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Midline Submental Intubation Might Be the Preferred Alternative to Oral and Nasal Intubation in Elective Oral and Craniomaxillofacial Surgery When Indicated

Huijun Jin, MD, * and Pavan Manobar Patil, MDS, DNB, FISCLP†

Purpose: No consensus exists to date regarding the best method of controlling the airway for oral or craniomaxillofacial surgery when orotracheal and nasotracheal intubations are unsuccessful or contraindicated. The most commonly used method of tracheostomy has been associated with a high degree of morbidity. Therefore, the present study was conducted to determine the indications, safety, efficacy, time required, drawbacks, complications, and costs of the midline submental intubation (SMI) approach in elective oral and craniomaxillofacial surgical procedures.

Materials and Methods: A retrospective case series study was used to evaluate the surgical, financial, and photographic records of all patients who had undergone oral or craniomaxillofacial operations at Sharda University School of Dental Sciences, Greater Noida, from April 2006 to March 2014. The indications, drawbacks, time required for the procedure, ability to provide a secure airway, intra- and postoperative complications, and additional costs associated with SMI were analyzed.

Results: Of the 2,823 patients treated, the present study included 120 patients (97 men and 23 women, aged 19 to 60 years). The average time required for SMI was 10 ± 2 minutes. No episode of intraoperative oxygen desaturation was noted. One intraoperative complication, an injury to the ventral surface of the tongue, was encountered. Two patients developed infection at the skin incision site. No significant additional cost was incurred with the use of SMI.

Conclusions: SMI has been successfully used in elective oral and craniomaxillofacial surgical procedures for which oral and nasal intubations were either not indicated or not possible. The advantages include a quick procedure, insignificant complications, the ability to provide a stable airway, and no added costs, making SMI a quick, safe, efficient, and cost-effective alternative in such cases.

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Direct laryngoscopy remains the technique of choice for placing an endotracheal tube (ETT) in patients undergoing elective oral or craniomaxillofacial surgery under general anesthesia. However, alternative techniques are needed for difficult airways, unsuccessful intubations, and cases in which unrestricted access to the dental occlusion and craniofacial skeleton is

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Address correspondence and reprint requests to Dr Patil: Department of Oral and Maxillofacial Surgery, Sharda University School of simultaneously desired. No consensus has been reached to date regarding the best method of controlling the airway when orotracheal and nasotracheal intubation are contraindicated.¹ Intraoperative ETT changes and tracheostomy remain common methods of managing the airway in such circumstances.² However, in an effort to eliminate the morbidity associated

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with tracheostomy² and the risk of intraoperative airway compromise during tube changes, techniques such as submental intubation³ (SMI) and retromolar intubation have recently been developed.

Altemir,³ in 1986, published the first report on SMI. This technique was developed to avoid tracheotomy, particularly in patients with maxillofacial trauma in whom short-term intermaxillary fixation was required. Since then, several investigators have described modifications to the original technique.⁴⁻⁹

We have used SMI in elective oral or craniomaxillofacial surgery in preference to tracheostomy or intraoperative ETT changes in indicated cases for the previous 8 years. The purpose of the present study was to analyze the indications, safety, efficacy, drawbacks, time required for the procedure, complications, and cost effectiveness with SMI in elective oral or craniomaxillofacial surgery during the previous 8 years. The results of the present study could indicate whether SMI can be regarded as a quick, safe, efficient, and cost-effective alternative to nasal and/or oral intubation, when indicated.

Materials and Methods

STUDY DESIGN AND SAMPLE

To address the research purpose, we designed and implemented a retrospective study. The study sample was derived from the population of patients who had presented to the School of Dental Sciences, Sharda University, Greater Noida, India, for evaluation and management of oral or craniomaxillofacial complaints from April 1, 2006 to March 31, 2014. To be included in the study sample, the patients had to have had unsuccessful or contraindicated oral or nasal intubation, no injuries to the floor of the mouth, an adequate mouth opening for oral intubation, no indications for prolonged intubation, and consented to the procedure. The patients were excluded as study subjects if they required prolonged intubation, presented with injuries to the floor of the mouth, had an inadequate mouth opening for oral intubation, or refused the procedure and those with a follow-up duration of less than 3 months. Owing to the retrospective nature of the present study, it was granted an exemption in writing by the University of Sharda institutional review board. All patients provided written informed consent.

STUDY VARIABLES

The demographic data (age and gender) for all the patients, time required for establishment of SMI, duration for which the tube was in use, any incidents of oxygen desaturation during the procedure, intra- or postoperative complications associated with the procedure, and additional cost were evaluated. All patients were followed up for a period of 3 months.

OPERATIVE TECHNIQUE

The method for SMI followed in our practice is similar to the technique advocated by MacInnis and Baig⁵ in 1999. Orotracheal intubation was accomplished, and the tube was secured temporarily with the help of adhesive tape. Surgical skin preparation of the perioral and submental regions was performed using povidone-iodine solution, and the regions were draped with sterile towels. The proposed line of incision in the submental crease was then marked 3 cm behind the lower border of the symphysis menti, bisecting the midline of the face, and approximately 2 cm in length (Fig 1). The surgical site was infiltrated with local anesthetic solution containing 2% lidocaine with 1:80,000 epinephrine (Lox, Neon Laboratories, Ltd, Andheri [East], Mumbai, India). The mouth was opened, and a suitable mouth prop was used to maintain the opening. The tongue was elevated in a superoposterior direction with 2-0 black braided silk tongue retraction suture (Mersilk, Johnson & Johnson, Ltd, Baddi, Himachal Pradesh, India), exposing the ventral surface of the tongue and floor of the mouth. The site was marked (Fig 2) and infiltrated with local anesthetic solution containing 2% lidocaine with 1:80,000 epinephrine. A 1-cm midline incision was made using a no. 15 surgical blade (Paramount Surgimed, Ltd, Bhiwadi, Rajasthan, India) posterior to the opening of Wharton's ducts. The incision was developed in an anteroinferior direction between the geniohyoid, genioglossus, mylohyoid, and anterior digastric muscle bellies using a blunt hemostat in a strict midline plane. The target point was the previously placed submental skin incision line. When the hemostat was palpated with a finger under the skin of the submental



FIGURE 1. Submental skin incision marked in the neck. Jin and Patil. Midline Submental Intubation. J Oral Maxillofac Surg 2015.



FIGURE 2. Sublingual intraoral incision marked behind the opening of Wharton's ducts. *Jin and Patil. Midline Submental Intubation. J Oral Maxillofac Surg 2015.*

area, the skin and subcutaneous tissue were incised over the tip of the blunt hemostat to complete the dissection (Fig 3). Ribbon gauze, clamped with a hemostat at 1 end, was then held with the hemostat from the intra-oral dissection and led into the mouth. The ribbon gauze was discarded. The armored (flexometallic) ETT was disconnected from the circuit, and the universal connector was disconnected. The ETT was grasped by the hemostat from the submental wound and delivered through the submental opening. The anesthesiologist reattached the connector to the armored tube and reconnected the anesthetic equipment (Fig 4). The tube was secured to the skin of the submental region with 2-0 silk sutures (Fig 5). Intraorally, the tube lay in the right or left sublingual sulcus. At the end of the surgical procedure, the ETT was passed



FIGURE 3. Hemostat in the open position to widen the submental pathway. Jin and Patil. Midline Submental Intubation. J Oral Maxillofac Surg 2015.



FIGURE 4. Endotracheal tube seen in its intraoral position in the right sublingual sulcus. *Jin and Patil. Midline Submental Intubation. J Oral Maxillofac Surg 2015.*

back through the intraoral incision into the mouth, reversing the original path. It was then brought out through the mouth on extubation. The oral incision was closed using 3-0 polyglactin 910 suture (Vicryl, Johnson & Johnson, Ltd, Aurangabad, India), and skin closure was achieved using 4-0 nylon sutures (Ethilon, Johnson & Johnson, Ltd, Baddi, Himachal Pradesh, India).

STATISTICAL ANALYSIS

All patients were assessed intraoperatively and followed up postoperatively during hospitalization for wound-associated complications and subsequently at 1, 3, and 6 weeks and 3 months postoperatively. Clinical examination and photographic records were maintained for all patients. Neurologic examination of the surgical wound area was



FIGURE 5. Submental endotracheal tube in place with sutures.

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Sample size (n) $120/2823$ Gender (n) $93 (77.5)$ Male $93 (77.5)$ Female $27 (22.5)$ Age (y) 42 ± 24 Indications for SMI $Midface$ fractures with occlusalMidface fractures with occlusal $34 (28 33)$
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alterations
Nasal fractures associated with 9 (7.5)
occlusal alterations
Panfacial fractures 29 (24.16)
Oral surgical procedures in 6 (5)
patients with intranasal
pathologic entities
A history of posterior nasal 3 (2.5)
bleeding after trauma
Base of skull fractures (eg, 23 (19.16)
Le Fort II and III fractures)
A history of cerebrospinal fluid 4 (3.33)
leak after trauma
Orthognathic surgery with 6 (5)
conventional nasotracheal
intubation or nasofibroscopic
intubation not possible
Combined genioplasty and 5 (4.16)
rhinoplasty procedures
Nasopharyngeal angiofibroma 1 (0.83)
Time required for procedure 10 ± 2
(minutes)
Complications (n)
Intraoperative 1 (0.83)
Postoperative 2 (1.96)

 Table 1. SUMMARY OF DESCRIPTIVE STATISTICS FOR

 STUDY VARIABLES

Data presented as n (%) or mean \pm standard deviation.

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performed using the pin prick test in the sublingual mucosa and submental skin and subjectively by questioning the patients about any complaint of altered or lost sensation in the surgical wound area. The integrity of the sublingual salivary ducts and their salivary outflow was observed clinically and by milking the ducts manually.

The safety of the procedure was defined as the ability of the procedure to be performed without any significant intra- or postoperative complications. The effectiveness was defined as the ability of the SMI to provide a secure airway for the entire length of the proposed procedure with no episodes of oxygen desaturation. Cost-effectiveness was estimated by the need for special armamentarium, a second surgical team, or an increased hospital stay because of the procedure or complications.



FIGURE 6. Healed submental scar.

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Results

The surgical records of 2,823 patients who had undergone oral or craniomaxillofacial surgery were analyzed. Of these patients, 1,896 were males and 927 were females (aged 40 ± 29 years). Nasotracheal intubation was used in 1,639 patients, orotracheal intubation in 1,064 patients, and SMI in 120 patients, and tracheostomy was preferred in 18 patients. The descriptive statistics for all study variables are presented in Table 1. Tracheostomy was preferred for patients who required prolonged assisted ventilation such as 12 patients with multiple trauma and severe neurological damage or major thoracic trauma, 1 patient with temporomandibular ankylosis, and 1 patient with oral submucosal fibrosis in whom blind nasal intubation or nasofibroscopic intubation was unsuccessful. Tracheostomy was also preferred for 2 patients with panfacial trauma and limited mouth opening and 2 patients with maxillofacial trauma with large wounds in the floor of the mouth.

In all patients, SMI permitted successful completion of the proposed procedures without interference from the ETT. The duration of use of the submental ETT was 3.8 ± 1.5 hours. No difficulties in passing the tube through the floor of the mouth were encountered, and the average duration of the procedure was 10 ± 2 minutes. The disconnection time from the ventilator was approximately 1.5 minutes. No significant oxygen desaturation occurred in any patient during the procedure. No hemorrhagic episodes were encountered. The only intraoperative complication encountered was a laceration on the ventral surface of the tongue, which healed uneventfully without any additional care. No postoperative motor or sensory deficit was observed or reported by any patient. Normal healing in the mucosa of the floor of the mouth was observed in all patients. Two patients had developed an infection at the skin incision site at 1 week postoperatively that was managed with oral antibiotics and cleansing with povidone-iodine solution twice daily for 3 to 5 days. The integrity of the salivary ducts was preserved, and a normal level of saliva fluids was maintained. The submental scar was well accepted by patients in all cases (Fig 6). No case of hypertrophic scarring was observed.

All patients who had undergone SMI were treated by the same surgical team that performed the operative procedure, needed no additional armamentarium, and had no increased hospital stay because of SMI. The interval to discharge from the hospital was independent of the use of SMI.

Discussion

The present study attempted to evaluate the indications, safety, efficiency, drawbacks, time required for the procedure, complications, and cost effectiveness encountered in our experience with SMI for elective oral or craniomaxillofacial surgery during the previous 8 years. The overall complication rate in our study was 2.5%. SMI maintained a secure airway without oxygen desaturation for all procedures, was quick (10 ± 2 minutes), required no second surgical team or additional armamentarium, and added no cost to the procedure or prolonged the hospital stay. From the results of the present study, SMI is associated with few, insignificant complications, provides a quick, efficient airway, and is cost effective.

Our unit has used the procedure for a wide variety of indications (Table 1). One intraoperative complication observed in 1 of our patients was an iatrogenic laceration of the ventral surface of the tongue. This resulted from an error in the surgical technique. The laceration, however, healed well without additional complications. Infection at the submental skin wound was noted in 2 patients. The submental scar in all the cases was imperceptible, except on close observation with the neck extended. The intraoral wound healed uneventfully in all the patients.

Caron et al,¹ in a review of 25 patients with maxillofacial trauma treated with SMI, reported 1 patient (4%) with infection at the incision site. Anwer et al¹⁰ reported 2 of 14 patients (14%) with postoperative superficial skin infections. We observed infection at the incision site in 2 patients (1.96%). Meyer et al⁷ reported 1 patient (4%) with hypertrophic scarring and 2 (8%) with floor of mouth abscesses in their series of 25 patients with maxillofacial trauma. We observed no cases of submental scarring or floor of the mouth abscess in our study.

SMI was first described as an alternative route for oral or nasal intubation, especially in cases of major maxillofacial trauma. Several other indications for the use of SMI, such as orthognathic surgery,^{11,12} craniofacial anomalies,¹³ reconstruction of a cancrum oris defect,¹⁴ and skull base access surgery,¹⁵ have since been reported.

Nasotracheal intubation is a contraindication in cases of trauma of the skull base because of the possibility of iatrogenic meningitis, difficult intubation, difficulty in treating fractures of the nasal pyramid at the same time, dislodgement of bony fragments into the cranial cavity, and the risk of iatrogenic cerebrospinal fluid leakage.¹⁶ Furthermore, nasal intubation might not be possible in the presence of untreated nasal pathologic entities, a grossly deviated nasal septum, or an overgrown maxilla.¹⁷ In such cases, oral or craniomaxillofacial procedures for which oral access or dental occlusion is involved are ideally suited for the SMI technique.

Retromolar intubation was introduced by Martinez-Lage et al¹⁸ in 1998 as an alternative to SMI. It involved extraction of the lower third molar tooth (when present) before performing a semilunar osteotomy in the anterior ramus large enough for the tracheal tube to lie below the occlusal plane in the retromolar space (space behind the last upper and lower erupted molar teeth). However, destruction of the bony anatomy led to criticism of this procedure. An alternative technique for retromolar intubation uses an ETT placed in the retromolar space fixed to the molar teeth or Erich arch bar with ligature wires.¹⁹ However, the retromolar space might not be adequate in many patients. The presence of the ETT in the oral cavity can impede the surgical field, affect placement of dental fixation devices such as intermaxillary fixation wires, and can risk dislodgement or extubation during manipulation of fractured bones.¹⁸ Overzealous fixation of the ETT by ligature wires can also damage the ETT.^{19,20} Nevertheless, this technique can be considered a superior option to SMI for patients with an adequate retromolar space and similar indications.

The lateral submental approach for endotracheal intubation by Altemir³ was faced with problems such as difficulty in tube passage, hemorrhage, damage to the sublingual salivary gland or Wharton's duct, and the formation of mucoceles.^{5,21} MacInnis and Baig⁵

modified the lateral submental technique to use a strict midline approach. A careful analysis of the anatomy of the anterior floor of the mouth indicated that, if a strict midline approach to SMI was adhered to, all major anatomic structures, including the Wharton ducts, lingual neurovascular plexus, and sublingual salivary gland, could be avoided. Moreover, minimal vascularity is present in the midline in contrast to the hemorrhage encountered using the lateral submental approach. Similar observations were noted in our experience. Stranc and Skoracki²¹ reported that mucocele formation is greater when the tube was passed from intraorally to the submental region. This results from incorporation of mucosal remnants in the surgical tunnel produced for SMI. However, we have not encountered any such complication in our study, although we exteriorized the ETT from orally to the submental skin surface.

Lim et al²² suggested covering the proximal end of ETT with a blue cap of a thoracic catheter to prevent entrapment of blood clots and soft tissue in the tube while traveling from the oral route to the submental route. We have considered this step unnecessary, because it would make grasping the ETT with a hemostat more difficult. We have preferred to use a suction catheter to evacuate the blood collected in the ETT orifice. We also prefer to close the intraoral wound to eliminate any chance of orocutaneous fistula formation, although this is not mandatory.^{1,5} Other complications reported in previous studies, such as damage to the tube apparatus,²³ abscess formation in the floor of the mouth,¹⁰ hypertrophic scarring,⁷ right bronchus tube dislodgement or obstruction,¹⁰ detachment of the pilot balloon,²⁴ accidental extubation,²⁵ excessive bronchial flexion,²⁵ lingual nerve paresthesia,²⁵ and dislodgement of the throat pack sticker in the submental wound,²⁵ were not encountered in our patients. We stabilize the ETT by holding it against the palate with the operator's finger or a metallic instrument while it is disconnected from the anesthetic apparatus and led out of the submental wound. This maneuver prevents the tube from over insertion into the right bronchus. Mahmood and Lello²⁶ have advocated a midline submental approach, with the intraoral mucosal incision centered on the mid-sagittal plane midway between the point of reflection of the mucosa from the mandible to the floor of the mouth and the submandibular duct papillae. They suggested that sublingual hematoma and edema could make an incision placed posterior to the ductal opening risky.²⁶ However, we have not encountered such an event to date.

The cost effectiveness of SMI was proved because it did not add to the cost of the procedure, apart from the extra 10 minutes of operative time. It has been routine in our institution to request the services of an otolaryngologist to perform a tracheostomy, which could be the case with other units around the world. This, along with the added cost of the specialized armamentarium and a tracheostomy tube, will increase the cost of the procedure significantly.

The drawbacks of SMI are that it is contraindicated for patients with severe neurologic damage or major thoracic trauma and patients who need repeated surgical interventions. These patients could require prolonged assisted ventilation. Therefore, tracheostomy has been considered safer than SMI for such patients. All the patients in our study were extubated in the immediate postoperative period. Hence, the effects on long-term airway support were not judged. Another limitation of SMI is that it cannot be performed in patients with a limited mouth opening. Arya et al²⁷ reported an eloquent solution to this drawback to retrograde SMI using a pharyngeal loop technique, thereby also making SMI an attractive option in such cases. Injuries to the floor of the mouth have also precluded the use of SMI.

The shortcomings of the present study were its retrospective design and the absence of a comparison of SMI with tracheostomy. However, the strength of the complete descriptive data from all patients, including the surgical technique, postoperative subjective and objective test results, and photographic records, has offset the shortcoming of the retrospective design. Furthermore, studies comparing SMI with tracheostomy are unlikely because the 2 techniques have entirely different indications and cannot be substituted for each another.

In elective oral and craniomaxillofacial surgical procedures with no indication for prolonged airway support and for which oral and nasal intubation is either not indicated or not possible, SMI provides a quick, safe, efficient, and cost-effective alternative. Therefore, we suggest that SMI should be the preferred method for intubation in such situations. Additional research should be directed at conducting a prospective randomized controlled study on the technique of SMI. Comparisons between different SMI techniques could also be studied to determine the most effective method.

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