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Non-contact applications of Nd:YAG laser in nasal surgery*†

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SUMMARY *Since its introduction into clinical medicine in 1976 the Nd:YAG laser has found its use also in nasal surgery. One hundred and twenty-two patients with different lesions of the nasal mucosa and skin (septal angiectasies, benign and malignant tumors, port wine stains, verrucas, et cetera) were treated with Nd:YAG laser. We employed the non-contact technique using focussing handpiece of the coagulation Nd:YAG laser MediLas 2 from MBB Company with an output power of 100 W. All patients were treated on an out-patient basis. Depending on the size, quality and site of the lesion different power and exposure time of laser application is used. The results show very good functional and cosmetic effect in 95% of cases. The ideal power and exposure settings for every type of lesions in the nasal region are discussed.*

Key words: Nd:YAG laser, nasal surgery

INTRODUCTION

Since the development of the ruby laser (Maiman, 1960), a series of newer laser devices have been put to practical use, and have led to advances in a variety of medical fields (Snitzer, 1961; Yahr and Strully, 1966; Apfelberg et al., 1980; Jako, 1972; Daniell, 1986). In 1977 the Nd:YAG laser saw its first clinically significant application when Kiefhaber and co-workers used it to control massive gastrointestinal bleeding (Kiefhaber et al., 1977). Since then its clinical application has spread to nearly all fields of medicine and today the Nd:YAG laser has also become a useful instrument in nasal surgery. This paper describes the method and results of the treatment of multiple categories of lesions in the nose and paranasal regions in 122 patients.

MATERIAL AND METHODS

Theoretical considerations

Lasers differ according to the type of medium used and the resulting wavelength, i.e. the colour of the light produced. Nd:YAG laser's active medium is a crystal of yttrium/aluminium garnet, with 1% of the yttrium atoms being replaced by neodymium ions, and emits invisible light in the near-infrared range at 1,064 nm (Dixon, 1983). The effect of the Nd:YAG laser on tissue depends on: (1) the type of target tissue (how it absorbs or scatters the light); (2) the power density (the power output of the laser in relation to the spot size of the focus beam); and (3) the duration of application. The total energy supply is a function of time multiplied by the power output and is measured in kJ. Because of its penetration depth (>5 mm), the Nd:YAG laser has the effect of a coagulation instrument which can seal off blood vessels with a diameter of up to several millimeters. By selecting the appropriate power settings the coagulation effect can also be limited to less than 0.2 mm if required. Laser beam energy can be transmitted down a quartz fibre inserted in a focussing handpiece or through the biopsy channel of a fibre-optic endoscope. We used a coagulation Nd:YAG laser MediLas 2 (MBB Company) with an output power of 0.5-95 W employing a non-contact technique with a focussing handpiece. A continuous or pulsed beam can be used with exposure times varying from 0.5-2 s. The handpiece is held perpendicular to the treated area with a focal length of 1-5 cm and a spot size of 0.5-2 mm. Good study of lesion parameters (type or quality, size, location, previous therapy) before starting treatment is extremely important. The treatment can be performed in one or more sessions.

Patients

We treated 122 patients, 73 females and 49 males, with an average age of 37 years (ranging from 12 to 87 years). All patients were treated under topical epimucosal or infiltration anaesthesia on an out-patient basis. Categories of the lesions treated with the Nd:Yag laser are summarized in Table 1.

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Table 1. Categories of lesions.

lesion	Number of patients
benign tumours	
– capillary haemangioma	6
– fibroma	2
– papilloma	1
malignant tumours	
– basocellular carcinoma	7
– spinocellular carcinoma	1
hypertrophic rhinitis	
– vasomotor	21
– allergic	7
hereditary haemorrhagic teleangiectasia	41
verrucas	28
nasal skin teleangiectasia	5
naevi flammei	3
total	122

RESULTS AND DISCUSSION

Benign and malignant tumours

Single laser pulses with an exposure time of 0.5–2 s were applied (Table 2). Laser power varied between 15 and 40 W. The flat tumour lesions needed less power and lower exposure times than the nodular lesions. Functional results were excellent with no signs of recurrence during follow up, ranging from 1–3 years.

Table 2. Categories of lesions and laser power settings.

lesion	power (W)	exposure time (s)
tumours	15–40	0.5–2
hypertrophic rhinitis	10–15	0.5–1
hereditary haemorrhagic teleangiectasia	10-15	0.5
verrucas	10–25	0.5–1
nasal skin teleangiectasia	5–10	0.5
naevi flammei	5–15	0.5–1

Low risks of infection and bleeding and a lower risk of metastasis by temporary sealing off of lymphatic and blood vessels offer some advantages in relation to conventional tumour surgery. Scarring after the treatment of skin lesions allowed a very good cosmetic effect, even in patients with more extensive skin capillary haemangiomas. Simple and precise beam guidance of the laser energy administered permit the treatment in anatomically unfavourable locations, such as the nasal canthi. They also permit out-patient treatment, especially in patients with a weakened general condition who can not be subjected to general anaesthesia.

Hypertrophic rhinitis

Patients with hypertrophic rhinitis were submitted to therapy with antihistamines, decongestants and cortisone-containing nasal sprays before being treated with laser. The anterior one-half or two-thirds of the inferior turbinate were coagulated by cross-hatching the mucosa with an average power of 10-15 W and an exposure time of 0.5–1 s. Thirteen patients with vasomotor rhinitis and 4 patients with allergic rhinitis have been followed for more than 1 year, and another 11 patients for more than 6 months. In the immediate post-operative period oedema and crusting were present during the first 2 weeks, and the patients were given isotonic saline solution for cleansing the nasal cavity thrice a day. After 4 weeks the final functional result was obtained. In the follow-up none had complications of atrophy or synechia. After laser treatment only the inferior turbinate with power settings from 10–15 W during maximally 1 s, no greater areas of mucosal atrophy were seen, not even after one year. Two-thirds of those patients had less drainage and nasal congestion with an improved airway. In 4 patients with an insufficient improvement after 3 months we repeated the laser therapy with the same power settings, and subsequent improvement was obtained.

Hereditary haemorrhagic teleangiectasia

The average power settings were 10–15 W with an exposure time of 0.5–1 s. The laser was used in a circular, rotatory motion around the edges of the central vessel or vascular stalk. In each session we coagulated only one side of the septum in order to prevent possible perforations. Seventeen of our patients suffered from chronic renal disease and were treated with haemodialysis. They experienced frequently attacks of severe epistaxis. After only one session of photocoagulation we noted a marked decrease in the severity and frequency of epistaxis.

Because of its precise, non-contact use without dependence on electrode application, pressure, electrode form and the absence of possible leakage currents – often leading to irritation of the mucous membranes and nerves – laser coagulation is superior to electrocoagulation.

Verrucas, nasal skin teleangiectasia, and naevi flammei

Depending on the size and depth of the lesions we used different power densities, varying from 5–25 W, with exposure times of 0.5–1 s.

Because the skin of the nose is very thin, there is a higher risk of scarring after Nd:YAG laser coagulation, so the power settings and exposure times should be chosen very carefully. By water cooling of the treated area a significantly better cosmetic effect can be obtained.

Our results show that the Nd:YAG laser qualifies for the therapy of cutaneous nasal benign and malignant tumours, pre-cancerous lesions, septal teleangiectasia with severe and moderate recurring epistaxis, vasomotor and allergic hypertrophic rhinitis, and some aesthetic cutaneous disorders of the nose, such as naevi flammei, teleangiectasia and verrucas. Nd:YAG laser properties offer some clinical advantages: (1) precise measurement and control of power density and exposure time; (2) precise and contactless handling in a dry surgical area; (3) performance under local anaesthesia; (4) low risk of infection and bleeding; (5) lower risk of metastasis by temporarily sealing-off the lymphatic and blood vessels; (6) minimal post-operative oedema and pain; (7) rapid healing with good functional and cosmetic result; (8) easy delivering through fibre-optics; and (9) lower morbidity in palliative treatments. There are also disadvantages, i.e. the equipment is expensive, the need for better safety precautions, and the need for special training of the surgeon. The indications for use of Nd:YAG laser in nasal surgery are summarized in Table 3.

Table 3. Indications for use of Nd:YAG laser in nasal surgery

- malignant tumours of nasal and paranasal skin areas (maximum diameter of 20 mm)
- benign tumours and verrucas of same areas
- naevi flammei
- chronic hereditary haemorrhagic teleangiectasia
- hypertrophic rhinitis not responding to conventional therapy

On basis of various studies on the tissue-coagulation effect and clinical experiences of other authors (Landthaler et al., 1983, 1986; Shapsay and Oliver, 1984; Joffe and Ogura, 1988) as well as our own results, we think that the Nd:YAG laser is a valuable supplement to modern nasal surgery.

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