Diode laser for paediatric airway procedures: a useful tool

Y. Bajaj, D. Pegg, S. Gunasekaran, L. C. Knight

**Introduction**

Lasers have been used in the treatment of various laryngeal lesions as the experience reported by Strong and Jako (1) with the clinical use of carbon dioxide laser in larynx. Despite earlier criticism, endoscopic laser treatments have gained widespread acceptance and have been used successfully in laryngeal surgery (2). Most of the procedures involve either excision or vapourisation of the tissues. A wide range of lasers have been used on the larynx. Diode laser is a portable and relatively inexpensive laser which is delivered via a fine glass fibre held probe. The objective of this study was to report our experience with the use of diode laser in a variety of paediatric airway pathologies. **Methods:** In this study, 90 diode laser laryngeal procedures were performed on 31 patients in the age range of 1 month to 16 years at the time of the operation. The follow up after the procedure has been in the range of 6 months to 3 years. **Results:** As per our records, 19/31 (61.3%) patients have been cured of their initial pathologies and were not under further review, 3/31 (9.6%) were having repeated laser treatments. The remaining 9/31 (29.0%) had to undergo further treatment. There was no laser-related intra-operative or postoperative complications. **Conclusions:** Diode laser is a good tool for several paediatric laryngeal pathologies. The ability to guide the laser light using the flexible glass fibre directly onto the area requiring vapourisation enables very precise treatment.

**SUMMARY**

Objective: A wide range of lasers have been used in the larynx. Diode laser is a portable and relatively inexpensive laser which is delivered via a fine glass fibre held probe. The objective of this study was to report our experience with the use of diode laser in a variety of paediatric airway pathologies. **Methods:** In this study, 90 diode laser laryngeal procedures were performed on 31 patients in the age range of 1 month to 16 years at the time of the operation. The follow up after the procedure has been in the range of 6 months to 3 years. **Results:** As per our records, 19/31 (61.3%) patients have been cured of their initial pathologies and were not under further review, 3/31 (9.6%) were having repeated laser treatments. The remaining 9/31 (29.0%) had to undergo further treatment. There was no laser-related intra-operative or postoperative complications. **Conclusions:** Diode laser is a good tool for several paediatric laryngeal pathologies. The ability to guide the laser light using the flexible glass fibre directly onto the area requiring vapourisation enables very precise treatment.
procedure all the patients were given a single dose of intravenous steroid (dexamethasone) by the anaesthetist.

**Results**

In this study, 90 diode laser laryngeal procedures were performed on 31 patients in the age range of 1 month to 16 years at the time of the operation. The procedures in this study were performed between January 2004 and September 2007. The details of diagnosis in this study group were as per Table 1. There was more than one laryngeal pathology in many patients. The number of procedures performed were listed in Table 2 (Figures 1–3). In few patients more than one procedure was performed at the same sitting. In general patients with subglottic stenosis and recurrent respiratory papillomatosis had to undergo multiple laser procedures. There were no laser-related intra-operative or post-operative complications. The number of laser procedures performed on individual patients has been listed in Table 3. One patient, who had two laser procedures for choanal stenosis, has not been included in this study concentrating on laryngeal pathology.

The patients in this study have been under regular follow up. Follow-up duration has ranged from 6 months to 3 years. As per our records 19/31 (61.3%) patients have been cured of their initial pathologies and were not under further review.
Another 9/31 (29.0%) had to undergo different operations (Table 4). The remaining 3/31 (9.6%) (all three recurrent respiratory papillomatosis) are undergoing repeated laser and other adjuvant treatments.

### Table 3 Number of laser procedures per patient

<table>
<thead>
<tr>
<th>Number of laser procedures</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
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<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
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<tr>
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<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 4 Operations after unsuccessful laser treatment

<table>
<thead>
<tr>
<th>Operation</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laryngotracheal reconstruction</td>
<td>4-cured</td>
</tr>
<tr>
<td>Awaiting laryngotracheal reconstruction</td>
<td>2</td>
</tr>
<tr>
<td>Dilatation</td>
<td>2 (1-cured; 1-repeat dilatations)</td>
</tr>
<tr>
<td>Division of web with microscissors</td>
<td>1-cured</td>
</tr>
</tbody>
</table>

Another 9/31 (29.0%) had to undergo different operations (Table 4). The remaining 3/31 (9.6%) (all three recurrent respiratory papillomatosis) are undergoing repeated laser and other adjuvant treatments.

### Discussion

A variety of different lasers have been used for procedures on the larynx, each with its own advantages and disadvantages. The CO2 laser with a wavelength of 10,600 nm has been used in the management of laryngeal disorders frequently. The diode laser has been recently being used for ENT procedures (3). The diode laser has excellent haemostatic properties as a result of high absorption in melanin and haemoglobin in the near-infrared portion of the spectrum (810 nm) (4).

The carbon dioxide laser with a wavelength of 10,600 nm is not colourimetrically absorbed, but is absorbed by water. Thus, laryngeal soft tissue is vapourised by CO2 laser because of high percentage of intracellular water (5). The Thulium:YAG laser with wavelength of 2000 nm has properties intermediate between the pulsed dye and CO2 laser. Its tissue interaction is closer to CO2 laser with greater thermal penetration in soft tissues. The pulsed dye laser wavelength 585 nm is absorbed preferentially by haemoglobin, which give its relatively tissue sparing and microvascular sparing properties. The potassium titanyl phosphate (KTP) laser with a wavelength of 532 nm is selectively absorbed by haemoglobin and not at all by water and offers an immediate and efficient vapourisation of tissues (6).

The advantages of laser excitations are that the procedures are minimally invasive, time saving and recovery is potentially faster (7). The specific advantage of the diode laser is that it is an economic contact laser delivered via a fine glass fibre. Like other fibre optically delivered lasers, this allows the surgeon to hold the fibre in a pencil-like holder (or guidance instrument) and manipulate the fibre tip accurately. In combination with a hand-held fibre and rigid endoscope to visualise the treatment area, great accuracy can be simply achieved. The fibre tip can be directed ‘around corners’ and into lesions providing a much easier manipulated laser than the commonly used CO2 laser, delivered in a straight line via a micromanipulator mounted on a microscope from a distance of 400 mm.

The development of fibre-guidance instruments enabled a precise and effective endolaryngeal laser surgery by fibre-guided laser lights such as Nd:YAG, diode, argon and KTP laser (8). The results of Nd:YAG laser using a specially designed instrument for fibre guidance with a malleable tip to move the fibre end precisely has been reported (8). This study reported on five patients with recurrent respiratory papillomas treated effectively with Nd:YAG laser using the fibre-guidance instrument. No acute perioperative or postoperative complications were reported in these patients. On reviewing the English literature there were no reports of treatment to paediatric airway pathologies using diode laser.

Koufman et al. (5) have reported on unsedated office-based laser surgery of the upper aero-digestive tract using flexible laryngoscope in adults. In their study they have used three different lasers: the pulsed dye laser, carbon dioxide laser and the Thulium:yttrium–aluminium–garnet laser in 433 patients with a 0.9% incidence of minor complications.

Fibre-based Thulium laser also has been used on the larynx by Zeitels et al. (9) in their series of 74 adult patients using both flexible and rigid laryngoscopes with good results. They judged haemostasis to be better with Thulium laser when compared with CO2 laser for en bloc laryngeal cancer resections. Zeitels et al. (10) have also reported good results with 532 nm pulsed KTP laser through the channels of flexible laryngoscopes as office-based procedure in 72 patients with glottic dysplasia and papillomatosis.

Low-powered diode laser at power of 400 mW has been used experimentally in canine models to weld mucosal grafts in the larynx. This is achieved by spot welding at the edges of the free graft (2). The diode
laser is a portable device that can provide good soft tissue welding (2).

Diode laser has been used in six cases of skull base tumours with intracranial extension to vapourise the residual tumour after surgical excision (11). The authors have suggested that use of diode laser in these cases avoided traction of the nerves and vessels. The diode laser has also been successfully used for interstitial laser ablation of 112 cases of osteoid osteoma (12).

Recurrent respiratory papillomatosis is the most common benign neoplasm of the larynx in children. The application of different laser systems such as CO₂ (13,14), pulsed dye laser (15), argon plasma coagulation (16), KTP laser (10,17) and Nd:YAG (8) have been discussed in various clinical studies. This study describes use of diode laser in these patients. Because of its good coagulation capabilities, the papillomas can be treated up to the infected basal layer, which are thought to be responsible for regeneration of the papillomas (14).

In this study, hand-held diode laser has been used in a variety of different pathologies in the paediatric larynx with good outcomes. Sixty-one per cent patients in this study have been successfully treated using only diode laser treatment. We have had no laser-related complications in this study group. We have not used the diode laser for many aryepiglottoplasties as in our institution we favour sharp dissection (18). We do not have data to suggest that diode laser works any better than other laser systems but find it easy, efficient and safe to use.

Conclusions
Diode laser is a good effective tool for paediatric laryngeal pathologies requiring laser treatment. The ability to guide the laser light using the flexible fibre directly onto the area to treat under rigid fibre optic visualisation, provides precise treatment.

References


13 Dedo HH, Kenneth CY. CO₂ laser treatment in 244 patients with respiratory papillomatosis. Laryngoscope 2001; 111: 1639–44.


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