

Dental Trauma related to General Anesthesia: Should the Anesthesiologist Perform a Preanesthetic Dental Evaluation?

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Abstract

Perioperative dental damage is one of the most common anesthesia-related adverse events and is responsible for the greatest number of malpractice claims against anesthesiologists; therefore, several dental considerations are warranted. A thorough evaluation may necessitate a dentist's help, requires that anesthesiologists receive more formal training regarding oral and dental anatomy, and enables performing the treatments necessary to minimize the risks of dental injuries. Nevertheless, this preanesthetic assessment is frequently overlooked by surgeons and anesthesiologists. The present study aimed to investigate, for both dentists and anesthesiologists, how often and under what circumstances dental trauma occurs during general anesthesia as well as isolate possible anatomical, dental, and anesthesiological risk factors, based on which suggestions for preventive measures could be made. Anesthesiologists must perform a thorough preoperative oral evaluation to help identify the dentition at risk; the evaluation should include the patient's dental history, oral/dental examination, and a specific discussion with the patient about any existing dentures or crowns. The dental examination should especially include an assessment of the patient's upper incisors—the teeth most likely to be injured during the perioperative period—for pre-existing damage. Preoperative notes should record any damages or missing teeth. In addition, anesthesiologists must take adequate intraprocedure precautions to prevent/minimize iatrogenic dental injury.

Introduction

Anesthesiologists' work often involves the mouths of patients; however, they may not have received comprehensive education about teeth, surrounding tissues, and intraoral prosthesis [1]. Perioperative dental damage is one of the most common anesthesia-related adverse events and is responsible for the greatest number of malpractice claims against anesthesiologists. The likelihood of perioperative dental trauma increases with the vulnerability of a patient's dentition and the presence of anesthesia-related risk factors. Therefore, it is crucial that anesthesiologists have a detailed knowledge regarding dental anatomy and pathology. The level of training of an anesthesia resident reportedly has no effect on the risk of dental injury, and the level of experience of the anesthesiologist was not a major determinant of dental injuries in patients with healthy dentition [2]. Minimizing perioperative dental trauma begins with the anesthesiologist's preoperative assessment of the patient's dentition and intraoral tissues. Clearly documenting patient's preoperative dental condition and notifying the patient of potential dental damage will minimize the cost of related postoperative dental treatment. Upon discovery of a dental condition that can be potentially damaged during anesthesia, a dental consultation should [3] be considered before proceeding with the surgical procedure. Exercising cautionary measures during certain procedures, such as laryngoscopy and tracheal extubation, may help prevent dental trauma.

In the event of dental injury, several management strategies can promote a swift and reasonable resolution. Increased awareness of intraoral conditions and related perioperative risk factors may minimize the incidence of dental damage and financial costs [1]. Although the anesthesiologist should

perform dental consultation prior to surgery, this consultation is frequently overlooked by surgeons and anesthesiologists. In the present review, we aimed to summarize, for both dentists and anesthesiologists, how often and under what circumstances dental trauma occurs during general anesthesia. Moreover, we wished to isolate possible anatomical, dental, and anesthesiological risk factors, based on which suggestions for preventive measures could be made.

Incidence and morbidity and anesthesia-specific risk factors

Oral injury occurred in 1 in 20 patients (5%) undergoing general anesthesia [4]. Although one study [5] found that dental injury occurred during 1% of procedures under general anesthesia, most retrospective analyses have reported that the incidence to be approximately 0.02–0.07% [5]: One [6] estimated the incidence to be 1 in 2805 (0.04%), and other [7] as 1 in 2073 (0.05%) with 86% of dental injuries discovered by the anesthesia provider. One study [8] reported that dental injuries resulted in 83 of 60,000 surgical procedures (0.13%) under general anesthesia. Prospective studies have reported higher rates (0.1–12%), especially at hospitals with anesthesiology training programs [9]. In addition, a survey of 816,690 patients who received anesthesia care in a large university hospital, revealed 360 dental injuries, for an overall incidence of 1:2,269 (0.044%) [10]. Patients receiving general anesthesia were at increased risk for dental injuries, with an incidence of 1:1,754 (0.057%), compared with patients receiving monitored anesthesia care, with an incidence of 1:12,500 (0.008%). Patients aged 18–65 years had a higher incidence of dental injuries, 1:1,818 (0.055%), than did pediatric patients, 1:7,692 (0.013%) [10]. Injury was most commonly sustained during laryngoscopy and required intervention in only 2% of cases [5].

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Despite these low rates, dental damage is the most frequent cause of anesthesia-related medico-legal claims [11]. The Harvard Risk Management Foundation found that dental trauma was the most common injury associated with malpractice claims, accounting for 29% of all cases filed between 1977 and 1986 [12]. While most dental damage is identified by the anesthesiologist at the time of intubation, several injuries may be missed. A retrospective study [7] of 161,687 operations under general anesthesia found that 14% of dental injuries were initially identified by the patient or a member of the recovery staff.

A large retrospective study [13] surveying the incidence of dental injury in over one million endotracheal intubations found that the incidence of dental damage during general anesthesia ranged from 1:150 to 1:1,000 intubations. Of these dental injuries, 47% were classified as dislodged or mobile teeth, 39.2% as chipped or fractured natural teeth, and 12.3% as damaged dental prostheses. Another study [8] also found that 75% dental injuries occurred during intubation for elective major surgery, 15% during tracheal intubation for minor surgery, and 10% during emergency surgery. Teeth avulsions accounted for 50% of injuries, followed by damage to crowns and bridges (14%) and luxation and fractures (>15%) [8]. In the large university hospital survey [10], emergency procedures were not associated with an increased risk of dental injury in the total patient population; nevertheless, among the 360 patients who sustained a dental injury, emergency procedures were associated with a higher incidence of injuring multiple teeth. Another study [14] involving 110 female patients (6–88 years) and 125 male patients (11–90 years) found that 66% of these patients were at a greater risk of perianesthetic dental injury due to pre-existing poor dentition. During intubation procedures without protective devices, dental subluxation/luxation occurred in 55% of patients, dental avulsion in 43%, exfoliation in 2%, and soft tissue damage in 0.9%. A study [15] of the frequency of and risk factors for dental damage after classic direct laryngoscopy for tracheal intubation in 536 adult patients found that 134 patients (25.0%) experienced dental damage affecting 162 teeth (147 maxillary and 15 mandibular). Enamel fracture was the most common injury. Inter-incisor gap (overjet) was regarded as a risk factor for injury to tooth number 8 (OR 2.5, 95% CI 1.0–5.9) and number of intubation attempts for injury to tooth number 9 (OR 5.3, 95% CI 1.3–22.0).

In a case report of a 32-year-old female [16], during laryngoscopy, all four upper incisors were avulsed and fell into her oral cavity without fracture. Her oral cavity was examined laryngoscopically but the teeth were not found. Radiological examination of her chest and abdomen and endoscopic examination of her esophagus yielded normal results. Head and neck imaging revealed a radiopaque lesion in the nasopharyngeal area. A later endoscopic examination of the nasopharyngeal area resulted in removal of the teeth after adenoidectomy.

Clearly, case-mix and comorbidity will have a major impact on the incidence [4].

Factors Rendering Teeth More Susceptible to Injury Dental and Anatomical Factors

Certain difficult anatomical conditions considered as typical

risk factors for tooth injury during anesthesia include limited mouth opening, limited mobility of the mandible, poor visibility in the hypopharynx, narrow thyromental distance, and low neck mobility. In addition, oral and dental health-related risk factors are caries, periodontitis, insufficient restorations, and existing ceramic restorations [3]. Dental injuries occur primarily in the 50–70-year age group, which is probably a result of the higher incidence of periodontal disease in this age group [11]. The incidence of dental injuries is approximately five times higher in patients with a pre-existing dental condition [3]. Anterior crowding increases the likelihood of damage and isolated teeth appear to be at particular risk. Generally, one tooth is damaged; however, injuries of two, three, and even four teeth have been reported [16].

The maxillary teeth are generally prone to injury (74.3%), especially those on the left side (41.7%). The maxillary central incisors are most often injured (51.8% of all the teeth injured; tooth 9, 27.1%; tooth 8, 20.6%), and maxillary lateral incisors are affected only half as often (21.8% overall; tooth 10, 14%; tooth 7, 3.7%). Molars are also noticeably injured (9.1% of all the teeth injured) [17]. The highest risk of the left maxillary central incisors suggests that laryngoscopy is a major factor [7,14,16] because during laryngoscopy, the anterior teeth are often unintentionally used for support [3].

Iatrogenic factors

Several anesthetic equipment can cause dental damage, particularly rigid equipment [10] if used inappropriately. The following devices are often associated with damage to teeth; therefore, extra care must be taken when they are used.

Laryngoscope: Upper incisors can be damaged if used incorrectly, the mechanism of this damage is a substantial force that is applied to the teeth by the laryngoscope blade when the clinician uses the patient's upper teeth as a fulcrum for levering the laryngoscope blade [18].

Oropharyngeal airways: Oropharyngeal airways should be used with caution for patients with vulnerable anterior teeth and should not be used as a bite block [1,6].

Jaw clamping: Use of a jaw clamp during light anesthesia, particularly when used with an oropharyngeal airway, can put pressure on the teeth.

Bite blocks: The correct placement of bite blocks can considerably reduce the incidence of dental damage during anesthesia. Bite blocks should be placed at the posterior aspect of the mouth to take advantage of the increased lateral and vertical stability of the molar teeth. Bite blocks should be made from an appropriate material and placed between molar teeth rather than incisors [6,13].

Suction devices: Aggressive suctioning in the posterior region of the mouth can cause oral injuries; dental injuries can occur when anterior teeth are subjected to extreme lateral forces. Suctioning should be therefore done with great care, preferably using a soft latex catheter [1].

Dental props and mouth gags: Dental props and mouth gags can damage teeth during insertion or removal or when they are moved from one side of the mouth to the other [11,13].

Where possible, the anesthesiologist should discuss the choice of equipment with the patient before the procedure, outlining the benefits and risks of each equipment, and ensure that the patient freely consents to the use of a particular piece

of equipment as well as record details of this discussion in the medical records.

Risk Management

Three strategies should be considered in risk management:

Risk avoidance: minimizing the incidence of dental injuries related to general anesthesia.

Damage control or loss prevention: minimizing the consequences of dental injuries related to general anesthesia.

Risk transfer or insurance: All or part of the economic consequences of the damage may be transferred to a third party in exchange for a premium. Each strategy can be considered in relation to dental trauma and anesthesia; however, none of the protective strategies are completely effective; vigilance is always required [4,14].

Risk avoidance

Planning is an essential part of risk management. Prevention of damage to the teeth can be managed both before and during the procedure by means of thorough evaluation as well as protective measures. The following measures that involve a participation of the patient, dentist, and anesthesiologist must be undertaken for optimum risk management.

Preprocedure measures: Patients awaiting an elective surgical procedure requiring a general anesthesia should be advised to visit their dentist first [6,19,20], and it is recommended that the patient be made aware of the possibility of dental trauma during the preoperative evaluation [1]. Furthermore, the preanesthetic dental examination should be conducted by an experienced anesthesiologist [8] and the findings must be documented in the notes [12,13] taken during the preanesthetic evaluation [1,7,9,11,14,21]. The anesthesiologist must especially look for aforementioned dental and anatomical risk factors such as difficulty in mouth opening and any loose crowns or dentures. This will help prevent problems during the administration of general anesthesia [20].

Intraprocedure measures: Patients should be examined [1] for dental damage after intubation, after extubation, and after recovery, and any significant findings should be noted. Failure to notice damage and not to know when it occurred will often complicate subsequent management [19]. To prevent damage to the teeth, a soft roll of gauze [1,6,9,10] could be placed on healthy non-restored posterior teeth, enabling them to better withstand excessive forces that can occur during emergency.

Risk transfer or insurance

The number of legal proceedings regarding professional liability is increasing with a subsequent increase in insurance premiums. The introduction of very high franchise clauses with unsettled insurance coverage leads hospitals to recede from contracts and insurers to abandon the market; meanwhile, medical facilities, hospitals, and medical staff spend more to insure themselves. Minimizing the incidence and consequences of dental injuries related to general anesthesia reduces the number of claims, insurance premiums, and costs of litigation process, thus improving physician-patient relationship [14].

Management of Dental Trauma

Anesthetic departments should develop protocols [6] for this, which should include the following:

All teeth fragments need to be recorded [6].

In case of any missing fragments, a chest radiography is necessary to exclude aspiration [6]. However, some dental prostheses are not radio-opaque and direct visualization may be required.

Although most dental fragments will pass through the gastrointestinal tract without causing harm, large prostheses may cause obstruction and perforation. These patients may therefore require surgical or endoscopic removal [3,6].

In children, the loss of a primary tooth does not require treatment. In fact, the return of an avulsed primary tooth into its original socket can damage the underlying permanent successor [1,6]. If a permanent tooth is displaced from its socket, it should be stored in cool, fresh milk or normal saline until it can be splinted or fixed back in place [1,6,8,9].

When the patient is sufficiently awake [1,6], a full explanation must be given. This should include a clear apology and a description of the events that led up to the damage and the efforts made to minimize any complications. The presence of a relative, a member of the nursing staff, or a patient liaison officer is often very useful in this situation. Similarly, from the junior anesthesiologist's point of view, the attendance of a senior colleague is invaluable and should be sought [6].

All actions and discussions should be clearly documented in the patient's records [6].

It is the responsibility of the anesthesiologist to organize an urgent dental assessment and arrange subsequent treatment. The patient should not leave hospital without a clear written treatment plan and arrangements for follow-up. A contact telephone number and address should also be provided [6].

However, even with experienced anesthesiologists who were adequately trained in the use of devices and aware of the potential damage while using excessive forces, some unexpected difficulties may lead to injuries. The damage to the teeth and oral structures may occur even in the absence of negligence.

Conclusion

Anesthesiologists must conduct a thorough preoperative evaluation of a patient's mouth. To help identify the dentition at risk, the evaluation should include a review of the patient's dental history; a specific discussion with the patient about any existing dentures or crowns; and an oral/dental examination, particularly of the patient's upper incisors—the teeth most likely to be injured during the perioperative period—including an inspection of the teeth for any pre-existing damage. Any existing conditions such as chips or missing teeth must be noted. In addition to preanesthetic evaluation, anesthesiologists must also take intraprocedure precautions and have knowledge of the measures required to be taken in case of any damage. All procedures and choice of the anesthetic equipment with their risks and benefits must be adequately discussed with the patient. These steps are necessary to minimize dental trauma and the costs and consequences associated with them, and require the involvement of the patient as well as dentists and anesthesiologists.

References

1. Yasny JS. Perioperative dental considerations for the anesthesiologist. *Anesthesia & Analgesia*. 2009; **108**: 1564-1573.
2. Gaiser RR, Castro AD. The level of anesthesia resident training does not affect the risk of dental injury. *Anesthesia & Analgesia*. 1998; **87**: 255-257.
3. Vogel J, Stubinger S, Kaufmann M, Krastl G, Filippi A. Dental injuries resulting from tracheal intubation--a retrospective study. *Dental Traumatology*. 2009; **25**: 73-77.
4. Contractor S, Hardman JG. Injury during anaesthesia. Continuing Education in Anaesthesia, *Critical Care & Pain*. 2006; **6**: 67-70.
5. Warner ME, Benenfeld SM, Warner MA, Schroeder DR, Maxson PM. Perianesthetic dental injuries: frequency, outcomes, and risk factors. *Anesthesiology*. 1999; **90**: 1302-1305.
6. Windsor J, Lockie J. Anaesthesia and dental trauma. *Anaesthesia & Intensive Care Medicine*. 2008; **9**: 355-357.
7. Newland MC, Ellis SJ, Peters KR, Simonson JA, Durham TM, Ullrich FA, et al. Dental injury associated with anesthesia: a report of 161,687 anesthetics given over 14 years. *Journal of Clinical Anesthesia*. 2007; **19**: 339-345.
8. Rosa Maria G, Paolo F, Stefania B, Letizia T, Martina A, Massimiliano D, et al. Traumatic dental injuries during anaesthesia: part I: clinical evaluation. *Dental Traumatology*. 2010; **26**: 459-465.
9. Bhatnagar N, Lin CJ, Orebaugh SL, Vallejo MC. Regional anesthesia considerations for awake endotracheal intubation and prevention and management of dental injuries. *International Anesthesiology Clinics*. 2012; **50**: 1-12.
10. Vallejo MC, Best MW, Phelps AL, O'Donnell JM, Sah N, Kidwell RP, et al. Perioperative dental injury at a tertiary care health system: An eight-year audit of 816,690 anesthetics. *Journal of Healthcare Risk Management*. 2012; **31**: 25-32.
11. Givol N, Gershtansky Y, Halamish-Shani T, Taicher S, Perel A, Segal E. Perianesthetic dental injuries: analysis of incident reports. *Journal of Clinical Anesthesia*. 2004; **16**: 173-176.
12. Ho AM, Hewitt G. Warning devices for prevention of dental injury during laryngoscopy. Preliminary report. *Journal of Clinical Monitoring and Computing*. 2000; **16**: 269-272.
13. Rosenberg MB. Anesthesia-induced dental injury. *International Anesthesiology Clinics*. 1989; **27**: 120-125.
14. Gaudio RM, Barbieri S, Feltracco P, Tiano L, Galligioni H, Uberti M, et al. Traumatic dental injuries during anaesthesia. Part II: Medico-legal evaluation and liability. *Dental Traumatology*. 2011; **27**: 40-45.
15. Mourão J, Neto J, Luís C, Moreno C, Barbosa J, Carvalho J, et al. Dental injury after conventional direct laryngoscopy: a prospective observational study. *Anaesthesia*. 2013; **68**: 1059-1065.
16. Ozer AB, Erhan OL, Demirel I, Keles E. Dental avulsion due to direct laryngoscopy during the induction of general anaesthesia and avulsed teeth in nasopharynx. *BMJ Case Reports*. 2012; 2012-006898.
17. Vogel J, Stübinger S, Kaufmann M, Krastl G, Filippi A. Dental injuries resulting from tracheal intubation--a retrospective study. *Dental Traumatology*. 2009; **25**: 73-77.
18. Kim HJ, Lee J-M, Bahk J-H. Assisted head extension minimizes the frequency of dental contact with laryngoscopic blade during tracheal intubation. *The American journal of emergency medicine*. 2013; **31**: 1629-1633.
19. Owen H, Waddell-Smith I. Dental trauma associated with anaesthesia. *Anaesthesia and Intensive Care*. 2000; **28**: 133-145.
20. Chidylo S, Zukaitis J. Dental examinations prior to elective surgery under anesthesia. *New York State Dental Journal*. 1990; **56**: 69-70.
21. Chadwick R, Lindsay S. Dental injuries during general anaesthesia: can the dentist help the anaesthetist? *Dental Update*. 1998; **25**: 76-78.