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ORIGINAL ARTICLE

# Submental intubation versus tracheostomy in maxillofacial fractures

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## Abstract

**Objective** To compare submental intubation with tracheostomy in patients with maxillofacial fractures who were operated under general anesthesia and nasotracheal intubation was contraindicated.

**Patients and methods** This prospective comparative study was conducted on 32 patients undergoing maxillofacial operations. All patients had a panfacial trauma (including naso-ethmoid orbital fracture combined with mandibular fracture). Patients who had unstable cervical vertebra, laryngeal trauma, urgent tracheostomy, and patients with expected prolonged postoperative ventilation were excluded from the study. Patients were randomly assigned to elective tracheostomy and submental intubation groups. The patients were evaluated according to the time required to do elective tracheostomy or submental intubation, the operation comorbidity and complications, and the postoperative scar.

**Results** The average time required to do submental intubation was 8.35 min versus 30.75 min required to do elective tracheostomy with significant difference ($p < 0.0001$). No complication was reported with submental intubation while in elective tracheostomy group, surgical emphysema was registered in two patients. The submental scar was acceptable in all patients while the tracheostomy scar needs scar revision in four cases ($p = 0.0325$).

**Conclusion** Submental endotracheal intubation appeared to be a simple, safe, and significantly faster reliable alternative to tracheostomy during surgical reconstruction of selected cases of maxillofacial fractures without indication for prolonged postoperative ventilation support with significantly lower morbidity.

**Keywords** Tracheostomy · Maxillofacial fracture · Submental intubation

## Introduction

In patients with panfacial fracture, naso-ethmoidal orbital fracture, or anterior skull base injury along with mandibular fracture, intraoperative class 1 occlusion must be obtained. This situation represents a challenging problem for endotracheal intubation [1].

Orotracheal intubation cannot be done if we want a good interdental occlusion, and nasotracheal intubation (NTI) is contraindicated if suspected anterior skull base injury is suspected [2].

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In these cases of oral and maxillofacial trauma, the solution of these problems is to do either tracheostomy or to change the position of the endotracheal tube from oral to nasal intraoperatively which adds a supplementary anesthetic risk to the patients [3] particularly in skull base fracture.

In such cases of craniofacial fractures, tracheostomy is the standard solution especially when there is a need for ventilator support postoperatively [4].

Tracheostomy may lead to many complications like intraoperative hemorrhage due to injury to cervical vessels or thyroid gland, pneumothorax, pneumomediastinum, wound infection, and an ugly scar [5].

Altemir was the first to develop the submental route for endotracheal intubation to avoid the possibility of interfering with oral and maxillofacial surgery, and without having to resort to tracheostomy [6].

The aim of the current study was to compare between submental intubation with tracheostomy in patients with maxillofacial fractures for whom surgical repair was performed and NTI was contraindicated.

## Material and methods

Three hundred and eight patients with maxilla-facial trauma were admitted to Zagazig University Hospitals, Zagazig, Egypt, in the period between January 2013 and March 2018. Patients who could be anesthetized through nasotracheal endotracheal intubation were excluded. Thus, 32 of those patients had panfacial trauma and were included in the study. The patients with panfacial trauma were randomly assigned to two equal groups (group A for submental intubation and group B for tracheostomy). Informed written consents were obtained from the patients and approval from the Zagazig University review board (IRB) was taken. Patients who had unstable cervical vertebrae or laryngeal trauma, expected prolonged ventilation and airway obstruction requiring urgent tracheostomy, were excluded from the study. The following parameters (operative time, comorbidity, complication, and scar) were recorded, tabulated, and analyzed.

Preoperative assessment of the patients was conducted by computed tomography (CT) maxilla-facial, axial, coronal, and 3D. Neck examination was done to assess cervical skin, previous neck scar, wound, neck masses, and anomalies. Assessment of mouth opening was performed which may affect the submental intubation.

### Operative technique

In submental intubation group A, the anesthesiologist intubated the patient first orally with a suitable cuffed endotracheal tube and secured the airway. Then we scrubbed and draped the neck. A small submental incision 1 cm in size, paramedian on one side was performed through the skin by scalpel. Blunt dissection through the superficial fascia, platysma muscle, deep fascia, and mylohyoid muscle to the floor of the mouth was conducted by a curved artery forceps. The exit from the floor of the mouth was extra-periosteal close to the lingual cortex of the mandible. The cuff valve and tube were first brought out from the submental incision. The oral endotracheal tube was disconnected from the circuit of the ventilator and its head was removed and caught by the tip of the artery forceps and got out from the submental incision and reconnected again to the circuit (Fig. 1).

At the end of the operation, if intermaxillary fixation was released or not used, the submental endotracheal tube was disconnected and removed back from the submental incision to the oral cavity, then the patient extubated if there is no need for the intubation after surgery. The submental incision was closed by a nylon 4/0 suture. When rigid MMF was used and maintained, the submental intubation was continued throughout the patients' recovery then extubation was conducted by pulling the tube through the skin followed by tying the sutures.

In tracheostomy group, the operation was done according to the standard technique described by Jackson [7] through a transverse neck incision.

At the end of the operation, the patients were transferred postoperatively to the ICU for 24 h, then to an ordinary room and the patients with tracheostomy were decannulated 48 h postoperatively.

Follow up for all patients were conducted at 1 month, 3 months, and 6 months postoperatively.

Statistical analyses were performed using SPSS 17 statistical software for Windows (SPSS Inc., Chicago, IL). The significance level was set at $p < 0.05$.

## Result

From 308 patients with maxilla-facial trauma, patients for whom nasotracheal intubation could be used were excluded. So, 32 patients with panacial fractures were included in the current study. In submental intubation group, 12 patients (75%) were males and 4 (25%) were females. The ages of the patients ranged from 20 to 60 years (mean = 33.65 years). Eight patients (50%) had naso-ethmoidal fracture with mandibular fracture, 5 patients (31%) had le forte II with condylar mandibular fractures, and 3 patients (19%) had a combination of Le forte II and naso-orbital ethmoid and parasymphyseal mandibular fractures. In 14 patients (87.5%), the trauma was due to motor vehicle accidents, and in 2 patients (12.5) was


**Fig. 1** **a** Through a paramedian small submental incision 1 cm in size, blunt dissection through superficial fascia, platysma muscle, deep fascia, and mylohyoid muscle to the floor of the mouth was conducted by a curved artery forceps. **b** The tube was brought out from the submental incision. **c** The tube pass at floor of the mouth extraperiosteally close to the lingual cortex of the mandible

due to occupational and fall accidents. Patients' comorbidities ranged from limb fractures in 5 patients, rib fractures in 2 patients, extradural hemorrhage in one patient, and CSF rhinorrhea in all patients.

All patients had CSF rhinorrhea that subsided after 2 days in 8 patients, 2 days in 6 patients, and 5 days in 2 patients. The operations were performed 6 days after trauma in 7 patients (44%), 7 days after trauma in 6 patients (37%) and 8 days after in 3 patients (19%).

In tracheostomy group, 13 patients (81%) were males and 3 (19%) were females. The age of the patients ranged from 18 to 55 years old (mean = 34.3 years). Eleven patients (69%) had naso-ethmoidal fractures with mandibular (parasymphyseal, body, and condylar) fractures. Four patients (25%) had Le forte II fracture with mandibular (symphyseal and condylar) fractures. One patient (6%) had Le forte III, naso-orbital-ethmoidal, and mandibular (parasymphyseal) fractures. In 13 patients (81%), the trauma was due to motor vehicle accidents while the remainder was due to falls and occupational injuries (19%). Patients' comorbidities included limb fractures in 4 patients, rib fractures in one patient, extradural hemorrhage in one patient, and CSF rhinorrhea in 14 patients. Fourteen patients (88%) had CSF rhinorrhea which subsided after 2 days in 8 patients (57%), 3 days in 5 patients (36%), and 5 days in one patient (7%). The operations were conducted 6 days after trauma in 9 patients (56%) and 7 days after trauma in 4 patients (25%) and 8 days after in 3 patients (19%) until edema resolved and patient's general condition became stable.

Both groups were matched as regards gender ($p = 0.6688$), age ($p = 0.3653$), type of fractures ($p = 0.794$), cause of trauma ($p = 0.62638$), associated comorbidity ($p = 0.97$), and interval between trauma and surgery ($p = 0.7225$) (Table 1).

In all cases of submental group, one endotracheal tube and the standard latero-submental approach were used. The duration required for submental intubation ranged from 5 to 10 min (mean $8.35 \pm 1.4$) that is significantly ($p < 0.0001$) shorter than the duration needed to perform tracheostomy (range 20 to 37 min with a mean of $30.75 \pm 4$) (Table 2).

After submental intubation, tube kinking was reported in one patient (10%). No significant bleeding, infection, salivary fistula, lingual nerve injury, hematoma, ranula formation, or orocutaneous fistula was observed following submental intubation.

After tracheostomy, surgical emphysema was detected in 2 patients (15%) with no reported significant bleeding, infection, pneumothorax, or trachea-esophageal fistula. Decannulation of the tracheostomy was successfully performed in all cases.

The scars in patients of submental group were hidden by the mandible and within a skin crease and acceptable in all patients. Tracheostomy was done through horizontal skin incision in all cases. Scar revision was required in four cases of tracheostomy group while not needed in any case of submental group with statistically significant difference ($p = 0.0325$).

## Discussion

Rigid maxillomandibular fixation (MMF) or manual MMF is mandatory intraoperatively for adequate reduction of the mandibular and most maxillofacial fractures [8–12].

**Table 1** Preoperative data in submental intubation versus tracheostomy groups

| Patients variables | | Submental intubation group | Tracheostomy group | *p* value |
|---|---|---|---|---|
| Gender | Males | 12 (75%) | 13 (81%) | 0.6688 NS $X^2 = 0.183$ |
| | Females | 4 (25%) | 3 (19%) | |
| Age | Range (years) | 20–54 | 18–35 | 0.3653 NS ($t = 0.9192$) |
| | Mean (years) | s33.65 ± 2 | 34.3 ± 2 | |
| Types of fractures | -Naso-ethmoidal with mandibular fracture | 8 (50%) | 11 (65%) | 0.794 NS ($X^2 = 1.585$) |
| | -Le forte II with mandibular fracture | 5 (35%) | 4 (20%) | |
| | -Le forte III with naso-orbital-ethmoid with mandibular fracture | 3 (15%) | 1 (15%) | |
| Causes of trauma | -Motor vehicle accidents | 14 (85%) | 13 (80%) | 0.62638 NS ($X^2 = 0.237$) |
| | -Occupational and falls | 2 (15%) | 3 (20%) | |
| Comorbidities | Limb fracture | 5 (35%) | 4 (20%) | 0.97 NS ($X^2 = 0.216$) |
| | Rib fracture | 2 (15%) | 1 (10%) | |
| | Extradural hemorrhage | 1 (10%) | 1 (15%) | |
| | CSF rhinorrhea | 16 (100%) | 14 (90%) | |
| Time of operation after trauma | 6 days | 7 (65%) | 9 (75%) | 0.7225 NS ($X^2 = 0.65$) |
| | 7 days | 6 (35%) | 4 (25%) | |
| | 8 days | 3 | 3 | |

$X^2$ chi-square test, *NS* non-significant

**Table 2** Operative and postoperative results of submental versus tracheostomy groups

| Parameters | Submental intubation group | Tracheostomy group | *p* value |
|---|---|---|---|
| Duration of procedure (minutes)<br>Range<br>Mean ± SD | 5–10<br>8.35 ± 1.4 | 20–37<br>30.75 ± 4 | < 0.0001 S ($T = 21.3032$) |
| Complications | Tube kinking (10%) | Surgical emphysema (15%) | |
| Scar revision | Not required | Required in 4 cases (20%) | 0.0325 S ($X^2 = 4.571$) |

$X^2$ chi-square test, S significant

Therefore, most maxillofacial trauma patients cannot be managed with orotracheal intubation, which is the standard way of securing the airway during surgical procedures [8].

So, in most cases of maxillofacial fractures, the airway is secured by NTI that does not interfere with the operative MMF and surgical approach [13]. But NTT could be kinked, occluded, or slipped during surgical repair.

Unfortunately, surgical reconstruction in patients with midfacial and panfacial fractures sometimes precludes NTI [8] and NTI is almost contraindicated in patients with associated skull base fractures because accidental passage of the tube into the cranial cavity is catastrophic [14]. In such cases of impossibility or contraindication of nasal intubation, tracheostomy is used. Tracheostomy has a 14 to 45% complication rate and its use should be judiciously considered [5, 15] besides its possible late sequels on the trachea [16].

Altemir [6] was the first to carry out his technique in submental intubation to avoid interference of endotracheal tube in the surgical field and to avoid doing a tracheostomy. He incised the skin in the submental paramedian region single finger breadth down the lower mandibular border, and then dissected through the cervical fascia and through the space between lower mandibular edge, anterior belly of digastric muscle, and mylohyoid muscle. The dissection through the floor of the mouth was done subperiosteally on the lingual surface of the mandible to avoid injury to Wharton's duct, lingual nerve, submandibular, and sublingual gland [6].

Several technique modifications were created by different authors. In the current study, we performed the incision in submento-submandibular area dissecting extraperiosteally as close as possible to the lingual surface of the mandible keeping away from the lingual nerve, salivary glands, and their ducts. One of the advantages of the technique is avoidance of intraoperative reintubation.

The midline approach was avoided because it can traumatize the Wharton's ducts, interferes with attachment of the genioglossi and geniohyoid muscles, and snug placement of the tube to the paralingual groove might also be compromised.

Injury to the mandibular lingual perforating vessels, which are present in the midline in 98% of instances [3], could lead to bleeding [17]. In the current study, and we did not encounter any significant bleeding. In all our cases, we approach fractures of the mandible through sublabial and/or percutaneous approaches [11, 18] without usage of neck incisions that could affect submental intubation.

In all of our cases, we used only one tube and the standard latero-submental approach as its complications are relatively rare and preventable with meticulous procedure [8]. Submental intubation was significantly faster than tracheostomy and used the same traditional endotracheal tube unlike tracheostomy that required tracheostomy tube. In addition, it is easy to be performed and so training on it will be easily applicable.

It is should be insured that submental intubation could not be used in patients requiring long-term airway maintenance.

Submental endotracheal intubation is a useful technique with very low morbidity and is suitable to replace tracheostomy during fixation of selected patients of maxillofacial fractures under GA, where NTI is risky or contraindicated and long-term ventilation support is not required.

In submental intubation, the patients' postoperative comfort is satisfactory, the extubation is simple, the scar is acceptable, and the possible complications of tracheostomy including the late complication are avoided. In addition, submental intubation should be the anesthesia choice in patient for whom neck extension is contraindicated or difficult that make tracheostomy is more difficult and risky.

So, surgeons and anesthesiologist should be trained and familial with submental intubation but it should be clear that if ventilator support is postoperatively needed, the surgical team should choose to do tracheostomy.

## Conclusion

Submental endotracheal intubation appeared to be a simple, safe, and significantly faster reliable alternative to tracheostomy during surgical reconstruction of selected cases of maxillofacial fractures without indication for prolonged postoperative ventilation support with significantly lower morbidity.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interests.

**Ethical approval** All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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