Abstract:

The Laryngeal Mask Airway (LMA) is an airway management device that is used to establish and maintain a patent airway for the patient. A palatal torus is a common benign bony exostosis, usually located in the midline of the palate, beneath the palatal mucosa It should be recognized by the CRNA during the preoperative anesthetic assessment. A palatal torus can hinder insertion of the LMA, while using the LMA standard insertion technique. Therefore, modification must be made to the operator's insertion technique with a folded LMA around a palatal torus.

Insertion of a Folded Laryngeal Mask Airway Around a Palatal Torus

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The Laryngeal Mask Airway (LMA) is an airway management device that is used to establish and maintain a supraglottic patent airway for the patient. The LMA has become an important airway tool for the Certified Registered Nurse Anesthetist (CRNA). A palatal torus is a common benign bony exostosis, usually located in the midline of the palate, beneath the palatal mucosa. If the palatal torus has a broad base it is called a sessile palatal torus. If it possesses a stalk-like base, it is referred to as a pedunculated palatal torus. (Figures 1 and 2)[1,2]

A palatal torus should be recognized by the CRNA during the preoperative patient examination and anesthetic assessment. A palatal torus can hinder insertion of the LMA while using the LMA standard insertion technique. Therefore, modification must be made to the operator's insertion technique with a folded LMA around a palatal torus.

The *LMA- Classic* ™ was conceived and designed by Dr. A.I.J. Brain of the Royal Berkshire Hospital in Reading, England in 1981.[3] The LMA was first used in a human patient in 1981. In 1988, the LMA went into production in the United Kingdom, where it underwent extensive clinical trials. By 1990, all operating rooms in the United Kingdom had purchased LMAs. The LMA was

approved for use in the United States in 1991, and became popular for use thereafter.[4,5] The LMA was included in the American Society of Anesthesiologists Difficult Airway Algorithm in 1993, and assumed an even more important role in the updated Difficult Airway Algorithm in 1996 and difficult airway protocols in 2002. [6,7]

An LMA is made of a tough and flexible medical-grade silicone, which can be washed in soapy water, rinsed, and autoclaved for sterility. LMAs are available in sizes 1-6. Selection for use in a particular patient is based according to the patient's weight in kilograms, and the relative size of the patient's hypopharynx.[8]The LMA was conceived because it establishes a relatively quick and non-stimulating patient airway, which is also gas-tight junction supraglottically.[9]

There are drawbacks for using a traditional facemask to deliver oxygen and other anesthetic gases to the patient. It is difficult to hold a facemask against the patient's face for long periods of time. There is a potential for nerve injury to the patient from the pressure used to hold the facemask tightly against the face. It is also difficult to establish a good seal with a facemask so that the anesthetic gases reach the patient and do not leak into and contaminate the operating room.

Tracheal intubation establishes a secure and definitive airway for the patient, but intubation has several drawbacks. Tracheal intubation requires

advanced technique for placement by the CRNA with a laryngoscope or fiberoptic scope. Tracheal intubation also requires the use of muscle relaxants, which pose potential dangers to the patient in the event of inability to intubate. Tracheal intubation is also very stimulating and invasive to the patient.[5]

A palatal torus can be an obstacle for the insertion of an LMA, and can astonish an unprepared CRNA. A modification to the shape of the LMA, prior to insertion, can efface the existence of a palatal torus barrier.

The palatal torus is a benign symmetrical, bony-hard, sessile (flat base) or pedunculated (stalked) exostosis found in the midline of the hard palate.[10,11,12] A torus is the most common oral exophytic lesion.[10] A torus consists of histologically normal mature bone with an outer cortical plate, and a core of cancellous bone.[12,13,14] This bony mass is covered by light pink coral colored, tightly-stretched palatal mucosa [2,12] They may appear flat, spindle shaped, as a single large nodule, or with multiple lobules.[10,12,13,15] See Figures 1& 2

The palatal torus is believed to be an inherited characteristic, and many members of the same family can have them present in their mouth.[12, 15,16,17] There is also a belief that bruxism (recurrent grinding, clenching, or gnashing of the teeth) can cause formation of a palatal torus through time, along the intermaxillary and palatomaxillary sutures.[17, 18] Their occurrence may also be linked to dietary and nutritional disturbances.[17] They can appear at any age, but are usually seen after puberty, and within the first thirty years of life.[9,12,15,17] Tori

are twice as prevalent in females, than in males.[9,12,13,15,17] They are more commonly seen in Asian populations, compared to African-American, and Caucasians.[12,13,16,18] They are seen in 20-25% of the American population.[11,12,13,15] Since the palatal torus is so slow-growing, it usually goes unnoticed by the patient, regardless of it's size.[15] The palatal torus is usually left untreated unless it interferes with speech or swallowing, is in the way for construction of a removable full denture or a removable partial denture, becomes a psychological barrier to the patient, or becomes chronically traumatized, causing ulceration during eating.[11,12,13,15,16,18]

Tori can exist in other areas of the mouth. (Table 1) There is no causal relationship for the occurrence of tori in various areas of the mouth in the same patient.[18]

A palatal torus can resemble other types of oral pathology. Ulceration of the thin palatal mucosal surface overlying the torus could resemble a carcinoma. Other lesions could be a palatal abscess, a minor salivary gland tumor, a benign pleomorphic adenoma, a mature cementifying or ossifying fibroma, an ossified subperiosteal hematoma, a non-resolved bony callus, an osteoma, an early osteosarcoma, or an early chondrosarcoma.[9, 11,13,14,16]

There are many techniques described in the literature, which are used to insert the LMA. Table 2 lists and describes techniques of LMA insertion described in the literature.

The Standard LMA Insertion Technique (Figures 3,4,5,6,7,8) described by Dr. Brain, is as follows: Select the correct size LMA for the patient. Remove all of the air from the LMA. Lubricate the concave surface of the LMA with a water-soluble jelly. It is assumed the patient is then properly monitored and pre-oxygenated. Intravenous anesthetic induction is best established with propofol. Potent inhaled volatile anesthetic gases work very well for LMA insertion in pediatric patients. Dr. Brain then inserts the LMA by holding the device in the operator's dominant hand, as though it were a pen (Figure 3). With the patient laying supine and the operator approaching from the top of the patient's head, the head is extended with flexion of the neck (the sniffing position), the same position used for tracheal intubation. The mask aperture (grating) must face forward, and the tip of the concave surface of the mask is inserted flatly, with the help of the non-dominant hand, against the hard palate of the patient (Figures 4,5). Gentle pressure is applied with the dominant index finger against the hard palate, focusing this pressure toward the occiput of the patient (Figure 6). The lubricated LMA is designed to mimic the shape of a bolus of food, causing the mask to slide gently across the hard and soft palate, into the hypopharynx. The mask is advanced until a definitive stop is felt (Figures 7,8). The LMA cuff is then inflated with a proper amount of air, based on the size of the LMA. The non-insertion hand should then hold the LMA tube in place while the anesthesia circuit or self-inflating resuscitation bag is

attached. Breath sounds and epigastric sounds are auscultated, and end tidal carbon dioxide is assessed.[8]

A large sessile or pedunculated palatal torus can become a formidable obstruction for any of the possible LMA insertion techniques, due to physical obstruction along the LMA insertion pathway. Insertion can be accomplished by folding the LMA cuff flaps toward the aperture. The LMA cuff flaps are held folded together by the thumb and middle finger against the tubing, with the index finger placed between the cuff and the tubing. (Figures 9,10,11,12,13) Once past the obstructive torus, the standard LMA insertion technique can be concluded. (Figures 14, 15)

In summary, the Laryngeal Mask Airway (LMA) is an airway management device that is used to establish and maintain a patent airway for the patient. The LMA was conceived because it establishes a relatively quick and non-stimulating, gas tight junction between this artificial airway and the trachea. A palatal torus is a benign symmetrical, hard, sessile (flat base) or pedunculated (stalked) exostosis found in the midline of the hard palate. A torus consists of histologically normal mature bone with an outer cortical plate, and a core of cancellous bone. This bony mass is covered by the pale pink colored or normal colored palatal mucosa. A palatal torus can be an obstacle for the insertion of an LMA, and can astonish the unprepared CRNA. A modification in the shape of the LMA, by folding the cuff of the LMA in half

toward the aperture, and then inserting it past the palatal torus can efface the existence of a palatal torus barrier. Once past the obstructive torus, the standard LMA insertion technique can be concluded. Dr. Brain emphasizes the standard insertion technique as the best insertion technique.[19, 32]

Table 1. Locations of Oral Tori and Exostoses[11, 12, 17]

Palate

Lingual aspect of the mylohyoid ridge of the mandible (may occur unilaterally or bilaterally)

Buccal aspect of the alveolar bone in the maxilla or mandible

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Table 2. LMA Insertion Techniques[19]

Insertion Technique	Description
The standard insertion technique [8, 9, 20, 21]	
The thumb insertion technique [9]	Used for patients in whom access to the patient from the top of the head is difficult or impossible. The thumb is positioned where the index finger is positioned in the standard insertion technique. The thumb pushes the LMA flat against the palate, and follows the mask around as it slides into the hypopharynx. The remaining four fingers slide over the patient's face.
The 90 or 180 degree rotational technique with or without a partially inflated LMA cuff [15, 22, 23]	The mask is inserted with the cuff partially inflated. If resistance is met in the posterior pharynx, the LMA is rotated 90° in the oral pharynx. The fully- deflated mask is inserted 180° opposite the standard insertion technique, and rotated 1800 as it entered the hypopharynx.
The Yodfat insertion technique. [24, 25]	A standard slightly-inflated LMA with a rigid stylet inserted within the LMA tubing bent at a 90 degree angle close to the

	laryngeal (cuffed) portion (the shape of the standard LMA is now looks like and is inserted similar to an LMA Fastrach™).
Laryngoscopic-guided insertion technique[26, 27]	The epiglottis and pharyngeal tissues are lifted to ease insertion of the LMA using the standard technique.
Insertion of an LMA with the patient in a prone position[28]	
Fiberoptic guided insertion of the LMA[29]	
Use of a skid or curved spoon to create an artificial hard palate or as a tongue retraction device [30, 31, 32]	Creates a smooth hard bend at the oral and pharyngeal junction.
Assistant facilitated insertion[33]	Use of an assistant to open the mouth extra wide with mandibular retraction or jaw thrust.
Anterior glottis retraction and head repositioning[34]	Emphasizes neck flexion to ease insertion due to a reduction in the acute angle between the oral and pharyngeal junction.
Lateral LMA position approach[35, 36]	The LMA is inserted at a 90^0 angle or less, and is rotated to the standard insertion position as it passes through the oral pharyngeal junction.
Partially or fully inflated cuff[37, 38]	Is believed to aid insertion by the removal

	of all folds from the LMA cuff.
Finger retraction of the posterior pharyngeal wall[36]	The LMA is inserted with a finger on the posterior wall of the mask guiding it as it moves past the oral pharyngeal junction.
Anterior tongue traction[36]	An assistant uses a gauze swab to retract the tongue forward out of the mouth.
Superior Laryngeal nerve block[39]	Used to prevent coughing and laryngospasm.
Anteriorly Deflated Rim[40, 41]	The LMA cuff is deflated prior to insertion, and the tip of the LMA is maneuvered forward, toward the aperture of the LMA.
The Folded LMA approach	Described in this paper.