Obstructive sleep apnea surgery: Patient perspective and polysomnographic results

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OBJECTIVE: **The goal of this study was to assess the outcomes of obstructive sleep apnea (OSA) surgery based on the patient perspective and polysomnographic data.**

STUDY DESIGN: **Fifty-six patients with severe OSA completed the 2-phase reconstructive protocol. A minimum of 6 months after the phase II surgery and after the postoperative polysomnography, questionnaires with visual analog scales (VAS 0-10) were mailed to the patients to assess their perceptions of treatment results.**

RESULTS: **Forty-two (75%) questionnaires were returned. The mean patient age was 46.3 years. The mean respiratory disturbance index improved from 58.7 to 10.0. The mean lowest oxygen saturation improved from 76.3 to 87.3%. All 42 patients reported improved sleep (VAS 8.7). Although 10 patients reported changes in speech, the changes were insignificant, with 9 of the patients scoring 0 on the VAS (VAS 0.08 ± 0.3). Five patients reported changes in swallowing, and their VAS scores were 0.5, 0.9, 1.0, 2.7, and 6.9 (mean VAS 2.4 ± 2.7). Forty patients (95%) were satisfied with their results and would undergo the reconstruction again.**

CONCLUSION: **Surgical airway reconstruction for severe OSA is a highly effective treatment option base on the objective as well as the subjective assessment.**

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It is well recognized that obstructive sleep apnea syndrome (OSAS) is associated with increased cardiovascular morbidity and mortality.[1,2] The psychomotor sequelae of OSAS, including excessive daytime sleepiness, daytime fatigue, and poor sleep quality due to sleep fragmentation, are also well established[3,4] and are likely the major impetus for many patients to seek treatment to improve their quality of life (QOL). Although nasal continuous positive airway pressure (CPAP) and tracheotomy are highly effective treatments for OSAS, these treatment modalities are often associated with poor patient compliance and acceptance. Despite the improvement in objective results, these treatments can have a negative impact on the QOL because of inconvenience, discomfort, and irritation from the nasal CPAP mask, as well as recurrent infection, bleeding, and social issues from tracheotomy.

Since the introduction of uvulopalatopharyngoplasty (UPPP) by Fujita et al[5] in 1979, the surgical treatment of OSAS has evolved dramatically. Modern surgical management of OSAS using multiple techniques, including laser-assisted uvulopalatoplasty (LAUP), UPPP, genioglossus advancement, hyoid suspension, tongue base reduction, and maxillomandibular advancement, has achieved a significant improvement in the surgical results.[6] The traditional assessment of surgical success has been based on the improvement of objective polysomnographic results. With the recognition that the patient perspective is a crucial aspect in the treatment results, recent studies have used patient-administered questionnaires to evaluate the treatment outcomes.[7-12] However, the complete assessment of OSAS treatment outcomes should include both subjective and objective results because a subjective improvement does not necessarily equal an improvement in objective measures.[13]

The objectives of this investigation were to evaluate the patient perspective of the outcomes and to determine whether the patient perspective of treatment outcomes was consistent with the postoperative polysomnographic results.

METHODS AND MATERIAL

During a 12-month period, 207 patients underwent airway reconstruction for the management of OSAS at the Stanford University Sleep Disorders and Research Center. Fifty-six patients in whom the phase I protocol failed (uvulopalatoplasty, genioglossus advancement, and/or hyoid suspension) and who subsequently underwent the phase II protocol (maxillomandibular advancement) were included in this study. Because of the nature of the study, it was classified as exempt by the local institutional review board. All of the patients had severe OSAS (respiratory disturbance index [RDI] > 40). All of the

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patients underwent preoperative and postoperative polysomnography, head and neck examination, fiberoptic nasopharyngoscopy, and cephalometric analysis. The final polysomnography was performed 6 months after completion of the phase II protocol. Variables examined included age, sex, body mass index (BMI), RDI, lowest oxygen saturation (LSAT), and the patient's subjective response to the following questionnaire.

Questionnaire

A minimum of 6 months after the phase II surgery and after completion of the postoperative polysomnography, a self-administered questionnaire with visual analog scales (VASs) was mailed to the patient to subjectively evaluate the following variables:

1. Sleep: Whether sleep quality changed after the completion of the reconstruction.
2. Speech: Whether alteration in speech existed after the completion of the reconstruction.
3. Swallowing: Whether alteration in swallowing existed after the completion of the reconstruction.
4. Postoperative pain and suffering: Whether postoperative pain and suffering were worse for phase I or phase II surgery.
5. Satisfaction: Whether the patients were satisfied with the outcomes of their reconstructions and whether they would undergo the 2-phase reconstructive protocol again.

VASs

A standard 10-cm VAS with anchors such as "no change or not affected" and "drastic change or severely affected" was used to subjectively evaluate each patient's complaints and to assess the following variables:

1. Sleep: A VAS of 0 (no change) to 10 (significantly better) was used to evaluate changes in the quality of sleep.
2. Speech: A VAS of 0 (no change) to 10 (severely affected/debilitating) was used to evaluate changes in the quality of speech.
3. Swallowing: A VAS of 0 (no change) to 10 (severely affected/debilitating) was used to evaluate changes in the quality of swallowing.
4. Postoperative pain and suffering after phase I surgery: A VAS of 0 (none) to 10 (severe) was used to evaluate postoperative pain and suffering.
5. Postoperative pain and suffering after phase II surgery: A VAS of 0 (none) to 10 (severe) was used to evaluate postoperative pain and suffering.
6. Satisfaction: A VAS of 0 (extremely unsatisfied) to 10 (extremely satisfied) was used to evaluate patient satisfaction with treatment outcome.

Statistical Analysis

The nonparametric Wilcoxon matched-pair signed rank test was used for statistical analysis. Results were expressed as mean, plus or minus standard deviation. Statistical evaluations were all completed at the 5% level of significance and generated using a SYSTAT computerized statistical package (SYSTAT Inc, Evanston, IL).

Polysomnography

The standard polysomnographic recording included electroencephalography (C3/A2, C4/A1, O2/A1 of the international 10-20 electrode placement system); electrooculography, chin and leg electromyography, and electrocardiography (modified V_2 lead). Respiration was investigated by oronasal airflow, thoracic and abdominal movements (inductive plethysmography), and oxygen saturation (pulse oximetry). Polysomnographic variables evaluated included the RDI (Apnea + Hypopnea/Total sleep time × 60) and oxyhemoglobin desaturation nadir (LSAT).

RESULTS

Forty-two (75%) patients (36 men) completed and returned the questionnaires. The mean age was 46.3 ± 6.6 years, and the mean BMI was 32.1 ± 6.0 kg/m^2. All of the patients attempted nasal CPAP use but elected surgical reconstruction because of intolerance of nasal CPAP. Four patients underwent temporary tracheotomy for airway protection during the period of reconstruction because of severe oxygen desaturation (LSAT < 60%). All 4 patients were successfully decannulated at the completion of the reconstruction. The mean RDI improved from 58.7 ± 21.5 to 10.0 ± 8.6 events per hour (P < 0.001). The mean LSAT improved from 76.3% ± 11.2% to 87.3% ± 4.6% (P < 0.01). Thirty-seven patients (88%) were cured (RDI ≤ 20 *and* 50% reduction in RDI), and all 42 patients reported improved sleep quality (mean VAS 8.7 ± 1.4, range 5.3-10). Temporary postoperative paresthesia of the inferior alveolar nerve distribution occurred in all of these patients; however, only 4 patients (10%) did not report either total or near total recovery within 6 months. No major infection was encountered. Minor infection involving the mandibular osteotomy sites occurred in 3 patients (7%) and completely resolved with local care and oral antibiotics. Although the questionnaires identified 10 patients with changes in speech, the changes were extremely subtle and insignificant, with 9 of the patients scoring 0 on the VAS (mean VAS 0.08 ± 0.3, range 0-0.8). Five patients reported changes in swallowing; the changes were mostly insignificant and their VAS scores were 0.5, 0.9, 1.0, 2.7, and 6.9 (mean VAS 2.4 ± 2.7).

The perceived pain and suffering after phase I surgery (mean VAS 5.9 ± 2.6, range 1.1-10) were found to be similar to those after phase II surgery (mean VAS 5.1 ± 2.7, range 0.1-10) (P = 0.12). Eighteen patients thought that the pain and suffering after phase I surgery were

worse. However, 16 patients thought that the pain and suffering were worse after phase II surgery. The remaining 8 patients thought that the postoperative recovery was not significantly different between the two phases. Forty patients (95%) were satisfied with their results and would undergo reconstruction again. The overall satisfaction rating included a mean VAS of 8.5 ± 1.9 (range 0.9-10).

Two patients (5%) responded that they would not go through the reconstruction again in retrospect. The first patient was a 54-year-old man with severe daytime fatigue and sleepiness. Polysomnographic findings were consistent with severe OSAS (RDI 56, LSAT 86%). Despite completing the 2-phase reconstructive protocol, he continued to have significant symptoms of daytime sleepiness, and postoperative polysomnography demonstrated persistent OSAS (RDI 35.7, LSAT 91%). The second patient was a 43-year-old man with severe OSAS (RDI 76.2, LSAT 82%). Although an improvement was achieved after airway reconstruction (RDI 20, LSAT 77.5%), he continued to have daytime sleepiness that affected his daily activity. He also reported significant changes in swallowing (VAS 6.9), which contributed to the dissatisfaction.

Fourteen (25%) patients (all men) did not respond to the questionnaire. They were younger (mean age 41.4 ± 11.7 years) and less obese (mean BMI 28.4 ± 4.4 kg/m^2). The severity of OSAS was similar; however, the cure rate was higher in this group, with 13 patients (93%) achieving an RDI of 20 or less. The mean RDI improved from 57.1 ± 25.4 to 9.3 ± 10.2 events per hour ($P < 0.001$). The mean LSAT improved from 79.9% ± 7.4% to 87.9% ± 3.5% ($P < 0.01$).

DISCUSSION

Because of different factors such as the individual patient's lifestyle and treatment expectations, the subjective outcomes can be highly variable and may not correlate with the objective outcomes. In addition, adverse events and complications may have a significant impact on the patient's perception of treatment outcomes irrespective of the objective results. A patient-administered questionnaire can provide insight into the patient's perceived outcomes that may not be readily provided during a clinical evaluation. By using a patient-administered questionnaire, Levring-Jaghagen et al[7] found a 29% incidence of persisting dysphagia after UPPP. Although most of these patients stated that the positive results overrode the disadvantage of the complications, a few patients did report that they regretted the operation. Similar results have also been found after LAUP.[8]

Speech changes have also been shown to occur after UPPP. Salas-Provance and Kuehn[14] demonstrated speech abnormalities after UPPP. However, because of the retrospective nature of their study, the preoperative speech patterns were not known. Because disordered speech may be more common in patients with OSAS,[15] it is possible that those patients with speech abnormalities might have had abnormal speech characteristics before surgery. Indeed, when preoperative and postoperative voice characteristics were examined, UPPP did not seem to have a significant effect on speech patterns.[16,17] Even when changes in speech were found, they did not appear to be of clinical significance.[18]

Maxillomandibular surgery can also affect speech patterns. Although the effect on speech is generally positive when skeletal malocclusion has been corrected,[19,20] the potential deleterious effect (ie, hypernasality) of maxillary advancement in patients with cleft palate is well known.[21,22] Because all of the patients in this study had undergone UPPP before maxillomandibular advancement, the soft palate in these patients was already shorter and stiffer.[23] Consequently, they may have been prone to postoperative speech problems due to the combined effect of these procedures. Although the patient-administered questionnaire identified changes in speech and swallowing in some patients, the effects of these changes did not have a significant adverse effect on the QOL. All of the patients who reported changes in speech thought that they were insignificant (mean VAS 0.08 ± 0.3). Of the 5 patients who reported changes in swallowing, only 1 had a swallowing problem that was reported to be significant (VAS 6.9). This patient was referred for the management of persistent OSAS after LAUP at another institution. There was a moderate degree of lateral pharyngeal wall scarring and stricture. This preexisting problem, along with the subsequent airway reconstructions, probably contributed to the dysphagia.

The results of this study showed that the 2-phase airway reconstruction achieved a significant cure rate in the treatment of severe OSAS, which was consistent with our previous reports.[24,25] In addition, there was an equally successful subjective result. Previous investigations of patient satisfaction after pharyngeal surgery (UPPP or LAUP) for sleep-disordered breathing demonstrated that 68% to 75% of the patients were satisfied with the procedure,[12,26,27] as opposed to 95% of the patients in this study. The high patient satisfaction in this study was likely the result of the high cure rate, in conjunction with the subjective improvement and the minimal adverse effects encountered. Clearly, all of our patients had severe OSAS with significant psychomotor sequelae and were at an increased risk for cardiovascular morbidity and mortality. Because of their inability to tolerate nasal CPAP, all of the patients were highly motivated to undergo surgical management, which might also have contributed to the high patient satisfaction rate.

Due to the nature of this study, there were methodological limitations. Because the study was conducted retrospectively, validated questionnaires commonly used in outcomes studies, such as the SF-36, could not be used. However, the study was conducted to assess the patient perspective of treatment results while considering the postoperative pain and suffering as well as the adverse effects. This objective was achieved. The results of this investigation further validated the application of the 2-phase protocol in the management of OSAS. The 2-phase protocol was developed to minimize the surgical procedures necessary for achieving a cure, thus avoiding excessive surgical interventions. Interestingly, even though the phase I surgery is less invasive in general than phase II surgery, the perceived postoperative pain and suffering were not significantly different. All of the patients who achieved an objective cure were satisfied with the outcomes. Although the patients underwent multiple operations to achieve a cure, the operations did not appear to have a negative impact on the patient perception of outcomes. Furthermore, the patient perspective of treatment outcomes was consistent with the postoperative polysomnographic results.

REFERENCES

1. He J, Kryger MH, Zorick FJ, et al. Mortality and apnea index in obstructive sleep apnea: experience in 385 male patients. Chest 1988;94:9-14.
2. Partinen M, Jamieson A, Guilleminault C. Long-term outcome for obstructive sleep apnea syndrome patients: mortality. Chest 1988;94:1200-4.
3. Stepanski E, Lamphere J, Badia P, et al. Sleep fragmentation and daytime sleepiness. Sleep 1984;7:18-26.
4. Bonnet MH. The effect of sleep disruption on performance, sleep, and mood. Sleep 1985;8:11-9.
5. Fujita A, Conway W, Zorick F, et al. Surgical correction of anatomic abnormalities of obstructive sleep apnea syndrome: uvulopalatopharyngoplasty. Otolaryngol Head Neck Surg 1981; 89:923-34.
6. Sher A, Schechtman K, Piccirillo J. The efficacy of surgical modifications of the upper airway in adults with obstructive sleep apnea syndrome. Sleep 1996;19:156-77.
7. Levring-Jaghagen E, Nilsson ME, Isberg A. Persisting dysphagia after uvulopalatoplasty performed with steel scalpel. Laryngoscope 1999;109:86-90.
8. Isberg A, Levring-Jaghagen E, Dahlstrom M, et al. Persisting dysphagia after laser uvulopalatoplasty. A videoradiographic study of the pharyngeal function. Acta Otolaryngol (Stockh) 1998;118:870-4.
9. Walker RP, Garrity T, Gopalsami C. Early polysomnographic findings and long-term subjective results in sleep apnea patients treated with laser-assisted uvulopalatoplasty. Laryngoscope 1999;109:1438-41.
10. Mickelson SA, Ahuja A. Short-term objective and long-term subjective results of laser-assisted uvulopalatoplasty for obstructive sleep apnea. Laryngoscope 1999;109:362-7.
11. Cohen SR, Suzman K, Simms C, et al. Sleep apnea surgery versus tracheostomy in children: an exploratory study of the comparative effects on quality of life. Plast Reconstr Surg 1998;102: 1855-64.
12. Miljetteig H, Mateika S, Haight JS, et al. Subjective and objective assessment of uvulopalatopharyngoplasty for treatment of snoring and obstructive sleep apnea. Am J Respir Crit Care Med 1994;150:1286-90.
13. Simmons FB, Guilleminault C, Miles LE. The palatopharyngoplasty operation for snoring and sleep apnea. An interim report. Otolaryngol Head Neck Surg 1984;92:375-80.
14. Salas-Provance MB, Kuehn DP. Speech status following uvulopalatopharyngoplasty. Chest 1990;97:111-7.
15. Monoson P, Fox A. Preliminary observation of speech disorder in obstructive and mixed sleep apnea. Chest 1987;92:670-5.
16. Rihkanen H, Soini I. Changes in voice characteristics after uvulopalatopharyngoplasty. Eur Arch Otorhinolaryngol 1992;249: 322-4.
17. Coleman RF, Sly DE. Preoperative and postoperative voice analysis of uvulopalatopharyngoplasty patients. Arch Otolaryngol Head Neck Surg 1991;117:1345-9.
18. Zohar Y, Finkelstein Y, Talmi Y. Surgical concepts in uvulopalatopharyngoplasty. Complications and sequelae. In: Chouard CH, editor. Chronic rhonchopathy. Paris: John Libbey Eurotext; 1988. p. 363-7.
19. Vallino LD. Speech, velopharyngeal function, and hearing before and after orthognathic surgery. J Oral Maxillofac Surg 1990;48: 1274-81.
20. Witzel MA, Ross RB, Munro IR. Articulation before and after facial osteotomy. J Maxillofac Surg 1980;8:195-202.
21. Kummer AW, Strife JL, Grau WH, et al. The effects of Le Fort I osteotomy with maxillary movement on articulation, resonance, and velopharyngeal function. Cleft Palate J 1989;26:193-200.
22. Okazaki K, Satoh K, Kato M, et al. Speech and velopharyngeal function following maxillary advancement in patients with cleft lip and palate. Ann Plast Surg 1993;30:304-11.
23. Wright S, Haight J, Zamel N, et al. Changes in pharyngeal properties after uvulopalatopharyngoplasty. Laryngoscope 1989;99: 62-5.
24. Riley RW, Powell NB, Guilleminault C. Maxillofacial surgery and obstructive sleep apnea: a review of 80 patients. Otolaryngol Head Neck Surg 1989;101:353-61.
25. Riley RW, Powell NB, Guilleminault C. Obstructive sleep apnea syndrome: a review of 306 consecutively treated surgical patients. Otolaryngol Head Neck Surg 1993;108:117-25.
26. Macnab T, Blokmanis A, Dickson RI. Long-term results of uvulopalatopharyngoplasty for snoring. J Otolaryngol 1992;21:350-4.
27. Wareing MJ, Callanan VP, Mitchell DB. Laser assisted uvulopalatoplasty: six and eighteen month results. J Laryngol Otol 1998;112:639-41.