Open Access Original Research Article

MedPeer Publisher
Abbreviated Key Title: MedPeer
ISSN : 3066-2737
homepage: https://www.medpeerpublishers.com

Dental Trauma During Orotracheal Intubation: Comprehensive Analysis, Risk Stratification, Prevention, and Multidisciplinary Recommendations

DOI: 10.70780/medpeer.000QGVK

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ABSTRACT

Background & Objectives: Orotracheal intubation is a critical medical procedure performed daily in anesthesiology and emergency medicine. However, it carries significant risks of perioperative dental trauma, representing one of the leading causes of anesthesia-related medicolegal claims. With the expanding prevalence of advanced aesthetic and restorative dental materials—such as high-strength ceramic crowns, laminate veneers, and fixed prostheses—the vulnerability of compromised dentition during airway manipulation has markedly increased. This review provides an in-depth analysis of injury mechanisms, epidemiological incidence, clinical risk factors, and modern preventive strategies.

Methods: A comprehensive synthesis of biomedical literature (2013–2024) was conducted alongside an in-depth analysis of representative clinical cases involving dental trauma during orotracheal intubation in patients with modern fixed prostheses and cosmetic restorations.

Key Findings: While large-scale retrospective registries report an incidence of dental trauma between 0.04% and 0.1%, rigorous prospective assessments reveal injury rates exceeding 25% when including subclinical enamel chipping and restoration loosening. Primary risk factors include advanced patient age (>40 years; 15-fold risk increase), pre-existing periodontal disease, dental mobility, and anatomical airway difficulties. A structured 4-tier risk stratification framework (Low, Moderate, High, Very High) is presented with tailored preventive protocols.

Conclusion: Iatrogenic dental injuries are not random events; they result from predictable biomechanical stresses. Effective prevention requires systematic preoperative dental screening, routine adoption of video laryngoscopy, custom 3D-printed protective splints, and structured interdisciplinary collaboration between anesthesiologists and dental surgeons.

KEYWORDS

Dental trauma, Orotrachial intubation, Prostheses, Laryngoscopy, tooth protector, endotracheal intubation, dental veneers, prosthodontics

MAIN ARTICLE

1. Introduction

Orotracheal intubation represents a fundamental, life-sustaining medical procedure in general anesthesia, critical care, and emergency resuscitation. Despite its routine nature, it carries substantial inherent risks of perioperative dental trauma [1,2]. Historically, dental injuries have been reported as the single most frequent adverse event and the leading source of medicolegal claims against anesthesiologists, accounting for approximately one-third of all malpractice litigations in anesthetic practice [1,4].

Over the past two decades, the field of restorative and aesthetic dentistry has undergone a major technological transformation. High-strength monolithic ceramics (such as zirconia and lithium disilicate), porcelain laminate veneers (commonly referred to as 'Hollywood Smile' restorations), and complex implant-supported fixed partial dentures have become widespread across all patient demographics. Although these modern restorative materials exhibit remarkable compressive strength and outstanding aesthetic fidelity, they possess distinct biomechanical limitations—particularly low fracture toughness against sudden, non-axial shearing and tensile loads [9]. Consequently, they require heightened vigilance during laryngoscopy and endotracheal tube securement.

Perioperative dental complications can result in devastating functional, aesthetic, psychological, and financial consequences for patients, alongside severe medicolegal liabilities for clinicians. An understanding of dental anatomy, biomaterial properties, and predictive risk factors is therefore indispensable for modern airway practitioners.

2. Methods and Ethical Considerations

This study is structured as a narrative review and integrative clinical synthesis of clinical cases and epidemiological data addressing dental trauma associated with orotracheal intubation. A structured literature search was conducted across international biomedical

databases (PubMed/MEDLINE, Scopus, Google Scholar, and EMBASE) spanning publications from 2013 to 2024.

The search strategy utilized combinations of controlled MeSH terms and keywords, including: 'dental trauma', 'dental injury', 'orotracheal intubation', 'endotracheal intubation', 'laryngoscopy', 'prosthodontics', 'dental veneers', 'tooth protector', and 'airway management'. Inclusion criteria encompassed clinical trials, prospective and retrospective cohort studies, systematic reviews, and detailed clinical case reports detailing injury mechanisms, risk classification, and preventive interventions in patients with natural, restored, or prosthetic dentition. Identified risk factors and preventive modalities were synthesized into an evidence-based clinical risk stratification framework.

3. Results

3.1. Epidemiology and Incidence

The reported incidence of dental trauma associated with general anesthesia varies substantially depending on study methodology and diagnostic criteria (Table 1). Large-scale retrospective studies relying on voluntary adverse incident reporting, such as the landmark registry by Newland et al. (summarized by Neto et al. [1]), document low rates of approximately 0.048% (1 in 2,073 anesthetics). These registries predominantly capture severe, clinically overt injuries requiring immediate intervention (such as tooth avulsion or gross fracture)

Conversely, prospective observational investigations that perform systematic pre- and post-operative oral examinations report dramatically higher incidences, reaching 25.0% to 25.6% [2,3]. This marked discrepancy underscores the under-recognition of subclinical enamel infractions, partial dislocations (subluxations), tooth contusions, and minor restoration loosening in routine retrospective recording.

3.2. Primary Risk Factors

Multivariate analyses across the reviewed literature demonstrate that perioperative dental trauma is multifactorial, stemming from demographic, anatomical, pathological, and procedural variables (Table 2). Pre-existing dental pathology—particularly tooth mobility and periodontal attachment loss—constitutes the single strongest patient-related predisposing factor. Furthermore, while prospective studies such as Mabrouk et al. [2] report an elevated risk in patients aged >40 years (OR: 15.0), the wide 95% confidence interval (1.685–133.551) in small cohorts indicates that age-related risk should be interpreted as a recognized clinical vulnerability rather than a rigid mathematical multiplier.

3.3. Risk Stratification and Illustrative Clinical Cases

3.3.1. Proposed Risk Stratification Matrix

To assist clinical decision-making, we established a proposed four-level risk classification matrix (Table 3), matching patient-specific dental characteristics to tailored airway management protocols and preventive interventions.

3.3.2. Illustrative Clinical Cases

Case Report 1: Debonding of Maxillary Aesthetic Laminate Veneers ("Hollywood Smile")

- Patient Profile: 45-year-old female, ASA Physical Status I.
- Surgical Indication: Elective major abdominal surgery under general anesthesia.
- Medical History: Unremarkable; no systemic co-morbidities.
- Initial Dental Status: Six maxillary anterior ceramic laminate veneers (#13 to #23 FDI) bonded 18 months prior.
- Risk Stratification: Moderate Risk.
- Complication: Complete adhesive debonding and dislodgement of maxillary anterior veneers occurring during laryngoscopy and endotracheal tube adhesive strapping.
- Contributing Factors: Excessive lateral fulcrum pressure during direct laryngoscopy; vulnerability of the resin-ceramic adhesive interface to localized shear stress.
- Clinical Management: Immediate intraoral retrieval of dislodged units to prevent aspiration; post-extubation dental consultation, surface conditioning, and complete adhesive re-cementation.

Case Report 2: Catastrophic Structural Fracture of a Supra-Radicular Overdenture

- Patient Profile: 52-year-old male, ASA Physical Status II.
- Surgical Indication: Open abdominal surgical procedure.
- Medical History: Well-controlled hypertension.
- Initial Dental Status: Long-standing mandibular supra-radicular overdenture supported by retained root attachments.
- Risk Stratification: High Risk.
- Complication: Complete catastrophic structural fracture of the prosthetic acrylic base and dislodgement of prosthetic teeth during airway instrumentation.
- Contributing Factors: Material aging and micro-fatigue of the acrylic resin matrix; localized focal compressive load exerted by the rigid laryngoscope blade.

- Clinical Management: Complete intraoral fragment retrieval; emergency postoperative prosthodontic evaluation and comprehensive prosthetic fabrication.

Case Report 3: Complete Dislodgement of a 3-Unit Fixed Dental Bridge

- Patient Profile: 58-year-old male, ASA Physical Status II.
- Surgical Indication: Laparoscopic abdominal surgery.
- Medical History: Type 2 Diabetes Mellitus with chronic microvascular involvement.
- Initial Dental Status: 3-unit posterior porcelain-fused-to-metal (PFM) fixed partial denture supported by compromised abutment teeth.
- Risk Stratification: Very High Risk.
- Complication: Total debonding, dislodgement, and mobilization of the 3-unit fixed bridge during endotracheal tube placement and oral suctioning.
- Contributing Factors: Severe underlying chronic periodontitis, advanced horizontal alveolar bone loss, impaired crown-to-root ratio, and diabetic microangiopathy.
- Clinical Management: Immediate retrieval of dislodged prosthetic unit; subgingival periodontal scaling and root planing, provisional re-cementation, and secondary periodontal splinting.

4. Discussion

The biomechanical durability and clinical performance of restorative dental biomaterials have advanced markedly over recent decades, driven by the introduction of high-performance ceramics and adhesive polymers. However, clinical resilience under physiological mastication does not inherently protect against non-physiological, concentrated shear forces encountered during airway instrumentation.

A foundational in vitro investigation by Almohammed et al. [9] rigorously evaluated the mechanical properties of five contemporary aesthetic ceramic materials utilized for monolithic restorations: three multilayer monolithic zirconia ceramics (GNX, ZCP, UPC), a polymer-infiltrated ceramic network (ENM), and a lithium disilicate glass-ceramic (EMX) as a reference control. Their findings demonstrated significant variations in flexural strength, fracture toughness, and modulus of elasticity among materials. While monolithic zirconia exhibits exceptional compressive strength, thinner aesthetic glass-ceramics and resin-matrix ceramics remain prone to catastrophic cleavage or interfacial adhesive debonding when exposed to eccentric point loads. These findings emphasize that mechanical laboratory testing must guide clinical airway protocols, particularly in patients harboring high-stress ceramic restorations.

During conventional direct laryngoscopy (Macintosh or Miller blades), the maxillary central incisors often inadvertently serve as a mechanical fulcrum point when the practitioner encounters poor glottic exposure. Biomechanical studies demonstrate that peak forces exerted on maxillary incisors can easily exceed 40–50 N—well above the failure threshold of aged resin cements, compromised post-and-core foundations, or periodontally unstable abutments. Preventive strategies—including specialized dental guards, optimized blade selection, and video laryngoscopy—have demonstrated substantial efficacy in mitigating iatrogenic dental damage [10,11]. Furthermore, simulation-based medical education has proven indispensable for improving laryngoscopy technique and preventing fulcrum-induced leverage.

Our analysis underscores that perioperative dental injuries are not random or unpreventable misadventures; rather, they are predictable outcomes of mechanical interactions between the laryngoscope blade, tube fixation forces, and the patient's baseline oral architecture. Proactive risk management rests upon two core pillars: Multidisciplinary Collaboration and Technological Innovation.

4.1. Multidisciplinary Collaboration

Preventing perioperative dental trauma requires seamless, active coordination across specialties. Delineating clear interprofessional roles ensures that high-risk patients are identified early and managed collaboratively throughout the perioperative pathway (Table 5).

4.2. Technological Innovations and Clinical Impact

Technological advancements in airway devices and additive manufacturing have revolutionized dental risk mitigation (Table 6). The integration of indirect video laryngoscopy significantly reduces the requirement for direct line-of-sight alignment of the oral-pharyngeal-laryngeal axes, thereby substantially decreasing mechanical torque transmitted to the maxillary dentition [5]. However, video laryngoscopy does not eliminate dental contact entirely; cautious technique remains essential.

Implementing modern airway technologies and customized 3D-printed splints yields major clinical, financial, and medicolegal benefits (Table 7). In addition to protecting anatomical integrity, this preventive approach substantially mitigates hospital expenditures associated with emergency prosthodontic repairs and litigations, while significantly bolstering patient satisfaction [10,11].

4.3. Standardized Perioperative Management Protocol

Based on the synthesized evidence, we advocate for the institutional implementation of a standardized three-phase perioperative dental safety bundle:

- Preoperative Assessment & Documentation: Systematic oral cavity examination during the pre-anesthetic consultation. Mandatory charting of all missing, mobile, restored, or prosthetic teeth, accompanied by photographic documentation and explicit patient informed consent regarding baseline dental vulnerabilities.
- Interdisciplinary Involvement: Early referral to a dental surgeon for patients identified in Moderate, High, or Very High risk categories; joint planning with surgical teams when operating in the oral or maxillofacial field.
- Atraumatic Airway Execution: Routine selection of video laryngoscopy or flexible fiberoptic bronchoscopy for high-risk patients; deployment of patient-specific 3D-printed or soft elastomeric tooth guards; strict avoidance of teeth as fulcrum leverage points; atraumatic endotracheal tube strapping.
- Postoperative Verification & Rapid Intervention: Immediate systematic oral inspection upon extubation with comparative photographic verification. In the event of dental trauma or prosthetic dislodgement, emergency retrieval, tooth preservation in appropriate medium (Hank's balanced salt solution or milk), and immediate dental consultation.

5. Conclusion

The prevention and management of dental trauma during orotracheal intubation constitute a multifaceted clinical challenge requiring an anticipatory, systematic, and multidisciplinary approach. The key conclusions of this study are threefold:

- Multimodality of Risk: Dental injuries are not stochastic accidents; they result from predictable mechanical forces interacting with underlying anatomical and prosthodontic vulnerabilities.
- Crucial Role of Technology: Modern advances—specifically video laryngoscopy, real-time force sensing, and additive 3D-printed customized dental guards—significantly diminish the risk profile.
- Essential Interdisciplinary Synergy: Protecting dental integrity relies upon structured communication and coordinated protocols connecting anesthesiologists, dental specialists, intensivists, and nurse anesthetists.

Ultimately, perioperative dental preservation is not a static endpoint but a continuous quality improvement endeavor that places patient safety, functional integrity, and aesthetic well-being at the core of modern anesthetic care.

FIGURES:

Figure 1. Complete debonding and displacement of maxillary anterior aesthetic veneers following orotracheal intubation.

Figure 2. Structural fracture of a supra-radicular overdenture resulting from compressive laryngoscopy forces.

Figure 3. Complete dislodgement of a 3-unit fixed partial denture associated with severe periodontal attachment loss.

TABLES :

Table 1. Epidemiological Prevalence and Incidence of Dental Trauma During Intubation

Study / Reference	Study Population & Cohort Size	Reported Incidence (%)	Clinical Spectrum & Diagnostic Notes
Newland et al. (summarized in Neto et al. [1])	161,687 general anesthetics (Retrospective registry)	0.048% (1 in 2,073)	Severe reported injuries (tooth avulsion, luxation, crown fracture)
Mabrouk et al. [2]	43 prospective surgical patients (Systematic exam)	25.6% (11 of 43)	Systematic exams; identified partial dislocations/subluxations (most common), contusions, and fractures
Mourão et al. [3]	536 prospective surgical patients (Direct laryngoscopy)	25.0% (134 of 536)	Systematic pre/post direct laryngoscopy; captured enamel infractions, subluxations, and minor trauma

Table 2. Identified Primary Risk Factors for Perioperative Dental Injury

Risk Category	Clinical Risk Factors	Clinical Impact & Odds Ratio	Key References
Demographics	Age > 40 years	Higher baseline periodontal disease; increased vulnerability observed in prospective cohorts (e.g., Mabrouk et al. OR: 15.0; 95% CI: 1.685–133.551)	Mabrouk et al. [2] Mourão et al. [3]
Dental Status	Pre-existing tooth mobility (Grade I–III)	Major independent determinant of avulsion/luxation during airway instrumentation	Gaudio et al. [4] Neto et al. [1]
Medical Conditions	Periodontal disease & alveolar bone loss	Significant elevation in mechanical fragility and loss of periodontal ligament resilience	Neto et al. [1] Warner et al. [8]
Procedural Factors	Difficult intubation (Cormack-Lehane III/IV)	Strong positive correlation with increased blade manipulation and inadvertent levering forces	Tankard et al. [5] Mourão et al. [3]

Table 3. Proposed Literature-Informed Clinical Risk Stratification Framework

Risk Level	Dental Characteristics	General Recommendations	Specific Clinical Actions	References
Low Risk	Sound natural dentition; no mobility; healthy periodontium	Standard pre-anesthetic airway assessment	Conventional direct laryngoscopy; gentle technique avoiding dental contact	Komasawa [6]
Moderate Risk	Isolated restorations, veneers, inlays/onlays, mild gingival recession	Preoperative dental charting & patient informed consent	Application of commercial soft tooth protectors; careful blade positioning	Alharthi et al. [7] Razaeian et al. [11]
High Risk	Multiple extensive prostheses, fixed bridgework, moderate mobility	Specialized dental consultation; high-definition photography	Custom 3D-printed protective splints; routine video laryngoscopy (VL)	Lee et al. [10], Warner et al. [8]
Very High Risk	Advanced periodontal breakdown, severe mobility, complex multi-unit restorations	Multidisciplinary case review (Anesthesiology & Dental Surgery)	Non-contact intubation (fiberoptic bronchoscopy / awake intubation); potential pre-op dental stabilization or deferral	Tankard et al. [5] Gaudio et al. [4]

Table 4. Comparative Analysis of Illustrative Clinical Cases

Clinical Parameter	Case 1	Case 2	Case 3
Trauma Mechanism / Type	Adhesive Debonding / Dislodgement	Structural Base Fracture	Complete Dislodgement
Anatomical Location	Maxillary Anterior (#13 to #23)	Mandibular / Maxillary Arch	Posterior Segment
Patient Age & Gender	45 years, Female	52 years, Male	58 years, Male
Prosthetic Restoration	Ceramic Laminate Veneers	Supra-Radicular Overdenture	3-Unit Fixed Bridge (PFM)
Risk Stratification	Moderate Risk	High Risk	Very High Risk
Contributing Factors	Localized shear force at resin-ceramic interface	Compressive load on aged acrylic resin matrix	Severe periodontal bone loss and reduced crown-to-root ratio

Table 5. Interprofessional Roles and Responsibilities in Perioperative Dental Safety

Healthcare Discipline	Core Responsibilities	Primary Clinical Objective	Key References
Anesthesiologist	Preoperative dental risk stratification, airway device selection, gentle intubation technique	Primary prevention of dental contact and levering injury	Neto et al. [1], Warner et al. [8]
Dental Surgeon / Prosthodontist	Specialist pre-anesthetic oral assessment, fabrication of custom splints, rapid post-injury repair	Technical dental expertise and restorative management	Mabrouk et al. [2] , Lee et al. [10]
Intensivist / Critical Care	Post-extubation airway surveillance, acute management of dislodged prostheses/aspiration	Airway rescue and secondary complication prevention	Komasawa [6]
Nurse Anesthetist (IAR)	Continuous intraoperative monitoring of tube strapping, equipment preparation, oral care	Patient safety assurance and procedural execution	Alharthi et al. [7]

Table 6. Emerging Technologies for Perioperative Dental Preservation

Technology	Clinical Application	Demonstrated Safety Benefit	Key References
Video Laryngoscopy (VL)	Indirect glottic visualization without axis alignment	Eliminates levering force on maxillary incisors; improves view	Tankard et al. [5] Mourão et al. [3]
Real-Time Force Sensors	Dynamic force monitoring integrated into laryngoscope blades	Provides real-time biofeedback to prevent excessive pressure	Komasawa [6]
3D Additive Printing	Rapid digital scanning and fabrication of bespoke splints	Precise anatomical adaptation; homogeneous force dispersion across dental arch	Lee et al. [10], Razaeian et al. [11]

Table 7. Clinical, Economic, and Medicolegal Impact of Structured Dental Protection

Outcome Dimension	Observed Clinical & Institutional Impact	Key Reference
Medicolegal Risk Reduction	Systematic pre-anesthetic documentation and informed consent mitigate liability and malpractice claims associated with perioperative dental injury	Neto et al. [1], Gaudio et al. [4]

Patient Safety & Clinical Experience	Proactive screening and tailored protective devices prevent avoidable emergency dental repairs, maintaining patient satisfaction	Komasawa [6] Lee et al. [10]
Institutional Cost Containment	Early detection of mobile teeth and prosthetic vulnerability avoids unplanned intraoperative complications, emergency dental consultations, and secondary repair expenses	Alharthi et al. [7] Warner et al. [8]
Overall Perioperative Quality	Integration of standardized safety checklists and atraumatic airway techniques lowers the incidence of post-extubation dental trauma	Tankard et al. [5], Mourão et al. [3

ACKNOWLEDGEMENTS

The authors have no acknowledgements to declare and report no conflicts of interest.

Informed Consent: Written informed consent was obtained from all patients for publication of this manuscript and accompanying clinical images.

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