ABSTRACT
Surgical differences in mild versus moderate to severe disease with additional tips and tricks are described during performing robotic lingual tonsillectomy.

Key Words: Robotic lingual tonsillectomy, Surgical technique

INTRODUCTION
Lingual tonsil hypertrophy may cause significant morbidity and is frequently the cause of persisting peripheral obstructive sleep apnea syndrome, especially in the patients with a history of previous adenotonsillectomy. The goal of lingual tonsillectomy, which includes the removal of the mucosa and lymphoid tissue of the tongue base, is to enlarge the oropharyngeal section of the airway. In the tongue base area, superficial layer that composed of lymphoid tissue, is surgically safe, however, deep layer which is composed of muscles covering great vessels and crucial nerves is relatively dangerous. Herein, tongue base reduction with additional tips and tricks is described during robotic lingual tonsillectomy (RLT).

Description of Surgery
We previously reported our technique of RLT using the Da Vinci robotic surgical system (Intuitive Surgical, Sunnyvale, CA, USA) [1]. The surgeon’s cart should be located at the end of the operating room, allowing free space to maneuver the surgical cart, which is placed on the right side of the patient, opposite to the surgeon. The assistant is seated at the head of the patient, especially for blood and smoke suctioning (Figure 1).

After the patient entubated transnasally, tongue body is placed with 1-0 silk sutures to retract the tongue anteriorly and displaced by a mouth gag. A Feyh-Kastenbauer/Weinstein-O’Malley (FK-WO) oral retractor with the adapted design of a blade was used for better visualization and access to the base of tongue. The smaller mouth-gag blades may provide a better exposure for lateral boundaries of tongue base. Nevertheless, if it is hard to see the lateral, repositioning the tongue blade may be necessary during the surgery. Only two robotic 5 mm arms are used for every patient: a Maryland Dissector for grasping and dissection of tissues and a Monopolar Cautery for dissection and coagulation (Figure 2).
DISSECTION PLANE OF TONGUE BASE

Moderate to Severe Disease: We prefer to excise lingual tonsils in two pieces in moderate or severe diseases where lingual tonsils are extremely hypertrophic. In this procedure, an initial incision on the midline of tongue base, from foramen caecum down to epiglottic tip and vallecula is made to divide lingual tonsils into two. Foramen caecum is the key point for the upper limit of the resection and the midline of the tongue base. Monopolar cautery is used to dissect in the sublymphatic and supramuscular plane to avoid damage to the muscular structures. This sequence is possible in all cases of lingual hypertrophy (mild to severe).

Mild Disease: En bloc resection of lingual tonsils is possible when lingual tonsillar hypertrophy is mild. This procedure, en-bloc lingual tonsillectomy, is started with the dissection of lateral border of tongue base mucosa (Figure 3). Mucosal branches of dorsal lingual artery are cauterized with monopolar cautery. When the supramuscular plane is reached, the care must taken to stay in dissection plane to avoid damage to the neurovascular bundle. If not, the lingual artery and its branches can be damaged.

Borders of tongue base;

- Superior border; Sulcus terminalis
- Inferior border; Glosso-epiglottic sulcus
- Lateral Border; Amygdalo-glossus sulcus
- Medial Border; Foramen caecum to median glossoepiglottic fold

Keypoint 1: Lingual tonsils are surrounded by thin capsule of connective tissue which separates them from adjacent structures.

Keypoint 2: En-bloc resection method requires a good exposure of all tongue base borders and meticulous planning. It starts with dissection of amygdalo-glossus sulcus, the lateral boundary of tongue base.

Keypoint 3: In the case of extreme lingual tonsillar hypertrophy, the central tongue base debulking may be necessary for better lateral manipulation.
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**KEEPING THE DISSECTION IN SUBCAPSULAR PLANE**

The dissection is carried out with monopolar cautery close to the muscular plane. The scope is kept closer to the dissection area for better identification of vessels, nerves and muscular compartment (Figure 4). On the lateral dissection plane, the branches of dorsal lingual arteries and veins can bleed and be commonly controlled with monopolar cautery (Figure 5). No clip placement is required. The surgeon should obtain control of the lingual artery at the lateral aspect of the dissection as the vessel enters the tongue musculature. As the dissection comes to down limit of surgery, the care must taken not to damage to hyoepiglottic ligament, which stabilizes the epiglottis during deglution (Figure 6).

The surgical specimen removed in en-bloc fashion is seen in Figure 7.

**Keypoint 4:** After lingual tonsillectomy, if the epiglottis is significantly retroflexed and still continues to obstruct the hypopharyngeal airway, an epiglottoplasty is done to relieve the obstruction.
TAKE HOME MESSAGES

1. Using the robot results in fewer complications and possibly better speech and swallowing after surgery with a 3D awareness of the surgical anatomy when compared to traditional surgeries.

2. To avoid nerve damage, lingual tonsillectomy is performed more thoroughly in the central part of the tongue.

3. Foramen caecum is the key point for upper limit of surgical field and crucial in to avoid damage to circumvallate papillae area and taste function.

4. The neurovascular bundle, consisted of lingual artery and nerve, lies 2.2 cm inferior and 1.3 cm lateral to the foramen cecum. The hypoglossal nerve is approximately 1.6 cm lateral to the foramen cecum.

REFERENCES
