

# Airway management using LMA-evaluation of three insertional techniques-a prospective randomised study

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## Abstract

**Background and Aims:** Laryngeal Mask Airway [LMA] insertion has become as a basic procedural skill needed for all health care providers. Search for the most successful insertion technique continues. We evaluated the success rate of the three LMA insertion techniques- standard, 90 degree rotational and 180 degree rotational technique.

**Material and Methods:** A total of 180 patients of ASA I-II aged 18-65 years undergoing open superficial surgical procedures with (LMA® Unique™ Airway, Teleflex®, Teleflex Medical Europe Ltd, Ireland) as an airway management device and with neuromuscular blocking agents, were randomly allocated to three groups, in this prospective randomized study. In the standard technique group ( $n = 60$ ), the LMA was inserted by standard digital intraoral method. In the 90 degree rotational technique group ( $n = 60$ ), the LMA was rotated counter-clockwise through 90 degree in the mouth and advanced until the resistance of the hypopharynx was felt, and then straightened out in the hypopharynx. In 180 degree rotational technique, LMA was inserted back-to-front, like a Guedel airway. The parameters studied were: the LMA placement success at first attempt, insertion time, need for more than one attempt at insertion, need for external airway manipulations, postoperative sore throat, blood staining and other post-operative (airway related) complications.

**Results:** The first attempt success rate in the standard technique was 83.9%, in 90 degree rotational technique was 75% and 180 degree rotational was 93.5%. The first attempt success rate was higher in 180 degree rotational group compared to 90 degree rotational group ( $P < 0.05$ ), but there was no statistically significant difference ( $P > 0.05$ ) between 90 degree rotational group and the standard technique group. There was no statistically significant difference among the two groups in terms of the secondary outcomes.

**Conclusion:** We conclude that 180 degree rotational technique of LMA insertion is more successful than 90 degree rotational technique in adult patients under general anaesthesia.

**Keywords:** Adult, general anaesthesia, healthcare, hypopharynx, laryngeal mask airway, postoperative

## Introduction

Laryngeal mask airway (LMA) introduced as an airway equipment in anaesthesiologist armamentarium, has now become a basic airway aid for all type of health care providers including the paramedical handling the out-of-hospital cardiac arrest situation. In that context, the search for the simplest technique of insertion of these devices with a high success rate continues.

Various methods and techniques have been described regarding the insertion of LMA.<sup>[1-3]</sup> The most primordial technique is the standard technique or digital technique. Another technique which is quite popular is the 180 degree technique. This 180 degree technique was described and validated through studies by Brimacombe in 1993.<sup>[4]</sup> This 180 degree method was shown to be as successful as the standard technique.<sup>[4]</sup> Another insertion technique called 90 degree rotational technique<sup>[3]</sup> was described recently by Hwang *et al.*, in which the LMA is inserted until

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**How to cite this article:** Shyam T, Selvaraj V. Airway management using LMA-evaluation of three insertional techniques-a prospective randomised study. *J Anaesthesiol Clin Pharmacol* 2021;37:108-13.

**Submitted:** 05-Mar-2019 **Revised:** 30-May-2020

**Accepted:** 09-Jul-2020 **Published:** 10-Apr-2021

### Access this article online

Quick Response Code:



**Website:**  
www.joacp.org

**DOI:**  
10.4103/joacp.JOACP\_60\_19

the entire cuff was inside the mouth, rotated counter-clockwise through 90 degrees and advanced until the resistance of the hypopharynx was felt, and then straightened out in the hypopharynx. This technique has been shown to have higher success rate compared to the standard technique.<sup>[3]</sup> None of the previous studies has compared the success rate of all the three techniques for insertion of Laryngeal mask airway (LMA® Unique™ Airway, Teleflex®, Teleflex Medical Europe Ltd, Ireland). Hence, we hypothesised that the 90 degree insertion technique of LMA Unique, would have more success rate at first attempt compared to the standard technique and the 180 degree rotational technique in patients coming for elective superficial open surgical procedures under general anaesthesia. The primary objective of this prospective randomised study was to evaluate and compare the success rate of 90 degree rotational LMA placement method with that of the standard digital and 180 degree rotational technique of LMA placement in patients coming for various superficial open surgeries under general anaesthesia.

## Material and Methods

After Institutional Ethical Committee approval (CSP-MED/16/OCT/31/150) and informed patient consent, 180 healthy adults of ASA grade I and II, of age group 18-65 years scheduled for various open superficial surgical procedures under general anaesthesia with LMA® Unique™ Airway, Teleflex®, Teleflex Medical Europe Ltd, Ireland) as airway equipment were enrolled for this prospective randomized study. The sample size was calculated to be 52 cases in each group with first attempt success rate as primary outcome based on a pilot study done with 9 cases in each group, with the first attempt success rate of 88% and 65% between the groups with power of 80% and an alpha error of 0.05. Considering a drop rate of 15%, sample size of 60 was arrived at in each group. Exclusion criteria included: Patients refusal, emergency surgery, obese patients BMI >30 Kg/sq.m, gastro-esophageal reflux disease, laparoscopic procedures, intra peritoneal and abdominal procedures, head and neck surgery, surgical procedures of expected longer duration more than one hour, surgical procedures requiring prone position, anticipated difficult airway and suspected full stomach or at with risk of aspiration due to other co-morbid illnesses.

The patients were randomized to one of the 3 groups, standard technique (Group A), 90 degree rotation technique (Group B) and 180 degree technique (Group C) using computer generated randomized numbers and randomisation was concealed by closed envelope technique.

The monitors (Phillips IntelliVue MP50, Philips Electronics Ireland Ltd, Dublin) used were non-invasive blood pressure,

electrocardiography, SpO<sub>2</sub> oxygen saturation, end-tidal carbon dioxide, and temperature monitor. All patients were premedicated with midazolam 1 mg intravenous 5-10 minutes before induction of general anaesthesia. Patients were pre-oxygenated and induced with fentanyl 2 microgram per kg and propofol 2 milligram per kg. After checking for bag mask ventilation all patients were paralysed with intravenous Atracurium 0.05 mg/Kg body weight in all cases. A mixture of sevoflurane 2% in air oxygen with total flow of 3 litres/min and FiO<sub>2</sub> of 0.4 was used for maintenance of general anaesthesia, which was started soon after administration of propofol. LMA insertion was attempted at 3 minutes after administration of intubating dose of atracurium. Insertion was performed by a single experienced anaesthesiologist in all the cases.

In Group A (Standard Technique), the classical digital method of LMA insertion was used in all the patients. The standard technique was performed according to the manufacturer's instructions. The posterior aspect of the deflated mask was coated with a water-based lubricant. The LMA cuff was fully deflated and held like a pen and inserted while pressing up along the palato-pharyngeal curve using the index finger. The LMA was advanced into the hypopharynx until definite resistance was felt. While in group B (90-Degree Technique),<sup>[3]</sup> the LMA was lubricated on the posterior and both lateral aspects with water-based lubricant. The LMA was inserted inside the mouth, rotated counter-clockwise through 90 degrees and advanced until the resistance of the hypopharynx was felt, and then straightened out in the hypopharynx. In group C (180-degree technique),<sup>[4]</sup> the LMA was inserted with the laryngeal aperture pointing cephalad and rotate it 180 degrees as it enters the hypopharynx.

LMA size 3 or 4 was selected based on patient's body weight (<50 Kilograms and more than 50 kilograms respectively).<sup>[5,6]</sup> LMA was inserted according to the allotted technique for that patient and the cuff is inflated with 20 ml of air if size 3 LMA was used, and 30 ml of air if size 4 LMA was used.<sup>[5,6]</sup> The intra cuff pressure was maintained at 60 cm H<sub>2</sub>O with a manometer. Effective ventilation with the LMA was judged by a square wave capnograph trace and no audible leak, and exhaled tidal volume of  $\pm$  50 ml of the set tidal volume in the anaesthetic ventilator. All patients were ventilated with 8 ml/Kg tidal volume.<sup>[7,8]</sup> In case of ineffective ventilation, external manipulations in the form of chin lift, jaw thrust, head extension, or flexion of the neck was done to obtain optimal position during LMA insertion. Such manipulations if required were recorded in each group. The effectiveness of ventilation through the inserted LMA was determined by an observer who was blinded for the type of insertion technique used. The need for the external manipulations was also elicited by the same observer who was blinded for the type of insertion technique used.

One attempt at LMA insertion was defined as the act of LMA entry into the patient's mouth and removal from the mouth. Three attempts were allowed in each group. If placement of the LMA insertion was not successful after 3 attempts, it was considered as a failure. The failed attempt was subsequently managed at the discretion of the attending anaesthesiologist with any device, and subsequent attempts were not controlled by the study design. However, the chosen technique was recorded. The time to insertion was defined as the time between introduction of LMA into the mouth, up to inflation of the LMA cuff and achieving an effective ventilation (i.e., Effective ventilation with the LMA was judged by a square wave capnograph trace and no audible leak, and exhaled tidal volume of  $\pm 50$  ml of the set tidal volume in the anaesthetic ventilator) as defined earlier.<sup>[8,9]</sup> External airway manipulation was defined as any manual external manipulation intended to improve LMA insertion.

Oropharyngeal leak pressure (OLP) was measured by closing the adjustable pressure limiting valve in the anaesthesia machine, pressurizing the closed circle system with a fresh gas flow of 3 litres/minute and checking the pressure at which equilibrium is achieved with the rate of fresh gas flow. The pressure is checked with an aneroid manometer.<sup>[8]</sup> After successful insertion, the LMA placement was checked with a fiberoptic endoscope (Karl Storz Endoscopy-America, Inc. El Segundo, California) passed through the LMA airway tube and placed about 1 cm from the tip of the tube, the fiberoptic bronchoscope view of the larynx is noted: grade 4 only vocal cords visible, 3-cords and posterior epiglottis visible, 2-cords and anterior epiglottis visible, 1- vocal cords not seen.

At the end of the procedure, LMA was removed after patient became fully conscious and adequate spontaneous ventilation. Neostigmine 50 mcg/Kg intravenous and glycopyrrolate 10 mcg/kg intravenous was used to reverse the non-depolarising neuromuscular blockade. Postoperative sore throat was assessed immediately after extubation in the post anaesthetic care unit and followed till 24 hours in the postoperative period. Similarly, the LMA surface was checked for blood stain and it was noted down as an evidence of airway injury.

The primary outcome measure seen was the LMA placement success at first attempt. The secondary outcome measures observed were insertion time, need for more than one attempt at insertion, need for external airway manipulations, oropharyngeal leak pressure, grade 4 FOB view, postoperative sore throat, blood staining and other postoperative airway related complications (airway injury).

All the parameters were collected by the same anaesthesiologist who was blinded to the type of insertion technique used for

LMA placement. The sample size was calculated based on a pilot study because no previous study was done with the similar comparison between the three techniques of LMA placement. The pilot study included 9 cases in each group. A sample size of 180 (60 in each group) was deemed necessary to identify a statistical significant difference in the primary outcome measure of this study (LMA placement success rate at first attempt). The sample size was calculated to be 52 cases in each group, based on a pilot study with the first attempt success rate of 88% and 65% between the groups with power of 80% and an alpha error of 0.05. Considering a drop rate of 15%, sample size was arrived at 60 in each group. The study parameters were compared between Group A against Group B and Group B against Group C.

The surgical procedures are selected in such a way that they satisfy the exclusion criteria of the study and were all involving superficial less invasive procedures of short duration less than one hour duration such as fibroadenoma breast, split skin grafting of lower limb, hydrocoel, circumcision, wound debridement of lower limb, lipoma excision, etc.

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference in continuous variables between the three groups, the one way ANOVA was used. To find the significance in categorical data Chi-Square test was used. Student t test was used to compare the demographic data and the time for insertion. The success at first attempt, need for more than one attempt, the presence of bleeding, and the occurrence of complications were compared using Chi-square analysis. In all the above statistical tools the probability value 0.05 is considered as significance value.

## Results

The distribution of basic characteristics like age, weight, height, sex and duration of surgery among the three groups were comparable and there was no statistically significant difference among the three groups as shown in Table 1. The distribution of the type of surgeries included in the study in the three groups are presented in Table 2.

The primary outcome measure studied was the success rate at first attempt [Table 3]. LMA was placed successfully in the first attempt in 83.9% (50/60) of cases in Group A. It was 75% (45/60) in Group B and 93.5% (56/60) in Group C. There was no statistically significant difference between the 90

**Table 1: Comparison of the basic characteristics among the Three Groups**

Parameter	Group A	Group B	Group C	P
Age (in years)	37.68±12.42	33.29±11.15	39.03±14.12	0.18
Weight (in kilograms)	58.94±9.22	57.16±9.46	58.45±10.11	0.75
Height (in centimetres)	162.34±24.56	165.76±29.40	166.19±21.84	0.81
Sex (F)	67.7%	74.2%	74.2%	0.81
Duration of surgery (in minutes)	39.68±18.21	32.13±12.09	38±18.88	0.18

**Table 2: Distribution of type of surgery among the three groups**

Name of surgery	Group A	Group B	Group C
Open inguinal hernioplasty	10	12	11
Eversion of sac	8	6	7
Upper limb-open reduction and internal fixation	7	5	6
Lower limb split skin graft	6	8	7
Trendelenberg procedure	3	4	5
Fibroadenoma breast-excision	7	6	6
Hemorrhoidectomy	10	9	8
Anal lateral Fissurectomy	9	10	10

degree rotational technique and the standard technique. There was a statistically significant difference between the 90 degree and the 180 degree rotation technique ( $P = 0.039$ ). The 180 degree rotational technique was found to be more successful at first attempt than the 90 degree rotational technique. The insertion time (in seconds) was  $25.97 \pm 6.13$  in Group A,  $28.32 \pm 11.45$  in Group B and  $29.00 \pm 16.25$  in Group C. There were no significant differences between the two comparisons ( $P = 0.582$ ) as shown in Table 3.

While comparing the need for more than one attempt for successful LMA placement, it was found that there was statistically significant difference between group B and C ( $P = 0.04$ ), while there was no statistically significant difference between group A and group B as shown in the Table 3.

The requirement for airway manipulations was greater in group B compared to Group A and C. 8 (13.3%) cases required airway manipulations in Group A, 12 (20%) in Group B and 7 (11.66%) in Group C. There was a statistically significant difference between group B and C. Hence, group B required more manipulations than group C.

Postoperative complications like sore throat, laryngospasm, blood staining in the LMA, etc., were noted. Postoperative sore throat was recorded in 11 patients. It was seen in 5 (8%) patients in Group A, 4 (6.6%) patients in Group B and 2 (3.3%) patients in Group C. The differences were not statistically significant as shown in the Table 3.

Blood staining in the oral cavity or on the LMA at the end of procedure was observed in 13.3% patients of group A, 10%

in Group B and 6.6% in Group C. The differences were not statistically significant as shown in the Table 3. One patient each in Group A, group B and group C had laryngospasm, one patient had lip injury in group B.

There is no statistically significant difference among the three groups in terms of Oro-pharyngeal leak pressure as shown in the Table 3.

Results of fibreoptic assessment of the glottis view showed no significant difference in the incidence of grade 4 view between the comparisons. But the 180 degree rotational technique has lesser incidence of grade 4 view which was not statistically significant from the 90 degree rotational technique.

Our study didn't come across any dropouts of participants (as shown in the consort diagram Figure 1). There was no need for an alternate airway device or technique in the event of failure of the corresponding LMA insertion technique in each group.

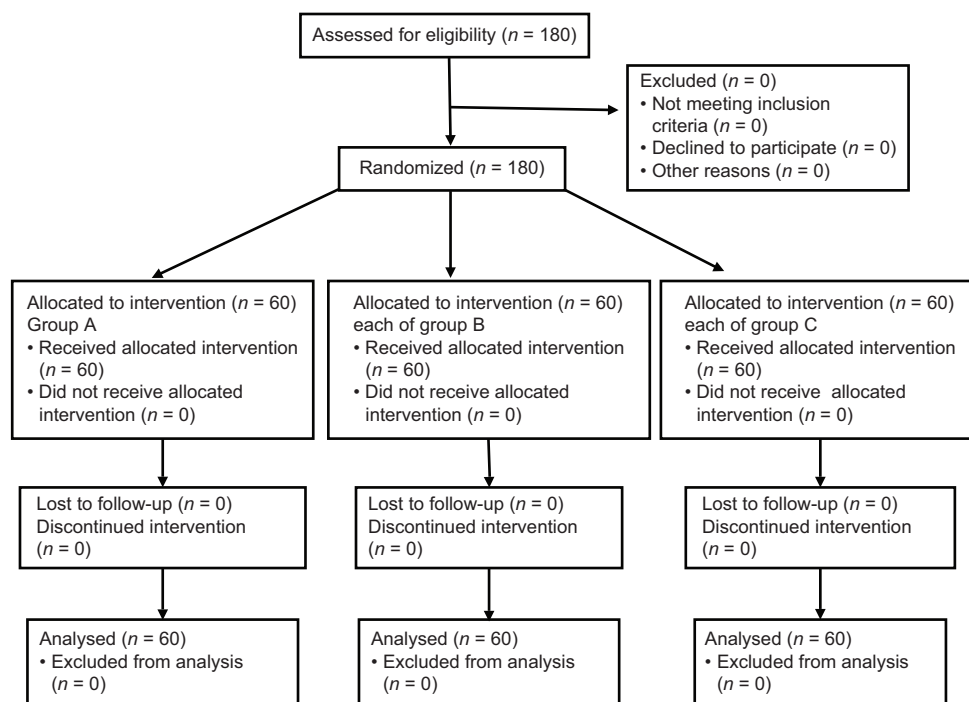
We found that when comparing 90 degree rotational technique to that of standard and 180 degree rotational technique of LMA placement, 90 degree method was as successful in at first attempt of insertion as the standard method, but not as successful as 180 degree method at first attempt. In terms of the secondary outcomes studied, there was a statistically significant difference in the need for more than one attempt between the 90 degree rotational techniques compared to 180 degree rotational technique. Among the other secondary outcome parameters, there were no statistically significant difference in parameters like insertion time, requirement for airway manipulation, postoperative sore throat, post-operative bleeding and oro-pharyngeal leak pressure in the two comparisons.

## Discussion

We found that the technique of LMA insertion using the 90 degree rotational degree was as successful as the standard technique.<sup>[10]</sup> Some of the earlier studies have shown that the 90 degree rotational technique is more successful than the standard technique. We reasoned this is because successful insertion attempt was not defined accurately by these studies. We defined one successful insertion attempt as one which

**Table 3: Comparison of primary and secondary outcome measures among the three groups**

Insertion Parameters	Group A	Group B	Group C	P (A vs B)	P (B vs C)
Success at First Attempt	83.3% (50/60)	74.2% (45/60)	93.5% (56/60)	0.34	0.03*
Need for second attempt	13.33% (8/60)	20% (12/60)	6.66% (4/60)	0.95	0.02*
Need for third attempt	3.33% (2/60)	5% (3/60)	-	0.72	-
Need for Airway Manipulation	13.3% (8/60)	20% (12/60)	11.6% (7/60)	0.27	0.16
Post Operative Sore Throat	8% (5/60)	6.6% (4/60)	3.3% (2/60)	0.73	0.39
Post Operative Bleeding	13.3% (8/60)	10% (6/60)	6.6% (4/60)	0.69	0.16
Oropharyngeal Leak Pressure (cm H <sub>2</sub> O)	22.84±3.089	23.32±2.548	22.00±2.966	0.50	0.06
Insertion Time (Seconds)	25.97±6.129	28.32±11.441	29.00±16.250	0.31	0.84
Fiberoptic view Incidence of grade 4 view	48.2%	50%	40.4%	0.52	0.48
Fiberoptic view Incidence of grade 1 view	13.33%	10%	20%	0.45	0.04*

**Figure 1:** Consort flow diagram

gives an effective ventilation, and the effective ventilation has the expired tidal volume  $\pm 50$  ml of the set tidal volume on the volume control mode anaesthetic ventilator.<sup>[11]</sup> This may be the cause for the discrepancy in deciding one successful attempt in the earlier studies.

We used fully deflated cuff for insertion because fully deflated cuff has been shown to have less complications compared to half deflated cuff for LMA insertion.<sup>[12]</sup> The half-filled cuff may be too voluminous to pass through the pharynx, and hence may cause injury to the passing structures. Most of the earlier studies investigating the success among the various techniques have used partially inflated cuff.<sup>[10]</sup>

The 180 degree rotational technique has been shown to improve the ease and success of laryngeal mask airway insertion in children<sup>[13,14]</sup> and also in adults<sup>[4]</sup> compared to the

standard technique. But when we compared 180 degree with the 90 degree rotational technique, we found that 180 degree is more successful in terms of first attempt success rate.

There might be the criticism that the rotation technique could increase the likelihood of mucosal injury, but our secondary outcome measure blood staining on the LMA didn't show increased incidence of injury due to the rotational technique as shown in the earlier reviews.<sup>[10]</sup> The incidence of blood stain and the sore throat which are our secondary outcomes are not significant among the two rotational techniques.

When we address whether muscle relaxants improve the insertion of LMA placement, it was shown that even miniscule doses of succinylcholine<sup>[15]</sup> provides significantly better condition for LMA insertion, and also reduced propofol doses were needed and number of attempts

decreased. Hence we used atracurium as the muscle relaxant.

During our insertion, we found that compared to the standard technique, inserting the LMA with its lumen rotated (both 90 degree and 180 degree) makes it easier to insert the LMA along the posterior pharyngeal wall. However, rotating back to align it with the laryngeal inlet was challenging in some cases. This finding is supported by the finding of Brimacombe *et al.* in 1993 who found that 180-degree rotational technique results in some residual rotation in the coronal plane in adults.<sup>[4]</sup> This finding of residual rotation of the LMA after its final position in the pharynx was the reason for poor grades in the fiberoptic in view in spite of adequate and effective ventilation and success rate in the 180 degree rotational technique group.<sup>[4]</sup>

The other advantage about this rotational technique of LMA placement, what we realized is that there is no need for the insertion of the finger into the oral cavity to achieve proper placement compared to the standard technique.

Our study has a few limitations. First, blinding was not done due to the nature of the study which introduces a potential source of bias. Second, we didn't monitor the depth of anaesthesia using a BIS monitor, we used traditional subjective clinical signs for knowing the depth. Third, the insertion was done by the same anaesthesiologist which can be a possible source of bias. Earlier studies also used a single experienced anaesthesiologist. We investigated these techniques in the most basic supra glottic airway device.

## Conclusion

We conclude that 180 degree rotational technique of LMA insertion was more successful than the other two methods namely 90 degree rotational technique and standard insertion technique of LMA placement in adult patients undergoing surgical procedures under general anaesthesia.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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