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Submental Intubation As An Alternative Technique To Tracheostomy In The Airway Management Of Complex Maxillofacial Surgery In A Tertiary Care Hospital

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ABSTRACT
Background*: Management of airway in oral and maxillofacial surgery is challenging as both anaesthesiologists and surgeons have to work in the same area. Both specialists require adequate knowledge, skill and collaboration to ensure the safety of the patient during intraoperative as well as postoperative period and to decrease associated morbidity and mortality. Maxillofacial injuries and fractures are almost always related to moderate to severe accidents because of their prominent anatomical placement.*
Objectives: *The aim of this study is to find out submental intubation as an alternative technique to tracheostomy in the airway management of complex maxillofacial surgery in a tertiary care hospital.*
Methods: *This cross-sectional study was conducted in the Department of Anaesthesiology of Dhaka Dental College and Hospital from May 2022 to April 2023. A total number of 89 patients were included in this study who had complex maxillofacial injuries such as panfacial fracture required open reduction and internal fixation, craniomaxillary surgery, with or without epistaxis, CSF leakage and basal bone fracture or orthognathic surgery with rhinoplasty where nasotracheal or orotracheal intubation is either contraindicated or may causes obstacles to surgical field.*
Results: *The male patients were 86.52% of this study, 50.56% of the male were aged between 16-25 years and 4.49% of the female were aged between 16-25 years. The mean time required for the procedure was 5.99 ±1.01 minutes, mean additional time required for recovery was 6.36±1.34 minutes, mean ventilation disconnection time was* 1.64 ± 0.20 minutes, mean *duration of postoperative stay was 1.47 ±2.33 hours and mean duration of hospital stay (after surgery) was* 6.11 ±1.34 days.
Conclusion: *Submental endotracheal intubation is simple, safe and significantly quicker alternative technique to tracheostomy for airway management during selected complex maxillofacial surgeries where there is no indication for prolonged mechanical ventilatory support during postoperative period. Submental intubation should be considered by both anaesthesiologists and maxillofacial surgeons in challenging cases, where an alternative airway technique is required.*
Keywords*: Submental Intubation, Tracheostomy, Maxillofacial Surgery.*

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I. INTRODUCTION

Management of airway in oral and maxillofacial surgery is challenging as both anaesthesiologists and surgeons have to work in the same area. [1,2] Both specialists require adequate knowledge, skill and collaboration to ensure the safety of the patient during intraoperative as well as postoperative period and to decrease associated morbidity and mortality. [3] During maxillofacial surgery anaesthesiologists can apply several technique to establish a safe airway. Nasotracheal intubation is commonly used in oral and maxillofocial surgery where anaesthesiologists insert the endotracheal tube through naris into nasopharynx and trachea. [4] Maxillofacial injuries and fractures are almost always related to moderate to severe accidents because of their prominent

anatomical placement. The most frequent places for fractures are the mandible and zygomatic arch. [5] A total of 21.8% of maxillofacial injuries require open reduction and internal fixation [6]. The architecture of the upper airway may be altered as a result of panfacial or maxillofacial trauma, as well as diverse components (soft tissue, bony and cartilaginous) frequently with little external sign of the deformity. In many of these circumstances intubation through the mouth or nose during the surgical repair is inappropriate. Nasotracheal intubation can cause more obstacles in patients with comminuted midfacial fractures, skull base fractures and naso-orbital-ethmoidal reconstructive surgeries for both anaesthesiologists and surgeons. Anaesthesiologists may face extreme difficulty during nasotracheal intubation as comminuted fractures impede the smooth insertion of endotracheal tube through nasopharynx and may cause more harm to the patient and for both orotracheal and nasotracheal intubation surgeons will get less reconstructive space due to tube occupancy. [7] The traditional and short-term procedure for gaining airway access in these patients is elective short-term tracheostomy. It might, however, lead to both early and late complications. Obese patients, kids and those with thyroid swelling find the treatment challenging [8]. Haemorrhage, surgical emphysema, pneumothorax, pneumomediastinum, and recurrent laryngeal nerve palsy are among the 6-8% common acute sequelae. The prevalence of delayed problems is 60% and they include tracheal stenosis, tracheoesophageal fistula, poor visible scar, stomal and respiratory tract infections, tube blockage, difficulties decannulating and dysphagia [9]. Submental intubation has fewer postoperative problems and requires less postoperative care than tracheostomy, which shortens the length of hospitalization. Even a setup with few resources can perform this technique [10]. Francisco Hernandez Altemir, a Spanish maxillofacial surgeon, made the initial suggestion for preoperative submental intubation in craniofacial injuries in 1986. When oral and nasal endotracheal intubation were not possible, he advocated it as an alternative to short-term elective tracheostomy. When postoperative anatomy is likely to return to normal and long-term postoperative breathing or protection of the airway is not anticipated, this approach may be used [11]. The use of temporary intermaxillary fixation in individuals in whom nasotracheal intubation is not possible or maxillofacial injuries with accompanying nasal bone and skull base fractures are indications for submental intubation [12]. Due to the little distortion of the nasolabial soft tissue, this approach has been effectively used in orthognathic procedures and elective aesthetic face surgeries, expanding its application far beyond maxillofacial surgeries. In certain cleft lip and palate surgeries, the treatment of postcancrum oris deformities, oronasal fistulas and other procedures, it is also used when the surgeons use both the nasal and oral airways [13]. The current indications for submental intubation include the correction of congenital abnormalities, skull base surgery, multiple or difficult facial osteotomies, transfacial oncologic treatments of the cranial base and pediculated craniofacial surgeries. Patients' refusal, bleeding diathesis, laryngotracheal disruption, infection at the proposed site, gunshot wounds to the maxillofacial region, long- term airway maintenance, tumor ablation in the maxillofacial region and a history of keloid formation are all reasons to avoid submental intubation. The aim of the study is to find out submental intubation as an alternative technique to tracheostomy in the airway management of complex maxillofacial surgery in a tertiary care hospital.

II. METHODS

This cross-sectional study was conducted in the Department of Anaesthesiology of Dhaka Dental College and Hospital from May 2022 to April 2023. A total number of 89 patients were included in this study who had complex maxillofacial injuries such as panfacial fracture required open reduction and internal fixation, craniomaxillary surgery, with or without epistaxis, CSF leakage and basal bone fracture or orthognathic surgery with rhinoplasty where nasotracheal or orotracheal intubation is either contraindicated or may causes obstacles to surgical field. The selection criteria of patients for this study was the age group of 16 to 45 years old irrespective of sex who had American Society of Anesthesiologists (ASA) physical status I (normal health) and II (mild systemic disease). Patients under the age of 16 years, above the age of 45 years old, ASA physical status III (severe systemic disease with definite functional limitation), IV (severe systemic disease that poses a continuing threat to life), V (moribund patients not expected to live for 24 hours with or without surgery), VI (brain-dead patients whose organs are being harvested for transplant), patient’s refusal, infection at the proposed site, damage to the floor of the mouth, required prolonged ventilation and patients needed mandibular surgery were excluded from this study.

Figure I: Incision for submental intubation on right lateral from midline of the chin.

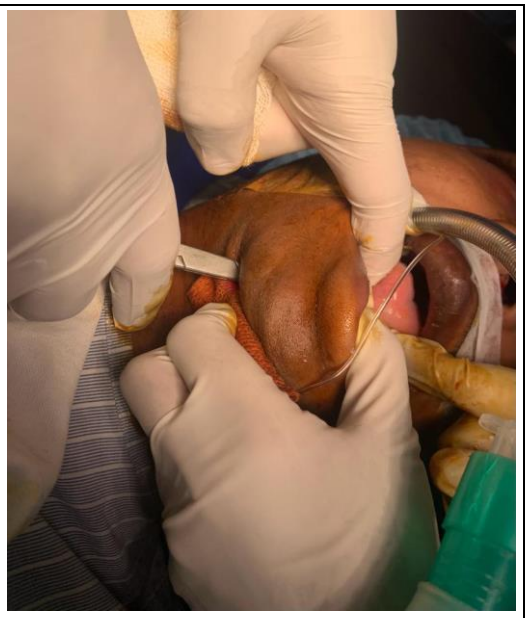

Figure II: Making tunnel using haemostat with guidance of fingertip

All the selected patients visited the assigned anaesthesiologist for preanaesthetic checkup where airway assessment was emphasized with mallampati scoring, measurement of mouth opening, thyromental distance, cricosternal distance and cervical spine movement. Informed written consent was taken from the patients. After confirming nothing per oral status patient was sent to the operation theatre on the scheduled operative day. IV cannulation was done by 18G IV cannula. Premedication was given with injection glycopyrrolate 4µgm/kg body weight & diazepam 5mg. After preoxygenation with 100% oxygen for 3 to 5 minutes induction was done with injection propofol 2 mg/kg body weight and injection fentanyl 2µgm/kg body weight. After laryngoscopy orotracheal intubation was done by using injection suxamethonium 2mg/kg body weight with appropriate sized reinforced cuffed flexo-metallic endotracheal tube whose connector was loosened earlier to facilitated submental intubation procedure and then pharyngeal pack was given. With all aseptic precaution submental intubation was done by making a 1 cm transverse incision 1.5-2 cm right of left from the midline of the chin, parallel to the basal margin of the mandible. The incision was made submental laterally instead of midline to avoid trauma to the Wharton ducts and hamper the attachment of genioglossus and geniohyoid muscles and to avoid injury to the lingual vessels that 98% of the cases are along the midline and lead to bleeding and sublingual hematoma.[14]

Figure III: Making intraoral incision and creating continuation through extraoral incision using haemostat

Figure IV: Grasping deflated pilot balloon with haemostat through intraoral incision

		
Figure V: Getting deflated pilot balloon outward through the tunnel	**Figure VI: Grasping distal end of endotracheal tube & pulling outward through the tunnel of submental region**	**Figure VII: Stabilizing endotracheal tube with suture**

The incision can then be deepened by blunt dissection through three of the muscles of the floor of the mouth; the geniohyoid, genioglossus, and the anterior bellies of the digastric muscles with a large curved haemostat with the guidance of fingertip to the floor of the mouth, behind the caruncles of the salivary duct to penetrate the mucosa of the floor of the mouth for creating a tunnel where the endotracheal tube was inserted outward after the pilot balloon was deflated and insert through the tunnel outward as, the tube blocks the passage. Then the pilot balloon was reinflated and endotracheal tube was connected to the breathing circuit immediately. The tube was fixed by suturing with 1-0 silk to the skin of the submental region to avoid any intraoperative displacement. After completion of surgery, the tube sutures were removed and the tube was reinserted inside the oral cavity turning it into an orotracheal intubation again and proceed to extubation. The submental wound was sutured using 3-0 silk and the intraoral wound was allowed to heal by secondary intention. The patient remained hemodynamically stable during perioperative period and the vital signs were within the normal parameters for a successful surgical outcome. None of the patients required postoperative ventilation. Time required for the procedure, duration of postoperative stay and duration of hospital stay was recorded. Patients were reviewed at 1 week and 1 month.

Collected data were edited and analyzed according to the objectives and variables by IBM software-Statistical package for Social Science (SPSS 25) version. Ethical clearance was taken from the IRB of the institution.

III. RESULTS

During submental intubation procedure there was no immediate complication, no emergency situation arises so there was no need to change the method of intubation. Submental intubation facilitated the surgical procedure without any obstruction to the surgical field and helped in fixation of complicated maxillofacial fracture.

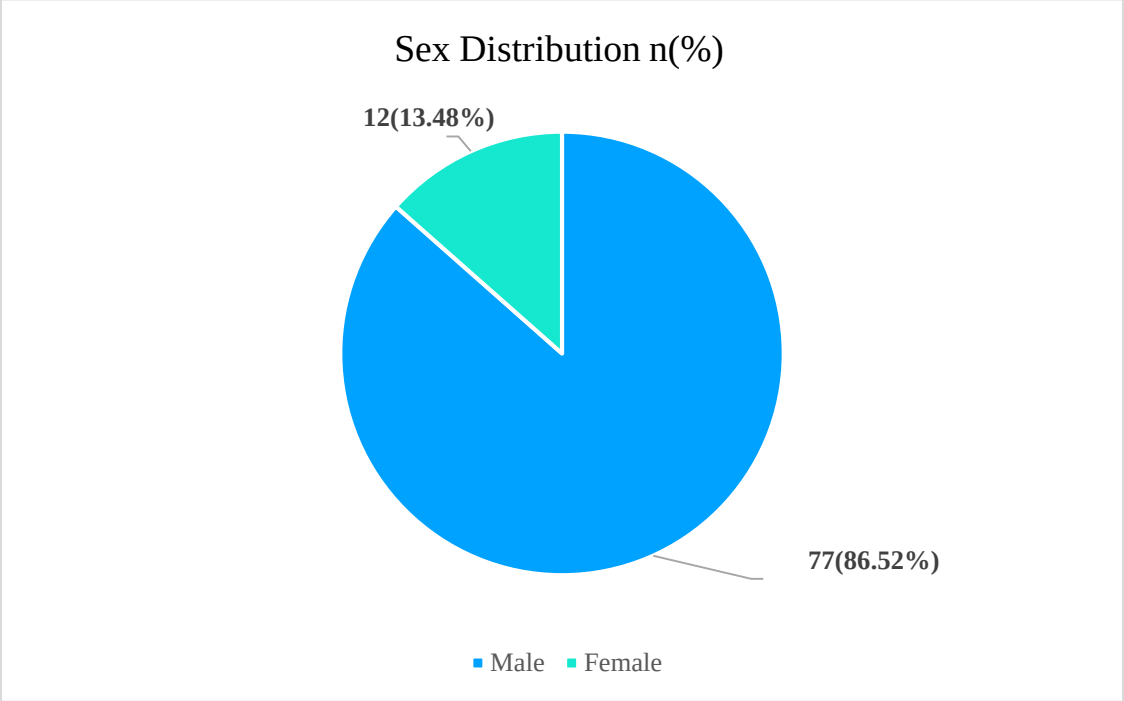

Figure VIII: Distribution according to sex

Figure VIII show among 89 patients 77(86.52%) were male and 12(13.48%) were female.

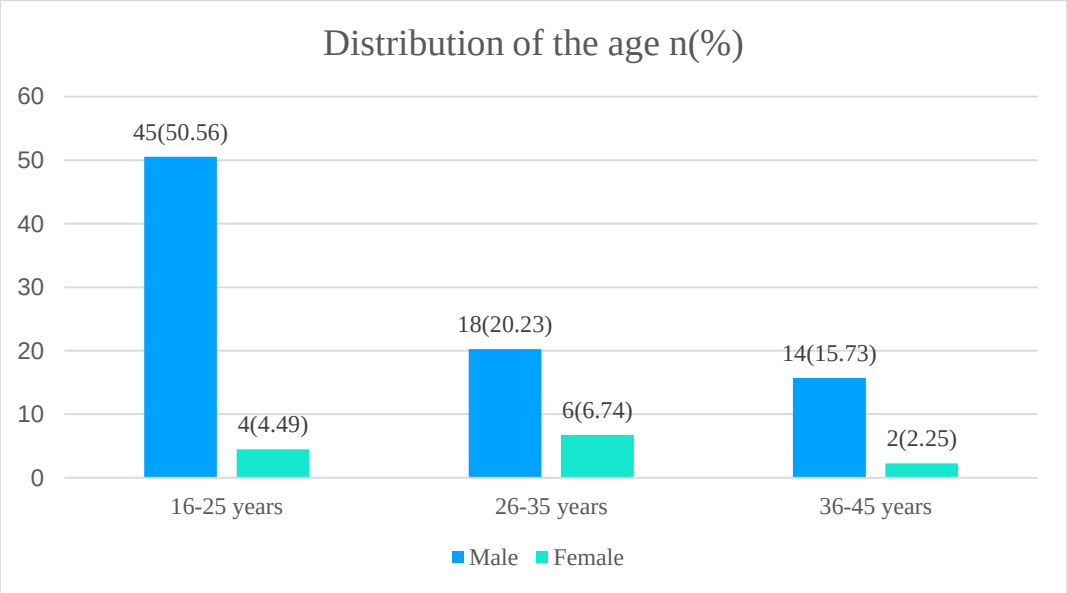

Figure IX: Distribution according to Age

Figure IX shows 50.56% of the male were aged between 16-25 years and 4.49% of the female were aged between 16-25 years. About 20.23% of the male were aged between 26-35 years and 6.74% of the female were aged between 26-35 years. And 15.73% of the male were aged between 36-45 years and 2.25% of the female were aged between 36-45 years.

Table I: Distribution of patients by mechanism of injury

Mechanism of injury	n=89	%
Motor vehicle crashes	72	80.90
Fall from height	7	7.87

Mechanism of injury	n=89	%
Non fall impact	10	11.23

Table I shows 72(80.90%) patients were presented with the history of motor vehicle crash, 7(7.87%) were presented with the history of fall from height and 10(11.23%) had the history of non fall impact.

Table II: Different duration related to submental intubation procedure

Durations	Mean±SD	Min-Max	Median
Time required for the procedure (minutes)	5.99 ±1.01	5-8	6
Additional time required for recovery (minutes)	6.36 ± 1.34	5-10	6
Ventilation disconnection time (minutes)	1.64 ± 0.20	1.5-2.5	1.5
Duration of postoperative stay (hours)	1.47 ±2.33	0-22.50	1.08
Duration of hospital stay (After surgery) (days)	6.11 ±1.34	1-9	6

Table II shows the different durations related to submental intubation. The mean time required for the procedure was 5.99 ± 1.01 minutes, mean additional time required for recovery was 6.36 ± 1.34 minutes, the mean ventilation disconnection time was 1.64 ± 0.20 minutes, the mean duration of postoperative stay was 1.47 ±2.33 hours and the mean duration of hospital stay (After surgery) was 6.11 ± 1.34 days.

Table III: Complications of submental intubation:

Types of Complications	Number of patients n (%)
1. Excessive bleeding	0 (0%)
2. Endotracheal tube damage	3 (3.37%)
3. Premature extubation	1 (1.12%)
4. Infection	2 (2.25%)
5. Hypertrophic scar formation	1 (1.12%)
6. Fistula formation	0 (0%)
7. Damage to the lingual nerve	0 (0%)
8. Mucocele formation	0 (0%)

Table III shows the complications of submental intubation. Here, 3.37% had endotracheal tube damage, 1.12% had premature extubation, 2.25% had infection and only 1.12% had hypertrophic scar formation.

IV. DISCUSSION

To maintain anaesthesia airway management is the most important part and in case of oral and maxillofacial injury the anatomy of airway can easily distorted. The techniques and equipment for airway management developed day by day after Persian surgeon Desault in advertently placed tube into the trachea. [14] In 1871 German surgeon Trendelenberg adopted a method of delivering chloroform into tracheostomy tube to manage airway for anaesthetic purpose in human. [15]

In complicated oral and maxillofacial injury, the whole management is challenging for both anaesthesiologists and surgeons and to overcome these difficulties there should be good teamwork. Airway management through orotracheal or nasotracheal intubation may obstruct the operating field for the surgeons and can be potential source of infection. Nasotracheal intubation may also cause complications such as cranial intubation, epistaxis, trauma to the pharynx, pressure necrosis of the external nares, otitis media, sinusitis, sepsis and inability to pass a tube through nasal passages mostly due to deviation of the nasal septum, hypertrophy of nasal turbinates and it can result in transfer of microorganisms from the nose to the bronchial tree which may cause respiratory tract infection. [16-20] Moreover during nasotracheal intubation more bleeding can occur from fragile nasal mucosa which can cause failed intubation as well as aspiration of blood. Ballon of endotracheal tube may damage during nasotracheal intubation due to sharp exposed bony part of nasal bone or maxilla caused by

injury. Due these disadvantages nasal tube switch technique is excluded where the endotracheal tube is intraoperatively shifted from the oral to nasal route described by González-Garcia et al. [21]

In case of panfacial trauma tracheostomy is an alternative traditional technique to oral and nasotracheal intubation which may cause complications such as haemorrhage, subcutaneous or medistinal emphysema, stromal infection, necrotizing stromal infection, tracheal stricture, tracheo-oesophageal fistula and extensive granulation. [22] Some potentially lethal complications like cardiac arrest caused by stimulation of vagus nerve, post hypercapnic shock and aeroembolism may occur during the procedure of tracheostomy. [23] Cricothyroidotomy is the procedure for emergency airway management & is not useful in case of prolonged ventilation. Moreover, complications like subglottic stenosis, subglottic granulation tracheomalacia, transient hoarseness, aspiration pneumonia, pain at stoma scar, stoma site bleeding, stoma site abscess, subglottic ulceration even death limit the use of cricothyroidotomy. [24] Martinez-Lage et al described retromolar intubation which prevents the interference with occlusion in oral and maxillofacial surgery but disadvantages like increased patient trauma, operative field obstruction and chance of intraoperative endotracheal tube displacement limits its use. [25] The two variations of submental intubation (i.e. midline and paramedian) have become the techniques of choice to maintain the airway during surgical procedure of panfacial fracture.

Since Altemir's original study was initially published, various variations of submental/submandibular endotracheal intubation have been tried in the hopes of achieving better results. All submentotracheal intubation adjustments are fundamentally transmylohyoid rather than submental, was thought to be a more appropriate word by Gadre and Waknis. [26] This technique is also referred to in the literature as submandibular intubation by Anwer et al. [27] or as transmylohyoid intubation by Adeyemo et al. [28] Bögi and Incze [29] in 1996 recommended the use of submental intubation by a paramedian approach. This technique provides a secure airway, a properly exposed surgical field for fixation, allows maxillary and mandibular articulation, thereby avoiding the disadvantages and complications of oral and nasal intubation, as well as tracheostomy.

In this study 50.56% of the male were age between 16-25 years and 4.49% of the female were aged between 16-25 years. About 20.23% of the male were age between 26-35 years and 6.74% of the female were aged between 26-35 years. And about 15.73% of the male were age between 36-45 years and 2.25% of the female were aged between 36-45 years. About 86.52% of the patients were male and 13.48% of the patients were female. Another study showed ages of the patients, all of whom were male, ranged from 19 to 35 (mean: 27). [30] This study revealed that, the mean time required for the procedure was 5.99 ± 1.01 minutes, mean additional time required for recovery was 6.36 ± 1.34 minutes. A previous study showed; the mean time required for intubation was 8.43 (±0.84) minutes whereas elective tracheostomy required 30.75 minutes. [31, 32] In this study the mean ventilation disconnection time was 1.64 ± 0.20 minutes. A previous study showed that, the average time for anesthesia circuit disconnection during SI procedure was 1.5 ± 0.35 min. [32] This study showed that, the mean duration of postoperative stay was 1.47 ±2.33 hours and the mean duration of hospital stay (After surgery) was 6.11 ±1.34 days. Another study found that, the mean period of hospital stay in patients with submental intubation was 7.95 (±1.49) days. [33] This study revealed that 3.37% had endotracheal tube damage, 1.12% had premature extubation, 2.25% had infection and only 1.12% had hypertrophic scar formation. All the complications were effectively managed. Various other complications described in the literature (e.g. excessive bleeding, fistula formation, damage to the lingual nerve, mucocele formation) were not experienced in this study.

Among several modifications to this procedure like anterograde and retrograde approaches using two endotracheal tube, using "rule of 2-2-2" (2-cm-long incision, 2 cm from the midline and 2 cm medial and parallel to the mandibular margin) described by Nyárády et al were useful.

Limitation of the study

The present study was conducted in a very short period due to time constraints and funding limitations. The small sample size was also a limitation of the present study.

V. CONCLUSION

Submental endotracheal intubation is simple, safe and significantly quicker alternative technique to tracheostomy for airway management during selected complex maxillofacial surgeries where there is no indication for prolonged mechanical ventilatory support during postoperative period. Although submental intubation may be a successful procedure with little or no patient morbidity, anesthesiologists and surgeons must take safety precautions because patients with complex maxillofacial trauma may need immediate difficult airway management. Submental intubation is always performed as a follow-up procedure in the management of complex maxillofacial injuries after the airway has been stabilized by orotracheal intubation. To avoid unintentional extubation while manipulating the endotracheal tube, it must be held securely. The technique presents a low incidence of perioperative complications and excludes the complications of tracheostomy. Submental intubation should be considered by both anaesthesiologists and maxillofacial surgeons in challenging cases, where an alternative airway technique is required.

VI. RECOMMENDATION

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

VII. ACKNOWLEDGEMENTS

The wide range of disciplines involved in submental intubation as an alternative technique to tracheostomy in the airway management of complex maxillofacial surgery research means that editors need much assistance from referees in the evaluation of papers submitted for publication. I would also like to be grateful to my colleagues and family who supported me and offered deep insight into the study.

DECLARATION

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Conflict of interest: None declared.
Ethical approval: The study was approved by the ethical committee of Dhaka Dental College Hospital, Dhaka.

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