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*Otolaryngology -- Head and Neck Surgery* 2005 133: 211  
DOI: 10.1016/j.otohns.2005.03.061

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# Transpalatal Advancement Pharyngoplasty Outcomes Compared With Uvulopalatopharyngoplasty

B. Tucker Woodson, MD, Sam Robinson, MB, BS, FRACS, and Hyun J. Lim, PhD, Milwaukee, Wisconsin

**OBJECTIVE:** Uvulopalatopharyngoplasty (UPPP) success rates in patients classified with Friedman stage 3 is reported as 8%. Surgical failure may result from persistent obstruction at the palate, which may be addressed by pharyngoplasty with palatal advancement (PA). The effectiveness of PA versus UPPP was evaluated by using polysomnographic outcomes in a retrospective cohort of patients classified with Friedman stage 3.

**METHODS:** Surgical records were reviewed for PA (n = 47) and UPPP (n = 124). Clinical records were reviewed and reclassified by Friedman stage. Respiratory data were collected from overnight polysomnography. Statistical analysis was conducted of continuous variables (ANOVA), categorical variables ( $\chi^2$ ), and adjusted odds ratios by using logistic regression.

**RESULTS:** PA (n = 30) and UPPP (n = 44) did not differ in baseline apnea hypopnea index (AHI), age, or BMI. Both PA ( $48.3 \pm 24.6$  to  $19.8 \pm 16.8$  events per hour,  $P < 0.000$ ) and UPPP ( $47.9 \pm 30.0$  to  $30.9 \pm 24.2$  events per hour,  $P < 0.000$ ) improved with surgery. In the PA group, final AHI was lower ( $17.1 \pm 30.1$  versus  $28.5 \pm 25.6$ ,  $P < 0.04$ ) and postoperative change was greater ( $30.9 \pm 24.2$  versus  $19.8 \pm 16.8$ ,  $P < 0.02$ ). For patients with Friedman stage 3, odds ratio of having an AHI of  $<20$  events per hour and a greater than 50% reduction with PA compared with UPPP was 3.80 (95% CI, 1.41-10.29,  $P < 0.013$ ). Adjusted for age, body mass index, preoperative apnea severity, and tongue-base surgery, OR was 5.77 (95% CI of 1.80-17.98).

**CONCLUSIONS:** Polysomnographic outcomes using AHI support the use of palatopharyngoplasty using palatal advancement as an effective treatment of obstructive sleep apnea. PA may offer benefit over UPPP alone in patients classified with Friedman stage 3.

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Uvulopalatopharyngoplasty as first described by Fujita et al<sup>1</sup> in 1981 is a common surgical procedure applied for the treatment of obstructive sleep apnea syndrome (OSAS). However, using this technique, failure rates are reported from 30% to 90%.<sup>2,3</sup> A systematic review of the literature in 1996 identified a 42% success rate in published studies using polysomnographic outcomes of an apnea hypopnea index (AHI) of less than 20 or an apnea index of less than 10 events per hour.<sup>4</sup> Better success rates remain elusive despite attempts at improved selection and alternative techniques.

Multiple methodological issues hamper attempts at assessing and improving surgical success rates. Differences in patient anatomy, surgical technique, and variable methods of patient selection make meaningful comparisons of equivalent patient groups difficult. Lack of comparative or randomized studies, in turn, contributes to uncertainty about surgery's effectiveness.

Recently, Friedman et al<sup>5</sup> reported on a simple reproducible clinical staging system that demonstrated power to stratify UPPP success rates into 3 defined groups. In this classification, stage I patients demonstrated a 70% success rate; stage II, a 50% success rate; and stage III, an 8% success rate. Because the system was based on common upper airway exam findings, it allows both prospective and retrospective staging of patients. Similarly staged patients may then be compared.

The etiology of surgical failure is multifactorial, but failure often continues to occur in the upper pharynx at the level of UPPP surgery.<sup>6,7</sup> Manometry identifies the retro-palatal site as a primary site of persistent airway obstruction. When successful, UPPP improves airway collapsibility and

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structure, and when unsuccessful, structural improvements are less.<sup>8-10</sup> Overall, data suggest that persistent upper airway obstruction is associated with technical failure of the retropalatal segment proximal to the level of UPPP excision of the palate.

Multiple UPPP modifications have been described to better reconstruct the upper pharyngeal airway. Palatal advancement pharyngoplasty has been offered as an alternative to traditional techniques. This technique enlarges and stabilizes the upper pharyngeal airway not by aggressive resection or modification of soft tissues but by altering bone and soft tissue attachments of the posterior maxilla. Initial studies supported a clinical improvement and subsequent reports demonstrated experimental improvement in retropalatal closing pressures and airway cross sectional airway size.<sup>11-13</sup> Comparative studies have to date been lacking and their utility impeded by the inability to define comparable treatment groups. The goal of this study is to assess the treatment effectiveness of palatal advancement pharyngoplasty compared with traditional UPPP.

## METHODS

Institutional review board approval was obtained for this retrospective review. Eligible patients required subjects to be classified as Friedman stage 3, significant symptoms of snoring or daytime sleepiness, and ineffective medical treatment with nasal continuous airway pressure (CPAP). Patients having palatal surgery were identified in two ways both by review of billing (BTW) and operative scheduling records (SAR, BTW). All patients undergoing palatal advancement surgery for OSAS beginning in January 2000 were reviewed. At this time, the technique was altered to include incision of the tensor tendon aponeurosis to allow for greater soft palate mobilization and advancement. Patients undergoing UPPP were retrospectively identified in both authors practice sites through review of surgical records. For 1 site (BTW), additional UPPP patients were identified before 2000 using Current Procedural Terminology billing codes (42145) beginning in 1995.

### Polysomnography

All patients included in the study underwent a baseline full polysomnogram (PSG), which included electroencephalogram (at least 2 channels), electrooculogram, chin and leg muscle electromyograms, electrocardiogram, measures of oronasal airflow using thermistors (BTW) and pressure transducers (SAR), thoracic and abdominal efforts, body position, and pulse oximetry. Apnea was defined as cessation of inspiratory airflow  $\geq 10$  seconds. Hypopnea definitions were not always stated in the sleep study reports, but it is uniformly defined using the clinical standard set by the Center for Medical Services (CMS) as a reduction of inspiratory airflow of  $\geq 10$  seconds with an associated 4% decrease in oxyhemoglobin saturation. The methods of postoperative testing in the US cohort varied. Insurance

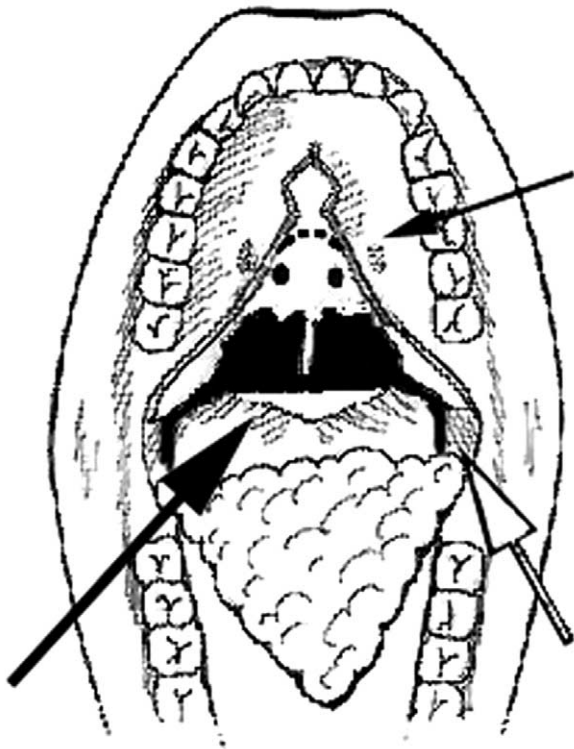
coverage denials were common, and patients refused study costs of in-lab testing. As an alternative, in-home testing using validated cardiorespiratory devices was offered to patients (Edentrace or Itamar Medical).<sup>14,15</sup> Records were hand scored and or individually reviewed by a board-certified sleep physician (B.T.W.) using apnea and hypopnea criteria noted above.

### Friedman Staging

Friedman staging was performed retrospectively. This staging system uses 4 physical exam characteristics (palatal position (1-4), tonsil size (1-4), and body mass index ( $>$  or  $<$  40 kg/M<sup>2</sup>) and the presence of significant craniofacial abnormalities to classify an individual into 4 stages. Stage III patients are defined by lack of tonsil hypertrophy ( $<$ 50% impingement of the distance from the tonsil pillar to the midline, ie, tonsil = 1+, 2+) combined with the inability to visualize the free margin of the soft palate with the mouth open (palate and tongue position = 3+, 4+). For both sites, clinical staging was initially done as described by Fujita.<sup>16</sup> In reclassification, Malampati II and III as described by Fujita are classified as Friedman stage 3 unless tonsil hypertrophy is present (equivalent of tonsil size 3+,4+). Malampati I as defined by Fujita (depending on tonsil size) may be Friedman 1 or 2 but cannot be Friedman stage 3. Stage IV represents severe retrognathia, a sella-nasion-supramentale (SNB) and of 74 degrees or less, or morbid obesity (BMI  $>$  40).

### Surgical Technique

Pharyngoplasty using the technique of palatal advancement differs from earlier descriptions in a shorter palatal flap, more aggressive palate mobilization, and palate advancement using an osteotomy leaving soft tissue attached to bone. A palatal flap is created with its tip approximately 1 cm anterior to the planned osteotomy of the hard palate (Figure 1). Anteriorly, a vertical midline incision is extended and allows for wider exposure proximally. The palatal flap is medial to the greater palatine foramen. Its base is flared laterally over the hamulus when posterior to the junction of the hard and soft palate. The flap is elevated off bone staying superficial to the tensor aponeurosis, which is identified and its attachments preserved. For this series, 2 methods of soft palate mobilization were used (Figure 2). Initially, electrocautery divided and separated the soft and hard palates at the insertion of the soft tissue to bone. Later, the hard and soft palate were separated with an osteotomy of the posterior hard palate, leaving 2-3 mm of bone to which the tensor aponeurosis remains attached. Five to 10 mm of posterior hard palate is removed with a rotary drill. Proximal to this osteotomy, drill holes are placed through the palate for subsequent placement of sutures. These sutures support the osteotomized segment and palatal advancement. Soft tissues and the palatal flap are closed in layers. If patients had not undergone prior UPPP, a conservative uvulopalatal flap, or conservative UPPP similar to that of



**Figure 1** Intraoral view of pharyngoplasty with palatal advancement. The palatal flap is constructed with its tip 1 cm anterior to the level of bone removal (dotted line). The flap is medial to the greater palatine foramen (stippled area, small arrow). A vertical midline incision is extended anteriorly and this allows wider exposure. The location of the palatal drill holes are shown leaving a 5-mm margin of bone. The nasal septum is visible in the midline. The posterior osteotomized segment remains attached to the tensor tendon (large solid arrow). Laterally, the tensor tendon is incised medial to the hamulus (open arrow).

Ikamatsu was performed.<sup>17-18</sup> In 10 palatal advancement patients, no UPPP was done. The traditional method of UPPP was described by Fujita and Fairbanks.<sup>19</sup>

Tongue-base surgical procedures varied and included both limited segmental osteotomies and genioglossus advancement, hyoid suspension, and glossectomies both with and without radiofrequency techniques.

## STATISTICAL ANALYSIS

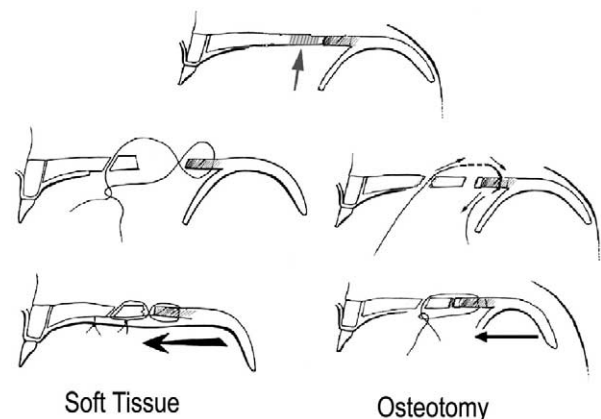
Baseline characteristics between groups were compared by using ANOVA for continuous variables. Descriptive statistics was used to summarize data. Student's *t*-test was used for comparison of continuous variables, and  $\chi^2$  was used for comparison of categorical variables. For estimating unadjusted odds ratio and logistic analysis, the success indicator was created as follows: AHI-post value of  $< 20$  and 50% reduction from AHI-pre value was treated as success and was otherwise treated as failure.<sup>20</sup> Odds ratio (OR) with 95% confidence interval (CI) for success was calculated. A

logistic regression model was used to examine difference in 2 groups and to estimate the OR for success, controlling for the selected baseline demographic and clinical factors. Regression model also was used to predict AHI-post value, controlling for the selected baseline demographic and clinical factors.<sup>21</sup> The variable showing *P* value of  $< 0.05$  was considered statistically significant. Analysis was carried out with SAS statistical software, version 8.<sup>22</sup>

## RESULTS

A total of 47 palatal advancement patients were identified (38 BTW, 9 SAR) from January 2000 to January 2004. Seventeen were excluded for reasons including non-Friedman stage 3 ( $n = 4$ ) and lack of postoperative PSG ( $n = 13$ ). A total of 418 patient records were identified by using billing and surgical records of possible UPPP patients. Archived records were unavailable for clinical staging in 294. Of the remaining 124, exclusions included missing baseline or follow-up polysomnography ( $n = 32$ ), surgical operative report absent or indicating nonstandard UPPP ( $n = 19$ ), and non-stage 3 ( $n = 29$ ). Thirty palatal advancement and 44 UPPP patients were eligible for review. Mean time from surgery to postoperative polysomnography for the palatal advancement group was 4.8 months and 9.7 months for the UPPP group.

Demographics of the patient populations are given in Table 1. Patients did not differ in apnea severity, body mass index, or age. A greater proportion of palatal advancement patients had tongue-base procedures. Tongue-base surgical procedures are listed in Table 2. For both palatal advance-



**Figure 2** Two methods of pharyngoplasty with palatal advancement are diagrammed. Initially, a soft-tissue technique was performed. The attachments to the soft palate to the hard palate were sharply incised, exposing the nasopharynx. Posterior hard-palate bone was removed, and the soft palate was advanced (left). Subsequently, the technique was modified to perform an osteotomy. Distal palatal bone was removed (top small arrow), leaving a 2- to 3-mm bony attachment to the soft palate. Once mobilized, the bony segment and soft palate are advanced and suture tied (right).

**Table 1**  
Palatal advancement compared with UPPP on the basis of tongue-base procedure

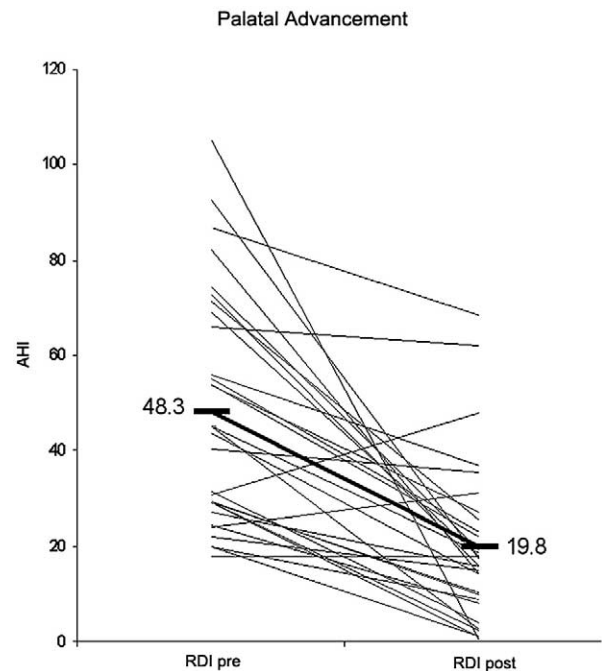
Demographic group	Palatal advancement (n = 30)	UPPP (n = 44)	P value
Pre-AHI	48.3 (24.6)	47.9 (30.0)	NS
Age	48.2 (8.3)	45.5 (10.0)	NS
Body mass index	31.1 (4.6)	32.7 (6.4)	NS
Tongue procedure	20	18	<0.05
Gender (F:M)	7:23	4:40	NS

ment and UPPP groups, there was a significant decrease in AHI in the postoperative compared with the preoperative values (Figures 3 and 4). When controlled for tongue-base surgery, the palatal advancement group demonstrated a greater change in AHI ( $28.5 \pm 25.6$  and  $17.1 \pm 30.1$  events per hour,  $P < 0.02$ , respectively) and a lower final AHI ( $19.79 \pm 16.8$  versus  $30.9 \pm 24.2$  events per hour,  $P < 0.04$ ) than the UPPP group (Table 3).

Comparison of clinical outcomes was also performed using 2 definitions of a clinical effectiveness. Using criteria of an AHI of  $<20$  and adjusted for preoperative AHI, age, BMI, and tongue-base surgeries, the odds ratio of success for palatal advancement over UPPP was 3.88 (95% CI of 1.17 to 12.89). Using a criteria of an AHI of  $<20$  events per hour combined with a  $>50\%$  decrease from preoperative levels, the palatal advancement performed better than UPPP (unadjusted OR, 3.80; 95% CI, 1.41 to 10.29,  $P < 0.013$ ). When adjusted for age, BMI, pretreatment AHI, and tongue-base surgery, the adjusted OR was 5.77 (95% CI of 1.80 to 17.98).

In 10 palatal advancement and 26 UPPP patients, tongue-base surgeries were not performed (Figure 5). AHI in the palatal advancement group improved ( $52.1 \pm 29.0$  to  $15.0 \pm 12.8$  events per hour;  $P < 0.005$ ), but not the UPPP group ( $46.5 \pm 34.7$  to  $26.0 \pm 23.8$  events per hour,  $P < 0.57$ , Table 4).

Complications of palatal advancement surgery were reviewed in 47 procedures. Temporary oronasal fistula was



**Figure 3** AHI is shown for individual patients with pharyngoplasty with palatal advancement (n = 30). Mean values are shown.

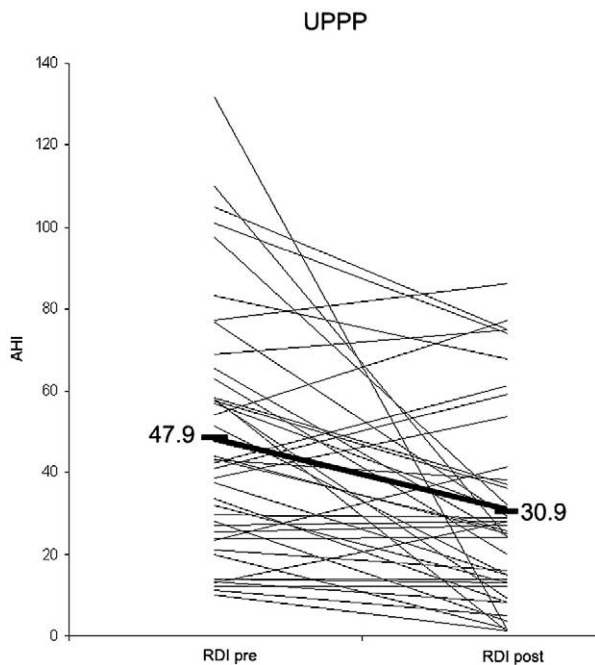
observed in 6 (12.7%). Fistula all resolved with conservative treatment using occlusive oral splints and secondary suture reapproximation. Temporary dysphagia was seen in 3 patients. In 1 of these 3, significant nasal regurgitation developed, requiring a partial release of the palatal advancement and causing a secondary oronasal fistula. With the use of a temporary splint, the fistula closed, and swallowing difficulty resolved. No speech changes were reported in any patient.

## DISCUSSION

The current study evaluates a retrospective cohort of patients having palatal advancement pharyngoplasty who were classified by the Friedman staging system as stage 3 (unfavorable for UPPP). Results were compared with a matched historical control group having UPPP by the same surgeons at 2 institutions using a similar surgical algorithm. Analysis

**Table 2**  
Palatal advancement compared With UPPP on the basis of tongue-base procedure

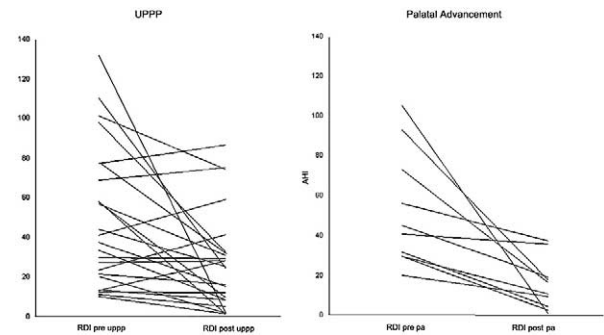
Tongue-base procedure	Palatal advancement	UPPP
None	10	26
Glossectomy or radiofrequency tissue-ablation tongue	3	6
Genioglossus advancement (osteotomies)	16	12
Hyoid suspension	4	4
Epiglottopexy	1	0
Total with tongue procedures	20	17



**Figure 4** AHI is shown for individual patients with UPPP ( $n = 44$ ). Mean values are shown.

demonstrated that groups were similar in age, body mass index, and pretreatment AHI disease severity. Groups did differ in frequency of tongue-base surgeries. Results adjusting for tongue-base surgeries, body mass index, pretreatment AHI severity, and age supported that palatal advancement improves AHI compared with traditional UPPP. Palatal advancement demonstrated greater changes in AHI, a lower final AHI, and a higher percentage of successfully treated patients.

Assessing a surgical procedure's effectiveness for OSA is difficult. Outcomes are affected many variables in addition to the procedure used; the most critical potentially being the population studied. Without being able to control this variability, attributing success to a procedure is difficult. To stratify a population undergoing surgery, pretreatment disease severity, body mass index, Mueller's maneuver, and cephalometry have been used.<sup>23</sup> All have historically failed to accurately predict UPPP outcomes.<sup>4</sup> More recently, a staging system has been described by Friedman et al.<sup>5</sup> This method stratifies patients into 3 distinct groups by using common physical exam findings. This



**Figure 5** AHI is shown for patients who underwent pharyngoplasty (right, palatal advancement and left, UPPP) without tongue-base surgeries.

method could be applied retrospectively to clinical records to restage and identify those included in stage 3. In this group, published success rates using UPPP alone are reported to be as low as 8%.

The cause of UPPP failure continues to be poorly understood. Undoubtedly, multiple causes exist. Although failure caused by obstruction at nonpalatal airway sites occurs, technical failure at the palate after UPPP failure is common. This tenet is supported by persistent obstruction proximal to the UPPP site, no change or worsening of closing pressures (a measure of airway collapsibility), and no improvement in retropalatal cross sectional area in UPPP nonresponders.<sup>6-10</sup> UPPP also may worsen upper airway structure. To better treat the airway, future options include more aggressive direct modifications of the distal soft palate, or alternatively, procedures that modify surrounding structures. Because more aggressive soft-tissue resection may be associated with increased complications, alternative techniques are required. Previous studies of pharyngoplasty using palatal advancement described the technique and demonstrate a clinical effect.<sup>11</sup> Clinical data were limited. Studies of airway mechanics demonstrated improvements in retropalatal size, shape, and collapse, particularly in the lateral pharyngeal wall (Figure 6).<sup>12,13</sup> Surgical techniques have continued to evolve and improve. Despite some similarity, several major differences exist. The most significant is the incision and release of the tensor tendon. This allows for a less restricted advancement of the soft palate.

The concept of palatal advancement is based on an understanding of OSA pathophysiology. The primary craniofacial predictor of OSA severity is maxillary constriction.<sup>24</sup>

**Table 3**  
Apnea hypopnea index for palatal advancement compared with UPPP

Procedure	Pre-AHI	Post-AHI	Change in AHI	<i>P</i> value, pre vs. post	<i>P</i> value between groups
UPPP ( $n = 44$ )	47.9 (30.0)	30.9 (24.2)	17.1 (30.1)	<0.000	
Palatal advancement ( $n = 30$ )	48.3 (24.6)	19.8 (16.8)	28.5 (25.6)	<0.000	<0.02

**Table 4**  
**Palatal advancement and UPPP alone without other tongue-base procedures**

Procedure	Pre-AHI	Post-AHI	Change in AHI	<i>P</i> value
UPPP (n = 26)	46.5 (34.7)	26.0 (23.8)	20.5 (34.7)	<0.57
Palatal advancement (n = 10)	52.1 (29.0)	15.0 (12.8)	37.1 (31.8)	<0.005

Both maxillofacial surgery and rapid maxillary expansion may address this abnormalities. However, despite both having success, both are infrequently applied. As an alternative, palatal advancement palatopharyngoplasty modifies this segment combining a posterior maxillectomy with soft palate mobilization. Retropalatal airway size is increased without altering dentition or facial appearance. Favorable posterior airway changes come at the expense of the oropalatal airway and the oral route of ventilation. Because oral obstruction may theoretically worsen, the algorithm used for palatal advancement pharyngoplasty includes tongue-base reduction or advancement surgery in patients with large tongues, which may impair oral ventilation (relative macroglossia) after advancement.

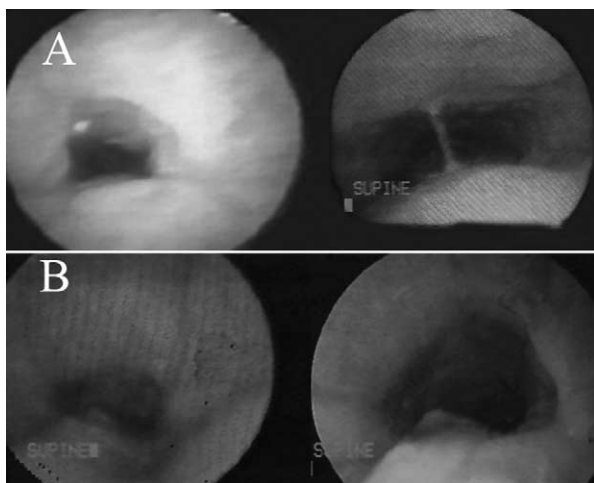
This study used a historical UPPP comparison group. Historical control groups may differ in many uncontrolled, unrecognized, or unmeasured characteristics and this may alter results of the study. However, short of a randomized trial, many of these issues are difficult to address. Randomized trials for surgical procedures may be dauntingly difficult. A randomized study of isolated palatal surgery in a

group of Friedman stage 3 patients poses extreme difficulty given the low success rate of UPPP and the morbidity of surgery. It is for this reason that for this study, we did not exclude those having tongue-base surgeries. Palatal surgery as the only treatment for this stage of disease is inappropriate for many patients. Assessment of palatal surgery must be done in conjunction with tongue-base surgeries to be meaningful. Tongue-base surgery did have an effect in this group. However, when adjusted for tongue-base surgery, the odds of a successful clinical effect for palatopharyngoplasty with advancement increased (OR 3.8 [unadjusted for tongue base surgery] to OR of 5.7).

To reduce variability, only patients treated by the same surgeons (B.T.W., S.R.) with UPPP and palatal advancement groups were included. Both UPPP and palatal advancement patients were drawn from the same community population. Both surgeons used similar surgical techniques. The major selection bias determining the type of surgery selected was the time of the accrual. UPPP was the primary palatal technique early in the series for both authors (B.T.W. to 2000 and S.R. to 2002). Only recently was palatal advancement performed more. Lack of posttreatment PSG precluded a larger number of patients with UPPP being included and was not initiated by the treating surgeon.

In-lab attended polysomnography (PSG) was used to measure sleep and ventilatory outcomes for all preoperative studies. Insurance coverage for in-lab postoperative PSG often was not available. As an alternative, 2 validated cardiorespiratory sleep studies devices were used for follow-up (WatchPat 100 [Itamar Medical Ltd, Caesarea, Israel] and Edentrace [Nellcor Puritan Bennett, Kanata, ON]). Because these may miss hypopneas or respiratory-related arousals with minor or no desaturation or change in airflow, a consistent definition of hypopnea using CMS criteria requiring a 4% desaturation was used. This is the most common clinical definition and allows hypopneas to be clearly identified on the cardio-respiratory study. The variability in PSG outcomes due to potentially different sleep technicians, sleep study equipment, diagnostic, and split-night sleep study protocols was not addressed. Given that the AHI is an arbitrary metric of OSA severity, this study is limited by not using other measures. Lowest oxygen saturation level was not used because these data often were not accurately available. Ultimately, evaluation of surgical effectiveness may require assessment with non-PSG based measures.

Overall, the complication rate of this study was low. No serious complications occurred. In 6 of 47 patients, oronasal



**Figure 6** Preoperative and long-term postoperative photographs of the retropalatal airway in 2 patients (A and B) are shown. Preoperative (left) and postoperative (right) are shown with the posterior pharyngeal wall to the top and the soft palate to the bottom of the photographs. (A) There is significant enlargement in the lateral pharyngeal walls, which are now concave in appearance. (B) In this patient, the velopharynx is constricted with a small opening as well as proximal muscular posturing of the palate in the preoperative photo. Postoperatively, the enlargement of the velopharynx and muscular posturing is absent.

fistula occurred (12.7%). These were treated with an occlusive self-retaining oral splint. This allowed healing, a normal diet, and speech. An increase in fistula frequency occurred when the technique changed and the tensor tendon was incised to increase mobilization of the palate. We speculate that the pull of the levator and other muscles during swallowing and speech disrupted the wound despite the placement of multiple sutures in the strong tensor aponeurosis. To address this, the osteotomy method was developed, leaving the soft palate attached to bone, which is then advanced. Fistulas have decreased, but this issue warrants observation. As with all palatopharyngoplasty techniques, perioperative pain is significant for 7 to 10 days; however, unless combined with a uvulopalatal flap or tonsillectomy, our impression is that odynophagia is less than traditional UPPP. Because of the risk of fistula, a soft diet is recommended for at least 2 weeks.

## CONCLUSION

This study supports the effectiveness of palatal advancement pharyngoplasty in reducing disease severity as measured by AHI for the surgical treatment of OSA in patients who are at high risk of UPPP failure when traditional techniques are used.

## REFERENCES

1. Fujita S, Conway WA, Zorick FJ, et al. Evaluation of the effectiveness of uvulopalatopharyngoplasty. *Laryngoscope* 1985;95:70–4.
2. Maisel RH, Antonelli PJ, Iber C, et al. Uvulopalatopharyngoplasty for obstructive sleep apnea: a community's experience. *Laryngoscope* 1992;102:604–7.
3. Cahali MB. Lateral pharyngoplasty: a new treatment for obstructive sleep apnea hypopnea syndrome. *Laryngoscope* 2003;113:1961–8.
4. Sher AE, Thorpy MJ, Shprintzen RJ, et al. Predictive value of Muller maneuver in selection of patients for uvulopalatopharyngoplasty. *Laryngoscope* 1985;95:1483–7.
5. Friedman M, Ibrahim H, Bass L. Clinical staging for sleep-disordered breathing. *Otolaryngol Head Neck Surg* 2002;127:13–21.
6. Woodson BT, Wooten MR. Manometric and endoscopic localization of airway obstruction following uvulopalatopharyngoplasty. *Otolaryngol Head Neck Surg* 1994;111:38–43.
7. Shepard JW, Thawley SE. Localization of upper airway collapse during sleep in patients with obstructive sleep apnea. *Am Rev Respir Dis* 1990;141:1350–5.
8. Schwartz AR, Schubert N, Rothman W, et al. Effect of uvulopalatopharyngoplasty on upper airway collapsibility in obstructive sleep apnea. *Am Rev Respir Dis* 1992;145:527–32.
9. Isono I, Shimada A, Tanaka A, et al. Effects of uvulopalatopharyngoplasty on collapsibility of the retropalatal airway in patients with obstructive sleep apnea. *Laryngoscope* 2003;113:362–7.
10. Caballero P, Alvarez-Sala R, Garcia-Rio F. CT in the evaluation of the upper airway in healthy subjects and in patients with obstructive sleep apnea syndrome. *Chest* 1998;113:111–6.
11. Woodson BT. Retropalatal airway characteristics in UPPP compared to transpalatal advancement pharyngoplasty. *Laryngoscope* 1997;107:735–40.
12. Woodson BT, Toohill RJ. Transpalatal advancement pharyngoplasty for obstructive sleep apnea. *Laryngoscope* 1993;103:269–76.
13. Woodson BT. Acute effects of palatopharyngoplasty on airway collapsibility. *Otolaryngol Head Neck Surg* 1999;121:82–6.
14. Bar A, Pillar G, Dvir I, et al. Evaluation of a portable device based on arterial peripheral tonometry (PAT) for unattended home sleep studies. *Chest* 2003;123:695–703.
15. Redline S, Tosteson T, Boucher MA, et al. Measurement of sleep-related breathing disturbances in epidemiologic studies. *Chest* 1991;100:1281–6.
16. Wittig R, Fujita S, Fortier J, et al. Results of uvulopalatopharyngoplasty (UPPP) in patients with both oropharyngeal and hypopharyngeal collapse on Mueller's maneuver. *Sleep Res* 1988;17:269.
17. Powell N, Riley R, Guilleminault C, et al. A reversible uvulopalatal flap for snoring and sleep apnea syndrome. *Sleep* 1996;19:593–9.
18. Ikematsu T. Palatopharyngoplasty and partial uvulectomy method of Ikematsu: a 30 year clinical study of snoring. In: Fairbanks DNL, Fujita S, Ikematsu T, et al, editors. *Snoring and sleep apnea*, 1st ed. New York: Rivlin Press; 1987. p. 130–134.
19. Fairbanks DNF. Cold surgical instrument uvulectomy and uvulopalatoplasty. In: Fairbanks DNL, Fujita S, Ikematsu T, et al, editors. *Snoring and sleep apnea*, 3rd ed. New York: Rivlin Press; 2003. p. 131–135.
20. Homer DW, Lemeshow S. *Applied logistic regression*. New York: Wiley, 1989.
21. Neter J, Kutner MH, Nachtsheim CJ, et al. *Applied linear statistical models*. New York: McGraw-Hill, 1996.
22. SAS Software: usage and reference. Version 8. Cary, NC: SAS Institute Inc.; 1997.
23. Sher AE, Thorpy MJ, Shprintzen RJ, et al. Predictive value of Muller maneuver in selection of patients for uvulopalatopharyngoplasty. *Laryngoscope* 1985;95:1483–7.
24. Dempsey JA, Skatrud JB, Jacques AJ, et al. Anatomical determinates of sleep disordered breathing across the spectrum of clinical and non-clinical subjects. *Chest* 2002;122:40–51.