

An analysis of anesthetists' awareness, knowledge, and attitudes toward peri-anesthetic dental trauma

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Abstract

Background/Aim: Peri-anesthetic dental trauma is a common anesthesia-related complication. It is the reason for a significant number of malpractice lawsuits against anesthetists through insurance companies. The frequency, outcomes, and risk factors related to peri-anesthetic dental trauma have been well documented. The aim of this study was to evaluate anesthetists' awareness, knowledge, and attitudes toward peri-anesthetic dental trauma.

Material and Methods: This nationwide, cross-sectional, descriptive study comprising 220 anesthetists was conducted in Turkey between June 2019 and May 2020. A specific questionnaire was created using Google Forms and delivered to 591 participants via WhatsApp. Pearson's Chi-squared test and the Fisher-Freeman-Halton tests were used to analyze the results.

Results: The overall response rate was 37.2% (220 out of 591 participants). Of the 80.5% of the participants who encountered peri-anesthetic dental trauma during their practice, 32.8% had encountered avulsion and 32.8% reported that they had caused soft tissue injuries. More than one-third of the participants (38.9%) stated that the patient group that was the most at-risk for peri-anesthetic dental trauma was older people with missing teeth. Half of the participants (50.9%) stated that avulsed teeth could be replanted; among them, 21.8% and 11.8% specified that the ideal replantation time was <30 min and that the ideal storage medium for the avulsed tooth was fresh milk, respectively. Furthermore, 88.1% of the participants noted that peri-anesthetic dental trauma occurred more frequently during emergency intubations and only 20.9% were aware of custom-made mouthguards.

Conclusions: Anesthetists lack knowledge around peri-anesthetic dental trauma and its interventions.

KEYWORDS

dental avulsion, dental trauma, difficult intubation, macintosh laryngoscopy, oro-tracheal intubation complication

1 | INTRODUCTION

The probability of peri-operative dental trauma increases with the vulnerability of the patient's dentition and the presence of associated anesthesia-related risk factors.^{1,2} The process of minimizing dental injuries begins with the anesthesiologist's pre-operative assessment of the patient's dentition and intra-oral tissues.³ Clear documentation of the pre-operative dental condition and notifying the patient of potential dental damage will diminish the costs of any related post-operative dental treatment.⁴ Following the discovery of a potentially hazardous dental disease, a consultation with a dentist should be considered before proceeding with the surgery.⁵ Taking precautionary measures, such as performing laryngoscopy and tracheal extubation, during risky procedures can aid in the prevention of dental trauma.⁶ In the event of such an injury, several management tactics can promote a swift and reasonable resolution. Furthermore, establishing increased awareness around intra-oral conditions and their related peri-operative risk factors may diminish the incidence of dental damage and its resulting financial costs.⁷

Injuries that develop within seven days of a procedure that required general anesthesia and dental consultation and that lead to recommendations for repair, stabilization, or extraction of the involved teeth or supporting structures are defined according to anesthetic dental injuries.⁸ Peri-operative dental damage is one of the most common anesthesia-related adverse events and it is responsible for a large number of malpractice claims against anesthesiologists.⁹ Despite this, studies have shown that anesthesiologists may not have received comprehensive education on teeth and their surrounding tissues, as well as the use of an intra-oral prosthesis.^{3,9} Previous retrospective studies have reported that the incidence of dental injuries during anesthesia ranged from 0.02% to 39.1%⁹⁻¹³; but when assessed prospectively, some studies have reported an incidences that ranged from 12.1% to 38.6%.¹⁴⁻¹⁶

Difficult airway and dental injury management present unique challenges for anesthesiologists.¹⁴ The frequency, outcomes, and risk factors of peri-anesthetic dental trauma (PADT) have been well documented in the anesthesiology community. Dental injuries are frequent complications of oro-tracheal intubation, and the major causal factors are (A) poor dentition,^{1,2} (B) aggressive laryngoscopy,¹⁷ (C) insufficient anesthesia and curarization,¹⁰ (D) emergency interventions,⁶ (E) lack of experience of the anesthesiologist,⁶ (F) lack of alternative intubation devices,¹ (G) lack of correct prophylactic measures,⁶ and (H) difficult anatomical conditions.¹⁸ Several studies have used hospital and insurance company records to evaluate PADT, some of which were retrospective in nature.^{5-7,18-24} However, there is a lack of prospective studies that assess PADT.¹³⁻¹⁶ In addition, few studies have evaluated anesthesiologists' knowledge of dental trauma and its limitations.²⁵⁻²⁸

The primary aim of this study was to create awareness around PADT by evaluating it from the perspective of the anesthesiologist. Additional aims were to evaluate anesthesiologists' clinical experiences in relation to PADT, dental and anesthetic-related risk factors, preventive measures for PADT, and knowledge around tooth avulsion based

on the risks described in the literature. The findings of this study may prove useful in determining whether anesthesiologists consider PADT to be a clinical problem. In addition, it will indicate the differences in PADT management between residents and anesthesiologists.

2 | MATERIAL AND METHODS

This nationwide, survey study on PADT was conducted between September 2019 and May 2020, after receiving approval from the local ethics committee (2019/117).

A two-part study was designed. The first part involved a nationwide survey of teaching hospitals with residency programs in anesthesiology. Subsequently, anesthesiologists from public hospitals were included in the study as the second part of the survey. A questionnaire was developed and distributed among the residents, staff anesthesiologists, assistant professors, associate professors, and professors of anesthesiology in various residency training programs nationwide via Google Forms. In cases where participants could not meet face-to-face, the questionnaire was filled using a WhatsApp® (WhatsApp, Menlo Park) link (<https://forms.gle/Sbk9FmW2tm1wgLNj8>).

A special survey form was designed so that it was divided into four parts. The first part comprised questions pertaining to personal information, such as gender, years of service in anesthesiology, and career level. The second part comprised the pre-operative dental status evaluation experience. Participants were asked whether their patients had consulted a dentist for a pre-operative dental evaluation to prevent PADT. Additionally, they were asked whether they had attended any educational or training activities related to dental trauma (Table 1). The third part of the survey included questions about participants' experiences with PADT. They were asked whether they had encountered PADT due to a pre-existing dental condition or as a result of iatrogenic factors (Table 1).

The fourth part was related to the anesthesiologists' general opinions with respect to PADT and the use of mouthguards, effect of a professional career level on PADT experience and its treatment, use of emergency or elective laryngoscope procedures, and presence of pre-existing prosthetic rehabilitation knowledge (Table 1).

Data were entered and analyzed using IBM SPSS Statistics version 22.0 (SPSS Inc.). Whenever appropriate, the data that were obtained from the questionnaire were converted and assigned numerical coding values. Pearson's chi-squared test was used to statistically analyze the relevant categorical variables in terms of their frequency distribution. The Fisher-Freeman-Halton test (Fisher's exact test) was applied when the expected value was less than five in more than 20% of the cells in the R by C tables. Using a 95% confidence interval (CI) and a 20% response distribution, the minimum sample size was calculated as 220 participants ($n = 2000$, according to The Turkish Journal of Anesthesiology & Reanimation Association). A 95% CI was applied to all analyses. The level of statistical significance was set at $p < .05$ for all statistical evaluations.

TABLE 1 Descriptive Questions That Were Included in the Questionnaire

Question	Answer	n	%
1. Gender?	Male	97	44.1%
	Female	123	55.9%
2. Career level?	Resident	153	69.5%
	Assistant professor	7	3.2%
	Associate professor	5	2.3%
	Professor	5	2.3%
	Staff anesthetist	50	22.7%
3. Number of years of service?	1–4	126	57.3%
	5–10	57	25.9%
	11–15	14	6.4%
	>15	23	10.5%
4. Have you ever participated in a dental trauma training activity?	Yes	26	11.8%
	No	194	88.2%
5. Do you think you can adequately assess a patient's pre-anesthetic dental condition by yourself?	Yes	137	62.3%
	No	83	37.7%
6. Do you refer your patients to a dentist for a pre-anesthetic dental evaluation?	Yes	42	19.1%
	No	178	80.9%
7. Have you ever caused PADT during laryngoscopy/intubation/extubation/etc.?	Yes	177	80.5%
	No	43	19.5%
7a. If yes, what kind of trauma did you cause?	Crown fracture	15	8.5%
	Tooth luxation	32	18.1%
	Tooth avulsion	58	32.8%
	Lip/gum bleeding	58	32.8%
	Dental prosthesis displacement	14	7.9%
7b. If yes, have you ever encountered an emergency such as a fractured tooth or displaced prosthesis that was lodged in the larynx/esophagus/trachea?	Yes	53	30.1%
	No	123	69.9%
7c. If yes, have any of your patients made litigation claims for this complication?	Yes	0	0.0%
	No	171	100.0%
8. Can the shape, angle, and type of laryngoscope blade affect the chances of dental trauma occurring?	Yes	172	78.5%
	No	47	21.5%
9. In which of the following situations are the probabilities of dental trauma higher? (Multiple options may be selected)	Older adults who have missing teeth	64	38.9%
	Adults who have missing teeth	42	25.0%
	Adults who have a full set of healthy teeth	37	22.0%
	Primary dentition (ages 0–4)	31	18.4%
	Primary dentition (ages 5–7)	48	28.5%
	Mixed dentition (ages 7–12)	64	38.0%
10. Can an avulsed tooth be replanted?	Yes	112	50.9%
	No	108	49.1%
10a. If yes, what is the ideal time within which the replantation should take place?	<30 min	48	43.6%
	1 h	15	13.6%
	2 h	28	25.5%
	>2 h	19	17.3%
10b. If yes, would you replant it yourself or seek assistance from a dentist?	I would call the dentist to come to the operating room	57	51.4%
	I would replant the avulsed tooth myself	13	11.7%
	I would tell the patient to go to the dentist after they were discharged from the hospital	41	36.9%
	(No answer)	109	49.5%

(Continues)

TABLE 1 (Continued)

Question	Answer	n	%
10c. If yes, what is the ideal storage medium for an avulsed tooth until it is replanted by a dentist? (Multiple options may be selected)	Saliva	35	31.5%
	Sterile saline	70	63.0%
	Sterile sponge	25	22.5%
	Fresh milk	26	23.4%
	Water	5	4.5%
11. Should patients who have removable prostheses keep them in their mouths during anesthetic procedure, such as laryngoscopy or prolonged intubation, or do you recommend that patients remove prostheses?	They must remove their prosthesis	213	97.7%
	They do not need to remove their prosthesis	5	2.3%
12. Are you aware of the role of mouthguards in protecting against PADT?	Yes	71	32.3%
	No	149	67.7%
13. What type of mouthguard do you think could be more protective?	Custom-made	46	65.7%
	Stock type	1	1.4%
	Boil & Bite type	23	32.9%
14. Does an increase in the number of years of service in anesthesiology increase the possibility of encountering PADT?	Yes, it increases the possibility of encountering PADT	9	4.1%
	No, it decreases the possibility of encountering PADT	179	81.7%
	It does not matter	31	14.2%
15. Which intubation technique is more likely to cause PADT? Emergency intubations or elective surgery?	Emergency intubation	193	88.1%
	Elective intubation	1	0.5%
	It does not matter	25	11.4%
16. Do you think that you have received sufficient education on the jaws and teeth anatomy, physiology, and pathology?	Yes	50	22.7%
	No	170	77.3%

Abbreviation: PADT, Peri-anesthetic dental trauma.

3 | RESULTS

A total of 591 anesthetists were included in the study. The overall response rate was 37.2% (220/591), while the response rate among the anesthesiology residents was 76.5% (153/200). The respondents comprised 153 residents, 50 staff anesthetists, 7 assistant professors, 5 associate professors, and 5 professors (69.50%; 22.70%; 3.20%; 2.30%; and 2.30%; respectively). A majority of the participants (88.2% [$n = 194$]) had not received any education or training on PADT. Despite this, 62.3% ($n = 137$) of the participants stated that they were competent enough to perform a dental examination before administering an anesthetic.

Overall, 88.5% ($n = 177$) of the participants stated that they had encountered PADT, of which, 32.8% ($n = 58$) had encountered avulsion and 32.8% ($n = 58$) had caused soft tissue injuries. However, none of them had faced litigation.

One hundred and twelve participants (50.9%) believed that avulsed teeth could be replanted and 43.6% ($n = 48$) stated that the ideal replantation time was ≥ 30 min. However, 108 participants (49.1%) said that the avulsed teeth could not be replanted (Table 1).

Overall, 21% (48/220) of the participants demonstrated adequate knowledge of dental avulsion. A total of 36.9% ($n = 41/112$) of the participants said that avulsed teeth could be replanted, but they would recommend that the patient visits a dentist following discharge from the hospital. Of the 102 participants who knew

about replantation, 18 (8.2%) stated that the ideal storage medium was fresh milk. Seventy-one (32.7%) anesthetists knew that mouthguards could be used to prevent PADT. One hundred and fifteen (75.2%) resident doctors and 62 (92.5%) senior doctors stated that they had encountered PADT ($p < .05$; Table 2). There was a statistically significant difference in the distribution of doctors and the incidence of PADT ($p = .011$; Table 2). Of the participants who had encountered PADT, 80.6% ($n = 137$) stated that they did not have a sufficient level of education on PADT (Tables 3, 4 and 5). Less than half (46.9%; $n = 83$) of those who had encountered PADT stated that avulsed teeth could not be replanted, whereas 53.1% ($n = 94$) who had encountered PADT stated that they could be replanted ($p > .186$; Table 6). Finally, 34.5% ($n = 61$) of the anesthetists who had encountered PADT stated that they were aware of the use of mouthguards ($p > .159$; Table 7).

4 | DISCUSSION

This was the first study in Turkey that involved a nationwide range of anesthetists. Anesthetists are among the most common occupational groups that encounter tooth avulsions. In addition, there is limited knowledge regarding the procedures that are followed upon encountering tooth avulsions during their practice. There are no studies that have discussed the knowledge of dental trauma among

TABLE 2 Number of participants who had encountered PADT when providing treatment and the association between the career level and the PADT incidence

		Caused PADT		Chi-square (sd)	p-value**
		Yes n(%)	No n(%)		
Type of Participants	Residents	115 (75.2%) ^{Aa}	38 (24.8%) ^{Bb}	8.98 (2)	.011 ^a
	Staff Anesthetists	46 (92%) ^{Ba}	4 (8%) ^{Ab}		
	Lecturer Anesthetists	16 (94.1%) ^{Ba}	1 (5.9%) ^{Ab}		
Career Level	Junior Doctors	115 (75.2%) ^{Aa}	38 (24.8%) ^{Bb}	8.94 (1)	.003 ^b
	Senior Doctors	62 (92.5%) ^{Ba}	5 (7.5%) ^{Ab}		
Years of Service	1–4 years	91 (72.2%) ^{Aa}	35 (27.8%) ^{Bb}	13.13 (3)	.005 ^a
	5–10 years	51 (89.5%) ^{Ba}	6 (10.5%) ^{Ab}		
	11–15 years	13 (92.9%) ^{Ba}	1 (7.1%) ^{Ab}		
	>15 years	22 (95.7%) ^{Ba}	1 (4.3%) ^{Ab}		

Note: Different lower case letters in the same row indicate a significant difference. Different upper case letters in the same column indicate a significant difference.

Abbreviations: PADT, Peri-anesthetic dental trauma; sd, Standard deviation.

^aFisher–Freeman–Halton Test.

^bPearson Chi Square test.

**p > .05.

TABLE 3 Relationship between the pre-anesthetic dental status and PADT and association between a consultation with a dentist prior to administering anesthesia and the PADT incidence

		Caused PADT		Chi-square (sd)	p-value**
		Yes n(%)	No n(%)		
Adequate knowledge to carry out a pre-anesthetic dental status evaluation	Yes	112 (81.8%) ^{Aa}	65 (78.3%) ^{Aa}	0.389 (1)	.533 ^b
	No	25 (18.2%) ^{Aa}	18 (21.7%) ^{Aa}		
Consulting a dentist for the pre-anesthetic dental status evaluation	Yes	37 (88.1%) ^{Aa}	140 (78.7%) ^{Aa}	1.927 (1)	.165 ^b
	No	5 (11.9%) ^{Aa}	38 (21.3%) ^{Aa}		

Note: Different lower case letters in the same row indicate a significant difference. Different upper case letters in the same column indicate a significant difference.

Abbreviations: PADT, Pre-anesthetic dental trauma; sd, Standard deviation.

^bPearson Chi Square test.

**p > .05.

anesthetists. This study revealed that they lacked sufficient experience with respect to PADT.

Iatrogenic injury is a broad term that may be defined as “harm, hurt, damage, or impairment that results from the activities of a doctor.”²⁹ These activities include physical injuries, adverse drug reactions, surgical mishaps, and equipment failure-associated adverse outcomes.¹⁰ Such peri-anesthetic events result from the pressure that is exerted while using the stiff, metallic laryngoscope blade. Tracheal intubation using conventional direct laryngoscopy is an essential skill in anesthetic practice and, in some clinical situations, its use is mandatory.³⁰ Endotracheal intubation or oropharyngeal endoscopy using a rigid scope is associated with the potential risk of dental damage through instrument manipulation.³¹ In this study, 78.5% of the participants (172/220) were aware that

the laryngoscope shape increased the possibility of trauma to the teeth. Despite the progress in intubation techniques and devices, peri-operative dental damage is still one of the most common anesthesia-related adverse events. It is responsible for the highest number of malpractice lawsuits against anesthetists,⁶ accounting for more than 33% of all complaints.³² Surprisingly, in this study, none of the participants who had caused PADT had encountered compensation-related litigation. The state insurance system provides such treatments free of charge. Retrospective studies that have reviewed hospital records, statements from the anesthesia residency program directors, and insurance company records found that the incidence of the occurrence of dental trauma in patients who underwent general anesthesia ranged from 0.02% to 0.27% over a period of 11 years.^{1,19,20} Prospective studies have

TABLE 4 Association between previous education/training and the PADT incidence, and the association between the knowledge of avulsion and previous education/training on the jaws and teeth

		Caused PADT		Chi-square (sd)	p-value**
		Yes n(%)	No n(%)		
Adequate education and training on the jaws and teeth	Yes	40 (80%) ^{Aa}	137 (80.6%) ^{Aa}	0.009 (1)	.927
	No	10 (20%) ^{Aa}	33 (19.4%) ^{Aa}		
An avulsed tooth can be replanted	Yes	28(56%) ^{Aa}	84 (49.4%) ^{Aa}	0.671 (1)	.413
	No	22(44%) ^{Aa}	86 (50.6%) ^{Aa}		

Note: Different lower case letters in the same row indicate a significant difference. Different upper case letters in the same column indicate a significant difference.

**p > .05.

TABLE 5 Relationship between the post-avulsion reaction and education

	Adequate education and training on the jaws and teeth		Chi-square (sd)	p-value**
	Yes	No		
	n(%)	n(%)		
I would call a dentist into the operating room to perform the replantation	10 (35.7%) ^{Aa}	48 (57.1%) ^{Aa}	3.904 (2)	.142
I would replant the avulsed tooth myself	5 (17.9%) ^{Aa}	8 (9.52%) ^{Aa}		
I would recommend that the patient visit a dentist after discharge from the hospital	13 (46.4%) ^{Aa}	28 (33.3%) ^{Aa}		

Note: Different lower case letters in the same column indicate a significant difference. Different upper case letters in the same row indicate a significant difference.

Abbreviations: PADT, Peri-anesthetic dental trauma; sd, Standard deviation.

**p > .05.

TABLE 6 Relationship between knowledge of avulsion and the PADT incidence

		Caused PADT		Chi-square (sd)	p-value**
		Yes	No		
		n(%)	n(%)		
An avulsed tooth can be replanted	Yes	94 (53.1%) ^{Aa}	18 (41.9%) ^{Aa}	1.751 (1)	.186
	No	83 (46.9%) ^{Aa}	25 (58.1%) ^{Aa}		

Note: Different lower case letters in the same column indicate a significant difference. Different upper case letters in the same row indicate a significant difference.

Abbreviations: PADT, Peri-anesthetic dental trauma; sd, Standard deviation.

**p > .05.

reported a higher incidence than those obtained from retrospective hospital records (12.1%–25.0%).^{14,16} According to insurance company claim records, the proportion of patients who have been affected by PADT is higher than that mentioned in hospital records. Researchers have stated that 11%–40% of patients who experience possible anesthesia-related dental injuries lay claims with insurance companies for dentition restoration.^{4,14–16} However, only a few of these studies were conducted after interviewing anesthetists.^{20,25,26} In this study, 80.5% (n = 177) of the anesthetists had had experiences with PADT in their careers. Retrospective records carry the possibility of problems with missed cases and lack of data entry.^{11,20} This study had a higher PADT rate than other studies. Iatrogenic injuries during the peri-anesthetic period are more likely

to be remembered by anesthetists than they are likely to be recorded in retrospective hospital records.

The difficult anatomical conditions that are typical risk factors for dental injury during tracheal intubation include limited/restricted mouth opening, limited mandibular mobility, poor hypopharyngeal visibility, narrow/shortened thyromental distance, decreased neck mobility, macroglossia, retrognathism, and the presence of prominent incisors.^{2,18,33} The American Society of Anesthesiologists Task Force on the management of a “difficult airway” define a difficult laryngoscopy as the inability to visualize any portion of the vocal cords via conventional laryngoscopy. Difficult intubation is defined as “an airway that requires more than three attempts or more than 10 min to be secured by direct laryngoscopy.”⁸ A difficult tracheal

		Caused PADT		Chi-square (sd)	p-value**
		Yes	No		
		n (n%)	n (n%)		
Aware of mouthguards	Yes	61 (34.5%) ^{Aa}	10 (23.3%) ^{Aa}	1.988 (1)	.159
	No	116 (65.5%) ^{Aa}	33 (76.7%) ^{Aa}		

Note: Different lower case letters in the same column indicate a significant difference. Different upper case letters in the same row indicate a significant difference.

Abbreviations: PADT, Peri-anesthetic dental trauma; sd, Standard deviation.

** $p > .05$.

TABLE 7 Relationship between awareness of the use of mouthguards during intubation and the PADT incidence

intubation may result in dental damage.^{1,2} The substantial force that the laryngoscope blade places on the teeth when the clinician uses the patient's maxillary anterior teeth as a fulcrum can result in dental damage.³⁴ Anesthetists work in patients' mouths. However, they may not have received comprehensive education about the teeth and their surrounding tissues, and intra-oral prostheses. The anesthetist should perform a dental consultation prior to surgery. However, this is frequently overlooked by both surgeons and anesthetists. Previous studies have strongly advocated for pre-anesthetic dental consultation to prevent PADT.¹⁰ If a dentist cannot be consulted, a pre-anesthetic dental status evaluation must be performed by an experienced anesthetist.^{10,11}

The pre-operative assessment of the dentition and intraoral tissues should be performed meticulously. Clear documentation of the patient's pre-operative dental condition and notification of the potential for dental damage minimizes the cost of related post-operative dental treatment. Upon discovery of a dental disease that could be worsened when administering anesthesia, the anesthetist should consider recommending a dental consultation before proceeding with the surgery.² Exercising precautionary measures during certain procedures, such as laryngoscopy and tracheal extubation, may help prevent dental trauma.²

Dental injuries are not only cosmetic, but also represent a severe personal injury. Inadequate dentition, oral disease, tissue damage, and irregular and severe dental caries can result in functional limitation causing difficulties with chewing, eating, and speaking.¹ The anesthetists who had encountered PADT reported incidents when the tooth/crown/bridge had dislodged and fallen into the oral cavity. This emergency situation usually requires laryngoscopy/bronchoscopy/esophagogastroendoscopy to prevent inadvertent aspiration, lung infection, or unrecognized ingestion.^{33,35}

The questions in the fourth part of the survey measured the anesthetists' knowledge of PADT to determine their awareness of dental trauma. Several management strategies can promote swift and reasonable resolution in the event of a dental injury. Increased awareness of the intra-oral conditions and related peri-operative risk factors may minimize the incidence of dental damage and associated financial costs.²

One of the controversies in the literature is that the possibility of causing trauma increases with an increase in the physician's number years of service.^{10,18,20} The likelihood of peri-operative dental

trauma increases with the vulnerability of the patient's dentition and the presence of anesthesia-related risk factors. Therefore, anesthetists must have detailed knowledge of dental anatomy and pathology. The level of training that an anesthesia resident receives does not affect the risk of dental injury, and the anesthetist's level of experience was not a significant determinant for dental injuries in patients with a healthy dentition.^{8,10,17} Moreover, 92.5% of the senior anesthetists who caused PADT stated that they were more likely to cause injury ($p < .05$). Excessive force or incorrect laryngoscope use can cause edema, bleeding, and dental and soft tissue damage, even when performed by a skilled professional.¹⁰

When asked in which age group PADT was most frequently encountered, 38.9% of the anesthetists gave the answer that was most compatible with the literature^{3,18,21} ($n = 64$, old people with missing teeth). Some studies have reported that removable dentures should be kept in the mouth during laryngoscopy.^{11,36} However, nearly all the anesthetists in this study indicated that they would ask the patient to remove the dentures before administering general anesthesia.

Direct laryngoscopy carries the greatest risk of dental injury from excessive force or incorrect laryngoscope use. Bucx et al.¹⁷ and Kim et al.³⁷ demonstrated that most anesthetists use the patient's maxillary incisors as a fulcrum to lever the laryngoscope blade and secure a better view of the epiglottis.² Bucx et al. stated that routine laryngoscopy exerted significant force on the maxillary teeth that may be worsened by the prominent flange of the Macintosh blade.²¹ Most anesthetists responded correctly to the question on the relationship between laryngoscope types and PADT. The Macintosh laryngoscope has proven its usefulness for over half a century and is still one of the most popular laryngoscopes, although the design and manipulation of the blade have a major influence on the risk of dental trauma.¹⁷ Studies have suggested several methods, such as the use of modified blade types with lower flange heights, to reduce dental injury.^{31,37} However, the modified blade is not widely available and may be limited in its ability to displace the tongue out of the line of sight.³⁴ With recent technological advances, various video laryngoscopes have been developed and used in clinical practice for easy visualization. Video laryngoscopes are thought to exert less force on the anterior teeth than conventional laryngoscopes.³⁸ Nevertheless, Macintosh laryngoscopes are still used most often.³⁹

PADT occurs more frequently in elective or emergency intubations. Some studies have found that emergency procedures have an increased PADT risk.^{18,32} The anesthetists in this study stated that PADT occurred more frequently in emergency intubations, indicating that they were not aware of the at-risk elective patients. Rosa Maria et al. found that 75%, 15%, and 10% of dental injuries occurred during intubation for elective major surgery, minor surgery, and emergency surgery, respectively.⁶ Direct laryngoscopy carries the greatest risk of dental injury, and the anterior maxillary teeth are damaged the most frequently. Another major cause of dental damage is the oral airway placement in the oropharynx. This can expose vulnerable teeth to injuries that commonly occur during emergencies secondary to the forces related to clenching, grinding, and mastication.^{6,10} The majority of the participants (88.1%) in this study stated that PADT was encountered more frequently in emergency intubations, contrary to previous study findings.³ This essentially means that anesthetists work while lacking awareness of the real risk.

Mouthguards are flexible appliances that are placed within the oral cavity to protect oral tissues from traumatic forces.⁴⁰ Custom-made mouthguards, which are prepared by a dentist, are characterized by their excellent retention, small size, and comfort. Additionally, their shape may be adjusted to the user's requirements.⁴⁰ The findings from this study indicated that more than half of the anesthetists did not know about mouthguards. Studies have shown that a lack of knowledge of mouthguards poses a challenge for PADT prevention.^{13,41,42}

Avulsion of permanent teeth is one of the most severe dental injuries, and the prognosis is dependent on the actions taken at the accident site and promptly after avulsion. In most situations, replantation is the treatment of choice, but it cannot always be performed immediately. Appropriate emergency management and treatment plans are essential to ensure a good prognosis. As part of the emergency management, an avulsed tooth should be held by the crown and washed (for up to 10 s) under saline, milk, or Hanks Balanced Salt Solution and replanted immediately, irrespective of the stage of root development.³⁴ In this study, half of the participants (49.1%) stated that the avulsed tooth could not be replanted. The participants lacked knowledge regarding replantation of an avulsed tooth. A small group of participants (11.7%) stated that if they encountered an avulsed tooth that was related to PADT, they would replant the tooth in the alveolar socket themselves but 51.4% said that they would call a dentist to perform the replantation. Most dentists work in public dental hospitals or specialty practices in Turkey. The absence of dentists in hospitals where general anesthesia is used poses a challenge for both patients and anesthetists.

In conclusion, this study demonstrated that anesthetists and anesthesiology residents in Turkey lack knowledge regarding PADT and they need to be better informed, particularly with respect to tooth avulsion. Furthermore, the majority of participants were unaware of the importance, role, and types of mouthguards.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

The first author Dr Dođan planned this study and carried out the writing of the article. Dr Altintepe Dođan checked the statistical results and helped write this manuscript. Dr Altintepe organized the questionnaire and helped distribute it to anesthetists. Dr Şahin did the statistical arrangement of the questionnaires and the conversion of the information into tables. Dr Çelik helped distribute questionnaires.

ETHICAL APPROVAL

This study protocol was reviewed and approved by the local Ethics Committee at the Afyonkarahisar Health Science University, Afyonkarahisar, Turkey (no: 2019/117).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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