How I Do It
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Advancements in Tongue Suspension Suture Techniques for Obstructive Sleep Apnea: A Step-by-Step Guide

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폐쇄성 수면 무호흡 환자에서 개선된 설근부 현수술 : 단계별 가이드

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Background and Objectives Obstructive sleep apnea (OSA) is a multifactorial disease that affects the velopharynx, oropharyngeal lateral wall, tongue, and epiglottis. Tongue collapse is difficult to identify precisely, and treatment outcomes are inconsistent. Therefore, we describe here advancements in tongue suspension suture techniques, which is a safe and effective method for managing OSA patients who have obstruction in the tongue area.
Subjects and Method A 28-year-old female presented to our otorhinolaryngology clinic with snoring and sleep apnea. Her tonsil size was II/II and her body mass index was 30.94 kg/m^2. The apnea-hypopnea index was 69.9 and the lowest O_2 saturation was 84%. We performed uvulopalatopharyngoplasty and tongue base traction using the advancements in tongue suspension suture techniques.
Results At the 1- and 3-month postoperative follow-up visits, the patient reported subjective improvement in sleep and quality of life, with no adverse events.
Conclusion Advancements in tongue suspension suture techniques may offer a viable option for improving tongue base obstruction in OSA patients.
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Keywords Obstructive sleep apnea; Seep disorder; Snoring; Surgery; Tongue.

Introduction

Obstructive sleep apnea (OSA) is characterized by repeated episodes of obstructive apnea and hypopnea during sleep. Clinically significant OSA has been reported to affect 14% of middle-aged adults in the United States and 49% in Europe, contributing to increased cardiovascular risk and mortality.[1)] Continuous positive airway pressure (CPAP) remains the gold standard and first-line treatment for OSA patients. However, challenges with patient compliance often lead to treatment failure.[2)] For patients who fail CPAP treatment, multidimensional surgery, including soft tissue and skeletal interventions, provides an alternative.[3)]

OSA is a multifactorial disease that commonly affects the velopharynx, oropharyngeal lateral wall, tongue, and epiglottis.[3)] Treatment for velopharyngeal obstruction, the most common type of obstruction, typically yields good results for OSA patients.[3)] In contrast, tongue collapse is more difficult to identify and treat, leading to inconsistent outcomes.[4)] Surgical management of tongue obstruction involves reducing the volume and suspending the tongue base, but such procedures carry a high risk of complications,[4,5)] including adverse respiratory events from an enlarged hypopharyngeal space and

risks associated with mandible osteotomy, such as hematoma, infection, and injury to the lower teeth.

To address these concerns, we developed minimally invasive advancements in tongue suspension suture techniques, designed to stabilize the tongue base. This technique is safe, efficient, and time-saving.

Methods

Surgical technique

Under general anesthesia, the patient was placed in the supine position with the neck at full extension. The operator stood in front of the patient. The oral cavity was disinfected using Aqua-better iodine diluted with 50% saline. After administering a local injection of 1% xylocaine mixed with 1:100000 diluted adrenaline at the midline of the chin, a 0.5 cm incision was made using a No. 11 surgical blade. The patient's mouth was opened with a self-retractor, Both sides of the middle third of the sulcus terminalis were marked using a surgical pen under 30° telescope monitoring. A 2-0 polydioxanone (PDO) suture was passed through the chin and pushed deep into the mouth floor and tongue (Fig. 1). The cone was tightened on the periosteum of the low margin of the mandible and buried under the skin of the chin. This cone eliminates the need for ties to secure the thread. After tightening the suture, an enlarged retrolingual air space with a deep dimple at the base of the tongue was observed (Supplementary Video 1). The hypertrophic palatine tonsil were removed using coblation and electrocautery.

PDO thread

Our PDO threads (Youngs thread 1220; Y.Jacobs Medical, Inc.) are 1000 mm long, featuring multiple spikes and a single cone made of poly lactic-co-glycolic acid (Fig. 2). The cone anchors the thread to the tissue. The PDO threads have contralateral spikes directed to the cone, with each 1 cm of thread has ten spikes. Previous studies have used barbed sutures, where cogs clasped onto the skin to help suspend tissue in various areas of the face. However, our PDO thread design introduces a cone, which offers a significant advantage. The rigid, cone is a hard cone-shaped PDO that fixes the thread to the periosteum of the mandibular bone (Fig. 3), preventing thread movement and eliminating the need for ties. Previous studies have shown that threads penetrate the tongue base muscle,[6] but in our technique, the thread fixes the muscle using barbs inside the tissue, which is a key feature of our approach. When inserting the thread, the depth should be adjusted while gently touching the root of the tongue with the opposite hand to ensure proper placement. Once the thread is inserted into the root of the tongue, it cannot be controlled, so careful attention must be given during insertion. The plastic shield should only be removed after confirming the correct position. Additionally, previous techniques have typically used one thread, whereas our method employs two threads. The cone disappears within 14 months of surgery, and the PDO thread dissolves completely after approximately 6 months.

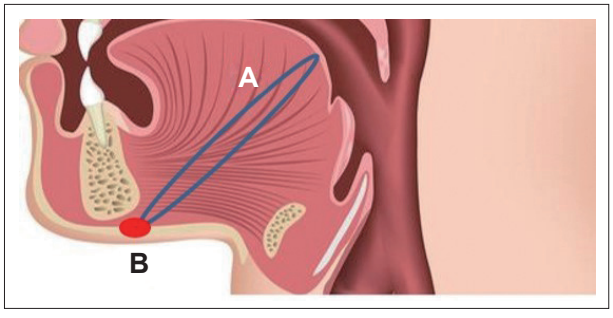

Fig. 1. Image of our modified tongue suspension suture technique. (A) polydioxanone passer emerging from the tongue base and (B) the cone placed in the middle of the chin.

Results

A 28-year-old female patient presented to our otorhinolaryngology clinic with snoring and sleep apnea. Her tonsil size was II/II and her body mass index (BMI) was 30.94 kg/m^2. Polysomnography revealed an apnea-hypopnea index of 69.9 and a lowest O_2 saturation of 84%. The Epworth Sleepiness Scale score was 3. Although CPAP treatment was initially recommended, the patient declined due to difficulty keeping the mask on her face. Consequently, we planned surgical intervention. A nasopharyngeal endoscopy revealed narrowing of the uvula and tonsils, suggesting partial obstruction at the uvular, tonsillar, and tongue levels (Fig. 4).[7] We performed a uvulopalatopharyngoplasty and tongue base traction using the advancements in tongue suspension suture techniques. The patient reported subjective improvements in sleep and quality of life at both the 1- and 3-month postoperative follow-up visits, with no adverse events.

Discussion

Tongue surgery poses a significant challenge in patients with OSA and tongue obstruction. This study introduces a novel technique—advancements in tongue suspension suture

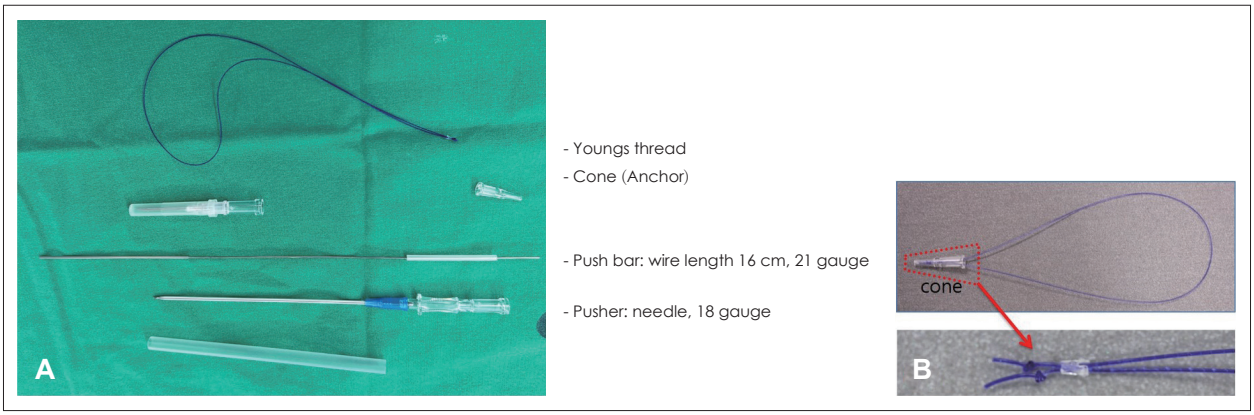

Fig. 2. A: Polydioxanone (PDO) thread, cone, push bar, and pusher. B: PDO threads were 1000 mm long, with multiple thorns and one cone (poly lactic-co-glycolic acid).

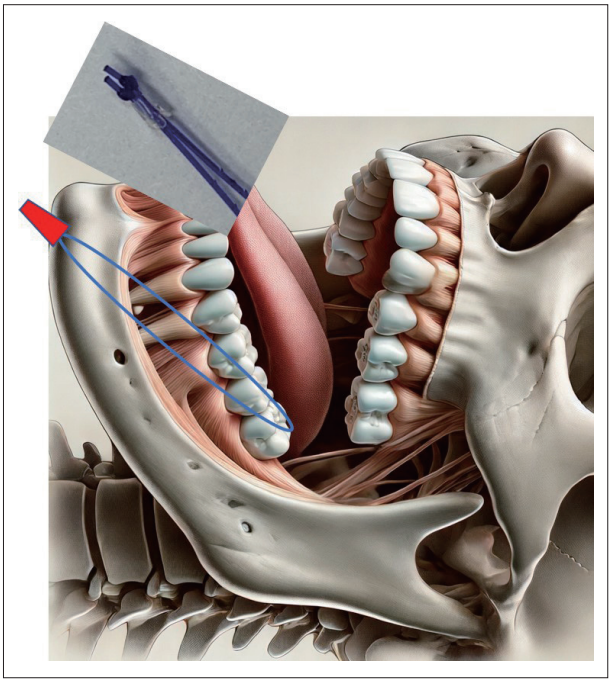

Fig. 3. The cone is a hard cone-shaped polydioxanone that fixes the thread to the periosteum of the mandibular bone.

techniques—aimed at addressing tongue obstruction in OSA patients. The results showed improvements in daytime sleepiness and minimal swallowing-related morbidities.

Various surgical options exist for OSA patients with tongue obstruction, including hypertrophic lingual tonsil resection, radiofrequency, coblation for tongue volume reduction and genioglossus advancement. However, the success rate ranges widely from 40%–70%.[8]

Additionally, mandible osteotomy of these procedures vary, and mandible osteotomy can carry risks such as infection and injury to the lower teeth. A minimally invasive tongue base suspension technique is therefore essential.

A tongue base surgery kit[9] has previously been introduced, with a specially designed screw to stabilize the suture over the inner lower gum. Additionally, Medtronic acquired the Repose system (Repose Surgical Kit, CKA Air Vance; Medtronic, Inc.), with which the suspension suture is inserted through a submental incision. However, these techniques have involved the bone. Therefore, inspired by rejuvenation surgery, we developed the advancements in tongue suspension suture techniques, with which the tongue is suspended using a PDO thread with a unique spur directed to the opposite side of a cone. Moreover, the PDO spur contracts in the soft tissue, including the genioglossus muscle. When tightened, the suture supports the anterior hypopharyngeal airway and tongue base, preventing obstruction. In our study, tightness of the suspension was determined by digitally feeling tightness at the tongue base, where an indentation could be felt. Overcorrection was avoided to prevent tissue strangulation, pain, and swelling.[6] Consequently, the volume of the tongue decreases over time.

This novel technique has several advantages. First, given that there is no external scar, our technique has superior cosmetic outcomes, which is becoming increasingly important when comparing new techniques with the conventional tongue base surgery. Second, the tongue suspension suture technique does not require ties or screws. With the Repose system, a screw is pierced into the mandible, which increases the potential for infection and foreign body sensation, both of which can be avoided with our technique. Third, our technique is minimally invasive, while previous interventions for treating patients who have OSA with tongue obstruction have involved excisions. Therefore, severe complications such as hematoma, dysphagia, odynophagia, dysarthria, edema, lingual atrophy, hypoesthesia of the tongue, reduced flexibility, and airway obstruction can be avoided postoperatively. In our

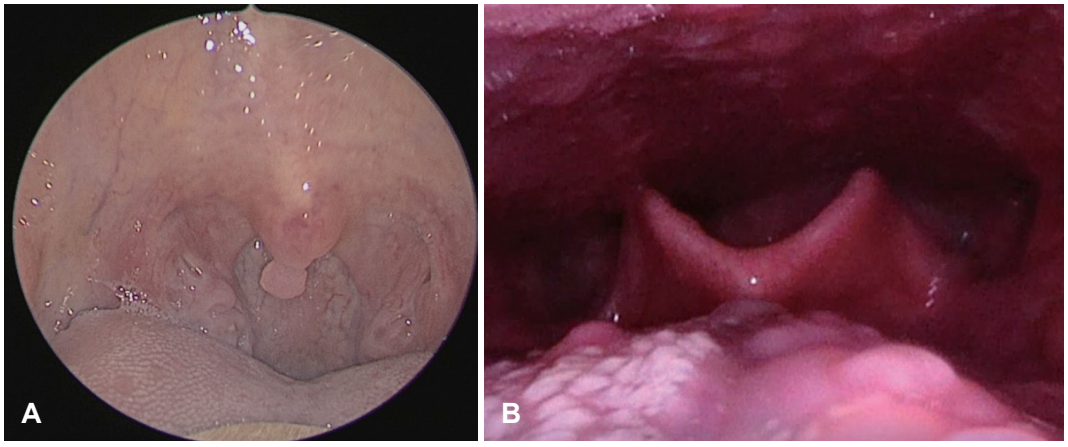

Fig. 4. She has partial obstruction in (A) uvular, tonsil and (B) tongue levels based on reference 7.

study, none of the patients had major perioperative complications, nor alterations in taste, or speech in the follow-up after one month. Fourth, our advancements in tongue suspension suture techniques can be combined with the classical uvulopalatopharyngoplasty. Vicente[10] noted that the best response to tongue base surgery with uvulopalatopharyngoplasty was obtained in patients with a BMI <35 kg/m^2. And we did combined approach both uvulopalatopharyngoplasty and tongue suspension. The method of combining tongue suspension to stabilize the tongue and volume reduction to widen the hypopharyngeal space together for a synergetic effect could be an alternative treatment option.[9] Fifth, this procedure requires a short time to perform since no bone needs to be tied due to the presence of the cone, and only 3−4 seconds are needed to place the cone. Sixth, the direction of contraction can easily be changed owing to the cone, allowing for more flexibility during surgery. Moreover, no special skills are required; any ENT doctor can easily perform this surgery and it can be collocated with other OSA surgeries.

However, one potential concern is that our PDO thread is an absorbent material, and we do not know how much pulled tissue remains after absorption. And also fibrosis around the suture may theoretically reduce a loss of tension, the actual effects of suture migration or suture breakage are unknown.[11] Our patient exhibited marked improvement in symptoms on short-term follow-up; however, long-term follow-up is necessary to confirm our surgical results.

In conclusion, our advancements in tongue suspension suture techniques provide a promising option for improving tongue base obstruction in OSA patients. Based on our findings, this technique is safe, efficient, and simple to perform.

Supplementary Video Legend

Video 1. Video demonstrates the whole procedure. The patient's mouth was opened via a self-retractor. A suture passer attached to a 2-0 PDO suture was passed through the chin and pushed deep into the mouth floor and tongue until it emerged from the marked point at the tongue base. The cone was tightened on the periosteum of the low margin of the mandibula and buried under the skin of the chin. With this technique, ties are not needed to fix the thread due to the cone. After tightening the suture, an enlarged retrolingual air space with a deep dimple at the base of the tongue was showed in video.

Supplementary Materials

The Supplement is available with this article at https://doi.org/10.3342/kjorl-hns.2024.00612.

Acknowledgments

This observational study was performed in accordance with the Declaration of Helsinki on Biomedical Studies Involving Human Subjects. This retrospective study was approved by the Institutional Review Board (IRB) of Ewha Womans University, Seoul Hospital (No. 2021-11-021).

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Author Contribution

Conceptualization: Boo-Young Kim. Data curation: Jung Ho Bae. Formal analysis: Boo-Young Kim. Funding acquisition: Boo-Young Kim. Investigation: Young Jae Kim. Methodology: Young Jae Kim, Jung Ho Bae. Project administration: Jung Ho Bae, Boo-Young Kim. Resources: Young Jae Kim, Jung Ho Bae. Software: Boo-Young Kim, Jung Ho Bae. Supervision: Jung Ho Bae, Young Jae Kim. Validation: Boo-Young Kim. Visualization: Boo-Young Kim. Writing—original draft: Boo-Young Kim, Jung Ho Bae. Writing—review & editing: Boo-Young Kim, Jung Ho Bae.

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