

Original article

Impact of radiofrequency turbinate reduction on the sleep quality of bed partners of patients with obstructive sleep apnea

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Abstract

Background: Obstructive sleep apnea (OSA) negatively impacts not only patients' sleep quality but also that of their bed partners. Radiofrequency (RF) turbinate reduction is commonly performed in OSA patients with symptomatic nasal obstruction due to inferior turbinate hypertrophy and has been shown to improve patients' sleep quality and daytime sleepiness. However, its effect on the sleep of bed partners has not been evaluated.

Objective: This study aimed to assess the effects of RF turbinate reduction in OSA patients with nasal obstruction on their bed partners' sleep quality and quality of life.

Methods: Bed partners of OSA patients who underwent RF turbinate reduction between November 2023, and August 2024 were prospectively enrolled. Participants completed validated questionnaires, including the Functional outcomes of sleep quality (FOSQ), Short Form-36 (SF-36), Epworth sleepiness scale (ESS), and a visual analog scale for patients' snoring intensity. Preoperative and 3-months postoperative results were compared.

Results: Twenty-five bed partners of OSA patients met the inclusion criteria and completed all questionnaires. Significant postoperative improvements were observed in bed partners' sleep related parameters, including the average FOSQ score (16.1 ± 2.7 to 17.9 ± 1.9 ; ES = 1.2 [95% CI, 0.7 – 1.7]), ESS (10.6 ± 4.6 to 7.6 ± 2.8 ; ES = 1.1 [95% CI, 0.6 – 1.6]), and SF-36 score (73.2 ± 16.0 to 80.0 ± 12.0 ; ES = 1.1 [95% CI, 0.6 – 1.6]) ($P < 0.001$ for all).

Conclusion: RF turbinate reduction in OSA patients with nasal obstruction significantly improves bed partners' sleep quality, daytime sleepiness, and quality of life within three months postoperatively.

Keywords: Bed partner, FOSQ, obstructive sleep apnea, radiofrequency turbinate reduction, sleep quality.

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Obstructive sleep apnea (OSA) is a common sleep problem characterized by repetitive upper airway obstruction during sleep, which can lead to serious consequences if left untreated⁽¹⁾. Various treatments for OSA are available, including non-surgical options such as continuous positive airway pressure (CPAP), oral appliances, behavioral modifications, and surgical therapy.^(2, 3) Nasal obstruction is one cause of OSA. Narrowing of the nasal airway can increase the collapsibility of the pharyngeal airway in various ways and affect most OSA management^(4 - 6), thus nasal problems should be treated properly. Nasal surgery is a common treatment when medications are ineffective or cannot be discontinued. Such surgery can improve OSA-related daytime sleepiness and sleep quality and may be beneficial for patients using therapeutic devices.^(7, 8) Studies showed that nasal surgery in patients with nasal obstruction can significantly reduce snoring.^(4, 9) Radiofrequency (RF) turbinate reduction is one of the procedures used to relieve nasal obstruction caused by hypertrophy of the inferior turbinate. This procedure utilizes radiofrequency energy to shrink the size of the inferior turbinate submucosally.⁽¹⁰⁾ With proven long-term clinical safety, affordability, and ease of performance, it is one of the most common nasal surgeries performed to relieve nasal obstruction.⁽¹¹⁾

OSA affects not only patients but also their bed partners. Witnessing patients choking or experiencing breathing difficulties during sleep can be frightening and disturbing. In addition, noisy snoring sound can also suffer bed partners' sleep.^(12, 13) While many studies showed the effects of OSA treatments on patients' sleep quality and quality of life^(12, 14, 15), the impact on the sleep quality of their bed partners of these patients have received less attention. Therapeutic devices such as CPAP and oral appliances have demonstrated improvements in bed partners' sleep quality.^(12, 13, 16) After nasal surgery, studies have shown significant improvements in snoring sound, reduction of daytime sleepiness and patients' sleep quality^(14, 15), but none focused on bed partners.

Therefore, this study aimed to assess the impact of RF turbinate reduction on sleep quality of OSA patients' bed partners.

Materials and methods

We conducted a single-center, prospective cohort study at the ENT Clinic, King Chulalongkorn Memorial Hospital, Bangkok, Thailand, between November 2023 and August 2024. The study was approved by the Institutional Review Board (IRB), Faculty of Medicine, Chulalongkorn University (IRB no. 0522/66).

All subjects provided written informed consent before inclusion in the study.

We performed isolated RF turbinate reduction on OSA patients referred by sleep physicians due to nasal obstruction from inferior turbinate hypertrophy that interfered with the effectiveness of their OSA treatment and met the indications for RF turbinate reduction, which included nasal obstruction caused by inferior turbinate hypertrophy that had a poor response to medical treatment. Additionally, they had a nasal obstruction VAS score of at least 4 on a 0-10 cm scale, where 0 represents "the best nasal breathing" and 10 represents "complete nasal obstruction."⁽¹⁷⁾ Bed partners of these patients, with age > 18 years, were potential candidates for inclusion in the study. Eligible bed partners had to share a bed with OSA patients for at least 3 nights per week for over 3 consecutive months before the inclusion date. Exclusion criteria included 1) use of medications or poorly controlled or chronic comorbidities that may affect sleep quality; 2) psychiatric disorders or intellectual disabilities that could influence questionnaire responses; and 3) patients had undergone surgeries other than RF turbinate reduction or had other nasal obstruction condition e.g. nasal valve collapse, deviated nasal septum or chronic rhinosinusitis.

Intervention

Bed partners who met the study criteria were invited to participate in the study. The primary outcome measure was disease-specific sleep quality assessed using the Thai version of the Functional Outcomes of Sleep Questionnaire (FOSQ).⁽¹⁸⁾ Secondary outcome measures included self-reported sleepiness (Thai version of the Epworth Sleepiness Scale (ESS))⁽¹⁹⁾, health-related quality of life using the Short Form-36 (SF-36) questionnaire⁽²⁰⁾, and subjective assessment of snoring intensity using a numeric scale from 0 to 10, with higher score indicating greater snoring intensity. All questionnaires were administered and completed by bed partners at baseline and 3 months post-operatively.

FOSQ is a self-report tool designed to assess the impact of sleep quality on various aspects of daily life.⁽²¹⁾ It consists of 30 items focusing on five domains: general productivity, vigilance, social outcome, activity level, and sexual relationship. Scores range from 5.0 to 20.0, with higher scores indicating better functioning. A score above 17.9 is considered indicative of normal sleep-related quality of life.⁽²¹⁾ Daytime sleepiness was measured using the ESS, an 8-item questionnaire assessing the likelihood of falling asleep in various situations.⁽²²⁾ Scores range from 0 to 24, with higher

scores indicating greater daytime sleepiness. A score above 9 usually reflects excessive daytime sleepiness. SF-36 is a self-administered questionnaire designed to evaluate health-related quality of life. It assesses eight domains: limitations in physical activities, social activities, role activities due to physical health problems, bodily pain, general mental health, role activities due to emotional problems, vitality (energy and fatigue), and general health perceptions.⁽²³⁾ Scores range from 0 to 100, with 100 indicating the best score. The SF-36 is a generic, coherent, and easily administered quality-of-life measure that has been widely used and validated in various patient populations.^(20, 23, 24)

All OSA patients underwent RF turbinate reduction under local anesthesia at King Chulalongkorn Memorial Hospital. Local anesthesia was achieved by applying a cotton strip with 1:1 mixture of lidocaine and oxymetazoline into each nostril, followed by injection of 1.0% xylocaine into each inferior turbinate. The RF turbinate reduction was performed in a serial technique by inserting the probe submucosally into the swollen segments of the inferior turbinate, using a 4 MHz microsurgical radiofrequency (RF) generator (Curis, Sutter Medical, Freiburg, Germany) and a bipolar needle electrode. The procedure was conducted with an energy setting of 7 W, with the automatic power stop function activated.

Postoperative medications included post-operative oral antibiotics and as needed analgesics.

As all patients with OSA who underwent an isolated RF procedure in this study were referred by sleep physicians due to nasal obstruction interfering with treatment effectiveness, the assessment period occurred prior to the time designated by the sleep physician for initiating alternative OSA therapy. Accordingly, none of the patients received concurrent OSA treatment during this period.

Statistical analysis

Statistical analyses were conducted using SPSS Statistics version 29. Regarding sample size, the calculation was based on a previous study which reported a clinically significant improvement in FOSQ scores of 2.1. To achieve a power of 90.0% with a significance level of 0.05, a minimum of 13 participants was required. Following a potential 20.0% dropout rate, we aimed to recruit at least 16 pairs. Ultimately, 25 pairs were enrolled, ensuring sufficient statistical power.

Demographic data and outcomes are presented as mean and standard deviation (SD), and changes in

scores are reported as percentages. Preoperative and postoperative means of FOSQ, ESS, SF-36, and snoring intensity scores were compared using a paired Student's *t*-test. A $P < 0.05$ was considered statistically significant.

Results

A total of 27 bed partners met the inclusion criteria and participated in the study; however, 2 were subsequently excluded due to loss to follow-up. Therefore, 25 bed partners were included in the statistical analysis, consisting of 10 males (40.0%) and 15 females (60.0%), with an average age of 50.1 ± 14.2 years (range: 29 - 76 years). Eighteen (72.0%) were spouses of the patients, 3 (12.0%) were parents, 3 (12.0%) were siblings, and 1 (4.0%) was an offspring. On average, they shared a bed with the patients for 6.3 ± 1.3 days per week, with 24 bed partners shared a bed with the patient every day. The average body mass index was 23.5 ± 3.5 kg/m². Common comorbidities among the bed partners included allergic rhinitis, dyslipidemia and hypertension. The characteristics of the bed partners are summarized in **Table 1**.

The OSA patients were all diagnosed with in-lab polysomnography. These patients exhibited varying levels of disease severities: 7 cases of mild OSA, 15 cases of moderate OSA, and 3 cases of severe OSA. Preoperatively, the average nasal obstruction VAS scores were 7.5 ± 0.9 . This score significantly improved to 2.4 ± 1.0 at 1-week postoperative ($P < 0.001$). All patients underwent RF turbinate reduction without any observed postoperative complications.

Sleep quality among bed partners, the primary outcome, was evaluated using FOSQ questionnaires (**Table 2, Figure 1**). At baseline, the average FOSQ score for bed partners was 16.1 ± 2.7 . A significant increase in the average overall score was observed, rising to 17.9 ± 1.9 at 3 months postoperatively (ES = 1.2 [95% CI, 0.7–1.7]; $P < 0.001$). Postoperative improvements were statistically significant across all domains: general productivity (3.5 ± 0.5 to 3.8 ± 0.3 ; ES = 0.9 [0.5, 1.4]; $P < 0.001$), vigilance (3.2 ± 0.7 to 3.6 ± 0.4 ; ES = 0.9 [0.4, 1.4]; $P < 0.001$), social outcome (3.4 ± 0.7 to 3.6 ± 0.5 ; ES = 0.5 [0.1, 0.9]; $P = 0.017$), activity level (3.0 ± 0.7 to 3.6 ± 0.4 ; ES = 1.4 [0.8, 1.9]; $P < 0.001$), and sexual relationship (3.0 ± 1.1 to 3.3 ± 0.9 ; ES = 0.6 [0.2, 1.0]; $P = 0.007$). The most robust change was observed in the activity level domain, while the least improvement occurred in the social outcome domain (**Table 2**).

Table 1 Baseline characteristics of the bed partners.

Baseline characteristics	Bed partners (n = 25)
Sex, n (%)	
Male	10 (40.0)
Female	15 (60.0)
Age (year), mean $\pm$ SD	50.1 $\pm$ 14.2
Relationship with OSA patients, n (%)	
Spouses	18 (72.0)
Parents	3 (12.0)
Siblings	3 (12.0)
Offspring	1 (4.0)
BMI (kg/m ²), mean $\pm$ SD	23.5 $\pm$ 3.5
Underlying disease, n (%)	16 (64.0)
Allergic rhinitis	7 (28.0)
Dyslipidemia	7 (28.0)
Hypertension	5 (20.0)
Diabetes mellitus	2 (8.0)
Cancer	2 (8.0)
Cardiovascular disease	1 (4.0)
Cerebrovascular accident	1 (4.0)
Osteoarthritis	1 (4.0)
Spending time with OSA patient (day/week), mean $\pm$ SD	6.3 $\pm$ 1.3

Data are presented as mean + standard deviation or as number (percentage)

N, number of bed partners; SD standard deviation; OSA patients, obstructive sleep apnea patients; BMI, body mass index.

Table 2. Functional outcomes of sleep questionnaire (FOSQ) scores of bed partners before and after radiofrequency turbinate reduction (n = 25).

Variables	Pre-op, Mean $\pm$ SD	Post-op, Mean $\pm$ SD	Effect size [95% CI]	P-value**
General productivity	3.5 $\pm$ 0.5	3.8 $\pm$ 0.3	0.9 [0.5, 1.4]	<0.001*
Vigilance	3.2 $\pm$ 0.7	3.6 $\pm$ 0.4	0.9 [0.4, 1.4]	<0.001*
Social outcome	3.4 $\pm$ 0.7	3.6 $\pm$ 0.5	0.5 [0.1, 0.9]	0.017*
Activity level	3.0 $\pm$ 0.7	3.6 $\pm$ 0.4	1.4 [0.8, 1.9]	<0.001*
Sexual relationship	3.0 $\pm$ 1.1	3.3 $\pm$ 0.9	0.6 [0.2, 1.0]	0.007*
Overall	16.1 $\pm$ 2.7	17.9 $\pm$ 1.9	1.2 [0.7, 1.7]	< 0.001*

Data are presented as means + standard deviation (SD).

*Differences between preoperative and postoperative levels with $P < 0.05$.

** Tested using paired t test

Pre-op, pre-operative radiofrequency turbinate reduction; Post-op, post-operative radiofrequency turbinate reduction; CI, confidence interval.

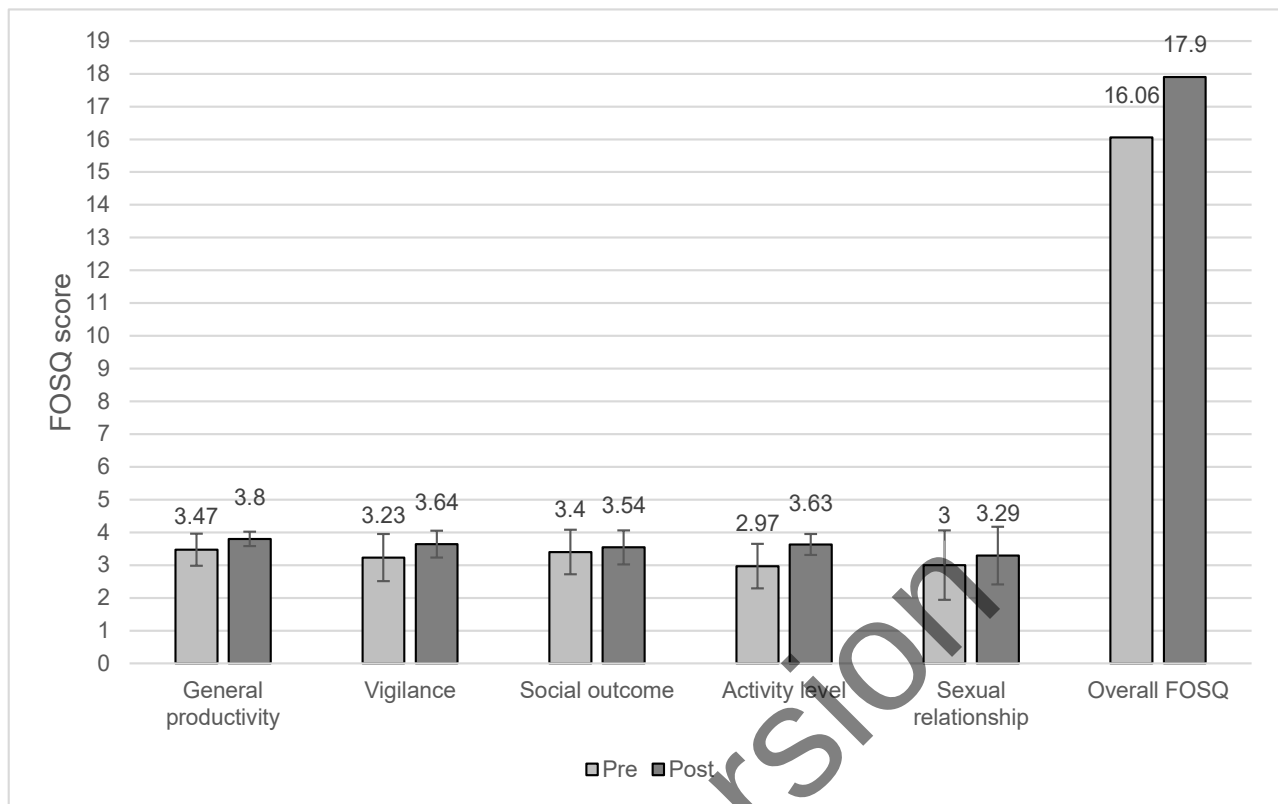


Figure 1. Bar chart displaying the mean score of the 5 subscales and overall of the Functional outcomes of sleep questionnaire (FOSQ) before and after treatment. *Pre* pre-operative radiofrequency inferior turbinate reduction, *Post* post-operative radiofrequency inferior turbinate reduction; FOSQ, Functional outcomes of sleep questionnaire.

Analysis of secondary outcomes, as shown in **Table 3**, revealed a significant reduction in bed partners' sleepiness, with the average ESS score decreasing from 10.6 ± 4.6 to 7.6 ± 2.8 ($ES = -1.1 [-1.6, -0.6]$; $P < 0.001$), indicating that the sleepiness significantly improved. The average snoring intensity scored by the bed partners also significantly decreased from 4.8 ± 1.8 to 3.1 ± 1.5 ($ES = -0.9 [-1.3, -0.4]$; $P < 0.001$).

The quality of life, as assessed by the SF-36, showed a significant increase in the average overall score from 73.2 ± 16.0 to 80.0 ± 12.0 ($ES = 1.1 [0.6, 1.6]$; $P < 0.001$). Among the eight domains, five showed statistically significant improvements: bodily pain (71.7 ± 22.9 to 84.2 ± 13.9 ; $ES = 0.8 [0.4, 1.3]$; $P < 0.001$), general health (60.6 ± 20.2 to 68.5 ± 16.1 ; $ES = 0.8 [0.4, 1.3]$; $P < 0.001$), vitality (65.4 ± 18.9 to 72.2 ± 14.5 ; $ES = 0.6 [0.2, 1.0]$; $P = 0.006$), social functioning (77.0 ± 20.9 to 86.5 ± 17.7 ; $ES = 0.7 [0.3, 1.1]$; $P = 0.002$), and mental health (74.6 ± 17.8 to 83.2 ± 12.3 ; $ES = 0.8 [0.3, 1.2]$; $P < 0.001$). The most robust changes were found in bodily pain domain as shown in **Table 3**.

Discussion

Evidence supports that OSA is a shared condition that negatively affecting not only patients' physical and mental health, daytime functioning, and sleep condition but also the well-being of their bed partners.⁽¹³⁾ Compared to the general population, spouses of patients with loud-snoring OSA are more likely to report sleep difficulties and daytime sleepiness.⁽²⁵⁾ The sleep quality and quality of life of bed partners of OSA patients are often poorer than average.^(16,26) Clinically significant sleep disturbances are commonly reported by bed partners before OSA treatment.⁽²⁶⁾ Loud snoring, disrupted sleep, frequent awakenings, and witnessed respiratory pauses or choking can significantly disturb bed partners. Thus, OSA treatments can benefit both the patients and the bed partners.⁽¹³⁾ Various OSA treatments, including CPAP and oral appliances, have shown beneficial effects on bed partners' sleep quality and quality of life.⁽¹³⁾ Improvements in bed partners' sleep following OSA treatment with CPAP have been demonstrated both subjectively and objectively, with increased sleep efficiency and reduced arousals measured by in-lab polysomnography.⁽¹²⁾ However, evidence regarding bed partners' sleep quality following sleep apnea

Table 3. Epworth sleepiness scale (ESS), visual analogue scale (VAS) and Short-Form 36 (SF-36) of Bed Partners Before and After Radiofrequency Turbinate Reduction (n = 25).

Variables	Pre-op, Mean $\pm$ SD	Post-op, Mean $\pm$ SD	Effect size [95% CI]	P-value**
ESS	10.6 $\pm$ 4.6	7.6 $\pm$ 2.8	-1.1 [-1.6, -0.6]	<0.001*
VAS of snoring	4.8 $\pm$ 1.8	3.1 $\pm$ 1.5	-0.9 [-1.3, -0.4]	<0.001*
SF-36				
Overall	73.2 $\pm$ 16.0	80.0 $\pm$ 12.0	1.1 [0.6, 1.6]	<0.001*
Physical health				
Physical functioning	75.4 $\pm$ 19.4	77.4 $\pm$ 20.0	0.2 [-0.2, 0.6]	0.246
Role physical	81.0 $\pm$ 23.1	81.0 $\pm$ 22.0	0.0 [-0.4, 0.4]	1.000
Bodily pain	71.7 $\pm$ 22.9	84.2 $\pm$ 13.9	0.8 [0.4, 1.3]	<0.001*
General health	60.6 $\pm$ 20.2	68.5 $\pm$ 17.0	0.8 [0.4, 1.3]	<0.001*
Mental health				
Vitality	65.4 $\pm$ 18.9	72.2 $\pm$ 14.5	0.6 [0.2, 1.0]	0.006*
Social functioning	77.0 $\pm$ 20.9	86.5 $\pm$ 17.7	0.7 [0.3, 1.1]	0.002*
Role emotional	80.0 $\pm$ 27.2	86.7 $\pm$ 23.6	0.4 [-0.0, 0.8]	0.057
Mental health	74.6 $\pm$ 17.8	83.2 $\pm$ 12.3	0.8 [0.3, 1.2]	<0.001*

Data are presented as means + standard deviation (SD).

*Differences between preoperative and postoperative levels with $P < 0.05$.

** Tested using paired t -test.

Pre-op, pre-operative radiofrequency turbinate reduction; Post-op, post-operative radiofrequency turbinate reduction; ESS, Epworth Sleepiness Scale; VAS, visual analogue scale; SF-36, short-form 36; CI, confidence interval.

surgery remains limited. In particular to RF method, a study reported that RF tissue ablation at the soft palate and tongue base in OSA and snoring patients improved the emotional state of their bed partners.⁽²⁷⁾

Nasal obstruction is highly prevalent among OSA patients.⁽²⁸⁾ Nasal surgery, such as RF turbinate reduction, is commonly indicated when non-surgical therapy fails^(9, 29) or when patients refuse other surgeries or general anesthesia, as RF turbinate reduction can be performed under local anesthesia. Although a significant reduction in the apnea-hypopnea index has not been consistently demonstrated following nasal operation, several benefits have been reported, including reduced daytime sleepiness and improved sleep architecture has been reported. At least a 2 cm water reduction in CPAP therapeutic pressure and improved adherence have been reported following RF turbinate reduction.⁽⁷⁾ The procedure was also widely accepted as a standard and safe for snoring relief^(9, 29), potentially enhancing bed partners' sleep quality and quality of life.

Despite the variations in OSA severity among patients in this study, postoperative outcomes were generally favorable. Our findings demonstrated that RF turbinate reduction in OSA patients significantly benefits their bed partners' sleep. Although not all potential confounding factors affecting bed partners sleep quality in this study could be controlled, isolated RF turbinate reduction significantly improvements. The overall change from the baseline in FOSQ score was statistically significant with average postoperative

FOSQ score exceeding 17.9, a level considered indicative of normal functional status, thereby supporting the clinical relevance of the observed improvement sleep quality improvement.⁽²¹⁾ All five FOSQ domains also exhibited significant improvements. This suggests that the intervention not only enhanced nighttime sleep but also meaningful improved on daytime functioning in bed partners.

Regarding health-related quality of life measured by SF-36, significant improvements were observed in the domain of bodily pain, general health, vitality, social functioning, mental health, as well as in overall scores. Notably, the significant gains in social functioning and vitality reflect a substantial enhancement in the overall quality of life. The improvement in vitality is consistent with the FOSQ results, aligning with Parish's study, which showed significant improvements in vitality and social function of bed partners after CPAP treatment.⁽¹⁶⁾ An interesting finding was the significant improvement in the bodily pain domain of the SF-36 among bed partners, despite the absence of direct medical intervention. While bed partners underwent no medical intervention. This may be attributed to the well-established association between documented sleep deprivation and increased pain sensitivity. Improved sleep quality may enhance psychological well-being and increase pain threshold, thereby reducing the perception of physical discomfort. Similarly, the reduction in ESS scores by 3.0 points exceeds the established MCID of 2-3, indicating a noticeable decrease in daytime somnolence among bed partners.

Our results are in agreement with the study by Beninati W, *et al.*⁽¹²⁾ that showed improvements of sleep efficiency and reduction of arousal index in spouse of CPAP treated OSA patients. The exact mechanism behind improved sleep quality is not fully understood. However, it is likely related to the reduced snoring intensity, as evidenced by the significant reduction in snoring loudness postoperatively. Reduced noise may have alleviated disrupted sleep patterns, leading to better sleep quality and daytime function. Thus, RF turbinate reduction is a promising intervention to enhance sleep quality and quality of life in this population.

To the best of our knowledge, this is the first prospective study focusing on bed partners' sleep quality following radiofrequency inferior turbinate reduction for OSA patients. The significant improvement of sleep quality, excessive daytime sleepiness, snoring severity and health-related quality of life were clearly demonstrated. However, several limitations should be noted, including the short follow-up period and non-randomized study design. In addition, patient-reported nasal obstruction (VAS) was assessed only at one week postoperatively. Although longer period VAS data were not collected, RF inferior turbinate reduction is known to provide sustained reductions in turbinate volume and improved nasal patency for at least 6-12 months, which is consistent with the sustained reduction in snoring observed in our results. Future research should include a randomized controlled trial with a larger sample size and longer follow-up.

Conclusion

Radiofrequency inferior turbinate reduction for obstructive sleep apnea patients with nasal obstruction positively affects bed partners' sleep quality and health related quality of life, as measured by FOSQ and SF-36, and can reduce partners' sleepiness to the normal range, during a 3-month follow-up period.

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Conflict of interest statement

All authors have completed and submitted the International Committee of Medical Journal Editors Uniform Disclosure Form for Potential Conflicts of Interest. All authors declare that they have no conflicts of interest.

Data sharing statement

All data generated or analyzed in the present study are included in the published article. Further details are available for non commercial purposes from the corresponding author upon reasonable request.

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