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The palatal septal cartilage implantation for snoring and obstructive sleep apnea☆

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ABSTRACT

Objective: Patients with snoring and obstructive sleep apnea frequently have nasal and palatal obstruction. The objective of this study was to investigate the safety and feasibility of a palatal septal cartilage implant (SCI) for snoring and obstructive sleep apnea.

Methods: This was a preliminary study of 10 consecutive patients who were enrolled retrospectively from electronic charts. The patients had undergone a single-stage operation including septoturbinoplasty and palatal SCI at a tertiary referral hospital. After nasal surgery, the harvested cartilage was prepared and trimmed into strips for palatal implantation. Key procedures of palatal SCI include vertical tunneling of the midline and paramedian soft palate, insertion of the septal cartilage strips, and fixation suture of the implants. The primary outcome measures were adverse events, including implant extrusion, infection, bleeding, velopharyngeal insufficiency and globus symptoms, assessed by the Glasgow–Edinburgh Throat Scale (GETS) questionnaire (10-item, 8-grade [0–7] Likert scale). Secondary outcomes were subjective snoring loudness (visual analogue scale, VAS), excessive daytime sleepiness (Epworth sleepiness scale, ESS) and objective apnea-hypopnea index. All patients were followed up for at least 1 year.

Results: None of the aforementioned adverse events were noted during the one-year follow-up. Among the ten items of the GETS, the median score of nine items was 0, and the median score of the total GETS was 2.0, which was classified as "asymptomatic". The snoring loudness improved significantly from 8.0 points (IQR 8.0–9.0) preoperation to 4.0 points (IQR 2.5–6.0) at 3 months postoperation and 4.5 points (IQR 3.3–6.0) at 1 year postoperation ($P = 0.002$ and $P = 0.002$, respectively). The ESS score improved significantly from 11.5 points (IQR 8.3–18.5) preoperation to 8.0 points (IQR 6.3–10.8) at 3 months postoperation and 8.5 points (IQR 6.3–10.8) at 1 year postoperation ($P = 0.004$ and $P = 0.004$, respectively). The apnea-hypopnea index significantly decreased from 54.7 (IQR 23.4–62.8) to 20.5 (IQR 14.7–45.6) ($P = 0.047$) in patients with a lower tongue position (modified Mallampati class $\leq$ II; $n = 7$).

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Abbreviations: GETS, Glasgow–Edinburgh Throat Scale; AHI, apnea-hypopnea index; OSA, obstructive sleep apnea; SCI, septal cartilage implantation; PSG, polysomnography; CPAP, continuous positive airway pressure; BMI, body mass index; VAS, visual analog scale; ESS, Epworth sleepiness scale; IQR, interquartile range.

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Conclusion: Palatal SCI is a safe and feasible procedure. The advantages include providing implants of tailor-made length, biocompatible autologous cartilage and no need for extra-payment for the implant material. By using the SCI procedure, both nasal obstruction and sleep-disordered breathing can be managed in a single-stage operation. The long-term effectiveness of SCI deserves further research.

1. Introduction

Obstructive sleep apnea (OSA) is characterized by repeated upper airway obstruction during sleep [1]. Clinical symptoms of OSA include snoring, daytime sleepiness, nasal obstruction, and impaired quality of life [2]. Snoring is the most common manifestation of OSA, which is largely attributable to vibration of the soft palate and can be exacerbated by nasal obstruction [3]. Accordingly, a combination of nasal surgery (septoturbinoplasty) and palatal surgery (uvulopalatopharyngoplasty, UPPP) is widely used in the treatment of snoring and OSA [4].

Although UPPP is the most commonly used technique in sleep surgery, it has been criticized for having high complications in the treatment of OSA [5]. A pillar implant[@] has been used to strengthen the soft palate, lessen its flutter and consequently reduce snoring [6]. However, the drawbacks of partial extrusion, uniform length, and expensiveness limit its use [7]. Septoturbinoplasty is a commonly performed surgery for relieving nasal obstruction, including resection of the septal cartilage, which has also been performed in rhinoplasty [8]. Therefore, we utilized the resected strips of septal cartilage from concurrent nasal surgery and designed a novel technique to implant the septal cartilage into the soft palate to treat snoring and OSA.

In this study, we first demonstrate the procedure of palatal septal cartilage implantation (SCI), and we report preliminary outcomes on its safety and efficacy for treating snoring and OSA. All patients were followed up for at least 1 year to detect potential delayed complications. The results of this technique may be helpful in contributing to an integrated reinforcing treatment for OSA.

2. Material and methods

2.1. Patient selection

The study included 10 consecutive patients who underwent nasal and palatal SCI surgery between August 1, 2015 and December 31, 2015. Patients were selected using the following criteria: age 18–65 years, OSA diagnosis confirmed by polysomnography (PSG), intolerance or unwillingness to have nasal continuous positive airway pressure (CPAP) therapy, symptoms of nasal obstruction and snoring, narrowing of nasal passage from deviated septum and hypertrophy of inferior turbinate in conjunction with palatal flutter and collapse during fiberoptic nasopharygoscopy with Muller's maneuver [9], tonsil size grade I–II, and body mass index (BMI) < 35 kg/m^2. Patients with modified Mallampati class IV tongue position [10], retrognathia, craniofacial abnormalities, chronic rhinosinusitis, trismus, anesthetic allergies, and/or poorly controlled medical disorders were excluded from surgical consideration. This study was approved by the Institutional Review Board of Chang Gung Medical Foundation (No: 104-9802B).

2.2. Polysomnography

In the laboratory, standard, night-long PSGs were performed at baseline and at 3 months after surgery. All respiratory events were recorded using the scoring criteria defined by the American Academy of Sleep Medicine guidelines, 2012 [11]. Apnea was defined as a drop in the peak signal excursion by $\geq$90% of pre-event baseline using an oronasal thermal sensor for $\geq$10 s. Hypopnea was defined as a decrease $\geq$30% in the nasal pressure signal excursions for $\geq$10 s accompanied by either desaturation of 3% or more from the pre-event baseline or an arousal from sleep. The main parameter of PSG used in this study was the AHI, defined as the total number of apneas plus hypopneas per hour of sleep.

2.3. Surgical procedure of SCI

All patients underwent transoral endotracheal intubation under general anesthesia. First, septoturbinoplasty was performed. The quadrangular cartilage was harvested with the perichondrium on only one side, and the L-strut was kept intact (Fig. 1A). The harvested cartilage was preserved in sterile saline with gentamicin (50 mg/500 ml) until implantation (Fig. 1B). Patients then underwent bilateral tonsillectomies. Subsequently, the harvested cartilage was cut into 2-mm wide strips (Fig. 1C), with the strip lengths adjusted according to the length of the soft palate in each patient. Shallow scoring incisions were made on the cartilage strips to increase the contact surface area and improve the binding strength. Next, sterile methylene blue was used to mark the junction of the hard and soft palates, and local anesthesia was administered by injecting lidocaine HCl (1%) and epinephrine (1:100,000) into the soft palate.

After 10 min, a 3-mm incision was made in the midline of the soft palate, approximately 5 mm below the junction of the soft and hard palates. Converse scissors were used to create a vertical tunnel between the muscular and glandular layers from the junction of the soft and hard palates to the base of the uvula. The first pre-prepared cartilaginous strip was then inserted into the midline submucosal tunnel, and the incision was closed with 4-0 Vicryl (Ethicon). This was repeated for the remaining two implants into bilateral para-midline tunnels at horizontal intervals of 2 mm. An additional simple suture was placed in the middle of the implanted cartilage to keep the implant in the inserted position (Fig. 1D). The procedure of cartilage preparation and palatal implantation generally lasted between 15 and 20 min.

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