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Evaluation of dentoalveolar and temporomandibular joint injuries during endotracheal intubation: a survey study

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ABSTRACT

Aims: Endotracheal intubation is a widely utilised technique in the fields of anesthesia and resuscitation. However, dentoalveolar and temporomandibular joint (TMJ) injuries may occur frequently during this procedure. Such injuries can result in patient morbidity and, in some cases, may also give rise to medico-legal issues. It is therefore essential to develop a comprehensive understanding of the prevalence of such injuries, the risk factors that contribute to their occurrence, and effective management strategies to minimize the likelihood of these complications arising.

Methods: A cross-sectional study was conducted to evaluate the knowledge and attitudes of 227 anesthesiologists across Turkiye regarding dentoalveolar and TMJ injuries occurring during endotracheal intubation. A previously validated online questionnaire consisting of 20 questions was administered. Data were analyzed with IBM SPSS v23 software, and the significance level was evaluated as $p<0.05$ using Fisher's exact test with Monte Carlo correction between categorical data.

Results: The survey revealed that 67.4% of the participants reported cases of dental trauma in adult patients, with a smaller percentage (28.2%) reporting cases in pediatric patients. The survey also revealed that the use of protective devices was minimal, with only 5.3% of participants reporting their use. However, a significant proportion (93%) of the participants stated that education should be provided on the prevention and management of dental trauma. The most common site of injury was the anterior teeth of the maxilla (82.8%), and the most common type of trauma was tooth fracture (56.6%). Furthermore, temporomandibular joint dislocation was reported in 26.4% of participants during the intubation process.

Conclusion: Dentoalveolar and TMJ injuries during endotracheal intubation are a prevalent yet under-researched problem. This study underscores the necessity for training programmes to formulate preventive measures and emergency intervention methods. Preoperative dental assessments and the utilization of protective devices can markedly reduce the incidence of such injuries.

Keywords: Dentoalveolar injuries, temporomandibular joint injuries, endotracheal intubation, survey

INTRODUCTION

Endotracheal intubation is a widely utilized technique in the fields of anaesthesia and resuscitation, particularly in emergency settings. This procedure entails the insertion of a probe through the oral and nasal cavities, extending into the trachea, with the objective of maintaining an open airway and facilitating artificial respiration. However, the teeth, which are located in the anterior part of the face and act as a functional natural barrier, are at risk of damage during this procedure and may be among the most frequently affected structures in endotracheal intubation.[1] Preoperative dental injuries are among the most common anaesthesia-related medico-legal complaints and account for approximately one third of all medico-legal cases.[2] Dental trauma or other intraoral damage during general anaesthesia contributes to the overall morbidity of the patient and constitutes a significant problem that may result in legal proceedings.[3] It is important to note that such injuries occur during surgical interventions not directly related to dental trauma. In particular, complications such as unexpected pain, aesthetic problems, and functional impairments may have a detrimental effect on the patient's quality of life and normal functioning, and thereby threaten overall well-being.[4] Furthermore, the financial burden of

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prosthetic replacement for lost or damaged teeth can prove to be a considerable strain on the patient.[5,6] In rare cases, life-threatening complications such as oesophageal perforation and mediastinitis have been reported in association with the aspiration of dentures or teeth. The majority of dental injuries occurring in the preoperative period (50-75%) take place during tracheal intubation.[1] Although the incidence of dental injuries in general has been reported to range between 0.06% and 12%, the actual prevalence of these rates may be underestimated.[7] During intubation, anaesthetists may use the upper teeth as a fulcrum if they do not have a clear view of the glottic orifice. Supporting the upper jaw and thus the upper anterior teeth during laryngoscopy may improve the line of sight and facilitate placement of the endotracheal tube. This use of the laryngoscope explains the frequency of dental injury during difficult intubation.[8]

A number of factors have been identified that can lead to accidents during endotracheal intubation. These factors are either directly related to the intubation process (e.g., inadequate alignment of the pharyngeal, laryngeal and buccal axes, inadequate compression of the base of the tongue, or the presence of airway obstructions and laryngeal stenosis) or to skeletal and dental abnormalities. Skeletal predisposing factors include, in particular, the presence of skeletal class II malocclusion, restricted mouth opening, reduced mandibular mobility, temporomandibular joint diseases and osseo-articular problems. Dental predisposing factors include carious lesions, extensive restorations, endodontically treated teeth, periodontal lesions, fixed prostheses, rhizalised deciduous teeth, dental malpositions and the presence of isolated teeth. These factors may increase the risk of complications during intubation, potentially leading to damage to the teeth.[9,10]

Major dental injuries reported during anaesthetic procedures include subluxation, crown fracture and tooth avulsion. Effective management of these common complications is of paramount importance for both patient safety and the success of the treatment process.[11] The maxillary anterior region, and more specifically the maxillary incisors, are the most commonly affected. This is due to the direct contact of the maxillary left central incisor with the laryngoscope blade, which is used as a fulcrum for positioning the laryngoscope.[12]

Tooth loss can have a direct impact on the patient's quality of life, potentially resulting in aesthetic, functional or psychological concerns. For the clinician, it is critical to prevent life-threatening complications such as tooth aspiration. Consequently, reducing the risk of dental injury during anaesthetic procedures and addressing emerging issues promptly are crucial for patient health and clinical success.[13]

The present study was conducted for the purpose of evaluating the knowledge and attitudes of anaesthesiologists with regard to the management of dentoalveolar and temporomandibular joint injuries. The study aims to reveal the physicians' approaches to such injuries, their level of awareness, and their strategies in the prevention or treatment of possible complications.

METHODS

This cross-sectional study was conducted online with 227 general anesthesia and reanimation physicians in Turkiye in order to evaluate their knowledge and attitudes about dentoalveolar and temporomandibular joint injuries during endotracheal intubation. Ethics Committee approval of our study was obtained from Mersin University Clinical Researches Ethics Committee (Date: 10.07.2024, Decision No: 2024-644). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The study utilized a questionnaire comprising 20 questions, which had been developed by adapting existing, validated questionnaires.[11,14,15] The administration of the questionnaires was conducted in Turkish, the official language of the Turkish Republic. The survey started with a reminder that participation was voluntary, and all participation was entirely based on free will. The target sample size was determined to be 207 individuals, with a confidence level of 95% (1-α), a power level of 80% (1-β), and an effect size of g=0.064.[16]

Statistical Analysis

The data were analyzed using IBM SPSS V23. The Fisher's exact test with Monte Carlo correction was used to analyze the relationship between the categorical data. Frequency and percentage were used to represent categorical data. The significance level was taken as $p<0.05$.

RESULTS

Demographic Characteristics

Of the 227 anesthesiologists who participated in the study, 43.6% were female and 56.4% were male, and the age distribution was concentrated in the 25-30 (34.8%) and 31-35 (27.8%) age groups.

Prevalence of Dental Traumas

The rate of individuals reporting dental trauma in adult patients was 67.4%, while this rate was 28.2% in pediatric patients. The most common site of injury was the anterior maxillary teeth (82.8%), and the most common type of trauma was tooth fracture (56.6%) (**Table 1**). The approach adopted by anesthetists in cases of trauma to teeth or oral tissues was found to vary:

- 34.4% of them stated 'I solve it myself',
- 30.8% of them responded 'I refer the patient to the relevant department in dentistry',
- 30.8% of them answered 'I call the consulting physician' (**Table 1**).

Protective Measures and Awareness

The rate of protective device use was low (5.3%) and 93% of the participants stated that training on the prevention and management of dental trauma was necessary (**Table 1**).

Trauma Management and Awareness

In the management of serious injuries such as tooth avulsion, the majority of the participants (79.7%) stated that they referred the case to dentistry. However, only 13.7% stated that they preserved the avulsed tooth in a suitable solution, while

Table 1. Descriptive statistics of variables

	Frequency	Percentage
Gender		
Woman	99	43.6
Male	128	56.4
Age		
25-30 age group	79	34.8
31-35 age group	63	27.8
36-40 age group	26	11.5
41-50 age group	43	18.9
Over 51 age group	16	7
How many years have you been working in this field as an expert? (as of the beginning of your residency training)		
1-5 years group	126	55.5
6-10 years group	39	17.2
11-15 years group	19	8.4
16-20 years group	18	7.9
Over 21 years group	25	11
Are you aware that you could potentially cause trauma to the teeth, jaw, or oral tissues during endotracheal intubation?		
Yes	223	98.2
No	4	1.8
Have you ever caused trauma to the teeth, jaw, or oral tissues during endotracheal intubation in any pediatric patient?		
Yes	64	28.2
No	163	71.8
Have you ever caused trauma to the teeth, jaw, or oral tissues during endotracheal intubation in any adult patient?		
Yes	153	67.4
No	74	32.6
If your answer to question 5 or 6 is "yes", did you notice this situation yourself?		
Yes	153	90
No	17	10
What do you do if you cause trauma to the teeth, jaw, or oral tissues?		
I may not notice the situation	9	4
I solve it myself	78	34.4
I refer the patient to the relevant department in dentistry	70	30.8
I call the consulting physician	70	30.8
Do you use dental protectors to prevent any dental trauma during endotracheal intubation?		
Yes	12	5.3
No	215	94.7
Which area of teeth is most traumatized during endotracheal intubation?		
Maxilla anterior	188	82.8
Mandibula anterior	34	15
Mandibula posterior	4	1.8
Maxilla posterior	1	0.4
What type of trauma have you most frequently encountered during endotracheal intubation?		
Dental damage	111	50.2
Temporomandibular joint damage	8	3.6
Palatal soft tissue damage	57	25.8
Gingival soft tissue damage	45	20.4
In which age group have you mostly encountered dental trauma?		
0-6 age group	17	7.9
7-15 age group	14	6.5
16-25 age group	3	1.4
26-65 age group	64	29.9
66 years and older group	116	54.2
Which is the most common type of dental trauma you encounter during endotracheal intubation?		
Fracture of the visible part of the tooth in the mouth	116	56.6
Tooth avulsion	73	35.6
Fracture of the tooth filling	16	7.8

Table 1. Descriptive statistics of variables (continues)

	Frequency	Percentage
Have you ever caused dental avulsion during endotracheal intubation?		
Yes	95	41.9
No	132	58.2
What do you do with an avulsed tooth?		
I would discard the tooth	23	10.1
I would immediately replant and stabilize it	10	4.4
I would replant it after completing my current operation	9	4
I would replant and stabilize it after completing my current operation	4	1.8
I would refer the patient to the relevant department in dentistry	181	79.7
How do you preserve the avulsed tooth when referring your patient to the dentist?		
I wrap it in a moist sponge/tissue	68	30
I wrap it in a dry sponge/tissue	53	23.4
I send it in saliva	1	0.4
I send it in a solution specifically developed for this purpose	31	13.7
I send it in distilled water	8	3.5
I send it in milk	6	2.6
I have no information about this	60	26.4
Have you experienced temporomandibular joint dislocation during endotracheal intubation?		
Yes	60	26.4
No	167	73.6
What do you do in case of a temporomandibular joint dislocation?		
I am often not aware of it	18	7.9
I reposition it	145	63.9
I refer the patient to a dentist	58	25.6
I do nothing	6	2.6
Have you received training on what to do after dental trauma?		
Yes	20	8.8
No	207	91.2
Do you think training should be provided on preventing dental trauma or its emergency management during endotracheal intubation?		
Yes	211	93
No	16	7

26.4% stated that they did not have any information on this subject.

Temporomandibular Joint Injuries

Among the participants, 26.4% reported experiencing temporomandibular joint dislocation during intubation. In this case, 63.9% replaced the dislocation themselves, while 25.6% referred the patient to the dentist. The rate of those who did not recognize the dislocation was 7.9%.

Education and Requirements

The majority of the participants (91.2%) stated that they had not received any training on the management of dental trauma, whereas 93% stated that such training was necessary.

Methods of Preservation of Avulsed Tooth and Distribution According to Years of Professional Experience

An analysis of the methods of preservation of avulsed teeth was conducted according to years of professional experience, revealing significant differences between different groups. While 27.8% of novice (1-5 years) anesthetists stated that they wrapped the avulsed tooth in a damp sponge or tissue, 30.2% stated that they had no information on this subject. In the

group with 6-10 years of experience, the proportion of those who preferred wrapping the avulsed tooth in a dry sponge or tissue increased to 30.8%. However, the rate of using 'solution specifically developed for this purpose' in this group was 10.3% (Table 2).

In the more experienced group (11-15 years), the proportion of wrapping in damp sponge/tissue increased to 42.1%, while the proportion of wrapping in dry sponge/tissue decreased to 15.8%. In this group, the use of developed solutions was recorded as 21.1%. Amongst participants with 16-20 years of experience, the use of moistened sponges was 38.9%, and 11.1% of those kept avulsed tooth in milk. In the group with 21 years of experience and above, 40% wrapped in moist sponge/tissue, and 20% wrapped in dry sponge/tissue. In this group, the use of distilled water reached 12%, and the rate of those who said 'I have no information' was recorded as 16% (Table 2).

As shown in Table 2, the relationship between professional experience and avulsed tooth preservation method was found to be statistically significant (p=0.048). Significant differences were observed between the 1-5 year and 6-10-year groups, as well as between the 1-5 year and 16-20-year groups.

Temporomandibular Joint Dislocation Management

Significant differences were found between participants who experienced temporomandibular joint dislocation and those who did not in terms of their attitudes towards this condition. Among the participants who experienced dislocation, 78.3% stated that they repositioned the dislocation themselves, 13.3% referred the patient to a dentist, and 6.7% stated that they were not aware of the dislocation. The proportion of those who did not perform any intervention was 1.7%.

Among the participants who did not experience dislocation, the rate of those who said 'I reposition it' decreased to 58.7%, while the rate of those referring to a dentist increased to 29.9%. The proportion of those who were not aware of the dislocation was 8.4%, and the proportion of those who did not perform any intervention was 3%.

The differences in management between those who experienced temporomandibular joint (TMJ) dislocation during endotracheal intubation and those who did not were statistically significant (p=0.043) (Table 3). This finding suggests that the experience of dislocation may have a bearing on the management approach.

A statistically significant correlation was identified between the approaches applied after causing trauma to the teeth, jaw or oral tissues and the status of causing trauma in pediatric patients (p=0.004) (Table 4). In adult patients, no statistically significant correlation was found between causing trauma to teeth, jaw or oral tissues during endotracheal intubation and the approaches applied after trauma (p=0.353) (Table 4).

Table 2. Examination of the relationship between year of specialisation and avulsed tooth preservation status

	1-5	6-10	11-15	16-20	Over 21	Total	Test statistics	p
How do you preserve an avulsed tooth?								
I wrap it in a moist sponge/tissue	35 (27.8)	8 (20.5)	8 (42.1)	7 (38.9)	10 (40)	68 (30)		
I wrap it in a dry sponge/tissue	29 (23)	12 (30.8)	3 (15.8)	4 (22.2)	5 (20)	53 (23.4)		
I send it in saliva	0 (0)	0 (0)	0 (0)	0 (0)	1 (4)	1 (0.4)		
I send it in a solution specifically developed for this purpose	20 (15.9)	4 (10.3)	4 (21.1)	1 (5.6)	2 (8)	31 (13.7)	33.177	0.048*
I send it in distilled water	4 (3.2)	1 (2.6)	0 (0)	0 (0)	3 (12)	8 (3.5)		
I send it in milk	0 (0)[a]	3 (7.7)[b]	1 (5.3)[ab]	2 (11.1)[b]	0 (0)[ab]	6 (2.6)		
I have no information about this	38 (30.2)	11 (28.2)	3 (15.8)	4 (22.2)	4 (16)	60 (26.4)		

*Fisher's exact test with Monte Carlo correction, [a,b]No difference between proportions with the same letter, n (%)

Table 3. Perspectives on TMJ dislocation among anesthetists who have and have not encountered TMJ

	Yes	No	Total	Test statistics	p
What do you do in case of a temporomandibular joint dislocation?					
I am often not aware of it	4 (6.7)	14 (8.4)	18 (7.9)		
I reposition it	47 (78.3)[a]	98 (58.7)[b]	145 (63.9)	7.904	0.043*
I refer the patient to a dentist	8 (13.3)[a]	50 (29.9)[b]	58 (25.6)		
I do nothing	1 (1.7)	5 (3)	6 (2.6)		

*Fisher's exact test with Monte Carlo correction, [a,b]No difference between proportions with the same letter, n (%), TMJ: Temporomandibular joint

Table 4. Evaluation of the post-traumatic attitude of physicians who encountered dental trauma during endotracheal intubation in pediatric and adult patients

Pediatric	Yes	No	Total	Test statistics	p
What do you do if you cause trauma to the teeth, jaw, or oral tissues?					
I may not notice the situation	5 (7.8)	4 (2.5)	9 (4)		
I solved it myself	31 (48.4)[a]	47 (28.8)[b]	78 (34.4)	12.879	0.004*
I refer to the patient to the relevant department in dentistry	15 (23.4)	55 (33.7)	70 (30.8)		
I called the consulting physician	13 (20.3)[a]	57 (35)[b]	70 (30.8)		
Adult					
What do you do if you cause trauma to the teeth, jaw, or oral tissues?					
I may not notice the situation	7 (4.6)	2 (2.7)	9 (4)		
I solved it myself	57 (37.3)	21 (28.4)	78 (34.4)	3.196	0.353*
I refer to the patient to the relevant department in dentistry	47 (30.7)	23 (31.1)	70 (30.8)		
I called the consulting physician	42 (27.5)	28 (37.8)	70 (30.8)		

*Fisher's exact test with Monte Carlo correction, [a,b]No difference between proportions with the same letter, n (%)

DISCUSSION

Although anesthetists are among the occupational groups that frequently encounter preoperative dental damage, knowledge about the procedures they perform when they encounter such situations is quite limited. In the literature, there are few studies evaluating the level of knowledge about dental trauma among anaesthetists.[14] In the context of our study, a questionnaire-based investigation was conducted to evaluate the knowledge and experience levels of general anesthesia and reanimation physicians, who are at high risk of encountering traumatic dental injury (TDI) cases, regarding dentoalveolar and temporomandibular joint injuries during endotracheal intubation. Additionally, the study aimed to determine their training status in this area.

Despite advances in intubation techniques and devices, preoperative dental damage remains one of the most common adverse events associated with anesthetic administration. It accounts for the largest proportion of malpractice claims against anesthetists, comprising more than 33% of all complaints.[17,18] Retrospective studies of hospital records, anesthesia residency programme directors' reports and insurance company records have shown that the incidence of dental trauma in patients treated under general anesthesia ranged from 0.02% to 0.27% over an 11-year period. In contrast, prospective studies reported a higher incidence compared to retrospective data (12.1%-25.0%).[14]

Research indicates that between 11% and 40% of patients suffering from dental injuries related to anesthesia make claims to insurance companies for the cost of dental restoration.[14] However, only a limited number of these studies have been conducted with the views of anaesthetists.[14,19] In our study, 28.2% (n=64) of anesthetists reported experiencing preanesthetic dental trauma (PADT) in pediatric patients, while 67.4% (n=183) reported such experiences in adult patients during their careers. Notably, the rate of PADT reported in adult patients in this study was higher compared to previous studies. This discrepancy is believed to stem from the fact that iatrogenic injuries occurring in the preanesthetic period are more likely to be recalled by anesthetists than accurately reflected in retrospective hospital records.

Existing studies, similar to our study, show that anaesthetists do not have sufficient experience in TDI, dental avulsion management and PADT.[11,14] In the study by Dubey et al.,[11] only 30% of anaesthetists stated that the tooth should be implanted immediately. This rate was only 4.4% in our study. In addition, in the study by Dubey et al.,[11] almost half of the participants (40%) did not want to reimplant on their own because they thought it was not their specialty, or they did not have enough information. In our study, 79.7% of anaesthetists said, 'I refer to the relevant department in dentistry." The positive change in this rate can be attributed to the increase in awareness of specialties in dentistry over the years.

In case of a delay in reimplantation, the avulsed tooth should be stored in a suitable environment to prevent the loss of vitality of the periodontal tissues around the avulsed tooth.[20] Dubey et al.[11] found that almost half of the anaesthetists (40%) thought that the avulsed tooth should be kept in gauze. However, the most ideal medium for storing an avulsed tooth is considered to be Hank's solution.[18] Similarly, in our study, 30% of the participants said, 'I wrap it in a moist sponge/tissue'.

Our study demonstrated that the management differences between those who experienced temporomandibular joint dislocation during endotracheal intubation (26.4%) and those who did not (73.6%) were statistically significant, suggesting that the experience of dislocation may affect the management approach. There is almost no study evaluating the opinions of anaesthetists about TMJ dislocation during endotracheal intubation. As a result of damage to the TMJ and surrounding structures, the use of mouth guards should become mandatory to prevent postoperative TMJ and facial pain.[21]

Consistent with previous research, the data obtained indicate that these professional groups are generally not trained in TDI, with the vast majority (91.2%) lacking any formal training background on this subject.[16,19,22,23] Moreover, 93% of the respondents believe that training programs on this topic should be implemented.

A comprehensive preclinical evaluation is essential for mitigating the risk of dental injuries during anesthesia. The anesthetist must meticulously evaluate potential risk factors, such as poor oral hygiene, mobile teeth and a history of difficult intubation.[24] In cases where such risks are present, it is recommended that patients be referred to a dentist prior to the planned surgical procedure. Preoperative dental interventions can reduce these risks by treating caries, replacing loose restorations, splinting or extracting removable teeth. In addition, a suitable protective appliance can be provided for use during surgery.[25] In the survey, only 5.3% of participants reported using a protective appliance. The paraglossal straight blade technique is an effective alternative for reducing the risk of dental injury in patients with removable anterior teeth or missing right maxillary molars. This technique offers a lower risk compared to the traditional Macintosh laryngoscope and is a practical method to prevent tooth damage.[26] Dental injury is more likely when using the Macintosh blade. It is therefore recommended that the Miller blade be selected in patients at risk of dental trauma. In addition, it is advised that the size of the laryngoscope be reduced in order to prevent dental trauma.[12] In addition, specialized designs such as the 'dental protective blade', enhanced laryngoscope blade' and 'callander laryngoscope blade' have been developed to protect the teeth during direct laryngoscopy and have been widely adopted for clinical use. Devices used to protect teeth include individually adaptable thermoplastic shields and pre-moulded dental shields. Shields made of thermoplastic material, cellulose acetate foil or ethylene vinyl-acetate can be customized to the patients' oral structure, while pre-engineered dental shields offer a more practical and faster solution, contributing to the prevention of dental trauma.[27]

CONCLUSION

This study set out to investigate the prevalence of dentoalveolar and temporomandibular joint injuries occurring during endotracheal intubation in anesthetic practice, and the level of awareness of these conditions. The findings show that such

injuries have a high prevalence and that adequate precautions are generally not taken. In particular, it was determined that the use of protective devices was at a very low level and the majority of healthcare professionals did not receive adequate training in this field. It is vital to prioritise prevention and effective management of dental and temporomandibular joint injuries in order to enhance patient safety and reduce medico-legal risks. In this context, a comprehensive oral and dental health assessment, identification of risk factors and appropriate protective measures should be taken prior to anesthesia procedures. Furthermore, the development of training programmes for such injuries and the raising of awareness among healthcare professionals will play an important role in reducing possible complications. In conclusion, increasing awareness among anaesthetists and implementing standardized protective measures can significantly reduce the incidence of perioperative dental and temporomandibular joint injuries. The findings of this study contribute to fill the existing gaps in the literature and provide a reference for future research.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Mersin University Clinical Researches Ethics Committee (Date: 10.07.2024, Decision No: 2024-644).

Informed Consent

All participants signed a free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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