

## КЛИНИЧЕСКОЕ ПРИМЕНЕНИЕ ИЗЛУЧЕНИЯ ДИОДНОГО ЛАЗЕРА ДЛЯ ХИРУРГИЧЕСКОГО ЛЕЧЕНИЯ ПАЦИЕНТОВ СО СТОМАТОЛОГИЧЕСКИМИ ЗАБОЛЕВАНИЯМИ

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**Обоснование.** Травматичность хирургических операций в стоматологии диктует необходимость поиска малоинвазивных методов альтерации тканей. Применение лазеров позволяет решить эту проблему, так как лазерное излучение отличается меньшей операционной травмой, селективностью воздействия, активацией репаративных процессов в ране. **Цель.** Повысить эффективность хирургического лечения стоматологических пациентов путем применения диодного лазера. **Материалы и методы.** В клинике проведено обследование и хирургическое лечение 134 пациентов в возрасте от 18 до 82 лет с различными стоматологическими заболеваниями. Хирургическое лечение проводилось традиционным методом и с помощью диодного лазера «PICASSO Lite» с длиной волны 810 нм производство AMD Lasers (США) мощностью от 0,6 до 1,0 Вт. Критериями оценки эффективности применения лазера являлись данные клинических методов исследования. **Результаты.** По сравнению с традиционным методом лечения, при использовании хирургического лазера менее выражены послеоперационный отек и боль. Разница в сроках заживления операционной раны при использовании хирургического лазера по сравнению с традиционным составила  $3 \pm 0,5$  суток у пациентов, раны которых были ушиты, в случае заживления раны под фибриновой пленкой и под йодоформным тампоном разница составила  $7 \pm 0,5$  суток. Раневой дефект, созданный лазерным излучением, по сравнению со скальпельным значительно быстрее проходит все стадии раневого процесса. Кроме того, селективное удаление патологических тканей уменьшает вероятность травмирования слизистой оболочки полости рта, что приводит к сокращению сроков лечения. **Выводы.** Таким образом, применение диодного лазера позволяет совершенствовать технику хирургического лечения и повысить эффективность лечения пациентов со стоматологическими заболеваниями полости рта.

**Ключевые слова:** диодный лазер, слизистая оболочка полости рта, стоматологические заболевания.

## CLINICAL APPLICATION OF DIODE LASER RADIATION FOR SURGICAL TREATMENT OF PATIENTS WITH DENTAL DISEASES

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**Background.** Traumatism of surgical operations in dentistry dictates the need to search for minimally invasive methods of tissue alteration. The use of lasers makes it possible to solve this problem, since laser radiation possesses a lower operative injury, selective action and activates the reparative processes in the wound. **Aim.** To increase the effectiveness of surgical treatment of dental patients by using a diode laser. **Materials and Methods.** In a clinic, 134 patients from 18 to 82 years of age with various dental diseases were examined and underwent surgical treatment using a traditional method and a diode «PICASSO Lite» laser with 810 nm wavelength from AMD Lasers (USA), with the radiation power in the range from 0.6 to 1.0 W. The criteria for evaluation of the effectiveness of laser application were the data of clinical examination. **Results.** In comparison with the traditional method of treatment, use of a surgical laser resulted in a less pronounced postoperative edema and pain. The difference between healing time of the operative wound after use of surgical laser and after the traditional treatment was  $3\pm 0.5$  days in case of suturing of the wound and  $7\pm 0.5$  days in case of wound healing under the fibrinous film and under the iodoform tampon. The wound defect induced by laser radiation passed all stages of the wound process much faster than with use of scalpel. In addition, selective removal of pathological tissues reduced the likelihood of injury to the oral mucosa, which leads to reduction in the duration of treatment. **Conclusions.** Thus, the use of a diode laser allows to improve the technique of surgical treatment of patients and increases the effectiveness of treatment of patients with dental diseases.

**Keywords:** *diode laser, oral mucosa, oral dental diseases.*

A problem of high incidence rate of dental diseases among Russian population remains one of most important ones [1,2]. At the modern stage of development of medical science and practice, the quality and effectiveness of dental care depend on the quality of therapeutic process especially in the conditions of dental outpatient clinics. Medical technologies do not stay at the same level, in particular, there is a wide application of minimally invasive surgical methods aimed at minimization of injurious effects and at reduction of the risk of postoperative complications.

In surgical dentistry high intensity laser radiation is used as an alternative to cutting instruments. Being a multifunctional instru-

ment, laser radiation possesses a wide spectrum of biological effects, a high hemostatic effect, bactericidal effect, sterility, minimal traumatic effect on tissues, an insignificant postoperative edema, mild pain syndrome which may even be absent [3,4,5]. Of all variety of dental lasers, the most financially available and widely spread are diode lasers that have a wide spectrum of indications and are easy to handle [6]. Reliability of diode lasers is ensured by use of electronic and optical components with few mobile elements [7]. It is worth noting that laser radiation can be easily delivered through thin quartz light guides to any point of exposure practically without losses, which is especially im-

portant in surgical procedures in the mouth cavity [8].

*Aim of study* – to improve effectiveness of surgical treatment of dental patients by use of a diode laser.

### Materials and Methods

In the period from 2016 to 2018 in the Dental Center of I.M. Sechenov First Moscow State Medical University (Sechenov University) and Dental Polyclinic of RyazSMU 134

patients from 18 to 82 years of age were examined and given surgical treatment for neoplasms of the oral mucosa, pericoronitis, gingival hypertrophy, shortened frenulum of the lower lip, small buccal cavity of mouth.

Surgical treatment was conducted by a traditional method and with use of a «PICASSO Lite» diode laser with 810 nm wavelength manufactured by AMD Lasers (USA) (Fig. 1).



Fig.1. Diode laser «PICASSO Lite»

Depending on the used method of treatment patients were divided into 2 groups by random sampling technique. In I group traditional method of treatment was used in 58 patients, in II group 76 patients received surgical treatment with a diode laser.

In I group surgical treatment was conducted under infiltration anesthesia with anesthetics of articaine line. Tissues were excised with scalpel № 15C with subsequent application of stitches on the postoperative wound or with covering the wound surface with iodoform tampon, fixed with stitches. To prevent collateral edema, local application of cold was recommended for 15-20 minutes every 2-3 hours on the first day after the operation. In the postoperative period antibacterial, anti-inflammatory, analgesic and desensitizing therapy were administered, and locally – oral baths of 0.05% chlorhexidine solution. On the 5<sup>th</sup>-6<sup>th</sup> day when the wound surface

covered with granulations, iodoform tampon sutured to the wound surface was removed and application of solkoseryl (dental adhesive paste) was recommended on the surgical wound area 2 times a day. In case of suturing, stitches were removed on the 7<sup>th</sup> day.

Treatment with surgical laser was conducted under anesthesia with anesthetics of articaine line given in lower quantity than in traditional treatment. Diode laser with 810 nm wavelength and 0.6 to 1.0 W radiation power was used in continuous or pulsed mode in a contact way with 30 msec pulse duration and 30 msec interval. The procedure was bloodless, with formation of coagulation layer covering the wound surface. To prevent collateral edema, application of cold was used for 15-20 minutes every 2-3 hours on the first day after the operation. In the postoperative period the patients were not administered antibacterial and antihistamine drugs.

Intensity of pain syndrome was determined by 4-point pain assessment scale (Ohnhaus E.E., Adler R., 1975). Scale parameters: severe pain – 3 points, pain of moderate intensity – 2 points, mild pain – 1 point, absence of pain – 0 points. In the presence of pain sensations a single intake of non-steroid anti-inflammatory drugs (NSAID), rinsing of the mouth cavity with 0.05% chlorhexidine solution three times a day were recommended.

### Results and Discussion

In surgical treatment of I group of patients with the traditional method (using scalpel №15C) there was intraoperative bleeding from the wound surface which impaired visualization of the operative field. In II group of patients with surgical treatment with the diode laser, the operation ran without bleeding and with simultaneous formation of coagulation

film on the wound surface. Circular movements of the optic fiber permitted formation of the coagulation film over the whole wound surface. Good visualization of the operative field was noted due to reduced intraoperative bleeding which enabled excision of tissues in a precisely determined amount.

According to the data of our clinical studies, in patients of II group operated with the diode laser, no evident collateral edema and pain syndrome were noted, which eliminated the need for non-steroid anti-inflammatory drugs (Table 1). Patients of I group given traditional treatment noted pain and edema within the first 3 days after surgical intervention with the underlying intake of analgesics. Thus, the data obtained by us confirm reduction in edema and pain syndrome in surgical treatment with the diode laser [3-5].

Table 1

### Characteristics of the Postoperative Period

Groups	Period of wound healing	Pain syndrome			Collateral edema		
		1 <sup>st</sup> day after operation	3 <sup>d</sup> day after operation	7 <sup>th</sup> day after operation	1 <sup>st</sup> day after operation	3 <sup>d</sup> day after operation	7 <sup>th</sup> day after operation
I group Traditional treatment (n=58)	7 <sup>th</sup> day	2	1	0	1	2	0
II group Diode laser (n=76)	10 <sup>th</sup> day	0	0	0	0	0	0

Note: Scale used: 3 – severe pain; 2 – moderate intensity pain; 1 – mild pain; 0 – no pain

In clinical examination of the wound in early postoperative period it was found that after operation with use of laser radiation in II group of patients epithelization occurred on the 7<sup>th</sup> day. On the 30<sup>th</sup> day soft elastic scars formed.

In I group of patients with traditional treatment epithelization occurred by the 10<sup>th</sup> day, with persistence of infiltration of soft tissues until the 14<sup>th</sup> day. After 1.5 month, formation of dense scar tissue was observed.

The obtained results corresponded to changes in the area of wound surface depending on the kind of surgical intervention. Thus, on the 3<sup>d</sup> day the wound surface area in patients of II group twice decreased, and on the

5<sup>th</sup> day reduction in the wound surface area continued. Epithelization of postoperative wound was observed on the 7.0<sup>th</sup> ±0.5 day due to complex antibacterial, antiinflammatory and stimulating effects of laser radiation on regenerative processes [3,4,8].

In patients of I group granulations appeared on the 3<sup>d</sup> day and completely covered the wound surface by the 5<sup>th</sup> day. After the 6<sup>th</sup> day the wound was managed by the open technique, and by the 14.0<sup>th</sup>±0.5 day the wound surface covered with a young connective tissue (Fig. 2). Examination after 30 days revealed beginning of formation of coarse scars on the mucous membrane which sof-

tened and became elastic only by the 6<sup>th</sup> month, with maturation of the tissue.

In both groups of patients there were no

purulent-inflammatory complications in the postoperative period, which is attributed to bactericidal effect of laser radiation [6].

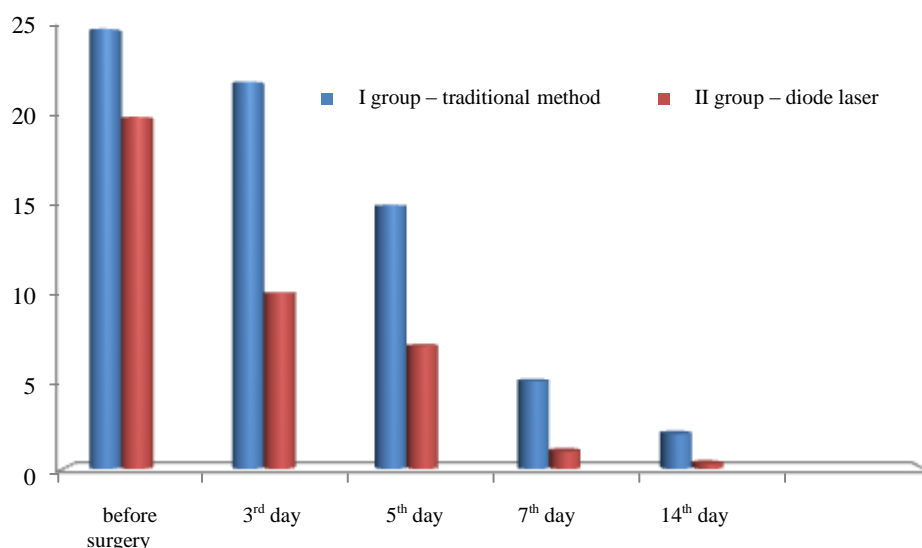


Fig. 2. Dynamics of parameters of the wound surface depending on the method of treatment (cm<sup>2</sup>)

**Clinical case 1.** A female patient S., 21 years old, applied to the outpatient clinic with complaints of periodical pain, restriction in the opening the mouth, discomfort in the region of the third lower molar on the right, permanent biting of the mucous membrane with the upper molar within half a year. On examination the mucous membrane was locally hanging over the distal lingual cusp of 4.8 tooth, which erupted to 3/4 of its crown out of the alveolar socket. The antagonist tooth completely erupted. At the moment of examination, no signs of

inflammation were seen on mucosa of the retromolar region (Fig. 3). On X-ray examination, 4.8 tooth was in the dental arch. The mouth opened to 3.5 cm. The diagnosis: pericoronitis in the region of 4.8 tooth, half-impaction of 4.8 tooth. The patient was made operation of operculectomy with a diode laser under infiltration anesthesia. The hanging mucous membrane was excised in the pulsed-periodic mode with 0.7 W radiation power (Fig. 4). Postoperative period ran without complications, epithelization occurred on the 10<sup>th</sup> day.



Fig. 3. The hanging edge of mucous membrane before operation



Fig. 4. Surgical wound after excision of the mucous membrane by a diode laser

**Clinical case 2.** A female patient D., 82 years old, was directed from the orthopedic department for elongation of the clinical crown of 4.2 tooth (Fig. 5). On examination: fracture of the crown part of 4.2 tooth. Under infiltration anesthesia the crown part of 4.2 tooth was extracted (Fig. 6) and gingivectomy was conducted with the diode laser in pulsed-periodic mode with 0.7 W radiation power (Fig. 7). The contour of the gingival edge recovered. After that an orthopedic structure was fixed in the mouth cavity. In the postoperative period no complications were observed. In the postoperative period formation of the optimal esthetic contour of the gingiva in the region of surgical intervention was noted (Fig. 8).

**Clinical case 3.** A female patient M., 20 years old, was directed from orthodontic department for plasty of the frenulum of the lower lip. On examination: high attachment of

the frenulum of the lower lip, recession of the gingiva in the region of 4.1, 3.1 teeth (Fig. 9).

Under infiltration anesthesia resection of the frenulum was implemented from the alveolar process to the mucogingival junction with the diode laser in the continuous mode of operation with 0.7 W radiation power (Fig. 10). Epithelization was observed on the 10<sup>th</sup> day (Figs. 11, 12).

**Clinical case 4.** A female patient D., 19 years old, referred to the outpatient clinic with complaints of the neoplasm on the tongue. Anamnesis: the patient noticed formation about 1 month before and noted its slow growth. On examination of the mouth cavity a neoplasm of round shape 0.3 cm by 0.3 cm in size on a narrow base was seen on the left part of the anterior third of the tongue (Fig. 13); it was soft, painless and mobile to palpation. Clinical diagnosis: papilloma of the tongue.



Fig. 5. A view in the mouth cavity before the operation



Fig. 6. A view in the mouth cavity after removal of the crown part of 4.2 tooth with the diode laser



Fig. 7. A view of the formed gingival edge after excision with the diode laser



Fig. 8. A view in 10 days after gingivectomy with the diode laser and orthopedic treatment



Fig. 9. Shortened frenulum of the lower lip before the operation



Fig. 10. A view of the mouth cavity after correction of the frenulum with the diode laser



Fig. 11. A view of the postoperative region in 5 days after the operation



Fig. 12. A view of the postoperative region in 14 days after the operation



Fig. 13. Papilloma of the tongue before the operation



Fig. 14. Surgical wound after treatment with the diode laser

The neoplasm was excised under infiltration anesthesia using a diode laser of 0.7 W radiation power in the continuous mode (Fig. 14). The obtained material was sent to pathohistological examination. Postoperative

period was without complications. Epithelization of the wound was observed on the 7<sup>th</sup> day (Fig. 15). The diagnosis was verified pathomorphologically.

**Clinical case 5.** A female patient V., 47 years old, referred to the clinic with complaints of a neoplasm in the region of the crown of 1.6 tooth. Anamnesis: the patient detected the neoplasm about 3 months before, noted its slow growth. On examination of the oral cavity a neoplasm was found on the max-

illa between the crowns of 1.6 and 1.7 teeth on the vestibular and palatal side on a wide base, of dense-elastic consistence, painless and mobile to palpation (Fig. 16). Clinical diagnosis: fibromatous epulis of the maxilla in the region of 1.6 and 1.7 teeth.



Fig. 15. A view of postoperative wound in 7 days after surgical treatment with the diode laser



Fig. 16. A view of fibromatous epulis before the operation



Fig. 17. Operative wound after excision of epulis with the diode laser

Under infiltration anesthesia excision of the neoplasm was conducted using diode laser in the continuous mode with 0.8 W radiation power (Fig. 17). The obtained material was sent to pathohistological examination (Fig. 18). Postoperative period was without complications. Epithelization was observed on the 7<sup>th</sup> day (Fig. 19). The diagnosis was verified pathomorphologically.

**Clinical case 6.** A female patient, 74 years old, referred to the outpatient clinic

with complaints of formations of cyanotic color on the upper and lower lip. Anamnesis: the patient noticed the formations 10 years before as painless spots of blue color. They grew slowly without making any discomfort. Recently they began to increase. On examination spots of cyanotic color and round shape were detected on the right side of the red border of the lower lip and on the left side of the upper lip, 0.3 cm and 0.5 cm in diameter, respectively (Fig. 20). Formations were immo-





Fig. 18. Pathohistological preparation



Fig. 19. A view of postoperative wound in 7 days after surgical treatment with the diode laser

bile, painless to palpation, with positive filling syndrome. The diagnosis: cavernous hemangiomas on the right side of the lower lip and on the left side of the upper lip. Ablation was conducted with the diode laser under infiltration anes-

thesia (Figs. 21, 22). Immediately after laser treatment the formations significantly diminished and grew paler. Postoperative period was without complications. In 10 days regression of vascular structures was observed (Fig. 23).



Fig. 20. A view of hemangiomas before operation



Fig. 21. Action of the diode laser radiation on hemangioma on the lower lip



Fig. 22. Action of the diode laser radiation on hemangioma on the upper lip

Fig. 23. A view of postoperative region on the 10<sup>th</sup> day after laser treatment

### Conclusion

Thus, according to the data of the study, a diode laser with 810 nm wavelength reduces injury to tissues in surgical procedures in patients with dental diseases of the oral cavity. Besides, laser radiation provides a more favorable course of postoperative period, re-

duces edema and pain syndrome, accelerates healing of the postoperative wound, reduces risk of inflammatory purulent complications. Introduction of the laser into a wide clinical practice will permit to improve effectiveness of treatment and prevent recurrences of diseases.

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**Дополнительная информация [Additional Info]**

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