

# Microdebrider Versus CO<sub>2</sub> Laser Removal of Recurrent Respiratory Papillomas: A Prospective Analysis

Kimberly Pasquale, MD; Brian Wiatrak, MD; Audie Woolley, MD; Linda Lewis, RN, CNS

**Objective:** To compare postoperative patient discomfort, voice quality, and procedure time and cost for removal of recurrent respiratory papillomas using the microdebrider versus the CO<sub>2</sub> laser. **Study Design:** A randomized prospective study comparing children undergoing excision of recurrent respiratory papillomas by CO<sub>2</sub> laser versus excision by microdebrider. **Methods:** For the 6-month study, patients for whom removal of recurrent respiratory papillomas was indicated were randomly assigned by birth year to microdebrider or CO<sub>2</sub> laser therapy. Disease severity was scored as the sum of ratings of 1+ (minimal), 2+ (moderate), or 3+ (severe) for involvement of 27 areas of the aerodigestive tract by direct microlaryngoscopy immediately before treatment. Parents scored patient discomfort and improvement in voice quality 24 hours after surgery, using a 5-point (0 = no pain; 4 = worst pain) and a 10-point (1 = minimal change; 10 = significant improvement) scale, respectively. **Results:** Nineteen patients ranging in age from 2.5 to 20 years underwent 32 procedures in all. Groups did not differ significantly in age, sex, or severity of disease. For disease of equivalent severity, microdebrider treatment was associated with equivalent 24-hour-postoperative pain scores, greater improvement in voice quality, shorter procedure times, and lower overall procedure cost. **Conclusions:** Immediate postoperative results indicate that the microdebrider may be as safe as and, at some institutions, might be more cost-effective than the CO<sub>2</sub> laser for removal of recurrent respiratory papillomas. **Key Words:** Recurrent respiratory papillomas, microdebrider, CO<sub>2</sub> laser, pediatric voice quality, postoperative pain, cost comparison.

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From the Department of Pediatric Otolaryngology (B.W., A.W., L.L.), Children's Hospital of Alabama, and the Division of Otolaryngology—Head and Neck Surgery (K.P.), The University of Alabama at Birmingham, Birmingham, Alabama, U.S.A.

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Send Correspondence to Brian Wiatrak, MD, Children's Hospital of Alabama, 1600 7th Avenue, South ACC 320, Birmingham, AL 35233, U.S.A. E-mail: brian.wiatrak@chsys.org

## INTRODUCTION

Recurrent respiratory papillomatosis (RRP) is the most common benign laryngeal neoplastic condition in the pediatric population. The disease, characterized by recurrent growth of benign papillomas that can affect the entire aerodigestive tract, has been recognized for more than 300 years. More recently, RRP has been found to be due to human papilloma virus (HPV) infection.<sup>1</sup>

More than 90 types of HPV have been identified to date, with types 6 and 11 being primarily responsible for papillomas of both the aerodigestive and genital tracts.<sup>2</sup> Tumors caused by HPV have been described histologically as benign nonkeratinizing squamous cell lesions composed of multiple fronds of stratified squamous epithelial cells gathered around a fibrovascular core. Human papilloma

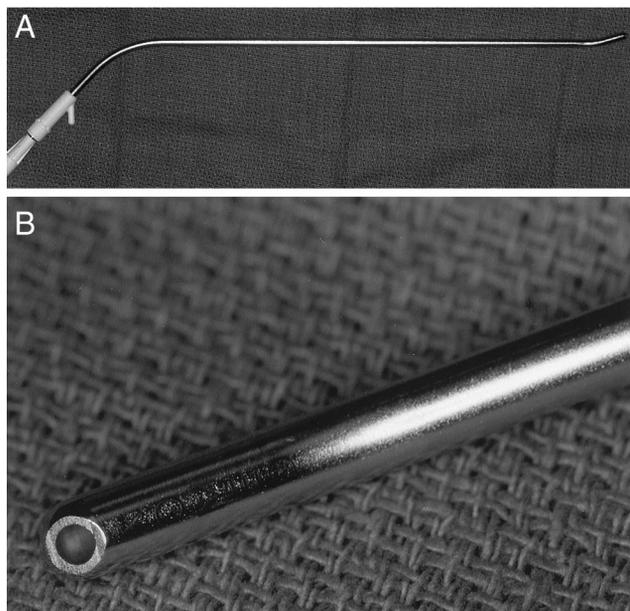


Fig. 1. (A) Xomed Skimmer angle-tip, 4-mm laryngeal blank allows debridement of laryngeal or tracheal papillomas under microscope or endoscopic visualization. (B) Close-up view of the laryngeal blade tip. The small opening allows precise debridement of papillomatosis tissue with minimal damage to surrounding tissue.

Scoring Sheet

Date of Surgery \_\_\_\_\_  
 Adjuvant Therapy \_\_\_\_\_  
 Initiation Date \_\_\_\_\_

Symptoms			<b>SEVERITY RATING</b>
Voice Quality	Normal	_____	1+ Minimal
	Mild Hoarseness	_____	2+ Moderate
	Moderate Hoarseness	_____	3+ Severe
	Severe Hoarseness	_____	
	Aphonic	_____	
Airway	No Obstruction	_____	
	Mild Obstruction	_____	
	Moderate Obstruction	_____	
	Severe Obstruction	_____	

**LARYNX**

Epiglottis	Lingual Surface	_____	
	Laryngeal Surface	_____	
Ary-epiglottic Folds	Right	_____	Left _____
False Vocal Cords	Right	_____	Left _____
True Vocal Cords	Right	_____	Left _____
Anterior Commissure		_____	
Posterior Glottis		_____	
Subglottis		_____	
Other		_____	

**TRACHEA**

Upper 1/3	Anterior	_____	Posterior	_____
Middle 1/3	Anterior	_____	Posterior	_____
Lower 1/3	Anterior	_____	Posterior	_____
Bronchi	Right	_____	Left	_____

**TOTAL SCORE** \_\_\_\_\_

**OTHER**

Nose	_____	Esophagus	_____
Palate	_____	Lungs	_____
Pharynx	_____	Other	_____

Fig. 2. Papilloma staging system used to assess severity of disease in patients in the present study.

Score sheet developed by Brian Wiatrak, MD, Children's Hospital/University of Alabama at Birmingham.

virus has been detected not only in the lesions but also in otherwise histologically normal adjacent epithelium. Human papilloma virus appears to target epithelial cells, where it can exist in either an active or a latent form.<sup>3</sup>

The incidence of RRP is estimated to be 4.3 per 100,000 in the pediatric age group and 1.8 per 100,000 in adults.<sup>4</sup> The disease course is variable, ranging from spontaneous permanent remission to relentless recurrences requiring multiple surgical procedures and possibly emergent airway intervention to malignant transformation (2% to 3% of cases) and death.<sup>5</sup> Two forms of RRP have been recognized: a juvenile, more aggressive form, and an adult form. Children with RRP commonly present with symptoms of an obstructed airway: hoarseness, increased work

of breathing, stridor, and ultimately total airway obstruction. No cure has yet been found for RRP, and its morbidity and mortality are high, despite excision (use of the CO<sub>2</sub> laser has become standard since the early 1990s) and adjunctive therapies as necessary in aggressive cases.<sup>6</sup>

The microdebrider, a new alternative to laser ablation techniques, is gaining popularity for endoscopic sinus surgery and, with the development of a new laryngeal blade, for removal of laryngeal lesions. The microdebrider's laryngeal blade (the 4-mm Skimmer Angle-Tip, XOMED Surgical Products, Jacksonville, FL) incorporates a suction device that enables the user to pull the papilloma away from underlying tissue, making it easier to remove the diseased mucosa (Fig. 1). We conducted a

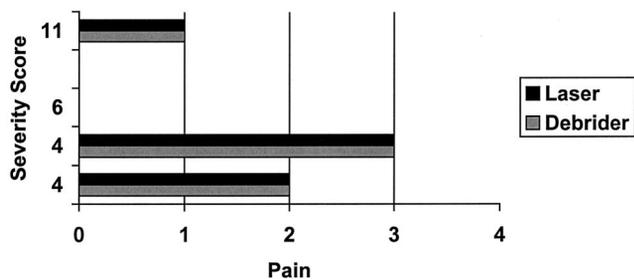


Fig. 3. Pain 24 hours after microdebrider (gray bars) or CO<sub>2</sub> laser (black bars) removal of recurrent respiratory papillomas, controlling for disease severity.

prospective randomized trial to compare the safety and effectiveness in improving voice quality of the microdebrider and the CO<sub>2</sub> laser in young patients with RRP. This is the first prospective comparison of these two techniques.

### MATERIALS AND METHODS

Nineteen patients with RRP requiring surgical treatment were included in the 6-month study. Their ages ranged from 2.5 to 20 years (average age, 6.2 y). The patients underwent 32 procedures in all. For each procedure, the patient was randomly selected by birth year to undergo surgical debridement using either the CO<sub>2</sub> laser or microdebrider.

#### Papilloma Removal and Disease Severity Scoring

Each papilloma debridement procedure was performed with the patient under general anesthesia with intermittent oral endotracheal intubation. Rigid endoscopy was performed initially to examine the larynx and trachea and score the severity of the disease.

The pediatric otolaryngology attending surgeon (B.W. or A.W.) during endoscopy scored each patient's disease severity using a scoring system (Fig. 2) developed by Wiatrak<sup>7</sup> and Wiatrak et al.<sup>8</sup> The scoring system uses a scale ranging from 1+ to 3+ (1+ = minimal, 2+ = moderate, 3+ = severe) to grade disease in each of 11 laryngeal areas (lingual surface, right and left aryepiglottic folds, right and left false vocal cords, right and left true vocal cords, anterior commissure, posterior glottis, subglottis, and other), 9 tracheal areas (anterior and posterior upper one-third, middle one-third, and lower one-third; right and left bronchi; and tracheostomy stoma), and 7 other areas (nose, pal-

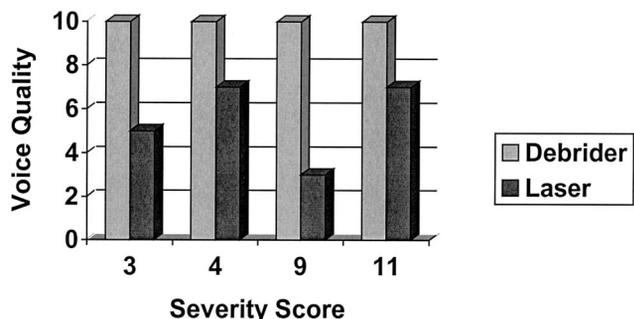


Fig. 4. Improvement in voice quality 24 hours after microdebrider (gray bars) or CO<sub>2</sub> laser (black bars) removal of recurrent respiratory papillomas, controlling for disease severity.

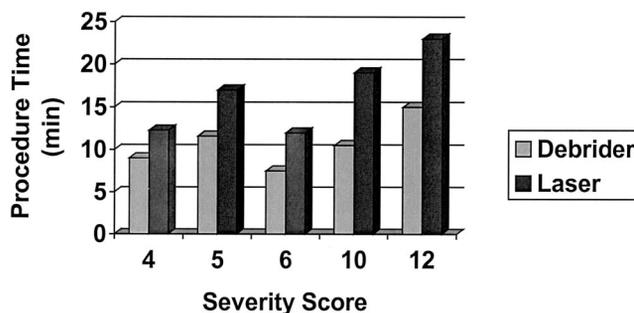


Fig. 5. Duration of procedure using microdebrider (gray bars) or CO<sub>2</sub> laser (black bars) to remove recurrent respiratory papillomas, controlling for disease severity.

ate, pharynx, esophagus, right and left sides of the lung, and other). Although this staging system incorporates extralaryngeal sites, all of the patients in the present study had only laryngeal involvement.

A Lindholm laryngoscope was used to expose and suspend the larynx, and biopsy of the laryngeal tissue was performed. An Neo-Synephrine-soaked cottonoid pledget was placed on each papilloma for 1 to 2 minutes for hemostasis. The pledgets were removed, and either a CO<sub>2</sub> laser (using all standard precautions) or the microdebrider was used to remove all visible papillomatous disease, sparing normal tissue. The duration of the procedure was measured from the time the larynx was suspended until the last papilloma was removed.

#### Pain Assessment and Voice Quality Improvement Evaluation

Before the patient was discharged from the hospital (the same day as the procedure), the parents were given a pain and voice quality improvement evaluation form to be completed 24 hours after the procedure. Pain was assessed using a scale ranging from 1 to 5 (1 = minimal discomfort; 5 = most severe pain). Improvement in voice quality after the procedure was assessed on a scale ranging from 1 to 10 (1 = minimal voice improvement; 10 = significant voice improvement).

#### Statistical Analyses

We compared treatment with the CO<sub>2</sub> laser and treatment with the microdebrider for patients' level of pain 24 hours after the procedure, improvement in voice quality 24 hours after the procedure, duration of the procedure, and cost of equipment and supplies and operating room time for the procedure.

Student *t* test for subgroups by severity of disease scores was used to evaluate the significance of differences between the treatments in pain 24 hours after the procedure, improvement in voice quality 24 hours after the procedure, duration of the procedure, and total cost of the procedure.

### RESULTS

There were 12 male and 7 female patients in the microdebrider group, with a mean age of 5.96 years. The nine male and six female patients in the CO<sub>2</sub> group had a mean age of 7.1 years. The age difference between the two groups was not statistically significant.

Preoperative disease severity scores ranged from 1 to 20 (average score, 8.8). The average disease severity score for the microdebrider group was 10.42, and for the CO<sub>2</sub> laser group it was 6.57. This was a statistically significant difference of 0.0414.

TABLE I.  
Costs for Equipment/Supplies and Operating Room Time for Microdebrider vs CO<sub>2</sub>Laser Removal of Recurrent Respiratory Papillomas.\*

Microdebrider		CO <sub>2</sub> Laser	
Equipment	Cost/Procedure	Equipment	Cost/Procedure
Xomed Shaver	\$147.00	CO <sub>2</sub> Laser	\$292.45
Xomed Blade	\$237.25	Micromanipulator	\$ 80.20
		Smokehouse	\$ 28.15
		Airsafe filter	\$ 56.15
		Miscellaneous	\$ 97.50
Total equipment cost	\$284.25	Total	\$554.45
Use of OR for 1 hour	\$614.90		\$892.40

For children with similar disease severity scores, pain scores were equivalent for those treated using the microdebrider or CO<sub>2</sub> laser (Fig. 3). For children with similar disease severity scores, improvement in voice quality tended to be greater for those treated using the microdebrider, but statistical significance was not achieved ( $P < .388$ ). (Fig. 4). For children with similar disease severity scores, procedure time was shorter ( $P < .05$ ) than for those treated with the microdebrider (Fig. 5). For children with similar disease severity scores, the overall cost of the procedure at our institution was less for those treated using the microdebrider compared with the CO<sub>2</sub> laser (Table I). This is based on the cost of operating room time and the necessity of having specialized nursing in the operating room.

## DISCUSSION

Since the early 1970s, the CO<sub>2</sub> laser using the micro-manipulator has been the instrumentation of choice for debridement of pediatric laryngeal papillomatosis. This instrument has demonstrated excellent hemostatic ability and precision in removal of abnormal tissue. Until recently, the vast majority of pediatric otolaryngologists involved in the care of patients with RRP preferentially used CO<sub>2</sub> laser over other techniques for surgical debridement of papillomas.<sup>9</sup> However, recently, reports in the literature have been appearing regarding the use of the microdebrider for the surgical debridement of laryngeal papillomatosis.<sup>10-12</sup> Although the CO<sub>2</sub> laser has an excellent record based on historical precedent, there are potential down sides to its use as compared with the microdebrider, including risk of laser fire, increased cost, and potentially increased time of procedure. To our knowledge, the current study is the first prospective study comparing the use of the microdebrider versus the traditional technique (CO<sub>2</sub> laser).

Introduction of the specialized airway blade for the microdebrider has made it possible to remove papillomatous tissue from the upper aerodigestive tract while avoiding thermal injury to the underlying or adjacent tissue that occurs when papillomas are ablated with the CO<sub>2</sub> laser. In the present study we found that for patients with disease of equivalent severity, removing recurrent respiratory papillomas using the microdebrider was associated with equivalent postoperative discom-

fort. There was a tendency toward better short-term improvement in voice quality, shorter procedure time, and decreased overall operative cost compared with the standard CO<sub>2</sub> laser treatment.

One weakness of the design of the current study is that parents were not blinded to the treatment, leading to a placebo effect in which they expected less pain and improvement in voice quality when their child had received the new (microdebrider) treatment. Obviously, this would not affect the outcome variables of the duration of the procedure or operation room costs.

Regarding the time and costs we report for the microdebrider and CO<sub>2</sub> laser procedures, other institutions may not set up or charge for procedures in the same way as at our institution. In particular, some institutions may not charge for use of the CO<sub>2</sub> laser equipment but this cost would be partially offset by the cost of an additional registered nurse to assist with the procedure. Also, if a laser-safe endotracheal tube is used, the cost of the equipment for CO<sub>2</sub> laser ablation would be greater. Each surgical team would have to calculate procedure time and costs based on individual factors at their institution.

The current study is a short-term study presenting initial data in a relatively small population of patients. The data obtained in the current study suggest the need for a larger, possibly multi-institutional study to assess long-term results in a large group of patients.

## CONCLUSION

The microdebrider may be an equivalently safe and possibly lower-cost alternative for removal of recurrent respiratory papillomas in children, although additional objective studies are needed to evaluate longer-term risks and benefits of this new procedure.

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