

# Assessing the Impact of Hyoid Suspension in Multilevel Sleep Surgery: A Systematic Review and Meta-analysis

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## ABSTRACT

**Objective:** There are numerous well-established approaches to the surgical treatment of obstructive sleep apnea (OSA). While uvulopalatopharyngoplasty (UPPP) remains the most utilized method for addressing obstruction at the level of the soft palate, there is no clear consensus among sleep surgeons regarding the optimal approach for hypopharyngeal obstruction. Hyoid suspension (HS) has been proposed as a potential solution, but its effectiveness and role in the surgical management of OSA remain unclear. This study consists of a scoping review of the primary literature evaluating the impact of HS on polysomnographic outcomes and its utility in contemporary practice.

**Methods:** 4 databases (PubMed, Cochrane, Scopus, Embase) were searched through December 2024. Study screening, risk of bias analysis, and data extraction were performed independently by two reviewers. All conflicts were resolved by a third reviewer. Outcome variables included apnea-hypopnea index (AHI), Epworth Sleepiness Scale (ESS), and lowest oxygen saturation (LSAT).

**Results:** From 1102 studies screened, 22 met inclusion criteria, comprising 98 patients with isolated HS and 738 with HS plus UPPP. Average AHI reduction was similar between groups (HS: 23.3 [95% CI 17.2–29.4]; HS+UPPP: 22.7 [95% CI 16.8–28.6]). ESS improvement was not significant for HS alone (3.89 [95% CI 1.14–8.92]) but was significant for HS+UPPP 4.84 [95% CI 3.57–6.11]). Both groups demonstrated LSAT improvement (HS: -12.3 [95% CI -20.2–-4.46]; HS+UPPP: -9.13 [95% CI -14.2–-4.10]). Surgical success by Sher's criteria was 28% for HS alone and 27% for HS+UPPP.

**Conclusion:** Both isolated HS and HS combined with UPPP resulted in comparable reductions in AHI and improvements in oxygen saturation. However, only the HS+UPPP group showed a statistically significant improvement in daytime sleepiness (ESS). Surgical success rates were modest and nearly identical between groups (~27–28%), suggesting that HS—whether performed alone or with UPPP—may have limited efficacy as a primary intervention for OSA.

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## Introduction

Obstructive sleep apnea (OSA) is a common disorder marked by recurrent upper airway collapse, leading to poor sleep quality and increased health risks. Continuous positive airway pressure (CPAP) is the gold-standard treatment, but poor adherence has driven interest in surgical alternatives. Multilevel sleep surgery (MLS) is well established, with uvulopalatopharyngoplasty commonly used for palatal obstruction, though the optimal approach to hypopharyngeal obstruction remains uncertain.

Hyoid suspension advances and stabilizes the hyoid bone to address hypopharyngeal collapse and is performed alone or with UPPP as part of MLS. However, its clinical role is debated, with mixed evidence on objective outcomes. This study presents a scoping review and meta-analysis evaluating the impact of HS on polysomnographic variables and its utility in contemporary practice.

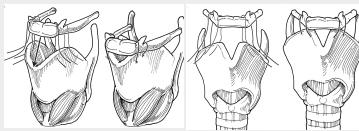


Figure 1. Hyoid Suspension showing advancement of hyoid bone over the thyroid cartilage.

## Methods and Materials

- Design:** Scoping review
- Data sources:** PubMed, Cochrane, Scopus, Embase
- Search terms:** “hyoid suspension,” “hyoid myotomy,” “obstructive sleep apnea,” “multilevel sleep surgery”
- Inclusion criteria:** Adults ( $\geq 18$  years) with OSA who underwent isolated HS or HS with UPPP
- Exclusion criteria:** Age  $< 18$ , no diagnosis of OSA
- Total studies screened:** 1102
- Studies meeting criteria:** 22

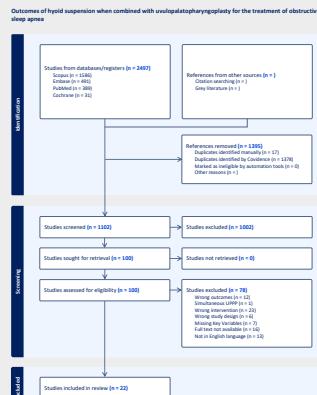


Figure 2. PRISMA flowchart outlining literature search process

## Results

### 1. Apnea-Hypopnea Index (AHI)

Both HS alone and HS + UPPP resulted in similar reductions in AHI. The pooled mean change in AHI was 23.3 events/hour (95% CI 17.2–29.4) for HS alone and 22.7 events/hour (95% CI 16.8–28.6) for HS + UPPP, demonstrating that both approaches significantly improved airway obstruction.

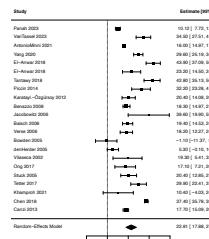


Figure 3. AHI Forrest Plot

### 2. Epworth Sleepiness Scale (ESS)

Patients undergoing HS + UPPP experienced a statistically significant improvement in daytime sleepiness (mean change 4.84, 95% CI 3.57–6.11). HS alone showed a smaller improvement (3.89, 95% CI 1.14–8.92) that was not statistically significant, suggesting combined surgery may provide more symptomatic relief.

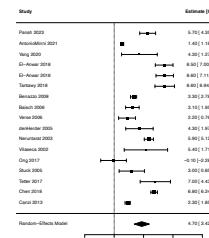


Figure 4. ESS Forrest Plot

### 3. Lowest Oxygen Saturation (LSAT)

Both groups demonstrated improvements in oxygenation during sleep. The mean increase in LSAT was -12.3% (95% CI -20.2–-4.46) for HS alone and -9.13% (95% CI -14.2–-4.10) for HS + UPPP. Improvement was slightly greater in HS alone, but both interventions were beneficial.

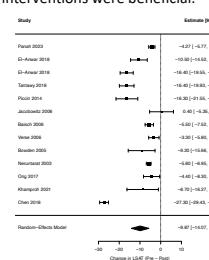


Figure 5. LSAT Forrest Plot

## Results cont.

### 4. Sher Success Rate

Overall surgical success, defined as postoperative AHI  $< 20$  and  $\geq 50\%$  reduction from baseline, was similar between groups: 28% for HS alone and 27% for HS + UPPP.

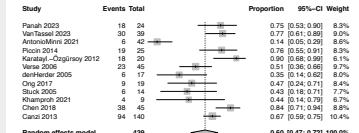


Figure 6. Sher Success Rate Forrest Plot

Outcome	k	N	Effect (95% CI)	Power
AHI	22	804	22.81 (17.88, 27.74)	100.0
ESS	17	705	4.7 (3.42, 5.98)	100.0
LSAT	13	416	-9.97 (-14.07, -5.68)	99.6
Sher Success	12	439	1.51 (0.87, 2.26)	31.3

Table 1. Effect Sizes and Power for Key Outcomes

### Power

Analyses for HS alone and HS + UPPP were well-powered for AHI and LSAT, moderately powered for ESS, and underpowered for Sher Success, reflecting limited confidence in surgical success estimates.

## Conclusions

- Hyoid suspension (HS), alone or combined with UPPP, improves airway obstruction as reflected by reductions in AHI.
- HS + UPPP produces a statistically significant improvement in daytime sleepiness (ESS), whereas HS alone shows smaller, non-significant changes.
- Both interventions improve oxygenation during sleep (LSAT), with slightly greater increases observed in HS alone.
- HS alone and HS + UPPP both produced significant, well-powered improvements in AHI and LSAT, supporting the role of hyoid suspension in OSA treatment.
- ESS improvement was more consistent with HS + UPPP, highlighting the value of combining hyoid suspension with palatal-level surgery in multilevel approaches.
- Future research may elect to focus on larger, prospective studies with polysomnography, standardized functional outcomes, and careful patient selection to clarify the role of HS in multilevel OSA surgery.

## REFERENCES



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