Al-Azhar Med. J. *July, 2015, 133-142*
DOI: 10.12816/0018607 ***Issues_title_English:*** 2015 Vol.44 Issue 2-3

USE OF THE RING-ADAIR-ELWYN (RAE) TUBE AS AN ALTERNATIVE FOR FLEXIBLE REINFORCED ARMORED TUBE FOR SUBMANDIBULAR APPROACH FOR ENDOTRACHEAL INTUBATION TO AVOID SURGICAL INTERRUPTION IN PATIENTS WITH PANFACIAL FRACTURES

By

Tarek Abdel-Salam Seleem*, Samy Eleowa and Ahmed Taha****

*Departments of Anesthesia & Intensive care; **Plastic Surgery & Burn,
Faculty of Medicine, Al-Azhar University

ABSTRACT

Background: Maxillofacil and dental surgery are challenges for the anesthetist, because the surgical procedures are just around the upper airway. So, the corner stone in the maxillofacial surgical patients is the patient safety during and after operation. Previous studies recommended the use of reinforced armored tube for submandibular tracheal intubation in maxillofacial surgical patients. The current study tested the RAE tube as an alternative technique to armored tube in the submandibular route for tracheal intubation in maxillofacial surgical patients.

Objectives: The study aimed to compare the RAE tube as an alternative to flexible reinforced armored tube in submental endotracheal intubation in maxillofacial surgery.

Methods: A total of thirty patients had undergone submental intubation for management of maxillofacial surgical procedures. The submandibular intubation by RAE tube was chosen in 15 patients as an alternative for flexible armored tube in another 15 patients when the oral and nasal intubation was not suitable and not safe for the surgical procedure. We excluded "from the start" the patient that required prolonged assisted ventilation because the tracheostomy is the preferred choice for all.

Results: From November 2013 to November 2014, thirty patients with traumatic panfacial fractures were admitted to the Plastic Surgery and Burn Department at Al-Azhar University Hospitals within the subspeciality of Maxillofacial Surgery. Endotracheal oral intubation by laryngoscope was successful in all patients of the studied groups. No statistical difference was recorded between the studied groups as regard the time of intubation (9-13min), and no recorded intraoperative or postoperative major complications. Both types of the tube provided secured airway and an uninterrupted surgical access to the oral and nasal cavity. Also, it carried an access for good hemostasis and allowed intraoperative control of dental occlusion. The technique was found to be easy and convenient with uneventful intraoperative and postoperative periods. The technique was satisfactory to the surgeon, the anesthetist, the patients and the relatives.

Conclusions: Submandibular tracheal intubation by RAE tube is an effective and useful technique for airway control in maxillofacial surgery. It can be used as a good alternative to reinforced armored tube in maxillofacial surgical patients.

Keywords: Complications, airway; submental; tracheal intubation; RAE tube, maxillofacial surgery.

INTRODUCTION

Patient safety during and after operation are challenge for the anesthetist in the maxillofacial surgical patients as the surgical procedures just around the upper airway. Maximum patient safety with minimal interruption to the surgery is the action of teamwork between the surgeon and the anesthetist. A talented skillful cooperation and distinctive experience are required for maxillofacial anesthetist due to incorporated unique airway problems through the surgical procedure **(Haddock and Barnard, 1993)**.

Maxillofacial operation needs a special maneuver that can interfere with the standard oral route for tracheal intubation. Maxillofacial injury may be associated with skull base fracture which is contraindicated for nasal intubation. The tracheostomy is an alternative option to the oral and nasal intubation **(Mak & Ooi, 2002 and Saravanan & Arrowsmith, 2005)**.

However, the tracheostomy carries a high risk of complications, especially in children, obese patients, and patients with an enlarged thyroid gland **(Durbin, 2005)**. The immediate perioperative complications of tracheostomy include loss of airway, arterial desaturation, hemorrhage, subcutaneous emphysema, pneumomediastinum, pneumothorax, and recurrent laryngeal nerve damage, with incidences ranging from 6–8%. Late complications, including stomal and respiratory tract infections, tracheal stenosis, tracheoesophageal fistula, and ugly scar can reach an incidence as high as 60% **(Jafar et al., 2013)**.

A series of previous studies suggested an alternative method for tracheostomy through introducing the tracheal tube through the submental **(Hernandez Altemir, 1986)** or a submandibular **(Stoll et al., 1994)** incision to bypassing the surgical area as a way to avoid the complications of tracheostomy. Elective use of submental endotracheal intubation approach in maxillofacial surgery has been described as efficacious and beneficial to the surgeons where an unobstructed oral or nasal cavity was observed **(Santosh & Gopendra, 2012 and Joseph Raajesh et al., 2013)**.

The study aimed to compare the RAE tube as an alternative to flexible reinforced armored tube in submental endotracheal intubation in maxillofacial surgery.

PATIENTS AND METHODS

The study was approved by the Local Ethical Committee in the Anesthesia and intensive care Department at Al-Azhar University Hospitals. An informed consent was obtained from each patient after detailed discussion. A total of thirty patients of both sexes with maxillofacial surgery scheduled for submental intubation were reviewed prospectively from November 2013 to November 2014. Age of the patients ranged from 18 to 55 years. When the oral intubation was unsuitable and the nasal intubation was contraindicated or impossible for the surgical procedures, the patients were included in the study, where it excluded patients' required prolonged assisted ventilation, such as multitraumatized patient, severe neurological damage or major thoracic trauma, where the tracheostomy was a preferred choice for

them. Under general anesthesia, the selected patients were classified into two equal groups, i.e. armored group: randomly scheduled for submental intubation with flexible armored tube, and RAE group: randomly scheduled for submental intubation with oral RAE tube.

The operator (anesthetist) carefully prepared an appropriate size armored tracheal tube (Figure: 1-A) for the armored group by removing its universal fixed connector to become removable but fitting connector. For the RAE group, a proper size cuffed oral RAE tube was prepared (Figure 1 - B).

After induction of the same standard anesthetic technique for all patients, orotracheal intubation was performed firstly to secure the patient's airway because the studied technique requires a time. After standard endotracheal intubation and confirming the position of the tube in both groups, the anesthetist perform an external incision under complete aseptic conditions at 2 cm lateral to median line on the right side of the lower border of the mandible at the posterior submandibular region to avoid an injury to the mandibular branch of the facial nerve (Figure 2).

The operator dissected bluntly the skin, subcutaneous tissue, platysma, deep cervical fascia and mylohyoid planes in an upwards direction towards the mouth cavity by medium-sized curved artery forceps (pedicle clamp) to reach the oral mucous membrane (Figure 3, 4). Tunnel for the endotracheal (ET) tube was created by repeated opening of the pedicle clamp to pass through it.

After ventilating the patient with 100% oxygen and isoflurane for 5 minutes, pilot balloon of the selected tube was first grasped and brought out through the skin incision (Figure 5). This was followed by supporting the tube in the oro-pharynx by the tip of the anesthetist's index finger under direct vision using the laryngoscope. The removable connector was detached followed by disconnection of the tracheal tube from the ventilator by the assistant. The pedicle clamp was reintroduced again through the tunnel to grasp the distal end of the ET tube (Figure 6). The tube was reconnected to the ventilator after reconnecting the removable connector and suction of the blood from the end of the tube (Figure 7).

Endobronchial intubation was diagnosed by ultrasonographic scans (taking 30 seconds or less) to confirm the tracheal placement.

The tube was secured at the skin exit site with a strong silk stay suture followed by circumferentially adhesive tape applied to the tube over the stay suture (Figure 7). A pharyngeal pack was then inserted to seal the blood and debris during surgery. The anticipated procedure was carried out after completion of submandibular intubation where the final position of the submandibular endotracheal intubation was shown in (figure 8).

At the end of the operation, after removal of the tube connector, the tracheal tube was pulled in reverse order from the tunnel to the oral cavity followed by the pilot balloon. However, the tube can lift in place during the early postoperative period if the patients need a postoperative control of the airway. The submandibular skin incision was sutured.

The data recorded included demographic data of the patients (age, sex,

weight, type of fracture), time required for intubation (start from skin incision to fixation of the tube by adhesive plaster), intraoperative complications (obstruction, kinking, migration, disconnection or difficult suction) and postoperative complications related to submental intubation approach. Anesthetists' and surgeons' satisfaction were recorded in both groups.

Data were analyzed using SPSS version 18.0. Qualitative data were expressed as frequency and percentage while the quantitative data were expressed as mean ± SD. Chi-square test was used in order to compare proportions between two qualitative parameters. A probability value <0.05 was considered statistically significant.

RESULTS

The demographic data of patients in both groups showed no statistical difference between them as regard age, sex, weight and type of fracture (Table 1).

Table (1): Demographic data for patients in both groups.

Groups / Parameters	Armored Group (No. 15)	RAE Group (No. 15)	P value
Age (year)	36.8±14.2	38.2±13.2	0.211
Sex			
Number (male/Female)	11/4	10/5	0.690
Percentage (%)	73.33% : 26.66%	66.66% : 33.33%	
Weight (kg)	78.8±14	76.9±16.2	0.192
Type of fracture			
Panfacialwith fracture base of the skull	9	7	0.464
Mandibular fractures with fracture base of the skull	4	6	0.439
Postburn scar of the face	2	2	1.000

Endotracheal oral intubation by laryngoscope was successful in all patients of the studied groups except 4 patients who had post-burn scar in the face which needed fibrotic intubation. Submandibular intubation was performed successfully on 14 patients of the armored group and 13 patients of RAE group (93.3% and 86.7% respectively).

As regard the time of submandibular intubation (start from skin incision to fixation of the tube by adhesive plaster) no statistical difference was recorded between the studied groups (9-13min).

As regard the intraoperative complications, no major complication were recorded except 2 patients in the RAE group complaining of intraoperative obstruction where the problem was solved simply, where the anesthetist asked the surgeon to reposition of the instrument. Another 2 patients complained of difficult suction that simply was solved by straitening the RAE tube. As regard the disconnection at the level of removable connector that recorded in one patient in every group, it was prevented by fixation of the connector with the tube and anesthesia circuit by adhesive silk plaster all-over the procedure.

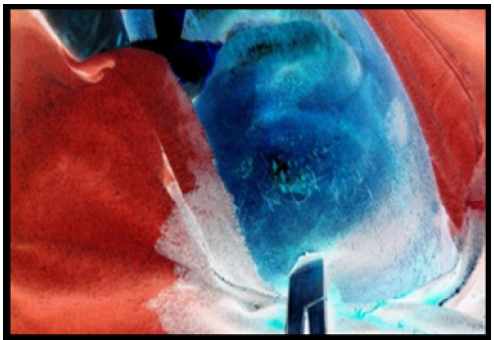

Figure (3): Curved artery forcepsin the submandibular incision

Figure (4): Curved clamp in the mouth cavity

Figure (5): Sliding of the pilot baloon throgh the submandibular incision

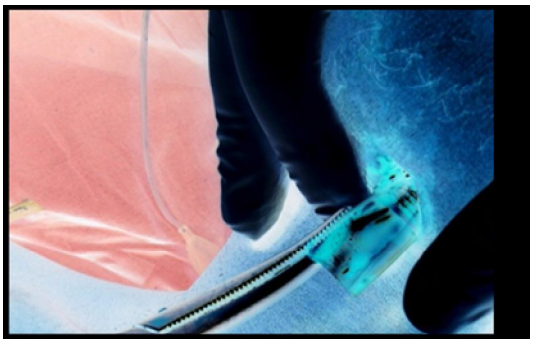

Figure (6): Sliding of the endotracheal tube through the Submandibular incision

Figure (7): Fixation of the endotracheal tube in the skin

Figure (8): The final position of the submandibular endotracheal intubation

As regard the previous data, both types of the tubes provided secured airway and an uninterrupted surgical access to the oral and nasal cavity. Also, it carried an access for good hemostasis and allowed intra-operative control of dental occlusion. The technique was found to be easy and convenient with uneventful intraoperative and postoperative periods.

Table (2): Intraoperative complications of the studied groups**.**

Parameters \ Groups	Armored Group (No. 15)	RAE Group (No. 15)	P value
Obstruction (through the oral cavity)	0	2	0.143
Kinking (outside and inside the oral cavity)	0	0	--
Migration (endotracheal migration)	0	0	--
Disconnection (at the removable connector)	1	1	1.000
Difficult suction (through the tube)	0	2	0.143

No major postoperative complications occurred to our patients and postoperative follow up examinations revealed no injury to any of the adjacent structures. Only two of the studied patients had postoperative superficial infection that responded well (within 3-4 days) to a local treatment in the form of cleaning of the infected wound with antiseptic solutions, drainage, and daily dressing. The technique was satisfactory to the surgeon as regards the accessibility to the surgical field and to the anesthetist concerning the safety of the patient's airway, where all the intraoperative complications that recorded in the RAE group were solved simply by simple maneuvers. Also, all patients and relatives accepted the performance of the technique well and appeared satisfied as tracheostomy was avoided with the lack of scarring (Table 2).

DISCUSSION

Airway management in patients with panfacial fracture is a challenge for both the anesthetist and the surgeon, and it requires good harmony between them. In most cases of maxillofacial region, the airway can be initially secured by oral/nasal endotracheal intubation (**Arti et al., 2015)**. Nasal endotracheal intubation is often contraindicated in the presence of fracture of base of the skull (**Sarita et al., 2014)**. Comminuted midfacial fractures cause physical obstruction to the passage of nasotracheal tube. Further, the presence of nasotracheal tube can interfere with surgical reconstruction of fractures of the naso-orbital ethmoid (NOE) complex, so, the surgical repair of maxillofacial trauma requires modification of the standard anesthesia technique (**Arti et al., 2015)**.

Submental intubation (SMI) has been regularly practiced as a method of securing airway in complex faciomaxil-

lary surgeries where nasal intubation is considered contraindicated. Flexible reinforced armored tube has been used routinely for submental intubation to avoid compression by the acute angulations at the submental incision site (**Joseph Raajesh et al., 2013**). Reinforced armored tubes do not get compressed by the acute change of angle that is produced when they traverse orocutaneous plane at the site of submental incision. So, it has been used routinely for this route (**Sarita et al., 2014)**.**Green and Moore (1996)** suggested using two tubes, a conventional orotracheal tube that secure the patient's airway where the second reinforced armored tube was passed from exterior to interior through the incision. The MaGill forceps was used to manipulate the second tube (just after removal of the first tube) into the oro-pharynx to guide it inside the vocal cords and then into the trachea. This technique can overcome the problem of the non-removable connector of the second reinforced armored, but it still carries a drawbacks of damaged cuff of the reinforced armored tracheal tube during the vigorous manipulation by the MaGill forceps. **Drolet et al.(2000)** advocated another modification to avoid the use of the MaGill forceps through lubricated tube exchanger to replace the submental tracheal tube with a fresh reinforced armored tube. **Amin et al. (2002)** used a 100% silicone wire reinforced tube with a removable connector, originally designed for use with the incubating laryngeal mask airway.

Kink resistant preformed angle in RAE tubes make it as considerable option for this purpose. The oral RAE tracheal tube characterized by its unique design that assures patent airway while reducing risk of kinks and disconnects through a performed curve removes circuit from the surgical field. Its curve can be temporarily straightened to allow easy passage of suction catheters. The correct position of the tube was confirmed by rectangular mark aids at the preformed curve. The RAE tubes may offer an additional advantage to the reinforced tubes as low cost nature, presence of the preformed curve at the submental incision and ease removal of the tube connector (**Joseph Raajesh et al., 2013**).

Kink resistant preformed angle in RAE tubes helped **Joseph Raajesh et al. (2013)** to consider it as an option for this purpose where they used it in 3 cases only. In agreement with the current study, they concluded that the procedure did not pose any difference or difficulty from the routine submental intubation done with reinforced armored tube. Also, the removable connector and the low cost nature and easy availability of the RAE tubes may offer an additional advantage to the reinforced armored tubes.

Total duration for submental positioning of the tube (in the current study) ranged from 8 minutes to 14 minutes in both groups, but there was no need for removing of the connector in RAE tube that release time and effort. The mean time required for the procedure in the study of **Ramakrishna et al. (2011)** was 10 min which was in agreement with the current study.

In the present study, the posterior submandibular approach that was considerably far away from the potential complications of submaxillary duct and sublingual gland involvement was used.

Complications were rare because the area did not have any large vessels or nerves.

The study reported that the technique was easy and effective. Also, it appeared safely as regards the patient's airways where it provides an excellent approach to the whole face, and the oral cavity without interruption to the surgical field by the tube. It is possible to perform an intermaxillary fixation without the need for tracheostomy. Good communication between the surgeon and anesthesiologist was essential to minimize the potential complications. The tube was further negotiated so that the distal curve of the angle was placed at the external incision. This provided a clear surgical field and ability to treat all the injuries in single surgery. This was in agreement with ***Carlos and Degrandi.*** **(2015).**

No reported airway complications or hypoxic episodes during passing of the tube through the incision or during the surgical procedure. No recorded major post-operative complications like injury to Wharton's duct, mucocele, hemorrhage or prolongation in hospital stay. This was in agreement with **Joseph Raajesh et al. (2013)** and **Sarita et al. (2014)**.

CONCLUSION

Submandibular tracheal intubation by RAE tube was an effective and useful technique for airway control in maxillofacial surgery and there was no difference between it and the flexible reinforced armored endotracheal tube. Availability of the RAE tube and low coast made it a good alternative to reinforced armored tube in maxillofacial surgical patients.

REFERENCES

1. **Amin M, Dill-Russell P, Manisali M, Lee R and Sinton I. (2002):** Facial fractures and submental tracheal intubation. Anaesthesia, 57:1195-9.
2. **Arti C, Grandim B V, Vikas S, Praveen A and Rohit S. (2015):** Submandibular intubation in pan-facial trauma patients: an alternative approach for intraoperative airway management. International Journal of Research and Development in Pharmacy and Life Sciences, 1549-1558.
3. **Carlos R and Degrandi O. (2015):** Submental tracheal intubation for a patient with multible facial fractures. Anesthesiology News Airway Management, 8 (44):71-2.
4. **Drolet M, Girard J, Poirier Y and Grenier S. (2000):** Facilitating submental endotracheal intubation with an endotracheal tube exchanger. Anesth Analg., 90: 222-223.
5. **Durbin CG, Jr. (2005):** Early complications of tracheostomy. Respir Care, 50: 511–5.
6. **Green JD and Moore UJ. (1996):** A modification of sub-mental intubation. Br J Anaesth., 77(6):789-91.
7. **Haddock AR and Barnard NA. (1993):** Maintaining the airway during the treatment of severe facial injuries. Br Dent J., 174: 56–7.
8. **Hernandez Altemir F. (1986):** The submental route for endotracheal intubation. A new technique. J Maxillofac Surg., 14: 64–5.
9. **Jafar HF, Moustafa AA, Aziz D, Ismail F, Hesham E, Yasir A and Firas N. (2013):** Submandibular intubation; our experience in Qatar and a short review of literature, Egyptian Journal of Ear, Nose, Throat and Allied Sciences, 119–121
10. **Joseph Raajesh I, Tripathy Debendra K, Devakumari S and Ravindra Bhat R. (2013):** Modification of submental intubation using oral Ring‑Adair‑Elwyn tubes in faciomaxillary surgeries: A novel approach (Letters to Editor) Indian Journal of Anaesthesia, 57(4): 418-19.
11. **Mak PH and Ooi RG. (2002):** Submental intubation in a patient with beta-thalassaemia

major undergoing elective maxillary and mandibular osteotomies. Br J Anaesth., 88: 288–91.

12. **Ramakrishna S. Shenoi, Samprati J. Badjate, Nilima J and Budhraja S. (2011):** Submental orotracheal intubation: Our experience and review Annals of Maxillofacial Surgery, 1(1): 37-41.

13. **Santosh KY and Gopendra D. (2012):** Submental Intubation Including Extubation: Airway Complications of Maxillomandibular Fixation, Hindawi Publishing Corporation Case Reports in Anesthesiology,10 (37):53-6.

14. **Saravanan P and Arrowsmith JE. (2005):** Retrograde submental intubation after faciomaxillary trauma. Anesth Analg., 101: 1892–4.

15. **Sarita G, Pranav P, A Nayyar and Sanjeevani K. (2014):** Submento-submandibular approach for tracheal intubation. International Journal of Medical Science and Public Health, 3(6): 741-45.

16. **Stoll P, Galli C, Wachter R and Bahr W. (1994):** Submandibular endotracheal intubation in panfacial fractures. J Clin Anesth., 6: 83–6.

[illegible] (RAE) [illegible]

طارق عبد السلام سليم* - سامى عليوة - أحمد طه****

***قسم التخدير والعناية المركزة و **قسم جراحة التجميل والحروق**

كلية الطب - جامعة الأزهر

خلفية البحث: جراحة الوجه والفكين تشكل تحديا لأطباء التخدير لأن العمليات الجراحية تكون قريبة جدا من المجرى الهوائى. لذا، فإن حجر الزاوية بالنسبة للمرضى فى عمليات جراحة الوجه والفكين هو سلامة المريض أثناء وبعد العملية. وقد أوصت دراسات سابقة باستخدام الأنبوبة الحنجرية المدرعة تحت الفك السفلي لتصل إلى القصبة الهوائية في مرضى عمليات جراحة الوجه والفكين." لذلك" تختبر الدراسة الحالية أنبوبة RAE باعتبارها تقنية بديلة للأنبوبة المدرعة في إستعمالها تحت الفك السفلي لتصل إلى القصبة الهوائية وذلك في مرضى عمليات جراحة الوجه والفكين.

الهدف من البحث: المقارنة بين أنبوبة RAE كبديل للأنبوبة المرنة المدرعة في إستخدامها تحت الفك السفلى كطريقة للوصول إلى القصبة الهوائية في جراحة الوجه والفكين.

المرضى وطرق عمل البحث: تم إختيار ثلاثين مريضا يعانون من كسور فى الوجه والفك العلوى يخضعون لطريقة تركيب الأنبوبة الحنجرية تحت الفك السفلى لتصل إلى االقصبة الهوائية وذلك لإدارة العمليات الجراحية فى الوجه والفكين. وقد تم اختيار طريقة تركيب الأنبوبة الحنجرية تحت الفك السفلي بواسطة أنبوبة RAE في خمسة عشر مريضا،وفى خمسة عشر مريضا أخرى تم إختيار التنبيب تحت الفك السفلى بواسطة الأنبوبة المرنة المدرعة. وتستخدم هذه الطريقة عندما تكون طريقة تركيب الأنبوبة الحنجرية عن طريق الفم أو الأنف غير مناسبة وغير آمنة لإجراء العمليات الجراحية فى الوجه والفكين. وقد استثنينا فى هذه الدراسة "منذ البداية" المرضى الذين تتطلب حالتهم التهوية المساعدة لفترات طويلة لأن الشق الحنجرى للقصبة الهوائية هو الخيار المفضل لهم.

النتائج: كانت طريقة تركيب الأنبوبة الحنجرية عن طريق الفم بإستخدام المنظار الحنجرى ناجحة في جميع مرضى المجموعتين ما عدا أربعة مرضى تم تركيب الأنبوبة الحنجرية لهم بإستخدام منظار القصبة الهوائية الضوئى المرن. لم يتم تسجيل فارق إحصائي بين المجموعتين من حيث الوقت المستغرق لتركيب الأنبوبة تحت الفك السفلى (9-13دقيقة) وكذلك لا فرق بينهما من حيث حدوث مضاعفات أثناء أو بعد العملية الجراحية. كلا النوعين من الأنابيب الحنجرية التى تم دراستها توفر مجرى هوائى آمن ومضمون مع سهولة الوصول إلى الحقل الجراحي فى تجويف الفم والأنف دون إنقطاع. وتوفر أيضا، سهولة الوصول لتختر الدم جيدا وتسمح أيضا بإمكانية قفل الفكين أثناء العملية. وقد تم إستحداث هذه التقنية لتكون فترة العملية وما بعدها سهلة ومريحة و هادئة. وكانت التقنية مرضية للجراح، وطبيب التخدير، والمرضى وأقاربهم لعدم تركيب شق حنجرى.

الاستنتاج: طريقة تركيب الأنبوبة الحنجرية تحت الفك السفلي بواسطة أنبوبة RAE هى تقنية فعالة ومفيدة للسيطرة على مجرى الهواء في جراحة الوجه والفكين. ويمكن استخدامها كبديل جيد للأنبوبة المرنة المدرعة في مرضى عمليات جراحة الوجه والفكين حيث لا توجد فروق كبيرة بينها وبين الأنبوبة المرنة المدرعة ولكنها تتميز برخص ثمنها و سهولة الحصول عليها أكثر من الأنبوبة المرنة المدرعة.