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Editorial Review

Lasers in rhinology

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The medical use of lasers (light amplification by stimulated emission of radiation) has caught the imagination of both the public and doctors but it is important to remember that just because a procedure can be done with a laser it does not mean that it should be done. Many patients attend with the mistaken belief that if a laser is used their problem will be cured. However, as many nasal symptoms are the manifestation of an ongoing process (for example allergic rhinitis), they can only be palliated temporarily and it is therefore important not to reinforce or raise the expectations of cure.

The range of wavelengths gives rise to different properties which are suited to different types of procedure. For example, whilst the CO_2 laser is relatively inexpensive and the ultrapulse is useful for laser resurfacing of the aging skin[1] and for treating rhinophyma,[2] it has a poor coagulative effect, cannot be transmitted through a flexible fibre and is cumbersome for intranasal use. Most other lasers can be used through a flexible fibre-optic cable and handpieces that include a suction channel for aspirating fumes are increasingly available. An instrument that incorporates a suction channel and an end which can be directed through a 45 degree angle using the handle without removing the device has recently been developed.[3] It is best to choose a delivery device with a small diameter as this will allow better access and visibility.

It is important to appreciate that at optimum power density the laser energy vaporizes or ablates tissue, but if it is used at suboptimal levels, at an oblique angle, or when the beam is not focused or used at low energy levels, then suboptimal ablation can occur. Under these circumstances burnt tissue can accumulate and with continued use in the same area there is a risk of thermal injury as heat is then dissipated through the charcoal. Charcoal cannot be ablated by laser but it can easily be removed by gentle curettage and then laser ablation can be continued as normal on the underlying tissue. Suboptimal ablation can be used to the surgeon's advantage to produce haemostasis when necessary by simply defocusing the beam.

Safety is crucial and patients' eyes should be covered with damp swabs and the laser should be attended by someone whose sole task is to place the laser on standby whenever it is removed from the nose or at the request of the surgeon to 'standby'.

Recent improvements in the potassium titanyl phosphate (KTP) laser have meant that its excellent haemostatic properties can be matched by an ability to ablate bone which is particularly useful in turbinectomy and endoscopic laser-assisted dacryocystorhinostomy (ELDCR). The KTP laser has a 'fluttering' quality as opposed to the shotgun-like noise of the holmium:YAG laser and it can be used in patients on warfarin or aspirin with only a little more pre-operative oozing than in a normal patient.

ELDCR is a recently introduced technique for the relief of epiphora which is primarily due to distal obstruction of the nasolacrimal duct.[4,5] A light pipe placed through the superior punctum and cannaliculus into the sac greatly helps to define the thinnest part of the lacrimal bone and minimize the amount of bone that needs to be ablated before the sac is exposed. Published studies have shown that the success rates are between 60–95 per cent,[6–8] compared to 80–90 per cent for the long-established external DCR approach.[9] Proponents of the ELDCR technique argue that the benefits of a minimally-invasive procedure under local anaesthetic with minimum morbidity outweigh the small decrease in long-term post-operative fistula patency.[4,5] Patients can have this performed as a day-stay procedure and there is minimum bleeding at surgery. Per-operative and post-operative haemorrhage are rare and this is an advantage over external DCR. This is particularly relevant to those patients on warfarin or in whom a general anaesthetic carries an unacceptable risk, or who want to avoid an external scar. The Holmium laser is

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powerful and able to ablate bone but although it has quite good haemostatic properties it splatters and coats the end of the endoscope, especially if there is any oozing. Defocusing the beam is particularly easy with the Holmium laser which has a divergent beam, and its power density rapidly falls off as the delivering fibre is drawn away from the tissue. The KTP laser is more haemostatic, quieter and there is less collateral damage. The results of ELDCR rarely reach the 90–97 per cent reported by external DCR[10] but care needs to be taken in interpreting results. Some series have selected individuals with pure distal obstruction whereas in reality many patients have some proximal involvement as well that may affect outcome. The degree of selection is an influential factor and deserves scrutiny when comparing results. The presence of systemic diseases such as sarcoidosis or Wegener's granulomatosis will also adversely affect the result.[11]

The CO_2, argon and Holmium lasers have all been described as being of benefit in the management of hereditary haemorrhagic telangectasia but any benefit from the scarring of telangiectatic is relatively short-lived and it is only a temporary measure. The initial success of the silastic vestibular obturator[12] worn for eight out of every 24 hours, along with intermittent laser ablation of telangiectatic vessels in combination, works well and looks set to replace Young's procedure.

Cutaneous telangiectases and port wine stains or flat macular lesions can be reduced by a flashlamp pulsed dye laser and need several treatments. Thick cutaneous haemangiomas do not do well with laser treatment.

The Nd:YAG laser works best in contact with nasal mucosa and its energy is scattered widely therefore affecting a relatively larger area and so it is less precise than other lasers. It needs continuous irrigation to reduce collateral thermal damage. It is possible to use it in non-contact mode in turbinate surgery, hereditary haemorrhagic telangiectasia, and skin telangiectasia but it has not been shown to have any advantages over other lasers and its ability to penetrate mean that care is required in selecting its power settings.[13] It is haemostatic but awkward to use. The diode laser has less penetration than the Nd:YAG laser, is more compact than the CO_2 laser and has been used for turbinate surgery in idiopathic rhinitis but it needs further evaluation.[14] The ebium laser offers the promise of well-defined soft tissue ablation but it is less haemostatic than the KTP and holmium lasers and a suitable delivery system is awaited.

Lasers have been used for turbinate surgery in both idiopathic rhinitis and allergic rhinitis when allergen avoidance and medical treatment have failed to control the symptoms of nasal obstruction. Conventional turbinate resection and/or diathermy have a poor reputation for controlling symptoms one year post-operatively.[15,16] In comparison there are some reports of laser turbinate surgery providing an improvement after a year[17,18] and it is associated with less bleeding.[19] Whilst some workers use the CO_2 laser,[20] the KTP laser is preferred by the majority because of its superior homeostatic properties and its ease of use.[21] Crusting and debris follow laser turbinate surgery for four or more weeks in spite of regular douching. It is important to emphasize to patients that laser surgery will not cure their underlying rhinitis and that in future further medical treatment or surgery is not only likely but probable.

The holmium or the KTP laser can be used to debulk residual tumours of the skull base to provide symptomatic relief with good effect to produce an airway and reduce bleeding when a craniofacial resection is no longer advisable.

On an experimental level, low energy level laser energy has been shown to allow cartilage to be shaped *in vitro* while causing little damage to chondrocytes by a process known as solublization of cartilage.[22] Under ordinary conditions, mechanical resistance to cartilage reshaping originates in large forces attracting water to proteoglycan molecules. Under moderate laser heating the internal stress normally present in the cartilage is momentarily reduced when the water bound to the proteoglycan molecules is freed. If the bound-to-free water phase transition is effected without damage to the surrounding proteins a stable modified cartilage configuration may be achieved.[23–26] The results of studies *in vivo* are awaited. The laser has also been used to measure mucociliary wave frequency *in vivo*[27] and to assess mucosal blood flow *in vivo*.[28,29]

The expense of lasers, and the time it takes to set them up and meet health and safety regulations, means that they are used by relatively few enthusiasts in rhinology. Their use has been advocated for a wide range of intranasal techniques[21] but these need to be compared with other forms of surgery before their use can be recommended for other than the specific tasks mentioned in this text when they have been supported by controlled studies. ELDCR has so many advantages for a sizeable proportion of the patients who require nasolacrimal surgery that it is rapidly establishing a place in this area of surgery. For other nasal surgery such as turbinate reduction or inducing submucosal scarring, the vaporization of polyps, tumours, synechiae, papillomas or septal surgery, it has yet to justify its use over other techniques in controlled studies that have measured clinical outcome, surgical time, expense and risk.

References

1 Chernoff WG, Cramer H. Rejuvenation of the skin surface: laser exfoliation. *Facial Plast Surg* 1996;**12**:135–45

2 Simo R, Sharma VL. The use of the CO_2 laser in rhinophyma surgery: personal technique and experience, complications and long-term results. *Facial Plast Surg* 1998;**14**:287–95

3 Sroka R, Rosler P, Ing D, Janda P, Grevers G, Leunig A. Endonasal laser surgery with a new laser fibre guided instrument. *Laryngoscope* 2000;**110**:332–4

4 Sadiq SA, Ohrlich S, Jones NS, Downes RN. Endonasal laser dacryocystorhinostomy – medium term results. *Br J Ophthalmol* 1997;**81**:1089–92

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5 Bakri SJ, Carney AS, Downes RN, Jones NS. Endonasal laser-assisted dacryocystorhinostomy. *Hosp Med* 1998;**59**:210–5
6 Kong YT, Kim TI, Kong BW. A report of 131 cases of endoscopic laser lacrimal surgery. *Ophthalmology* 1994;**101**:1793–800
7 Metson R, Woog JJ, Puliafito CA. Endoscopic laser dacryocystorhinostomy. *Laryngoscope* 1994;**104**:269–74
8 Hehar SS, Jones NS, Sadiq SA, Downes RN. Endoscopic holmium: YAG laser dacryocystorhinostomy – safe and effective as a day-case procedure. *J Laryngol Otol* 1997;**111**:1056–9
9 Bartley GB. The pros and cons of laser dacryocystorhinostomy. *Am J Ophthalmol* 1994;**117**:103–6
10 McLachlan DL, Shannon GM, Flanagan JC. Results of dacryocystorhinostomy. *Ophthalmology* 1980;**11**:427–30
11 Fergie N, Jones NS, Downes RN, Bingham BJG. Dacryocystorhinostomy in nasolacrimal duct obstruction secondary to sarcoidosis. *Orbit* 1999;**18**:217–22
12 Lobo CJ, Hartley C, Farrington WT. Vestibular closure with a silastic obturator – an alternative to Young's procedure in bleeding diatheses. *Rhinology* 1999;**37**:131–2
13 Dobrovic M, Hosch H. Non-contact applications of Nd:YAG laser in nasal surgery. *Rhinology* 1994;**32**:71–3
14 Min YG, Kim HS, Yun YS, Kim CS, Jang YJ, Jung TG. Contact laser turbinate surgery for the treatment of idiopathic rhinitis. *Clin Otolaryngol* 1996;**21**:533–6
15 Warwick-Brown NP, Marks NJ. Turbinate surgery: How effective is it? A long-term assessment. *ORL* 1987;**49**:314–20
16 Jones AS, Lancer JM. Does submucosal diathermy to the inferior turbinates reduce nasal resistance to airflow in the long term? *J Laryngol Otol* 1987;**101**:448–51
17 McCoombe AW, Cook JA, Jones AS. A comparison of laser cautery and submucosal diathermy for rhinitis. *Clin Otolaryngol* 1992;**17**:297–9
18 Cook JA, McCoombe AW, Jones AS. Laser treatment of rhinitis – one year follow-up. *Clin Otolaryngol* 1993;**18**:209–11
19 Levine HL. Lasers in nasal and sinus surgery. In: Schaefer SD, ed. *Rhinology and sinus disease*. St Louis: Mosby, 1998;74–7
20 Kubota I. Nasal function following carbon dioxide laser turbinate surgery for allergy. *Am J Rhinol* 1995;**9**:155–61
21 Bhatt NJ. *Endoscopic Sinus Surgery – New Horizons*. San Diego: Singular Publishing Group, 1997
22 Sviridov A, Sobol E, Jones N, Lowe J. The effect of holmium laser radiation on stress, temperature and structure of cartilage. *Lasers Med Sci* 1998;**13**:73–7
23 Sobol EN, Bagratashvili VN, Sviridov AP, Omelchenko AI, Kitai MS, Shechter AB, *et al*. Study of cartilage reshaping with a holmium laser. *Proc SPIE* 1996;**2623:**544–7
24 Sobol EN, Bagratashvili VN, Sviridov AP, Omelchenko AI, *et al*. Phenomenon of cartilage shaping using moderate laser heating. *Proc SPIE* 1996;**2623**:548–53
25 Sviridov AP, Sobol EN, Jones N, Lowe J. Effect of Holmium laser radiation on stress, temperature and structure in cartilage. *Lasers Med Sci* 1998;**13**:73–8
26 Sobol E, Kitai MS, Sviridov AP, Jones NS, Milner T, Wong B. Heating and structural alterations in cartilage under laser radiation. *IEE J Quantum Electronics* 1999;**35**:532–9
27 Paltieli I, Fradis M, Ben-David J, Podoshin L, Shiti H, Kam Z. In vivo measurement of human nasal mucociliary motility using laser light scattering instrument. *Ann Otol Rhinol Laryngol* 1997;**106**:856–62
28 Porter M, Marais J, Tolley N. The effect of ice packs upon nasal mucosal blood flow. *Acta Oto-Laryngol* 1991;**111**:1122–5
29 Soh KBK. Laser technology in research, diagnosis and therapy in rhinology. *Clin Otolaryngol* 1996;**21**:102–5

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