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Electrocautery Versus Carbon Dioxide Laser for Uvulopalatoplasty in the Treatment of Snoring

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Laser-assisted uvulopalatoplasty is a popular method for reducing snoring. Drawbacks are the large initial expense of the laser unit and related equipment and required safety precautions. The equipment required for electrocautery for cautery-assisted uvulopalatoplasty is significantly less expensive to obtain and operate compared with the carbon dioxide laser. Ninety-eight patients were randomly assigned to one of two treatment groups to undergo uvulopalatoplasty: one performed with the carbon dioxide laser and the other with electrocautery. We compared postoperative pain, time off work, efficacy, and the number of treatments required to achieve a satisfactory result. We found no statistically significant difference in any of these parameters between the two treatment groups ($P > 0.05$). Our data show that the use of the carbon dioxide laser offers no advantage over electrocautery in performing uvulopalatoplasty to treat snoring.

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INTRODUCTION

Snoring is a common problem with many sociomedical manifestations. Approximately 25% of men and 15% of women snore habitually.[1,2] If severe enough, snoring can result in separate sleeping arrangements. Nonsurgical treatment measures consisting of alcohol avoidance, weight loss, and altering sleep position are only minimally successful. Prosthetic and tongue-retaining devices have been shown to be effective in 60% of patients.[3] Unfortunately, long-term compliance with these devices is poor.

In many individuals the pathophysiology of snoring involves sound emanating from vibrations of the uvula, soft palate, and tonsillar pillars.[4] Surgical treatment has therefore been directed toward these anatomical areas. In 1981, Fujita et al.[5] discussed Ikematsu's treatment of snoring by surgical excision of pillar mucosa and partial excision of the uvula. The authors modified this procedure for the treatment of obstructive sleep apnea and called it the *uvulopalatopharyngoplasty* (UPPP). This procedure involves excision of the uvula and a portion of the soft palate, and tonsillectomy and has until recently been the standard treatment for snoring.

Results of UPPP show a 75% to 100% initial success rate.[6–11] However, the long-term success rate is only 50%.[6] Complications include intubation difficulties (many patients have full necks and large tongues),[12] hemorrhage (2%), postoperative nasal regurgitation (20% to 60%), and permanent velopharyngeal insufficiency (0.5%).[1] In addition, each patient requires overnight hospitalization and a period of convalescence.[13]

Laser-assisted uvulopalatoplasty (LAUP) was developed in 1990[14] and introduced in the United States by Coleman[15] in 1993 for the outpatient treat-

ment of snoring. LAUP allows selective excision of the uvula and soft palate during two to five outpatient sessions. This technique prevents overresection and maintains palate function. Morbidity is lower owing to smaller excisions (compared with UPPP, which involves a single large resection) and patients are usually able to return to work the following day. LAUP has been shown to be 85% to 90% effective in alleviating snoring. Postoperative pain peaks on approximately the 4th postoperative day and resolves by day 10. The primary complication is mild bleeding (3%), which can usually be controlled by silver nitrate application.[16]

Laser-assisted uvulopalatoplasty has been criticized for its expense and the lack of controlled studies of the procedure.[17] Specially designed lasers and oropharyngeal attachments can cost $50,000. In addition, laser precautions must be enforced, specific rooms must be used, and all surgical personnel require periodic laser safety training and medical surveillance.

Electrocautery is now being used for outpatient cautery-assisted uvulopalatoplasty in which selective tissue excision is the same as in LAUP.[18] This alternative to the laser is more economical; standard equipment typically costs less than $8000, and the procedure does not require special training or safety precautions.

MATERIALS AND METHODS

Between May 1995 and August 1996 820 patients were evaluated at Naval Medical Center, Portsmouth, Virginia complaining of loud bothersome snoring that was disruptive to them and their sleeping partners in their home or berthing compartment. Polysomnography studies were obtained on 420 patients. Seventy-eight patients demonstrated significant obstructive sleep apnea and were treated by continuous positive airway pressure or various surgical procedures ranging from UPPP, tonsillectomy, adenoidectomy, genioglossal advancement, or tracheotomy. Of the remaining patients who returned for follow-up, 103 were enrolled into this prospective randomized study under a protocol approved by the Investigational Review Board of Clinical Investigation Division, Naval Medical Center, Portsmouth, Virginia. Study participants were randomly assigned to one of two treatment groups. The surgical procedure for both groups involved identical incisions and extent of tissue resected from the soft palate and uvula. The only difference was in the apparatus used for cutting the tissue: surgery in one group involved using the electrocautery unit, whereas the other group used the CO_2 laser.

The diagnosis of snoring was made primarily from the patients' history. Each patient completed an initial questionnaire prior to any treatment. All patients had a thorough history and a complete head and neck examination. Close inspection was given to the nose, nasopharynx, oral cavity, oropharynx, hypopharynx, and larynx in order to identify the primary area of the patients' obstruction that produced the snoring sounds. Flexible fiberoptic nasopharyngoscopy to visualize the velopharyngeal space and hypopharynx was performed. A modified Müller's maneuver (forceful inspiration with the mouth closed and nasal passages pinched shut) was performed to visualize the site and degree of airway collapse. The patient was also instructed to produce a snoring sound to allow identification of the vibrating tissue that was generating the sound.

Patients were enrolled into this study if they met the following criteria.

- Loud obnoxious habitual snoring that disrupted their sleeping companion(s).
- Nonobstructing tonsils and/or adenoids.
- Long or redundant soft palate and uvula.
- Absent or mild obstructive sleep apnea with a respiratory disturbance index of less than 20.
- Failure to achieve satisfactory reduction in snoring by means of conservative measures.

Patients were excluded from this study if they had or exhibited the following.

- Significant obstructive sleep apnea with a respiratory disturbance index of greater than 20.
- Submucous cleft of the soft palate.
- Obstructing tonsils and/or adenoids.
- A bleeding disorder.
- Uncontrolled hypertension, severe trismus, cleft palate, velopharyngeal insufficiency.
- Snoring generated from the nose or hypopharynx.
- Uncontrollable gag reflex.

Patients were also excluded if they were pregnant or if they played wind instruments or used their voices professionally.

All procedures were performed in the Otolaryngology—Head & Neck Surgery clinic at the Naval Medical Center, Portsmouth, Virginia. Informed consent for participating in this clinical investigation and for performing each procedure was obtained.

Topical and local anesthesia with the patient awake sitting up in an examination chair without sedation was achieved. Benzocaine 20% (Hurricaine, Beutlich L.P. Pharmaceuticals, Waukegan, IL) was sprayed onto the soft palate, uvula, and oropharynx. Additional topical anesthesia of dyclonine 0.5% gargle (Dyclone, Astra Pharmaceuticals, Westborough, MA) was also administered if a significant gag reflex persisted. One to 2 cc of lidocaine 2% with epinephrine, 1:100,000, was injected with a 27-gauge needle into the base of the uvula and the junction of the soft palate and uvula at least 3 minutes after administering topical anesthesia. Then 10 minutes more were allowed to elapse before commencing the procedure.

Uvulopalatoplasty

Full-thickness vertical incisions were made on the free edge of the soft palate approximately 1 to 1.5 cm in length on both sides of the uvula. The uvula was then reshaped by reducing its length by 60% to 90%. A Yankauer suction was held near the corner of the mouth, and the patient was instructed to take in a deep breath and slowly

exhale through the mouth during the actual cutting maneuvers, in order to avoid inhaling the plume.

Cautery-Assisted Uvulopalatoplasty

Anesthesia was achieved in the manner described above and a grounding electrode pad was applied on the patient's flank. The procedure was then performed as described above, with a Force 2 electrosurgical generator (Valleylab, Boulder, CO) in the pure cut power mode of 20. A hand-controlled electrosurgical pencil and needle electrode (#60-0182-001 Aspen Lab, Englewood, CO) was used to make the incisions. The mucosal incision is initiated by first dotting the mucosa with the electrocautery (Fig. 1), then connecting the lines together as the incision is carried more deeply with short side to side strokes. The uvula is then grasped with self-retaining forceps in order to avoid aspiration or ingestion as the posterior mucosal incision is completed (Fig. 2). The coagulation mode using a power setting of 20 is sufficient for hemostasis as needed, to achieve the end result as seen in Figure 3. Care was exercised to avoid collateral burn injury to adjacent structures directly or indirectly by way of arcing to metallic instruments in the mouth that could transmit electrical current to nonoperative areas, thereby causing unwanted burns.

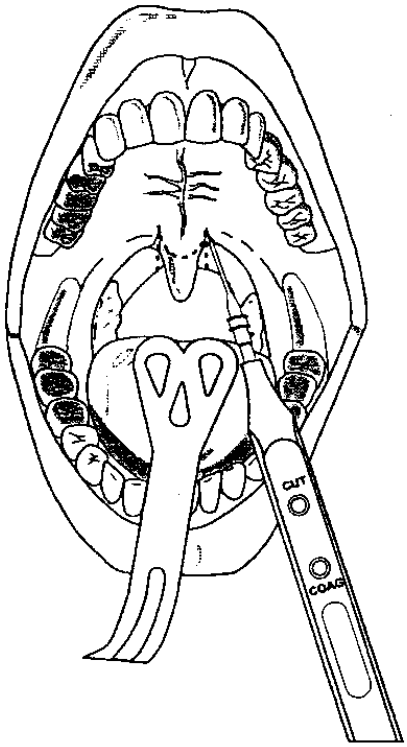

Fig. 1. Initial mucosal incision location is marked by dotting the surface with the needle point.

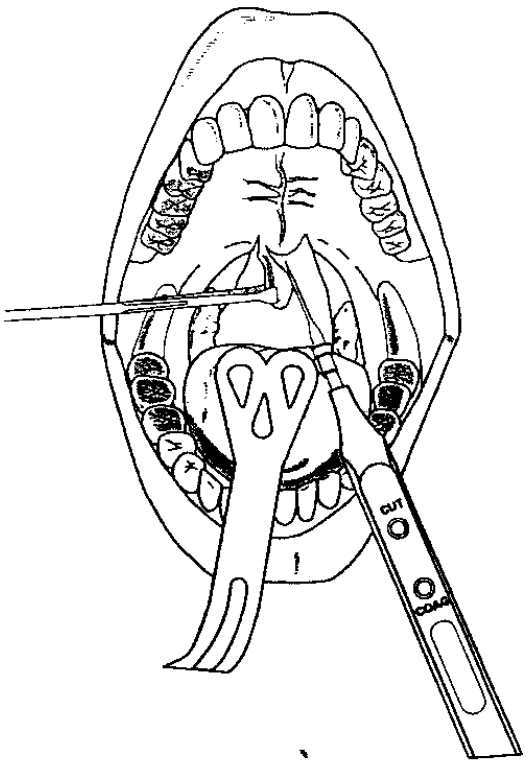

Fig. 2. Resected portion of uvula and soft palate is held with forceps as incisions are completed.

Laser-Assisted Uvulopalatoplasty

Anesthesia was achieved as described above. The procedure was then performed as described above with the Sharplan 40C CO_2 laser (#24-070, Laser Industries Inc., Tel-Aviv, Israel) set on 15 to 20 W in the continuous mode with the Sharplan 230-mm focal length oropharyngeal handpiece with back-stop. The focused setting was used to make the incisions for the uvulopalatoplasty, and the defocused setting was used for ablating tissue and hemostasis as needed. All standard Navy laser safety procedures were employed. Adjacent doorways and windows displayed laser eye hazard warnings. All people in the operative area including surgeons, surgical assistants, observers, and the patient wore protective eyewear to prevent laser injuries. Only those surgeons holding current laser safety training and a current laser eye examination performed the laser-assisted procedure.

After the procedure patients were given an analgesic prescription for 5 to 7 days, along with an instruction sheet with advice on diet and activities. The patients were seen in follow-up 7 to 14 days later and then again in 4 to 6 weeks. Information was collected and recorded on a data sheet at follow-up visits. This information included:

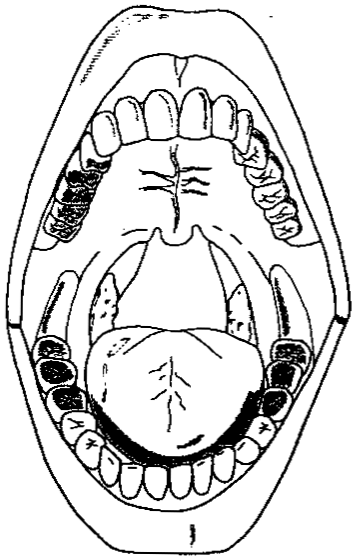

Fig. 3. Final appearance of soft palate and uvula remnant.

- number of work days missed;
- number of days after the treatment that pain intensity peaked;
- number of days required for all pain to resolve;
- 0 to 5 scaled score of maximum pain experienced (0: no pain; 3: moderate pain; 5: severe pain);
- 0 to 5 graded score of snoring loudness (0: no snore; 3: moderate snore; 5: extremely loud snore);
- 0 to 5 graded score of snoring frequency (0: no snoring; 3: infrequent; 5: constant snoring);
- 0 to 5 graded score of voluntary snorting (0: no snort; 3: moderate snort; 5: extremely loud snort).

Progress in snoring reduction was assessed when the patient was seen 4 to 6 weeks after surgery to determine if additional treatments were needed. These were performed if the patient still snored or was able to voluntarily make a snorting sound. No further treatments were performed once the desired result had been achieved, ie, when the patient was satisfied with the elimination or reduction of loud bothersome snoring and/or was unable to voluntarily make a snorting sound. After a maximum of five procedures had been completed and/or a satisfactory result had been achieved, a follow-up questionnaire was completed by all patients. Their scores on the various parameters such as grade of snoring and degree of success in altering snoring were then compared with the pretreatment questionnaire.

The final improvement in snoring was classified into three groups as described by Walker et al.[19] in 1995 as follows.

1. Cured: snoring was completely eliminated or significantly reduced by more than 70%.
2. Improved: a satisfactory reduction to an acceptable level of 30% to 70%.
3. Failure: no change in snoring or reduction in snoring of less than 30% was appreciated.

We also compared the number of work days missed, severity of postoperative pain and duration of symptoms experienced between the two groups. Data were analyzed and compared by the Student's *t*-test, chi-squared test, Kruskal-Wallis test, and Wilcoxon two-sample test.

RESULTS

As of November 1996, a total of 98 patients had finished all treatments (Table I). Analysis of the data failed to reveal any significant difference in the pain experienced in each group. The delay from when the procedures were performed until the onset of the most significant discomfort experienced was the same ($P = 0.45$ by *t*-test), as was the number of days until pain resolved ($P = 0.10$ by *t*-test) (Table II). The severity of pain experienced ($P = 0.22$ by *t*-test) and the number of working days missed was also similar ($P = 0.97$ by *t*-test) (Tables III and IV).

No significant difference was seen between either treatment modality's ability to effectively reduce snoring ($P = 0.26$ by Wilcoxon two-sample test, *t*-test and Kruskal-Wallis test) (Table V). There was likewise no significant difference in the number of procedures required to achieve the end results (Table VI) ($P = 0.98$ by Fisher's exact test and chi-squared test). The complications experienced in both groups (Table VII) were also the same.

Based on the data obtained from the 98 patients completed at this time, the statistical power of the results was determined to be 0.99.

DISCUSSION

Surgical therapy for the treatment of loud snoring is a commonly requested procedure in the average otolaryngology practice. Despite growing evidence of the health concerns of snoring,[20–22] this malady is still typified as one with social consequences—not a medical issue. Snoring is typically described as the annoying sounds generated by loose, redundant soft tissue of the upper airway in the sleeping individual. Often this originates from

TABLE I.
Demographic Data by Group.

	CAUP (n = 51)	LAUP (n = 47)
Men (n)	48	43
Women (n)	3	4
Age (y)	40 (25–50)*	42.9 (23–75)*

*Numbers in parentheses are ranges.
CAUP = cautery-assisted uvulopalatoplasty; LAUP = laser-assisted uvulopalatoplasty.

TABLE II.
Duration of Pain by Group After Each Procedure.

	CAUP			LAUP		
	Mean	Range	SD	Mean	Range	SD
Pain peaked on day no.	3.63	0–8	±1.59	3.32	0–10	±2.287
Resolution of pain on day no.	11.03	0–24	±4.266	10.02	0–21	±4.262

the most posterior-inferior edge of the soft palate and uvula that has become enlarged.[4] Other areas can contribute to sound production when significant airspace encroachment has occurred, as seen with hypertrophy of the palatine tonsils, lingual tonsils, adenoids, or mandibular retrognathia with posterior tongue displacement. Surgical therapy has therefore been directed to the area of vibration by way of excision, scarification, or surgical ablation by scalpel, laser, or electrocautery. Since its introduction in 1964 by Ikematsu and modification by Fujita et al.[5] in 1981, the uvulopalatopharyngoplasty has remained the standard procedure that all other procedures are compared against for safety and effectiveness. The major draw-backs of the UPPP are the need for general anesthesia and the risks of developing short-term or permanent velopharyngeal incompetence.[23] Currently, the other procedures performed as an alternative to UPPP involve excising less of the soft palate. These procedures are usually performed in an ambulatory setting under local or topical anesthesia and frequently without intravenous sedation. Because less tissue is excised or ablated, the patient experiences significantly less pain, as evidenced by fewer missed days of work, and is able to resume a regular diet sooner.

The CO_2 laser was used in 1990 when Kamami[14] introduced the laser vaporization of the palatopharynx. In the late 1980s, he was one of the few surgeons who performed CO_2 laser ablation of the tonsils in an ambulatory setting. He also used the laser to incise soft palate tissue in patients who failed to experience adequate resolution in snoring after UPPP. These patients requested an alternative to revision of a UPPP under general anesthesia. About the same time, the Swedish surgeon Carenfelt[24] published his experience with the CO_2 laser in a procedure that closely resembled the UPPP, and called it a laser uvulopalatoplasty. The following year, Wennmo et al.[25] published a study that compared excision of the uvula and a portion of the soft palate with CO_2 laser under magnification with a micromanipulator, to scalpel UPPP with and without tonsillectomy. The reduction in snoring appeared similar with all methods, but each group consisted of a small number of patients and the extent of tissue resected in the laser group was the same as what is resected in UPPP except for the palatine tonsils. Postoperative pain experienced in the laser group was more pronounced than in the other groups, which the authors postulated was a result of not suturing the wounds closed as was performed in the other groups.

Laser vaporization of the palatopharynx was modified by Coleman[15] in 1993 and was coined *laser-assisted uvula-palatoplasty*. This procedure involves a series of several treatments spaced 4 to 6 weeks apart that involves making two vertical incisions in the soft palate just lateral to the uvula, and then coring out the uvula (leaving the anterior and posterior mucosa). Excitement in the lay press about the procedure was fueled by aggressive marketing campaigns by the laser industry. This in turn created demand among patients who now expected, if not insisted, to undergo this new form of therapy over more accepted and proven procedures. Training seminars flourished as the medical community scrambled to keep pace with this new demand. In this way, an unproven, poorly studied therapy became the "standard" treatment, all before undergoing extensive evaluations for safety and efficacy.[26,27]

Since the addition of the CO_2 laser, several other procedures to reduce snoring have been described.[19,28,29] The similarity between these procedures is that they do not require the CO_2 laser. The

TABLE III.
Severity of Pain Experienced by Group After Each Procedure.

	Severity of Pain						
		Mild		Moderate/Severe		Severe	
Group	None	n	%	n	%	n	%
CAUP	0	23	24	64	68	7	8
LAUP	0	26	27	53	58	14	15

TABLE IV.
Total Number of Work Days Missed Per Patient for all Treatments by Group.

Days (n)	CAUP* (n = 51)	LAUP† (n = 47)
0	30	31
1	13	8
2	5	1
3	1	5
6	2	2

*Mean = 0.75; range, 0–6; SD ± 1.006.
†Mean = 0.78; range, 0–6; SD ± 0.982.

TABLE VI.
Number of Procedures Required by Group.

	CAUP (n = 51)		LAUP (n = 47)	
Procedures (n)	n	%	n	%
1	26	51	21	45
2	13	25	14	30
3	8	16	8	17
4	2	4	2	4
5	2	4	2	4
6	0		0	

offending area of the soft palate and uvula is excised by snare, scalpel, or electrocautery. Hemostasis in the tissue bed is achieved by electrocauterization, thus making the end result essentially the same as if the tissue was originally excised with the electrocautery.

This is the contention for our modification of LAUP. The electrocautery is a proven instrument for excising soft palate and uvula tissue as seen in the UPPP. The same sequential uvulopalatoplasty can be performed with the electrocautery, hence the cautery-assisted uvulopalatoplasty. This procedure is quick and easy to perform, and can be done during regular clinic hours with no disruption to seeing other patients. Cautery-assisted uvulopalatoplasty does require introducing an extra instrument into the oropharynx briefly at the end of the procedure, but this was easily tolerated by all patients and did not pose a problem for the operator.

When using standard electrocautery, the added expense of the laser apparatus and operating costs are not passed on to the patient. Cumbersome laser safety precautions based on OSHA standards are bypassed. When using the laser, access to the operative area is restricted and special eye protection is worn. Along with this, a laborious time-consuming safety check-off list is completed prior to every procedure, adding to the time and expense of using the laser. These safety measures make performing laser procedures in a busy clinic potentially cumbersome and disruptive to their efficiency. This is bypassed when the laser procedures are performed in a free-standing surgery center, but the extra expense is then passed on to the patient in the form of a separate charge for use of the facility.

Based on the results obtained at this time, we would need in excess of 1000 more patients to reveal if any slight benefit or superiority exists in one procedure over the other.

CONCLUSION

Snoring surgery has undergone extensive changes over the past decade with the development of several surgical procedures that involve altering the uvula and soft palate. Changes in the health care insurance industry have emphasized cost containment, and patients often bear the financial burden for this elective procedure. We have the responsibility of treating patients the best we can, while holding down the costs of the care provided.

Sequential uvulopalatoplasty by electrocautery in an outpatient setting under local or topical anesthesia without sedation appears to be a safe and effective treatment for reducing bothersome snoring without obstructive sleep apnea. The results obtained with cautery-assisted uvulopalatoplasty are equivalent to LAUP. We will continue to study the safety and long-term efficacy of this form of therapy, along with its role in the management of patients with obstructive sleep apnea.

TABLE V.
Effectiveness in Reduction of Snoring by Group.

	CAUP (n = 51)		LAUP (n = 47)	
	n	%	n	%
Cured (>70% reduction)	26	51	23	49
Improved (30%–70% reduction)	23	45	21	45
Unchanged (<30% reduction)	2	4	3	6

TABLE VII.
Complications Experienced by Group.

	CAUP (n = 51)		LAUP (n = 47)	
	n	%	n	%
Temporary VPI	2	4	1	2
Infection	1	2	1	2
Bleeding requiring $AgNO_3$	1	2	1	2
Nasopharyngeal stenosis	0		0	
Permanent VPI	0		0	

VPI = velopharyngeal insufficiency.

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