

Effect of Minimally Invasive Palatopharyngoplasty for OSA

微創顎咽成型手術治療阻塞型睡眠呼吸中止症的效果



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Objective

Upper airway surgery is considered an alternative therapy to OSA because long-term adherence to CPAP treatment was reported to have failed in 25% to 50% of the patients with OSA. Uvulopalatopharyngoplasty (UPPP) is the most common type of sleep surgery, which contributed to a 35% to 65% successful therapy while used alone in articles review. The procedure is initiated with tonsillectomy because the palatine tonsils directly obstruct the pharyngeal space and impede the surgeons’ approach to the deep pharyngeal muscles. However, tonsillectomy or extensive tissue destruction to oropharynx may increase the ratio of postoperative complications, such as bleeding, dysphagia, dysesthesia and velopharyngeal insufficiency. Thus, surgically effective treatments for OSA that minimize invasiveness merit investigation. Various minimally invasive upper airway surgeries have been reported in therapies for sleep related breathing disorder, but the surgical effect was inevitably concerning because the palatine tonsils and pharyngeal musculature were not treated intraoperatively. However, systematic reviews have noted insufficient evidence regarding whether minimally invasive palatopharyngoplasty is essential for the treatment of OSA.

In this study, we analyze the surgical outcomes of patients with OSA and small tonsils who underwent minimally invasive palatopharyngoplasty (MIP). The correlation between polysomnographic outcome and DISE findings was also investigated. This study clarifies whether tonsillectomy or extensive oropharyngeal tissue destruction is always necessary for OSA, thus aiding sleep surgeons in their selection of candidates for MIP.

Methods

Study Participants

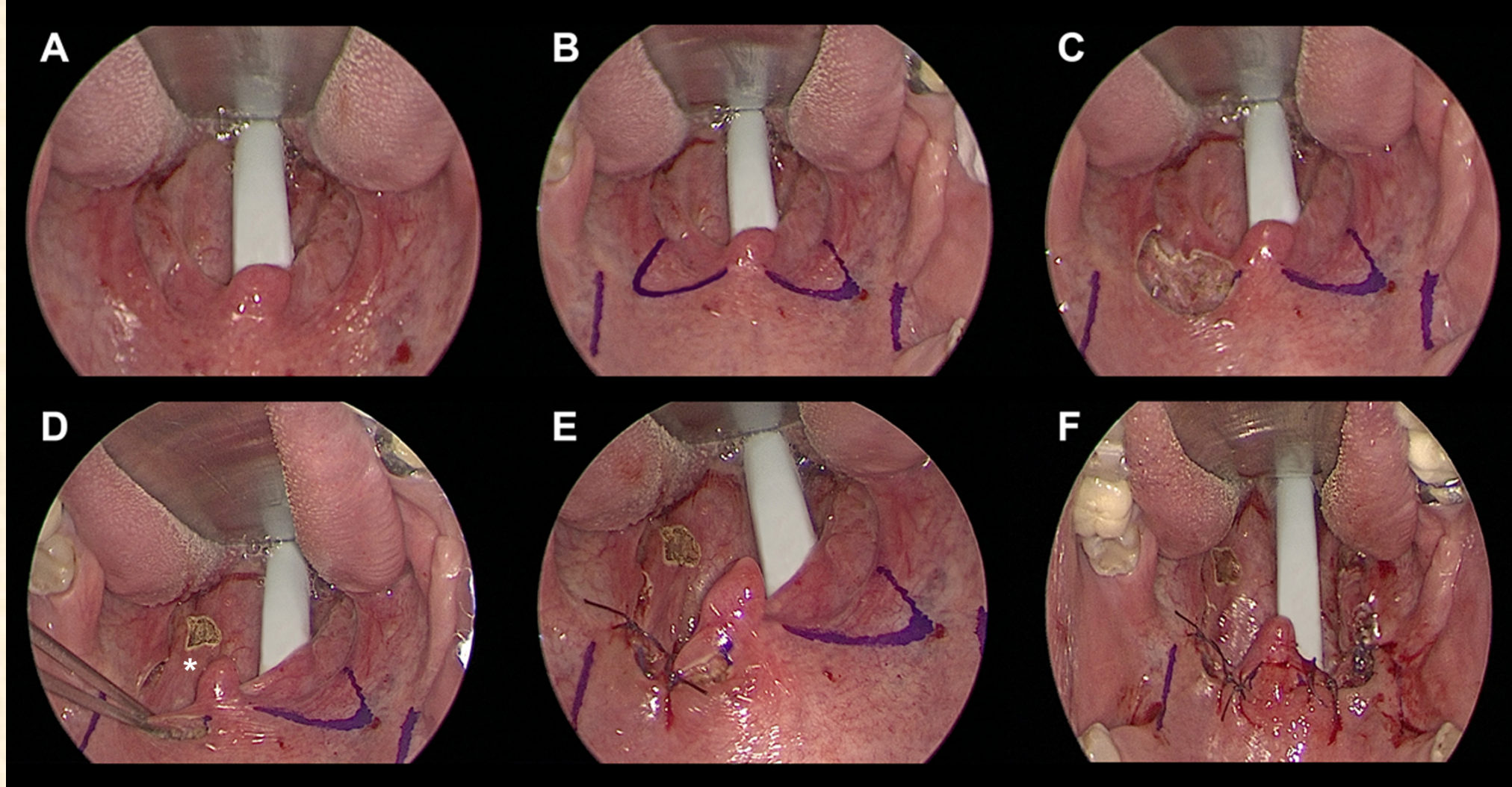
This retrospective cohort study assessed the responses of 26 patients with OSA to MIP, from November 2017 to Mar 2021 at a tertiary referral hospital. The inclusion criteria were as follows: (1) The apnea–hypopnea index (AHI) > 5 events/h; (2) BMI <30 kg/m²; (3) tonsillar size was classified as grade 0–2; (4) Friedman tongue position was at stage I, II or III; (5) no complete collapse had occurred at the oropharynx, tongue base, epiglottis, or larynx in DISE immediately before upper airway surgery; (6) no prior upper airway surgery had been performed other than nasal surgery; and (7) patients were unwilling to accept CPAP therapy or were nonadherent to CPAP therapy under the care of a board-certified sleep medicine specialist.

DISE with Target-Controlled Infusion System (TCI-DISE)

DISE was performed in a supine position in an operation room immediately before MIP. A target-controlled infusion system was employed to reach anesthesia of absent arousal to loud verbal stimulation and maintain the bispectral index (BIS) level at approximately 60–70. When the required BIS level was achieved, a flexible endoscope was used to assess potential obstructions in the upper airway. All DISE findings were recorded and scored on the velum, oropharyngeal lateral walls, tongue base, and epiglottis (VOTE) classification system.

Surgical Procedure

Submucosal fat tissue in the semilunar-shaped supratonsillar area was removed, with careful preservation of the palatopharyngeus muscle (PM). The supratonsillar mucosa was elevated laterally to expose the pterygomandibular raphe, which provided the high tensile strength required to support the suspension sutures of the PM. The PM was partially lysed inferiorly to decrease the vertical tension and thus facilitate the suspension. We used 3–0 V-Loc or 1–0 Polysorb sutures to secure the PM to the pterygomandibular raphe. Each suture was passed through the pterygomandibular raphe first and then through the PM. After the suspension of PM and wound closure, the soft palate was advanced and thus contributed to the expansion of the retropalatal space. The uvula was either preserved or shortened to 1 cm in length if required. (Figure A to F)



Results

Surgical Outcome

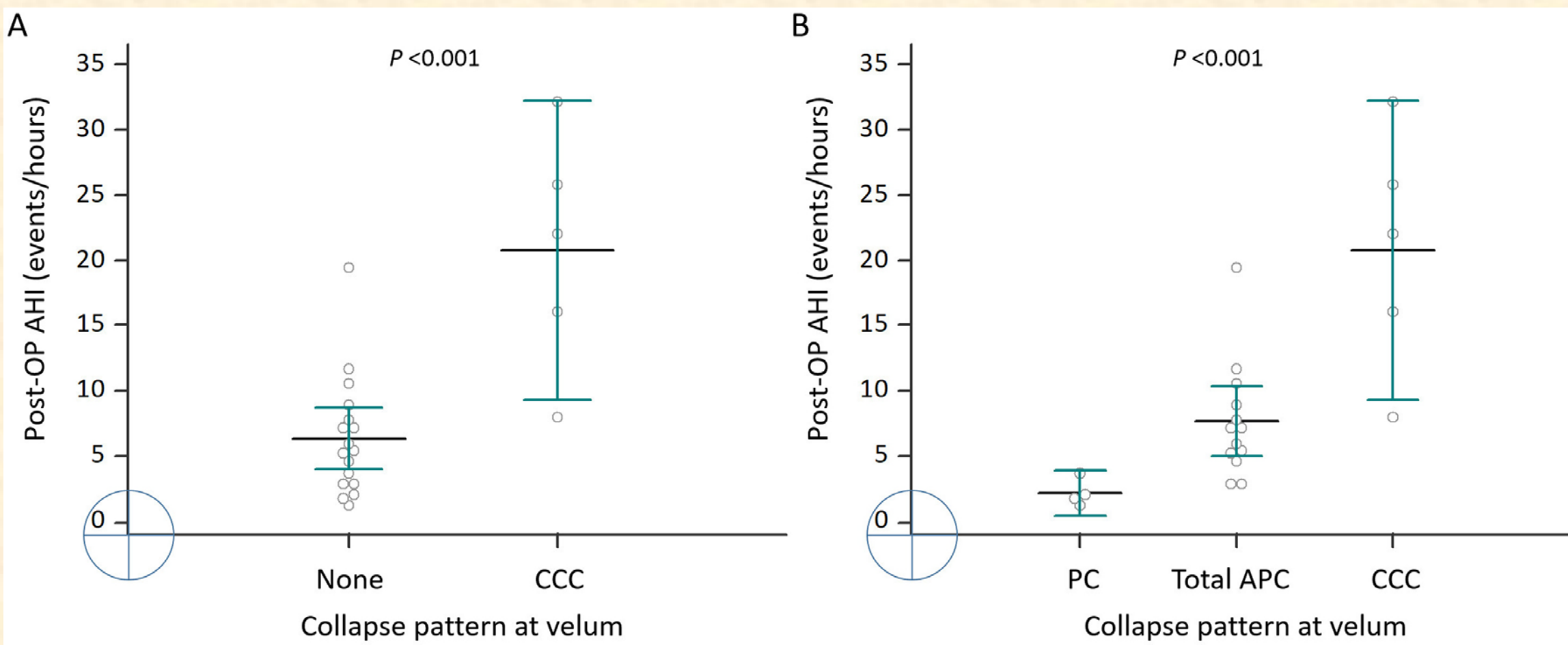
A total of 26 patients who satisfied the inclusion criteria. Among the 26 patients, 17 were male and 9 were female; they had a median age of 45.3 years [interquartile range (IQR): 40–60 years], a baseline AHI of 23.8 events/h [IQR: 13.1– 38.0 events/h], and a minimum arterial oxyhemoglobin saturation (SaO₂) of 84% [IQR: 79–89%]; these values constituted significant improvements from the baseline ($P < 0.001$, Wilcoxon signed-rank test). A total of 21 patients (21/26, 80.8%) and 17 patients (17/26, 65.4%) fulfilled the loose and strict criteria of surgical success after MIP, respectively. All patients in our study were free of postoperative events except for one patient who presented short-term velopharyngeal insufficiency, which disappeared within 1 week after surgery.

Correlation Between Sleep Endoscopy and Surgical Outcome

The surgical outcomes comprised the follow-up AHI value and the minimum SaO₂, AHI reduction ratio, and surgical success rate. The groups of OSA patients with CCC and other collapse pattern were compared with respect to these parameters. Patients presented CCC in preoperative TCI-DISE, their follow-up AHI values were significantly higher than those of patients with complete APC and partial collapse. In addition, the surgical success rate (either of loose or strict criteria) was significantly lower in patients with CCC in TCI-DISE.

Change in AHI scores, oxygen saturation, and ESS scores before and after surgery			
Variable	Pre-op	Post-op	<i>P</i>
Male/Female, n	17/9	-	-
Age (year)	45.3 [40.0, 60.0]	-	-
AHI (events/hours)	23.8 [13.1, 38.0]	7.1 [3.7, 11.7]	<0.001
Minimum SaO ₂ (%)	84.0 [79.0, 88.0]	87.2 [83.0, 89.0]	0.004
ESS total score	11.2 [6.0, 14.0]	5.5 [3.0, 7.0]	<0.001
ESS ≥11 points, n (%)	12 (46.2)	2 (7.7)	0.002

Abbreviations: AHI, apnea–hypopnea index; SaO₂, arterial oxyhemoglobin saturation; ESS, Epworth sleepiness scale; pre-op, preoperative; post-op, postoperative; Data were presented as frequency (percentage) or median [25th, 75th percentile].

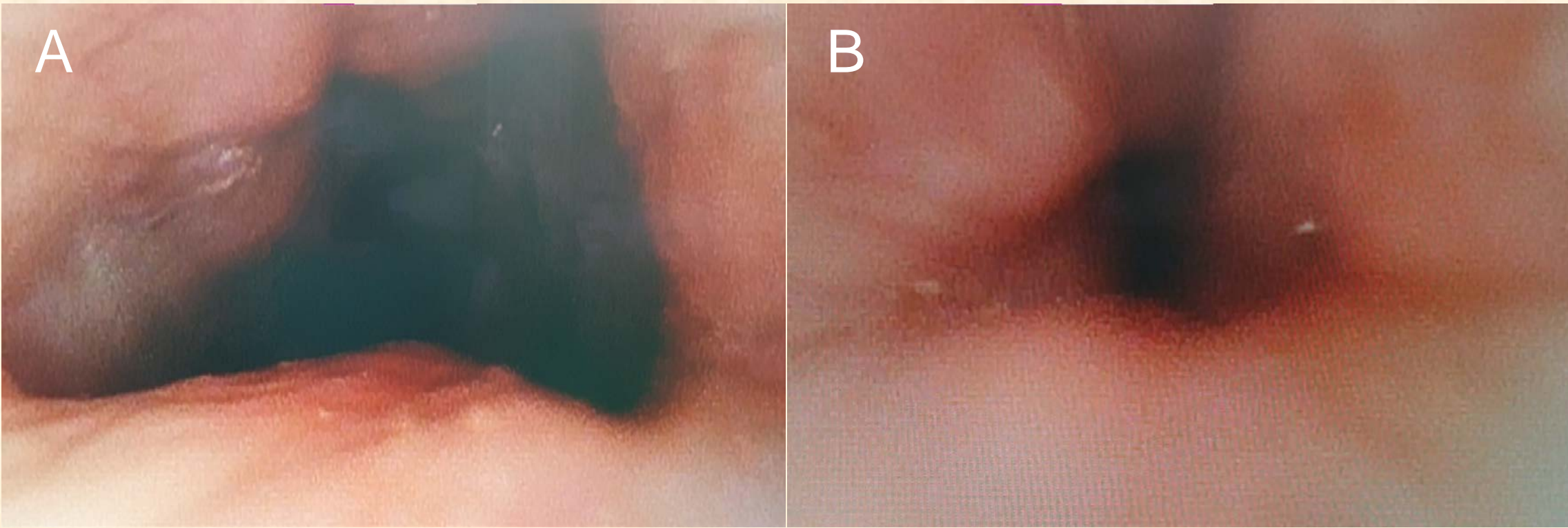


Velum status	N	Post-op AHI (events/ hours)	Post-op Minimum SaO ₂ (%)	AHI reduction ratio (%)	Surgical success (loose definition)#	Surgical success (strict definition)*
Pre-op velum						
Non-CCC	20	5.6 [2.9, 7.8]	88.2 [83.0, 90.0]	66.2 [55.4, 78.7]	19 (94.1)	16 (80.0)
CCC	6	22.3 [16.1, 25.8]	85.5 [83.0, 87.0]	53.0 [33.7, 61.8]	2 (33.3)	1 (16.7)
<i>P</i> value		0.001	0.431	0.169	0.024	0.021
Pre-op velum						
PC	4	1.9 [1.5, 2.9]	89.5 [85.5, 92.0]	67.3 [59.6, 79.4]	4 (100)	4 (100)
Total APC	16	7.0 [5.2, 8.9]	87.4 [83.0, 89.0]	61.8 [55.4, 78.7]	15 (93.8)	12 (75.0)
CCC	6	22.3 [16.1, 25.8]	85.5 [83.0, 87.0]	53.0 [33.7, 61.8]	2 (33.3)	1 (16.7)
<i>P</i> value		0.001	0.412	0.264	0.038	0.021

Abbreviations: AHI, apnea–hypopnea index; CCC, complete circumferential collapse; APC, anterior–posterior collapse; pre-op, preoperative; post-op, postoperative; Data were presented as frequency (percentage) or median [25th, 75th percentile]; # ≥50% decrease in the AHI relative to the baseline value and a postoperative AHI of <20 events/h; * ≥50% decrease in the AHI relative to the baseline value and a postoperative AHI of <10 events/h.

Postoperative Sleep Endoscopy

For the five participants with poor surgical outcome (four with CCC and one with complete AP collapse preoperatively), we performed postoperative sleep endoscopy to assess residual collapse in the upper airway. In the postoperative sleep endoscopy, complete AP collapse was observed among four participants: three patients with preoperative CCC and the other with preoperative complete AP collapse. CCC remained in one participant after MIP (A: expiration; B: inspiration).



Conclusion

Our study demonstrated the effect of MIP on OSA and indicated that tonsillectomy is not always essential for the treatment of OSA, particularly for patients with small tonsils, and with only retropalatal obstruction in DISE. The presentation of CCC in sleep endoscopy indicates a relatively poor surgical outcome, and thus patients with OSA with such DISE findings are not candidates for MIP.