

Airway Management Following Head and Neck Microvascular Reconstruction: When is a Tracheostomy Necessary?

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Abstract: Head and neck free flap reconstruction presents complex airway challenges due to postoperative swelling, bleeding, and anatomical distortion that can jeopardize breathing. Many centers once performed routine prophylactic tracheostomy for major cases, yet modern evidence favors a selective strategy. Avoiding an unnecessary tracheostomy when feasible can reduce morbidity, shorten hospital stay, accelerate return to oral intake, and lower cost. Contemporary practice relies on careful intraoperative assessment. Low-risk patients can be extubated immediately or after brief observation, whereas high-risk features—extensive tongue or base of tongue resection, bilateral neck dissection, bulky flap, or marked edema—mandate a tracheostomy to avert obstruction. There is new update to TRACHY (an acronym that represents Tumor extent, Reconstruction type, Airway anatomy, Coexisting conditions, History of prior treatment, and bilateral neck dissection “laterality”) scoring systems and risk stratification tools, which assign risk points to support decisions. Once a tracheostomy is placed, decannulation proceeds when airway patency is secure, the patient is alert with a strong cough, the surgical site is stable, swallowing is safe or alternative feeding is available, capping trials are successful, and the multidisciplinary team agrees. A tailored approach therefore balances airway safety with the benefits of tracheostomy avoidance, optimizing outcomes for patients undergoing complex head and neck reconstruction.

Keywords: airway management, tracheostomy, free flap reconstruction, head and neck surgery, decannulation criteria

Introduction

Head and neck oncologic resections with microvascular free flap reconstruction present unique airway management challenges. Extensive resections and bulky flap reconstructions can cause significant postoperative upper airway edema, bleeding, or anatomic distortion, risking airway obstruction. Traditionally, many centers performed prophylactic tracheostomy for all major head and neck free flap cases to secure the airway.¹ However, accumulating evidence indicates that routine elective tracheostomy may not be necessary in every case.^{1,2} Avoiding unnecessary tracheostomies can reduce patient morbidity, improve recovery, and lower health-care costs.³ On the other hand, inappropriately withholding a needed airway can lead to life-threatening obstruction. This review synthesizes recent studies on perioperative airway management in this context, focusing on predictors for requiring tracheostomy, timing and criteria for decannulation, airway assessment tools, and airway-related complications.

Airway Management Strategies and Evolving Practices

Prophylactic Tracheostomy vs Alternative Strategies

In the past, an “elective” tracheostomy was often performed at the end of the primary tumor resection and flap reconstruction to preempt airway compromise. Many institutions have moved away from one-size-fits-all tracheostomy toward selective strategies. Two common alternatives are delayed extubation, keeping the patient intubated overnight in intensive care for observation, and immediate extubation in the operating room for low-risk cases. Recent multi-center experiences demonstrate that both alternatives can be safe in appropriately chosen patients.^{3,4}

A large prospective study of 720 patients involving all types of major oral surgery revealed that avoiding upfront tracheostomy and instead using overnight intubation followed by extubation led to significantly shorter hospital stays (mean ~7.2 vs 11.5 days) and quicker return to oral diet (5.1 vs 7.2 days) compared to routine tracheostomy.⁵ In that series, over 90% of patients managed with delayed extubation never required a tracheostomy. Similarly, a 2024 cohort study (193 patients) from a United States cancer center that extubated most patients immediately after surgery reported that only 2.1% needed an unplanned “rescue” tracheostomy, with no airway-related mortalities.⁴ These data suggest that for appropriately selected head and neck patients with free flap repair, a well-planned extubation strategy may obviate tracheostomy without compromising safety.

Global Trends

There is a worldwide trend toward tracheostomy avoidance in suitable patients. A decade ago, a United Kingdom survey found nearly one-third of centers still did a tracheostomy for every free flap case.⁶ Now, many high-volume centers in North America, Europe, and Asia have moved toward a selective tracheostomy approach, meaning they intubate and observe overnight, reserving tracheostomy only for patients with certain risk factors. Recent series from Taiwan,⁷ India,⁵ and Portugal⁸ have all concluded that routine tracheostomy is unnecessary and often over-utilized. Enhanced Recovery After Surgery (ERAS) protocols for head and neck reconstruction also encourage minimizing invasive interventions and expediting recovery, which aligns with avoiding unnecessary tracheostomies.^{9–11} Nevertheless, practice is not uniform globally; some centers still err on the side of prophylactic tracheostomy, especially where intensive care unit (ICU) resources for overnight observation are limited or where prior institutional culture favors tracheostomy. The COVID-19 pandemic further influenced practices.¹² Overall, the contemporary approach is to individualize airway management, performing a tracheostomy only when specific risk factors dictate its necessity. The common risk factors for requiring tracheostomy after head and neck microvascular repair are listed in [Table 1](#). Notably, more than 90% of head and neck cancer patients might have one or more of these factors, so the presence of a single risk factor does not automatically mandate a tracheostomy. A holistic, case-by-case assessment is needed.

Intraoperative Decision-Making

The decision on airway management is typically made intraoperatively towards the end of the free flap reconstruction. The surgical and anesthesia teams jointly assess factors such as airway swelling, bleeding, and patient physiology. If the airway appears sufficiently patent and the patient is stable, an attempt at extubation is often favored.² However, if there is any doubt about airway safety—for example, significant tongue/base-of-tongue swelling, extensive pharyngeal edema, difficult anatomy, or the patient remains obtunded—a tracheostomy is performed for definitive airway security.^{2,13}

Many institutions have developed internal algorithms or guidelines. As an example, Singh et al³ proposed that patients with bilateral neck dissection or oropharyngeal resections requiring additional exposure procedures should

Table 1 Risk Factors for Requiring Tracheostomy After Head and Neck Microvascular Reconstruction

Category	Key Risk Factors
Surgical Factors	<ul style="list-style-type: none"> • Bilateral neck dissection (extensive neck surgery on both sides) • Multiple or extensive free flaps (very large or more than one flap needed for reconstruction) • Tumor involving posterior oropharynx (eg base of tongue, near airway) • Extensive resection (large surgical defect in airway-adjacent structures) • Bulky flap (free flap tissue causing potential airway narrowing due to edema or size)
Patient Factors	<ul style="list-style-type: none"> • Obstructive sleep apnea (baseline risk of airway collapse) • Obesity (increased soft tissue around airway, higher obstructive sleep apnea risk) • Poor pulmonary reserve (chronic lung disease or low lung capacity) • Older age or frailty (reduced physiologic reserve to tolerate airway obstruction)
Treatment History	<ul style="list-style-type: none"> • Prior head and neck radiotherapy (radiation fibrosis and edema in airway tissues) • Previous extensive neck surgery (scar tissue causing reduced tissue compliance) • Salvage surgery for recurrence (prior treatment effects increase swelling and fibrosis)

receive a primary tracheostomy, whereas patients with unilateral neck dissection and no other high-risk features can be safely managed with delayed extubation. Newer protocols favor a “wait-and-see” extubation trial for most patients, with the capability to perform an urgent tracheostomy if the extubation fails. This selective approach has been validated by multiple studies showing low rates of reintubation or emergency tracheostomy when careful criteria are applied.^{5,14–16} In summary, the contemporary strategy is tailored: routine prophylactic tracheostomy is no longer standard, and each case is managed according to its risk profile and intraoperative findings.

Predictors of Tracheostomy Requirement

Not all head and neck free flap patients carry equal risk for airway compromise. Extensive research has identified specific predictors for which patients are likely to require a tracheostomy versus those who can be safely extubated. These predictors can be broadly categorized into surgical factors and patient factors.

Defect Location and Extent

Perhaps, the strongest predictors are related to the location and size of the resection. Large defects involving the tongue base, floor of mouth, or oropharynx are well known to cause significant postoperative edema in critical airway structures. A 2019 analysis of 533 cases by Cai et al found that defects of the tongue, floor of mouth, or oropharynx were significantly associated with needing a tracheostomy.¹ Essentially, resections that cross the midline or involve the tongue base/oropharynx leave patients at higher risk of obstructing their airway from swelling or hemorrhage.

Ledderhof et al (2020) similarly reported that composite resections involving the floor of mouth had a high incidence of airway complications (15.4%) and thus often warranted prophylactic tracheostomy.¹⁷ In contrast, more “lateral” or anterior oral cavity tumors (eg confined to the buccal mucosa, lateral tongue, or mandibular alveolus) have a lower risk of airway compromise. A recent Portuguese study (116 cases in 2019–2020) concluded that patients with lateral oral cavity tumors and smaller T-stage (T1–T2) could frequently avoid elective tracheostomy.⁸

Reconstruction Type and Flap Bulk

The choice of flap and its bulkiness also influence airway risk. Heavier, thicker flaps such as the anterolateral thigh or bulky rectus abdominis flaps can cause more mass effect in the oral cavity or oropharynx, as well as increased edema due to larger tissue volume transplanted. In Cai et al’s study, a “bulky soft-tissue flap reconstruction” was a significant risk factor for tracheostomy.¹ On the other hand, thin fasciocutaneous flaps like the radial forearm free flap contribute less to airway narrowing. The Myatra study’s results underscore that favorable factors for delayed extubation included limited surgical extent (eg primary closure) or use of a thin fasciocutaneous free flap.⁵ These conditions differ from more extensive composite resections (eg those requiring bulky myocutaneous flaps or bone-containing flaps), which inherently carry higher risk of airway compromise. Indeed, one 2024 study found that use of a forearm flap was associated with tracheostomy avoidance, an odds ratio (OR) = 0.15, indicating patients with radial forearm free flap were much less likely to need tracheostomy.⁴

Similarly, if no flap or only a local flap is needed for very limited defects, the airway risk is inherently lower. Composite bony reconstructions (eg fibula flap for mandible) can be double-edged: they involve large surgeries but also by removing the mandible they may open up the airway space. In fact, the Nebraska cohort noted that “mandibulectomy” as a variable was associated with a lower likelihood of tracheostomy with an OR = 0.04 on multivariate analysis.⁴ However, extensive segmental mandibulectomies crossing the midline still pose risk due to floor-of-mouth involvement. Tsai et al (2024) identified that cross-midline segmental mandibulectomy was an independent predictor of post-extubation airway failure in oral cancer patients managed without prophylactic tracheostomy.⁷

Neck Dissection

Neck dissection contributes to postoperative neck swelling and can reduce lymphatic drainage. A bilateral neck dissection is a well-established risk factor for difficult airway in the recovery period. Removing lymphatic tissue on both sides of the neck leads to more diffuse edema and can also weaken neck support for the upper airway structures. Multiple studies have found bilateral neck dissection to significantly increase the need for tracheostomy.^{3,4,18} For

example, multivariate analysis by Holcomb et al (2024) showed bilateral neck dissection tripled the odds of requiring tracheostomy (OR ~3.13).

Even a unilateral neck dissection adds some risk, though generally manageable. Singh's data from the United Kingdom suggested that free flap patients with only unilateral neck dissection could usually be extubated safely without tracheostomy,³ whereas bilateral dissection often warranted one. The combination of floor-of-mouth or tongue base resection plus bilateral neck dissection is particularly high risk—this scenario in Ledderhof's series is where airway events were most frequent.¹⁷ In contrast, if no neck dissection is needed, the airway risk is markedly lower.

Prior Radiation or Chemotherapy

Patients who have received prior radiation to the head-neck region have fibrotic, less compliant tissues that may respond to surgery with more swelling and inflammation. Scarred neck skin can also make reintubation or emergent surgical airways more challenging. Cai et al found a history of radiotherapy significantly correlated with needing tracheostomy (OR ~3.4).¹ Prior chemoradiation often implies more advanced disease and more extensive surgery as well, compounding the risk. In the same study, a history of chemotherapy trended toward increased tracheostomy need, though not reaching significance. These patients may benefit from a lower threshold for elective tracheostomy, given the unpredictable nature of tissue edema in previously irradiated fields.

Patient Factors

Patient-specific factors are sometimes overlooked but can be important. Poor baseline pulmonary function or obstructive sleep apnea (often associated with higher BMI) could impair the patient's ability to protect their airway or handle secretions after extubation.^{3,4} Interestingly, some recent findings are counterintuitive regarding age and BMI. Tsai et al noted older age was a risk factor for post-op airway events in extubated patients, which fits the intuition that elderly patients have less physiological reserve.⁷ However, the Nebraska study found age >70 years was actually associated with lower odds of tracheostomy (OR 0.33), possibly reflecting a tendency to avoid invasive procedures in the very old or that surgeons selected smaller, less risky surgeries for older patients.⁴

In addition to tumor-related factors, patient comorbidities and physiologic reserves, such as chronic pulmonary disease, obesity or obstructive sleep apnea, and overall frailty,¹⁹ can impact the risk of airway compromise and thus must be considered in airway planning. Low body mass index (BMI < 20, possibly a marker of frailty or malnutrition) was associated with increased tracheostomy need in that same study (OR ~3.8).⁴ Comorbidities such as cardiovascular and cerebrovascular disease, chronic lung disease, and diabetes were flagged by Tsai et al as more prevalent in patients who suffered airway complications.⁷ These conditions might not directly cause obstruction, but they can slow recovery or affect breathing and coughing strength. Smoking status is another factor: heavy smokers may have reactive airways and coughing that could either demand a secure airway or conversely complicate tracheostomy care. The smokers in Cai's cohort had higher tracheostomy rates, OR ~2.36.¹ Moreover, perioperative support resources (eg intensive care monitoring capabilities and experienced staffing levels overnight) can sway the decision towards a safer course.

Collectively, the need for tracheostomy is multi-factorial. Patients with advanced tumors (T3–T4), midline or base-of-tongue involvement, bilateral neck dissection, and bulky flap reconstructions are prime candidates for a prophylactic tracheostomy. By contrast, those with small lateral defects, minimal or thin flaps, and limited neck dissection often do well without a tracheostomy. These predictors are being used to guide more selective airway management.

Preoperative Airway Assessment and Planning

Proper airway management starts before the surgery, with a thorough preoperative assessment. The goals are twofold: (1) to plan a safe anesthesia strategy for intubation and intraoperative airway management and (2) to predict postoperative airway risks to guide the need for tracheostomy or other interventions.

Anatomic Airway Evaluation

The anesthesiology team evaluates standard airway parameters such as mouth opening, Mallampati score, thyromental distance, and cervical spine mobility preoperatively.^{20–22} Patients with large intraoral or pharyngeal tumors may pose a difficult intubation, sometimes necessitating an awake fiberoptic intubation or video laryngoscopy-assisted intubation at

the start of the case. Fiberoptic examination of the upper airway can be performed in clinic or immediately prior to induction to assess how much the tumor is encroaching on the airway lumen.²³ If severe obstruction is present (eg a near-total supraglottic obstruction by tumor), a prophylactic awake tracheostomy before resection might even be considered.²⁴ However, in most cases, tumors that require free flap reconstruction are still intubatable with careful technique. The key is anticipation—for instance, a patient with a large tongue tumor and trismus should prompt an awake nasendoscopy and a well-planned awake intubation to avoid losing the airway during induction.

Risk Stratification Tools

Beyond the technical intubation, surgeons and anesthesiologists collaborate to stratify the risk of postoperative airway compromise. In recent years, several predictive scoring systems have been proposed. These include: the Kruse-Lösler score (2005)²⁵ based on tumor location and size, the Cameron score (2010)²⁶ which factors in tumor site (cutaneous, mouth, oropharynx) and neck dissection, the “TRACHY” score (published 2018),²⁷ and more recently the scoring model by Cai et al (2019)¹ which incorporates defect, neck dissection, flap type, and comorbidities.

The common aim is to create an objective tool to guide whether a patient “needs” a tracheostomy. For example, the TRACHY score assigns points for factors like tumor crossing midline, size of tongue resection, etc., and a threshold score ≥ 5 was recommended to perform a tracheostomy. Similarly, Cai’s model assigns weights based on OR of risk factors such as bilateral mandible defect (score 4), bilateral neck dissection (score 3), radiotherapy history (score 2), oropharynx defect (score 2), etc., and suggests tracheostomy if total score ≥ 3 (with < 2 suggesting safe extubation, and 2–3 intermediate).

These systems are valuable educational tools, but none has been universally adopted into routine practice. One issue is that many scoring systems were derived in single institutions with specific patient populations, and they sometimes give discordant recommendations for the same patient. For instance, the study applying Cameron and TRACHY scores to 116 patients found the two systems only agreed ~54% of the time on whether a tracheostomy was indicated.⁸ This underscores that clinical judgment still prevails. Nevertheless, using such tools in the preoperative planning meeting can highlight risk factors that might be overlooked and provide a checklist-like approach to airway planning.

Multidisciplinary Planning

Ideally, the decision-making for airway management is done as a team. Many centers hold a preoperative huddle involving the surgeon, anesthesiologist, and nursing team to discuss the case complexity. Important considerations include: “Given the planned resection and flap, do we expect significant swelling? Does this patient have any unique risk? What is our plan A and plan B for extubation?” If the team anticipates borderline airway status post-op, they might elect to consent the patient for a possible tracheostomy and have equipment ready. Conversely, if they anticipate no tracheostomy, they plan for postoperative monitoring accordingly. Part of pre-op planning is also patient counseling—explaining to the patient and family whether a temporary tracheostomy is expected or if the aim is to avoid it. Therefore, preoperative assessment combines standard airway evaluation with risk stratification for post-op obstruction. Tools like scoring systems and thorough airway exams help inform the plan, but they augment rather than replace clinical judgment. The outcome of this planning is an initial strategy (extubation vs tracheostomy) that will be confirmed or revised based on intraoperative findings.

Postoperative Airway Management and Monitoring

Whether a patient is extubated or has a tracheostomy, vigilant postoperative monitoring is critical in the first 24–48 hours after head and neck free flap surgery. This period carries the highest risk for airway events due to swelling peaking, potential bleeding, and effects of anesthesia wear-off on airway reflexes.

If Patient is Intubated (Delayed Extubation Strategy)

For delayed extubation strategy, the focus is on controlling factors that could worsen airway edema—adequate sedation/analgesia to prevent agitation, head elevation to promote venous drainage, and possibly steroids. The ICU team assesses the patient’s readiness for extubation the next day. Key assessments include a cuff leak test and direct airway visualization. The cuff leak test involves deflating the endotracheal tube cuff and checking for an audible air leak or

a drop in ventilator peak pressure, indicating that air can pass around the tube—a surrogate for adequate airway caliber.²⁸ A positive cuff leak (good air leak) suggests less severe laryngeal/tracheal edema, whereas the absence of a cuff leak raises concern for significant swelling.²⁹ It is important to note that while a cuff leak test is a helpful screening tool, it is not foolproof; patients with no cuff leak can sometimes still be extubated successfully, so results are interpreted in context.

Therefore, many anesthesiologists will also perform a flexible fiberoptic laryngoscopy through the endotracheal tube to directly inspect the glottis and tongue base before extubation. This allows visualization of flap position, hematoma, or edema. If the airway looks patent and the patient is starting to wake, they will proceed with extubation. Some protocols call for exchanging the endotracheal tube for a hollow airway exchange catheter prior to extubation, which can serve as a guide for rapid reintubation if the patient fails extubation. In a prospective Indian study of 720 patients, using such a “staged extubation” approach, none of the delayed extubation patients who met extubation criteria experienced an irreversible airway loss—any who did show signs of compromise could be quickly reintubated or given a tracheostomy without adverse outcome.⁵

If Patient Has a Tracheostomy

In cases where a prophylactic tracheostomy is done, immediate post-op management revolves around tracheostomy care and monitoring for tracheostomy-related complications. The team should ensure the tracheostomy ties are secure—this is especially important in free flap patients who often have bulky dressings or flaps in the neck that could dislodge a poorly secured tracheostomy tube. One nursing article highlighted innovative ways to secure tracheostomy collars in these patients to prevent displacement, given the critical nature of a fresh tracheostomy in a swollen airway. The patient is typically kept sedated or at least not fully awake immediately after surgery even with a tracheostomy, to prevent coughing/bucking that might stress fresh microvascular anastomoses. However, over-sedation is avoided to allow neurological monitoring and because a benefit of tracheostomy is that the patient can be awake and breathing comfortably. Within the first 24 hours, the cuff may be switched from inflated to deflated intermittently to assess airflow around the tracheostomy and begin weaning if appropriate.

Observation for Complications

The team must watch for signs of airway compromise. Warning signs include: increased work of breathing, use of accessory muscles, stridor if extubated, or high peak airway pressures and agitation if intubated. In tracheostomy patients, indicators are diminished airflow through the tracheostomy, the patient “bucking” or attempting to breathe around it, or oxygen desaturation. Nursing staff in the ICU or step-down unit are trained to call rapid response or the surgical team at the first sign of airway trouble, as these events can escalate quickly.

In extubated patients, one must also monitor for bleeding into the airway. Any expanding neck hematoma in a recent free flap patient can threaten both the flap and airway patency and often necessitates urgent bedside opening of sutures or return to the OR—potentially including securing the airway first if not already secured. In the Portuguese series of 116 tracheostomy cases, no airway emergencies were reported, possibly due to having the tracheostomy in place, whereas in primarily extubated cohorts, approximately 2–8% of patients required emergent reintubation or tracheostomy for airway compromise.⁸ These statistics highlight that with proper monitoring, even those few patients who do develop airway obstruction can be rescued in a controlled manner.

Multidisciplinary Approach

Early postoperative airway management is often a collaboration among surgeons, intensivists, anesthesiologists, and specialized nursing such as tracheostomy nurses or respiratory therapists. Many institutions have airway emergency protocols in place for head and neck post-op patients—for instance, a difficult airway cart at the bedside, and surgeons on standby especially the first night. Having an otolaryngology or anesthesia team member experienced in fiberoptic intubation on call is advisable.

In summary, the postoperative phase requires constant vigilance. For delayed extubation strategies, tools like the cuff leak test and fiberoptic exam guide the timing of extubation, usually on postoperative day 1 if all is well. If extubation fails or appears too risky, a tracheostomy is performed—some centers will do it bedside in the ICU if needed emergently,

Table 2 Criteria for Safe Tracheostomy Decannulation

Decannulation Criteria	Description and Rationale
Sufficient airway patency	Clinical examination or endoscopy demonstrates that the tongue base, oropharynx, and supraglottic area are clear of significant edema
Alertness and protective reflexes	Patient is awake, follows orders, has intact cough and swallow reflexes, and handles secretions without choking
Effective cough and secretion clearance	Able to cough up secretions through the mouth; no respiratory distress during capping trials
Stable surgical site	No expanding hematoma or need for immediate reoperation
Nutritional plan secure	Either swallowing safely or alternative feeding established to minimize aspiration risk
Successful tracheostomy capping trial	Tracheostomy was corked/plugged for approximately 24 hours, allowing the patient to breathe properly through the upper airway.
Multidisciplinary agreement	Surgeon, anesthesiologist, and nursing/respiratory therapy agree that the criteria are met

while others bring the patient to the OR. The overall objective is to ensure a secure airway at all times, either via a tube or a tracheostomy, until the patient demonstrably can maintain their own airway.

Tracheostomy Decannulation: Timing and Criteria

Once a tracheostomy has been placed, the next consideration is how long to keep it and when it can be safely removed. In the context of temporary tracheostomies for head and neck free flap patients, the goal is to decannulate as soon as the patient's airway is stable to minimize tracheostomy-related morbidity and hasten recovery. Criteria for safe tracheostomy decannulation is listed in [Table 2](#).

Typical Timing

For most patients who receive a prophylactic tracheostomy after head and neck reconstruction, decannulation usually occurs about one week post-surgery, once the peak edema has resolved. Reported averages range from 5–10 days post-op. In a 2019 series from Peking University, the mean decannulation time was $\sim 7.9 \pm 1.8$ days after surgery. Similarly, a single-institution audit found a median decannulation day of 5 (interquartile range 4–10 days) for temporary tracheostomies in free flap patients.³⁰

Decannulation tends to be delayed beyond one week in patients who had more extensive surgery or any postoperative complications like flap issues or pulmonary infections. For example, Cai et al noted one outlier patient with a flap necrosis who was decannulated on day 22 and only discharged on day 33, illustrating that surgical complications can prolong the need for airway protection.¹ On the other hand, some institutions practicing very early decannulation have reported success; an Israeli team described a “one-stage decannulation” protocol in which they removed the tracheostomy in ICU as early as postoperative day 5–6 on average, with monitoring for 24 hours, achieving decannulation by day 7 in all 24 patients studied.³¹ None of those patients required reintubation, suggesting that with strict criteria, decannulation before the one-week mark is feasible.³¹ However, this aggressive approach has not been widely adopted, and most surgeons are more comfortable waiting about a week.

Decannulation Criteria

The fundamental requirement for decannulation is that the patient no longer needs the tracheostomy for airway patency or toileting. Specific criteria commonly include:

- Resolution of Hazardous Edema: The swelling of the tongue, floor of mouth, and neck should be significantly reduced. Often clinical examination or nasendoscopy is used to confirm that airway structures are no longer edematous enough to obstruct breathing.

- **Protective Airway Reflexes and Consciousness:** The patient should be awake, alert, and able to manage their secretions. They need an effective cough and gag reflex to clear mucus and protect against aspiration.
- **Cuff Down Trials:** Many protocols perform a trial where the tracheostomy cuff is deflated and the tracheostomy tube is corked or covered for a period (eg 12–24 hours) to see if the patient breathes comfortably around the tracheostomy tube. During this trial, oxygen saturation and respiratory rate are monitored. Successful completion indicates the patient can handle breathing through the natural upper airway.
- **Absence of High Oxygen/ventilation needs:** The patient should not be requiring high levels of respiratory support. If they are still needing frequent suctioning or have copious secretions (eg due to pneumonia), it might be safer to keep the tracheostomy until that resolves.
- **Swallowing Assessment:** This is somewhat controversial in timing—some surgeons prefer to ensure the patient can swallow safely before removing the tracheostomy, especially if a cuffed tracheostomy was serving as a safeguard against aspiration. Others decannulate earlier and then do swallow evaluations with the natural airway.
- **Pulmonary Reserve:** The patient’s lungs should be in good condition. If they remain on ventilator support or have significant pulmonary edema/atelectasis, decannulation is delayed.
- **No Immediate Need for Reoperation:** If a patient needs a second-look surgery or neck re-exploration in the first week, the team often keeps the tracheostomy in until after that procedure, to avoid having to re-intubate through a normal airway in a swollen field.

When these criteria are met, the actual decannulation is usually performed in a stepwise manner: downsizing the tracheostomy tube to a smaller diameter for a day or two, capping it to ensure the patient tolerates full airflow through the upper airway, and then removing it if all goes well. Some teams expedite this by skipping the downsizing and doing a “one-stage” removal after a successful capping trial, as described by Wasserzug et al.³¹ After decannulation, the stoma is covered with a dressing and the patient is observed for ~24 hours to ensure they do not develop respiratory distress. The stoma usually closes on its own within days.

Delayed or Failed Decannulation

Early decannulation is beneficial—it allows the patient to speak, improves coughing and mobilization, and often shortens hospital stay.³² Recent evidence suggests no increase in complications with earlier decannulation when proper criteria are met. However, despite meeting initial criteria, a subset of patients experience delayed decannulation, meaning they require the tracheostomy for longer than the typical period, or failed decannulation, where an attempt to remove the tracheostomy results in respiratory compromise and the tracheostomy has to be reinserted. An analysis by Isaac et al indicated about 15% of tracheostomy patients had delayed decannulation and around 14% had decannulation failure, often related to factors like total glossectomy or complications.³³

In more recent practice, these rates may be lower with better protocols. Predictors of delayed decannulation align with those needing a tracheostomy in the first place: larger or bulky flaps, postoperative complications, and advanced age could all prolong the need for a secure airway. A recent study recommended that in head and neck free flap patients, efforts should be made to decannulate by 10 days if possible, as prolonged tracheostomy beyond 10 days increases risk of tracheal stenosis and infection.³⁴ They advocated that if a patient is still not meeting criteria by 10 days, a thorough evaluation is needed to identify why (eg unresolved edema, silent aspiration, etc.) and address those issues.

Airway-Related Complications in Head & Neck Free Flap Patients

Airway management in the context of head and neck free flap surgery must balance preventing one set of complications (those due to airway obstruction) against causing another set of complications (those due to the airway intervention itself).

Tracheostomy-Related Complications

Temporary tracheostomies, while generally safe, carry complication rates of 5–15% in head and neck surgery patients. Early complications include bleeding from the stoma or thyroid vessels, infection, subcutaneous emphysema,

pneumothorax, and tube blockage or displacement. In Singh's 2016 study, 12% of patients experienced serious complications, including one cardiorespiratory arrest from tube obstruction.³ Other risks include pneumonia (1.55–4%),¹ hemorrhage from tracheal erosion (0.7–2%),³⁵ and accidental decannulation (0.5–1%).³

Beyond physical complications, tracheostomies impact quality of life by delaying speech and oral feeding while increasing hospital stays by approximately 2.2 days.³⁶ Long-term tracheostomies (over 10 days) elevate the risk of subglottic stenosis and granulation tissue formation, leading to stenosis and scar formation at the stoma site. Though fatal complications are rare with no deaths reported in recent large cohorts, these potential issues underscore why avoiding tracheostomy when possible is advantageous.

Complications of Prolonged Intubation/Delayed Extubation

For patients receiving overnight intubation rather than immediate tracheostomy, the main risks include extubation failure and prolonged intubation effects. Extubation failure rates in head and neck free flap patients are relatively low—Tsai reported 7.6% experiencing adverse airway events requiring reintubation or secondary tracheostomy,⁷ while Myatra's study found only about 6% in the delayed extubation group ultimately needed tracheostomy.⁵ These events, when they occur, can be managed if they happen in ICU under monitoring—usually by reintubation fiberoptically or doing a tracheostomy at bedside. The goal is to avoid a “crash” scenario where the patient obstructs unexpectedly. That is why careful adherence to extubation criteria and having trained staff present is essential.

Extended intubation poses risks of laryngeal injury and post-extubation edema, which may cause stridor. While the cuff leak test helps predict these complications, it is not completely reliable.³⁷ Treatment for post-extubation laryngeal edema typically involves nebulized epinephrine and possible reintubation if respiratory distress occurs.

Impact on the Flap and Surgical Outcome

Airway issues can indirectly impact the success of the microvascular reconstruction. Episodes of severe coughing or bucking on the tube can precipitate hematoma formation under the flap or cause venous pressure spikes that threaten the anastomosis. That is one reason to keep patients adequately sedated while intubated and, if a tracheostomy is in place, to ensure the tracheostomy tube is secured to prevent excessive movement or cough.

Conversely, performing a tracheostomy introduces another incision in an already operated neck, which theoretically could increase the risk of wound infection or flap exposure if not placed carefully. Most surgeons place the tracheostomy away from the flap pedicle, often on the contralateral side or a lower tracheal ring, to avoid interfering with the microvascular pedicle in the neck. In rare cases, stoma infection could track to the neck and endanger the flap or cause carotid exposure.³⁸ Fortunately, reported infection rates are low with temporary tracheostomies in this setting, especially with prophylactic antibiotics often given as part of head-neck surgery protocols.^{39–41}

From a swallowing and voice perspective, tracheostomy and prolonged intubation both can cause temporary dysfunction. An endotracheal tube passing through the glottis can lead to vocal cord edema or ulceration, and a tracheostomy with cuff inflated prevents subglottic air passage needed for speech and can reduce airflow for an effective cough. A study on quality of life after free flap surgery noted that patients with prolonged tracheostomy had delayed return of normal speech and felt socially isolated during that period.⁴² These issues typically resolve after decannulation, but they contribute to patient dissatisfaction in the early recovery.

Comparison of Approaches

To contextualize complications, it helps to compare outcomes between those who get tracheostomy and those who do not. Comparison of airway management approaches is listed in [Table 3](#).

- **Hospital Stay and Recovery:** Multiple studies confirm tracheostomy tends to prolong hospital stay. As noted, one large study showed a 2.2-day longer stay with tracheostomy, and the United Kingdom study by Singh showed tracheostomy patients stayed ~27 days vs ~20 days without tracheostomy ($p = 0.03$).³ Earlier ability to speak and eat in the no-tracheostomy group likely facilitates faster recovery milestones.
- **Return to OR:** Unplanned OR returns for airway or bleeding complications occur more frequently in tracheostomy patients according to some analyses. This might stem from larger disease burden in these patients or challenges

Table 3 Comparison of Airway Management Approaches

Approach	Typical Use Case	Advantages	Potential Complications/Drawbacks
Elective tracheostomy	High-risk reconstructions (tongue/base of tongue with bulky flap, bilateral neck dissection)	<ul style="list-style-type: none"> Secure airway facilitates pulmonary toileting after the surgery Avoids emergency intubation in a swollen airway 	<ul style="list-style-type: none"> Surgical risks include bleeding, pneumothorax, and infection There are 5–15% risk of complications³ Patient feel discomfort and is unable to speak Longer ICU/hospital stay³ Require decannulation step
Delayed extubation	Moderate-risk cases or uncertainty exists	<ul style="list-style-type: none"> Avoids upfront tracheostomy if extubation is successful Short-term intubation usually well-tolerated Patient can speak or eat sooner 	<ul style="list-style-type: none"> Require ICU care and sedation Risk of laryngeal edema from endotracheal tube²⁸ Extubation failure in 2–8% requiring reintubation/tracheostomy⁷ Patient cannot speak while intubated
Immediate extubation	Low-risk cases (small lateral oral cavity flaps, no significant tongue/base involvement)	<ul style="list-style-type: none"> Avoids both tracheostomy and prolonged intubation No ICU is required just for airway surveillance No post-operative sedation is required 	<ul style="list-style-type: none"> Risk of developing swelling or bleeding in first hour Reintubation challenging in fresh wounds Not suitable in the condition with any airway doubt Emergency management needed if failure (~2%)³

managing both tracheostomy and flap. Notably, the Nebraska 2024 study⁸ demonstrated significantly fewer unplanned reoperations in tracheostomy-avoidance patients, suggesting this approach correlates with smoother recovery without increasing airway emergency interventions.

- **Mortality:** The airway-related mortality in modern free flap series is very low. Studies focusing on tracheostomy vs no tracheostomy have not shown differences in 30-day mortality.^{4,5,14} In other words, avoiding a tracheostomy when appropriate does not appear to increase the risk of death; no mortalities were attributed to failed airways in the recent literature reviewed. This suggests that as long as backup plans are in place, patients are not being lost to sudden obstruction.

Complications Summary

Evidence suggests tracheostomy-related complications including infection, bleeding, blockage, and extended ICU stays typically outweigh extubation failure risks in appropriate candidates, supporting more selective tracheostomy use. However, prophylactic tracheostomy remains necessary for highest-risk patients who would face greater complications without it.

The complication profile necessitates individualized care. Best practice involves patient stratification to provide tracheostomy only to those truly needing it while avoiding unnecessary morbidity in others. Regular outcome monitoring is essential—frequent early decannulation suggests criteria should be tightened to reduce overuse, while excessive extubation failures indicate need for stricter guidelines or more prophylactic tracheostomies.

Conclusion

Growing evidence supports a shift from routine prophylactic tracheostomy toward a selective, risk-stratified approach for head and neck free flap reconstruction. Large prospective and cohort studies show that when clear criteria guide immediate or delayed extubation, more than 90% of patients avoid tracheostomy without airway-related mortality, while achieving shorter hospitalization and faster return to oral intake. Objective tools such as the TRACHY score and the Cai scoring model highlight tumor extent, bilateral neck dissection, bulky flap size and comorbidity burden as dominant predictors of airway compromise, yet they complement rather than replace multidisciplinary judgement.

For high-risk scenarios—extensive tongue or base-of-tongue resection, cross-midline mandibulectomy, bilateral neck dissection or thick soft-tissue flaps—a primary tracheostomy remains prudent to pre-empt obstruction and facilitate pulmonary toileting. Conversely, patients with lateral oral cavity defects, thin radial forearm flaps or unilateral neck dissection can usually be extubated safely in theatre or after brief intensive-care observation. Should clinical doubt arise, a “wait-and-see” strategy with overnight intubation offers a reversible safeguard and is associated with low re-intubation rates.

Once a temporary tracheostomy is placed, timely decannulation—ideally within ten days—infection, stenosis and speech delay. Successful removal hinges on resolution of hazardous oedema, intact airway reflexes, effective cough, stable flap and the patient’s ability to maintain oxygenation during capping trials. Centers employing structured decannulation protocols report failure rates below fifteen percent and no increase in adverse events with earlier removal.

Current literature also underscores the broader recovery benefits of tracheostomy avoidance: reduced ICU utilization, fewer unplanned returns to theatre and improved early quality-of-life metrics including voice and swallowing. Nevertheless, fatal airway loss remains rare across all strategies, provided that rigorous monitoring and rapid rescue pathways are in place.

In summary, the safest and most efficient airway management paradigm is tailored rather than routine. Therefore, airway management in head and neck free flap surgery should be individualized, summarizing risk factors, decision tools, and patient-centered benefits of avoiding unnecessary tracheostomy.

Abbreviations

BMI, body mass index; COVID-19, coronavirus disease 2019; ERAS, Enhanced Recovery After Surgery; ICU, intensive care unit; OR, odds ratio; TRACHY, tracheostomy risk scoring system (predictive score for need of tracheostomy); pre-

op, preoperative; post-op, postoperative; T1, tumor stage 1 (small primary tumor); T2, tumor stage 2; T3, tumor stage 3; T4, tumor stage 4 (advanced primary tumor).

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