ABSTRACT

Background: Maxillofacial fractures present unique airway problems to the anaesthesiologist. Nasotracheal intubation is contraindicated due to associated Lefort I, II or III fractures. The requirement for intraoperative maxillomandibular fixation (MMF) to re-establish dental occlusion in such cases precludes orotracheal intubation. Tracheostomy has a high complication rate and in many patients, an alternative to the oral airway is not required beyond the perioperative period. Hernandez1 in 1986 first described "The submental route for endotracheal intubation". Later some workers faced difficult tube passage, bleeding, and sublingual gland involvement with this approach. They modified this to strict midline submental intubation and there were no operative or postoperative complications in their cases.6, 7&8. Therefore we used mid line approach for submental orotracheal intubation in this study to demonstrate its feasibility and reliability and that it can be used as an excellent substitute to short term tracheostomy.

Patients & Methods: We used midline submental intubation in 25 cases selected out of 310 consecutively treated patients with maxillofacial trauma over a 3 year period. After induction orotracheal intubation was done with spiral re-inforced tube. A 1.5-2.0 cm skin incision was made in the submental region in the midline 2.0 cm behind the symphysis and endotracheal tube was taken out through this incision in all the cases. At the end of the surgery the procedure was reversed, the submental wound was stitched; all the patients could be extubated & none of them required post-operative mechanical ventilation.

Conclusion: There were no significant operative or postoperative complications. Postoperative submental scarring was acceptable6. We conclude that midline submental intubation is a simple and useful technique with low morbidity. It can be chosen in selected cases of maxillofacial trauma and is an excellent substitute to tracheostomy where postoperative mechanical ventilation is not required.

KEYWORDS: Submental orotracheal intubation, Maxillofacial injury, Tracheostomy.

Modern surgical management of fractures of the maxillofacial skeleton usually involves open reduction and accurate rigid fixation using miniplates. For accurate functional reconstruction of facial fractures involving tooth-bearing segments of bone, a period of intraoperative maxillomandibular-fixation is essential to ensure restoration of pretraumatic occlusion. This is not possible without bringing the dentition together. This precludes the use of an orotracheal tube. Naso tracheal intubation in these patients is controversial because of the potential complications, including cranial intubation, epistaxis and intracranial or sinonasal infection and the tube may interfere with the assessment and reduction of these fractures.7,15

Submental intubation is an alternative method of establishing an airway in the patients with Le Fort I, II &III fractures presenting for maxillofacial surgery, if they do not require long-term ventilatory support. It was first described by Hernandez Altemir1 in 1986. However, MacInnis & Baig6 found it less satisfactory because of difficult tube passage, bleeding, and sublingual gland involvement. Therefore, they modified their approach to a strict midline submental incision with satisfactory results.6,7&8 In the present study; we also used a midline submental approach for orotracheal intubation.

This provides a secure airway and allows an unobstructed surgical field for adequate reduction and fixation of midfacial and panfacial fractures. The potential indications for submental intubation besides craniomaxillofacial trauma are cleft lip - palate patients undergoing orthognathic surgery where nasal intubation is not possible and elective craniomaxillofacial procedures where reference to dental occlusion is required.

Advantage of this route is that it avoids potential complications associated with nasal intubation and tracheostomy. Tracheostomy is still considered the treatment of choice for patients with extensive craniomaxillofacial injuries.
injuries and multisystem trauma and those who require long-term ventilatory support. However, it is associated with complications such as haemorrhage, surgical emphysema, tube blockage, recurrent laryngeal nerve injury, tracheal stenosis and poor scar appearance.\textsuperscript{7,11,13}

**PATIENTS AND METHODS**

After taking approval from ethical committee, 25 patients were selected for submental intubation out of 310 cases operated in the faciomaxillary surgery department from Nov. 2006 to Nov. 2009. All the patients in this series of submental intubation were males and ages ranged from 20.98-37.42 years (mean 29.20 ± 8.22 years). The patients were mainly having midfacial fractures (Le Fort I-II) & panfacial fractures (midfacial and mandibular fractures). The mechanism of injury was mainly blunt trauma resulting from road traffic accident. Associated injuries included traumatic brain injury and fractures of upper and lower extremities. They were posted for fixation of mandibular, maxillary and nasal bone fractures hence oral and nasotracheal intubation was contraindicated. They did not require postoperative mechanical ventilation hence we were reluctant to do tracheostomy only for intraoperative period and we opted for submental intubation. The following variables were evaluated to assess the results of submental intubation technique: (1) time required for submental intubation, (2) accidental extubation, (3) postoperative complications like hemorrhage; injury to the sublingual duct, submandibular duct, or lingual nerve; orotracheal fistula; and infection, and (4) healing of intraoral and submental scars. The time required for submental intubation was calculated starting from the completion of the orotracheal intubation to the fixation of the submental tube.

Thorough PAC was done, if there was any need for long-term mechanical ventilation then they were not included in the study. Informed written consent was taken from all the patients. In the operation theatre intravenous drip was started with ringer lactate in all the patients. Inj. Ranitidine 50 mg, 0.2 mg Glycopyrrolate, Ondensetron 4.0 mg and Butorphanol 1.0 mg IV was given. The patient was oxygenated with 100% oxygen for 5 minutes. Induction was done with Propofol 2.0 mg kg\textsuperscript{-1} and suxamethonium 1.5 mg kg\textsuperscript{-1} was given after testing for adequate mask ventilation. The patient's trachea was intubated orally using a 7.0 -7.5 mm ID spiral re-inforced tracheal tube.

Before intubation the universal connector of the spiral re-inforced tube was separated with an artery forceps and re-attached so that it can be separated rapidly from the tube while pulling the tube submentally. Using an aseptic technique, the skin of the neck, lower face and the end of the tracheal tube were cleaned with an appropriate antiseptic solution. Care was taken not to dislodge the tube at this stage. A 1.5-2.0 cm skin incision was made in the submental region in the midline 2.0 cm behind the symphysis.

Blunt dissection was done through the subcutaneous fat, platysma, investing layer of deep cervical fascia, anterior bellies of digastic, geniohyoid and genioglossus muscles. Mouth opening was maintained using a gag or dental prop and the tongue was retracted, exposing the floor of the mouth. A closed pair of medium-sized artery forceps was introduced into the submental incision, until the tip of the artery forceps tented the mucosa of the floor of the mouth. Then the tented oral mucosa was incised to see the tip of the artery forceps into the oral cavity taking care to avoid damage to the sublingual and submandibular duct and lingual nerve. The blades of the artery forceps were separated to a distance equal to the diameter of the tube. The pilot tube was grasped by the artery forceps and pulled through the passage in the floor of the mouth. The patient's lungs were ventilated with 100% oxygen for five minutes. The tip of the artery forceps was quickly re-inserted through the submental incision. The tracheal tube was briefly disconnected from the breathing circuit and the universal connector was removed. Then the end of tracheal tube was grasped and pulled out in the oral-to-skin direction. The connector was re-attached, the cuff re-inflated and the tracheal tube reconnected to the breathing circuit.

The position of the tracheal tube was checked using capnography and chest auscultation. Careful monitoring of haemodynamic parameters and SpO2 was done during the change over period. The distance marking on the tube at the skin exit site was noted. The tube was secured to the skin of the submental region with 2-0 black silk suture and Elastoplast was applied to prevent accidental displacement of the tube during manipulation of the mandible. A throat pack was inserted in all the cases. Anaesthesia was maintained with Oxygen (30%), Nitrous oxide (70%), Isoflurane (0.5-1.0%) and Vecuronium bromide 0.08 mg kg\textsuperscript{-1}. Then the patients were fully prepared and draped giving full access to the facial bones with no airway tube within the surgical field. Controlled mechanical ventilation could be done in the usual way throughout the reconstructive surgery.

At the end of the operation the procedure was reversed. The skin sutures were cut and the tracheal tube disconnected from the breathing circuit. The universal connector was removed and the tracheal tube was pulled back through the passage in the floor of the mouth, followed by the pilot tube. The tube was connected with the breathing circuit and secured. The submental incision was closed with 2-3 monofilament skin sutures. The neuromuscular block was reversed and all the patients were extubated at the end of the surgery. The stitches were removed after...
5-7 days. Oral defect was left to heal by itself. All the patients were given perioperative broad-spectrum antibiotics and postoperative chlorhexidine mouth washes.

Photograph of a patient with maxillofacial trauma. The spiral re-inforced tracheal tube has been taken out through submental incision and connected to breathing circuit.

RESULTS
Patients' demographic and clinical data included 25 male patients with mean age 29.2 ± 8.22 years (range 20.98--37.42 years) and mean weight 64.76 ± 8.9 kg (range 55.86--73.66 kg). The mechanism of injury was mainly blunt trauma resulting from road traffic accidents (n=22) and fall from height (n=3). All patients had Le Fort I or II fractures with nasal bone or mandibular fractures. Associated injuries included traumatic brain injury (n=4) & fractures of upper or lower extremities (n=8). The submental endotracheal intubation was done in all the patients without any problem. The mean duration of the procedure was 7.08 ± 0.81 minutes and was associated with minimal bleeding. The airway was never compromised, ventilation was interrupted for less than a minute, and no episode of arterial desaturation occurred during the procedure. The mean duration of maxillofacial surgery was 6.60 ± 0.93 hours (range, 5.68-7.53 hours). At the end of the surgery the submental intubation was returned to standard orotracheal intubation and two to three sutures were placed in the skin. There was no requirement for intraoral sutures. Extubation was done at the end of surgery in all the cases.

No patient required tracheostomy. Patients were seen postoperatively at 2 weeks and then at various intervals up to 6months depending on the nature of their injuries. No significant perioperative or long-term complications had been noted. In our series there were minor complications in three cases. Venous bleeding was encountered in one patient when the pilot tube cuff was pulled out of the mouth, which responded to simple pressure with gauze packs. Infection of the submental wound occurred in two patients who responded to local measures in 4-5 days. There was no postoperative haemorrhage, no salivary gland or duct injury and overall excellent scars.

DISCUSSION
The critical indication for submental intubation is the requirement for intraoperative maxillomandibular-fixation in the presence of injuries that preclude nasal intubation and in a situation where a tracheostomy is not otherwise required. Twenty five patients were chosen for submental intubation. All patients had a mobile maxillary segment together with additional injuries that precluded nasal intubation. The occlusal fractures occurred at various levels. The injuries that precluded nasal intubation included nasal bones fractures and full thickness nasal lacerations. Two patients had associated fracture of frontal bone and cribriform plate leading to cerebrospinal fluid rhinorrhea. All patients required a period of intraoperative MMF.

Submental intubation was first described by Hernandez Altemir1 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 used surgical approach for intubation 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 submandibular ducts, sublingual gland, and lingual nerve.

Several workers used Altemir's technique with good success and with no problems. However, MacInnis & Baig6 found it less satisfactory because of difficult tube passage, bleeding, and sublingual gland involvement. Therefore, they modified their approach to a strict midline submental incision with satisfactory results. In the present study; we used a midline submental approach. We found the technique to be easy and effective. It provided an excellent uninterrupted approach to the whole face and the oral cavity without any interruption by the tube and it appeared completely safe as regards the patients' airways. No airway complications or hypoxic episodes occurred during the technique but the patients may be exposed to hypoxia if difficulties are encountered during manipulation of the tube through the incision. Since our cases involved concomitant nasal reconstruction surgery in addition to maxillary or mandibular fixation, by using a submental tube, intraoperative exchange from nasal to oral tube that carries risk of aspiration, can interfere with the surgical field, disturb sterilization & recent repair of fractures; was avoided.

To prevent kinking of the tube, non-kinkable
flexometallic or spiral re-inforced tube with removable universal connector should be chosen. Some armoured tubes have irremovable universal connector. They have to be cut off and the cut edges of the reinforcing wire are trimmed. Some workers suggested use of 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. The drawback of this technique is that the cuff of the tracheal tube can be damaged during the manipulation by the McGill forceps.

To overcome the problem of the irremovable connector, a lubricated tube exchanger can be used to replace the submental tracheal tube with a fresh re-inforced armoured one. A 100% silicone wire-reinforced tube with a removable connector, originally designed for use with the intubating laryngeal mask airway (ILMA) has also been used for submental intubation. This tube has the advantage that it has a connector that is specifically designed for detachment and re-attachment during insertion of the ILMA, making it ideal for submental tracheal intubation. Hernandez Altemir has also recently reported the use of the laryngeal mask airway via the submental route.

Where universal connector is irremovable, after doing the routine orotracheal intubation, the second submental spiral re-inforced tube is passed from exterior to interior and oro-tracheal tube is removed over the tube exchanger. Then the tube exchanger is passed through the second spiral re-inforced tube which is then slid over the tube exchanger into the trachea. This decreases the time, patient is exposed to hypoxia and there are no chances of damage to the cuff of the tracheal tube. By careful removal of the fixed connector by artery forceps, before the start of the anaesthesia, it can be smoothly transformed into a removable connector.

The direction in which this passage is created is also important. The development of mucocele has been reported by Stranc and Skoracki in a case where submandibular intubation was done. It was probably due to inclusion of mucosal fragments while making mucocutaneous track because they had done blunt intraoral perforation of the mucous membrane of the mouth and dissected the track from the oral side to the skin. No such complication occurred in our cases when the track was made from exterior to interior.

Accidental dislodgement of the tube may occur during pulling the tube end through the track. This can be avoided by carefully checking the tube position before fixation. The tube should be supported in the oro-pharynx by the anaesthetist's index finger while the tube is being pulled through the track. Accidental extubation and inward displacement of the tube have also been reported while manipulating the mandible during surgery.

In this series we used an orotracheal tube through a submental route during the entire surgery. This technique provided a secure control of the airway and caused no interference in the surgical field. There was no problem in disconnecting the tube and passing it through the submental route. All patients were extubated at the end of the procedure. All the tubes used in this study had removable universal connector. Midline approach for submental orotracheal intubation is preferable for two reasons: first, in this area only a few anatomic structures are present and there is a minimum risk of nerve or vascular damage; second, the scar is less visible behind the symphysis and was well accepted by the patients in our series.

Postoperative airway protection may be needed after maxillofacial surgical procedures when there is an anticipated risk of airway oedema or haematoma, a delayed return of consciousness or a possibility of reoperation within the early postoperative days. Removal of 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, all the patients were extubated after the surgery. Although it appeared safe and allowed adequate postoperative care, still some authors recommend that submental tube should be avoided after maxillomandibular fixation. A strong wire cutters should be available at the patients' side for emergency access to the oral cavity in case tube is dangerously misplaced with an enormous tissue swelling in the oral cavity. Because of rigid plate fixation immediate postoperative maxillomandibular fixation is not done now and is postponed until after extubation. Nevertheless, some authors recommend that the submental tracheal tube may be left in the postoperative period as it appears to be better tolerated than oro-tracheal tube, more easily fixed and avoids the chances of patient biting the oral tube.

The morbidity associated with submental tracheal intubation is low. It also avoids the risks of iatrogenic meningitis or trauma of the anterior skull base after nasotracheal intubation. No episodes of potential complications e.g., accidental extubation, leaking cuff, damage to adjacent structures such as the submandibular and sublingual ducts and lingual nerve, oro-cutaneous fistula and anomalous scar formation have been reported. In this series venous bleeding was encountered in one patient when the pilot tube cuff was pulled out of the mouth, which responded to simple pressure with gauze packs. Infection of the submental
wound occurred in two patients who responded to local measures & recovered in 4-5 days.\textsuperscript{13,15} No other complications were encountered in the intra-operative or postoperative period.

The advantages of submental intubation as compared to tracheostomy are that the potential complications associated with tracheostomy such as loss of airway, haemorrhage, surgical emphysema, pneumomediastinum, pneumothorax, recurrent laryngeal nerve damage, injury to cervical vessels or the thyroid gland, tracheal stenosis, stomal and respiratory infections, tracheoesophageal fistula and a scar in an obvious location, which can be depressed or hypertrophic, are avoided.\textsuperscript{7,15} Although these complications are usually rare, they are completely eliminated with the use of submental intubation. Loss of airway and haemorrhage are still potential risks with submental intubation; although the risk of haemorrhage causing loss of airway is much less because of the relative differences in anatomy and any blood collected will pool in the oral cavity rather than directly into the trachea.\textsuperscript{7}

This method of intubation is contraindicated for patients who require a long period of assisted ventilation, i.e. multitrauma patients with severe neurological damage or major thoracic trauma, and patients expected to need repeated operations.\textsuperscript{16} In such cases a tracheostomy is a safer procedure than endotracheal intubation. Submental intubation is therefore recommended in patients suffering from maxillofacial trauma who will not require prolonged airway management.

In conclusion submental tracheal intubation is an effective and useful technique for airway control. It can be used as a good alternative to short term tracheostomy in selected maxillofacial fracture patients when tracheal intubation through both the oral and nasal routes is contraindicated. It provides a safe and reliable route for the endotracheal intubation and avoids the difficulties and morbidity of nasotracheal intubation and tracheostomy. It also allows operative control of the dental occlusion and concomitant surgery of the nasal pyramid in major maxillofacial trauma patients. It is useful both in the emergency setting and for elective procedures. The simplicity of the technique lies in the fact that no specialized equipment or technical expertise is required.

The midline approach is preferable as there is less risk of damage to the submandibular and sublingual ducts and lingual nerves. The scar is in a more favourable position, and the midline is usually relatively avascular hence midline submental intubation should be chosen in selected cases of maxillofacial fractures.\textsuperscript{6,7,16}

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