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Dental injuries resulting from tracheal intubation – a retrospective study

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Abstract – Even though it is known that dental injuries may occur in connection with tracheal intubation, the topic has hardly been evaluated in literature so far. Thus, this retrospective study was conducted including the data of 115–151 patients. All patients involved had been exposed to general anesthesia between 1995 and 2005. The resulting tooth injuries were assessed according to the following parameters: age, kind of hospital conducting treatment, intubation difficulties, pre-existing tooth damage, type and localization of tooth, type of tooth damage, and the number of teeth injured. At least 170 teeth were injured in 130 patients, while patients 50 years of age and older were especially affected. In contrast to older patients where in the majority of cases the periodontium (lateral dislocation) was injured, in younger patients dental hard tissue (crown fracture) was more likely to be affected. It was calculated that patients from the cardiothoracic surgery clinic were showing the highest risk of tooth damage. In more than three-fourth of all cases the anterior teeth of the maxilla, especially the maxillary central incisors, were affected. Pre-existing dental pathology like caries, marginal periodontitis and tooth restorations were often distinguishable prior to operation. Mouthguards in connection with tracheal intubation are not generally recommended as preventive device, due to the already limited amount of space available. Instead, pre-existing risk factors should be thoroughly explored before the induction of intubation narcosis.

It is known that there is a relatively high risk of incurring dental injury by endotracheal intubation during general anaesthesia. Thus, in literature this is one complication described relatively often (1–9). Since during laryngoscopy anterior teeth are often used for support unintentionally (10), they are predestined to experience injury (1, 4, 7, 8, 10, 11). The frequency of dental injury is indicated to be between 0.17% and 12.1% (2, 3, 9, 11–14). Difficult anatomical conditions being typical risk factors for tooth injury during intubation are limited mouth opening, limited mobility of the mandibula, poor visibility in the hypopharynx, narrow thyromental distance, and low mobility of the neck (15). Just like the anatomical conditions, oral and dental health also plays an essential role. Here typical risk factors are caries, marginal periodontitis, insufficient restorations, and existing ceramic restorations (4, 11). Most tooth injuries happen already at the beginning of the intubation by laryngoscopy (9, 10). Next to direct damage by the laryngoscope, dental injury can also be caused by biting on the endotracheal tubus by the patient during emergence from general anaesthesia (1). In literature crown and root fractures (44.8%) are stated to be the most common form of injury followed by dislocations (20.8%), and avulsions (20.8%) (2, 8). However, all in all the data available about tooth injuries by intubation are rather fragmentary. Aim of the present study was to find out how often and under what conditions dental trauma occurred during intubation in connection with general anaesthesia. Additionally, it was sought to isolate possible risk factors, and thus being able to make suggestions for preventive measures.

Materials and methods

Included in the study were all patients who received general anaesthesia in the department of anaesthesia at the university hospital, Basle from the beginning of 1995 to the end of 2005. The data from these 115 151 general anaesthesias conducted during these 11 years was extracted from the yearbooks of the university hospital, Basle. The data of the resulting tooth injuries during that time was collected from incident reports of the department of anaesthesiology. The collected data is comprised of (i) the patient's personal information (name, birth date), (ii) operative information (date of operation, institution treating the patient, degree of difficulty of the intubation categorized under easy, average, or difficult, emergency or elective intubation), (iii) data related to tooth injury (what tooth, how many teeth, pre-existing tooth damage, what type of tooth injury), and (iv) official data (liabilities, name and signature of

the responsible anaesthesiologist, date it was put on record). Tooth injuries that were caused by intubation were evaluated statistically according to age of the patient, indication for intubation (emergency vs elective anaesthesia), and according to the institution's scientific discipline the operation took place. Following parameters were also of interest: possible difficulties during intubation, known or unknown pre-existing tooth damage (caries, marginal periodontitis, reconstruction) localization and type of injured tooth, what type of tooth injury occurred, as well as the number of teeth injured.

Statistical analysis was done by JMP (Statistical Discovery, Version 6.0; SAS Institute Inc., Cary, NC, USA). Comparison analysis was determined by chi-quadratic multi-field test and one-way ANOVA. A regression model was used for multivariate analysis. Unknown and incomprehensible information was not included in the calculations, nor given in percentage.

Results

The 115 151 patients who had received general anaesthesia for treatment in the years 1995–2005 amounted to 130 registered cases of tooth injuries (74 in males, 56 in females), which corresponds to a frequency of 1.13‰. In reality at least 170 teeth were injured. The exact number of injured teeth could not be exactly established in 16 patients. The age distribution showed a mean age of 57.6 years (3.1–94.4). Only eight patients were affected from the first three decades of life. More than half of the patients were between 50 and 80 years of age (Fig. 1). In most cases of patients with tooth injuries, intubation was conducted under arranged conditions (90/108). Only in 18 cases intubation was carried out under emergency conditions (18/108). In 22 patients the conditions under which intubation was conducted could not be clearly reconstructed.

Where the distribution of tooth injuries from different surgical disciplines was concerned, the general surgery clinic was affected the most with 48/127 patients (37.8%) followed by the cardiothoracic surgery clinic (21/127, 16.5%). Comparatively, the clinic of neurosurgery (15/127, 11.8%) and the ear, nose, and throat clinic (14/127, 11%) also showed many tooth injuries (Table 1). The records of five patients did not clearly state the clinic conducting treatment.

Table 1. Percentages of operating clinics on the total of intubation during general anaesthesia between 1995 and 2005, the number of tooth injuries, and the calculated risk of tooth injury during general anaesthesia in different clinics

Operating clinic	Total of intubation during general anaesthesia in percent	Patients experiencing tooth injuries (%)	Calculated risk (‰)
Cardiothoracic surgery	4.1	21 (16.5)	2.08
Neurologic surgery	5.3	15 (11.8)	1.16
General surgery	18.4	48 (37.8)	1.05
Ear, nose, and throat diseases	6.2	14 (11)	0.92
Urology	5.2	5 (3.9)	0.39
Orthopaedic surgery	17.5	8 (6.3)	0.19
Gynaecology	12.9	6 (4.7)	0.19
Corrective surgery	18.9	7 (5.5)	0.15
Ophthalmology	11.5	1 (0.8)	0.04
Unknown	–	5	–
Total/arithmetic mean	100	130 (100)	0.53

When the number of tooth injuries from each single clinic is divided by the amount of total operations in the time span observed, the risk of tooth injury by intubation during general anaesthesia can be calculated for every clinic individually. Therefore, the cardiothoracic surgery clinic showed the highest risk (2.08‰), the ophthalmological clinic the least (0.04‰). Also in the ear, nose, and throat clinic and the neurosurgical clinic the theoretical risk (0.92‰ or 1.16‰) was higher in comparison to the arithmetical mean (0.53‰). The general surgery clinic was on one hand the clinic with the most tooth injuries, but on the other hand it also had the second to largest number of overall operations. Thus, compared with the cardiothoracic surgery clinic, it has only half the theoretical risk (1.05‰).

Oral and dental health of every patient was assessed prior to every general anaesthesia with intubation by the anaesthesiologists.

Pre-existing dental pathology (caries, marginal periodontitis, reconstructions) were provably present in two-thirds of the patients (66/104, 63.5%). In 38 patients (38/104, 36.5%) no pre-existing dental pathology was present. In 26 cases there was no record concerning pre-existing dental pathology. However, these were noticed by the anaesthesiologists only in one fifth of

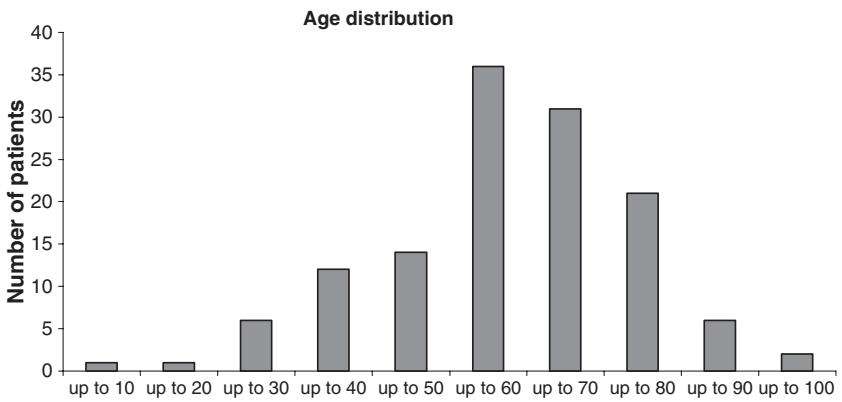

Fig. 1. Age distribution of patients experiencing tooth injury by intubation during general anaesthesia (n = 130).

the patients prior to intubation (20/105, 19%). In 85 patients (85/105, 81%) no pre-existing dental pathology was noticed prior to intubation. In 25 cases there were no corresponding statements in the records. In 53 patients (53/84, 63.1%) the dental records from before the operation were in agreement with the pre-existing tooth pathology. In 31 cases (31/84, 36.9%) pre-existing tooth-pathology became apparent only through the incident reports. However, in 46 cases no statement could be made about this parameter.

Mostly teeth of the maxilla (74.3%) were prone to injury, and then especially on the left side (41.7%). The teeth most often injured (51.8% of all the teeth injured, applying the FDI two-digit notation tooth 21 to the rate of 27.1%, tooth 11 to 20.6%) were the maxillary central incisors; maxillary lateral incisors were affected only half as often (21.8% of all the teeth injured, tooth 22 to the rate of 14%, tooth 12 to 3.7%) (Table 2). Molars were also noticeably injured (9.1% of all the teeth injured). The tooth injuries that occurred most often were crown fractures (32.5%) and dislocations (29.3%). Restorations were rarely damaged or became lost (21.1%). Avulsions (17.1%) occurred most infrequently but still quite often. Periodontal damage (avulsion and dislocation) was observed more often with increasing age of the patient. The mean age determined for avulsions was 66.7 years, for dislocations 61.8 years. In comparison the mean age determined for crown fractures was 48.8 years ($P < 0.001$).

Difficulties in intubation were documented in 116 cases (116/130) of patients with tooth injuries. Intubation circumstances were mostly described as easy (54/116, 46.6% of all patients), and less commonly as difficult (44/116, 37.9%). The intubation circumstances were described as average in 18/116 cases (15.5%). Analysis of whether intubation difficulties could be accountable for multiple tooth injuries showed that in most patients (72.8%) merely one tooth was injured. Incidence of two injured teeth was observed as often either in easy (10.5%) or in difficult (8.6%) intubation circumstances ($P = 0.3$). Rarely three or more teeth were injured (5.7%), and then more often under difficult intubation circumstances. Avulsions occurred twice as often in easy (10.6%) than in difficult intubations (4.8%). In contrast dislocations were much more likely to be found in difficult intubations (14.4%) ($P = 0.01$). Crown fractures occurred similarly often under easy as well as difficult intubation circumstances (14.4%). Damage to fillings and prosthetic work occurred most frequently during easy intubations (14.4%). Under emergency conditions exclusively maxillary anterior teeth (9/9) were injured, and then primarily the central incisors (5/9). In two thirds of the emergency intubations tooth injuries occurred on the left side (10/15, in three this parameter was unknown). Periodontal injuries occurred most often during emergency intubations (dislocations: 6/15, avulsions: 4/15) whereas crown fractures and damage to fillings and dental prostheses (22/82, 26.8%) were more likely to occur in elective intubations (28/82, 34.1%, in eight this parameter was unknown). Assessment of damages also includes the evaluation of the anaesthesiologist in charge and whether there was a suboptimal management by the anaesthesia team involved. In 42/130 cases no management error was documented, in 57/130 cases no entry was made in the records. Generally dental trauma is one of the typical risk factors of tracheal intubation. Therefore, it is astonishing that even so in 31/130 cases a suboptimal management was distinctly documented.

Table 2. Comparison between the kind of tooth injury and the tooth affected ($n = 108$ with 62 unknown)

	Kind of tooth injury				
Tooth	Avulsion	Dislocation	Crown fracture	Damage to fillings or dental prostheses	Total
Central incisor	5	18	26	8	57
Lateral incisor	6	11	3	4	24
Canine	3	1	5	4	13
Premolar	2	2	0	2	6
Molar	1	0	5	2	8
Total	17	32	39	20	108

Discussion

In the present retrospective study the risk of tooth injury during general anaesthesia involving intubation was 1.13‰. Frequencies published in literature vary strongly (7). Some authors indicate lesser frequencies ranging anywhere from 0.17‰ to 0.25‰ (retrospective studies 9, 13, 14), others considerably higher ones from 2.1% to 12.1% (prospective studies 6, 11). The result of the present study coincides with the results of a North-American study (12) registering a frequency of tooth injuries of 1.0‰ in 1 135 212 tracheal intubations in one year. The number of patients experiencing tooth injuries by intubation clearly increases with age, which should be in accordance with the age distribution of operations within the population. In patients older than 66.7 years a distinctly increasing risk of avulsion or at least dislocation by intubation was shown. The most likely reason is the loss of attachment, since chronic marginal periodontitis is often a disease appearing later in life. The affected periodontium may not be able to compensate for shear forces possibly arising during intubation. In contrast younger patients primarily suffered from crown fractures.

The presumption that emergency intubation might be a risk factor for tooth injury (11) was not confirmed in the present work. Intubation difficulty does not seem to be a risk factor in itself. There was a similar distribution of easy and difficult intubation circumstances when tooth injuries occurred, and this coincides with data of other authors (16). However, it could be demonstrated that the type of tooth injury depends on the kind of intubation difficulty, such as dislocations occur more often in difficult intubation circumstances. A possible reason for the latter might be that even though special care and attention is given during difficult intubations, more force has to be applied which leads to an increase in

periodontal injuries of individual teeth (10). The general surgery clinic showed most dental injuries ($n = 48$ patients). The cardiothoracic surgery clinic caused indeed fewer tooth injuries ($n = 21$ patients), but it also performed clearly fewer operations within the same trial period giving with 2.08‰ the highest calculated risk for all clinics. One reason for this high risk could be among other things the use of double lumen tubes for one-lung ventilation during lung operations. Double lumen tubes are bigger in size than normal endotracheal tubes and less flexible. This causes them to need much more room which in turn makes intubation more difficult. The above average tooth injuries occurring in the neurosurgical clinic could be explained by the patients being in prone position for back operations, and because of it the tubus exerting pressure onto the teeth over and over again. Where the increased risk in the ear, nose and throat clinic is concerned, it might have to do with limited operating space, since the tubus is situated in the area that is operated on. Comparable data has not been found in literature.

Pre-existing dental pathology seems to be an additional risk factor for tooth injury in intubation. In 66/104 documented cases (63.5%) the anaesthesiologist was able to distinguish pre-existing dental pathology prior or after the incident. Risk factors in terms of pre-existing dental pathology like caries, advanced marginal periodontitis, and existing restorations (3, 8–11, 16) were described in other studies. These pre-existing dental pathologies were held responsible for the emerging tooth injuries in 32% (16)–67% (8) of all cases. However, it is important for the prevention of tooth injuries, whether the anaesthesiologist in charge notices pre-existing dental pathology during the pre-examination, since it can possibly be taken care of by dental treatment prior to operation. In 31 patients (36.9%) pre-existing tooth injuries were noticed only after the incident. Yet, the assessment of oral and dental conditions is difficult without standardized methods like panoramic radiography and periodontal status, and only possible with corresponding dental expertise. Therefore, in terms of minimizing the risks, many authors advocate or demand closer co-operation with dentists when general anaesthesia with intubation is planned (4, 6, 7, 12, 17).

During intubation the most common types of tooth injury were crown fractures (32.5%) and dislocations (29.3%). In most cases only one tooth was injured (72.8%), and primarily maxillary teeth were affected (74.3%). This is in accordance with the results of other studies (11, 13, 16, 18). The left side of the maxilla was more often affected than the right (41.7% vs 32.6%). Above all this should be due to the fact that by conventional laryngoscopy for the hypopharynx and the glottis to become visible, the tongue is picked up by the laryngoscope from behind by use of the left hand and replaced to the top left side. For this the patient is in dorsal position. This movement to the left of the laryngoscope might explain the increase of tooth injuries in the left maxilla. Noteworthy is the frequent injury of molars (9.1%), primarily on the right side (80%). This could be explained by two things (i) that the fixation of an endotracheal tube is by the majority of cases on the right side, and (ii) that the tip of the laryngoscope moves to the right when positioning the tube. The latter could also be an explanation of why injured molars mostly suffered from crown fractures (62.5%). Tooth injuries through endotracheal intubation are a rare but typical complication, and one of the most common reasons to sue for damages in anaesthesiology (1, 4, 7, 11, 19). Improvement of laryngoscopes has been demanded for years. By decreasing the size of the instruments, the limited space available may be used more efficiently avoiding injury to teeth (20). Today next to fibreglass optics there are other further advanced intubation systems and new laryngoscope models and materials available for application (21–24). Some authors recommend protecting mouthguards during general anaesthesia. However this is a controversial topic in literature (25–27). Especially in high risk patients there is often a limited amount of space for laryngoscopy, which is further reduced by a mouthguard. Besides a mouthguard cannot always prevent tooth injury (17).

In principle, evaluation of dental status prior to intubation, best done by a dentist, could make a contribution to risk minimization (4, 6, 7, 12, 17, 28). However, taking into consideration the thereby evolving costs, primarily only patients showing specific risk factors should receive dental evaluation: patients aged 60 and older, patients with upcoming cardiac or thoracic surgery, poor oral health, and large prosthetic reconstructions. Basic requirement for that is a sound liaison between medical and dental scientific societies as well as between the anaesthesiologist in charge and the treating dentist (19).

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