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Extralaryngeal Complications in Laryngeal Microsurgeries: A Narrative Review

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Abstract: This narrative review aims to investigate extralaryngeal complications associated with laryngeal microsurgeries (LMS), focusing on their incidence, risk factors, and preventive strategies. Although LMS primarily target intralaryngeal pathologies, complications involving the teeth, oral mucosa, cranial nerves, and cardiovascular system can significantly impact postoperative recovery. A comprehensive literature search was conducted in PubMed, Scopus, Web of Science, Cochrane, Google Scholar and OVID databases, covering the past 20 years. Studies reporting on extralaryngeal complications such as dental trauma, mucosal injuries, nerve damage, and cardiovascular events during LMS were included. Relevant data on incidence, risk factors, and preventive measures were analyzed and synthesized narratively. The most frequently reported complications included dental injuries, mucosal trauma, and nerve damage—particularly involving the lingual, glossopharyngeal, and hypoglossal nerves. Cardiovascular complications, although rare, were also documented. Identified risk factors included pre-existing dental disease, prolonged surgical duration, and inadequate protection during suspension laryngoscopy or intubation. Most complications were minor and self-limiting, but some resulted in prolonged recovery or patient discomfort. Extralaryngeal complications in LMS are common but largely preventable. Strategies such as preoperative dental assessment, the use of protective mouthguards, minimizing suspension time, and appropriate anesthetic management are essential to reduce these risks. Further research is warranted to evaluate long-term outcomes and improve preventive approaches, especially in high-risk and pediatric populations.

Keywords: Laryngeal; Microsurgery; Laryngoscopy; Complications; Intubation.

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1. Introduction

Laryngeal microsurgery (LMS) is a highly specialized procedure used to treat a wide range of laryngeal conditions, including vocal fold lesions, benign and malignant tumors, and airway obstructions [1]. These surgeries are critical for restoring and preserving vocal function, as well as addressing life-threatening conditions such as airway stenosis and cancer. However, despite their effectiveness, LMS are associated with a variety of extralaryngeal complications. These complications, which often involve the teeth, oral mucosa, and nerves, can significantly affect patient recovery and postoperative quality of life [2, 3].

The primary objective of this review is to explore the most common extralaryngeal complications encountered during LMS, assess their incidence, identify associated risk factors, and evaluate preventive strategies. While these surgeries primarily focus on treating intralaryngeal pathologies, the extralaryngeal consequences, such as dental

trauma, mucosal injury, and nerve damage, can cause significant postoperative discomfort, prolong recovery times, and even necessitate additional medical interventions [4]. Furthermore, cardiovascular events, although rare, have also been reported in high-risk patients, complicating the postoperative course [5–9].

Addressing these complications is crucial for improving patient outcomes and ensuring optimal recovery. By understanding the factors that contribute to these complications, clinicians can better prepare for and manage potential risks, thus reducing the occurrence of long-term or severe consequences [10]. In addition, extralaryngeal complications have a direct impact on clinical practice, as they influence postoperative care protocols, patient counseling, and the overall approach to laryngeal microsurgical techniques [11]. Therefore, it is imperative to develop and implement effective preventive strategies to mitigate these risks and enhance the overall safety of laryngeal surgeries.

While no official ENT society guideline exclusively addresses extralaryngeal complications, recent consensus documents—such as the European Laryngological Society's statement on informed consent — highlight the importance of discussing these risks with patients [6]. This review aims to summarize the extralaryngeal complications associated with LMS, focusing on their causes, risk factors, and preventive strategies.

2. Materials and methods

2.1 Study Design

This narrative review followed a systematic approach to identify and evaluate studies on extralaryngeal complications in LMS. The review focused on complications such as dental injuries, nerve damage, and mucosal trauma associated with both perioperative intubation and suspension laryngoscopy.

2.2 Literature Search

A comprehensive literature search was conducted using databases such as PubMed, Scopus, and OVID. The search included articles published in English from the last 20 years. The following search strategy was used: ("laryngeal microsurgery" OR "suspension laryngoscopy") AND ("dental injury" OR "teeth injury" OR "dental trauma" OR "lingual nerve injury" OR "lingual nerve damage" OR "hypoglossal nerve injury" OR "hypoglossal nerve damage" OR "mucosal trauma" OR "oropharyngeal trauma" OR "complications" OR "extralaryngeal complications").

2.3 Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: focused on extralaryngeal complications of LMS; reported on the incidence and risk factors associated with complications such as dental injury, nerve damage, or mucosal trauma; and included both prospective and retrospective study designs.

Studies were excluded if they were case reports or reviews without primary data; did not clearly distinguish between intralaryngeal and extralaryngeal complications; and focused solely on pediatric populations or procedures unrelated to laryngeal microsurgery.

2.4 Data Extraction and Synthesis

Data were extracted regarding the type of complications, incidence rates, risk factors, preventive measures, and patient outcomes. The extracted data were synthesized into a narrative format to provide a comprehensive overview of the findings. Incidence rates were compared across studies, with particular attention to differences between anesthetic perioperative intubation and suspension laryngoscopy. Preventive strategies and recommendations were highlighted based on the findings from the reviewed literature.

2.5 Quality Assessment

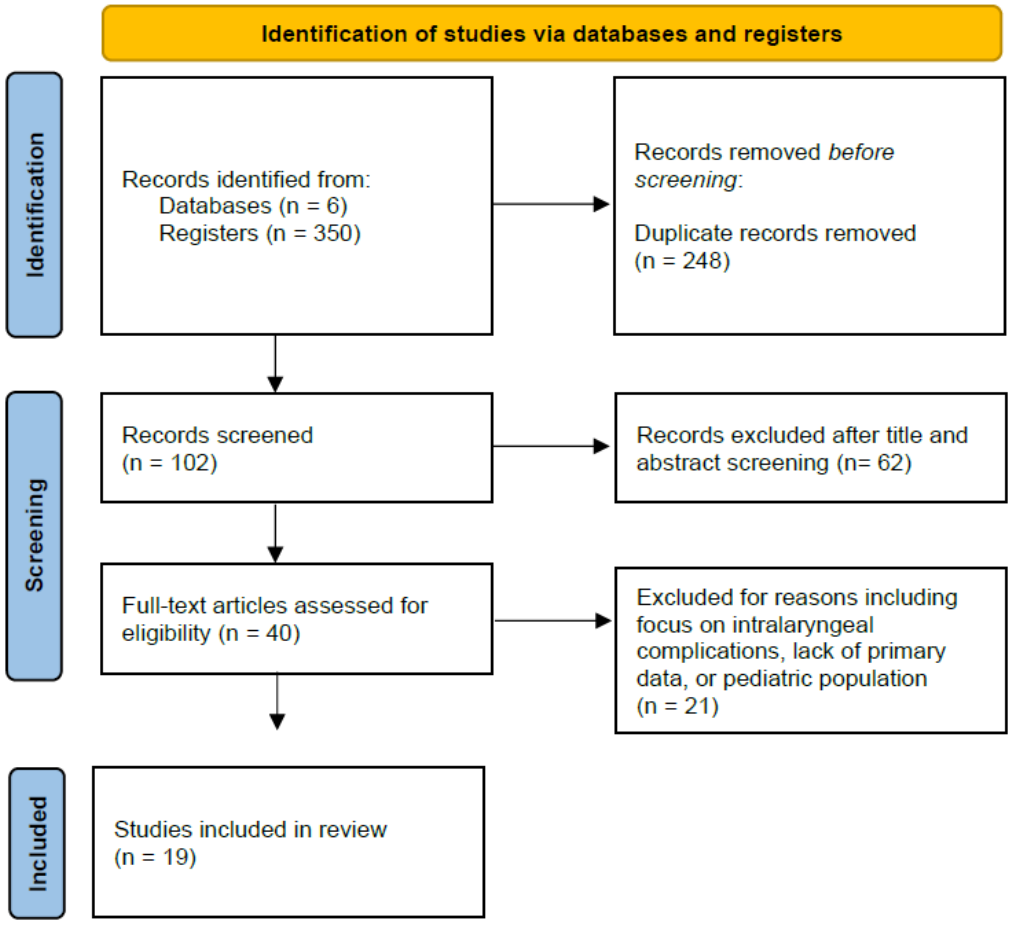
The quality of the included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools for observational studies. Studies were evaluated for methodological rigor, clarity of outcome reporting, and relevance to the review's objectives. High-quality studies were given more weight in the synthesis of findings. This methodology allowed for a broad examination of extralaryngeal complications, providing insights into how these issues can be minimized to improve patient outcomes.

In this review, we define "extralaryngeal complications" as any adverse event occurring during or after laryngeal microsurgery that affects anatomical structures outside the larynx, including the teeth, oral mucosa, cranial nerves (e.g., lingual, hypoglossal), and cardiovascular system.

3. Results

The literature search yielded a total of 350 records. After the removal of duplicates, 102 unique records remained for screening. Title and abstract screening led to the exclusion of 62 records that did not meet the inclusion criteria. The full texts of 40 articles were then assessed for eligibility. Among these, 21 articles were excluded for reasons including a primary focus on intralaryngeal complications, lack of original data, or inclusion of pediatric populations. Ultimately, 19 studies were included in the final narrative review. A summary of the selection process is presented in the adapted PRISMA flow diagram (Figure 1).

Figura 1. Adapted PRISMA flow diagram illustrating the process of identification, screening, eligibility assessment, and inclusion of studies in the present narrative review on extralaryngeal complications in laryngeal microsurgeries.



The included studies identified several key extralaryngeal complications associated with LMS, most notably dental injuries, nerve damage, mucosal trauma, and cardiovascular events. The reported incidence and severity of these complications varied considerably across studies and were influenced by factors such as the type of laryngoscope employed, procedural duration, and patient-specific anatomical or dental characteristics. According to findings by Klussmann et al. [3] and Rosen et al. [12], approximately 79% of patients undergoing LMS experienced at least one extralaryngeal complication. Importantly, 86% of these complications were considered minor and self-limiting, comprising reversible mucosal lesions, mild hematomas, transient edemas, or cardiovascular fluctuations [3, 5, 7, 10, 12].

3.1 Sore Throat

Sore throat is the most reported postoperative complication, affecting 40.0% to 66% of patients following LMS. Despite its high prevalence, no significant association was found between the incidence of sore throat and the size of the tracheal tube used during the procedure. The median duration for resolution of a sore throat is typically 1 day [5,10].

3.2 Dental Injuries

Dental trauma is an extralaryngeal complication encountered during LMS, particularly during anesthetic perioperative intubation. The incidence of dental injuries ranges from 0.55% to 6.5%, depending on the study design and the characteristics of the patient population [1]. A significant difference in dental injury rates is observed between anesthetic perioperative intubation and suspension laryngoscopy, with injury rates of 4.86% during intubation compared to 1.70% during laryngoscopy [2].

Immediate tooth loosening is rarely observed in suspension laryngoscopy, while fractures are more common during anesthetic perioperative intubation, likely due to the design of intubation tools such as the Macintosh and Miller blades, which can exert greater unintended force on teeth. Deep periodontal disease is a significant risk factor for dental injuries, with studies showing that 92% of such injuries occur in patients with pre-existing periodontal disease and no injuries were reported in patients with healthy teeth [3]. Other dental conditions, such as cavities, dental fillings, and partially fixed dentures, also contribute to a higher risk of dental trauma, making patients with poor dental health particularly susceptible [2, 4]. Additional risk factors include the use of larger laryngoscopes, prolonged procedures, and patient-specific factors like obesity and smoking [2, 10, 12, 13].

Preventive strategies are critical for reducing the incidence of dental injuries. The use of dental impression silicone putty (DISP) mouthguards has been proven effective in protecting teeth, particularly in patients with compromised dental structures. These custom-made mouthguards offer an additional layer of protection by distributing the pressure exerted by the laryngoscope over a larger surface area, thereby reducing localized force on individual teeth and minimizing the risk of injury [1].

3.3 Tongue-Related Complications and Lingual Nerve Injury

Tongue-related complications occur in approximately 16.9% of LMS cases, including numbness (13.8%), taste disorders (4.4%), and pain (4.2%). In 21.1% of numbness and 25.0% of taste disorder cases, symptoms persist for over two weeks [10]. Female sex (30.4% vs. 7.4%) and longer surgeries (>60 min: 31.6% vs. <30 min: 8.1%) are significant risk factors [5, 10, 11, 14]. Lingual nerve injury, a key cause, results from compression or stretching during laryngoscope insertion or suspension [11, 12], with reported incidence ranging from 2.6% to 12.5%, typically resolving spontaneously [11]. Risk increases with longer procedures and anatomical factors like smaller oral cavities, especially in female patients [12]. Injuries are generally neurapraxias, leading to temporary dysfunction

without lasting deficits. Prevention involves minimizing tongue pressure and careful laryngoscope positioning. Most cases resolve within weeks, and early recognition with patient counseling improves postoperative outcomes [11].

3.4 Glossopharyngeal and Hypoglossal Nerve Injuries

In addition to the lingual nerve, both the glossopharyngeal and hypoglossal nerves can be affected during LMS, potentially leading to complications such as difficulty swallowing (dysphagia) or impaired tongue movement [12] Although these nerve injuries are less common than lingual nerve injuries, they can still cause significant temporary dysfunction, often lasting for several weeks. Glossopharyngeal and hypoglossal nerve injuries have been reported in up to 3.8% of cases [12]. Fortunately, these complications are typically self-limiting and tend to be resolved over time without requiring extensive treatment. In more severe cases, steroids may be administered to reduce inflammation and facilitate recovery [11].

The hypoglossal nerve injury was likely caused by direct pressure exerted by the laryngoscope blade on the base of the tongue or by neck hyperextension during the procedure, which may have led to compression or stretching of the nerve. To minimize the risk of nerve injury, it is recommended that surgeons limit the duration of suspension. One suggested approach is to restrict suspension to 30 consecutive minutes, followed by a brief relief of suspension for approximately three minutes to reduce the likelihood of nerve damage [5, 11, 14–16].

3.5 Mucosal Lesions

Mucosal lesions, such as hematomas, erosions, and lacerations, are common extralaryngeal complications that frequently occur in the oral cavity and pharynx during laryngeal microsurgeries. These injuries are typically caused by the pressure exerted by the laryngoscope on the soft tissues [1]. Minor mucosal lesions are reported in up to 75% of patients [1, 12], with erosion being the most common type, accounting for 55% of all mucosal injuries. Other types of lesions include hematomas (29%), bleeding (7%), fissures (3%), and swelling (5%). Most of these mucosal lesions heal spontaneously within a few days and do not result in long-term complications [5, 6, 12, 16–18].

To prevent mucosal trauma, it is important to minimize the pressure applied by the laryngoscope and utilize appropriate protective devices, such as silicone mouthguards, which help reduce the risk of injury by distributing pressure more evenly across the soft tissues [1].

3.6 Swallowing Difficulties (Dysphagia)

Postoperative dysphagia is a common extralaryngeal complication that can occur following LMS. While typically temporary, dysphagia can persist for several days or even weeks, causing significant discomfort and inconvenience for the patient. Approximately 16% of patients report difficulties swallowing after surgery [12]. This condition may arise due to compression of the lingual or glossopharyngeal nerves or trauma to the pharyngeal tissues during the procedure.

Management of postoperative dysphagia is generally conservative, as these swallowing difficulties are typically transient and resolve without requiring specific interventions. However, it is crucial to inform patients about the possibility of this complication prior to surgery, helping them to manage their expectations and alleviate any concerns during the recovery process [12].

3.7 Cardiac Complications

Asystole is a rare but potentially fatal complication during LMS, typically triggered by exaggerated vagal reflex stimulation due to laryngeal manipulation. Two notable cases illustrate this risk: In Case 1, a 55-year-old male undergoing CO_2 laser cordectomy

for vocal fold carcinoma experienced bradycardia progressing to asystole. This was caused by stimulation of the epiglottis, innervated by the superior laryngeal nerve, exacerbated by cervical hyperextension and vagotonic drugs like propofol and fentanyl. Management with atropine and CPR restored normal rhythm, with no neurological damage post-surgery [9]. In Case 2, an 85-year-old female undergoing suspension microlaryngoscopy for subglottic stenosis experienced asystole due to direct vagal stimulation during laryngoscope insertion. Similar management with atropine and deeper anesthesia using remifentanil and sevoflurane resolved the issue, and the patient had an uneventful recovery [8]. Risk factors in both cases included advanced age, use of beta blockers, and vagotonic agents like remifentanil. Immediate removal of the laryngoscope and administration of vagolytic drugs such as atropine are critical for managing vagal-induced asystole.

A study by Wenig et al. [7] involving 100 patients undergoing LMS revealed notable cardiovascular alterations, with 26 patients experiencing elevated blood pressure and 4 developing arrhythmias, such as sinus tachycardia. Despite these cardiovascular changes, no myocardial infarctions or lasting ischemic events were observed, and all ECG abnormalities were transient. The study highlighted the importance of careful anesthetic management, particularly the use of agents like fentanyl, to reduce cardiovascular stress responses. These findings indicate that, with appropriate anesthesia and vigilant monitoring, serious cardiac complications during LMS can be effectively minimized, even in patients with pre-existing cardiovascular conditions.

Moreover, Muller [19] reported that mild cardiovascular reactions, such as transient blood pressure and heart rate changes, were observed in 68% of patients undergoing LMS. This underscores the need for prophylactic strategies such as deep anesthesia and the use of vagolytics to prevent life-threatening cardiac events during laryngeal surgeries. Together, these studies emphasize the critical role of anesthetic management and intraoperative vigilance in safeguarding patient outcomes during these high-risk procedures. Other complications reported by Okui include cough, which affected 13.5% of patients with a median recovery time of two days, temporomandibular joint pain in 4.0% of patients, cervical pain in 2.0%, and numbness of the lips in 0.7% of patients [10].

4. Discussion

The findings from this review confirm that extralaryngeal complications are a frequent concern in LMS. These complications—ranging from dental injuries to nerve damage—highlight both the complexity of these procedures and the need for improved preventive measures. The prevalence of these complications underscores the importance of patient-specific risk assessments and the adoption of tailored preventive strategies to minimize postoperative discomfort and long-term complications.

Dental injuries remain one of the most prevalent extralaryngeal complications, with incidence rates ranging widely depending on the study and patient population. For example, Corvo et al. [4] reported a higher prevalence of dental injuries in patients with compromised dental health, particularly those with periodontal disease, whereas Klussmann et al. [3] found a broader range of factors contributing to dental trauma, including the type of laryngoscope used and the duration of the procedure. Both studies, however, underscore the importance of preoperative dental assessments and the use of protective silicone mouthguards. These protective devices are now standard practice in reducing the risk of dental injuries, but further research could explore alternative materials or improved designs to enhance their effectiveness.

Additionally, studies are needed to examine whether different laryngoscope designs could further reduce the risk of dental trauma by distributing pressure more evenly during the procedure. Although the use of dental impression silicone putty (DISP) mouthguards has been shown to be effective in preventing dental injuries during laryngeal microsurgeries, comparative data between DISP and other protective devices—such as thermoplastic mouthguards—remain scarce. Cerchiai et al. [1] demonstrated the ben-

efits of DISP in reducing oral complications, especially in patients with compromised dental health. However, no studies to date have directly compared DISP to alternative materials or mouthguard designs. Future research should therefore prioritize comparative trials to evaluate the relative efficacy, patient comfort, and cost-effectiveness of various protective devices used during LMS [1].

The incidence of mucosal trauma is another key finding that warrants further attention. Both Corvo et al. [4] and Cerchiai et al. [1] report high rates of erosions and hematomas, particularly in patients undergoing longer procedures. This trend suggests that surgical duration plays a critical role in the development of mucosal lesions. Despite the self-limiting nature of these injuries, they can cause significant discomfort postoperatively and prolong recovery. Future research should focus on the optimization of surgical techniques to minimize mucosal pressure and on the development of protective coatings for laryngoscopes that reduce tissue friction during the procedure. Additionally, strategies to reduce suspension times without compromising surgical outcomes could further decrease the risk of these complications.

Nerve injuries, while less common than dental or mucosal complications, represent a significant concern due to their potential for prolonged recovery and impact on quality of life. Okui et al. [10] reported a higher incidence of lingual nerve damage in their patient cohort, particularly in procedures lasting longer than 60 minutes. In contrast, Klussmann et al. [3] reported lower rates of nerve injuries but similarly emphasized the role of surgical duration in increasing the likelihood of nerve damage. This discrepancy in findings suggests that there may be other contributing factors, such as patient anatomy or the type of instruments used, that affect the likelihood of nerve injury. More research is needed to identify these factors and develop preventive strategies, such as the use of nerve monitoring during surgery to detect and mitigate compression or stretching of nerves.

Cardiovascular complications are relatively rare but pose a significant risk, particularly in patients with pre-existing conditions. Muller [19] and Wenig et al. [7] both reported instances of elevated blood pressure and arrhythmias during LMS, especially in patients undergoing procedures of longer duration or those with pre-existing cardiovascular risks. The occurrence of asystole [8, 9] further underscores the need for careful preoperative cardiovascular assessments and the use of prophylactic strategies, such as deep anesthesia and vagolytic agents, to minimize the risk of life-threatening events during surgery. Future studies should focus on refining anesthetic protocols and identifying high-risk patients more accurately to prevent these rare but serious complications.

Long-term outcomes and patient-reported quality of life following extralaryngeal complications such as nerve injuries and cardiovascular events remain underexplored in the literature. Studies by Okui et al. and Wenig et al. have shown that while most complications are transient, a subset of patients may experience persistent symptoms—such as dysesthesia, dysgeusia, or exercise intolerance—that can negatively affect daily functioning and overall satisfaction with the surgical outcome. These findings highlight the importance of long-term follow-up and patient-centered counseling to address ongoing symptoms and manage expectations. Further research should explore the duration and functional impact of these sequelae using validated quality-of-life instruments and longitudinal study designs [7, 10].

Although pediatric populations were excluded from this review, it is important to recognize that children may present distinct anatomical and physiological characteristics that influence the risk and nature of extralaryngeal complications during laryngeal microsurgery. Factors such as smaller airway dimensions, increased tissue fragility, and differences in nerve maturation may alter both the incidence and presentation of complications in younger patients. Future studies specifically targeting pediatric cohorts are necessary to better understand these differences and to develop age-appropriate preventive strategies.

While this review has identified several key trends in extralaryngeal complications, there are important gaps in the current literature that warrant further investigation. For instance, rare complications such as permanent nerve damage or severe cardiovascular events are not well-documented, making it difficult to assess their true incidence or identify effective preventive measures. Additionally, the current body of research lacks comprehensive studies comparing the long-term outcomes of different laryngoscope designs, surgical techniques, and preventive devices. Future research should prioritize the following areas: development of advanced protective devices for both dental and mucosal protection; evaluation of newer laryngoscope designs that reduce pressure on extralaryngeal structures; studies focusing on nerve monitoring during surgery to prevent nerve damage; and a large-scale trial assessing the effectiveness of anesthetic modifications in reducing cardiovascular risks.

5. Conclusions

This review highlights the significant impact of extralaryngeal complications in LMS, such as dental injuries, mucosal trauma, and nerve damage, common yet largely preventable with appropriate measures. Identifying key risk factors, including pre-existing dental conditions, prolonged surgical time, and cardiovascular comorbidities, allows clinicians to tailor preventive strategies, such as preoperative assessments, silicone mouthguards, limited suspension times, and optimized anesthesia with vagolytic agents. Incorporating these practices into routine care enhances postoperative recovery and patient outcomes. Nonetheless, gaps remain in understanding the long-term consequences of nerve injuries and rare cardiovascular events, underscoring the need for further research on improved surgical tools, nerve monitoring, and anesthetic protocols to ensure safer, more effective LMS procedures.

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