REASONING FOR THE APPLICATION OF VIOLET LASER PHYSIOTHERAPY DEVICE FOLLOWING SURGERIES IN THE ORAL CAVITY

A.V. Lepilin[1], Yu. M. Rajgorodskij[2], D. A. Grigoryeva[1], N.L. Erokina[1], G. R. Bakhteeva[1], D.A. Domenyuk[3]

[1] Department of Surgical Dentistry and Maxillofacial Surgery, Saratov State Medical University, Saratov, Russia
[2] LLC "TRIMA", Saratov, Russia
[3] Department of General Practice Dentistry and Child Dentistry, Stavropol State Medical University, Stavropol, Russia

Correspondence address:
Department of general practice dentistry and child dentistry, Stavropol State Medical University, 310, Mira Street, Stavropol, Russia 355017.
E-mail: domenyukda@mail.ru, tel: 8-918-870-1205

ABSTRACT — Preventing purulent complications in the postoperative period is an important issue that a maxillofacial surgeon has to face. This study offers a view on the clinical dynamics as well as on some laboratory data obtained from cases where violet-range wavelength laser was used after oral surgeries. A five-day course of treatment (wavelength of 405 nm) led to no microflora observed in 86.3% of the cases.

KEYWORDS — laser therapy, violet radiation spectrum, postoperative complications, microbiological study.

After an oral surgery, it is important to prevent postoperative complications, including those of infection & inflammatory nature. This is associated with microorganisms and chronic sites of infection in the mouth (odontogenic, tonsillogenic, etc.) [1, 2, 9].

One of the most common complications following tooth extraction is alveolitis, where the occurrence, as different authors claim, varies between 3.4 and 42.8% [3, 4, 5].

A number of researchers investigating the etiology of alveolitis point at trauma- and infection-associated factors since once a tooth has been extracted the socket becomes subject to additional infection coming from the oral cavity flora [4, 6]. Alveolitis is more often due to staphylococci and streptococci. In case of inflammation developing in the tooth socket, its granulation and epithelization will slow down significantly [7, 11].

Nowadays, various physiotherapeutic methods appear a promising remedy to be employed for treating and preventing inflammation issues [10, 11, 12, 13, 14, 15, 16, 17, 18, 19].

Our earlier study into bacteria photoinactivation without a photosensitizer under the influence of laser and non-laser LED violet spectrum radiation (in vitro experiments) revealed the destruction of microorganisms from laser radiation with a wavelength of 405 nm [8]. This substantiates the relevance of studying the efficiency of a violet laser device in order to prevent oral cavity postoperative complications.

Aim

to explain the use of the violet spectrum laser physiotherapy device after tooth extraction to prevent and treat postoperative complications.

Materials and methods

We examined and treated 162 patients with acute and chronic odontogenic issues in the oral cavity, whereas 32 of the patients had acute periostitis; 56 — exacerbated chronic periodontitis; 7 — pulpitis of semi-impacted embedded dystopic teeth; 67 — hampered eruption with abnormal tooth position. All the participants were on inpatient treatment in the dental department of Saratov City Clinical Hospital #9. 92 of the examined patients were females (58%) with males accounting for the remaining pool 70 (42%); the patients' age ranged from 18 to 65 (mean age 32±3 yrs). Exclusion criteria — general somatic diseases, allergies, and pregnancy. The patients underwent surgery, which implied tooth extraction; all the cases were given a 5-day postoperative course of anti-microbial therapy (Ceftriaxone, 1 g once a day, intramuscular injection).

All the patients were divided into two groups — based on the physiotherapeutic treatment given in the postoperative period — similar by the nosological diseases. The first (main) group included 80 patients who received a postoperative course of violet spectrum laser therapy performed with the Lazurit device (OOO TRIMA, Saratov). The device output power at beaming 1 cm was 150 mW. The daily procedures were performed through sterile curved adjutages with a scattered beam from a distance of 1 cm from the center of the wound surface (the extracted tooth socket), the laser beam power density being at 90–100 mW/cm^2, continuously for 5 minutes, course — 5 days. The sec-

ond group (comparison group) included 82 patients who were undergoing conventional physiotherapeutic treatment (UHF therapy; UHF-60 device, MedTeKo, Mytischi) in their postoperative period. The condenser plates (3.6 cm in diameter each) were installed on the respective side after molars and premolars were extracted – one in the projection of molars, the other in the frontal jaw projection; after canine teeth and incisors were extracted, the plates were located in the upper or lower jaw alveolar process projection, right and left of the median line. The distance between the plates was observed strictly at 3.6 cm, with a gap of 1.5–2 cm. The irradiation power was 30–40 W. The patients underwent the procedure once a day for 10 minutes, the course being 5 days.

On the day of the surgery, just like after the five days of the physiotherapeutic treatment, all the patients underwent general clinical examination as well as microbiological tests, which included a traditional bacteriological study identifying the isolated pure bacterial cultures. The culture was obtained with the Gold sectoral method on a solid medium. Counting the number of the grown colonies was performed visually. A decadic logarithm with a table was used for the conversion of the colony forming units (CFU) number. A set of morphological, culture and biochemical features were used to identify the species of the isolated bacteria. The biochemical identification of pure streptococci and gram-negative bacteria strains was carried out through the STAFI-test 16, STREPTO-test 16 (Czech Republic), API (France) and MicroTax (Austria) test systems. The clinical follow-up went on for a month after the patients were discharged from the hospital.

The obtained results were given statistical processing employing the Microsoft Excel software package with the calculation of arithmetic mean values and the standard deviation. Fisher's exact test was used to compare the intergroup data distribution, while Student's t-test served to evaluate clinical scores. The outcomes were considered reliable at $p < 0.05$.

RESULTS

The patients in Group 1 reported no pain on Day 3.45±0.17 in the average. A clinical examination revealed that the postoperative edema of the face soft tissues at the surgery site resolved on Day 4.05±0.20.

All the patients had a clot in the tooth socket, while marginal epithelialization was observed on Day 5.45±0.23. Where multi-rooted teeth were extracted, the mucosa socket revealed full closure on Day 19.05±0.45; the cases with single-root teeth showed the same effect on Day 14.75±0.24. Within these terms, all the patients' X-ray images showed a bone pattern development.

As for Group 2, when a poll was conducted among them on Day 6 (Day 5 of physiotherapy) after the hospitalization, they reported lack of pain on Day 4.25±0.20. Examinations showed that postoperative edema in them resolved on Day 4.65±0.19.

In Group 2 patients, the clot in the tooth socket remained for a longer time, while marginal epithelialization was observed on Day 6.75±0.16. Follow-up examinations after their discharge from hospital showed that complete mucosa closure after the extraction of multi-rooted teeth was observed on Day 22.65±0.43, whereas the cases with single-root teeth extracted reached the same effect on Day 17.21±0.18. Only 89.8% of the patients were found to have a bone pattern within the same timeframe (Table 1).

A composition and concentration test of the wound fluid microflora during the surgery in Group 1 showed the presence of St. epidermidis (10^2 to 10^3) in 16 (20%) of the patients; St. viridians (concentration — 10^4) in 8 (10%) patients; St. aureus (concentration — 10^3) in 10 (12.5%) patients; Str. spp (concentration — 10^2 to 10^4) in 11 (13.8%) cases, and C. albicans (concentration — 10^2 to 10^3) in 9 (11.3%) patients; no microflora was detected in 26 (32.4%) patients.

After the treatment, 6.2% of the cases (five patients) were found to have St. epidermidis, whereas its concentration did not exceed 10^2; one patient was diagnosed with St. viridians (concentration of 10^2); St. aureus (concentration — 10^2) was found in 2 patients, with another 2 patients having Str. spp (concentration — 10^2), and one patient had C. albicans (concentration — 10^2). The remaining patients had no microflora detected (Table 2). The outcome shows no microflora identified after the treatment in 86.3% (69 people) of Group 1 patients, the explanation, as we see it, being the bactericidal effect of the Lazurit laser device [8].

Before the treatment, the Group 2 patients' microflora revealed neither qualitative nor quantitative significant difference if put against the patients of Group 1.

After a five-day course of treatment, a respective test carried in both groups showed pathogenic and potentially pathogenic microflora present in 11 patients of Group 1; as for Group 2, it was 23 patients who were found to have similar microflora.

The clinical examinations that we carried out revealed postoperative complications, such as alveolitis, in one patient Group 1 and in 3 patients Group 2, who were given further antibacterial therapy and socket curettage, with the Levomekol ointment further applied regularly via tamponing (Fig. 1).

Table 1. *Clinical features reflecting postoperative response in patients' tissues*

	Pain remaining	Postoperative soft tissue edema resolution	Beginning of marginal epithelialization
Group 1 (n=80)	3.45 ± 0.17*	4.05±0.20*	5.45±0.23*
Group 2 (n=82)	4.25 ± 0.20	4.65±0.19	6.75±0.16

Note : ** – p≤0.05 statistically significant compared to Group 2 patients' values*

Table 2. *Microflora at the surgery site through the treatment stages (Group 1; n=80)*

Microorganisms	No microflora identified abs. (%)		Microflora present abs. (%)	
	Prior to treatment	After a 5-day course of treatment	Prior to treatment	After a 5-day course of treatment
a) staphylococcus epidermidis	64 (80%)	75 (93.8%)*	16 (20%)	5 (6.2%)*
b) staphylococcus viridians	72 (90%)	79 (98.8%)*	8 (10%)	1 (1.2%)*
c) staphylococcus aureus	70 (87.5%)	78 (97.5%)*	10 (12.5%)	2 (2.5%)*
d) streptococcus spp	69 (86.2%)	78 (97.5%)*	11 (13.8%)	2 (2.5%)*
e) candida albicans	71 (88.7%)	79 (98.8%)*	9 (11.3%)	1 (1.2%)*

Note: ** – p≤0.05 statistically significant compared to the values before treatment*

Table 3. *Microflora at the surgery site after the treatment*

	No microflora identified	Microflora present
Group 1 (n=80)	69*	11*
Group 2 (n=82)	59	23

Note: ** – p≤0.05 statistically significant compared to Group 1 patients after treatment*

CONCLUSION

After tooth extraction and treatment, which included violet spectrum laser therapy (wavelength — 405 nm) the sockets recovered in shorter periods with a lower degree of prominence, while surrounding tissues' response (edema and pain) was stopped in a faster fashion. In 86.3% of the cases the postoperative wounds produced no culture growth (before the treatment some microflora was detected in all the patients), our explanation residing in the bactericidal effect of the laser, which was demonstrated in experiments in vitro, and where the elimination of microorganisms was due to the violet spectrum laser radiation [8].

The above suggests that violet spectrum laser therapy (wavelength — 405 nm; Lazurit device) used to treat patients after tooth extraction operation is a procedure that is effective, painless, safe and easy to perform, as well as it can be recommended as a method to be employed in dental clinics and maxillofacial hospitals.

Fig. 1. *Carrying out the procedure of laser therapy with violet spectrum light using the "Lazurit" apparatus*

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