CLINICAL APPLICATIONS OF DIODE LASERS IN ORAL SURGERY: A REVIEW

Doriana Agop-Forna *, Cosmin Creatu, Claudiu Topolceanu,
Mihaela Sălceanu, Decebal Vasincu, Norina Forna

Faculty of Dental Medicine, U.M.F. “Grigore T. Popa” Iasi

Correspondent author: Lecturer PhD Agop-Forna Doriana; e-mail dr.doriana.forna@gmail.com

Abstract

The goal of the diode lasers use in oral surgery is to overcome the disadvantages experienced in conventional oral surgical procedures and to provide minimally invasive procedures with lowest discomfort for patients. The possibility to use diode lasers in surgical procedures on soft oral tissues is due to the absorption of laser beam by tissue pigment and haemoglobin while it is poorly absorbed by hydroxyapatite and water. Diode lasers are especially used in aesthetic procedures such as gingival recontouring and gingival depigmentation, periapical surgery, operculectomy, and pro-prosthetic surgical procedures such as remodeling of mucosa on edentulous sites, dental crown lengthening, frenectomies and vestibuloplasty. Diode lasers are also recommended for the removal of oral benign lesions (ranula, mucocele, pyogenic granuloma, gingival hyperplastic lesions, fibrous hyperplasia, epulis fissuratum, hemangioma).

Key words: lasers, diode, oral surgery, pro-prosthetic stage

Introduction

The goal of the use of surgical lasers in dentistry is to overcome the disadvantages experienced in conventional oral surgical procedures and to provide minimally invasive procedures with lowest discomfort for patients (1,2,3). Diode lasers (810-1064 nm) are the most used lasers in dentistry due to small volume, low price, and ease of use compared with other categories of lasers (2,3). The possibility to use diode lasers in surgical procedures on soft oral tissues is due to the absorption of laser beam by tissue pigment and haemoglobin while it is poorly absorbed by hydroxyapatite and water (4). The most researched wavelengths of diode lasers re 808nm, 810nm and 940nm. Further studies are required to compare advantages and limits of these wavelengths and to determine the best choice in the oral surgery. Diode lasers are especially used in aesthetic procedures such as gingival recontouring and gingival depigmentation, periapical surgery, operculectomy, and pro-prosthetic surgical procedures such as remodeling of mucosa on edentulous sites, dental crown lengthening, frenectomies and vestibuloplasty (6, 7). The researches related to the effectiveness and safety of diode lasers in the removal of small exophytic lesions reported easy application, proper coagulation, the absence of suture and low levels of inflammation and pain, lower
healing and recovery time (7). Thus, diode lasers are also recommended for the removal of oral benign lesions (ranula, mucocele, pyogenic granuloma, fibrous hyperplasia, epulis fissuratum, hemangioma).

Material and Methods
A comprehensive search of the literature was performed until December, 2019 in the database Pubmed/MEDLINE. The following combination of terms was used for search: diode laser AND oral surgery. Inclusion criteria were as follows: full-text articles, published in English language between 2010 and 2020, reporting clinical trials and case series performed on human subjects by using high power diode lasers in oral surgery.

Exclusion Criteria: articles published before 2010, in a language other than English, not available in full text, studies assessing only other types of lasers or low-level laser therapy, clinical case reports. 303 articles were found in the first stage of search strategy. In the second stage of the search strategy, 2 independent researchers reviewed all the titles and abstracts and discarded all papers not meeting the inclusion criteria. 17 articles were reviewed after detailed evaluation of the selected papers.

Results
All studies included in review reported the effectiveness and safety of diode lasers when used in the aesthetic gingival procedures, crown lengthening, pro-prosthetic surgical procedures, the removal of gingival and fibrous hyperplasia, and the excision of the oral benign lesions. Table I show the indications of diode lasers in oral surgery as resulted from literature review.

Table I. Indication of diode lasers in the surgery of oral soft tissues

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Oral surgical procedures</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gingivectomy</td>
<td>8,13,14,15</td>
</tr>
<tr>
<td>2.</td>
<td>Removal of gingival hyperplasia and fibrous hyperplasia</td>
<td>11,12,16,17</td>
</tr>
<tr>
<td>3.</td>
<td>Frenectomy</td>
<td>9</td>
</tr>
<tr>
<td>4.</td>
<td>Vestibuloplasty</td>
<td>10</td>
</tr>
<tr>
<td>5.</td>
<td>Gingival depigmentation</td>
<td>14,15</td>
</tr>
<tr>
<td>6.</td>
<td>Excision of oral benign lesions</td>
<td>18-24</td>
</tr>
</tbody>
</table>
Five studies compared the intraoperative and postoperative parameters during oral surgical procedures performed with diode lasers and classic scalpel (8-12). Two studies compared diode lasers and electric scalpel (13,14). All studies found better results for diode lasers regarding posttreatment evolution. Three articles published researches comparing diode lasers with other type of lasers (Er:YAG, CO2) in oral surgical procedures (15-17). Seven articles included studies evaluating the postoperative evolution in prospective studies and clinical cases presentation (18-24). The categories of the investigated oral surgical procedures were as follows: prosthetic surgical procedures (9,10), aesthetic and crown lengthening gingival procedures (8,13,14,15), the removal of gingival and fibrous hyperplasia (11,12,16,17), and the excision of oral benign lesions (18-25). Table II shows brands of diode lasers, wavelengths and producers.

Table II. High power dental diode lasers used in oral surgery

<table>
<thead>
<tr>
<th>Brand</th>
<th>Producer</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>LightStream</td>
<td>RJ</td>
<td>808nm</td>
</tr>
<tr>
<td>EPIC</td>
<td>BioLase</td>
<td>980nm</td>
</tr>
<tr>
<td>Elexxion</td>
<td>Elexxion</td>
<td>810nm</td>
</tr>
<tr>
<td>Picasso Plus</td>
<td>AMD Lasers</td>
<td>810nm</td>
</tr>
<tr>
<td>Picasso LiteTouch</td>
<td>AMD Lasers</td>
<td>810nm</td>
</tr>
<tr>
<td>Cheese II</td>
<td>GigaLaser</td>
<td>980nm</td>
</tr>
<tr>
<td>Peralas</td>
<td>Wuhan Dimed</td>
<td>810nm, 980nm</td>
</tr>
</tbody>
</table>

Discussions.

A major issue approached in the studies regarding the lasers use in oral surgery is comparison of the intraoperative stage parameters (bleeding, pain, discomfort) and postoperative evolution (pain, discomfort, healing time) between conventional surgical procedures and diode laser procedures as well as between various type of lasers. One study compared the postoperative evolution in gingivectomies assisted by diode laser with gingivectomies carried out using conventional techniques and assessed that there are significant differences in favor of the laser group with regard to the postoperative evolution of (VAS) pain scores, and postoperative discomfort degree, on the 3rd, 7th and 10th day after surgery (8). The use of diode laser
facilitates the observance of the relationship between the final position of the restoration margin and the biological width of the periodontal space, while the preservation of the biological width of the periodontal space is imperative for the long-term success of the fixed prosthetic restoration.

One study compared the treatment of gingival hyperpigmentation by electric scalpel and diode laser (980nm) reporting significant less postoperative pain experimented by patients in laser group during the first 24 hours comparing to electric scalpel group (14). The analgesic effects of diode lasers can be attributed to the loss of impulse conduction due to the disruption of the sodium and potassium pumps in the cell membrane (14). A comparison between diode laser (808nm) and Er:YAG laser in the treatment of gingival melanin pigmentation reported significantly shorter time with the diode laser group than with the Er:YAG laser group and the absence of melanin recurrence during any follow-up session (13).

In the excision of gingival hyperplasia by diode lasers, it was recorded significant reduction of bleeding, pain and postoperative edema (12,13). In one study 83.7% of the patients showed self-limited bleeding and 94% of the patients showed postoperative pain of low intensity (13).

The excision of oral fibrous hyperplasia by diode lasers was assessed in four studies concluding the absence of intraoperative bleeding, lower discomfort, significant amelioration of postoperative complications for most patients and complete healing of oral soft tissues in 2-3 weeks (11,12,16,17). One study comparing excision by diode laser with CO2 laser reported better results for CO2 laser regarding intraoperative parameters and postoperative evolution in the removal of fibrous hyperplasia (16). One study concluded that the diode laser is a valid therapeutic instrument for excision of the oral lesions with diameter larger than 3 mm, due to the induction of severe thermal effects in lesions with diameter below 3 mm (20).

The most frequent pro-prosthetic surgical procedures (frenectomy, vestibuloplasty) can be performed by using diode lasers. One study investigated the use of diode laser in frenectomy (9). The use of pulse mode with a mean power of 2W offer a minimum duration of the working session (20 minutes), associated with the lowest levels of intra and postoperative pain and discomfort. The pain intensity was lower at
48 hours and absent at 7 days posttreatment. One study comparing classic surgical vestibuloplasty with vestibuloplasty assisted by diode laser, recorded more significant reduction of VAS pain indices and discomfort scores in the first 7 days posttreatment in the group treated with laser comparing to the group treated by using scalpel (10). Also, the analysis of healing processes concluded that the subjects in the laser group had better healing outcomes on the 1(st), 3(rd) and the 7(th) day compared to the subjects from scalpel group.

The excision of minor benign oral lesions by diode lasers was associated with the absence of postoperative complications for most patients but also larger adjacent carbonized areas were recorded compared to CO2 laser group (18). A clinical case study investigated postoperative evolution of 10 hemangioma cases treated by diode laser. After a 6 months follow-up period it was reported only one case of recurrence and the absence of postoperative complications (19). The treatment of oral papilloma lesions with diode lasers with different wavelengths (810-980nm) was evaluated in one study. The absence of postoperative complications and complete healing was reported in 95,4% cases on 30 days postoperatively (20).

Conclusions. The diode laser perform with excellent intraoperative and postoperative results in various surgical procedures on oral soft tissues. The reports of literature data sustain the replacement of conventional scalpel procedures with diode laser procedures with benefits such as the absence of intraoperatively bleeding and pain (in association with topical anesthesia), no need for suture, the decrease of inflammatory processes, lower postoperative pain intensity, decreased healing time.

References


