# Clinical Anatomy of Submental Intubation

## *A Review of the Indications, Technique, and a Modified Approach*

*DeAsia D. Jacob, MD, Fatma B. Tuncer, MD, David L. Kashan, MD, and Raffi Gurunluoglu, MD, PhD, FACS*

**Abstract:** Since its original description in 1986 by Hernandez, submental intubation has been used in a wide variety of craniomaxillofacial cases as a way to satisfy both surgeon and anesthesiologist to provide access to necessary surgical sites and airway protection. Many modifications to the original technique have been described. There has been a paucity of plastic surgery literature over the last 10 years that have reviewed the anatomy, technique, and complications. In this article, the authors review the pertinent anatomy related to this method of intubation. A cadaver was used to enhance visualization of important structures and to show the modification used by our group. Submental intubation provides a useful alternative to tracheostomy in several craniomaxillofacial procedures. Our approach uses a reinforced endotracheal tube to prevent kinking and provide additional intraoperative protection of the airway. Submental intubation may be indicated in select patients undergoing craniomaxillofacial surgery. Therefore, it is pertinent to be aware of the important anatomy and the complications of this technique to appropriately counsel patients. Our modification provides safe airway control.

**Key Words:** submental, submental intubation, craniomaxillofacial, craniomaxillofacial trauma

(*Ann Plast Surg* 2019;00: 00–00)

Submental intubation has gained wide acceptance in various clinical settings. Initially, the main indication for submental intubation was complex craniomaxillofacial trauma which requires intraoperative maxillomandibular fixation (MMF). Since its first description by Hernandez in 1986,[1] the indications have expanded into many craniofacial procedures including Le Fort I and other skull base procedures.[2,3] This method of intubation provides an alternative to tracheostomy, which carries many risks.[4–6] Craniofacial surgeons should be aware of indications, contraindications, and complications of submental intubation to treat complex maxillofacial traumas and craniofacial anomalies. Surgeons should also have the technique of submental intubation in their armamentarium because it requires tunneling of an endotracheal tube (ETT) through the floor of the mouth.

Submental intubation provides access to all facial, pharyngeal, and skull base structures without interference of an endotracheal or nasotracheal tube. This is especially important in the surgical repair of complex maxillofacial traumas, where evaluation and establishment of an occlusal relationship is required, and nasal intubation is not suitable because of concomitant nasal/naso-orbital-ethmoidal or skull base fractures. A commonly used method of securing the airway in this setting is tracheostomy. However, reported incidence of early complications of tracheostomy is 6% to 8%, and the incidence of long-term complications is 60%.[6,7] Thus, the main advantage of submental intubation as an alternative to tracheostomy is in its easy and quick performance and lower complication rate compared with tracheostomy. The goal of this review is to illustrate the steps of submental intubation on a cadaver model, to discuss the indications of submental intubation related to craniofacial surgery, and to review the modifications that can be applied in different settings. We also describe our novel approach which uses a universal connector and reinforced ETT of different sizes to configure a tube which does not kink and provides additional intraoperative protection of the airway.

Received December 28, 2018, and accepted for publication, after revision March 4, 2019.
From the Cleveland Clinic, Main Campus; Department of Plastic and Reconstructive Surgery, Cleveland, OH.
Conflicts of interest and sources of funding: none declared.
Reprints: Raffi Gurunluoglu, MD, PhD, FACS, Cleveland Clinic, 9500 Euclid Avenue, Desk A60, Cleveland, OH 44195. E-mail: GurunlR@ccf.org.

ISSN: 0148-7043/19/0000–0000
DOI: 10.1097/SAP.0000000000001948

## CASE PRESENTATION

A 32-year-old male presented with comminuted nasal bone fractures, left-sided type II and III and right-sided type I and II Le Fort fractures. The operation proceeded with normal orotracheal intubation which was then converted to submental intubation via the modified approach later described (Figs. 1A-C). The operation began with the placement of hybrid arch bars on both the upper and lower jaw. Bilateral labial incisions were made to expose the midface fractures, and a left transconjunctival incision was made to address the inferior orbital rim fracture. Disimpaction forceps were used to reduce the maxilla into appropriate occlusion which was determined by analyzing the wear facets of the teeth. Maxillomandibular fixation was performed using hybrid arch bars. Internal fixation was performed on the right nasomaxillary and zygomaticomaxillary buttresses using 0.6-mm midface craniofacial plates and on the left inferior orbital rim with 0.5-mm midface craniofacial plate. Lastly, the procedure concluded with closed nasal reduction. Patient was discharged home on postoperative day one. Submental, ocular, and intraoral incisions all healed well with no evidence of complications.

## APPLIED ANATOMY

On a fresh cadaver model, we dissected the structures between oral cavity and submental area. A 2-cm horizontal submental incision is made approximately 2 cm below the mandibular border in the midline (Fig. 2). Skin, subcutaneous fat, platysma muscle, and subplatysmal fat layers are dissected and retracted laterally (Fig. 3). Mylohyoid muscle and, laterally, the anterior belly of digastric muscle are visualized underneath the subplatysmal fat layer. These muscles are cut from their mandibular origin and retracted laterally (Fig. 4).

In the midline below the mylohyoid, the paired geniohyoid muscles appear as slender ribbons (Fig. 5). The geniohyoid muscles overlie the genioglossus muscle, which forms the base of the tongue. Genioglossus muscle is a paired structure and there is an avascular plane between the 2 genioglossus muscles (Fig. 6). The oral mucosa can easily be reached with blunt dissection of the genioglossus muscles in the midline (Fig. 7). The tube can be brought down in a relatively avascular plane between genioglossus, geniohyoid, digastric, and platysma muscles. The mylohyoid muscle is the only structure that is violated during submental intubation when blunt dissection is performed in the midline.

## A NOVEL APPROACH TO SUBMENTAL INTUBATION

The approach described in this section is the standard submental intubation technique with our modification applied. Technical modifications described in the literature are reviewed later. The universal

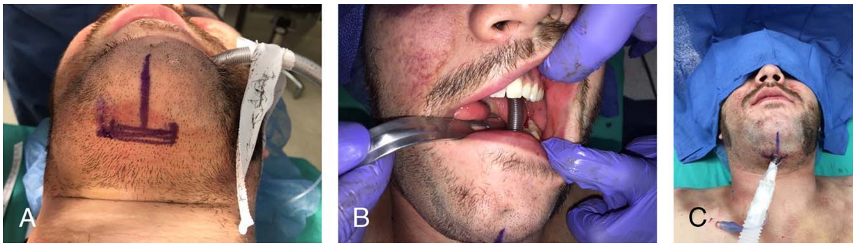


**FIGURE 1.** A, After oral intubation, vertical midline is marked. Then, submental incision is marked 2 cm below mandibular border. B, Intraoral view after submental intubation completed with reinforced tube. C, ETT secured to submental area.

connector for the reinforced ETT is firmly glued and must be circumferentially excised with the aid of a scalpel before intubation (Figs. 8A and B). This is the most challenging, but critical, portion of the case to ensure a safe and protected airway. The universal connector of an ETT that is 1 size smaller than the reinforced ETT to be used is confirmed to fit in its place before proceeding (Figs. 9A and B). This must be done first or the surgeon/anesthesiologist may find themselves unable to connect the ETT to its circuitry after intubation. The submental intubation starts with standard orotracheal intubation using a reinforced ETT. The submental area is prepped in sterile fashion. Prepping of oral cavity is optional. A 2-cm submental skin incision is made parallel to and 1 fingerbreadth beneath the mandibular border (see Fig. 2).

A tunnel is created by performing blunt dissection with a hemostat in the cranial direction. A small counterincision is made in the floor of the mouth overlying the hemostat (Fig. 10). The deflated pneumatic cuff is brought down first inferiorly through the incision (Fig. 11A), followed by the ETT with the aid of a hemostat (Fig. 11B). The correct position of ETT is confirmed with the anesthesiologist. This must be done by auscultating bilateral breath sounds, assessing end-tidal $CO_2$, as well as intraoral inspection to insure that the ETT has not been dislodged. The tube is then secured to the submental skin (Fig. 12). At the end of the operation, submental intubation is switched back to standard oral intubation. The deflated cuff and ETT are brought back into the oral cavity while the anesthesiologist is ensuring premature extubation does not occur. Submental and oral incisions are both closed in layers.

## DISCUSSION

Submental intubation can be used in various clinical situations. Severe maxillofacial trauma is by far the most common reason to perform submental intubation (Table 1). It is especially important for panfacial fractures where MMF is required intraoperatively and nasal intubation is not preferred due to nasoorbitoethmoid, skull base, or cribriform plate fractures. Nasotracheal intubation is contraindicated in certain skull base fractures due to incidence of accidental intracranial placement, risk of CSF rhinorrhea, and meningitis.[2] Submental intubation may also be performed in orthognathic surgery patients who have difficult airways due to large pharyngeal flaps or other airway anomalies and in whom nasal intubation attempts have failed.[7] Other times to consider submental intubation in orthognathic surgery are combined Le Fort I and III cases, where oral intubation would need to be switched to nasal intubation during the Le Fort I part of the surgery.[8] A larger, unobstructed operative field may be achieved with submental intubation in certain skull base procedures, such as skull base operations with transmaxillary access.[9] Some other times to consider submental intubation are orthognathic surgery with simultaneous rhinoplasty, where nasal intubation is switched to oral intubation at the end of orthognathic surgery to perform rhinoplasty and Le Fort I surgeries with placement of alar cinch suture, in which submental intubation permits accurate placement and tightening of the cinch suture to the optimal width.[3] It is also important to consider situations in which patients may not be an appropriate candidate for this intubation technique as shown in Table 2. Another point to consider is the patient who will require establishment of MMF during and after extubation for complex craniomaxillofacial fractures since submental intubation is converted to intraoral intubation at the end of surgery. In this case, tracheostomy may be a better alternative to submental intubation because it allows both airway control and proper fracture reduction and occlusion.

**FIGURE 2.** Submental incision.

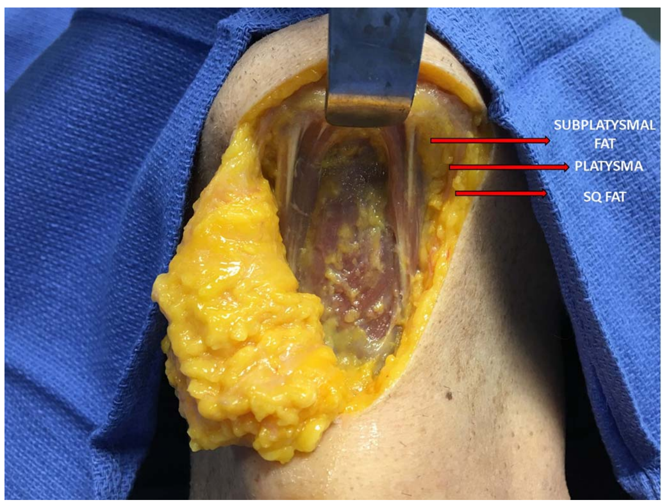


**FIGURE 3.** Initial layers of dissection with larger skin incision to highlight important anatomical structures.

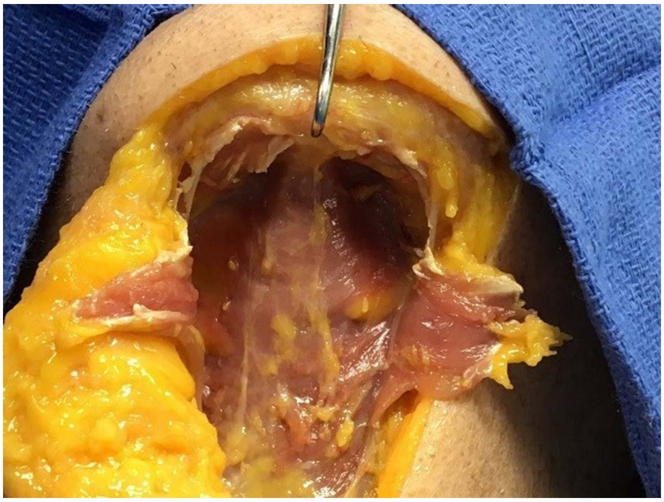

**FIGURE 4.** The anterior bellies of the digastric and the mylohyoid muscle are retracted laterally.

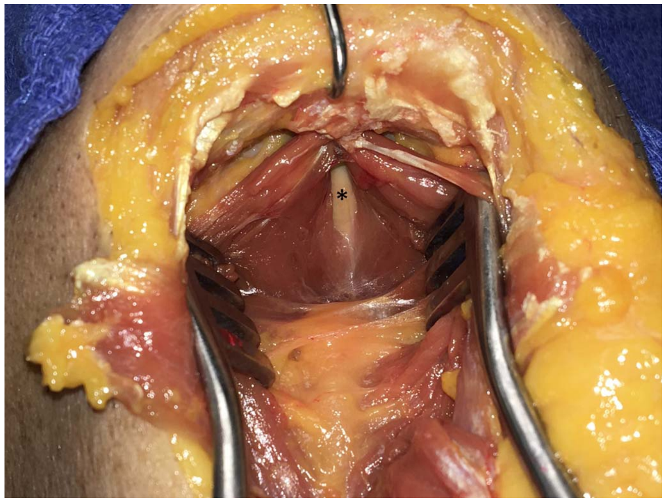

**FIGURE 6.** Paired genioglossus muscles are visible on either side of the oral mucosa (*) which lies in an avascular plane.

Since the original description of submental endotracheal intubation by Hernandez Altemir in 1986, many modifications have been made to the technique to safely use this route of intubation and promote ease to both surgeon and anesthesiologist.[1] In the original description, normal endotracheal intubation is first performed, then a 2-cm incision is made in the submental area 1 fingerbreadth from and parallel to the mandibular border. Blunt dissection is performed until a hemostat is able to be seen intraorally. A 2-cm intraoral incision is made along the gingival margin, and the ETT is temporarily disconnected from the circuit and pulled through the intraoral incision, followed by the pilot balloon, with the hemostat. After verifying placement, the tube is secured, and the case can proceed.[1] Nyárády et al[10] described the "rule of 2-2-2" to remember the main points of the technique for submental intubation. This involves a 2-cm-long incision that is 2 cm from the midline and 2 cm medial and parallel to the mandibular border.

A midline submental incision has been suggested by several surgeons as a way to protect the surrounding anatomical structures and to deal with unsatisfactory results. MacInnis and Baig[11] adopted the method of using a midline submental incision in the sagittal plane behind the submandibular duct papillae to avoid injury to neurovascular structures and to facilitate dissection in an avascular plane. Other variations of the midline incision have been described, such as placing the intraoral incision anterior to the submandibular duct papillae[12] and placing the intraoral incision lateral to the lingual frenulum.[13] Placement of the incision in the submandibular region[14] or parallel to the gingival margin[15] as opposed to submental or midline areas has also been described. We found that midline dissection in the submental triangle is relatively avascular and free of neurovascular structures.

Exteriorization of the tube can be difficult, and several adjustments to the originally described technique have been proposed. The simplest method to prevent trauma to surrounding tissues is using a sterile gloved finger to cover the end of the tube and use an instrument to facilitate passing it through the tunnel.[16,17] The blue cap from the end of a thoracic catheter has been described by Lim et al[18] to ease passage and prevent blood and soft tissue from entering the open end of the tube. To facilitate exposure while passing the tube, the use of long nasal flanges has also been described.[19] The ETT can also be passed through a sterile nylon tube inserted in the submental tunnel[10] or a nylon sac placed over the end of the tube.[20] In the original description by Hernandez, blunt dissection was used to create a pathway from

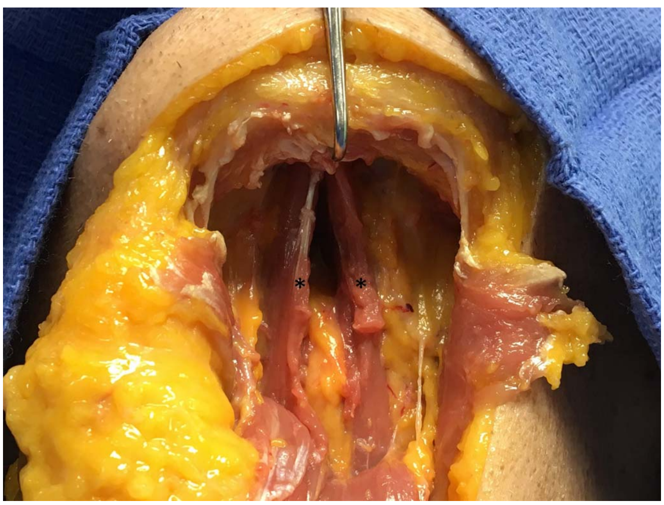

**FIGURE 5.** Paired geniohyoid (*) muscles.

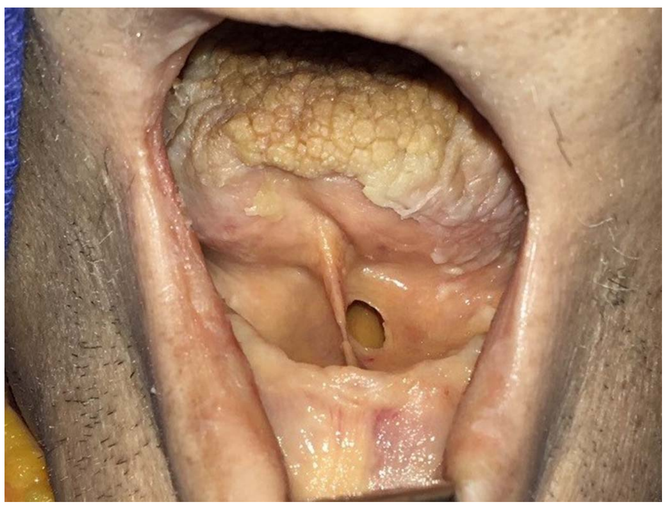

**FIGURE 7.** Blunt dissection from inferiorly allows a small incision to be made in the floor of the mouth for the tube to pass through.

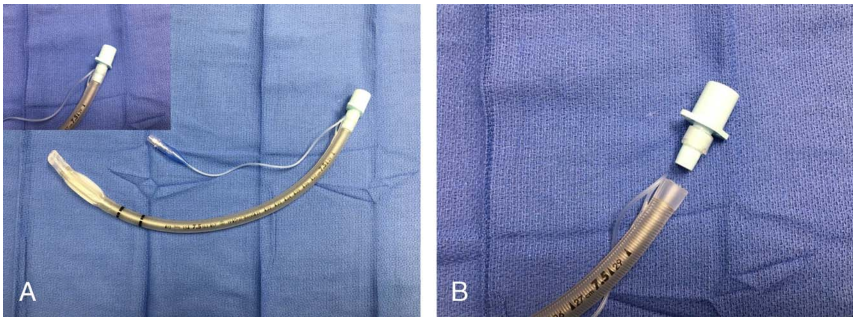


**FIGURE 8.** A, Example of reinforced ETT used in our approach for endotracheal intubation. Inset highlights the universal connector. B, Universal connector of tube removed with scalpel.

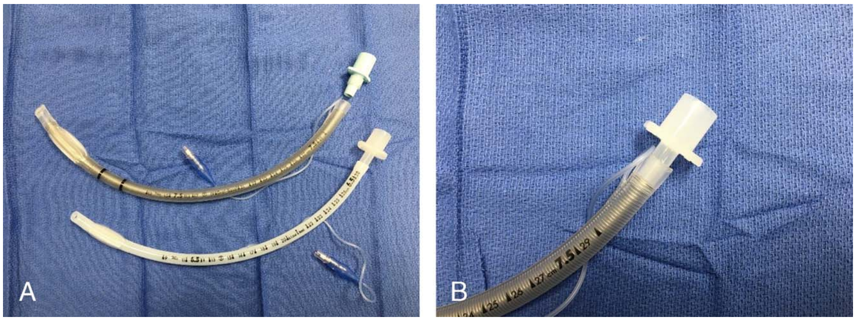


**FIGURE 9.** A, Reinforced tube with universal connector removed above a tube 1 size smaller with a removable connector. B, Removable universal connector firmly inserted into reinforced tube.

extraoral to intraoral incision.[1] Biswas and colleagues[21] modified the dissection technique to use a series of percutaneous dilators to create a tunnel and after several dilations the tube is passed over the dilator externally.

Although a standard ETT was originally described for use in submental intubation, other devices have also been suggested. The original author of this technique subsequently described the use of a laryngeal mask airway for submental intubation to be considered for use in patients who are candidates for submental intubation but who also have laryngotracheal trauma or those with unstable cervical fractures.[22] Other types of devices used in submental intubation technique were esophageal tracheal airway and the Sheridan preformed line of ETTs.[12,23] The main disadvantage of using a regular ETT during submental intubation is the higher likelihood of occlusion through kinking. Armored or reinforced ETTs have metal wire coils embedded in the wall of the tube shaft which make it more resistant to kinking. Thus, the use of reinforced tubes may be preferred over standard tubes during submental intubation as the tube makes a sharp U turn in this intubation technique. In contrast to a standard ETT, the connector of reinforced tubes is firmly fixed to the tube shaft and not detachable. In our modification, the connector of reinforced tubes is excised sharply by a scalpel and replaced with a connector of 1 size smaller regular ETT. This modification allows detachment of the connector of the reinforced tube during transfer in submental tunnel and reattachment with a smaller connector that fits tightly to the reinforced tube.

In the literature, the complication rate associated with submental intubation is reported to be approximately 6% overall.[16] It can be argued that the benefit of taking the relatively short time to perform submental intubation, less than 10 minutes has been reported by several authors,[16,24,25] is greater than the low risk of complications as it affords

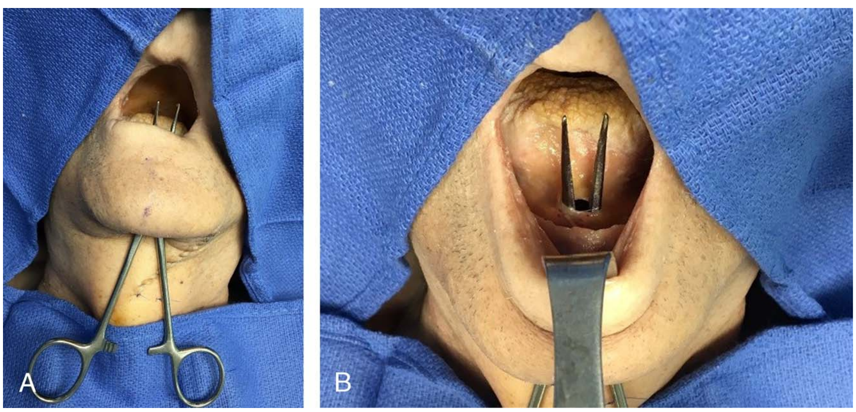


**FIGURE 10.** A and B, Blunt dissection with hemostat allows tunnel to be created to pass tube through.

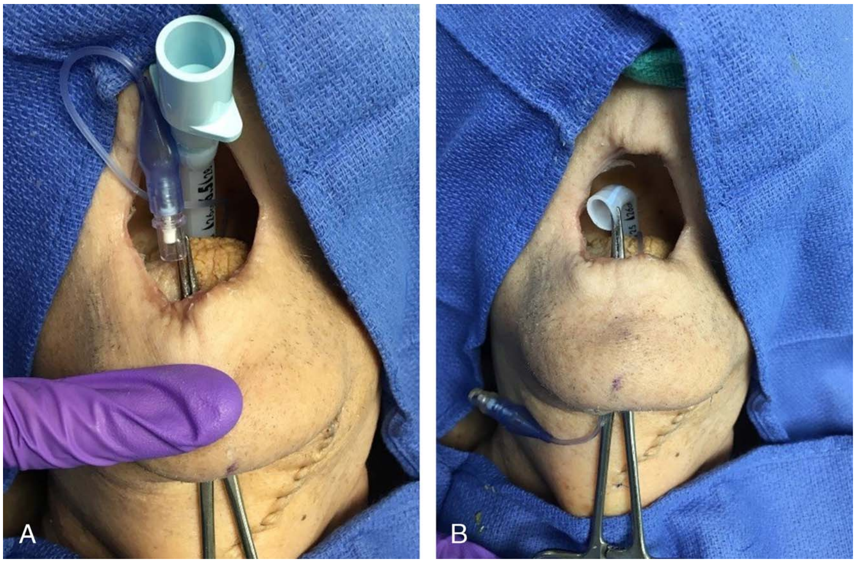


**FIGURE 11.** A, A hemostat is used to bring the pneumatic cuff through the tunnel. B, Next, the reinforced ETT is guided through the tunnel and exteriorized.

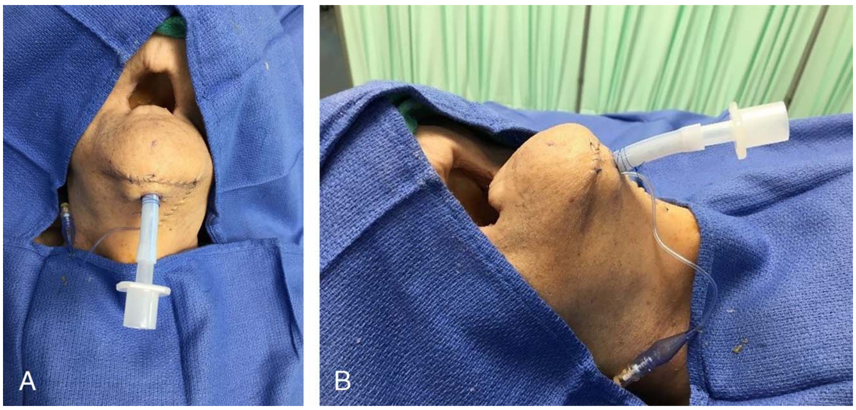


**FIGURE 12.** A and B, Upon completion of exteriorization and confirmation of correct tube placement, the tube is secured to the submental area.

you increased surgical exposure and the opportunity to see intraoperative changes in real time. A review of over 700 cases using submental intubation by de Toledo et al[16] showed that the most common complication was superficial skin infection, 42% of reported complications.

**TABLE 1.** Cases to Consider Submental Intubation

| |
|---|
| Panfacial trauma |
| Skull base fractures |
| Orthognathic surgery in patients with large pharyngeal flaps and/or other airway anomalies |
| Pharyngeal flap or structural anomaly which may impede nasal intubation |
| Combined Le Fort I and III operations |
| Certain skull base procedures, such as skull base operation with transmaxillary access |
| Extensive facial cancer infiltrating nose and lips |
| Orthognathic surgery with simultaneous rhinoplasty |
| Le Fort I surgery with placement of alar cinch suture |

Another common complication is salivary fistula.[16,26] Tube-related complications are not common but have the potential to be detrimental for patient and surgical team members. Damage to the ETT can occur in the form of dislodgement or obstruction of the tube, damage to the pilot balloon, damage to the tracheal tube cuff, or even accidental extubation.[2,16,27,28]

An important postoperative aspect to consider is the submental scar. Although the location of the scar is more favorable than a tracheostomy scar, it still has the potential to be visible and bothersome to the patient.[8,16,24,26] Damage to glandular and neurovascular structures has been reported and can cause difficult to control bleeding which is

**TABLE 2.** Contraindications for Submental Intubation

| Contraindications |
|---|
| Need for prolonged intubation |
| Infection or malignancy of the submental area |
| Coagulopathy |

**TABLE 3.** Summary of Literature Review

| Intraoral Incision | Exteriorization | Tube Choice | Complications |
|---|---|---|---|
| 2 cm, along gingival margin | Sterile finger covering end of tube | Standard ETT | Superficial skin infection |
| "Rule of 2-2-2" | Thoracic catheter blue cap | Armored/reinforced ETT | Unsatisfactory submental scar |
| Midline behind submandibular duct | Long nasal flanges | Esophageal tracheal airway | Tube/cuff damage or obstruction |
| Anterior to submandibular duct papillae | Sterile nylon tube | Sheridan preformed ETT | Damage to glandular or neurovascular structures |
| Lateral to lingual frenulum | Nylon sac | | Accidental extubation |
| | Blunt dissection | | Mucocele |
| | Percutaneous dilators | | Floor of mouth abscess |
| | | | Salivary tract fistula |

why knowledge of local anatomy is paramount.[2,8,26] Mucocele formation can also occur.[8,25,26,29] Abscesses in the floor of the mouth are rare but have been described and highlights the importance of proper sterile technique.[16,27] A summary of the literature review can be found in Table 3.

## CONCLUSIONS

Since its original description in the plastic surgery literature, there have been many modifications to the original technique but there have been few recent updates to the technique. Submental intubation has been shown to be an appropriate method of short-term airway management in panfacial fracture, orthognathic, and skull base procedures requiring operative fixation. Knowledge of the surgical anatomy and use of good surgical principles can help avoid the complications of this procedure. In this review, we introduced a beneficial new modification that allows both airway protection with reduced likelihood of tube kinking and good surgical exposure for fracture fixation. Our novel technique is useful for the plastic surgeon to have in their armamentarium.

## REFERENCES


1. Hernández Altemir F. The submental route for endotracheal intubation. A new technique. *J Maxillofac Surg*. 1986;14:64–65.
2. Cheong Y, Kang SS, Kim M, et al. Submental intubation in patients with complex maxillofacial injuries. *J lifestyle Med*. 2016;6:68–71.
3. Raithatha R, Naini FB, Patel S, et al. Long-term stability of limiting nasal alar base width changes with a cinch suture following Le Fort I osteotomy with submental intubation. *Int J Oral Maxillofac Surg*. 2017;46:1372–1379.
4. Trouillet JL, Collange O, Belafia F, et al. Tracheotomy in the intensive care unit: guidelines from a French expert panel. *Ann Intensive Care*. 2018;8:37.
5. Durbin CG. Indications for and timing of tracheostomy. *Respir Care*. 2005;50: 483–487.
6. Durbin CG, Faarc J. Tracheostomy: why, when, and how? *Respir Care*. 2010;55: 1056–1068.
7. Szantyr A, Szuta M, Zapała J. Airway management using submental intubation in head and neck surgery. *Folia Med Cracov*. 2016;56:79–85.
8. Eisemann B, Eisemann M, Rizvi M, et al. Defining the role for submental intubation. *J Clin Anesth*. 2014;26:238–242.
9. Biglioli F, Mortini P, Goisis M, et al. Submental orotracheal intubation: an alternative to tracheotomy in transfacial cranial base surgery. *Skull Base*. 2003;13: 189–195.
10. Nyárády Z, Sári F, Olasz L, et al. Submental endotracheal intubation in concurrent orthognathic surgery: a technical note. *J Cranio-Maxillofacial Surg*. 2006;34: 362–365.
11. MacInnis E, Baig M. A modified submental approach for oral endotracheal intubation. *Int J Oral Maxillofac Surg*. 1999;28:344–346.
12. Mahmood S, Lello GE. Oral endotracheal intubation: median submental (retrogenial) approach. *J Oral Maxillofac Surg*. 2002;60:473–474.
13. Bartkowski SB, Zapała J, Szuta M, et al. General anesthesia via tracheosubmental intubation from our own experience. *Aesthet Plast Surg*. 1999;23:292–295.
14. Stoll P, Galli C, Wächter R, et al. Submandibular endotracheal intubation in panfacial fractures. *J Clin Anesth*. 1994;6:83–86.
15. Nwoku AL, Al-Balawi SA, Al-Zahrani SA. A modified method of submental oroendotracheal intubation. *Saudi Med J*. 2002;23:73–76.
16. de Toledo GL, Bueno SC, Mesquita RA, et al. Complications from submental endotracheal intubation: a prospective study and literature review. *Dent Traumatol*. 2013;29:197–202.
17. Lima SM, Asprino L, Fernandes Moreira RW, et al. A retrospective analysis of submental intubation in maxillofacial trauma patients. *J Oral Maxillofac Surg*. 2011;69:2001–2005.
18. Lim HK, Kim IK, Han JU, et al. Modified submental orotracheal intubation using the blue cap on the end of the thoracic catheter. *Yonsei Med J*. 2003;44:919–922.
19. Meyer C, Valfrey J, Kjartansdottir T, et al. Indication for and technical refinements of submental intubation in oral and maxillofacial surgery. *J Cranio-Maxillofacial Surg*. 2003;31:383–388.
20. Adeyemo WL, Ogunlewe MO, Desalu I, et al. Submental/transmylohyoid intubation in maxillofacial surgery: report of two cases. *Niger J Clin Pract*. 2011;14: 98–101.
21. Biswas BK, Joshi S, Bhattacharyya P, et al. Percutaneous dilational tracheostomy kit: an aid to submental intubation [33]. *Anesth Analg*. 2006;103:1055.
22. Altemir FH, Montero SH, Altemir FH. The submental route revisited using the laryngeal mask airway: a technical note. *J Cranio-Maxillofacial Surg*. 2000;28: 343–344.
23. Hernández Altemir F, Hernández Montero S, Moros Peña M. Combitube SA through submental route. A technical innovation. *J Cranio-Maxillofacial Surg*. 2003;31:257–259.
24. Kumar AN, Chattopadhaya PK, Dua GMS. Submental intubation in complex craniomaxillofacial trauma cases. *Int J Otorhinolaryngol Head Neck Surg*. 2017;3:546–550.
25. Paetkau DJ, Stranc MF, Ong BY. Submental orotracheal intubation for maxillofacial surgery. *Anesthesiology*. 2000;92:912.
26. Kumar RR, Vyloppilli S, Sayd S, et al. Submental intubation: alternative short-term airway management in maxillofacial trauma. *J Korean Assoc Oral Maxillofac Surg*. 2016;42:151–156.
27. O'Connell JE, Kearns GJ. Submental intubation: a retrospective review of 45 cases. *Ir J Med Sci*. 2013;182:309–313.
28. Ahmed FB, Mitchell V. Hazards of submental tracheal intubation. *Anaesthesia*. 2004;59:410–411.
29. Stranc MF, Skoracki R. A complication of submandibular intubation in a panfacial fracture patient. *J Cranio-Maxillofacial Surg*. 2001;29:174–176.