

Article

Validation of a Suggested Pre-Operative Protocol for the Prevention of Traumatic Dental Injuries during Oroendotracheal Intubation: A Pilot Study

Daniela Silva ¹, Rita Miranda ², Inês Ferreira ³ , Ana Braga ⁴ , Joana Mourão ² and Irene Pina-Vaz ^{5,*}

¹ Faculty of Dental Medicine, University of Porto, 4099-002 Porto, Portugal

² Faculty of Medicine, University of Porto, 4099-002 Porto, Portugal

³ CINTESIS, Faculty of Medicine, University of Porto, 4099-002 Porto, Portugal

⁴ ALGORITMI Center, Department of Production and Systems, University of Minho, 4710-057 Braga, Portugal

⁵ CINTESIS, Faculty of Dental Medicine, University of Porto, 4099-002 Porto, Portugal

* Correspondence: igvaz@fmd.up.pt

Abstract: The aim of this study was to develop a protocol for oral pre-operative registration and dental risk assessment by the anaesthesiologist, determining its reliability through the inter-observer agreement between a senior dental student and an internal physician specializing in anaesthesiology. A convenience sample consisting of 35 patients was selected. These were observed during the anaesthesiology consultation, at Hospital de São João, Porto, Portugal. The protocol included a self-administered questionnaire and a brief clinical examination by the two observers. A descriptive analysis (qualitative and quantitative variables) was performed. The Fleiss Kappa index was used to measure the degree of agreement between the two observers. In most of the parameters defined, the agreement presented Kappa index values between 0.6 and 1, corresponding to good and excellent correlation, respectively. The general oral status was considered “poor”, with a great number of missing teeth, namely the upper central and lateral incisors. The proposed pre-anaesthetic protocol can be a reliable tool for the anaesthesiologists, which suggests the relevancy of incorporating interdisciplinary training between future health professionals. Further research is needed to assess its implementation, providing information about the pre-operative oral status, preventing intraoperative damage and potential medicolegal litigation.

Keywords: dental trauma; dental injury; endotracheal intubation; general anaesthesia; pre-anaesthetic protocol



Citation: Silva, D.; Miranda, R.; Ferreira, I.; Braga, A.; Mourão, J.; Pina-Vaz, I. Validation of a Suggested Pre-Operative Protocol for the Prevention of Traumatic Dental Injuries during Oroendotracheal Intubation: A Pilot Study. *Appl. Sci.* **2023**, *13*, 2091. <https://doi.org/10.3390/app13042091>

Academic Editor: Andrea Scribante

Received: 27 December 2022

Revised: 1 February 2023

Accepted: 2 February 2023

Published: 6 February 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The Association for Dental Education in Europe (ADEE) has recently reclassified four major domains or competences, namely: (i) Professionalism, (ii) Safe and effective clinical practice, (iii) Patient-centred care and (iv) Dentistry in Society. Hence, periodic curriculum reviews are advised to incorporate realistic environments for students with assessable criteria developed for undergraduate and post-graduate education. As an example, pilot studies can have a particular role, highlighting the need to improve awareness and implement preventive measures in a model of “holistic, evidence-based patient care to support the oral and general health of patients” [1]. To bridge between dental and medical practices, mutual undergraduate training can be an instrument to improve practitioner competence. Aside from mutual recognition, this might lead to reduced morbidity and litigation due to clinical procedures in their autonomous practice, such as intubation anaesthetic procedures. These main principles in dental education should extend to both pre- and post-graduate programs, and the mission must not only focus on training achievements but also enabling the direct provision of patient care [2]. However, dental students have been, in the last few decades, allocated to dental institutions, which work independently from hospital

environment. This prevents a regular discussion of clinical cases with emphasis on oral health as an integral part of patients' global welfare.

Scientific literature is scarce respecting dental trauma in patients undergoing general anaesthesia. Besides being a relevant cause of litigation, it can be enlightening of the lack of awareness between different professionals, such as dentists and anaesthesiologists. The incidence of dental and hard tissue injuries undergoing oroendotracheal intubation, for instance, have an estimated prevalence of 0.02% to 0.7% [3–8]. Other studies, however, report values of 12.1% [9]. These include enamel or crown fracture, damage to restorative or prosthetic rehabilitations, luxation or avulsion, as well as soft tissues injuries [8]. Despite the eventual low incidence, they are one of the main causes of medical negligence against the anaesthesiologists, occurring mainly during the act of classical laryngoscopy. Moreover, their aesthetic and/or functional consequences, as the social impact, are extremely important [3,4,7]. The anterior sextant of the maxillary region, more specifically the central maxillary incisors, is the most affected [8]. In fact, the left central incisor is reported to be the tooth with the highest risk of dental injury, due to the direct contact of the laryngoscope blade as well as its use as a fulcrum in order to position the laryngoscope [4,7,8,10]. Although the most frequent situation is that only one tooth is affected, traumatic injuries often occur simultaneously in two or more teeth [3,4,10]. The dental condition and the difficulty inherent to the intubation procedure are well known risk factors listed in the literature. Poor dentition stands out, including the absence of a great number of teeth, the huge presence of caries, extensive fillings, crown fractures, tooth mobility and limited degree of mouth opening [3,7,8,11,12]. Furthermore, a higher Mallampati score is generally correlated with an increased incidence of operative dental trauma [8,10,11].

In order to avoid possible medicolegal disputes, several authors have suggested a systematic documentation of the pre-operative patients' dentition and of the associated accidents [4,7,8,11–13]. Corroborating this need is the awareness that dental factors increase the susceptibility to trauma, accounting for 40% of injuries [14]. However, there are few publications on registration strategies that support the implementation of effective pre-operative measures to prevent damage, namely through the laryngoscopy procedures. A succinct protocol of the pre-operative registration that allows a more objective assessment of the oral status, which is susceptible to be regularly used by the anaesthesiologists in patients scheduled to general anaesthesia, could contribute to reducing the risk of dental injury and potential medicolegal disputes. The objective of the present study was thus to develop a dental risk assessment protocol for regular pre-operative anaesthesiologists' registration. For this purpose, specific parameters of the oral status were selected and a correlation between two observers, a final-year student of the Integrated Master of Dental Medicine and an internal physician specializing in anaesthesiology, were analysed.

2. Materials and Methods

The study was approved by the Ethics Committee of the Hospital Center of São João/Faculty of Medicine of the University of Porto, Portugal. Written informed consent was obtained from all participants after an oral explanation of its objectives and respective procedures. The investigation took place at a university hospital. The data collected refer to patients who attended the anaesthesiology consultation between the 24th of January and the 27th of February 2020, and who met the inclusion criteria. These included patients over 18 years of age who had scheduled surgeries and underwent general anaesthesia requiring tracheal intubation. All patients with an inability to provide informed consent and patients who refused to participate in the study were excluded.

The elaborated protocol included a self-administered questionnaire to patients, and a form for a clinical record of oral-dental evaluation outside of the dental setting. After a brief training on observation and oral registration given by the senior dental student to the anaesthesiologist intern, the data collection was carried out by both the dental student and by the anaesthesiology trainee, filling the clinical record form in duplicate. The training, given by the dental student, comprised didactic lectures and the required

maxillary and mandibular teeth nomenclature and identification, enabling a comprehensive knowledge of relevant dental and periodontal diseases. In the same sense, normal and pathological features of soft tissues that could be wrongly perceived as injuries due to intubation procedures were stressed. Additionally, a hands-on simulation was performed with a small sample of patients, with a demonstration by the dental student, of basic diagnostic procedures such as inspection of dental structure integrity, caries detection and periodontal probing. These two observers, with different pre-graduate backgrounds, were used to assess the agreement between each set of data to investigate if this form could be an adequate tool for an autonomous and reliable oral examination registration by the intern. The self-administered questionnaire was based on a published survey [15], which included four questions related to sex, age, weight and height, and 13 questions grouped into different categories: oral hygiene behavioural habits, specific systemic diseases and factors of dental risk fracture, such as a recent dental trauma or the presence of implants. It also addressed the sociodemographic characterization and medical history, oral hygiene routines, main reasons for dental medicine consultations and date of the last visit to the dentist. The questions related to the patients’ self-perception regarding their oral health focused on the presence of pain on chewing, gingival bleeding, tooth mobility and number of missing teeth.

The clinical examination was performed and registered in the form, including the evaluation of ‘index teeth’ considered to be at higher risk of injury during the intubation procedure—that is, the upper teeth 12, 11, 21, 22, 23 and one of the following teeth of the lower jaw, 32/31/33 [4,7,8,10,11,16]. From the latter, the tooth with the greatest mobility and therefore of the greatest periodontal involvement was chosen. When only one of these three lower teeth was present in the arch, that same tooth was then elected to be assessed. The evaluation included the following parameters: mobility, bleeding on probing, presence of neighbouring teeth, caries, restorations, malformations, removable or fixed prosthesis, presence of deciduous tooth, implant, orthodontic treatment, dental fracture, and history of trauma. Two other parameters were also evaluated: the protrusion of the upper incisors and the Mallampati score. This parameter is usually assessed in the anaesthesiology consultation, given the importance of airway valuation in order to predict the difficulty of intubation, which may be also reflected in dental trauma [4,7,8,11,13]. The protrusion of the upper incisors was assessed, due to its association to a higher risk of dental injury, by measuring the overjet—the distance between the upper and lower incisal edges of occluded maxillary and mandibular incisors—with a ruler [8,10,11]. Finally, the protocol also included the odontogram registration with the identification of missing teeth for a better understanding of the patient’s general oral condition.

In order to classify the general oral status of the sample, only the data from the clinical examination forms collected by the dental student were used.

Statistical analysis of the data was performed using IBM® SPSS® Statistics (Version 27.0). A descriptive analysis (qualitative and quantitative variables) was performed. The Fleiss Kappa index was used to measure the degree of agreement between the two observers regarding the studied clinical parameters. The concordance results were classified according to the levels presented in Table 1 [17].

Table 1. Classification, by levels, of the agreement results [17].

Kappa Value	
0–0.20	Null or slight agreement
0.21–0.40	Considerable
0.41–0.60	Moderate
0.61–0.80	Good
0.81–1	Excellent

3. Results

3.1. Analysis of the Questionnaire

Regarding the sociodemographic data of the sample, 54.3% of the patients were male and 45.7% female. The sample had an average age of 62.78 years with a standard deviation of 10.46, with ages between 35 and 89 years. The average weight was 77.49 KG, with a standard deviation of 23.69, and the average height was 161.97 cm, with a standard deviation of 18.65. Table 2 shows the percentages and frequencies corresponding to each answer given to the 13 questions in the questionnaire.

Table 2. Patients' responses to the pre-anaesthetic evaluation questionnaire.

	n	%
How frequently do you use mouthwash?		
More than once a day	0	0
Once a day	3	8.6
Sometimes	5	14.3
Never	27	77.1
How often do you brush your teeth?		
3 or more time a day	2	5.7
1\2 times a day	22	62.9
Sometimes	4	11.4
Never	7	20
When was the last time you went to the dentist?		
Less than 1 year	6	17.1
1 year ago	12	34.3
More than 1 year ago	17	48.6
More than 2 years ago	0	0
What was the reason for your last visit to the dentist?		
Check-up/cleaning	6	17.1
Fillings/root canal treatment	5	14.3
Tooth extraction	18	51.5
Placement of a crown, bridge or prosthesis	6	17.1
How many teeth do you have missing?		
None	3	8.6
1\2 teeth	1	2.8
More than 2 teeth	14	40
Most teeth	17	48.6
Do you experience gum bleeding?		
Never	13	37.1
Sometimes	21	60
Very often	1	2.9
Always	0	0
Do you experience pain on chewing?		
Never	25	71.4
Sometimes	10	28.6
Very often	0	0
Always	0	0
Do you experience tooth mobility?		
No	27	77.1
Only 1 tooth	8	22.9
2\5 teeth	0	0
Almost all teeth	0	0
Do you have a recent dental trauma?		
No	35	100
Yes, in the posterior teeth	0	0
Yes, In the anterior teeth	0	0
Do you have any implant?		
No	35	100
Yes, in the posterior teeth	0	0
Yes, In the anterior teeth	0	0

3.2. Correlation between Clinical Examination by the Two Observers

The results regarding the statistical evaluation of the agreement between the two observers, according to the Fleiss' Kappa index, are listed in Tables 3 and 4. The greatest discrepancies between the two observers were found in the following parameters: presence of "caries lesions" and "restorations". Regarding the parameters "malformations", "removable prosthesis", "deciduous tooth" and "implant", there was no variability and therefore it was not possible to calculate the Kappa index (marked in the Table 4 as NA—Not applicable). Regarding the registration of the number of missing teeth in the odontogram, Table 4, a moderate agreement was obtained, whereas for the protrusion parameters of the upper incisors and the Mallampati scale, the agreement was excellent.

Table 3. Results of interobserver agreement according to the Fleiss' Kappa index for each of the analysed parameters. (CI—Confidence interval; NA—Not applicable).

Tooth	11	21	22	12	23	31/32/33
Mobility	1.000 (CI 95%: 0.989–1.000)	1.000 (CI 95%: 0.986–1.000)	0.738 (CI 95%: 0.724–0.751)	0.778 (CI 95%: 0.767; 0.789)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.990–1.000)
Bleeding	0.827 (CI 95%: 0.817–0.838)	0.672 (CI 95%: 0.662–0.682)	0.915 (CI 95%: 0.905–0.925)	0.918 (CI 95%: 0.907–0.928)	0.847 (CI 95%: 0.837–0.857)	0.887 (CI 95%: 0.879–0.896)
Missing teeth	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.989–1.000)	0.770 (CI 95%: 0.755–0.784)	1.000 (CI 95%: 0.986–1.000)	0.910 (CI 95%: 0.901–0.920)
Dental caries	0.553 [0.542; 0.564]	0.506 [0.495; 0.517]	0.250 [0.239; 0.261]	0.101 [0.088; 0.113]	−0.026 [−0.040; −0.012]	0.565 [0.554; 0.575]
Fillings	−0.027 (CI 95%: −0.041; −0.014]	0.510 (CI 95%: 0.499–0.520)	0.780 (CI 95%: 0.769–0.791)	0.638 (CI 95%: 0.624–0.652)	0.779 (CI 95%: 0.768–0.790)	0.523 (CI 95%: 0.513–0.533)
Malformations	NA	NA	NA	NA	NA	NA
Removable prosthesis	NA	NA	NA	NA	NA	NA
Fixed prosthesis	1.000 (CI 95%: 0.986–1.000)	NA	NA	1.000 [0.986; 1.000]	NA	NA
Deciduous teeth	NA	NA	NA	NA	NA	NA
Presence of implants	NA	NA	NA	NA	NA	NA
Orthodontic treatment	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.988–1.000)
Dental fracture	1.000 (CI 95%: 0.989–1.000)	1.000 (CI 95%: 0.989–1.000)	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	NA	NA
History of trauma	1.000 (CI 95%: 0.986–1.000)	1.000 (CI 95%: 0.986–1.000)	NA	NA	NA	NA

Table 4. Results of interobserver agreement according to the Fleiss' Kappa index in relation to the protrusion of the upper incisors, Mallampati scale and registration of the number of missing teeth (odontogram). (CI—Confidence interval).

	Kappa de Fleiss	CI 95%
Protrusion I sup.	0.960	(0.953–0.966)
Mallampati scale:	0.870	(0.862–0.877)
Odontogram	0.480	(0.477–0.483)

3.3. Assessment of Oral Status

The data presented was collected from the clinical examination form registered by the dental student for pre-operative oral status assessment:

- A. Protrusion: Through the measurement of the overjet, a percentage of 37% corresponded to the measurement of 2 mm; 6% of the patients had an overjet greater than 4 mm.

- B. Mallampati scale: 46% of the patients presented a score 1, 26% a score 2 and 29% a score 3.
- C. Missing teeth: With regard to the upper incisors, 46% of the patients observed did not have both teeth 11 and 12 and 40% did not have teeth 21 and 22. Tooth 23 was absent in 43% of patients. In the lower jaw, 26% of patients did not present any of the three teeth selected for evaluation (teeth 31, 32 or 33).
- D. Mobility: No vertical mobility was registered—that is, grade 3 mobility was registered.
- E. Bleeding: The observed patients, presented in the great majority, bleeding shortly after probing.
- F. Odontogram: An average of 17 isolated teeth were registered. In total, 43% of the patients had an average of 26 missing teeth.
- G. Dental caries: In total, 60% of patients presented caries on tooth 11, 51% on teeth 21 and 22, 54% on tooth 12, 46% on tooth 23 and 34% on at least one of teeth 31/32/33.
- H. Malformations: No malformed teeth were detected, such as teeth with dentinogenesis and amelogenesis.
- I. Removable prosthesis: All patients who presented removable prosthesis in the ‘index teeth’ were informed by the anaesthesiologist that on the day of surgery, the prosthesis would be removed. In this case, the respective teeth were included in the parameter “removable prosthesis on that tooth”.

Thus, the following percentages were obtained, corresponding to the filling option “removable prosthesis in this tooth”: 50% (tooth 11), 60% (tooth 21), 60% (tooth 22), 54% (tooth 12), 57% (tooth 23), 74% (tooth 31\32\33).

- J. Fixed prosthesis: The presence of fixed prostheses, namely ceramic crowns, were observed in tooth 11 (3%) and tooth 12 (3%).
- K. Presence of deciduous teeth: The presence of deciduous teeth was not observed.
- L. Presence of implants: The presence of implants was not observed.
- M. Orthodontic treatment: A percentage of patients with brackets, accounted for as the presence of orthodontic treatment, was registered in 3% of the cases.
- N. Dental fracture: In total, 3% of the teeth observed were registered as ‘dental fracture’: enamel fracture in teeth 11, 21, 22 and 12, and enamel fissure in teeth 11 and 21. The history of trauma with dental injury was recorded in teeth 11 and 21, in a total percentage of 3%.

The general oral status of the sample was considered “poor” based on the criteria reported in the literature, mainly justified by the number and type of the missing teeth, namely upper central and lateral incisors, gingival bleeding after probing, high number of caries lesions and marked mobility in the index teeth.

4. Discussion

The present investigation made it possible to meet the defined objectives, namely the development of a succinct clinical evaluation protocol of registration strategy for a routine dental examination in every patient scheduled for general anaesthesia. The reliability of this protocol was demonstrated by the high correlation values obtained between the two observers, a senior dental student and an internal physician specialised in anaesthesiology. The “presence of orthodontic treatment”, “dental fracture”, “history of trauma” and “presence of fixed prosthesis” are examples that stood out due to the excellent agreement achieved. It should be noted that the interobserver concordance was only lower in the situations of “restorations detection” and “caries lesions”; it is understandable that caries lesions without enamel destruction, for example, are hardly detectable without the ideal conditions of lighting in a dental clinic. Furthermore, changes in colour or indirect signs such as swelling or bleeding in the adjacent gingiva to the carious lesion are difficult to detect by a professional without dental experience. The same is true for small restorations with aesthetic materials. Contrary to the presence of isolated or fractured teeth, which can be clearly perceived, major aesthetic restorations and periodontal involvement

were also reported as risk factors for dental injury in the anaesthetic act and may present higher diagnosis difficulties for professionals without dental training or the ideal logistical conditions [3,7,8,11–13]. Thus, it is imperative to define clear oral parameters representative of the potential risk that endotracheal intubation can imply and of reliable application by the anaesthesiologists prior to surgical procedures. For this, the brief training of the intern anaesthesiologist on oral observation and registration proved to be essential, as well as the selected strategy of identification and evaluation of ‘index teeth’. These are mentioned as representative of the risk of dental injury during endotracheal intubation procedures [4,7,10,11,16].

Patients with worse dentition status, with prosthetic work or more difficult airways, are reported as having a higher risk (approximately 20× higher) of dental damage than those who present “good dentition” and an “easier” airway [18]. Moreover, among patients classified as “easy to intubate”, in those with “worst dentition”, the probability of suffering dental injuries related to anaesthesia was three to four times higher [18]. Other authors highlight the pre-existing periodontal disease as the most likely cause of dental injury. It is also mentioned that, in patients with Angle Class II, Division 1 malocclusion, in which there is a pro-inclination of the central maxillary incisors, the risk of dental injury may increase. Recent studies reveal that in 90% of the patients with class I malocclusion, Angle division II and Mallampati score 3, there is contact between the blade and the teeth [8]. Thus, pre-surgical anaesthetic evaluation is reported as one of the relevant approaches that should be taken to minimize the risk of dental injury.

Through the data collected by the questionnaire, 20% of the patients who underwent surgery never brushed their teeth, the majority (77.1%) never used a mouthwash and nearly 50% had only been to the dentist as recently as 1 year ago, many of them for tooth extraction. Dental mobility was not a complaint reported by most patients, which can be explained by the reduced number of teeth present in the mouth. These data allowed us to anticipate that we were present to a population with a critical/poor oral status. This was confirmed by the clinical observation and reflected in an average of about 18 missing teeth per individual, a generalized bleeding on probing and a significant number of isolated teeth. A pre-existing poor oral condition, corroborated by the present findings, is considered to increase the risk of dental damage in the general anaesthesia procedure by 12×, leading the authors to emphasize the need for a careful risk assessment and pre-operative guidelines for the most critical teeth [18]. In this sense, the effect of a pre-operative protocol on the increased awareness of the patients is considered crucial in dental trauma prevention and consequently in the grade of litigious situations. Patients can still be advised to consult their dentist whenever severe dental pathology is detected, which eventually may require changes in the planned intubation route [4,6,7,15]. Apart from caries lesions treatment, mobile teeth splinted or extracted, and the use of protective devices such as mouthguards, although controversial, may be recommended. Despite this, none of these isolated preventive measures will guarantee the absence of oral or dental injury. Although all the professionals involved are advised to give the adequate information about the risks of dental trauma to the patient, it is the responsibility of the anaesthetist to ensure the safety of the procedure.

It is also claimed that anaesthesiologists must have a detailed knowledge about anatomy and dental development and be aware of the main risk factors for dental injury [16,19,20]. The moderate correlation in the odontogram registration, founded in the present study, emphasizes this issue. It would not be expected, at the outset, that anaesthesiologists would not recognize the number of missing teeth, but it can in fact be challenging in some situations whether the toothless space corresponds to one or more teeth, especially if the tooth loss occurred long ago.

These aspects do not preclude the validity of the protocol, but they warn of the need for more detailed and frequent exchange training between different health professionals, before its general use; a theme has been highlighted by other authors and advised by the recent education guidelines for a holistic patient care [1,6,16,19].

In the available literature, the evaluations of dental injuries associated with anaesthetic acts are most often retrospective. This may justify the lack of standardization in the way of recording pre-operative dental condition, as well as the distinct emphasis of each study attributed to this factor.

Although the literature is not coherent on which is the most common post-surgical accident, namely regarding dislocation or tooth avulsion, common in the upper incisor teeth the importance of a careful oral/dental evaluation is recognized by specialists of anaesthesiology [7,8,12]. The literature is, at the same time, scarce about a registration protocol that is simple but reliable, which is to be used by a medical professional without training in dentistry. In the present study, it was possible through a literature review to identify dental risk factors that could help the anaesthesiologists to classify specific oral conditions, as well as teeth with a higher risk of injury, to inform the patient and prevent iatrogenic injuries. It was essential to assess the correlation between both dental students and anaesthesiologist interns' evaluations in order to confirm or reject some of the selected variables, or even to reinforce the extension of the prior dental training. For this purpose, a correlation analysis was carried out and, in general, a good interobserver correlation was found, contributing to the validation of the pre-operative protocol suggested [10,18,21]. However, to be able to suggest clinical recommendations, the assessment of the oral status through this protocol needs to be correlated to the post-operative dental injuries.

A limitation of the study may be the sample size. A convenience sample was selected based on the greater ease of reconciling a larger number of patients and the availability of both observers in the referred period. Therefore, even though the "poor" oral condition has been generally reported, with a reduced number of remaining teeth—in particular, missing 'index teeth'—there are few investigations presenting a detailed chart to implement in view of a harmonization of the oral registration by the anaesthesiologists. However, further research is needed to address its role concerning pre-operative inspection and litigation about tooth injury following intubation.

5. Conclusions

The developed pre-operative protocol presented acceptable correlation criteria, allowing it to be used by an anaesthesiologist, after a brief training on clinical oral examination in dentistry. Exchange programs might be implemented to fulfil the requirements of patient-centred care amongst health students/professionals with different backgrounds.

Author Contributions: D.S. contributed to investigation and writing—Original Draft; R.M. contributed to investigation; I.F. contributed to formal analysis and writing—Original Draft; A.B. contributed to formal analysis and writing—Review & Editing; J.M. contributed to conceptualization, writing—Review & Editing and supervision; I.P.-V. contributed to conceptualization, writing—Review & Editing and supervision. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: All the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the local institutional Ethics Committee.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: Not Applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Field, J.; Cowpe, J.; Walmsley, D. *The Profile of Undergraduate Dental Education in Europe*; Association for Dental Education in Europe: Dublin, Ireland, 2017.
2. Gulabivala, K.; Ahlquist, M.; Cunnington, S.; Gambarini, G.; Tamse, A.; Bergenholtz, G.; Dummer, P.; Löst, C.; Ørstavik, D.; Sunay, H.; et al. Accreditation of postgraduate speciality training programmes in Endodontology. Minimum criteria for training Specialists in Endodontology within Europe. *Int. Endod. J.* **2010**, *43*, 725–737. [[CrossRef](#)] [[PubMed](#)]
3. Adolphs, N.; Kessler, B.; von Heymann, C.; Achterberg, E.; Spies, C.; Menneking, H.; Hoffmeister, B. 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. *Dent. Traumatol.* **2011**, *27*, 10–14. [[CrossRef](#)] [[PubMed](#)]
4. Sousa, J.M.B.R.; Mourão, J.I.B. Tooth injury in anaesthesiology. *Rev. Bras. Anesthesiol.* **2015**, *65*, 511–518.
5. Chadwick, R.G.; Lindsay, S.M. Dental injuries during general anaesthesia. *Br. Dent. J.* **1996**, *180*, 255–258. [[CrossRef](#)] [[PubMed](#)]
6. Hoffmann, J.; Westendorff, C.; Reinert, S. Evaluation of dental injury following endotracheal intubation using the Periotest technique. *Dent. Traumatol.* **2005**, *21*, 263–268. [[CrossRef](#)] [[PubMed](#)]
7. Kuo, Y.W.; Lu, I.C.; Yang, H.Y.; Chiu, S.L.; Hsu, H.T.; Cheng, K.I. Quality improvement program reduces perioperative dental injuries—A review of 64,718 anesthetic patients. *J. Chin. Med. Assoc.* **2016**, *79*, 678–682. [[CrossRef](#)] [[PubMed](#)]
8. Sahni, V. Dental considerations in anaesthesia. *JRSM Open* **2016**, *7*, 2054270416675082. [[CrossRef](#)] [[PubMed](#)]
9. Chen, J.J.; Susetio, L.; Chao, C.C. Oral complications associated with endotracheal general anesthesia. *Ma Zui Xue Za Zhi* **1990**, *28*, 163–169. [[PubMed](#)]
10. Newland, M.C.; Ellis, S.J.; Peters, K.R.; Simonson, J.A.; Durham, T.M.; Ullrich, F.A.; Tinker, J.H. Dental injury associated with anesthesia: A report of 161,687 anesthetics given over 14 years. *J. Clin. Anesth.* **2007**, *19*, 339–345. [[CrossRef](#)] [[PubMed](#)]
11. Gaudio, R.M.; Feltracco, P.; Barbieri, S.; Tiano, L.; Alberti, M.; Delantone, M.; Ori, C.; Avato, F.M. Traumatic dental injuries during anaesthesia: Part I: Clinical evaluation. *Dent. Traumatol.* **2010**, *26*, 459–465. [[CrossRef](#)] [[PubMed](#)]
12. Gaudio, R.M.; Barbieri, S.; Feltracco, P.; Tiano, L.; Galligioni, H.; Uberti, M.; Ori, C.; Avato, F.M. Traumatic dental injuries during anaesthesia. Part II: Medico-legal evaluation and liability. *Dent. Traumatol.* **2011**, *27*, 40–45. [[CrossRef](#)] [[PubMed](#)]
13. Giraudon, A.; de Saint Maurice, G.; Biais, M.; Benhamou, D.; Nouette-Gaulain, K. Dental injury associated with anaesthesia: An 8-year database analysis of 592 claims from a major French insurance company. *Anaesth. Crit. Care Pain Med.* **2018**, *37*, 49–53. [[CrossRef](#)] [[PubMed](#)]
14. Milne, A.; Lockie, J. Dental damage in anaesthesia. *Anaesth. Intensive Care Med.* **2014**, *15*, 370–372. [[CrossRef](#)]
15. Ruiz-López del Prado, G.; Blaya-Nováková, V.; Saz-Parkinson, Z.; Álvarez-Montero, Ó.L.; Ayala, A.; Muñoz-Moreno, M.F.; Forjaz, M.J. Design and validation of an oral health questionnaire for preoperative anaesthetic evaluation. *Braz. J. Anesthesiol.* **2017**, *67*, 6–14. [[CrossRef](#)] [[PubMed](#)]
16. Mourão, J.; Neto, J.; Luís, C.; Moreno, C.; Barbosa, J.; Carvalho, J.; Tavares, J. Dental injury after conventional direct laryngoscopy: A prospective observational study. *Anaesthesia* **2013**, *68*, 1059–1065. [[CrossRef](#)] [[PubMed](#)]
17. Landis, J.R.; Koch, G.G. The measurement of observer agreement for categorical data. *Biometrics* **1977**, *33*, 159–174. [[CrossRef](#)] [[PubMed](#)]
18. Tan, Y.; Loganathan, N.; Thinn, K.K.; Liu, E.H.C.; Loh, N.-H.W. Dental injury in anaesthesia: A tertiary hospital's experience. *BMC Anesthesiol.* **2018**, *18*, 108. [[CrossRef](#)] [[PubMed](#)]
19. Owen, H.; Waddell-Smith, I. Dental Trauma Associated with Anaesthesia. *Anaesth. Intensive Care* **2000**, *28*, 133–145. [[CrossRef](#)] [[PubMed](#)]
20. Laidoowo, E.; Baert, O.; Besnier, E.; Dureuil, B. Dental trauma and anaesthesiology: Epidemiology and insurance-related impact over 4 years in Rouen teaching hospital. *Ann. Fr. Anesth. Reanim.* **2012**, *31*, 23–28. [[CrossRef](#)] [[PubMed](#)]
21. Nenava, D.; Kv, N.; Kulkarni, S.; Agrawal, P.; Sharma, A. Dental trauma to general anesthesia: Does the anesthesiologist perform a pre-anesthetic dental evaluation. *Int. J. Appl. Res.* **2016**, *2*, 452–456.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.