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A comparative study to evaluate the difference between one tube method and two tube method of submental intubation in panfacial trauma

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Abstract
Anaesthesia for pan-facial surgeries is challenging because the anaesthesiologist and surgeon have to share the common upper airway field. We used submental intubation as an alternative to tracheostomy in the airway management of patients with complex panfacial fractures. The aim of our study was to evaluate the difference between 1 tube method and 2 tube method of submental intubation in panfacial trauma. We found that the 2 tube method is always a better option than conventional 1 tube method because there are less chances of compromising the airway due to difficulty during passing the tube and it can be performed with nondetachable connector tube.

Keywords: Submental intubation, panfacial trauma, tracheostomy, one tube method, two tube method.

Introduction
Road traffic accident is the most common cause of trauma in the world today. According to the WHO Global Status Report on Road Safety, launched in December 2018, have published that deaths due to road traffic accident annually has reached to 1.35 million. And it has become the leading cause of deaths of the young age people (between 5-29 years). Half of the death burden is disproportionately borne by the pedestrians, cyclists and motorcyclists, especially in the developing countries. It is estimated that in India nearly 1.3 lakh people die of the road traffic accident every year [1, 2].

In moderate to severe road traffic accident (RTA), due to the prominent anatomical locations, maxillofacial injuries and fractures are associated. The most common site of fracture being mandible and zygomatic arch. Nearly one-fifth of all maxillofacial injuries are treated by open reduction and internal fixation under general anesthesia [3].

In pan-facial surgeries, the biggest challenge is the delivery of anesthesia, as surgeon as well as the anesthetist has to share the same common airway region, while using conventional orotracheal intubation interferes with the surgical access of the operative field. It is also not opted in the management of temporary intramaxillary and maxillomandibular fixation of teeth as need for alignment check of fragments is there. In such cases, the nasotracheal intubation, tracheostomy, retromolar intubation and submental intubation become the preferred choices.

Nasotracheal intubation is not indicated in the case of pan-facial fracture, cervical spine injury, cranial base fracture with or without CSF rhinorrhea, haemocoagulatory dysfunction, blurred nasal area, and nasal packing. This can contribute to epistaxis, sinusitis, meningitis, sepsis, adenoid damage, dislodging of bone fragments, and occasionally intracranial intubation [3, 4].

In such patients, tracheostomy is an excellent method for airway establishment in both routine and emergency cases. However, it may be associated with immediate and/or late complications. Immediate complications are reported in nearly 6-8% patients which includes hemorrhage, surgical emphysema, pneumothorax, pneumomediastinum, and recurrent laryngeal nerve palsy. Delayed complications constitute about 60%, which includes stomal and respiratory tract infection, tube blockage, dysphagia, difficulty with decannulation, tracheal erosion, tracheal stenosis, tracheo-esophageal fistula and suboptimal visible scar [3, 5].

In patients, where nasotracheal intubation or tracheostomy cannot be performed, an alternative technique of airway management in pan-facial trauma available is the submental intubation. Francisco Hernandez Altemir, a Spanish faciomaxillary surgeon described this method in 1986, which gives excellent operative field access allowing for temporary intraoperative intermaxillary fixation without restoring to tracheostomy insertion [6].

But Altemir submental intubation has one bottle neck that it cannot be performed with the use of non-detachable connector tube and as such routine availability of armored detachable connector tubes is not there in the operating room. Later in 1996, Green and Moore *et al.* described a modification to the original technique which is known as Two Tube Method, in this technique an additional tube is inserted intraorally through submental incision and the first tube is replaced [6, 7].

The advantages of submental intubation are that it is easy to perform with minimal scar formation. There is minimal soft tissue distortion, no motor and sensory deficit, postoperative care is not needed much, cost effective, requiring lesser hospital stay and the most important there is uninterrupted surgical access. But there are few disadvantages of using submental intubation, these are there is an increase in airway pressure, it is not feasible for repeated operation and reexploration and it is not allowed to be kept beyond 7 days after insertion.

In the present study, we performed submental intubation with conventional one tube method and two tubes method (one antegrade and other retrograde), as it is thought that the later causes less hypoxia and in case of difficulty in retrieval, there is no need for detaching the connector.

In the present study, we tried to assess the feasibility and safety profile of submental intubation by 1 tube method and 2 tube methods, in panfacial fractures in nasoethmoidal region simultaneously with management of other Le Forte II and Le Forte III type fractures and to evaluate the overall outcome of airway management in such patients.

Aims and objectives

Primary objective

To evaluate the difference between one tube method and two tube method of submental intubation

Secondary objective

- To evaluate the haemodynamic variable and safety of submental intubation by both method.
- To evaluate the outcome of airway management in patient with pan facial fracture by submental intubation.

Material and methods

The present prospective, randomized study entitled "A comparative study to evaluate the difference between one tube method and two tube method of submental intubation in panfacial trauma" was carried out in the department of Anaesthesiology, Maharaja Yashwantrao Hospital, Indore (M.P.) from June 2018 to June 2019, wherein we had included 40 patients who were randomized into two groups of 20 patients each. Group 1 underwent 1-tube submental intubation and Group 2 underwent 2-tube submental intubation. Sample size calculation was based on convenient sampling technique.

All the patients with pan-facial fracture, including Le Forte II, Le Forte III, with naso-orbital ethmoidal fracture of ASA I and ASA II requiring surgical correction, were included in the study who were willing to provide their voluntary written informed consent form to participate in the study.

All those patients who were having severe neurological damage or major thoracic trauma, or history of keloid formation and those not willing to participate in the study were excluded from the study.

Prior to the initiation of the study in the institution, an approval from the Institutional Ethics Committee was obtained and then only study was initiated. Also prior to performing any study related procedures, a voluntary written informed consent was obtained from the patient and/or his/her legally acceptable representative after explaining them in detail about the study, procedures, risks / benefits etc.

Methodology

Preoperative preparation: All the patients were kept nil by mouth for 6 hours. Face preparation (shaving of the operative area) was done, patients were given preoperative antibiotics and half-an-hour prior to taking the patient for surgery mouthwash with chlorhexidine was done.

Premedication with injection glycopyrrolate 0.04 mg/kg, injection midazolam 0.05 mg/kg, injection ondansetron 4 mg and injection pantoprazole 40 mg was done.

After preoxygenation with 100% oxygen for 5 minutes, induction was done as per normal general anaesthesia protocol.

Surgical technique

Procedure for insertion of one tube

Airway was secured with orotracheal intubation and tube was fixed temporarily with the help of adhesive.

For submental intubation, the positioning of the patient was done with head extended with the help of shoulder pad.

Skin preparation of perioral region and chin was done with 10% iodine solution under full aseptic precautions and draped with sterile towel.

The incision site was marked with skin marker.

Local infiltration at the site of incision done with lignocaine 2% with adrenaline.

Subsequently, a 2 cm skin incision was made in the paramedian submental region, medial and parallel to the inferior border of the mandible

This was deepened using blunt dissection up to the oral cavity.

The breathing circuit was detached from the tube and universal connector of the flexometallic endotracheal tube was removed.

The pilot balloon followed by the outer end of the tube was brought out using an artery forceps through the incision, while stabilizing the tracheal end of the tube using a Magill's forceps.

Connector followed by Bain circuit was reattached to the tube and bilateral air entry was checked and the tube was fixed using skin suture and adhesive material.

At the end of the surgery, breathing circuit was detached from tube and the pilot balloon and the outer end of the tube was pulled back into the oral cavity, stabilizing the tracheal end with Magill's forceps and thus sub mental intubation was converted into orotracheal intubation.

After return of oropharyngeal reflexes and reversal, extubation was done uneventfully in the operation theatre.

Skin wound was closed under local anaesthesia with 2% xylocaine infiltration using suture with full asepsis.

Procedure for insertion of two tubes

After the local infiltration a 2 cm skin incision was made in the paramedian submental region, medial and parallel to the inferior border of the mandible under full aseptic precaution. A curved artery forceps was inserted through the platysma and mylohyoid muscles, as closely as possible to the lingual surface of the mandible to avoid the injury to the lingual nerve, sublingual gland and submandibular duct.

While the tongue was pushed backward, the tip of the artery forceps was visible just below the mucosal layer in the floor of the mouth. An incision was made over the top of the tip of the artery forceps, located antero-lateral to the wharton`s duct papillae.

The second long artery forceps was grasped by first forceps and taken out from the incision to the extraoral site to grasp the second endotracheal tube which was the flexo-metallic type or spiral embedded tube.

Now, the second tube was passed into the mouth from the outside to inside via incision with the help of long artery forceps and kept in the position in oropharynx with the help of magill forceps and ventilation was continued with the first tube.

The orotracheal tube was then removed and second tube was advanced into the trachea with Magill forceps.

The breathing circuit was reconnected with this submental tube and tube was fixed with 2-0 silk suture after confirmation of the correct position of tube.

At the end of the surgery reversal was done after return of proper reflexes. Extubation was done uneventfully through the external skin incision only.

Skin wound was closed under local anaesthesia with 2% xylocaine infiltration using suture with full asepsis.

Postoperative follow up done for immediate complications during hospitalized period and for late complications up to 6 months follow-up was done.

Outcome measures

Mean pulse rate, systolic blood pressure, diastolic blood pressure, respiratory rate, oxygen saturation and ETCO2 were recorded after primary intubation, during secondary intubation and after induction, time of procedure, assessment of operative field based on surgeon's opinion, ease of procedure based on surgeon's opinion and any adverse events noted during the procedure, formed our outcome measures.

Statistical analysis

The descriptive and inferential statistics was used in the present study. Age, opinion regarding operative field, opinion regarding ease of procedure, adverse events were presented in the form of numbers and percentages. Comparison of mean pulse rate, systolic blood pressure, diastolic blood pressure, respiratory rate, oxygen saturation and $ETCO_2$ within the group was done using Paired't' test. Association between age, opinion regarding operative field, opinion regarding ease of procedure and adverse events with groups (1 tube group and 2 tube group) was seen using Pearson Chi-square test. A p value of < 0.05 was taken as statistically significant.

Results

Demographic variables

In 1-tube group, there were 10% patients in the age group 18-20 years, 50% in 21-30 years, 20% in 31-40 years, 10% in 41-50 years and 10% in more than 50 years age group. In 2-tube group, there were 10% patients in the age group 18-20 years, 40% in 21-30 years, 30% in 31-40 years and 20% in 41-50 years age group.The mean age in the 1-tube group was 32.10 ± 11.45 years and in the 2-tube group it was 32.65 ± 10.09 years. The difference was found to be statistically not significant (p=0.873), showing a comparable mean age between the two groups. (Table no 1)

Table 1: Distribution of patients according to age

Age Group	1 Tube Group		2 Tube Group	
	No.	%	No.	%
18-20 years	2	10.0	2	10.0
21-30 years	10	50.0	8	40.0
31-40 years	4	20.0	6	30.0
41-50 years	2	10.0	4	20.0
>50 years	2	10.0	0	0.0
Total	20	100.0	20	100.0
Mean age (±SD)	32.10 ± 11.45		32.65 ± 10.09	
't' value, df	-0.161, df=38			
P value	0.873, Not significant			

Comparison of vitals

a) Pulse rate

1. **tube group:** The mean pulse rate was significantly higher during secondary intubation in comparison to the period of after primary intubation and after induction ($p<0.05$).
2. **tube group:** The mean pulse rate was significantly higher during secondary intubation in comparison to the period of after primary intubation and after induction ($p<0.05$).

b) Systolic blood pressure

1. **Tube group:** The mean systolic blood pressure was comparable at different time interval. The difference was found to be statistically not significant (p>0.05).
2. **Tube group:** The mean systolic blood pressure was comparable at different time interval. The difference was found to be statistically not significant (p>0.05).

c) Diastolic blood pressure

1. **Tube group:** The mean diastolic blood pressure was comparable at different time interval. The difference was found to be statistically not significant (p>0.05).
2. **Tube group:** The mean systolic blood pressure was comparable at different time interval. The difference was found to be statistically not significant (p>0.05).

d) Oxygen saturation

1. **tube group:** The mean SpO_2 was significantly lower during secondary intubation in comparison to the period of after primary intubation and after induction ($p<0.05$)
2. **tube group:** The mean SpO_2 was comparable at different time interval. The difference was found to be statistically not significant (p>0.05).

e) $ETCO_2$

1. **Tube group:** The mean $ETCO_2$ was significantly higher during secondary intubation in comparison to the period of after primary intubation and after induction ($p<0.05$).
2. **Tube group:** The mean $ETCO_2$ was comparable at different time interval. The difference was found to be statistically not significant (p>0.05).

Time of procedure

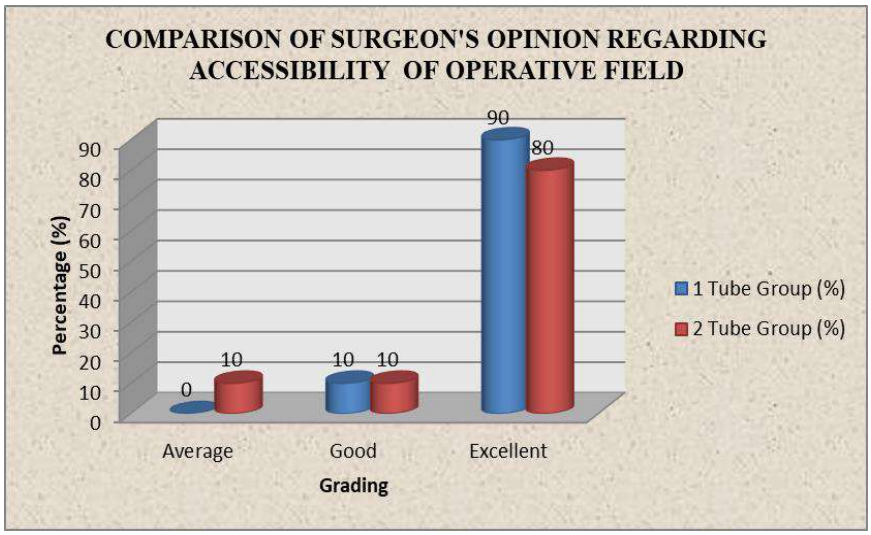
The mean time of procedure in the 1-tube group was 5.50 ± 1.42 minutes and in the 2-tube group it was 3.55 ± 0.99 minutes. The difference was found to be statistically significant (p=0.001), showing a higher mean time of procedure in the 1-tube group. (Table no 2)

Table 2: Comparison of mean time of procedure between the two groups

Time of Procedure	1 Tube [Mean±SD] (n=20)	2 Tube [Mean±SD] (n=20)	't' value	P value
Time of Procedure (min)	5.50 ± 1.42	3.55 ± 0.99	5.037, df=38	0.001*

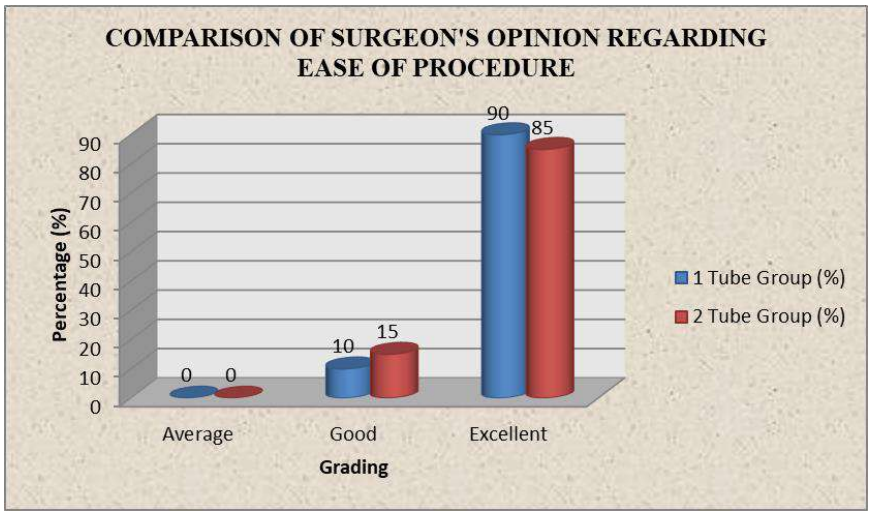
Unpaired't' test applied. *P* value < 0.05 was taken as statistically significant

Surgeon's opinion regarding accessibility operative field



Graph 1: Bar diagram showing comparison of surgeon's opinion regarding accessibility of operative field

Surgeon's opinion regarding ease of procedure



Graph 2: Bar diagram showing comparison of surgeon's opinion regarding ease of procedure

Adverse events

In the **1-tube group**, all the patients (i.e. 100%) patients had scar formation, 5% had infection and 10% patients had other type of problems which included pilot balloon damage during the procedure, while in the 2-tube group, 100% patients had scar formation and only 5% patients had infection. In both the groups, scar formation was the commonest adverse event seen.

Discussion

We report our experience of submental intubation in the airway management of patients with panfacial fractures. We studied 40 patients, 20 patients in 1 tube method group and 20 patients in 2 tube method groups. In both group majorities of the patients were in the age group 21-30 years. GDS Kalra *et al*. conducted the study of submental intubation in 40 patients of maxillofacial trauma out of which majority of the patients (65%) were in the age group of 18-30 years [8].

In our study we compared the mean value of various hemodynamic parameters like pulse rate, systolic blood pressure, diastolic blood pressure, blood oxygen saturation and end tidal CO_2 at different time interval within the group in both group 1 and group 2.

In 1 tube group there was significant changes (p value < 0.05) in mean value of pulse rate, SPO2 and ETCO2 seen during the secondary intubation as compared to after primary intubation and after induction. While in the 2 tube group significant changes was seen only in mean value of pulse rate during secondary intubation as compare to after primary intubation and after induction.

These finding correlate with the study of Sahand Samieirad *et al*. and Manish Banjare and Deepak Sharma who found that the double tube method is safe and even easier than conventional 1 tube method [5, 9].

In our study the mean duration of secondary intubation (submental intubation) in 1 tube group was 5.50 ± 1.42 minutes and in the 2-tube group it was 3.55 ± 0.99 minutes, showing a higher mean time of procedure in the 1-tube group. These finding is correlated with the case series of N. Kishoria *et al*. in which the duration of submental intubation was 8-10 min who used one tube method [10].

In our study, we used the paramedian approach for submental incision because (1) incision scar is hided better in paramedian region as compare to midline approach and, (2) there is less chances of injury to the wharton's duct, geniohyoid and genioglossus muscles, as compared to midline approach [11].

The complications of submental intubation include infection in the floor of the mouth, infection of the submental wound, salivary fistula, development of mucocele and facial scarring.[14] Infection of submental wound developed in two patient of our study, one patient in each group. The wound was cleaned and dressed with 10% iodine solution. Healing was achieved in 4-5 days. Ryosuke Kita *et al*. conducted the study of submental intubation in 30 patients, out of which, two patients developed submental wound infection [12].

ETT can be damaged during the manipulation through the incision, so that the surgical dissection should ensure enough space to retrieve the pilot balloon and the tube easily. In our study in 1 tube group there was damage of pilot balloon while pooling the tube out through the submental incision in two cases. We were inflate the cuff with the help of syringe and occluded the pilot balloon tip with an artery forceps in both cases and we found the pilot balloon remained inflated. Throat packing was done properly with no air leak was present. Geeta Patkar *et al*. and Drolet *et al*. evidenced damage to pilot cuff while pulling it through the submental incision. While there was no evidence of pilot balloon damage reported in 2 tube groups [13, 14].

Conclusion

Submental intubation is as easy and safe method of intubation to provide the unobstructed surgical field for the surgery. Two tube method is always a better option than conventional one tube method because there are less chances of compromising the airway due to difficulty during passing the tube because ventilation is continued from the orotracheal tube in 2 tube method and submental intubation can be performed with nondetachable connector tube in 2 tube method. The average time in performing 2 tube method of submental intubation was less than the conventional 1 tube method.

Conflict of interest: None
Sources of funding: None

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