Sleep Breath (2007) 11:39–43
DOI 10.1007/s11325-006-0080-z

ORIGINAL ARTICLE

Radiofrequency surgery of the tongue base in the treatment of snoring—a pilot study

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Published online: 18 November 2006

Abstract In a previously published study, a significant reduction of snoring was reported after treatment with radiofrequency surgery of the tongue base in patients suffering from obstructive sleep apnea syndrome. The aim of this study was to investigate the efficacy of radiofrequency surgery of the tongue base in the treatment of primary snoring. Twenty patients suffering from primary snoring (AHI<10/h, body mass index< 32 kg/m^2) and an isolated hypertrophic tongue base at clinical examination were enrolled in this clinical trial. The patients underwent bipolar radiofrequency surgery of the tongue base under local anaesthesia. Pre- and post-operative body weight, daytime sleepiness (Epworth sleepiness scale) and snoring scores (visual analogue scales) were evaluated by the patients and their bed partners, respectively. Postoperative follow-up data was collected 6–8 weeks after treatment. A statistically significant reduction of the preoperative snoring levels from 7.5±2.4 to 6.1±2.8 was seen after treatment (p<0.001). Body weight and daytime sleepiness remained unaffected. Only 3 out of 20 patients were satisfied with the result as defined by VAS<3. Despite statistically significant reduction of the subjective snoring scores after radiofrequency of the tongue base, only minimal clinical improvement was achieved. Only 3 out of 20 patients were satisfied with the results. With regard to the clearly beneficial effect seen in patients with obstructive sleep apnea, this result indicates different pathophysiological principles in the generation of snoring.

Keywords Primary snoring · Radiofrequency surgery · Tongue base

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Introduction

Snoring is a widespread disorder, mostly affecting middle-aged men [1–3]. In this group, the prevalence of snoring increases up to the age of 50 to 60 years and is then followed by a decrease [4]. Several studies have revealed that snoring not only correlates with age and gender, but also with body weight, nasal obstruction, alcohol, and tobacco consumption [1, 2, 5]. In itself, snoring is not harmful, but it may lead to social impairment. Therefore, snorers often seek medical advice and effective treatment. In the treatment of primary snoring, oral appliances and other implements seem to be beneficial [6]. Nevertheless, some patients are not willing or not able to use these devices on a daily basis. Therefore, a significant number of snores ask for a surgical procedure to treat their snoring. Despite numerous approaches to find an adequate surgical treatment for primary snoring, no gold standard exists. Various kinds of surgical procedures are available, most of which have been developed for the treatment of obstructive sleep apnea (OSA): uvulopalatopharyngoplasty [7, 8], tonsillectomy [9], laser-assisted uvulopalatoplasty [10], uvulaflap [11, 12], soft palate implants [13], or radiofrequency surgery of the tongue base or the soft palate [14–19]. Some of these procedures are rather invasive and connected with side effects such as post-operative pain or bleeding or persistent swallowing difficulties [20], whereas others show only moderate efficacy [19]. The success rates often deteriorate with time; the patients' overall satisfaction with these operations therefore seems low [8, 10].

Although the soft palate is the origin of snoring sounds in the majority of patients [21] showing typical anatomic variations such as a hypertrophic uvula or a thick soft palate with excessive soft tissue, the tongue base seems to be involved in 15 to 25% of the cases [21–23]. Patients

without typical findings at the soft palate and with clinical signs of tongue base obstruction may benefit from tongue base surgery. Radiofrequency surgery of the tongue base is technically simple, minimally invasive and can be performed on an outpatient basis under local anaesthesia [14, 17, 24, 25]. In patients with OSA and clinical signs of predominant tongue base obstruction, a significant reduction in snoring has been reported after radiofrequency surgery of the tongue base [17]. The aim of this pilot study was to investigate the efficacy of isolated radiofrequency surgery of the tongue base in the treatment of primary snoring in patients without anatomical findings at the soft palate and clinical signs of tongue base obstruction.

Materials and methods

This was a prospective study involving 20 patients suffering from primary snoring. The protocol was approved by the local ethics board of the Faculty of Clinical Medicine Mannheim of the University of Heidelberg; written informed consent was obtained from all the participants.

Patients

Twenty consecutive patients with the primary complaint of snoring were treated with radiofrequency surgery of the tongue base between November 2004 and October 2005 at the University Hospital Mannheim.

All patients were diagnosed with primary snoring and had a respiratory disturbance index (RDI) of below 10 and a maximum body mass index (BMI) of 32 kg/m^2 as diagnosed with polysomnography, clinical examination and questionnaires. Male and female patients between the age of 18 and 65 were included if signs of a hypertrophic tongue base were detected by clinical examination and laryngeal endoscopy (the extent of obstruction of the epiglottic valecula by the tongue base was used as marker). Other sites of obstruction, such as large tonsils or a hypertrophic soft palate, were ruled out by clinical assessment before entry into the study. None of the patients had undergone prior surgery for primary snoring. No surgical procedure apart from radiofrequency of the tongue base was allowed during the course of the study.

Methods

At the baseline visit, all patients underwent intensive clinical examination and endoscopy. Primary snoring was diagnosed during two nights of standard polysomnographic testing at the Sleep Disorders Centre at the Department of Otorhinolaryngology, Head and Neck Surgery Mannheim according to the principles of Sleep Medicine [26].

All patients filled out questionnaires before and 6 to 8 weeks after surgery. Daytime sleepiness was evaluated with the help of the Epworth sleepiness scale (ESS).

Although numerous attempts were made to assess and quantify snoring objectively [21, 27, 28], hardly any of these procedure could be established in the routine management of patients. As snoring is primarily a subjective complaint of the "listener", snoring is therefore predominantly assessed with subjective scales in the literature. In accordance to this, snoring scores were subjectively evaluated pre- and post-operatively with the help of the bed partners using standard 10 cm visual analogue scales (VAS), ranging from 0 (no snoring) to 10 (severe snoring/bed partner leaves the room).

The tongue base radiofrequency surgery was performed under local anaesthesia on an outpatient basis. Prilocaine 1% with adrenaline 1: 200,000 was used as local anaesthetic. Midazolam was used for sedation during ECG and pulse oximetry monitoring.

A Celon radiofrequency generator was used for the delivery of bipolar radiofrequency energy and a special needle device was used for the treatment of the tongue base (Celon AG, Teltow, Germany). In one session, twelve lesions were applied with 7 W. The patients left the hospital after an appropriate time of post-operative surveillance.

The follow-up visit was scheduled 6 to 8 weeks after surgery and included clinical examination and endoscopy. The same questionnaires including the parameters snoring (VAS), body weight (BMI) and daytime sleepiness (ESS) were answered post-operatively. With regard to snoring, a successful treatment was defined as a post-operative score of below 3 (VAS), a definition frequently used in the current literature [29, 30].

Statistics

The statistical analyses were conducted at the Department of Statistics of the Faculty for Clinical Medicine Mannheim. The rank sum test for paired comparisons (Wilcoxon) was used for the parameters snoring (VAS) and daytime sleepiness (ESS) whilst the *t* test was used for body weight (BMI).

Results

All 20 patients could be treated as mentioned above and no patient had to be withdrawn. Five female and fifteen male patients were treated. The average age was 41.9± 8.1 years (range 33–64 years). Mean BMI was 26.2± 3.3 kg/m^2 (range 18–32). The polysomnographic results showed a mean preoperative RDI of 2.3±2.1 (range 0–5.8), the mean time spent below an oxygen saturation of 90%

was 0.15±0.36% (range 0–1%) of the total sleep time. A total amount of 8–12 cm^3 of local anaesthetic (mean 8.6 cm^3) and 3–10 cm^3 of midazolam was needed for adequate local anaesthesia and sedation.

The results of the parameters snoring (VAS), body weight (BMI) and daytime sleepiness (ESS) are presented in Table 1.

There was no relevant change in BMI in the 20 patients. The post-treatment BMI was 26.4±3.4 kg/m^2 compared to 26.2±3.3 kg/m^2 at baseline. Daytime sleepiness also remained unchanged [preoperative score: 6.0±3.7 compared to 6.2±3.1 post-operatively ($p>0.05$)]. The mean preoperative snoring levels (VAS) of 7.5±2.4 were reduced to 6.1±2.8, post-operatively. This reduction was statistically significant ($p=0.0004$). In Fig. 1, individual pre- and post-operative snoring scores are shown.

No post-operative complications such as tongue infection or neural damage occurred. Postoperative pain was treated with oral non-steroidal anti-inflammatory drugs (diclofenac) as needed, antibiotics (amoxicillin 750 mg three times daily for 5 days) were provided prophylactically.

Discussion

As already mentioned, there is no gold standard therapy for primary snoring at present. Apart from conservative treatment options, many different surgical procedures are offered such as laser-assisted uvuloplasty [10], uvulopalatopharyngoplasty [7, 8] or radiofrequency surgery [14–19]. Initially, radiofrequency surgery of the soft palate seemed to be promising in the treatment of primary snoring, most recent results of a placebo-controlled study however showed that the reduction of snoring scores that may be achieved is only moderate [19].

There are only few studies addressing isolated radiofrequency surgery of the tongue base [14, 17, 31]. In these studies, several sessions with only a small number of lesions (1–4) per session were performed. In contrast, we applied a significantly higher number of lesions in a single session, leading to a comparable total number of lesions.

In a previous trial, in which isolated radiofrequency surgery of the tongue base was carried out, we were able to demonstrate a highly significant reduction of snoring [17]. The snoring scores in this study were reduced from 7.8±1.9 to 3.4±2.8 on the VAS [17].

This is the first study to evaluate the effects of isolated radiofrequency surgery of the tongue base in the treatment of primary snoring. Despite a statistically significant reduction of the snoring scores from 7.5±2.4 to 6.1±2.8, the overall clinical effect was only minimal and only 3 out of 20 patients were satisfied with the result after treatment as defined with a post-operative snoring score of below 3.

Table 1 Pre-and post-operative results of snoring (VAS), BMI and daytime sleepiness (ESS)

Patient number	VAS snoring		BMI (kg/m^2)		ESS	
	Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
1	8.2	7.7	25.24	25	7	7
2	7.9	7.6	29.2	29.8	3	6
3	2.8	1.8	23.05	23	3	3
4	10	6.8	30.4	30.04	3	5
5	5.4	4.3	25.4	25.4	2	2
6	7.9	5	23.7	24	11	6
7	9.8	10	27.1	27.43	5	8
8	9.4	7.8	30.12	30	5	5
9	10	9.6	29.4	29.7	7	12
10	3	3.2	23.6	24	9	7
11	6.4	5.3	26.3	26	5	5
12	8.5	8.6	26.85	27.78	1	5
13	4.6	1.2	24.7	24.69	9	10
14	9.5	6.9	26.1	26	12	13
15	6.9	5.9	22.1	22	12	9
16	5	0.2	18.4	18.4	0	0
17	8.6	8.6	31.5	31.5	4	5
18	9.8	5.5	29.3	29.5	3	5
19	5.6	6.5	23.1	24	7	5
20	9.8	9.3	28.9	29.3	11	6
Mean	7.5	6.1	26.2	26.4	6	6.2
SD	2.4	2.8	3.3	3.4	3.7	3.1

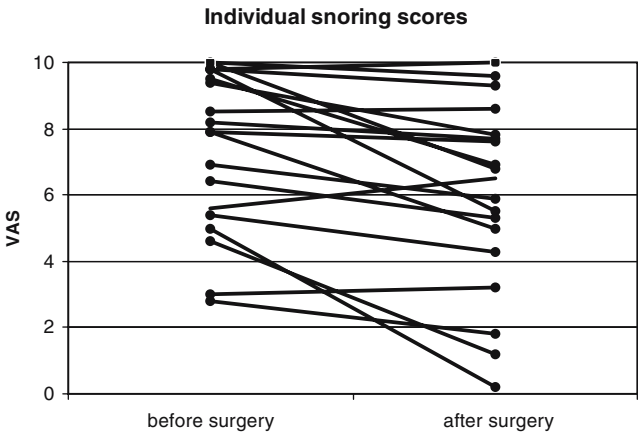

Fig. 1 Pre-and post-operative individual snoring scores

The present results are based on a short-term follow up of 6 to 8 weeks, which is comparable to other studies addressing radiofrequency surgery (6 to 8 weeks are based on the estimated time needed for tissue remodelling). In general, potential effects need to be reconfirmed after a longer follow-up period as results usually deteriorated over time. As the effects achieved in this trial are only marginal and radiofrequency surgery of the tongue base is not recommended for the treatment of snoring; additional follow-up periods were initially planned but are no longer indicated.

The uncontrolled nature is another limitation of the present pilot study. In the treatment of snoring, potential placebo effects need to be kept in mind especially with regard to subjective outcome evaluation. The present trial was designed as a pilot study to assess the potential value of the procedure in the treatment of snoring. Better designed, controlled trials would have been necessary to confirm beneficial effects, but with regard to the limited efficacy of the procedure demonstrated in the present trial there seems to be no rational for future controlled trials.

A comparison of the profound reduction of snoring after isolated radiofrequency surgery of the tongue base in the treatment of OSA with the present results in primary snoring seems to indicate that the pathophysiology of primary snoring and snoring in obstructive sleep apnea may be different. Regarding the results of this study, radiofrequency surgery of the tongue base is not recommended as a single approach in primary snoring.

Conclusion

Radiofrequency surgery of the tongue base is not recommended as a first line treatment for primary snoring. The present study supports the hypothesis of a different pathogenesis of snoring sounds in primary snoring and obstructive sleep apnea syndrome.

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