

Dental Trauma due To Intubating during General Anaesthesia: Incidence, Risks Factors, and Prevention

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Abstract

Iatrogenic injury can also occur while intubating or extubating patients during procedures requiring general anesthesia. Endoscopy and general anesthesia involve instrumentation that can injure soft tissues and dental tissues. Perioperative dental injury is the most common complaint among all medico-legal complaints related to anesthesia. Stress should be laid on the knowledge and understanding of risk factors to prevent any dental injuries. Patients who have the highest risk for dental injury are those who have pre-existing poor dentition. A thorough preoperative evaluation of a patient's mouth should be conducted in consultation with the dentist, before undergoing general anesthesia procedure. If injury does occur, patient can be referred to a dentist in the postoperative phase for restoration of the dental damage.

Key Words: Dental trauma, Anesthesia, Dental injury, Risk factors, Dental management

Introduction

The aim of the present review was to provide a comprehensive insight into the relatively untouched topic of dental trauma during general anesthesia. The relevant articles were handpicked by the reviewers on the basis of criteria observed by the reviewers their own findings during routine procedures carried out in the hospital setting. Iatrogenic injury is a broad term that may be defined as 'harm, hurt, damage or impairment that results from the activities of a doctor [1]. Iatrogenic injury can also occur while intubating or extubating patients during procedures requiring general anesthesia [2]. Some causes of iatrogenic injury are difficult to avoid, however, many such cases can be avoided through anticipation and high standards of practice.

Endoscopy and general anesthesia involve instrumentation that can injure soft tissues and dental tissues [3]. Perioperative dental injury is the most common complaint among all medico-legal complaints related to anesthesia and is the cause of one-third of the lawsuits regarding medico-legal anesthesia [3-5]. While most of the perioperative dental injuries occur during endotracheal intubation, they can also occur when excessive force is used for airway, endotracheal tube or laryngeal mask airway removal when the patient awakes from anesthesia or in the recovery room as result of a masseter spasm due to shivering [5-8].

An overall incidence of 0.06% and 12% of dental injury has been reported by various authors [1,8-13]. Several factors such as the condition of tooth and supporting tissue, impact of instruments on the dental arch and lack of anesthesiologist experience are the most commonly suggested culprits [1,2]. In view of the potential physical, economic and legal consequences of dental injury, it is prudent to establish standardized strategies of prevention. Documentation is another important aspect that could prove handy in case of any untoward event. Stress should be laid on the knowledge and understanding of risk factors to prevent any injuries [6,13-16]. The most immediate cause for concern in the case of dental injuries along with the prevention of the injuries is what should be done to reduce the incidence of injuries and what should be done after an injury occurs?

Incidence and morbidity

The incidence of peri-operative dental damage has been found to range from 0.02% to 0.07% [8,10,12] based on retrospective data. Warner et al. [8] analyzed the dental injuries of 598,904 consecutive cases 1987 through 1997 and reported 132 cases (1:4,537 patients) of dental injury. Similarly, Lockhart PB et al. [10] surveyed 133 directors of training programs in anesthesiology. The directors reported an average incidence of 1:1,000 dental injuries during or after 1,135,212 tracheal intubations in 1 year. However, a prospective study by Chen et al. [17] reported a much higher incidence. The authors examined 745 consecutive cases before and after endotracheal anesthesia and reported an incidence of dental damage to be 12.1%. It is said that the level of anaesthesia and resident training does not affect the risk of dental injury. Perioperative dental damage is the most common of all medico-legal complaints related to anaesthesia, comprising one-third of all medico legal anaesthetic claims [6,18-23]. Givol et al. conducted a retrospective analysis of incident reports concerning dental injury. They observed that the patients were most commonly in their 5(th) to 7(th) decade [18]. Eighty six percent of the injured teeth were the upper incisors. Lower incisors were more likely to be injured during an urgent intubation, or due to airway manipulation other than intubation. (i.e., oral airway insertion). The anesthesiologist is often immediately aware once a dental injury occurs, and, because of its highly sensitive and visible location, patients notice the injury soon after the procedure. Newland et al. [12] found that of all dental injuries, 14% were reported by the patient, whereas 86% were reported by the anesthetist.

In the peri-operative period, the majority of dental injuries (50-75%) occur during tracheal intubation [6,8,10,11,19,24]. When a satisfactory view of the glottis is difficult to obtain during laryngoscopy, the patient's maxillary anterior teeth are sometimes used as a fulcrum by the laryngoscope blade [25]. As a result, the maxillary incisors, particularly the maxillary left central incisor, are frequently damaged [10,12,18,26]. As the incisors, are single rooted teeth which are anteriorly placed with a forward dental axis and a small cross-sectional area, they are susceptible to fracture when strong vertical and/or an oblique force is applied [19]. Apart from

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laryngoscopy, dental damage can be caused by other events like aggressive suctioning in the posterior of the mouth [18]; oropharyngeal airway placement subjecting anterior teeth to extreme lateral forces and vigorous biting down upon the endotracheal tube or laryngeal mask airway (LMA) shaft during emergence from anesthesia [27]. Other events include the forceful removal of an oral airway, endotracheal tube, or LMA upon emergence, and shivering during the recovery phase which may cause spasm of the masseter muscle leading to excessive pressures while clenching and/or grinding of teeth [6,19,28]. Approximately 9-20% of anesthesia related dental injuries occur during tracheal extubation or in the recovery room [8,10,11,17-20,26,29,30].

In addition to the fluctuations in the causative events, the type of tooth injury varies as well. Enamel fracture and loosening/subluxation of a tooth were found to be 55.2% of all injuries, followed by tooth avulsion (9.0%), crown fracture (7.7%) [12], fracture of prosthetic restorations, crowns and bridges (14%) and discolouration of teeth. Some authors have also associated intubation under general anaesthesia with TMJ dysfunction and dislocation of the mandibular condyle [31-33].

Risk Factors

The main risk factors of dental trauma associated with laryngoscopy are difficult intubation [8,10,12,34] and poor pre-existing dental status [1,6,9,13,15,16,19,34,35]. Newland [12] reported that patients who are difficult to intubate have 20 times higher risk of dental injuries and Chen reported that in teeth with pre-existing pathology, an injury is about 5 times more likely [17]. Risk factors making teeth more vulnerable to injury can be discussed as i) Patients factors and ii) Iatrogenic factors.

Table 1. Devices and their possible associated damage.

Laryngoscope	Upper incisors can be damaged if not used properly. Can also lead to TMJ dysfunction
Oropharyngeal airways	Teeth crown and bridgework can be dislodged or damaged if the airway is cleared using force
Jaw Clamping	Use of jaw clamps during light anesthesia, particularly when used with an oropharyngeal airway, can put pressure on teeth
Bite Blocks	Can put pressure on teeth when used with a laryngeal mask airway or during oral fibre optic endoscopies
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
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

The tooth injury can occur with the experienced anaesthesiologist as well as inexperienced professionals and in both easy and difficult intubation. However, in many studies the lack of experience has been cited as an important causative factor [13,39,40].

Risk Management

Two strategies should be considered in risk management: Risk avoidance: minimizing the incidence 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

Patient's factors include limited mouth opening limited mandibular mobility, poor visibility in the hypopharynx, narrow thyromental distance, and low mobility of the neck. In addition, oral and dental health-related risk factors are prominent and large sized teeth, anterior crowding [4], isolated teeth [20], difficult mask ventilation, Periodontal diseases, presence of prostheses, previous history of difficult intubation, previous neck surgery, chemotherapy or prior radiotherapy to the oral cavity, tongue neoplasm, and oral trauma [16]. 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 [18]. Anterior crowding increases the chances 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 [36].

The maxillary teeth are generally prone to injury (74.3%). 51.8% of the injured teeth are Maxillary Central Incisors, whereas 21.8% are Maxillary lateral incisors. The left maxillary central incisors are the most commonly affected teeth (41.7%). Molars constitute 9.1% of all the injured teeth. The anterior teeth are often used as fulcrum during laryngoscopy, hence higher incidence of injury to the left maxillary central incisors [12,13,36-38].

The Iatrogenic factors include several anaesthetic equipments, particularly rigid equipments [37] if used inappropriately. The following devices are often associated with damage to teeth and therefore, care must be taken when they are used (*Table 1*).

be considered in relation to dental trauma and anaesthesia however, none of the protective strategies are completely effective [13,41].

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 involving participation of the patient, dentist, and anaesthesiologist must be undertaken for optimum risk management.

Pre-procedure measures: Patients awaiting an elective surgery requiring a general anesthesia should be advised to visit their dentist first [6,24,42], and the patient should be made aware of the possibility of dental trauma during the preoperative evaluation [5]. Forewarning patients about the potential adverse incident preoperatively can substantially decrease the likelihood of facing an uninformed, unprepared, or grieved patient post-operatively. The pre-anesthetic dental examination should be conducted by an experienced anaesthesiologist [43] and the findings must be documented in the notes [10,11] taken during the pre-anaesthetic evaluation [2,6,9,16,44]. To avoid any legal complications later on, the anaesthesiologist must especially rule out the established dental and anatomical risk factors such as difficulty in mouth opening and any loose prosthesis. In case the patient has any missing, damaged, or loose teeth, it should be confirmed with the patient and documented accordingly. A notation about the patient's periodontal status and oral hygiene can prove handy. Recognized risk factors such as dental trauma, radiation therapy and chemotherapy in head, bruxism, diabetes mellitus and autoimmune diseases, age, smoking status and early tooth decay in childhood should be identified during anaesthetic consultation. Any history of previous complication during anesthesia must be recorded so as to prevent complications during the administration of general anesthesia [24].

Intraprocedure measures: Patients should be examined 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 [6]. To prevent damage to the teeth, a soft roll of gauze [5,37,42,45] could be placed on healthy non-restored posterior teeth, enabling them to better withstand excessive forces that can occur during emergency. Ghabash recommended using surgical adhesive tape, 3M Microfoam Surgical Tape (3M ESPE, Neuss, Germany) on the laryngoscope blade [46]. This eliminates the damage of the incisal edges of the teeth by acting as a damper on teeth during pressure. There are no limitations in operative field visibility, as the tape is very thin (<1 mm), while the laryngoscope blade does not slip on the teeth during intubation. Another alternative method of protecting mineralized tissues as well as the soft tissue of mouth, during intubation in order to facilitate insertion of the laryngoscope is the use of a wooden tongue spatula supported on the first maxillary molars [47]. It has not been assessed yet whether the spatula causes damage by itself. The use of mouth guards, protective occlusal splints, similar to those used during sports where facial injuries are possible, has also been considered [6,13]. According to Sol Flores et al. [48] the presence of fixed prosthetic restorations such as crowns and bridges, especially those made of porcelain, which are very fragile, is the main indication for the use of mouth guards during surgical operations with intubation. The risk of dental damage, especially to the frontal part of dental arches significantly increases in cases of endodontic treated teeth. Mixed dentition in children between 5 and 10 years and teeth with class III and IV dental fillings are also characterized by a lower resistance to damage. The use of elastic occlusal splints is also recommended in edentulous cases, in which they could offer stable support for an inserted laryngoscope, protecting the soft tissues of the maxillary alveolar processes against

damage. To minimize the risk of avulsion and subsequent aspiration, all mobile teeth indicated to be extracted by the dental surgeon should be removed before the general anesthesia procedure. It is prudent to get a dental consultation and procedure necessary in such patients beforehand. In case of emergency, where it is not feasible to obtain a dental opinion and procedure, securing a mobile tooth using a 3–0 silk suture wrapped several times around the gingival margins can prove handy. Lee et al. [25] advocated using a Macintosh blade with a low-height flange (Callander modification) to reduce the frequency of direct contact between the blade and the maxillary teeth. However, a similar modification of Miller blade decreased the effectiveness of laryngeal visualization. Angulated blades like the McCoy and the Belscope, provide greater tooth-blade distances and better visibility than regular curved or straight blades [49-51].

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 anaesthesia reduces the number of claims, insurance premiums, and costs of litigation process, thus improving physician–patient relationship [13].

Management of dental trauma

In spite of all preventive measures, the injury to the dentition may occur. The anaesthetist should be prepared for any such untoward event. Few important guidelines, such as recording dental fragments [45], may prove handy. In such cases, a chest radiograph is mandatory to exclude aspiration [45]. Since all dental prostheses are not radio-opaque, direct visualization still is the mainstay and should be performed whenever in doubt. Utmost care is required in case of any aspiration as larger prostheses have the potential to obstruct and ultimately perforate as they pass through. Surgical or endoscopic removal is indicated in such cases [38,42]. No intervention is required in case of loss of a primary tooth [5,42]. However, an avulsed permanent tooth must be re-implanted. Also, it can be stored in cool, fresh milk or normal saline until a time when it can be splinted or fixed back in place in consultation with a dentist [5,42,43,45]. Proper documentation is must. All actions and discussions should be clearly documented in the patient's records [42]. The anaesthetist must make sure that patient does not leave hospital without a clear written treatment plan and arrangements for follow-up. Once stable, the patient must be referred to a dentist in the postoperative period.

Conclusion

The frequency of peri-anesthetic dental injury is high. Patients who have the highest risk for dental injury are those who have pre-existing poor dentition and characteristics (limited neck motion, previous head and neck surgery, craniofacial abnormalities, and a history of previous difficult tracheal

intubation). A thorough preoperative evaluation of a patient's mouth should be conducted in consultation with the dentist, before undergoing general anaesthesia procedure. 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 peri-operative 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 pre-anaesthetic evaluation, anaesthesiologists must also take intra-procedure precautions and have knowledge of the measures required to be taken in case of any damage. All procedures and choice of the anaesthetic 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 anaesthesiologists. If injury does occur, patient can be referred to a dentist in the postoperative phase for restoration of the dental damage.

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