Dental Traumatology

Dental Traumatology 2011; **27**: 10–14; doi: 10.1111/j.1600-9657.2010.00955.x

Dentoalveolar injury related to general anaesthesia: a 14 years review and a statement from the surgical point of view based on a retrospective analysis of the documentation of a university hospital

Nicolai Adolphs[1], Bernhard Kessler[1], Christian von Heymann[2], Eveline Achterberg[2], Claudia Spies[2], Horst Menneking[1], Bodo Hoffmeister[1]

[1]Department of Oral and Maxillofacial Surgery; [2]Department of Anaesthesiology and Intensive Care Medicine, Charité Centrum 7 für Anästhesiologie, Op-Management und Intensivmedizin, Charité Universitätsmedizin Berlin, Campus Virchow-Klinikum und Campus Charité Mitte, Berlin, Germany

Correspondence to: Nicolai Adolphs, Department of Oral and Maxillofacial Surgery, Centrum 9 für Unfall- und Wiederherstellungschirurgie, Charité Universitätsmedizin Berlin, Campus Virchow-Klinikum, Augustenburger Platz 1, Mittelallee 2, 13353 Berlin, Germany
Tel.: +4930450555022
Fax: +4930450555901
e-mail: nicolai.adolphs@charite.de

Accepted 5 November, 2010

Abstract – *Introduction*: Damage to dentoalveolar structures related to general anaesthesia is a well-known complication and may represent a relevant morbidity for affected patients. Central documentation of perioperative dentoalveolar injuries was performed since 1990 in the Department of Anaesthesiology and Intensive Care Medicine in cooperation with the Department of Oral and Maxillofacial Surgery at the Charité Universitätsmedizin Berlin, Campus Virchow-Klinikum. Documentation of perioperative dentoalveolar injury consisted of anaesthesia charts, reports of the anaesthesiologists and consultant maxillofacial surgeons. *Materials and methods*: Retrospective analysis of the data from 1990 to 2004 was performed according to this documentation with respect to incidence, matter, distribution of dental injury and therapeutic consequences. *Results*: Within 14 years 82 'dental injuries' with 103 affected teeth were documented in calculated 375 000 general anaesthesias. Incidence of 0.02% was very constant with an average of 5.5 events/year. Eighty-nine percent of the documented injuries occurred during scheduled operative procedures. Only 32.9% of the injuries took place during endotracheal intubation. In about 50% the injury was not related to intubation or extubation but happened during general anaesthesia. In 80% the dental injury was estimated by the anaesthesiologist as 'not avoidable'. In 83% pre-existing affection or structural injury of intraoral tissues was documented, in 32.7% of the affections sufficient therapy could be provided already during inhospital stay. *Conclusion*: Perioperative dentoalveolar injury is surely an annoying complication of general anaesthesia. However incidence is rare and seems to be unavoidable. Pre-existing damage to dentoalveolar structures is the main risk for additional injuries related to general anaesthesia. Adequate therapy can be provided by interdisciplinary concepts. There should be a fair balance between the benefit of the surgical procedure and the risk of dental injury related to general anaesthesia. Awareness of the problem and proper documentation are important factors for adequate management in liability cases.

Damage to dentoalveolar structures during endotracheal intubation and general anaesthesia is a well-known complication and may represent a relevant morbidity to affected patients.

The incidence of perioperative dental damage related to general anaesthesia varies between 0.01% up to 0.1% and seems to be very constant during the last 25 years (1–4). Pre-existing dental and periodontal damage is a well-known risk factor for additional lesions to the intraoral structures during general anaesthesia (5). However, dental damage is the predominant complaint in medicolegal claims against anaesthesiologists (6). After retrospective analysis of the documentation of a University Hospital from 1990 to 2004 data of incidence, modality and distribution of dental injury related to general anaesthesia as well as therapeutic consequences are reported and discussed from the point of view of the consultant maxillofacial surgeons.

Materials and methods

Since 1990 central documentation of 'perioperative dental injuries' was performed by the Department of Anaesthesiology and Intensive Care Medicine in coop-

eration with the Department of Oral and Maxillofacial Surgery, Campus-Virchow-Klinikum, Universitätsmedizin Charité Berlin, Germany.

Perioperative dental injury was defined as any noticeable change in patients dentition during or after general anaesthesia no matter if specific therapy was required or not. In case of observed or assumed 'perioperative dental injury' maxillofacial consultation was ordered by the anaesthesiologists in order to perform objective documentation and assessment of dental injury with respect to oral and periodontal status as well as therapeutic consequences. This consultation should have been performed routinely within 24 h after dental injuries by the in-house maxillofacial consultants.

Central documentation contained copies of the anaesthesia charts with specific information about patients, surgical and anaesthesiologic procedures and a written report of the injury by the responsible anaesthesiologist containing detailed data about moment and modality of dental injury and assessment if the injury would have been avoidable. Retrospective analysis of these data was performed between 2005 and 2009 by the Department of Maxillofacial Surgery that was responsible for the consultations after 'perioperative dental injuries'.

Results

About 25 000 general anaesthesias/year are performed by the Department of Anaesthesiology and Intensive Care Medicine at the Charité-Universitätsmedizin Berlin, Campus Virchow-Klinikum serving the surgical specialities of general and transplantation surgery, trauma and orthopaedic surgery, obstetric and gynaecology, ENT, neurosurgery, ophthalmic surgery, paediatric surgery and urology coming up to calculated 375 000 general anaesthesias from 1990 until 2004. The overall incidence of emergency procedures requiring general anaesthesia during the observation period was estimated to vary between 5 and 10% of all surgical procedures according to recent data from central anaesthesiologic documentation and is assumed to have been constant over time. Within the 14 year observation period 82 patients with 'perioperative dental injuries' had been collected in the central documentation representing an overall incidence of 0.02%. With an average of 5.5 documented events/year this value proved to be constant during the period under review although the occurrence varied from year to year (Fig. 1).

Perioperative dental injuries showed a different frequency dependent on the surgical department predominantly occurring in the general surgical 50% (n = 39) and trauma departments with 16.7% (n = 13). Incidence of dental injury in Gynaecology and Obstetrics, Neurosurgery, ENT, Ophthalmology, Urology and Maxillofacial departments were < 10%. Distribution between genders was quite equal with 40 female and 42 male patients. Mean age was 56.4 years (ranging from 8 to 86 years), mean body mass index was 26.6 kg m^{-2}. In 78 of 82 patients general morbidity or general risk factors were documented. Sixty-three patients were classified according to the risk stratification of the American Society of Anaesthesiologists (ASA) as ASA I 11.1% (n = 7), ASA II 55.6% (n = 35), ASA III 31.7% (n = 20) and ASA IV 1.2% (n = 1). Eighty-nine percent of the perioperative dental injuries occurred during scheduled surgical procedures, while only in 10.8% injuries occurred under emergency conditions. Mean operation time was 3.5 ± 1.9 h, 60.4% of the injuries occurred during procedures that had started between 7:30 and 12:00 a.m., 29.6% of the procedures were started in the afternoon. In 90.2% (n = 74) endotracheal intubation was documented, in 9.8% (n = 8) laryngeal masks were applied (Table 1). According to the documentation frequency of dental injuries seemed not to be related to the level of training of the anaesthesiologists and occurred as well among residents

Table 1. Anaesthesiologic technique and associated perioperative dental injuries 1990–2004 (n = 82)

	Endotracheal intubation	Laryngeal mask
n = 82	n = 74	n = 8
100%	90.2%	9.8%

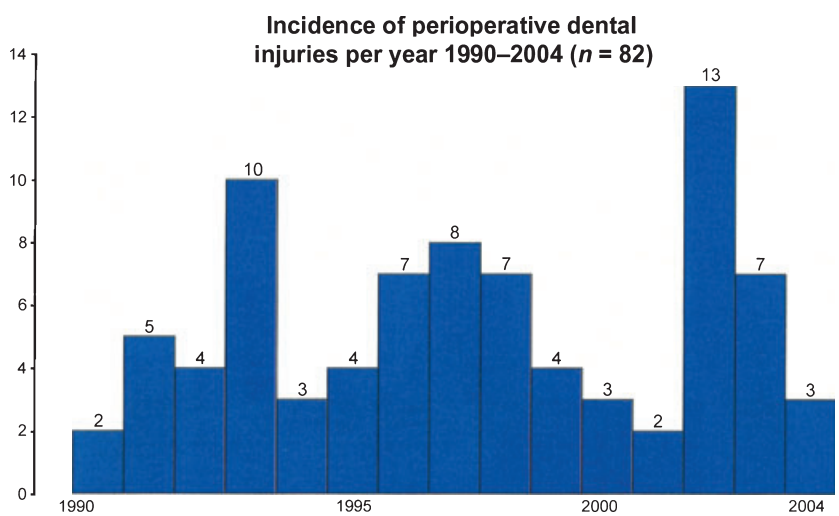

Fig. 1. Incidence of perioperative dental injuries between 1990 and 2004 (n = 82). Incidence of 0.02% overall, variance of dental injuries between 2 and 13 injuries per year with a mean of 5.5 occurrences.

as well as among consultants. More detailed data could not be evaluated as the level of training was not expressly specified in the files.

With respect to time of the injury in 76 of 82 patients data was available. In 32.9% (n = 27) injury occurred during intubation, in 8.5% injury occurred during extubation, in 51.2% (n = 42) injury occurred during ongoing general anaesthesia. In five patients 'sudden intraoperative biting on the tube' was documented.

Perioperative dental injuries

Preoperative information about possible perioperative dental injury was documented in 52.4% (n = 43), however documentation increased from 47.4% before the year 2000 up to 71.4% in 2004. Intraoral status was documented preoperatively in 75.6% (n = 62), in 24.4% (n = 20) no preoperative oral status was documented. In 35% (n = 29) 29 pre-existing 'tooth gaps' were documented, in 48% (n = 40) pre-existing prosthodontics were described, however, no professional dental or periodontal status was documented.

Distribution and modality of perioperative dental injuries

In 82 records perioperative injuries affecting 103 teeth were documented. In 67.1% (n = 55) of patients maxillofacial consultation had been performed effectively and specific documentation of dental injury was complete in 57.3% (n = 47). In 77 records precise information about location and modality of dental injury was available. Maxillary front teeth were significantly more affected than all other teeth. A total of 82.5% (n = 85) of the documented injuries were found between the maxillary canines. Most lesions concerned the left upper median incisor with 35.1% (n = 27). The distribution of affected teeth is shown in Table 2.

In 72% of patients (n = 59) only one tooth was affected, in 9.8% (n = 8) damage to two teeth was documented, in six patients three or more teeth were involved. Isolated damage to dental prostheses was documented in 5.2% (n = 4).

Loosening of teeth (39%; n = 32), fracture of crowns and teeth (28%; n = 23), lunation of teeth (20%; n = 17) were the main injuries. Minor tooth damage like infraction and fracture of the alveolar crest was less likely to occur (< 10%) (Fig. 2).

Management and therapy of perioperative dental injuries

Therapy after perioperative dental injury was performed by the patient's dentist in 57.3% (n = 47) after discharge from hospital, whereas in 32.9% (n = 27) therapy was performed by either the consulting maxillofacial surgeon or the patient was referred to the institution's dental school. Table 3 shows the different therapeutic treatments after perioperative dental injury. In 45% either extraction or no specific dental therapy was necessary. In 54% prosthodontics or conservative dental therapy was required. Reliable estimates of the costs for the different treatments and dental procedures could not be evaluated.

In 97% (n = 80) of the records there was an anaesthesiologist's assessment concerning the question

Table 2. Dental notation showing the distribution of 103 affected teeth in 82 documented perioperative dental injuries 1990–2004 with predominant affection of maxillary front teeth

Affections	0	0	2	0	2	8	6	21	27	17	6	2	0	3	0	0
Maxilla (n = 94)	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Mandible (n = 9)	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Affections	0	0	0	0	0	2	2	2	1	2	0	0	0	0	0	0

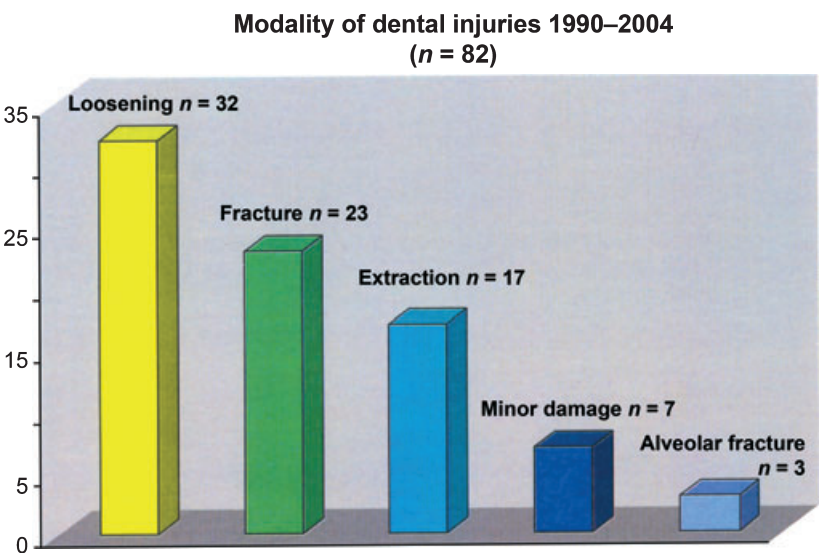

Fig. 2. Modality of perioperative dental injuries 1990–2004 (n = 82) - loosening of teeth was the main complaint in 39% of the records, in 28% dental fractures were recorded followed by luxation of teeth in 20%. Minor dental damage and alveolar fractures were less likely to occur.

Table 3. Therapy after perioperative dental injury in 82 records from 1992–2004

Modality of dental injury	Therapy						
	No specific therapy	Extraction	Complex prosthodontic treatment	Single crown	Splinting	Filling	*n*
Loosening	2	18	7	0	5	0	32
Fracture	2	8	10	3	0	0	23
Extraction	5	0	12	0	0	0	17
Minor damage	1	0	0	1	0	5	7
Alveolar fracture	0	1	1	0	1	0	3
n	10	27	30	4	6	5	82

if dental injury could have been avoidable. In 80% ($n = 64$) dental injury was judged by the anaesthesiologist as not avoidable, in 20% ($n = 16$) the injury was estimated as 'avoidable'. However, reasons for this appraisal could not be retrieved from the patient's records and anaesthesia charts.

Discussion

Data concerning modality, extent, distribution after perioperative dental injuries and therapeutic consequences in a major teaching hospital over a time period of 14 years and estimated 375 000 general anaesthesias could be evaluated.

The incidence of 0.02% is in accordance with other comparable evaluations and seems to be constant over time. In the literature incidence varies between 0.1 and 0.01%. Lockhart et al. (1) reported of an incidence of perioperative dental injuries of 0.1% after having reviewed the reports of over 1 million general anaesthesias using a questionnaire. Craig and Wilson (7) found an incidence of 0.02% in their study overlooking a total of 8312 general anaesthesias within 6 months in a general hospital. Chopra et al. (8) published their data after having reviewed the records of a university hospital in the Netherlands and found an incidence of 0.03% in 113 074 general anaesthesias (8). A Swedish study from 1992 reported an incidence of perioperative dental damage of 0.02% in 262 850 general anaesthesias (2). In 1999, Warner published their data from the Mayo Clinic after having reviewed 598 904 general anaesthesias from 1987 to 1997. They found an incidence of 0.02% for perioperative dental injuries that required specific therapy (3). A recent study from the US describes an incidence of 1 in 2073 general anaesthesias (9).

However due to medico legal aspects of perioperative dental injury, the awareness of the problem within anaesthesiologists is high. This is supported by reliable and full documentation in all 82 patients. When reviewing the data, improvements in documentation over time could be observed with special respect to the estimation of preoperative oral status and documented information of possible dental injuries.

The uneven distribution of dental injuries between different sub-specialities is likely to be explained by the fact that general surgical and trauma units performed extensively more operative procedures than the other specialities resulting in an accumulation of incidents in these units.

According to our findings dental injuries occurred predominantly during regular service times and in 10% under emergency conditions only. In 91.4% of the general anaesthetics an endotracheal intubation was documented, however, dental injury occurred in 51.2% ($n = 42$) during ongoing general anaesthesia and 48.8% ($n = 40$) during endotracheal intubation only. In five patients 'sudden intraoperative biting on the tube' was explicitly documented. This might emphasize an adequate depth of anaesthesia during the operative procedure respectively a good communication between surgeon and anaesthesiologist. However, routine use of mouth guards for general anaesthesias is not recommended and should be subjected to special indications according to Skeie & Schwartz (10). This practice is still recommended for daily clinical routine (11) and was practiced during the observation period of this study at our institution. Another aspect of dental injury is the experience or level of training of anaesthesia residents. Our data suggest that the level of anaesthesia residents training does not correlate with the risk of dental injury, which is important in a teaching hospital (12) with a high percentage of anaesthesiologists in training.

Pre-existing structural injury to dentoalveolar tissues due to decay or chronic parodontitis is a well-known risk factor for perioperative dental injury as well as difficult endotracheal intubation (13). Patients with pre-existing poor dentition are 3.4 times more likely to have dental injuries related to Anaesthesiologic procedures, patients who were difficult to intubate had a risk of approximately 20.8-fold (9). Up to 62% of dental injuries related to anaesthesia affected teeth that had pre-existing structural injuries (1, 4, 11). According to our findings in 83% of the patients damage to dentoalveolar structures was obvious preoperatively (35% 'tooth gaps' ($n = 29$), 48% presence of prosthodontics ($n = 40$) which may favour additional perioperative injury.

Loosening or luxation of teeth was documented in 59% ($n = 49$) of the injuries which is more likely to occur if chronic parodontitis has reduced dental attachment which occurs regularly with increasing age. With a mean age of 56.4 years of the affected patients this number seems reasonable. Fractures of dental hard tissues occurred in 28% ($n = 23$) and can be favoured by decay which as well may develop time-dependent.

Distribution of dental damage was in accordance with previous publications: The predominant affection of maxillary front teeth (82.5%) confirms data from the literature (1, 13). In the majority of reported injuries (59 of 82 patients, 72%) only one tooth was affected. In 45% (37 of 82 patients) either extraction or no specific dental therapy was performed. This can be explained either by the fact that the affected teeth seemed not worth to be preserved due to pre-existing structural damage or there was obviously no other treatment option due to the patients general situation according to the maxillofacial consultation. In summary interdisciplinary management of documented perioperative dental injuries resulted in sufficient initial therapy under inpatient conditions respectively caused professional dental treatment after discharge from the hospital.

Conclusion

Our findings confirm that the incidence of dental injury related to anaesthesiologic procedures over a broad range of surgical specialities and a large number of general anaesthesias is low. However, dental injury during endotracheal intubation or during anaesthesia does not seem to be completely avoidable. Pre-existing structural damage of dentoalveolar tissues was documented in the majority of affected patients which emphasizes preoperative assessment of the dental status. If perioperative dental injury has happened, prompt dental assessment by a specialist is recommended in order to provide adequate therapeutic management and avoid further dental vitiations during the hospitalisation. Specific appraisal of intraoral structures should be performed with respect to pre-existing structural deficiencies as documentation is an important argument in claims. Awareness of the problem, interdisciplinary concepts and proper documentation are important factors in order to provide adequate management in case of dental injury related to general anaesthesia.

References

1. Lockhart PB, Feldbau EV, Gabel RA, Connolly SF, Silversin JB. Dental complications during and after tracheal intubation. J Am Dent Assoc 1986;112:480–3.
2. Wang LP, Hagerdal M. Reported anaesthetic complications during an 11-year period. A retrospective study. Acta Anaesthesiol Scand 1992;36:234–40.
3. Warner ME, Benenfeld SM, Warner MA, Schroeder DR, Maxson PM. Perianesthetic dental injuries: frequency, outcomes, and risk factors. Anesthesiology 1999;90:1302–5.
4. Yasny JS. Perioperative dental considerations for the anesthesiologist. Anesth Analg 2009;108:1564–73.
5. Burton JF, Baker AB. Dental damage during anaesthesia and surgery. Anaesth Intensive Care 1987;15:262–8.
6. Cass NM. Medicolegal claims against anaesthetists: a 20 year study. Anaesth Intensive Care 2004;32:47–58.
7. Craig J, Wilson ME. A survey of anaesthetic misadventures. Anaesthesia 1981;36:933–6.
8. Chopra V, Bovill JG, Spierdijk J. Accidents, near accidents and complications during anaesthesia. A retrospective analysis of a 10-year period in a teaching hospital. Anaesthesia 1990; 45:3–6.
9. 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. J Clin Anesth 2007;19:339–45.
10. Skeie A, Schwartz O. Traumatic injuries of the teeth in connection with general anaesthesia and the effect of use of mouthguards. Endod Dent Traumatol 1999;15:33–6.
11. Aitkenhead AR. Injuries associated with anaesthesia. A global perspective. Br J Anaesth 2005;95:95–109.
12. Gaiser RR, Castro AD. The level of anesthesia resident training does not affect the risk of dental injury. Anesth Analg 1998;87:255–7.
13. Owen H, Waddell-Smith I. Dental trauma associated with anaesthesia. Anaesth Intensive Care 2000;28:133–45.