Clinical Usefulness of Proseal Laryngeal Mask Airway for Anesthesia during Dental Procedures in Children

Young-Jae Kim*[1]/ Hong-Keun Hyun**[1]/ Jung-Wook Kim***/ Ki-Taeg Jang****/ Sang-Hoon Lee*****/ Chong-Chul Kim******/ Teo Jeon Shin *******/ Yong-Seo Koo********

Aim: *Although the Proseal laryngeal mask airway (PLMA) has been widely used in anesthesia, little is known about its clinical effectiveness during dental procedures. We describe the clinical feasibility of the PLMA for managing airways in the field of pediatric dentistry. .****Study design:*** *We reviewed the medical records of children who underwent airway management with the use of the PLMA from January 2011 to December 2012 at an outpatient facility at Seoul National Dental University Hospital.* ***Results:*** *During the study period, the airways of 19 children were managed with the PLMA for dental procedures. During its placement, blood pressure and heart rate were stably maintained. There were no interruptions of the dental procedures. None of the children experienced oxygen desaturation or ventilation difficulty. In one patient, the PLMA was dislodged for a short time, but the problem was easily solved with repositioning. After transferring to the post-anesthetic care unit, there were no incidences of oxygen desaturation or vomiting. All of the children were discharged from the hospital without complications.* ***Conclusion:*** *The PLMA can be successfully used in airway management during dental treatment in children.*

Key words*: Airway Management; Laryngeal Mask Airway; Pediatric Dentistry*

*Young-Jae Kim MDS, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, Seoul National University, Seoul, Republic of Korea

**Hong-Keun Hyun MDS, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, Seoul National University, Seoul, Republic of Korea

***Jung-Wook Kim MDS, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, College of Dentistry, Seoul National University, Seoul, Republic of Korea

**** Ki-Taeg Jang MDS, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, College of Dentistry, Seoul National University, Seoul, Republic of Korea

***** Sang-Hoon Lee MDS, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, College of Dentistry, Seoul National University, Seoul, Republic of Korea

****** Chong-Chul Kim MDS, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, College of Dentistry, Seoul National University, Seoul, Republic of Korea

******* Teo Jeon Shin MD, Ph.D., Department of Pediatric Dentistry and Dental Research Institute, College of Dentistry, Seoul National University, Seoul, Republic of Korea

********Yong-Seo Koo MD, Ph.D., Department of Neurology, College of Medicine, Korea University, Seoul, Republic of Korea

[1] YJ Kim and HK Hyun equally contributed to this study.

Send all correspondence to:

Teo Jeon Shin Department of Pediatric Dentistry and Dental Research Institute, College of Dentistry, Seoul National University, Seoul, Republic of Korea
Phone: +82-2-2072-2607
Fax +82-2-744-3599
E-mail: snmc94@snu.ac.kr

INTRODUCTION

In spite of the popularity of the laryngeal mask airway (LMA) in anesthesia,[1-4] it has seldom been used in dentistry. Placement of a tube in the oral cavity could interfere with the dental procedure. However, the LMA ensures a stable airway and can be applied for airway management in the field of pediatric dentistry. The reinforced type LMA (RLMA) can provide easy surgical access because its shaft is flexible. It has been widely used as an airway adjunct for dental treatments.[5,6] However, gastric aspiration is nearly impossible to prevent during RLMA placement. The Proseal LMA (PLMA) is gaining popularity in various types of surgical procedures.[7] Unlike the RLMA, a gastric draining tube, through which gastric contents can be decompressed, is incorporated within the shaft of the PLMA. Patency of the PLMA shaft can be maintained with its bite block structure. However, the clinical usefulness of PLMA as an airway adjuvant has not been evaluated in the field of pediatric dentistry. We retrospectively reviewed experience with the PLMA as an airway adjuvant during dental treatment in children.

MATERIALS AND METHOD

Patients' medical records from January 1, 2011, to December 30, 2012, were retrospectively reviewed. Patients were included if they received airway management with the PLMA for outpatient general anesthesia. We reviewed the medical records and extracted data after obtaining the approval of our institutional review board.

In our institute, the PLMA had been considered for use when tracheal intubation was contraindicated, if short-term dental treatment was expected, or if prompt airway management was needed in emergency situations.

Perioperative anesthetic management is standardized at our institutes. Before general anesthesia, we review the medical history and perform a physical examination and laboratory tests at the discretion of the supervising anesthesiologists. We instruct all patients not to eat or drink for 6 hours prior to general anesthesia for children younger than 36 months, for 8 hours for children older than 36 months.

Anesthesia was induced using sevoflurane inhalation. When anesthesiologists decided to use the PLMA, they inserted it into the oral cavity without muscle relaxant. The size of the PLMA was chosen based on the manufacturer's recommendation (size 1.5 for infants 5–10 kg; size 2 for infants/children 10–20 kg; size 2.5 for children 20–30 kg; size 3 for children 30–50 kg).

The successive carbon dioxide curve in the capnogram and the placement of the upper incisors at the middle portion of the bite block were considered indicators of proper PLMA positioning. After PLMA insertion, either spontaneous or assisted ventilation was maintained during the dental procedures. Age-adjusted 1 minimum alveolar concentration (MAC) sevoflurane in combination with 50% nitrous oxide was administered throughout the procedures. During anesthesia, we monitored noninvasive blood pressure, oxygen saturation, end-tidal carbon dioxide pressure, temperature, and vital signs in the medical records every 5 min. After treatment, we inserted a tube into the gastric lumen of the PLMA to decompress the gastric contents.

During dental procedures, we recorded any kind of interruption together with its causes in the medical records. In addition, we documented intraoperative adverse events, including difficulty of ventilation, oxygen desaturation (<95%), dislodgement of the PLMA during dental treatment, and any other adverse event. Difficulty of ventilation was defined as an increase of end-tidal carbon dioxide pressure more than 55 mmHg, abrupt decrease of end-tidal carbon dioxide pressure, or loss of capnography. When dislodgement of the PLMA was suspected, the PLMA was repositioned to maintain adequate ventilation.

We collected the following data from medical records: start and end time of anesthesia, start and end time of dental procedures, any kind of intraoperative adverse events, number of interruptions of the dental procedures, total duration of stay in the post-anesthetic care unit (PACU), any kind of adverse events in the PACU, and vital signs, oxygen saturation, and end-tidal carbon dioxide tension during the dental treatments.

RESULTS

A total of 19 patients used the PLMA during the defined study period. We reviewed their medical records and analyzed their data. The demographics and types of dental procedures are presented in Tables 1 and 2. Table 3 shows anesthesia duration, procedure duration, and time to discharge from the hospital after transferring to PACU.

Among the 19 patients, we used the PLMA instead of an endotracheal tube (ETT) in two patients due to difficult airways. One patient diagnosed with Treacher-Collins syndrome had a history of difficult intubation. The other patient had an unanticipated difficult airway during anesthesia induction; therefore the PLMA was used to maintain his airway during general anesthesia. The PLMA was used as an alternative airway for two patients, a patient with severe tracheal stenosis and a patient with vocal cord palsy, because we considered the ETT irrelevant in managing their airways (Table 4). In one patient, we selected the PLMA to manage respiratory compromise during dental treatment under propofol sedation.

During dental procedures, intraoperative blood pressure and heart rateHR were maintained within the range of 80–120 % of baseline in all patients. In all cases, end-tidal carbon dioxide tensions were in the range of 28–50 mmHg. No patients required treatment for oxygen desaturation. In all cases, oxygen saturation was maintained above 98% during dental procedures. One patient managed with the PLMA due to a difficult airway required repositioning of the PLMA during the dental procedure because it became

Table 1. The demographics of patients who used the Proseal laryngeal mask airway from January 2011 to December 2012

Age (mean ± SD), years	4.5 ± 2.0
Sex (male/female), number	11/8
Height (mean ± SD), cm	102.8 ± 11.7
Weight (mean ± SD), kg	17.7 ± 5.2

Table 2. The types of dental procedures performed using the Proseal laryngeal mask airway from January 2011 to December 2012

Procedures	Number
Restorative treatment (more than 3 dental caries or lesions)	5
Restorative treatment (less than 2 dental caries or lesions)	6
Suture	2
Mucocele excision	3
Simple extraction	3

Table 3. Duration of different phases in children undergoing dental procedures using the Proseal laryngeal mask airway

	Time (minutes)
Anesthesia duration	48.9 ± 38.7
Procedure duration	41.3 ± 38.7
Time to discharge	32.6 ± 14.2

* Data are displayed as mean ± SD

Table 4. Characteristics of patients who used the Proseal laryngeal mask airway because endotracheal intubation appeared unsuitable or difficult for airway management

Patient	Sex	Age (yr)	Medical history
ID1	F	3	History of difficult intubation, Treacher-Collins syndrome
ID2	M	6	Unanticipated difficult intubation
ID3	F	3	Herpes simplex pneumonitis, severe tracheal stenosis due to long history of intubation
ID4	M	3	Vocal cord palsy, recurrent laryngeal nerve paralysis due to complications of neuroblastoma excision

dislodged for a short time. However, this patient did not develop oxygen desaturation. The 19 patients experienced no respiratory compromises during PLMA insertion. All patients received their planned dental treatment, and none of them experienced vomiting or difficulty of ventilation during their dental procedures or after transferring to PACU. None of the patients complained of a sore throat in PACU. All patients were discharged from the hospital without developing any complications. During a 1-day follow-up-check phone call, no one complained of any kind of complications.

DISCUSSION

Historically, airway management has been a significant concern when pediatric patients are sedated or anesthetized for dental treatment. For short-term treatment, sedation has been widely chosen in clinical practice. However, airway obstruction is a major concern during dental sedation. Pulling downwards on the teeth during treatment can cause flexion of the neck, compromising the patient's airway. Airway obstruction and hypoxemia can therefore develop during dental sedation. The interruption of dental procedures is often possible, especially during deep sedation. In this regard, securing the airway instead of keeping the airway open could be beneficial in many circumstances of dental treatment.

The LMA, first invented by Brain,[8] is simple to use in that it is easy to insert without trauma and can be advantageous at relieving or preventing an obstructed airway. Even if the oral cavity is completely filled with fluid, the LMA can be inserted without airway soiling. The LMA has been widely used as an adjunct to manage airways during anesthesia.[5,6,9] Especially in outpatient settings, the use of the LMA in dental anesthesia has been increasing due to its favorable properties.[5,6] Nevertheless, the LMA is rarely used in anesthesia for dental treatment, because it is inserted into the mouth, where treatments take place. Placement of a tube in the oral cavity can interfere with dental procedures. Clinically, the RLMA has been widely used as an alternative airway device in the area of dentistry. The RLMA has a flexible shaft, making it suitable for dental surgery by providing easy surgical access to the oral cavity. Traditionally, the RLMA has been used to manage airways and minimize airway soiling during oral surgery under general anesthesia.[3,5,6] However, it has no bite block structure, rendering airway obstruction possible if patients bite on the tube during treatment. Moreover, the RLMA has no lumen for inserting a gastric tube like the classic LMA, making it impossible to prevent gastric aspiration. Both a bite block and a gastric lumen are incorporated in the PLMA.[7] Therefore, impairment of ventilation by biting the tube can be prevented with the PLMA, and gastric decompression is also possible through the gastric tube, lowering the possibility of gastric regurgitation. We routinely insert a gastric tube suitable to the PLMA size to prevent gastric aspiration after dental procedures. None of our patients experienced vomiting during emergence from general anesthesia or during the postoperative period. Postoperative vomiting can cause serious complications especially at the period of emergence from anesthesia. The PLMA can thus be advantageous in patients with a high risk for postoperative nausea and vomiting.

Theoretically, the PLMA, which has a tube size larger than that of the RLMA, could interfere with dental procedures, especially with the rubber dam placement and mouth gag insertion. However, dental procedures were easily performed with the PLMA in most cases. The PLMA has a larger cuff than the classic type LMA and can give a better seal than other types of LMA.[7] Theoretically, the PLMA is unlikely to be dislodged during surgical procedures because it can easily mold into the hypopharynx during dental treatment due to its improved seal. Among our patients, the PLMA remained stably positioned during movement of the head and even through manipulation inside the oral cavity for treatment.[1] Indeed, only one patient experienced dislodgement of the PLMA during a dental procedure, and that was short and easily solved with repositioning. In most cases, airway obstruction and ventilation difficulty were not present during the procedures. This suggests that the PLMA can be used effectively to secure airways during dental procedures.

In this study, we chose the PLMA to manage the airways of four patients who were difficult to intubate or seemed unsuited for intubation. During PLMA insertion, we did not observe intraoperative complications except for short-term PLMA dislodgement in one patient. There were no respiratory complications during the treatments. Even dental procedures lasting more than 2 hours were successfully performed with the PLMA in place. This study shows that the PLMA can be effectively used for lengthy dental procedures. Its clinical usefulness for short-term dental procedures has already been described in the literature.[5,10,11] Placement of the PLMA itself might be beneficial to maintain airway patency in patients with a high risk of difficult intubation and those in an uncertain situation to intubate. In this regard, the PLMA could be advantageous for patients with anticipated difficult airways or a previous history of airway compromise. The PLMA is also applicable in situations in which airway patency is abruptly compromised irrespective of the causes.

Although we found that the PLMA could be used as an effective airway device for dental procedures, some important points remain to be considered during the PLMA placement: It is nearly impossible to check a correct bite when the PLMA is in place. For example, the placement of the PLMA itself can prevent dentists from performing a check-bite during crown treatments. When dental lesions at all quadrants are treated, the PLMA should be moved and fixed to the corner of the mouth opposite to the sites to be treated.

We also note some limitations in this study. A relatively small number of patients were included in this study. The reasons for using the PLMA in managing the airways were variable and not controlled. Thus, there could be some biases in our results. This could limit generalization of the results in a clinical setting. Data from prospective studies are required to demonstrate the clinical efficacy and safety of PLMA usage.

CONCLUSION

PLMA could be successfully used in airway management during pediatric dental treatment, especially if difficult intubation is anticipated or intubation is unsuitable for airway management under general anesthesia as, for example, during short-term dental procedures.

REFERENCES

1. Johnston DF, Wrigley SR, Robb PJ, Jones HE. The laryngeal mask airway in paediatric anaesthesia. Anaesthesia, 45: 924-927, 1990.
2. Smith I, White PF. Use of the laryngeal mask airway as an alternative to a face mask during outpatient arthroscopy. Anesthesiology, 77: 850-855, 1992.
3. Yazbeck-Karam VG, Aouad MT, Baraka AS. Laryngeal mask airway for ventilation during diagnostic and interventional fibreoptic bronchoscopy in children. Paediatr Anaesth, 13: 691-694, 2003.
4. Riazi J, Morrison DE. The laryngeal mask airway in pediatric anesthesia. Anesthesiol Clin North America, 16: 813-825, 1998.
5. Goodwin APL, Ogg TW, Lamb WT, Adlam DM. The reinforced laryngeal mask in dental day surgery. Ambulatory Surgery, 1: 31-35, 1993.
6. George JM, Sanders GM. The reinforced laryngeal mask in paediatric outpatient dental surgery. Anaesthesia, 54: 546-551, 1999.
7. Brain AIJ, Verghese C, Strube PJ. The LMA 'ProSeal'—a laryngeal mask with an oesophageal vent. Br J Anaesth, 84: 650-654, 2000
8. BRAIN AIJ. The laryngeal mask – A new concept in airway management. Br J Anaesth, 55: 801-806, 1983.
9. Hung WT, Hsu SC, Kao CT. General anesthesia for developmentally disabled dental care patients: a comparison of reinforced laryngeal mask airway and endotracheal intubation anesthesia. Spec Care Dentist, 23: 135-138, 2003.
10. Leach AB, Alexander CA. The Laryngeal Mask-an overview. Eur J Anaesthesiol Suppl, 4: 19-31, 1991.
11. Brimacombe J, Berry A. The laryngeal mask airway for dental surgery--a review. Aust Dent J, 40: 10-14, 1995.