**Objective:** To evaluate the impact of nasal surgery alone on quality of life (QOL) in patients with obstructive sleep apnea and nasal obstruction using generic and disease-specific QOL questionnaires.

**Design:** Prospective, longitudinal cohort study.

**Patients:** Fifty-one consecutive patients with obstructive sleep apnea (50 men and 1 woman; mean age, 39 years; mean [SD] apnea-hypopnea index, 37.4 [28.9] events/h; and mean ± SD body mass index [calculated as weight in kilograms divided by height in meters squared], 26.0 [3.5]) with symptoms of nasal obstruction due to a deviated nasal septum.

**Intervention:** Septomeatoplasty.

**Outcome Measures:** Surgical outcomes were measured using the Snore Outcomes Survey, the Epworth Sleepiness Scale, and the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) 3 months after surgery. We compared baseline and postoperative scores. Normative SF-36 data obtained from 4591 age- and sex-matched adults were used as references.

**Results:** Nasal obstruction symptoms significantly improved (mean [SD] visual analog scale score, −5.2 [1.4]; P < .001). Assessments also showed significant improvement in the Snore Outcomes Survey (P < .001) and Epworth Sleepiness Scale (P < .001) scores and 6 of the 8 SF-36 subscale scores (P < .05). Remarkable improvements were observed in disease-specific Snore Outcomes Survey (by 43.1%), Epworth Sleepiness Scale (by 27.3%), and generic SF-36 role-emotional (by 30.4%) and role-physical (by 20.7%) QOL subscales. The postoperative role-emotional, bodily pain, and social function dimensions of health were indistinguishable from referential population data (P > .05).

**Conclusions:** Correction of an obstructed nasal airway significantly improves disease-specific and generic QOL in adult patients with obstructive sleep apnea who also have nasal obstruction symptoms. After nasal surgery, patients may experience greater improvement in snoring and daytime sleepiness than in other generic health status. Our findings substantiate the role of nasal surgery in treating patients with obstructive sleep apnea and nasal obstruction.

study were therefore to investigate whether nasal surgery improves QOL and the degrees of improvement in disease-specific and generic QOL. The results reported herein could be beneficial to a better understanding of the efficiency of nasal surgery in the treatment of OSA from a comprehensive viewpoint of well-being and may be helpful in treatment decisions in patients with OSA and nasal obstruction.

METHODS

STUDY POPULATION

The study was performed according to the principles stated in the Declaration of Helsinki and was approved by the institutional review board of Chang Gung Memorial Hospital.

The work was conducted at a tertiary care referral center for sleep disorders. Forty-five consecutive adult patients (aged > 18 years) with symptomatic nasal obstruction were enrolled to receive nasal surgery as initial treatment for OSA. All patients had been referred to our hospital because of their habitual snoring, excessive daytime sleepiness, and other symptoms suggestive of OSA.

All patients underwent polysomnography in the sleep laboratory and received subjective questionnaires in the outpatient department at baseline and approximately 3 months after nasal surgery. Criteria for nasal surgery in the study included the complaint of nasal obstruction for more than 6 months and a deviated nasal septum and hypertrophy of the inferior turbinate shown by results of a nasal speculum examination.

Patients with a history of cardiopulmonary disease (coronary artery disease, chronic obstructive pulmonary disease, or asthma) or older than 60 years or who had pathologic obesity (body mass index [calculated as weight in kilograms divided by height in meters squared], > 40) were excluded from this study.

We provided a detailed explanation of the study and the nasal surgery procedures, including response, complications, and alternatives, and obtained written informed consents for nasal surgery from all patients before the operation.

SURVEY FORMS

All patients completed the questionnaires, including the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), Snore Outcomes Survey (SOS), and Epworth Sleepiness Scale (ESS) at baseline and 3 months after surgery. Patients were also asked to quantify the average intensity of their nasal obstruction by using a visual analog scale ranging from 0 (no obstruction) to 10 (severe obstruction).

The SOS contained 8 Likert-type items that evaluated the duration, severity, frequency, and consequences of problems associated with sleep-disordered breathing, in particular snoring (Figure 1). Because of the impact of sleep-disordered breathing on others, a separate Spouse/Bed Partner Survey (SBPS) containing 3 Likert-type items was also developed as an adjunct to the SOS (Figure 1). Scores on the SOS and SBPS are normalized on a scale ranging from 0 (worst) to 100 (best). A Mandarin Chinese version of the SOS was used in this study.

The 8-item ESS evaluated daytime somnolence in specific situations and generated a total score ranging from 0 (best) to 24 (worst). A Mandarin Chinese version of the ESS was used in this study.

The SF-36 is a widely used generic QOL measure that divides generic health into the following 8 domains: physical functioning, role-physical, bodily pain, generic health, vitality, social functioning, role-emotional, and mental health. The scores for individual items were normalized to a score ranging from 0 (worst) to 100 (best). The Chinese Taiwanese version of the SF-36 was used with permission in this study. The referential SF-36 data used for comparison in this study were obtained from a cohort of 4591 community-based sex- and age-matched adults in Taiwan.

SLEEP STUDY

Overnight polysomnography (Nicolet UltraSom system; Nicolet Biomedical Inc, Madison, Wisconsin) was performed in the usual manner to document sleep measures and architecture in each patient at the baseline. The measures used in this study were apnea-hypopnea index and minimal oxygen saturation. The apnea-hypopnea index was defined as the total number of apnea and hypopnea episodes per hour of sleep; apnea was defined as a 10-second breathing pause and hypopnea as a 10-second event during which breathing continues and the nasal pressure or the thoracoabdominal movement is reduced by at least 50% from baseline. The polysomnographic studies were manually scored by the study pulmonologist (N.-H.C.) who was blinded to the status of the patients.

SURGICAL TECHNIQUE

Nasal surgery was performed using local anesthesia. The septomeatoplasty procedures performed in this study included resection of the bowed septum and excision of the lateral part of the inferior turbinate shown by results of a nasal speculum examination. The nasal cavity was packed bilaterally for 1 day with Vaseline gauze strips (Chesbrough-Ponds USA Co, Greenwich, Connecticut) and nasal tampons (Merocel, Mystic, Connecticut) after the operation.
POSTOPERATIVE CARE

For each patient, a prophylactic oral antibiotic (ampicillin sodium, 500 mg) was given postoperatively every 6 hours for 3 days. A humid oxygen mask was used to lessen the dryness of the throat during sleep. Nasal packing was removed 1 day after the nasal operation.

OUTCOME MEASUREMENT

Changes of scores in QOL questionnaires after septomeatoplasty were the primary outcome measures. Improvements among generic and disease-specific QOL measures were the secondary outcome.

STATISTICAL ANALYSIS

We used a paired t test to compare preoperative and postoperative scores on the SOS, ESS, and SBPS and on the SF-36 subscales. In addition, preoperative and postoperative SF-36 subscale scores were compared with the age- and sex-adjusted referential population data using a paired t test. Results are expressed as mean (SD). A P < .05 was considered significant.

RESULTS

BASELINE DATA

Fifty-one patients (50 men and 1 woman) were enrolled in this study. Ages ranged from 23 to 59 years, with a mean age of 39 (10) years. The mean body mass index was 26.0 (3.5).

COMPLICATIONS

Hematoma of the nasal septum occurred in 1 patient (2%) on the third postoperative day, which was treated with drainage and repacking. In another patient (2%), nasal bleeding occurred on the seventh postoperative day and was controlled conservatively with ice packing and bed rest.

POLYSOMNOGRAPHIC CHANGES

Neither the apnea-hypopnea index (37.4 [28.9] vs 38.1 [32.7] events/h) nor minimal oxygen saturation (78.3% [11.9%] vs 79.5% [12.5%]) showed statistically significant improvement after nasal surgery alone (P > .05).

VISUAL ANALOG SCALE OF NASAL OBSTRUCTION

Before surgery, all 51 patients reported nasal obstruction. After surgery, 50 patients (98%) experienced improved nasal breathing. The average visual analog scale scores decreased significantly from 6.8 to 1.6 (P < .001) (Table 1).

SLEEP-SPECIFIC QOL

The SOS and SBPS scores improved significantly (P < .001) after nasal surgery. Compared with the preoperative snore-related health status, the degrees of improvement were 43.1% for the SOS and 50.4% for the SBPS. The ESS also showed a significant improvement (P < .001) after surgery. Compared with the preoperative status, the degree of reduction in sleepiness was 27.3% (Table 1).

GENERIC HEALTH STATUS

Before nasal surgery, all of the SF-36 subscale scores (except bodily pain) for the OSA patients were significantly worse than those of the referential Taiwanese population (P < .001). Compared with the preoperative generic health status, the degrees of QOL improvement were 30.4% for role-emotional, 20.7% for role-physical, 18.9% for vitality, 14.8% for mental health, 11.4% for generic health, 7.4% for social functioning, 1.6% for physical functioning, and 1.0% for bodily pain. However, the postoperative scores on 5 subscales (physical functioning, role-physical, vitality, generic health, and mental health) were still inferior to the referential data (P < .05) (Table 2). Figure 2 demonstrates the differences in the SF-36 subscale scores between the referential Taiwanese population and the OSA patients before and after nasal surgery.

COMMENT

This study investigated changes in QOL after nasal surgery by using generic and disease-specific QOL questionnaires. Our results showed that correction of an obstructed nasal airway can improve disease-specific and generic QOL to some extent. Compared with the relatively minor improvement in generic health status, we found that the effect of nasal surgery alone was significant in disease-specific QOL only. Five SF-36 subscale scores are still inferior to those of the referential population data.

Quality of life, which refers to global well-being, consists of related multifaceted concepts, including physical and psychosocial functioning, and is increasingly recognized as a relevant and important OSA outcome. The measures of QOL in OSA patients can be established and used in clinical and field studies by assessing disease-specific symptoms such as snoring and daytime sleepiness and generic health.
The study demonstrates that, when nasal breathing in OSA surgery on the part of the spouse or the bed partner, in SBPS scores shows a good level of satisfaction with the frequency of the patients’ snoring. The 50.4% increase in the degree of improvement in the duration, loudness, and frequency of the patients’ snoring after surgery. The SBPS to measure outcomes in the duration, loudness, and frequency of the patients’ snoring usually motivates the patient to seek treatment. Accordingly, this study included both the SOS and SBPS questionnaires for a 2-way assessment of snoring. The comparative results showed an increase of 43.1% in SOS scores and reflect the degree of improvement in the duration, loudness, and frequency of the patients’ snoring. The 50.4% increase in SBPS scores shows a good level of satisfaction with nasal surgery on the part of the spouse or the bed partner. The study demonstrates that, when nasal breathing in OSA patients is improved by nasal surgery, snoring decreases, and both the snorer and his or her bed partner benefit.

Daytime sleepiness is the dominant symptom of OSA. Subjects with nasal obstruction are found to have higher daytime sleepiness and lower QOL. Patients with OSA are frequently referred for nasal surgery in the logical belief that improved nasal breathing reduces daytime sleepiness. The ESS, created by Johns, is the most widely used scale in assessing daytime sleepiness, particularly in response to treatment. Verse et al reported a significant improvement of the mean ESS score from 12 to 8 after nasal surgery in 26 adult patients with sleep-disordered breathing. The present study showed similar results, with a mean ESS score that decreased from 11.0 to 8.0 (P < .001) after surgery. These findings are consistent with those of other reports and suggest that correction of an obstructed nasal airway generally alleviates daytime sleepiness in OSA patients.

Nasal obstruction is a risk factor for sleep-related breathing. Chronic nasal obstruction often elicits extranasal symptoms, including sleep disturbance, headache, daytime fatigue, lack of care, and thus a decline in health-related QOL. Generic QOL can relate to a wide range of subjective sensations and measures social, physical, and emotional functioning. The SF-36 is a well-known and the most widely used generic QOL instrument and was therefore chosen to assess generic QOL in this study. Gall et al reported that the scores of 4 domains (role-physical, role-emotional, vitality, and mental health) in the SF-36 subscales were found to decline in patients with mild OSA. Our study demonstrated that all subscales (except bodily pain) of the baseline SF-36 scores in the OSA patients were significantly worse (P < .001) than those of the referential Taiwanese population. We speculate that the divergence might be owing to different severity in OSA (mild vs severe) with and without an obstructed nasal passage between the 2 study groups. These findings suggest that nasal obstruction and OSA have significant and negative effects on SF-36 scores.

It is unclear whether and to what extent nasal surgery alone can improve generic QOL in patients with OSA and an obstructed nasal passage. Previous studies showed

### Table 2. Preoperative and Postoperative SF-36 Subscale Scores

<table>
<thead>
<tr>
<th>SF-36 Subscale</th>
<th>Reference Population (N=4591)</th>
<th>Study Population (N=51)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td>Physical functioning</td>
<td>96.8 (96.6 to 97.1)</td>
<td>91.4 (87.9 to 94.8) b</td>
</tr>
<tr>
<td>Role-physical</td>
<td>90.2 (89.5 to 90.9)</td>
<td>86.8 (57.1 to 80.1) b</td>
</tr>
<tr>
<td>Bodily pain</td>
<td>87.0 (86.5 to 87.5)</td>
<td>86.7 (81.3 to 92.2) b</td>
</tr>
<tr>
<td>Vitality</td>
<td>72.0 (71.5 to 72.5)</td>
<td>51.8 (46.1 to 57.6) b</td>
</tr>
<tr>
<td>Role-emotional</td>
<td>81.8 (80.9 to 82.8)</td>
<td>61.8 (49.3 to 74.3) b</td>
</tr>
<tr>
<td>Social functioning</td>
<td>88.6 (88.1 to 89.0)</td>
<td>79.4 (74.2 to 84.5) b</td>
</tr>
<tr>
<td>Generic health</td>
<td>73.5 (74.7 to 75.8)</td>
<td>58.7 (53.3 to 64.2) b</td>
</tr>
<tr>
<td>Mental health</td>
<td>75.1 (74.6 to 75.5)</td>
<td>59.4 (54.8 to 64.9) b</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey.

a Paired t test for preoperative vs postoperative comparison.
b P<.05 by the unpaired t test compared with the age- and sex-adjusted reference population.

**Figure 2.** Differences in the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) subscale scores between the referential Taiwanese population and patients with obstructive sleep apnea before and after nasal surgery. BP indicates bodily pain; GH, generic health; MH, mental health; PF, physical functioning; RE, role-emotional; RP, role-physical; SF, social functioning; and V, vitality.

Snoring is common in patients with obstruction of the nasal passage, leading to disturbed sleep architecture and sleep fragmentation and causing associated daytime sleepiness and impaired QOL. In this study, the SOS was used to measure outcomes in the duration, loudness, and frequency of the patients’ snoring after surgery. The SBPS is of equal importance and coordinates with the SOS because snorers may be unaware of their snoring, and the sleeping partner’s perception of the snoring usually motivates the patient to seek treatment. Accordingly, this study included both the SOS and SBPS questionnaires for a 2-way assessment of snoring. The comparative results showed an increase of 50.4% in SBPS scores shows a good level of satisfaction with nasal surgery on the part of the spouse or the bed partner. The study demonstrates that, when nasal breathing in OSA patients is improved by nasal surgery, snoring decreases, and both the snorer and his or her bed partner benefit.

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It is unclear whether and to what extent nasal surgery alone can improve generic QOL in patients with OSA and an obstructed nasal passage. Previous studies showed
that aggravated QOL resulting from rhinologic disorders can be relieved by the use of appropriate medications or surgical treatment.\textsuperscript{21,24} In this study, 6 of the 8 SF-36 subscale scores (all except physical functioning and bodily pain) improved significantly ($P<.05$) after nasal surgery. The degrees of QOL improvement, compared with the preoperative generic health status, were 30.4\% for role-emotional, 20.7\% for role-physical, 18.9\% for vitality, 14.8\% for mental health, 11.4\% for generic health, 7.4\% for social functioning, 1.6\% for physical functioning, and 1.0\% for bodily pain. These results suggest that, when nasal obstruction in OSA patients was relieved, their generic health improved and that the effects were especially remarkable in reducing role limitations caused by physical or emotional problems. Also, we found patients’ postoperative role-emotional status and social functioning may well improve to reach the levels of referential population data. These findings imply that nasal surgery, even when conducted alone, can still effectively revive QOL in individuals with both OSA and an obstructed nasal passage.

### CONCLUSIONS

Although more research is needed to elucidate causal pathways involving the effects of nasal obstruction on QOL, the results of this study show that the relief of nasal impediment could significantly improve disease-specific and generic QOL seen in OSA patients who also have symptomatic nasal obstruction. After nasal surgery, patients may experience greater improvement in sleep-related snoring and daytime sleepiness than in other measures of generic health status. Our findings substantiate the role of nasal surgery in treating nasal obstruction among OSA patients.

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### Author Contributions: Drs Li and Wang had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Li, Lin, Fang, and Wang. Acquisition of data: Li, Chen, and Wang. Analysis and interpretation of data: Li, Lin, and Wang. Drafting of the manuscript: Li, Lin, Fang, and Wang. Critical revision of the manuscript for important intellectual content: Li, Chen, and Wang. Statistical analysis: Li, Lin, Fang, and Wang. Administrative, technical, and material support: Li, Chen, and Wang. Study supervision: Li and Wang.

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### REFERENCES