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A new modification of uvulopalatopharyngoplasty for the treatment of obstructive sleep apnea syndrome

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Abstract

Objective: To evaluate objective and subjective improvement after applying a new surgical technique, two-piece palatopharyngoplasty (Two-P4), to the treatment of obstructive sleep apnea syndrome (OSAS).
Methods: Twenty-four patients with mild to severe OSAS underwent Two-P4 between January 2002 and November 2007. Polysomnography and Epworth Sleepiness Scale (ESS) score were used to evaluate surgical results.
Results: Mean apnea–hypopnea index (AHI) improved from 50.9 to 10.7 after Two-P4. Mean ESS score decreased significantly from 13.0 to 7.7. Body mass index was unchanged after surgery. Objective success as evaluated by a 50% reduction in AHI and by AHI <20 was obtained in 22 of 24 patients (91.7%). Mean reduction in AHI was 76.9% for all 24 patients, 86.2% for patients with Friedman's anatomical stage I, 78.9% for stage II, and 54.5% for stage III.
Conclusion: Two-P4 is a novel surgical treatment for OSAS patients with a high success rate (91.7%) as evaluated by reductions in AHI. Two-P4 keeps the middle soft palate intact to form independent scars on both sides, which constrict to stretch the soft palate and widen the pharyngeal space.

Keywords: OSAS; Surgical treatment; Modified uvulopalatopharyngoplasty; Scar formation; Pharyngeal volume; Two-P4

1. Introduction

Ikematsu described the first surgical treatment for snoring patients [1]. Fujita developed this initial technique into uvulopalatopharyngoplasty (UPPP), which has gained widespread use for the surgical treatment of patients with obstructive sleep apnea syndrome (OSAS) [2]. However, the reported success rates of only 30–65% are insufficient [2–5]. Many modifications of UPPP have been reported, but the results remain inadequate. Unexpected scar formation and inappropriate selection of patients for surgical treatment may contribute to these poor success rates. The major problem with pharyngeal surgery lies in the difficulty of anticipating scar formation. We present herein a new modification to the UPPP technique, which we have named ''Two-piece palatopharyngoplasty'' (Two-P4). Two-P4 preserves the middle soft palate and uvula as a buffer zone by making separate right and left scars. Scars on both sides pull the middle soft palate to each side, resulting in a wider, deeper pharynx. This is effective for preventing nasopharyngeal stenosis and preserving soft palate functions. The present study examined the effectiveness of Two-P4 for the treatment of patients with OSAS using the Epworth Sleepiness Scale (ESS) score and reductions in apnea–hypopnea index (AHI). Three-dimensional computed tomography (3D–CT) was also used to evaluate the results of Two-P4.

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2. Materials and methods

Subjects comprised 24 patients with OSAS (23 men, 1 woman; mean age, 40.8 ± 13.6 years; range, 17–74 years) who underwent Two-P4 between January 2002 and November 2007 in the Department of Otorhinolaryngology at Shiga Hospital of Social Insurance. According to Friedman's anatomical stage [6], ten patients were classified as stage I, nine patients as stage II, and five patients as stage III. Patients with Friedman's stage IV were not included in this study. Mean body mass index (BMI) of patients was 27.4 ± 4.0 (range, 19.7–37.4; Table 1). Polysomnography (PSG) was performed and ESS was determined before and 3 months after surgery. Ten patients underwent 3D–CT from skull base to larynx before and 3 months after surgery.

The first step in Two-P4 is tonsillectomy with preservation of the posterior pillar of the pharynx. The mucosa of the soft palate is then removed along with the anterior pillar. The area of resection for the mucosa is determined by pulling the posterior pillars forward and upward, until the upward margin is 2 cm below the edge of the hard palate (Fig. 1A and B). Excessive mucosa of the posterior pillar is removed, and the root of the posterior pillar is cut along with adjacent palatopharyngeal muscles to reduce tension on the mucosa (Fig. 1 C). Mattress sutures are used to avoid irregular scar formation (Fig. 1D).

Surgical success was defined as a ≥50% reduction in AHI and a postoperative AHI < 20. ESS scores were used to evaluate subjective excessive daytime sleepiness before and after surgery. Surgical results were also evaluated by lateral and posterior views from 3D–CT in the 10 patients for whom these results were available. These images clearly showed the narrowest area of the upper airway before and after surgery. The space between 5 mm upward and downward from the narrowest level was calculated as the pharyngeal volume. All study protocols were approved by the institutional research and ethics committee of Shiga Hospital of Social Insurance.

3. Statistical analysis

A two-tailed paired t-test was used to compare results between groups. Standard deviation (SD) was used as an index of variability. Statistical analysis was performed using SPSS software (SPSS, Chicago, IL), and values of $p < 0.05$ were accepted as statistically significant.

4. Results

All operations were performed under general anesthesia. Two-P4 leaves the middle soft palate and uvula as a buffer zone by making separate right and left scars. Scars on both sides pull the middle soft palate to each side, widening and deepening the pharynx (Fig. 2). Two patients experienced apnea and a decrease in SpO_2 just after surgery. However, adequate control was achieved using nasal continuous positive airway pressure (CPAP) and oxygen inhalation. Two patients complained of slight difficulty swallowing for a week after surgery. None of the 24 cases showed stenosis of the nasopharynx or taste disorder.

Mean AHI decreased significantly from 50.9 ± 22.3 to 10.7 ± 10.7 at 3 months after Two-P4, and 12 of the 24 patients (50%) showed AHI < 10. Objective success, as evaluated by a reduction in AHI of ≥50% and AHI < 20, was obtained in 22 of the 24 patients (91.7%) (Fig. 3). Mean reduction rate of AHI was 76.9 ± 22.2% for all 24 patients, 86.2 ± 12.0% in patients with Friedman's anatomical stage I, 78.9 ± 17.9% with stage II and 54.5 ± 31.8% with stage III (Table 1). Significant differences were seen between each group. We also examined PSG between 6 and 12 months after surgery in four patients. All these patients kept the postoperative AHI less than 50% and each AHI was 0.6, 1.0, 16.8 and 18.4.

$$\text{Reduction rate of AHI} = \frac{\text{PreAHI} - \text{PostAHI}}{\text{PreAHI}} \times 100$$

Most snores diminished significantly after surgery. ESS scores were also significantly decreased from 13.0 ± 4.7 to 7.7 ± 4.2 (Fig. 4). Improvements in ESS score were better in patients with Friedman's anatomical stage I (from 13.3 ± 3.2 to 5.8 ± 4.7) than in patients with stage II (from 11.4 ± 6.0 to 8.3 ± 2.7) or stage III (from 15.2 ± 3.6 to 9.8 ± 5.0). BMI did not change significantly between before (27.4 ± 4.0) and after surgery (27.2 ± 3.9). On 3D-CT, the narrowest point of the upper airway was revealed to be posterior to the base of the uvula, at the level of the soft palate. The airway was clearly seen to be extended at this point after Two-P4 (Fig. 5). Posterior-view 3D–CT showed these changes more comprehensively (Fig. 6), and phar-

Table 1
Outcomes for the 24 patients (23 men, 1 woman) as classified by Friedman's anatomical stage.

	Stage I (n = 10 age: 34.4 ± 9.2)		Stage II (n = 9 age: 42.6 ± 17.5)		Stage III (n = 5 age: 50.4 ± 5.7)		Total (n = 24 age: 40.8 ± 13.6)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
BMI	25.4 ± 3.7	25.4 ± 3.9	27.8 ± 3.0	27.3 ± 2.6	30.5 ± 4.7	30.3 ± 4.8	27.4 ± 4.0	27.2 ± 3.9
ESS score	13.3 ± 3.2	5.8 ± 4.7	11.4 ± 6.0	8.3 ± 2.7	15.2 ± 3.6	9.8 ± 5.0	13.0 ± 4.7	7.7 ± 4.2*
AHI	53.2 ± 24.5	6.6 ± 5.7	56.6 ± 23.1	11.7 ± 11.4	35.8 ± 8.4	17.2 ± 15.3	50.9 ± 22.3	10.7 ± 10.7**

* $p < 0.05$.
** $p < 0.01$.