Quest for an Ideal Route of Intubation for Oral and Maxillofacial Surgical Manoeuvres

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Abstract

Purpose The optimal route of intubation that may be planned for different oral and maxillofacial surgical manoeuvres.

Materials and Methods A study was performed on patients who underwent nasal, oral or submental route of intubation for elective oral and maxillofacial surgery under general anaesthesia. The study variables were the anaesthetic and surgeon factors that should be taken into consideration before intubation and during surgery, and also algorithms for uneventful surgical procedures. The outcome variables were influence of the ‘route of intubation’ on ‘surgical technique’ and vice versa. Overall results were compiled, tabulated and analysed using SPSS version 14.0.

Results The study sample comprised of 634 patients. It was found that 35 % (204) nasal, 7.5 % (4) oral and 0 % submental route of intubation had statistically significant influence on oral and maxillofacial surgical procedures and vice versa ($p < 0.001$).

Conclusion This present study concluded that the surgical access and visibility was immensely improved by following the anaesthetic and surgeon factors in conjunction with algorithms described for uneventful oral and maxillofacial surgical procedures. Further, this has also substantially minimized the influence of the ‘route of intubation’ on ‘surgical technique’ and vice versa.

Keywords Intubation route · Oral maxillofacial surgical manoeuvres · Influence factor

Introduction

An imperative factor for success of any surgical procedure definitely relies on larger exposure in conjunction with the dexterity of the operator. Oral and maxillofacial region presents a greater challenge to the surgeon, as the surgical procedures are just around the upper airway; hence it requires special attention for the patient safety during and after surgery. Maxillofacial surgeon operates in an area that is shared by both anaesthetist and the surgeon. Clear demarcation of area of concern is required for both. In order to provide better access and endotracheal tube (ETT) stability, surgical field must be maximized [1] in respective anatomical operating areas in head and neck region, with minimal impediment by ETT.

Studies have been published that have evaluated intubation techniques for difficult clinical situations, with relevancy to the head and neck region [2–4]. However, to our knowledge no studies have specifically evaluated the influence of ‘route of intubation’ and ‘surgical procedures’ of maxillofacial region on each other. The present study undertook such an endeavour to compile, analyze and represent wide variety of aspects, to evaluate optimal route of intubation that may be planned for different oral and maxillofacial surgical manoeuvres. This is a preliminary report of our results.

Materials and Methods

A study was performed from October 2008 till August 2014 in patients who had undergone elective oral and maxillofacial surgery under general anaesthesia with

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specific route of intubation (nasal, oral or submental). The study was conducted in the department of oral and maxillofacial surgery of the institution. The institutional review board provided ethical approval. After detailed discussion, written informed consent was obtained from each patient and from parents or the legal guardian in case of infants and children.

Patients with different injuries, pathologies and deformities with respect to head and neck region were included. All patients were diagnosed on the basis of case history, clinical examination, incisional biopsy, conventional radiographs and other imaging modalities such as computed tomography or magnetic resonance imaging if needed depending upon the situation. Additional investigations were performed as needed.

The preoperative medical assessment included routine surgical profile, electrocardiography, and chest radiography followed by pre-anaesthetic evaluation. Previous history of surgery under general anaesthesia, difficulty in intubation and complications during surgery was enquired for each patient and noted.

Patients with normal mouth opening (not <3 cm) [5] underwent nasal or oral intubation through direct laryngoscopy using McIntosh laryngoscope by directly visualizing the vocal cords. Patients with restricted mouth opening underwent either Fibreoptic intubation using Ambu® aScope™ 2 Ambu A/S Denmark [2], Blind intubation [3], or Retrograde intubation [6] depending upon the situation, through nasal route under regional airway anaesthesia [7]. Patients with panfacial trauma underwent submental intubation [8]. Treatment done under nasal, oral and submental intubation for different oral and maxillofacial surgical procedure was noted.

The internal diameter of ETT used ranged between 3 and 8 mm depending upon the age, sex and size of nare of the patient. Potex north and south polar preformed tracheal tubes (RAE—right angled ETT); flexo-metallic tubes were used.

We designed certain anaesthetic and surgeon factors in conjunction with algorithms for uneventful surgical procedure based on the influence of route of intubation on surgical technique and vice versa, and applied them in the study. The study variables were anaesthetic and surgeon factors that should be taken into consideration before intubation and during surgery, through type of approach (site of surgery— intraoral, extraoral or both) and side of surgery (one side—right/left or both sides) and also algorithms for uneventful surgical procedures (predictor variables).

In nasal intubation (whether carried through right or left nare and its influence on the surgical procedure) and oral intubation (whether the tube stabilized right side of the mouth or left side or centrally) was evaluated. In submental intubation, patients underwent intubation through right side as field of airway control was away from the surgical site.

Variable Outcomes

Influence of ‘route of intubation’ on ‘surgical technique’ and vice versa. “Influence factor” was assessed (whether any interruption in exposure of surgical site with route of intubation, removal of elastic adhesive bandage that was used to secure tube, accidental tube displacement, stretching of nose due to tube, compromising of accessibility and visibility, and tube dislodgement during surgery).

The database was constructed and statistical analysis performed using SPSS version 14.0. *p* value of <0.05 was considered statistically significant. Comparison of categorical variables between nasal, oral and submental intubation was done using Chi square test.

Results

The study comprised of 634 patients who underwent elective oral and maxillofacial surgery with nasotracheal (579 patients; 372 male and 207 female), orotracheal (53 patients; 34 male and 19 female) and submental (2 patients; both male) intubation respectively. The sex distribution showed that male was predominant gender. Mean age of the patients were 47 years (27–87 years, nasal intubation), 26 years (3 months–47 years, oral intubation) and 27 years (26–28 years, submental intubation) respectively. 45 % of the patients were with fractures of the facial skeleton as shown in Table 1. Factors that should be taken into consideration before intubation for successful oral and maxillofacial surgery are summarised in Table 2. Algorithms designed for uneventful surgery are shown in Figs. 1, 2 and 3. All patients were successfully intubated. Observations made during the study were described in the following subtitles.

Nasal Intubation (Table 3, serial no. 1)

Maxillomandibular fixation (MMF) was employed intra-operatively in 61 % of the patients for different maxillofacial surgical procedures requiring nasal intubation. This included surgical manoeuvres such as maxillary and mandibular fractures, enucleation of the large cysts of oral cavity, mandibulectomy (marginal and segmental), hemimandibulectomy and reconstruction with bone graft and orthognathic surgeries for correcting dentofacial deformities.

However, some of the surgeries do not require MMF (39 %), but necessitate nasal intubation. Surgeries done under this category include extraction of offending tooth following incision and drainage in orofacial space infection cases, plate removal due to infection, coronoidectomy, placing of intraoral distractors, resection/transection of fibrous bands in OSMF with or without

Table 1 Distribution of 634 patients based on diagnosis

Diagnosis	Number of cases (%)
Fracture of facial skeleton (lefort fracture, naso-orbito ethmoidal complex (NOE) fracture, mandibular fractures), nasal fractures, soft tissue lacerations, orbital fractures, zygomatic complex (ZMC) fractures, Panfacial trauma	290 (45.7 %)
Temporomandibular joint (TMJ) disorders—disc displacement, TMJ ankylosis	27 (04.3 %)
Cysts and tumors of oral cavity	96 (15 %)
Oral submucous fibrosis (OSMF)	21 (03.3 %)
Facial space infections, infected plates, osteomyelitis	32 (05 %)
Residual deformity and facial skeletal deformity requiring orthognathic surgery, distraction osteogenesis, nasal deformity	109 (17 %)
Vascular malformations, trismus, lesions requiring excisional biopsy such as ulcers, sialoliths, ranula; edentulous maxillary arch	42 (06.6 %)
Cleft lip and palate	17 (2.7 %)
Total	634

Table 2 Factors that should be taken into consideration before intubation and during surgery

Anaesthetic factors	Surgeon factors
1 Side of surgery—right side, left side and both sides	Informing the anaesthetist in detail in terms of access and visibility that is required for particular type of surgical procedure
2 Type of approach for surgery—intra oral, extra oral and both	Observe for any accidental dislodgement of tube during surgery
3 If intraoral, then area of surgery—maxilla (mainly involving palate), mandible (mainly involving tongue and floor of the mouth), buccal mucosa (right/left/both sides)	Complications associated with airway should be foreseen before intubation. Look before you leap
4 Change of head position depending on the approach and side of the surgery; especially in bilateral surgery. For example: bilateral TMJ ankylosis	If failed to intubate through desired nare, reflection of the tissues should be done with care to secure airway.
5 Maxillomandibular fixation if required to secure occlusion	In case of bilateral surgery, changing the head position from one side to other side, inform anaesthetist
6 Respective anatomical head and neck region where surgeon is operating (upper, middle and lower one-third of face)	American society of anesthesiologists (ASA) [5]. Physical factors associated with difficult intubation
7 Interference of tube during surgery	
8 Change of intubation from nasal to oral or oral to nasal if required	
9 Type of ETT—RAE: right angled ETT (north pole and south pole), flexo-metallic tube	
10 Apart from intubation factors, standard surgical principles should be matched to the situation	
Common factor	1. Good interaction between surgeon and anaesthetist pertaining to type of maxillofacial surgical procedure and route of intubation required 2. Both anaesthetist and surgeon factors should be taken into account

coronoidectomy and reconstruction with buccal fat pad that needed ‘intraoral access.’

In ZMC fractures reduction (Gilles temporal approach), TMJ problems like disc displacement, TMJ ankylosis, and

fractured condyle retrieval (mostly preauricular approach), placing extra oral distractors (submandibular approach), maxillectomy (Weber Fergusson incision) demanded ‘extra oral approach.’

Fig. 1 Algorithm showing type of oral and maxillofacial manoeuvres and route of intubation for intraoral surgery (#—fracture, BSSO bilateral sagittal split osteotomy)

Fig. 2 Algorithm showing route of intubation for extra oral surgery and both extraoral and intraoral surgery (#—fracture)

In TMJ ankylosis patients, if mouth opening was less than 35 mm after aggressive resection of ankylotic mass extraorally, coronoidectomy was done intraorally. Additionally, for

malignant tumors of oral cavity, neck dissection and reconstruction with flaps, aggressive dissection in conjunction with ligation of arteries and veins, for preservation of vital

Fig. 3 Algorithm showing route of intubation for maxillary surgical procedures (#—fracture)

structures, ‘both intra orally and extra orally’ large surgical access and visibility was needed.

Oral Intubation (Table 3, serial no. 2)

In cleft lip and palate repair, nasotracheal intubation interferes with closure of muscle and mucosa. Oral intubation is more favourable in such situations. In cleft palate repair, Dingman’s retractor positions the tube inferiorly over the tongue. Even though, most of these procedures are done intraorally, airway through mouth provided more surgical access (Fig. 4).

For nasal fracture reduction, rhinoplasty, debulking of upper lip due to excess soft tissue, dermoid cyst of preauricular and eyebrow, orbital fractures and tumors, soft tissue suturing in frontal and temporal region necessitated oral intubation as these surgeries do not constrain any intra oral procedure.

Submental Intubation (Table 3, serial no. 3)

Patients who underwent ORIF after MMF for panfacial trauma required intraoral and extraoral access on both sides.

Influence Factor (Table 3, serial no. 4)

Pertaining to type of approach, to perform surgery through nasal intubation (321 intra oral, 132 extraoral and 126 both intraoral and extraoral); oral intubation (12 intra oral, 35

extraoral and 6 both intraoral and extraoral) and submental intubation (2 patients, both intraoral and extraoral); the differences were statistically significant ($p < 0.001$). There were no statistically significant differences between the three routes of intubation with respect to the side of surgery ($p > 0.005$).

It was found that 203 (35 %) nasal, 4 (7.5 %) oral and 0 (0 %) submental route of intubation had statistically significant influence on oral and maxillofacial surgical procedures and vice versa with a p value less than 0.001 when compared with Chi square test.

Discussion

Andreas Versalius, in 1543 the renowned anatomist of Brussels, first described endotracheal intubation. The history of endotracheal intubation techniques include the early pioneering work done by Mac Ewan, Kuhn, Rosenberg, Meltzer and Auer, and Elsberg [9]. Kuhn in 1902 was the first to describe the nasotracheal intubation. He felt it was a more physiological approach to tracheal intubation. Magill in the 1920s popularised it for intra-oral surgery [1]. Since then endotracheal intubation is in practice as an artificial conduit between the atmosphere and the patient’s trachea for the purpose of alveolar gas exchange or protection of the lungs from extraneous substances [10].

Airway control is one of the most critical interventions required for saving a life [11]. The most common cause of

Table 3 Treatments done under nasal, oral and submental intubation. Statistical analysis of type of approach to perform surgery, side of surgery and influence factor

	Total number of treatments done (%)	Type of approach to perform surgery			Side of surgery		Influence factor (%)
		Intra oral	Extra oral	Both extra and intra oral	One side (right/ left)	Both sides	
1. Treatments done under nasal intubation							
Open reduction and internal fixation (ORIF) of facial skeleton (left 1 fracture, mandibular fractures)	224	82	76	66	67	157	73
Zygomatic arch reduction and ORIF of ZMC with or without other fractures	32		9	23	32		16
Condyle retrieval	9		9		9		3
Disc reposition of TMJ	1		1		1		—
Enucleation of cysts	52	52			49	3	8
1) Maxilla	22	22			22		6
2) Mandible	30	30			27	3	2
Partial Maxillectomy	7			7	7		5
Mandiblectomy (marginal, segmental resection)	7	3		4	7		2
Mandiblectomy and reconstruction with iliac graft	11	9		2	10	1	3
Orthognathic surgery	94	94				94	56
1) Maxilla	9	9				9	9
2) Mandible	58	58				58	12
3) Both maxilla and mandible	27	27				27	27
Resection of fibrous bands with or without cornoidectomy in OSMF and reconstruction with buccal fat pad (BFP) or nasolabial flap (NLF)	21	19		2 (NLF)		21	8
Gap/interpositional arthroplasty with or without cornoidectomy	26		22	4			6
1) Unilateral	18		16	2	18		1
2) Bilateral	8		6	2		8	5
Incision and drainage of facial space infection	13	10		3	13		4
Distraction osteogenesis	8	5	3			8	4
Neck dissection and reconstruction with pectoralis major myocutaneous (PMMC) flap	10			10	10		3
Neck dissection and reconstruction with temporalis flap	5			5	5		3
Plate removal due to infection (mandible)	14	14			12	2	5
Tumour excision (excisional biopsy)	31	22	9		31		—
Zygomatic implants	1	1				1	1
Debulking of lower lip (vascular malformation)	2		2		2		—
Facial reanimation	1		1		1		—
Cornoidectomy (for trismus cases)	5	5			3	2	2
Corticotomy	5	5			5		1
Total	579 (91 %)	321 (55 %)	132 (23 %)	126 (22 %)	282 (49 %)	297 (51 %)	203 (35 %)
2. Treatments done under oral intubation							
Cleft palate repair	11	11				11	—
Cleft lip repair	6			6	4	2	—
Nasal fractures reduction or NOE fractures.	4		4			4	—
Rhinoplasty and reconstruction with auricular cartilage or rib cartilage	5		5			5	—

Table 3 continued

	Total number of treatments done (%)	Type of approach to perform surgery			Side of surgery		Influence factor (%)		
		Intra oral	Extra oral	Both extra and intra oral	One side (right/ left)	Both sides			
Capillary haemangioma at junction of hard and soft palate	1	1				1	–		
Fat augmentation	1		1			1	–		
Debulking of upper lip due to excess soft tissue	2		2		2		–		
Dermoid cyst	3				3		–		
1) Post auricular	1		1		1		–		
2) Eye brow	2		2		2		–		
Soft tissue suturing (frontal, temporal)	16		16		12	4	4		
Orbital fractures	2		2		2		–		
Basal cell carcinoma of the eyelid	1		1		1		–		
Frontal bone prosthesis following NOE fractures	1		1			1	–		
Total	53 (9 %)	12 (23 %)	35 (66 %)	6 (11 %)	24 (45 %)	29 (55 %)	4 (7.5 %)		
3. Treatment done under submental intubation									
ORIF of Lefort II and mandibular fracture	2 (0.3 %)	–	–	2		2	–		
Type of approach to perform surgery		Side of surgery			Influence factor		p value		
Intraoral	Extraoral	Both intra oral and extra oral		One side (right/left)	Both sides	Yes		No	
4. Statistical analysis									
a) Nasal intubation	321	132	126		282	297	203	376	<0.001
b) Oral intubation	12	35	6		24	29	4	49	>0.05
c) Submental intubation	0	0	2		0	2	0	2	<0.001

serious morbidity and mortality is due to failure in securing the airway (0.13–0.3 %) [12]. It is estimated that complications of difficult airway may range up to one tenth of cases of elective general anesthesia [13].

The present study demonstrated important factors which enable both the anaesthetist and the surgeon, to efficiently work together and facilitate better patient safety and surgical outcome (Table 2). These factors are important in providing uninhibited surgical exposure, which designs the ‘route of intubation.’ Oral and maxillofacial manoeuvres, based on type of approach ($p < 0.001$) can be divided into three types; surgical procedures requiring intraoral, extraoral and both intraoral and extraoral approach as shown in Figs. 1 and 2.

Nasotracheal intubation remains the preferred techniques in most of the oral and maxillofacial surgical procedures [14]. In patients with restricted mouth opening conditions with difficult airway, nasotracheal intubation was found to be more suitable [1–3, 9, 15] and in cases,

that necessitate MMF [1, 16] as shown in Fig. 1. It is also useful in patients where direct laryngoscopy or orotracheal intubation is not possible [1].

The incidence of difficult intubation in the operating room was reported to range from 1.5 to 8.5 % [12]. Nare selection for intubation is one of the major concerns otherwise it can lead to influence factor due to failure to intubate through desired nare (Fig. 5). Intubation should be carried through nare opposite to the side of surgery (Fig. 6). This would maximize the surgical field and avoid ETT interference. In case of bilateral surgery, intubation should be carried out from right nare. This was in congruity to Jonathan L. Benumof who stated that the nare selected should be the one that the patient offers the least resistance to breathing. If the both nares offer equal resistance, then right nare should be chosen as the bevel of the nasotracheal tube which introduced through the right nare, will face flat nasal septum, reducing damage to turbinates. Left nare should be chosen when it provides more room for the

Fig. 4 Oral intubation—*intra oral procedure*, airway through mouth provided more surgical access and visibility and Dingman's retractor positions the tube inferiorly over the tongue

laryngoscopic blade and Magill forceps on the right side of the oropharynx [11]. At the same time surgeon's choice for the route of intubation should be considered by the anaesthetist. Preformed curved nasotracheal tubes (RAE; North and South pole tubes) may be used to minimize operative field interference [16].

It was observed that after maxillary orthognathic surgical procedures, during alar cinch suturing to reposition the nasalis muscle, nasotracheal tube interferes with suturing. At later stage, soft tissue changes are similar to those found in the aging face and are generally perceived as

unaesthetic. Simple solution is to switch from nasal to oral intubation (change of technique) *intra-operatively* [17, 18]. Merocel (polyvinyl acetyl sponge) may be used to prevent alar pressure during prolonged nasal intubation [19]. Nevertheless, nasotracheal intubation was not transformed into orotracheal in any of the patients in the present study.

In maxillary surgical procedures, nasotracheal tube has to be stabilized in a specific manner as shown in Fig. 3, to prevent any influence to the surgery, during reflection of tissues superiorly up to infra orbital foramen.

Thus, providing airway control through nose offers the maxillofacial surgeon more scope for surgical manoeuvre in operations of the head and neck [14] (Table 3, serial no. 1) as it improves surgical exposure and increases tube stability [1, 15].

The nasal route for tracheal intubation can be unsuitable for some maxillofacial surgical manoeuvres (Table 3, serial no. 2). It was observed that any maxillary surgical procedure that does not require MMF or if there are any interference with nasal intubation and, in purely extra oral surgical procedures without intraoral involvement, standard oral intubation was found to be more applicable significantly as shown in Figs. 2 and 3. Similar to nasotracheal intubation, ETT has to be stabilized opposite to the side of surgery, by positioning the tube at the corner of the mouth in oral intubation (Fig. 7). In case of bilateral surgery, ETT has to be stabilized centrally.

When both nasal and oral intubations are deemed unsuitable or may interrupt the surgical access or techniques and if MMF is required, airway control may be achieved with submental intubation [8, 20, 21] as shown in Fig. 2. Hernandez Altemir in 1986 first described this method [8]. The morbidity associated with this intubation is low [21]. This technique is alternative to elective short term tracheostomy avoiding its high risk complications [20].

In the present study, no major complications occurred with nasal and oral intubation except for nose pain and minor bleeding from the intubated nare in patients who

Fig. 5 Nasal intubation through same side of surgery lead to influence factor

Fig. 6 Nasal intubation opposite to the side of surgery—no influence factor

Fig. 7 Oral intubation opposite to the side of surgery (fat augmentation)—no influence factor

underwent nasal intubation. Postoperatively most of the patients complained of sore throat and neck pain with nasal and oral intubation which was managed conservatively and

resolved spontaneously within few days. Patients who underwent submental intubation had no complications except for minimal scar at incision site.

Contraindications and complications with specific route of intubation; nasal [22–24], oral [22], submental [20, 21] and other techniques of airway control [25–28] should be weighed by the maxillofacial surgeon and the anaesthetist, to have a safe airway control and proficient surgery. Thus, the choice of route of intubation requires good assessment and communication between the surgeon and the anaesthetist [29].

In conclusion, route of intubation undeniably plays an important role in maxillofacial surgery. It should be established in such a way that it does not sway oral and maxillofacial surgical manoeuvres. We wish to emphasize anesthetic and surgeon's factors in conjunction with algorithms described in the present study, which were instrumental in providing better access and visibility. This has also substantially minimized the impediment with ETT on surgical site and vice versa. Lastly, further researches are required to evaluate the effectiveness of anaesthetic and surgeon factors, and algorithms described in the study.

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Conflict of interest None declared.

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