Trans-oral tongue suspension: a promising technique

Original Article

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Abstract

Objectives: Presentation of the outcomes of tongue suspension using the technique described by Hsin et al. (2022), based on a case series of three patients.
Methods: One patient with snoring and two with moderate and severe Obstructive Sleep Apnea (OSA) according to Level III Polysomnography are presented. After identification on DISE of an anteroposterior collapse of the tongue base, Moore B 80–100%, associated with secondary collapse of the epiglottis, the patients underwent tongue suspension surgery following the technique described by Hsin et al.
Results: A good clinical outcome and healing were observed after the procedure, with resolution of both snoring and OSA in all patients. No major complications were reported.
Conclusion: This new technique proved to be safe and effective in treating OSA in adults with retrolingual obstruction. It has low morbidity, is easily performed, and can be integrated into multilevel approaches, expanding the therapeutic options for this condition.

Keywords: obstructive sleep apnea; snoring; tongue base suspension; transoral tongue suspension

Introduction

Obstructive sleep apnea (OSA) is a highly prevalent chronic respiratory disorder characterized by recurrent episodes of partial or complete collapse of the upper airway during sleep, resulting in intermittent apneas, sleep fragmentation, and excessive daytime sleepiness.[1-3] Its prevalence has risen substantially in recent decades, affecting approximately 49% of men and 23% of women[3], a trend largely attributed to the global increase in obesity rates.[1]

This condition is strongly associated with increased cardiovascular and metabolic morbidity, neurocognitive dysfunction, and higher overall mortality.[3,4]

OSA is a multifactorial disease characterized by multilevel airway obstruction in most cases.

This obstruction may occur at the level of the palate, lateral oropharyngeal wall, base of the tongue and/or epiglottis.[5-7]

Although non-invasive mechanical ventilation with positive airway pressure (PAP) remains the first-line treatment for moderate to severe cases of OSA[8-9], low adherence due to discomfort or intolerance limits its effectiveness and leads to the need to adopt alternative therapeutic options, among which surgical interventions stand out.[10-12]

Additionally, many patients present with simple snoring — without diagnostic criteria for OSA — which, although not associated with the same systemic repercussions as OSA, can still significantly affect patients' quality of life, social functioning, and interpersonal relationships, also prompting the pursuit of therapeutic solutions, including surgical interventions.

Accurate identification of the anatomical site of obstruction is essential for selecting the most appropriate surgical intervention. In this context, Drug Induced Sleep Endoscopy (DISE) has become an essential tool for the dynamic assessment of the airway and in planning the best therapeutic strategies.[6,7,13]

Among the performed surgical interventions, multilevel approaches have demonstrated superior outcomes compared to single-level procedures, particularly in cases with concomitant tongue base collapse.[5,6]

The base of the tongue is implicated as an important factor of obstruction in 46.6% to 70% of cases, especially in patients with moderate to severe OSA[14-15], and is a frequent cause of therapeutic failure of surgeries such as uvulopalatopharyngoplasty (UPPP).[16]

Surgical treatment of the tongue base has evolved in recent decades. These procedures primarily aim at volume reduction — as is the case with median glossectomy or transoral robotic surgery (TORS) — or mechanical stabilization of the tongue through suspension techniques. Traditional methods of tongue base suspension, such as the Repose® system, have shown variable success rates and often require external incisions with cervical approaches[8]. Moreover, these techniques remain limited in terms of cost, need for specific equipment, operative time and risk of complications, which restricts their widespread adoption.[8,9,17,18]

Hsin *et al.* (2022)[19] described a new transoral tongue suspension (TOTS) technique that uses a minimally invasive sublabial approach to fix the tongue base to the mandible without visible external scars, offering a promising alternative with lower morbidity compared to other techniques.

In this study, we present a case series of three patients who underwent this novel TOTS technique, highlighting its execution, safety and clinical outcomes, as a promising alternative for the surgical treatment of OSA with retrolingual obstruction.

Methods

The first patient is a 33-year-old caucasian female patient, healthy, with a BMI of 22.41 kg/m2, was referred to the Otorhinolaryngology (ORL) consultation due to complaints of snoring, gasping episodes and excessive daytime sleepiness associated with non-restorative sleep.

On physical examination, the oropharynx was assessed as Friedman Tongue Position class II, grade I tonsils in the Brodsky classification and normal dental occlusion. The hyomandibular distance corresponded to one finger, with no evidence of retrognathia.

She underwent a Level III Polysomnography (PSG), which excluded the presence of OSA, with a Respiratory Events Index (REI) of 1.7/h.

The second patient is a 41-year-old caucasian male patient, BMI of 26,53 kg/m2, with a history of psoriasis, treated with methotrexate, and a diagnosis of moderate OSA, with a REI of 29.5/h on Level III PSG. He was referred to the ORL consultation due to intolerance to the automatic positive airway pressure (APAP) device.

On physical examination, the oropharynx was assessed as Friedman Tongue Position class III, grade II/III tonsils, large uvula and normal dental occlusion. The hyomandibular

distance corresponded to one finger, with no evidence of retrognathia. The third patient is a 45-year-old caucasian male patient with a BMI of 26.98 kg/m2 and a diagnosis of severe OSA, with an REI of 35.5/h on Level III PSG, is being followed up in ORL consultation due to CPAP intolerance, having previously undergone expansion pharyngoplasty and radiofrequency of the base of the tongue.
On physical examination, the oropharynx was assessed as Friedman Tongue Position class IV, had macroglossia, absence of tonsillar tissue and normal dental occlusion. The hyomandibular distance corresponded to one finger, with no evidence of retrognathia.

Pre-operative assessment

To plan the most appropriate surgical approach, all three patients underwent preoperative DISE under continuous propofol infusion, with BIS values maintained around 60. In all cases, there was an anteroposterior collapse of the tongue base, Moore B 80-100%, associated with a secondary collapse of the epiglottis of 80-100% (Figure 1). Case 1 and Case 2 presented concomitant anteroposterior collapse of 75-100% of the genu and velum and 100% of the genu and velum, respectively. In Case 3, there was an associated anteroposterior collapse of 100% of the velum.

Surgical Technique

All patients underwent TOTS surgery according to the technique described by Hsin et al.[19]. In Case 1, in conjunction with anterior palatoplasty and in Case 2, in combination with transpalatal advancement.
TOTS was performed under general anesthesia, with the patient in the supine position and cervical hyperextension. The procedure began by disinfecting the oral cavity with povidone-iodine and infiltrating the lower vestibule with lidocaine and adrenaline 1:100000. A transverse incision approximately 3 cm long was made, 1.5 cm inferior to the gingival margin of the lower incisors (Figure 2).
After dissection of the tissues until the mandible was exposed, the midline between the central incisors was marked on the bone surface. Two parallel holes were then marked, 1 cm laterally from the midline (Figure 3), which were subsequently drilled with a cutting drill (Figure 4). The tongue was pulled out and the limits of the medial third of the

Figure 1
Preoperative DISE revealing anteroposterior tongue base collapse associated with a secondary collapse of the epiglottis during the inspiratory phase (B), as opposed to the expiratory phase (A).

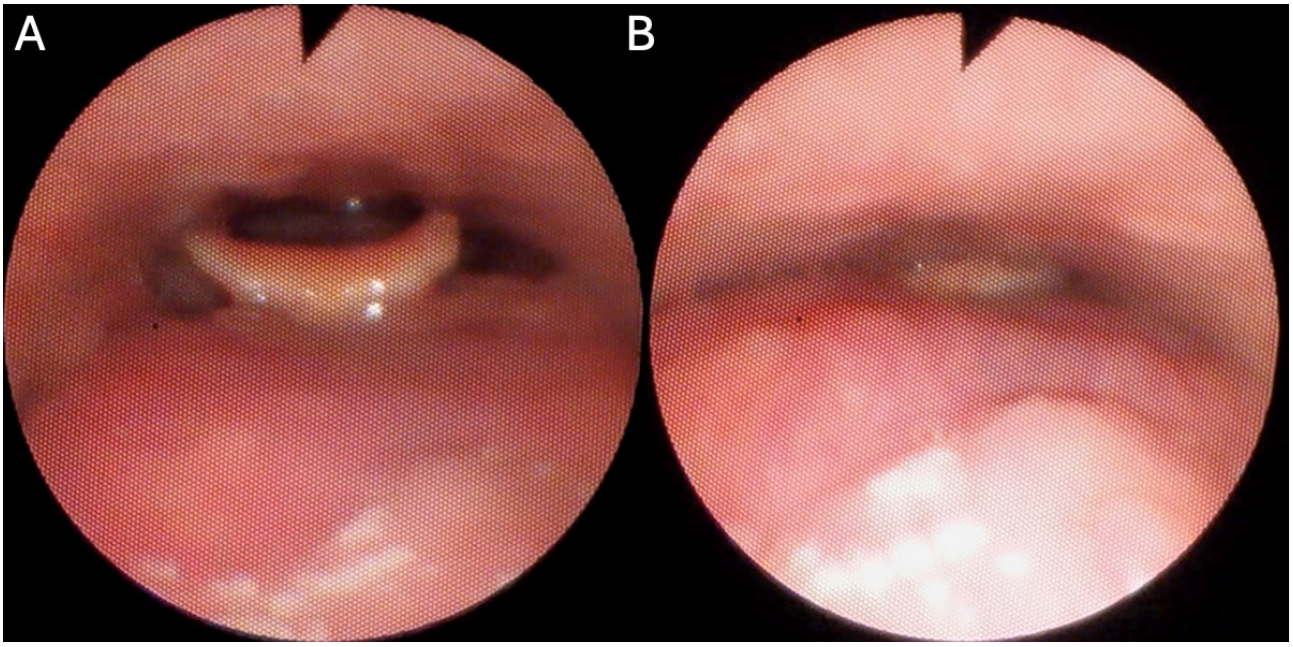


Figure 2
Transverse 3 cm incision in the vestibular area of lower lip

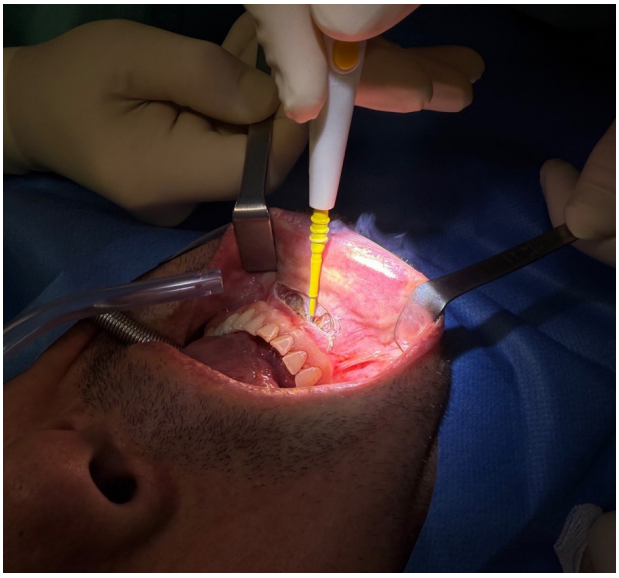
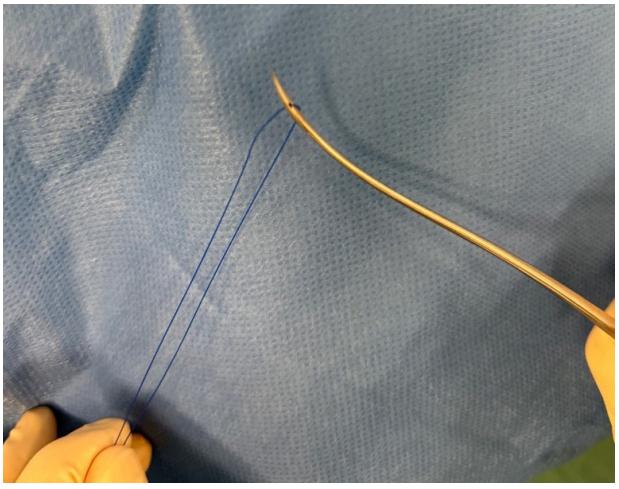


Figure 3
Markings on the mandible

terminal sulcus were marked bilaterally with a monopolar. Using a suture passer (Figure 5), a 2.0 prolene suture loop was passed between one of the holes and the marking at the base of the tongue (Figure 6) through the floor of the mouth and lingual tissue. Using the same suture passer,

Figure 4
Drilling of two holes in the mandible

Figure 5
Suture passer with the prolene 2.0 loop



a 3.0 silk loop was passed in a similar process on the contralateral side. Using a free needle, the prolene suture is passed submucosally to the contralateral marking at the base of the tongue and then guided through the silk loop, allowing it to be exteriorized through the opposite hole (Figure 7). The two ends of the prolene are then anchored anteriorly to the mandible with a stitch placed through one of the holes, in order to minimize the sensation of a foreign body (Figure 8). Endoscopic control was performed at this stage to confirm adequate tongue suspension. Finally, a simple submucosal and mucosal suture is performed at the sublabial incision (Figure 9).

Figure 6
Passage of prolene 2.0 through one of the holes

Figure 7
The two ends of the prolene loop (with two strands on each side) exteriorized through both mandibular holes

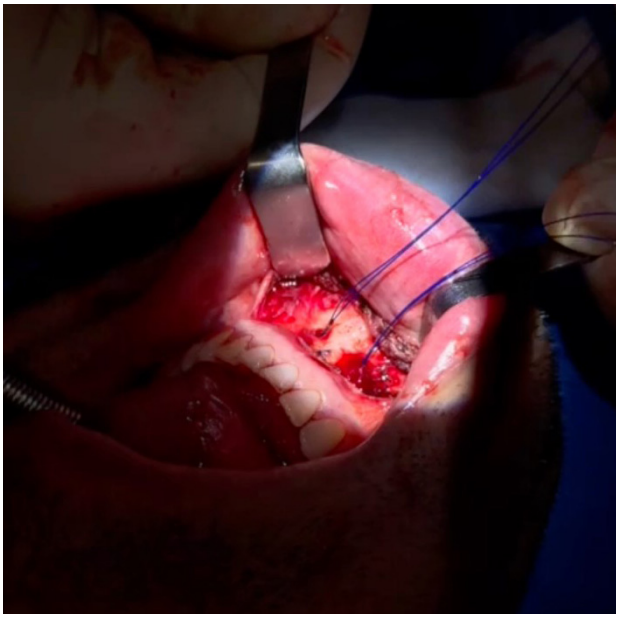


Figure 8
Anterior prolene fixation

Figure 9
Suture of sublabial incision

Results

All procedures were uneventful and yielded favorable outcomes. In the first patient, snoring resolved completely and remained absent at 8-month follow-up. In the second patient, there was a complete resolution of OSA, confirmed by Level III PSG at 5 months of follow-up (REI 3.7/h). In the third patient, there was an improvement in OSA's severity, which went from severe (REI 35.5/h) to moderate (REI 26.6/h) on Level III PSG at the end of the sixth month of follow-up. There were no major complications in the postoperative period. One patient presented dysarthria and mild dysphagia that improved after 4-5 days, while another patient reported mild hypoesthesia of the lower gum. There was a partial dehiscence of the surgical wound in two cases, both with good healing by secondary intention.

Discussion

OSA is a condition predominantly characterized by upper airway obstruction at multiple levels. Vroegop AV *et al (2016)*[14] demonstrated that the base of the tongue is involved in approximately 46.6% of cases. When associated with obstruction at the palate level, this combination represents the most frequently identified multilevel obstruction pattern, present in approximately 25.5% of cases. Surgery of the base of the tongue is a technical challenge, with variable results and a non-negligible risk of complications. Classical techniques such as Repose®, which uses a bone screw for fixation, in a cervical approach, have demonstrated variable success rates (approximately 25.8% when used alone and 67.6% in combination with UPPP) and greater associated morbidity. The modified tongue suspension technique, through a submental approach, without the use of a screw, has shown superior results, up to 74.5%, in comparative studies.[8]

TOTS represents an innovative technique in the treatment of OSA, offering a minimally invasive alternative to traditional tongue base suspension techniques. Developed by Hsin *et al. (2022)*[19], this approach aims to mechanically stabilize the tongue base through a transoral sublabial approach, avoiding external incisions and minimizing the risk of complications. In contrast, TOTS combines technical simplicity with good clinical results, as evidenced in this report of three cases.

In comparison with more complex approaches such as transoral robotic surgery (TORS), which despite presenting success rates close to 68% entails high costs, the need for advanced technology and longer operative time[9], TOTS stands out for its more accessible execution and less invasiveness. Likewise, concerning techniques such as laser or radiofrequency glossectomy, which have been associated with dysgeusia and prolonged dysphagia[18], TOTS demonstrated a lower complication rate and spontaneous resolution in all cases.

The results observed in this cohort are consistent with the existing literature. All patients demonstrated significant clinical improvement, with complete resolution of snoring and either normalization or substantial reduction in REI values. There were no major complications, and postoperative complications were mild and self-limited, highlighting the safety profile of the technique. These findings are in line with the data described by Hsin *et al. (2022)*, which indicate low complication rates associated with the technique described[19].

TOTS stands out for the absence of a skin incision, thus avoiding complications associated with it and consequently better aesthetic outcome. Additionally, it uses common instruments and has short surgical time, which favors its widespread adoption.

However, the small sample size and the short follow-up period limit a robust evaluation of the technique's long-term efficacy, particularly given the potential risk of suture migration over time. Moreover, no studies assessing the long-term outcomes of this technique have yet been published in the literature, and in our series these were not evaluated either due to the short follow-up period. Furthermore, no objective assessments of taste, swallowing or speech articulation were conducted in the postoperative period, which are key considerations due to the theoretical risk of injury to nerve structures during the procedure[18]. An additional limitation is the absence of an objective method to control the tension applied to the lingual tissue, which currently relies only on subjective endoscopic visualization. This drawback is common to all tongue suspension techniques described in the literature. Despite these limitations, the initial results are encouraging and suggest that TOTS may represent an effective, safe and economically viable alternative for patients with retrolingual obstruction and CPAP intolerance. Future studies with larger samples, longer follow-up and direct comparison with other techniques will be essential to validate its efficacy and define its role in the treatment of OSA. Whenever possible, a study will also be conducted in our department in the future to report long-term outcomes.

Conclusion

TOTS technique appears to be a safe, minimally invasive and effective surgical option for patients with obstructive sleep apnea or simple snoring associated with tongue base collapse and can be integrated into multilevel approaches. In the three cases described, the procedure demonstrated promising results, with resolution or significant improvement of symptoms and respiratory indices, associated with low postoperative morbidity.

However, additional studies with a larger patient sample and longer follow-up will be needed to validate these findings and determine the long-term efficacy of this technique.

Conflict of interest

The authors declare that they have no conflict of interest regarding this article.

Data Confidentiality

The authors declare that they followed the protocols of their work in publishing patient data

Protection of Human and Animal Subjects

The authors declare that the procedures followed are in accordance with the regulations established by the directors of the Committee for Clinical Research and Ethics and in accordance with the Declaration of Helsinki of the World Medical Association.

Privacy Policy, Informed Consent, and Ethics Committee Authorization

The authors declare that they have written consent for the use of patient photographs in this article.

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Availability of Scientific Data

There are no publicly available datasets related to this work

References

1 - Garvey JF, Pengo MF, Drakatos P, Kent BD. Epidemiological aspects of obstructive sleep apnea. *J Thorac Dis*. 2015 May;7(5):920–929. doi:10.3978/j.issn.2072-1439.2015.04.52.

2 - Bonsignore MR, Saaresranta T, Riha RL. Sex differences in obstructive sleep apnoea. Eur Respir Rev. 2019;28(154):190030. doi: 10.1183/16000617.0030-2019.

3 - Heinzer R, Vat S, Marques-Vidal P, Marti-Soler H, Andries D, Tobback N, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. Lancet Respir Med. 2015 Apr;3(4):310–318. doi: 10.1016/S2213-2600(15)00043-0.

4 - Toh ST, Hsu PP. Robotic obstructive sleep apnea surgery. Adv Otorhinolaryngol. 2017;80:125–135. doi: 10.1159/000470882.

5 - Eckert DJ, White DP, Jordan AS, Malhotra A, Wellman A. Defining phenotypic causes of obstructive sleep apnea: identification of novel therapeutic targets. Am J Respir Crit Care Med. 2013;188(8):996–1004. doi: 10.1164/rccm.201303-0448OC.

6- Lin HC, Weaver EM, Lin HS, Friedman M. Multilevel obstructive sleep apnea surgery. Adv Otorhinolaryngol. 2017;80:109–115. doi: 10.1159/000470879.

7 - Turhan M, Bostanci A. Robotic tongue-base resection combined with tongue-base suspension for obstructive sleep apnea. Laryngoscope. 2020 Sep;130(9):2285–2291. doi: 10.1002/lary.28443.

8 - Bostanci A, Turhan M. A systematic review of tongue base suspension techniques as an isolated procedure or combined with uvulopalatopharyngoplasty in obstructive sleep apnea. Eur Arch Otorhinolaryngol. 2016 Oct;273(10):2895–2901. doi: 10.1007/s00405-015-3814-3.

9 - Miller SC, Nguyen SA, Ong AA, Gillespie MB. Transoral robotic base of tongue reduction for obstructive sleep apnea: a systematic review and meta-analysis. Laryngoscope. 2017 Jan;127(1):258–265. doi: 10.1002/lary.26060.

10 - Bacak B, Porterfield L, Karelsky S. Multilevel airway obstruction phenotypes in adult OSA. OTO Open. 2023 Apr-Jun;7(2):e21. doi: 10.1002/oto2.21.

11 - Rotenberg BW, Murariu D, Pang KP. Trends in CPAP adherence over twenty years of data collection: a flattened curve. J Otolaryngol Head Neck Surg. 2016;45:43. doi: 10.1186/s40463-016-0156-0.

12 - Sawyer AM, Gooneratne NS, Marcus CL, Ofer D, Richards KC, Weaver TE. A systematic review of CPAP adherence across age groups: clinical and empiric insights for developing CPAP adherence interventions. Sleep Med Rev. 2011 Dec;15(6):343–356. doi: 10.1016/j.smrv.2011.01.003.

13 - De Vito A, Agnoletti V, Berrettini S, Piraccini E, Criscuolo A, Corso R, Campanini A, Gambale G, Vicini C. The importance of drug-induced sedation endoscopy (D.I.S.E.) techniques in surgical decision making: conventional versus target-controlled infusion techniques—a prospective randomized controlled study and a retrospective surgical outcomes analysis. Eur Arch Otorhinolaryngol. 2017 May;274(5):2307–2317. doi: 10.1007/s00405-016-4447-x.

14 - Vroegop AV, Vanderveken OM, Boudewyns AN, Scholman J, Saldien V, Wouters K, et al. Drug-induced sleep endoscopy in sleep-disordered breathing: report on

1,249 cases. Laryngoscope. 2014 Mar;124(3):797–802. doi: 10.1002/lary.24479.
15 - Kezirian EJ, White DP, Malhotra A, Ma W, McCulloch CE, Goldberg AN. Interrater reliability of drug-induced sleep endoscopy. Arch Otolaryngol Head Neck Surg. 2010 Apr;136(4):393–397. doi:10.1001/archoto.2010.26.
16 - Friedman M, Ibrahim H, Joseph NJ. Prediction of uvulopalatopharyngoplasty outcome: anatomy-based staging system versus severity-based staging system. Laryngoscope. 2004 Oct;114(10):1979–1984. doi:10.1097/01.mlg.0000143153.63075.43
17 - Calvo-Henriquez C, Boronat-Catala B, Rivero-Fernández I, Cammaroto G, Ibrahim B, Lechien JR. et al. Safety of tongue base procedures for sleep apnoea in adults: a systematic review and meta-analysis from the YO-IFOS study group. Acta Otorrinolaringol Esp (Engl Ed). 2022 Nov-Dec;73(6):384-393. doi: 10.1016/j.otoeng.2021.10.004.Eur
18 - Lin HC, Hwang MS, Liao CC, Friedman M. Taste disturbance following tongue base resection for OSA. Laryngoscope. 2016 Apr;126(4):1009–1013. doi: 10.1002/lary.25580.
19 - Hsin L-J, Lee Y-C, Lin W-N, Lu Y-A, Lee L-A, Tsai M-S, et al. Transoral tongue suspension for obstructive sleep apnea—A preliminary study. J Clin Med. 2022 Aug 24;11(17):4960. doi: 10.3390/jcm11174960.