 minutes, it should be stored in a medium that preserves the vitality of the peridontal ligament fibres. The best physiologic storage medium for avulsed tooth is Hank's balanced salt solution or cold fresh milk¹². For the protection of the root, the avulsed tooth should not be kept in dry tissue or cloth.
- If in doubt, the in-house dental officer on duty should always be contacted immediately for consultation and assessment. It is crucial to convey the following information: the age of the child, type of injured tooth(primary or permanent), type of injury and if the child is still under general anaesthesia.
- Proper documentation in the anaesthetic record of all actions and discussions is imperative.

Dental injury is a recurring problem in our institution. This audit has allowed us to implement new measures and recommendations which can keep the problem at bay.

CONCLUSION

The incidence of dental injury in our paediatric centre is 0.05% and is comparable to that widely

reported in the adult population. An accurate pre-operative dental assessment and documentation in the anaesthesia record should be obtained by the attending anaesthesia team. History from the child is vital. Better communication, minimal handover between staff and continuing education are important measures. A high index of suspicion of injury and knowledge of the patient's dentition state are critical for early intervention and minimising adverse events when dental injury occurs.

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