
Applications of the diode laser in otolaryngology - Original Article

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Abstract

We undertook a study to determine the usefulness and effectiveness of a relatively new, portable 980-nm wavelength diode laser with a fiberoptic delivery system. We tested the laser in several clinical situations, both in the operating room and in the office. We used it while performing 14 turbinate reduction procedures, one nasal polypectomy, one ablation of an oral papilloma, and one photocoagulation of nasal telangiectasias. Our preliminary findings indicate that the use of this laser was helpful in alleviating nasal congestion in the patients with turbinate dysfunction and in controlling epistaxis in the patient with telangiectasias. It was also effective in treating the polyp and papilloma patients. We did not experience any intra- or postoperative complications. The laser's flexible fiber delivery system is compatible with hollow instruments, allows for coaxial vision, and is ideally suited for intranasal use. Its portability and functional diversity make it an attractive alternative to the conventional carbon dioxide, argon, and neodimium:yttrium-aluminum-garnet lasers.

Introduction

Otolaryngologists use lasers for many surgical applications. Three of the most commonly used devices are the carbon dioxide ([CO.sub.2]), argon, and neodimium:yttrium-aluminum-garnet (Nd:YAG) lasers. The functionality of each is based on the action of electromagnetic radiation at a particular wavelength on different tissues in the body.

Within the past few years, a lightweight, portable, 980-nm wavelength diode laser with a fiberoptic delivery system (CeramOptec; Bonn, Germany) was introduced to the field of otolaryngology. Light at its particular wavelength is absorbed by tissues relatively independent of tissue type, which allows for homogeneous distribution at the surgical site. This laser compares favorably with several of the other thermal lasers used in otolaryngology; its tissue-cutting effect is comparable to that of the [CO.sub.2] laser, its coagulation effect is comparable to that of the argon laser, and it results in a slightly higher degree of absorption by tissue than does the Nd:YAG laser.

Materials and methods

The laser is housed in a portable 18 x 24 x 37-cm case and weighs 10 kg, so it can be easily transported between the office and the operating room. The length of set-up time is generally less than 5 minutes, and no warm-up period is necessary. The laser transmits radiation via a flexible quartz fiberoptic cable that can be used with a set of intranasal handpieces. These handpieces allow for optimal laser focusing. The laser-delivery technique is similar to that of other intranasal instruments.

In the office setting, we used the laser to perform turbinate volume reduction surgery on eight patients. After administering a topical anesthetic and a decongestant spray to the nasal cavity, we applied the laser in a near-contact mode, in which the tip of the laser was evenly brushed along the hypertrophied mucosa while it remained at a distance of 2 to 3 mm from the surface. We experienced no incidence of bleeding, and no patient experienced excessive pain. We found that best results were achieved when the laser was set at 4 to 6 W, and there was minimal postoperative crusting. We applied the laser through a 600- μ m-diameter fiber, usually for 100 to 140 seconds.

In the operating room, we used the laser to perform turbinate volume reduction surgery on six patients, nasal polypectomy in one, ablation of an oral papilloma in one, and photocoagulation of telangiectasias in a patient who had Osler-Weber-Rendu disease (hereditary hemorrhagic telangiectasia). For turbinate surgery

and the polypectomy, we used settings similar to those that we used in the office. For ablating the oral papilloma, we used a 600- μ m fiber at 12 W in both contact and near-contact modes; minimal bleeding was noted at the surgical site, and it responded to laser coagulation. In the patient with Osler-Weber-Rendu disease, we used a 600- μ m fiber at 4 to 6 W in near-contact mode to cauterize the telangiectasias.

Results

Our postoperative follow-up ranged from 1 to 8 weeks. Endoscopy revealed a decrease in turbinate hypertrophy in 12 of the 14 patients (85.7%) who had undergone turbinate reduction. Although nasal eschar formation was minimal, we did note that it was more common among those patients who had received more than 8 W of power. Subjectively, 12 patients reported improvement in their nasal breathing. There were no postoperative complications. The patient with Osler-Weber-Rendu disease had no further incidence of bleeding following surgery.

Discussion

The diode laser has been subjected to extensive experimental investigation, including pathologic and histologic studies to determine appropriate dosimetry (C. Morello, MD; unpublished data; 1998). It has been used in both dental and urologic (1) procedures as well as in veterinary medicine. (2) Its use is being studied in clinical trials for wound care and the treatment of facial and leg telangiectasias, endobronchial tumors, and disk compression.

There are three distinct application techniques for the diode laser:

- * First, it can be used in contact mode, in which the tip of the fiber is placed directly on the surface of the tissue. This mode is effective for both photocoagulation and vaporization of tissue, depending on the power density. At the low- or mid-power range, coagulation occurs; at a higher level, vaporization occurs.
- * Second, the laser can be used in near-contact mode, in which the tip of the fiber remains several millimeters apart from the tissue. This mode is largely used for tissue photocoagulation.
- * Third, the laser can be used for interstitial laser-induced thermotherapy, a minimally invasive method of treating both benign and malignant tumors. The laser is placed through puncture holes in the skin, and its energy is absorbed by local tissues. This hyperthermic state causes either immediate or delayed tissue necrosis via coagulation.

The 980-nm diode laser emits light in the near-infrared range (800 to 1,100 nm). This wavelength allows it to be transmitted via a thin, flexible quartz fiberoptic cable. Tissue response at this wavelength is determined by the absorption of water as well as by absorption of endogenous components such as hemoglobin and melanin. As a result, the diode laser has a large (up to 10 mm) penetration depth in biologic tissue, which makes it ideal for photocoagulation. By contrast, the [CO.sub.2] laser has a very shallow penetration depth and thus is best used for tissue vaporization.

The potential role for a portable, lightweight, versatile laser with the properties of the [CO.sub.2] argon, and Nd:YAG lasers is quite large. Our preliminary results with this laser are encouraging, and we have demonstrated its clinical usefulness. Moreover, the fact that this laser can be applied in conjunction with topical anesthesia alone is testament to its convenience.

References

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