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Endoscopic Assisted Coblation Lingual Tonsillectomy: Our Experience in Selected Cases with Obstructive Sleep Apnea

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Abstract

Background: Obstructive Sleep apnea (OSA) is a disorder characterized by frequent cessation of breathing (apnea) and or shallow breathing (hypopnea) during sleep. Multilevel obstructions, including both retropalatal and retrolingual obstructions, are usually identified in more than half of the OSA patients.

Aim of Study: The importance of tongue base hypertrophy in OSA is now clear. Butsurgery remains challenging. This study aimed to report our results in the assessment of lingual tonsillectomy by coblation for the management of tongue base hypertrophy in patients with moderate to severe OSA.

Patients and Methods: This prospective study was conducted between 2019 and 2021 on patients with moderate to severe OSA with retro-lingual collapse that was confirmed by awake and drug induced sleep endoscopy (DISE). Endoscopic assisted coblation lingual tonsillectomy (EACLT) was performed for all patients in combination with other palatal and/or nasal surgeries. Preoperative and 3 to 6 months after surgery, all patients underwent polysomnography and Epworth Sleepiness Scale (ESS), and values were assessed.

Results: Within the included 24 patients, the mean apnea hypopnea index (AHI) dropped significantly (p<0.001) from 46.87±15.86 preoperatively to 19.30±13.42 postoperatively. Successful outcome was reported in 16 patients (66.7%). The mean oxygen desaturation index (ODI) decreased from 43.41± 14/h to 19.93±13.7/h (p<0.001). The mean minimal oxygen saturation (SaO_2) increased from 77.46±11.01% to 86.22± 9.46% (p<0.001). Two patients (8.3%) developed delayed postoperative bleeding from the tonsillar bed. Otherwise, no significant intra or postoperative complications were reported. No patients developed tongue oedema or required ICU admission.

Conclusions: EACLTappears a safe and effective method for addressing lymphatic tongue base hypertrophy in patients with OSA with minimal side effects.

Key Words: *Coblation – Tongue base surgery – Obstructive sleep apnea – Lingual tonsillectomy.*

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Introduction

OBSTRUCTIVE Sleep apnea (OSA) is a disorder characterized by frequent cessation of breathing (apnea) and/or shallow breathing (hypopnea) during sleep **[1]**. Multilevel obstructions, including both retropalatal and retrolingual obstructions, are usually identified in more than half of the OSA patients **[2]**. In the past, tongue base hypertrophy as a cause of airway obstruction was usually overlooked. But, with the wide use of fiberoptic endoscopy either awake or during sleep in the evaluation of OSA patients, the importance of tongue base hypertrophy has been really emphasized. Missing dealing with the retrolingual obstruction and/or collapse is one of the important causes of failure in surgical treatment of OSA patients. Thus, advances have been attained in hypopharyngeal surgery and the concept of single-stage, multi-level surgery was shown up **[3-5]**.

With time, the tongue base is documented as a possible location of obstruction in many OSA cases. This problem often remains inadequately treated owing to the unpredictable efficacy of the available procedures **[3,6]**. Various surgical procedures were proposed to treat retrolingual obstruction including tongue base suspension **[6]**, reduction or resection of tongue base **[7-10]**, and advancement either genioglossus advancement or maxillomandibular advancement (MMA) **[11]**. Nonetheless, surgery of the tongue base remains challenging and critical due to difficult surgical access, poor visualization and presence of the neurovascular structures. The use of coblation in tongue base was first introduced by Robinson et al., **[12]** and with the technical advances of surgical instruments and visualization systems; lingual tonsillectomy with coblation has been applied widely to patients with OSA, showing less morbidity **[13]**. Although coblation has been increasingly used, still there is insufficient data reporting its outcome in lingual tonsillectomy. The aim of the present prospective study was to report our experience and highlight the technical tips and tricks in EACLT for management of tongue base hypertrophy in patients with moderate to severe OSA.

Patients and Methods

Patient selection and equipment:

A prospective clinical study was carried out in the department of Otolaryngology-Head and Neck Surgery, Zagazig University Hospitals, between 2019 and 2021. The study included 24 consecutive patients with the following criteria: Moderate to severe OSA with AHI ≥15, lymphatic lingual tonsillar hypertrophy as diagnosed by fiberoptic naso-endoscopy either isolated or combined with other areas of collapse, failed or not tolerated CPAP treatment and body mass index (BMI) ≤35.

We excludedpatients with severe medical illness or comorbid conditions, significant craniofacial anomalies affecting the airway like maxillomandibular hypoplasia, and BMI >35.

Preoperative assessment included full history taking, Epworth Sleepiness Scale (ESS) evaluation, clinical examination, and nocturnal polysomnography. Flexible awake nasoendoscopy was performed for all patients as well as drug-induced sleep endoscopy (DISE). In some cases, an additional MRI was performed (Fig. 1). Informed written consent was obtained from all patients, and the Zagazig University Research Review Board approved the study. EACLT was performed with or without procedure at other level of airway obstruction and/or collapse according to the preoperative fiberoptic naso-endoscopy and DISE.

Efficacy and safety were assessed by the same preoperative measures at 3 to 6 months postoperatively. The main aim of the present study was to assess success, defined by AHI <20, with ≥50% decrease from the preoperative level. Secondary objectives concerned ESS, nocturnal desaturations: Minimum SaO_2, oxygen desaturation index (ODI), and adverse events together with highlighting some tips and tricks on surgical technique.

We used a Coblator II Surgery System (ArthroCare ENT, Sunnyvale, CA) and an EVac 70 coblation wand (ArthroCare ENT). The tongue base was visualized using a 30-degree angled, rigid endoscope (4mm) connected to a camera and a video system. The endoscope was either held by the left hand of the main surgeon or occasionally by an assistant.

Surgical technique:

The procedure was performed with the patient under general anaesthesia with naso-tracheal intubation in the supine position with the patient in the sniffing position (head extended over neck and neck flexed over chest). The McIVOR mouth gag (Karl Storz, Tuttlingen, Germany) was applied to open the mouth (Fig. 2), and a sufficient time was spent at this step to ensure good tongue base exposure and this could be achieved by:

- The use of short medium-sized wide tongue blade.
- The use of vicryl suture applied to the tongue tip to retract the tongue forwards and expose the area of tongue base.
- Proper positioning of the blade just anterior to circumvallate papillae at the midline of the tongue to avoid any distortion of the tongue shape.

The surgeon usually sits at the head of the patient and the video monitor is placed at the feet of the patient. The shaft of the coblator was gently bent to allow easy accessibility to the tongue base. A coblation setting of 7 and a coagulation setting of 3 were used in our procedures (Fig. 3).

In our technique, we sometimes used the coblation as an ablation tool (the same as used during coblation adenoidectomy) (Fig. 4) or less commonly as a resection tool (the same as used during coblation tonsillectomy) (Fig. 5), in the latter case the scope had to be held by an assistant to allow the main surgeon to use his both hands. In either case, the procedure starts from the foramen caecum in midline down to glossoepiglottic furrow and laterally to amigdaloglossus sulcus on both sides keeping in mind to leave a rim of lateral tongue base mucosa on each side at the area of the amygalo-glossus sulcus to avoid possible circumferential stenosis. We used the epiglottis as an indicator for the volume to be reduced because at the end we have to have a clear view of the epiglottis. Ablating lymphatic tissue in the tongue base area was done layer by layer avoiding creating a deep tunnel; otherwise, control of bleeding would be difficult if encountered. To avoid injury to the neurovascular bundle which is located in an inferolateral direction; care was taken to be within 1 to 1.5cm from the midline and 1.5 to 2cm in depth taking into consideration that tongue protraction may make the dorsal lingual artery branches more superficial, so staying in a safe zone behind the foramen caecum and a line connecting both midpoints of circumvallate papillae helps us to avoid vascular injury **[14]**. In any case, a clip applier was available to control bleeding from minor branches of the dorsal lingual artery whenever encountered and couldn't be managed by the coagulation setting of the coblation.

Statistical analysis:

Data analysis was performed using the software SPSS version 20 (SPSS Inc, Chicago, IL). Paired *t*-test (for normally distributed data), Wilcoxon signed-rank test (for not normally distributed data) were used to measure differences in the studied parameters pre and postoperatively within each group. The level of statistical significance was set at 5% ($p<0.05$). A highly significant difference was present if $p\leq0.001$.

Results

A total of 24 patients (13 men and 11 women) underwent EACLT. Their mean age was 46.08± 5.41 years and mean BMI was 31.02±2.87kg/m^2. Among all studied patients; 5 patients had a history of septoturbinoplasty, 4 patients underwent previous UPPP, 2 patients had a history of genioglossus advancement, one patient underwent previous radiofrequency tongue base reduction and one patient underwent previous anterior palatoplasty, 1 patient underwent suspension pharyngoplasty, and 2 patients had history of tracheostomy (Table 1).

Table (1): Demographic data & history of the studied group.

Variable	(n=24)
Age:	
Mean ± SD	46.08±5.41
Range	37-54
Sex:	
Male N (%)	13 (54.2%)
Female N (%)	11 (45.8%)
Past surgery:	
No	16 (66.7%)
Yes	8 (33.3%)
Septoturbinoplasty	5
UPPP	4
Genioglossus advancement	2
RF tongue base	1
Tracheostomy	2
Palatoplasty	1
Pharyngoplasty	1

The surgical time for EACLT rangedfrom 15 to 45 minutes with a mean of 35.1±7.33 minutes. However, when multilevel surgery was done the overall surgical time ranged from 60 to 110.21 minutes with a mean of 81.13±19.21 minutes.

Most of the 24 patients underwent concomitant surgeries at the same time such as coblation tonsillectomy (n=12), relocation pharyngoplasty by coblation (n=12), anterior palatoplasty (n=2), turbinoplasty (n=6), and septoplasty (n=4).

Surgical outcomes:

While the BMI did not change significantly in the postoperative period (31.02±2.87kg/m^2 preoperative Vs. 30.56±3.16kg/m^2 postoperative) ($p=0.203$), There was a significant difference between the mean preoperative AHI (46.87±15.86/h) and postoperative AHI (19.30±13.42/h) ($p<0.001$). The improvement rate (AHI reduction <50%) was 83.3% (20/24). The success rate (AHI reduction <50% and postoperative AHI <20/h) was 66.7% (16/24). None of the patients reported worsening of AHI.

The mean ODI also significantly decreased from 43.41±14/h to 19.93±13.7/h ($p<0.001$) and the mean minimal SaO_2 significantly increased from 77.46±11.01% to 86.22±9.46% after surgery ($p<0.001$). The mean ESS significantly decreased from 13.71±3.84 to 5.4±3.71 after surgery ($p<0.001$) (Table 2).

Table (2): Comparison between preoperative and postoperative findings.

	Preoperative	Postoperative	test	*p*-value
BMI (kg/m^2)	31.02±2.87	30.56±3.16	*t* 1.113	0.203
AHI	46.87±15.86	19.30±13.42	w 4.29	<0.001*
ODI	43.41±14	19.93±13.7	w 4.25	<0.001*
LOS	77.46±11.01	86.22±9.46	*t* 6.09	<0.001*
ESS	13.71±3.84	5.4±3.71	w 4.21	<0.001*

BMI : Body mass index.
AHI : Apnea hypopnea index.
ODI : Oxygen desaturation index.
LOS : Lowest oxygen desaturation.
ESS : Epworth sleepiness scale.
t : Paired *t*-test.
w: : Paired Wilcoxon test.
*Denotes $p<0.05$.

Recovery from anaesthesia was event-less in all included patients. The postoperative pain was adequately controlled by analgesics and disappeared within 14 days. The VAS of the postoperative pain ranged between 2 and 4 (mean=3.08±0.8).

Adverse events:

No post-operative bleeding was recorded from the tongue base and we did not face an intra-operative bleeding from the main dorsal lingual branch of the lingual artery in any case, but two of the studied patients (8.3%) developed delayed post tonsillectomy bleeding from tonsilar bed; one was treated by conservative measures, while the other required intraoperative control using bipolar coagulation. Six patients (25%) developed transient foreign body sensation. However, all were improved within 3 months period. The most frequently recorded adverse event was tongue numbness that was evident in 7 patients (29.17%) but improved gradually within the first 3 months post-operatively. No patients developed tongue edema or required urgent tracheostomy. Only one patient required elective tracheostomy before proceeding to tongue base surgery and was decannulated on the 5th day.

No major complications were recorded and 14 patients (58.33%) were discharged on the same day and 6 patients were discharged (25%) on the second postoperative day and 3 patients discharged after 2 days while the patient for whom preoperative tracheostomy was done was hospitalized for 5 days till decanulation. Oral feeding with liquid and semisolid diet was started on the 1st day in all patients; no one required nasogastric tube insertion.

Fig. (1): MRI TSE Sagittal view showing lymphatic tongue base hypertrophy (area inside yellow dots).

Fig. (2): McIvor mouth gag with different sizes of tongue blades, usually the middle one is the preferred.

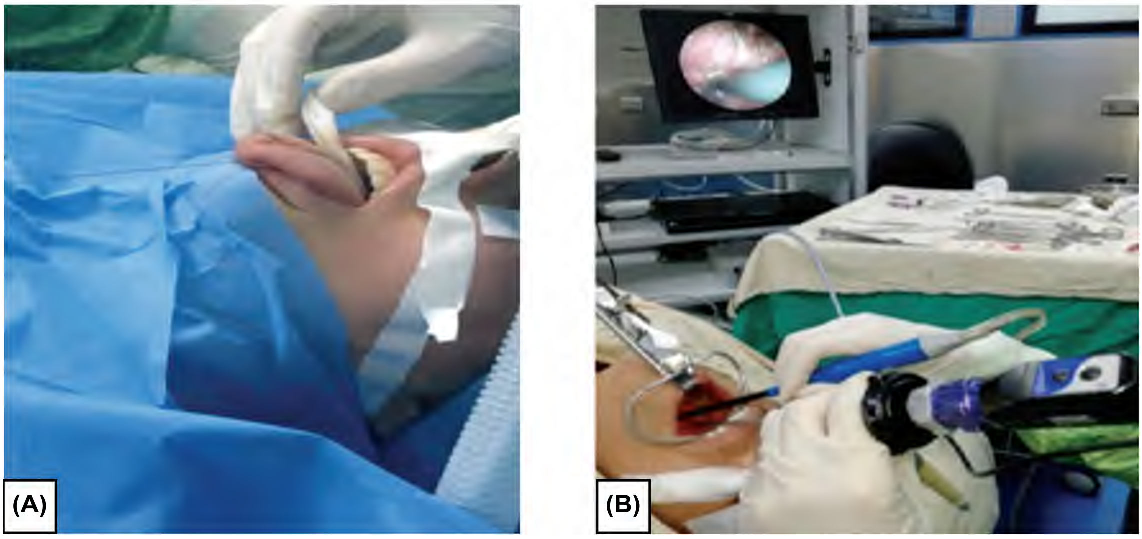

Fig. (3): (A) Tongue protraction suture, (B) Operating room setting showing both surgeon and monitor tower position.

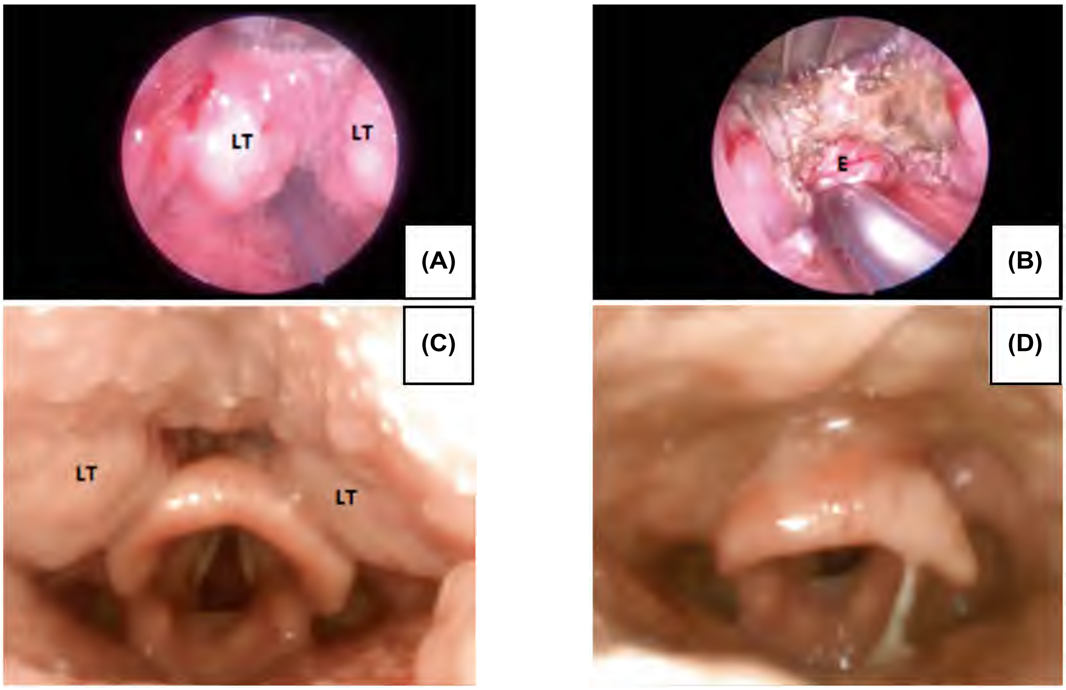

Fig. (4): Example for lingual tonsil ablation by coblation, (A & B) Intraoperative view before and after ablation (E = Epiglottis), (C) Preoperative awake fiberoptic endoscopic view. (D) 1 month post-operative awake fiberoptic endoscopic follow-up. LT = Lingual tonsil.

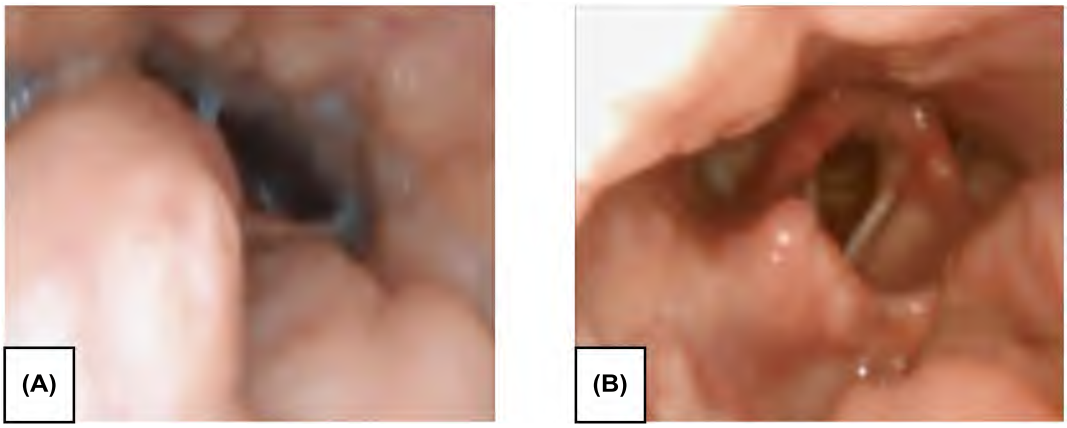

Fig. (5): Example for lingual tonsil resection and partial epiglottoplasty by coblation. (A) Preoperative awake fiberopticendoscopic view, (B) 1 month post-operative awake fiberoptic endoscopic follow-up.

Discussion

Surgical techniques for treatment of OSA range from procedures that increase or stabilize the airway by removing or repositioning tissues to procedures that completely bypass the site of airway collapse, such as tracheostomy **[15]**. To be effective, surgery must be tailored according to the patient's needs and directed to the main sites of collapse in the airway after proper endoscopic examination. Retro-lingual airway obstruction is a more common cause of OSA than previously realized and often represents an overlooked anatomical obstruction site particularly in some patients with continued OSA after surgical intervention. Addressing this area through lingual tonsillectomy represents one of the most challenging procedures in our practice. Difficult exposure, poor visualization, difficult hemostasis, airway edema, and excessive postoperative pain prevent many otolaryngologists from considering this procedure. There are many techniques that address the tongue base to treat retro-lingual obstruction in OSA patients, these techniques either working on the bony frame or reducing tongue base size. Several studies **[16-18]** described different techniques for tongue base resection including lingual tonsillectomy. These procedures are often associated with intra- or postoperative complications such as bleeding, respiratory difficulty, swallowing difficulty, dental injury, and taste change. Robinson et al., [12] first presented the coblation technique, which allows a submucosal minimally invasive tongue base resection. However, because they used suspension laryngoscopy, there were some limitations in terms of direct and clear visualization of the tongue base. Recently, endoscopic coblation of the tongue base was introduced [19-21].

The use of endoscope provides an excellent panoramic view and allows easy access to the lateral parts of the tongue without distortion of the anatomy unlike the use of suspension laryngoscope.

Coblation technology is based on a non-heat driven process of soft tissue dissolution which makes use of bipolar radiofrequency energy. This energy is made to flow through a conductive medium like normal saline. When current from the radiofrequency probe passes through a saline medium it breaks saline into sodium and chloride ions. These highly energized ions form a plasma field strong enough to break organic molecular bonds within soft tissue causing its dissolution. The thermal effect of this process is approximately (45-85 °C) [22].

Babademez et al., [13] in 2010 used coblation to perform midline glossectomy in OSA patients but his technique was different from ours as the coblation wand was introduced transorally while the surgeon is facing the patient not sitting at the head; we believe that using endoscope has an added value for better visualization of lingual tonsils. Chen et al., [23] used coblation in midline glossectomy but he used a 70° endoscope and the surgeon was sitting at the head of the patient. Our technique is similar to Cho et al., [24] who tried to simulate the effect of transoral robotic surgery (TORS) by coblation.

In our study, there were significant reductions in AHI, ODI, and ESS postoperatively. Our improvement rate (AHI reduction <50%) was 83.3% (20/24) and the success rate (AHI reduction <50% and postoperative AHI <20/h) was 66.7% (16/24), which is slightly higher than Babademez et al[13] who reported success rate of 62.5%, Chen et al[23] (63.6% success rate), and Lin et al., [25] (62.9% success rate), but lower than that of Park et al., [26] who reported 70.6% success rate in 17 patients.

None of our cases was admitted to ICU, and only one patient required elective tracheostomy that was done preoperatively under local anesthesia due to limited mouth opening and huge tongue base hypertrophy, and the patient was decannulated at the 5th day. Wee et al., [27] reported one patient who required reintubation and ICU admission for airway edema.

In the 2 cases presented with delayed postoperative bleeding in our study, we found the source of bleeding coming from the tonsillar bed and not from the tongue base because they underwent tonsillectomy and pharyngoplasty at the same procedure, Cho et al., [24] also reported 4 patients with delayed bleeding from the tonsillar bed. However, Chen et al., [23] reported 3 cases of postoperative tongue base wound bleeding and he attributed that to possible shedding of local pseudomembrane, large intraoperative wounds, restricted postoperative diet, and reduced local immunity.

Tongue numbness recorded in 7 of our patients was possibly due to tongue compression by mouth gag; fortunately, they all improved within 3 months. We reported the same results but in a larger percentage of patients and 6 months of recovery time in a previous study [28] discussing the outcomes of TORS for sleep apnea due to the same reason.

We strongly believe that to achieve an ideal transoral tongue base surgery, we have to have a magnificent endoscopy to improve visualization, a good exposure to reduce complications, a low thermal injury tool to reduce pain and edema and last but not least an efficient hemostasis to reduce intraoperative as well as post-operative bleeding. With the use of coblation, we were able to perform 4 functions (ablation, coagulation, suction, and irrigation) by the same hand piece.

However, the current study is a short-term study and represents a single institution experience. More larger, long term studies with prospective comparisons are required, so as to attain more stable results and stronger evidences. Another limitation of the study was the concomitant effect of procedure at other levels of obstruction such as tonsillectomy, which is a usual obstacle in sleep apnea studies.

Conclusion:

EACLT is a safe and effective method for addressing lymphatic tongue base hypertrophy in patients with OSA with accepted low profile side effects. The concept of surgery is the same as done with TORS; accordingly, this technique can be so beneficial especially in countries where robots are not yet available.

Conflict of interest:

The authors certify that they have no conflict of interest or financial relationship with any entity mentioned in the paper.

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استئصال اللوز اللسانية باستخدام جهاز (الكوبليشين) وبمساعدة المنظار فى حالات مختارة من المرضى الذين يعانون من انقطاع النفس الاسندادى النومى

مقدمة : انقطاع النفس الانسدادى النومى هو الأكثر شيوعاً بين اضطرابات التنفس أثناء النوم وفيه يحدث انقطاع متكرر للتنفس نتيجة انغلاق مجرى الهواء أثناء النوم.

الأهداف : هدفت هذه الدراسة إلى تقييم التقنية المحدثة لتقليل قاعدة اللسان باستخدام جهاز التردد الحرارى (الكوبليشين) وبمساعدة المنظار فى المرضى الذين يعانون من انقطاع النفس الاسندادى النومى.

المرضى وطرق العلاج : تضمنت هذه الدراسة السريرية مجموعة ٢٤ مريضاً يعانون من توقف التنفس أثناء النوم بشكل متوسط وشديد يحضرون فى قسم أمراض الأنف والأذن والحنجرة، كلية الطب، مستشفى جامعة الزقازيق. أجريت هذه الدراسة فى الفترة ٢٠١٩ من حتى ٢٠٢١. خضع جميع المرضى الخاضعين للدراسة لتقنية تقليل قاعدة اللسان باستخدام جهاز التردد الحرارى (الكوبليشين) لعلاج انسداد خلف اللسان بالاشتراك مع جراحات أخرى فى الأنف، و/أو الحنك فى بروتوكول متعدد المستويات وتم عمل مقارنة بين مؤشرات دراسة النوم قبل وبعد التدخل الجراحى.

النتائج : تراوحت أعمار الخاضعين للدراسة من ٣٧ إلى ٥٤ سنة. وبمقارنة مؤشرات دراسة النوم فقد هبط متوسط مؤشر انقطاع وقصور التنفس من 46.87±15.86 إلى 19.30±13.42 وتحسن متوسط أقل نسبة أكسجين بالدم أثناء النوم من 77.46±110.1 إلى 86.22±9.46 وتحسن أيضاً متوسط معدل ابو ور ثمن 13.71±3.84 إلى 5.4±3.71 عند المقارنة بين نتائج ما قبل وما بعد التدخل الجراحى.

الاستنتاجات : يمكن الاستنتاج أن استئصال اللوز اللسانية عن طريق (الكوبليشين) وبمساعدة المنظار يمكن أن يكون أمناً فى علاج انقطاع النفس الانسدادى النومى دون أى مضاعفات خطيرة.