Objective: To assess the advantages of powered instrumentation vs the carbon dioxide laser in treating patients with juvenile-onset recurrent respiratory papillomatosis.

Design: A retrospective study.

Setting: Tertiary care children’s hospital.

Patients: Patients operated on for juvenile-onset recurrent respiratory papillomatosis between January 1, 1999, and December 31, 2000. Papillomas were excised using the microdebrider in one group and the carbon dioxide laser in the second group.

Interventions: Direct laryngoscopy and bronchoscopy, suspension microlaryngoscopy, and excision of papillomas by the carbon dioxide laser or the microdebrider.

Main Outcome Measures: Operative time and postoperative complications.

Results: Seventy-three operations were performed (23 with the laser and 50 with the microdebrider). Sixteen patients were included, 10 with active disease and 5 with disease in remission; 1 was lost to follow-up. They had a mean age of 3.75 years, and the male-female ratio was 7:9. The patients presented mostly with hoarseness (13 [81%]). Four (25%) had soft tissue complications with the laser. The microdebrider was less time-consuming than the laser, although those treated with the microdebrider had more active disease. No factor could be used to measure treatment outcome due to disease variability. Those who were older, female, and African American tended to have less severe manifestations of disease.

Conclusions: The microdebrider proved to be less time-consuming than the carbon dioxide laser when used in patients with juvenile-onset recurrent respiratory papillomatosis. Soft tissue complications were nonexistent. In addition to safety, the microdebrider is more appealing to the surgeon, anesthesiologist, and parents, especially because these children often need subsequent surgical procedures.


Juvenile-onset recurrent respiratory papillomatosis (JORRP) is a challenging disease of viral etiology that is still perplexing parents and otolaryngologists by its unpredictable course. In contrast to the adult form, JORRP is more aggressive, necessitating frequent interventions to ensure airway patency. Although the disease goes into remission in some patients, in others it will never do so; in some, it will even recur after years of remission.

Juvenile-onset RRP affects children who have a mean age of 3.76 years and is considered the second most common cause of hoarseness in the pediatric age group. A triad has been noticed in several of these children, consisting of firstborn child, vaginal delivery, and a young mother. It is a relatively rare condition estimated to occur in 4.3 of 100 000 children younger than 14 years in the United States.

To communicate better among otolaryngologists dealing with RRP, a staging system has been agreed on, whereby the patient receives a clinical score depending on the presenting symptoms and a site score relying on the intraoperative findings. Papillomas can arise at different sites inside the aerodigestive tract, with a predilection to areas where squamous and respiratory epithelia meet. The most commonly involved area is the larynx.

A wide variety of treatment options have been suggested and studied since JORRP has been recognized. However, most researchers agree that surgery is the primary modality. Knowing that the normal-appearing tissue adjacent to the papillomas may harbor the human papillomavirus, especially in the active more aggressive form, eradication is not possible and, therefore, treatment should be conservative. To excise these papillomas, the carbon dioxide (CO2) laser has been found by many surgeons to be the best tool, allowing precise and bloodless vaporization of the lesion.

Recently, powered instrumentation was introduced in laryngology after it was
PATIENTS AND METHODS

All patients operated on for JORRP at Children’s National Medical Center using the microdebrider were included in this study. These patients were seen between January 1, 2000, and December 31, 2000. For comparison purposes, the patients operated on for JORRP using the CO2 laser during the preceding year (January 1, 1999, to December 31, 1999) were also enrolled in our study.

Knowing that different patients have differences in the severity, extent, and recurrence rate of the disease, we included the same patients in both groups (where applicable) to control these variables.

The medical records of these patients were reviewed, including clinic visits, operative reports, marked preprinted laryngeal sketches, anesthesia notes (preoperative and postoperative), and the clinical and site scores.

The clinical score relied on the history given by the parents at surgery regarding the quality of the patient’s voice, the presence of stridor or respiratory distress, and the urgency of the surgical intervention. The site score depended on the number of sites involved and the bulkiness of the lesion at each site, as determined intraoperatively by the surgeon.

Demographic information, including date of birth, sex, and race, was collected. The age at initial presentation and the presenting symptoms were noted. Intervals between operative sessions and the operative time were calculated. Any reported intraoperative and immediate or delayed postoperative complications were reviewed.

Because the operative time documented in the medical records included only the actual operative procedure, we asked the experienced operating room staff to time the preparation for each of the 2 methods studied herein. This additional factor (preparation time) was added to the surgical time to obtain the total operative time of the procedure:

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\text{Total Operative Time} = \text{Actual Operative Time} + \text{Preparation Time}.
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We studied the feasibility of using the number of operative sessions, the interval between these sessions, the clinical score, and the site score as a measurement of treatment outcome. The age at diagnosis, sex, race, and presenting symptoms were evaluated as possible predictors of disease severity.

Parents were called and asked by the clinical coordinator at our department about their impression concerning the immediate postoperative course following the use of the microdebrider compared with what they used to notice with the CO2 laser, and their opinion was noted.

Sixteen patients with JORRP were operated on between January 1, 1999, and December 31, 2000. During the study, the disease in 5 patients (31%) entered remission; 1 patient was lost to follow-up. The remaining 10 patients underwent 73 operative sessions, with a mean interval between surgical procedures of 10 weeks; the CO2 laser was used in 23 sessions, and the microdebrider was used in 50 sessions (Table). The mean age of the patients at first presentation was 3.75 years, with a male-female ratio of 7:9.

The most common presenting symptoms were hoarseness (13 patients [81%]), respiratory distress (8 patients [50%]), and stridor (2 patients [12%]).

No serious intraoperative complications were noted, except for severe glottic edema noted in 1 patient after using the CO2 laser. All the postoperative complications were delayed, including the anterior glottic web (in 3 patients [19%]) and posterior glottic scarring (in 1 patient [6%]), which occurred when the CO2 laser was the tool of choice. Tracheotomy was needed in only 1 case before presentation and was performed in another institution to secure the airways in a patient with extensive laryngotracheal disease. The patient later underwent decannulation uneventfully when the disease activity settled down.

The severity of the disease, as reflected by the site score, was the same or greater in patients treated with the microdebrider than in those treated with the laser, except in 1 patient. As expected, more operative sessions were needed in those treated with the microdebrider. However, the operative time (actual and total) was markedly shorter with the microdebrider (Table). The lowest preparation time was estimated to be 15 minutes for the laser and 5 minutes for the microdebrider.

The interval between the operative sessions was set by the surgeon (G.H.Z.) at the end of each operation. The chosen period depended on the severity of the disease, as reflected by the patient's symptoms and the intraoperative findings, and on the recent time intervals used for that particular patient. This interval highly influenced the number of operative sessions needed for each patient. The clinical score was often unreliable, depending on the accuracy of parents’ history. Therefore, all 3 of these factors could not be considered as possible measurements of a treatment outcome.

The site score was useful in reflecting the severity of the disease, especially when coupled with an intraoperative drawing. However, the variability of the disease even in the same patient, regardless of the treatment used or the surgical interval set, makes its use in measuring treatment outcome unrealistic.

The age at onset of the disease was highly predictive of the disease severity pattern: the younger the patient, the more severe the disease. The disease seemed to have a higher chance of entering remission in African American female patients, while the presenting symptoms had no predictive value.

The parents of 7 patients in whom the CO2 laser and the microdebrider were used during the study period were asked to comment freely on any differences they noted when the microdebrider was introduced in treating the papillomas. Five agreed that the operative session was shorter, their child was more comfortable postoperatively, and their child could phonate more clearly sooner. In general, parents were tried successfully in orthopedics and rhinology. We started using angled-tip 3.5-mm laryngeal and subglottic blades (Skimmer; XOMED Surgical Products, Jacksonville, Fla) (Figure) on all patients with JORRP who were being treated at Children’s National Medical Center around the beginning of 2000. This retrospective study assesses the advantages of using the powered instrumentation vs the CO2 laser.
more comfortable with the idea that their child was not exposed to the potential risks of the laser, which they always think about during each session.

The CO2 laser has long been used to excise papillomas, starting in the early 1970s. It has been favored over conventional instruments because of its hemostatic ability (while vaporizing papillomas) and its relative precision, especially with the introduction of the micromanipulator. In a survey published by Derkay in 1995, 92% of the respondents used the CO2 laser as the method of choice in treating papillomas.

However, the CO2 laser is not without potential risks and is grossly time-consuming. The complications related to the CO2 laser on the airways are well-known and include airway fire, airway perforation, and injury to distal airways. All of these can predispose to airway stenosis or distal spread of the disease. It is believed that traumatized epithelium may heal by squamous metaplasia, forming an ideal site for human papillomavirus infection, which may be subclinical first and then manifest later as papillomas at a new site.

The patient, the surgeon, and the operating room staff may inhale the surgical plume, which may contain the human papillomavirus DNA, as demonstrated by Kashima et al. This DNA may still be infectious, especially if it lodges in an abraded mucosal surface. Moreover, the plume contains combustion products and dispersed particles that can be harmful to the airways, as shown in an animal study performed by Freitag et al. in which decreases in arterial PO2 and tracheal cilia motility were noted.

Postoperative healing has also been a problem with the CO2 laser. Durkin et al. demonstrated in an experiment on dogs a delay in vocal cord wound healing when the CO2 laser was used vs the conventional microcup forceps. The effect of the laser was not limited to the epithelial layer treated but got beyond it, despite precise control of the used beam. In the submucosa, for example, a giant cell reaction was noticed, probably due to a char effect. At the vocalis muscle level, edema, and even destruction, was found, which led to fibrosis later.

These complications were actually encountered in patients with RRP treated by the CO2 laser. Crockett et al. reported a 36% incidence of soft tissue complications, including an anterior glottic web and posterior glottic and interarytenoids scarring. Moreover, a stroboscopic examination of patients whose disease was in remission revealed abnormalities in vocal fold function. Benjamin and Parsons found a 20% rate of an anterior glottic web in their patients, while Ossoff et al. reported an incidence of 13.6% (true vocal cord scarring and posterior glottic webs). The rate of complications was related to the surgical technique used rather than to the number of surgical sessions or the interval between the sessions. In our series, this rate
reached 25%, including an anterior glottic web and posterior glottic scarring.

To avoid these potential hazards and complications, we elected to use the microdebrider on all our patients with JORRP. Our rate of soft tissue complications decreased to zero after we adopted this new instrument.

During the past decade, powered instrumentation gained widespread use in the field of rhinology. This success encouraged the introduction of similar tools to be used on the larynx. Rare reports appeared recently in the English-language literature describing the use of the microdebrider in excising laryngeal papillomas. Myer et al12 described the function of this instrument, found it safe and efficient in removing laryngeal lesions, and considered it a valuable adjunct in treating RRP, especially when the lesion is bulky, avoiding the disadvantages of the CO2 laser in cost, required personnel, thermal injury, and staff injury. We found similar advantages, yet we used this instrument as an alternative to the laser on all our patients, whether they had bulky lesions or not and whether the diagnosis was new or they underwent multiple procedures.

In another report by Patel and Mackenzie,13 the microdebrider was used on 5 adult patients with RRP who were previously treated with the CO2 laser. These researchers concluded that the new technique is faster and safer and that the patients found the postoperative recovery with this method the same or better than that with the CO2 laser. To assess the time efficiency of this new technique, we measured the actual and the total operative time and compared both methods. We found that the microdebrider was by far less time demanding (Table). To avoid the differences existing among patients in age, sex, race, and severity of disease, each patient was considered her or his own control. More severe manifestations of disease (ie, a higher site score) usually means more papillomas to excise and, thus, a higher operative time, yet this variable was controlled by the fact that most of the patients treated with the microdebrider had an equal or a higher site score than those treated with the laser but still required a shorter operative time. Concerning the postoperative period, our findings were similar to those of Patel and Mackenzie, except that our patients belonged to the pediatric age group and, therefore, we relied on the parents’ opinion.

Because we are adopting a new technique, we tried to assess the feasibility of measuring the treatment outcome. However, no single factor could be used for that purpose. The unpredicted variation in disease activity makes it hard to measure the benefit of any mode of treatment. We tried to identify predictors of disease severity. Younger patients had more active disease, and the disease entered remission more often in African American female patients.

Therefore, powered instrumentation seems to be promising in the treatment of RRP. It provides a safer, faster, and cheaper way to excise laryngeal papillomas repeatedly. Until a cure is found for this disease, it may become the method of choice to keep patent airways in these patients.

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REFERENCES


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