Submandibular approach for tracheal intubation in patients with panfacial fractures

H. M. F. Anwer1 *, I. M. Zeitoun2 and E. A. A. Shehata2

1Department of Anaesthesia and 2Department of Maxillofacial Surgery, Faculty of Medicine, Alexandria University, Egypt

*Corresponding author: Department of Anaesthesia, Faculty of Medicine, Alexandria University, 51 Kafir Abdo St Zahran Towers, Rushdy, Alexandria, Egypt. E-mail: hfanwer@yahoo.com

Background. The oral route for tracheal intubation can interfere with some maxillofacial surgical procedures. At the same time, the nasal route can be contraindicated or impossible. Tracheostomy is the usual solution in these circumstances, but it carries a high incidence of complications. We tested the submandibular route for tracheal intubation as an alternative to tracheostomy in such situations.

Methods. The procedure was performed in 13 patients suffering from panfacial fractures associated with a fracture of skull base or a displaced nasal fracture, and in one patient with post-caustic burn scar affecting most of the face including the nose and requiring a full thickness skin flap surrounding the mouth.

Results. The technique was found easy and satisfactory for both the surgeon and the anaesthetist. It allowed uninterrupted surgical techniques and a secure airway. In six of the 13 patients, the submandibular tracheal tube was left in place for up to 44 h in the intensive care unit after the operation without complications or difficulties. Accidental dislodgement of the tube to the right main bronchus occurred in two patients while carrying out the procedure; it was rapidly detected and corrected. In another two patients, postoperative superficial infection occurred that responded well to local treatment. No other complications were encountered.

Conclusions. Submandibular tracheal intubation is a simple and effective technique for upper airway management in some maxillofacial surgical patients when both oral and nasal tracheal intubations are not convenient.

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Maxillofacial surgical patients present a specific challenge to the anaesthetist. The surgical procedure is just around the upper airway, which is critical to the patient safety during and after operation. The surgeon and the anaesthetist have to operate using good teamwork, in order to attain maximum patient safety with minimal interruption to the surgery. Nevertheless, maxillofacial anaesthesia incorporates unique airway problems that require distinctive experience and talented skilful cooperation.1

The standard oral route for tracheal intubation can be unsuitable for some maxillofacial surgeries. It can interrupt the surgical field and can interfere with teeth occlusion frequently needed for the adjustment and fixation of maxillary fractures. The nasal route can be used; however, it can be impossible as a result of a deformity or fractures in the nasal bone and it may interrupt some surgical accessibility.2 3

Also, naso-tracheal intubation is contraindicated in patients with fractures in the cribiform plate of ethmoid, which frequently accompany Le-Fort II and III maxillary fractures, because of the potential complications of infection and the possibility of cranial intubation.4–6 The standard solution in these situations is to perform an elective short-term tracheostomy before the operation. Tracheostomy, however, bears a high risk of complications, especially in children, obese patients, and in patients with an enlarged thyroid gland.7 An alternative method is to introduce the tracheal tube through a submental8 or a submandibular9 incision, so bypassing the surgical area and avoiding the complications of tracheostomy. We performed this clinical observational study to demonstrate the feasibility and the reliability of submandibular tracheal intubation as an alternative method for airway management in such situations.
Methods

The study was approved by the Institutional Human Research and Ethics Committee. After detailed discussion, informed consent was obtained from each patient or from the parents or the legal guardian in the case of children or incompetent patients. Submandibular tracheal intubation was performed on 14 selected patients undergoing surgery under general anaesthesia in the Maxillofacial Surgical Department at Alexandria University. Patients were chosen for the procedure when oral intubation was not suitable for surgical techniques, and nasal intubation was contraindicated or impossible. The likelihood that a patient would require prolonged assisted ventilation, such as multi-traumatized patient with severe neurological damage or major thoracic trauma, excluded the patient from the study and tracheostomy was the preferred choice.

The first step in performing the technique was preparing an appropriate size armoured tracheal tube by careful removal of its universal fixed connector to transform it into a removable but fitting connector (Fig. 1). Anaesthesia was induced with i.v. fentanyl 2 μg kg⁻¹ followed by propofol 2 mg kg⁻¹. Atracurium 0.5 mg kg⁻¹ was used for muscle relaxation, and the anaesthesia was maintained with isoflurane 0.8–1% and nitrous oxide 70% in oxygen 30%. After ordinary oro-tracheal intubation using the prepared armoured tracheal tube, a temporary draping of the mouth and the submandibular area was carried out. The side of the submandibular area used was dictated by the presence of mandibular fracture; however, the right side was usually preferred to permit room for the procedure to be done under vision using a left-handed laryngoscope. A 1.5 cm transverse skin incision was made in the submandibular area, about 1 inch below and 1/2 inch anterior to the angle of the mandible (Fig. 2). This distance from the lower border of the mandible was to avoid an injury to the mandibular branch of the facial nerve.

Using a medium-sized curved artery forceps (pedicle clamp), blunt dissection was carried out through the skin incision in an upwards direction towards the mouth cavity as close as possible to the inner side of the mandible. The tissue layers dissected were s.c. fat, platysma, investing layer of deep cervical fascia and the mylohyoid muscle, until the tip of the artery forceps tented the mucous membrane of the mouth cavity just medial to the second molar tooth. Incision of the mucous membrane over the tip of the artery forceps enabled the forceps to be introduced into the oral cavity (Fig. 3). The end of the cuff inflation tube (pilot tube) was grasped with the tip of the artery forceps and then pulled through the dissected track to come out through the submandibular incision (Fig. 4). The patient’s lungs were then ventilated with isoflurane 1% in oxygen 100% for 5 min and the artery forceps was reintroduced through the skin incision along the same track into

Fig 1 Preparation of an armoured tracheal tube by careful removal of its fixed connector to transform it into a removable but fitting connector.

Fig 2 A mark representing the site of the skin incision; 1 inch below and 1/2 inch anterior to the angle of the mandible.

Fig 3 The tip of an artery forceps seen in the oral cavity after blunt dissection through the skin incision, as close as possible to the inner side of the mandible.
the mouth cavity. The tracheal tube was then disconnected from the ventilator and its tube connector was removed. Under direct vision using the laryngoscope, and with the tube supported in the oro-pharynx by the tip of the anaesthetist’s index finger, the end of the tracheal tube was grasped by the tip of the artery forceps and pulled out through the submandibular incision, in the same way as the pilot tube (Fig. 5). The tube was supported in the oro-pharynx throughout to prevent accidental extubation or inward pushing of the tube as its end was being pulled out through the track. Any blood that might have intruded into the proximal part of the tube was suctioned immediately, and the tube connector was then firmly re-attached to the tube before reconnecting to the anaesthetic ventilator. After checking the tube position with capnography and chest auscultation, a mark was made on the tube at the skin exit site. A strong silk stay suture was then made fixing the tube to the skin of the submandibular region (Fig. 6). The tube was further secured to the skin with adhesive tape circumferentially applied to the tube over the threads of the stay suture. A pharyngeal pack was then inserted to seal the pharynx from blood and debris during surgery.

At the end of the operation, the stay suture and the adhesive plaster fixing the tube were removed and the tracheal tube was pulled back to the oral cavity after removal of the tube connector, followed by the pilot tube. Then, the oro-tracheal tube was reconnected to the anaesthetic ventilator and the submandibular skin incision was sutured. When postoperative control of the airway was needed, the submandibular tube was left in place during the early postoperative period (Fig. 7). Surgeons’ and anaesthetists’ satisfaction with the technique and the frequency of complications were recorded.

**Results**

From June 2003 to November 2005, 314 patients with traumatic facial fractures underwent open reduction and internal fixation from a total of 1137 surgical operations performed under general anaesthesia in the Maxillofacial Surgical Department at Alexandria University. Submandibular intubation was performed successfully on 14 patients (4 females and 10 males) (4.14% of facial fracture patients and 1.23% of the total surgical operations performed). Ten of the patients were adults with an age
ranging from 18 to 49 yr (mean 31.1 yr), and four patients were children aged from 6 to 12 yr (mean 8.5 yr).

In all the selected patients, oral intubation was not suitable and nasal intubation was contraindicated or impossible. Eleven patients had panfacial or midfacial fractures associated with fracture base of the skull (in five patients) and required additional rhinoplasty reconstruction surgery (in nine patients). Two patients had mandibular fractures associated with fracture base of the skull and one patient had post-burn scar of the face requiring a full thickness flap in both upper and lower lips (completely surrounding the mouth), and the nose had been previously reconstructed with full thickness flap leaving very narrow nasal apertures.

The technique was found to be easy and convenient. No problems were encountered during the procedure of intubation and submandibular exteriorization, and the intraoperative and the postoperative periods were uneventful. It provided a secure airway and an uninterrupted surgical access to the nose and to the oral cavity and allowed intraoperative control of dental occlusion. Six patients (two children and four adults) required postoperative airway protection during the postoperative period because of suspected postoperative airway oedema or some delay in the return to a satisfactory level of consciousness because of an associated head injury. Therefore, they had the submandibular tube left in place under careful supervision for a duration ranging from 6 to 44 h after surgery (median 22 h). No maxillomandibular fixation was used after operation while the submandibular tube was in place to allow immediate access to the oral airway. However, it appeared safe and well tolerated by the patients. There were no problems in the respiratory management of these patients and endotracheal suctioning could easily be done through the submandibular tube. Extubation in these patients was performed by pulling the tube through the submandibular incision which was then closed by tightening over the previously performed stay suture. In the rest of the patients, an oro-tracheal tube was reverted to at the end of surgery and the patients were extubated after recovery from anaesthesia before they left the operating theatre.

No major complications occurred to our patients and postoperative follow-up examinations revealed no injury to any of the adjacent structures. In two patients, the tube was accidentally pushed into the right main bronchus while tugging it through submandibular track, but this was rapidly detected and it was pulled back into the correct position before fixation. Two patients, an adult who was extubated in the operating room and a child in whom extubation was delayed in the postoperative period, had postoperative superficial infection. Both responded well to a local treatment in the form of drainage, frequent washing with saline and antiseptic solutions, and daily dressing and recovered completely after 3–4 days. The technique was very satisfactory to the surgeon as regards the accessibility to the surgical field and to the anaesthetist concerning the safety of the patients’ airways. Also, all the patients and their relatives accepted the performance of the technique well and appeared satisfied as tracheostomy was avoided.

Discussion
Submandibular intubation is a modification of submental intubation, first described by Hernandez Altemir in 1986 as an alternative method for short-term tracheostomy, when both oro-tracheal and naso-tracheal intubation are contraindicated, impossible, or may interrupt the surgical access or techniques. Altemir’s surgical approach for intubation was through a 2 cm submental incision just medial to the lower border of the mandible, approximately one-third of the distance between the symphysis and the angle of the mandible. Potential complications of
this approach include damage to adjacent structures, such as sublingual and submaxillary ducts, sublingual gland, and lingual nerve. Several investigators tried Altemir’s technique with good success and with no major problems. However, MacInnis and Baig found it less than satisfactory in their first two patients because of difficult tube passage, bleeding, and sublingual gland involvement. Therefore, they modified the approach in their next 15 cases to a strict midline submental incision with satisfactory results. Stoll and colleagues suggested a more posterior approach, in the submandibular area, avoiding injury to the important salivary structures. In the present study, we used a posterior submandibular approach that is considerably far away from the potential complications of submaxillary duct and sublingual gland involvement. We found the technique easy and effective. Although it provides an excellent approach to the whole face, and the oral cavity without any interruption by the tube, it appeared completely safe as regards the patients’ airways. No airway complications or any hypoxic episodes occurred during the technique, or the operation. The presence of the tube in the far posterior area of the oral cavity (Fig. 8) provided surgical access in an uninterrupted operative field inside the mouth. Furthermore, our cases involved patients requiring concomitant nasal reconstruction surgery in addition to mandibular or maxillary fixation. By using a submandibular tube, we avoided intraoperative exchange from nasal to oral tube that can interfere with the surgical field, disturb sterilization, and carries some risk of aspiration. Also, it can be difficult and disruptive in a patient who had recently had repair of fractures.

Another potential complication that has been presumed is the possibility of exposing the patient to hypoxia during the technique if difficulties are encountered during passing of the tube through the incision. Moreover, the universal connector of some armoured tubes are designed to be irremovable and may be required to be cut off and the cut edges of the reinforcing wire may need to be trimmed. Green and Moore suggested using two tubes: a conventional oro-tracheal tube securing the patient’s airway whereas a second armoured tube is passed through the incision, from exterior to interior. The second tube is then manipulated with McGill forceps into the oro-pharynx and then into the trachea just after removal of the first tube. A drawback of this modification is that the cuff of the tracheal tube can be damaged during the vigorous manipulation by the McGill forceps. Also, to overcome the problem of the irremovable connector, Drolet and colleagues used a lubricated tube exchanger to replace the submandibular tube with a fresh re-enforced armoured tube and Amin and colleagues used a 100% silicone wire-reinforced tube with a removable connector, originally designed for use with the intubating laryngeal mask airway. However, pulling the end of the tube through the deep cervical fascia in the submandibular area may probably be easier than in the tight submental area. Also, we found that by careful removal of the fixed connector using a mosquito forceps (Fig. 1), before the start of the procedure, it could be smoothly transformed into an acceptably fitting removable connector.

We agree with most authors that the subperiosteal passage of the tube is not essential, especially in the less cramped submandibular area. Injury to important structures in the floor of the mouth can be avoided by careful extraperiosteal blunt dissection of the passage as close as possible to the inner side of the mandible. The direction in which this passage is created is another point of concern. Stranc and Skoracki reported the development of mucocele attributed to inclusion of mucosal fragments while establishing the mucocutaneous track. They, however, used blunt intraoral perforation of the mucous membrane of the mouth and dissected the track from the oral side to the skin. No such complication has been reported when the track was made as in our series from exterior to interior.

Accidental dislodgement of the tube to the right main bronchus during pulling the tube end through the submandibular track occurred in the first two patients in our series. This indicates the importance of checking the tube position before fixation. Supporting the tube in the oro-pharynx by the tip of the anaesthetist’s index finger while the tube was being pulled through the track prevented the occurrence of such events in the subsequent patients. Accidental extubation and inward displacement of the tube were also reported with submental intubation while manipulating the mandible during surgery.

Postoperative airway protection is often needed after maxillofacial surgical procedures when there is an anticipated risk of airway oedema or haematoma, a delayed return of a satisfactory level of consciousness or a possibility of reoperation within the early postoperative days. Removing the tracheal tube may therefore be delayed until
the patient is fully awake, oedema has subsided and a patent and protected airway is guaranteed. In our series, six patients required the submandibular tracheal tube to be left in place for up to 2 days after the operation. Although it appeared safe and allowed adequate postoperative care, still the presence of an immediate access to the oral airway for rapid interference is mandatory. Using maxillomandibular fixation with the submandibular/submental tube left in place in the postoperative period lacks documented experience and is recommended by some authors to be avoided.10 11 13 In fact, a strong wire cutter constantly at the patients’ side can enable emergency access to the oral cavity in a few seconds, an assumption that can be dangerously misplaced with an enormous tissue swelling in an uncooperative distressed patient. On the other hand, rigid plate fixation was used in our patients that rendered immediate postoperative maxillomandibular fixation unnecessary. Therefore, postoperative maxillomandibular fixation was not performed in these patients or was postponed until after extubation. Nevertheless, the submandibular tracheal tube was not transformed into an oro-tracheal tube in the postoperative period as it appeared better tolerated by the patient and more easily fixed, in addition to avoiding the risk of disruption of the surgical reconstruction if the patient accidentally bit on the oral tube.11

In conclusion, our clinical study demonstrated that submandibular tracheal intubation is an effective and useful technique for airway control and is associated with only a small risk potential. It can be used as a good alternative to tracheostomy in some maxillofacial surgical patients when tracheal intubation through both the oral and nasal routes is not convenient.

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