OPTIMIZATION OF ANTIBACTERIAL THERAPY IN PATIENTS WITH ENDO-PERIODONTAL LESIONS

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Abstract

To improve the quality and effectiveness of medical care for patients with inflammatory periodontal diseases, it is necessary to search for new approaches in both diagnosis and treatment. The aim of our study is to determine the effect of the diode laser on the pathogenic microflora of periodontal pockets and root canals in patients with endo-periodontal lesions (EPL). We carried out a comparative assessment of the bacterial contents of the root canals and periodontal pockets by polymerase chain reaction (PCR) before and after treatment with a diode laser (Doctor Smile Simpler, wavelength 980 nm) for 54 patients with EPL. The control group consisted of 56 patients who were treated according to the generally accepted method, including professional oral hygiene, endodontic treatment, and curettage of periodontal pockets. Evaluation criteria were a qualitative assessment of the content of periodontopathogens in the root canal and periodontal pocket before and after and treatment. As a result of our study, we found a statistically significant ($p<0.01$) reduction in the colonization of periodontal pockets and root canals in patients with EPL after laser decontamination. The high technological effectiveness of the methods used in combination with the low risk of complications at the stages of endodontic and periodontological treatment provides an antibacterial effect and reduces the duration of inflammation. The results of treatment of patients using a diode laser give reason to recommend their use in the dental practice.

Key words: endo-periodontal lesions, endodontic treatment, periodontal treatment, periodontopathogens, diode laser.

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ОПТИМИЗАЦИЯ АНТИБАКТЕРИАЛЬНОЙ ТЕРАПИИ У ПАЦИЕНТОВ С ЭНДО-ПАРОДОНТАЛЬНЫМИ ПОРАЖЕНИЯМИ

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Резюме

Для повышения качества и эффективности оказания медицинской помощи пациентам с воспалительными заболеваниями пародонта необходим поиск новых подходов к диагностике и лечению патологии. Целью исследования было изучить влияние излучения диодного лазера на патогенную микрофлору пародонтальных карманов (ПК) и корневых каналов (КК) у пациентов с эндо-пародонтальными поражениями (ЭПП). Проведена сравнительная оценка бактериального содержимого КК и ПК методом полимеразно-цепной реакции (ПЦР) до и после лечения с применением стоматологического диодного лазера (Doctor Smile Simpler, длина волны 980 нм) у 54 пациентов с ЭПП. Группу контроля составили 56 пациентов, которым проводилось лечение по общепринятой методике, включающей профессиональную гигиену рта, эндодонтическое лечение и кюретаж ПК. Критерием оценки явилось качественное содержание пародонтопатогенов в КК и ПК до и после лечения. Выявлено статистически значимое ($p<0,01$) снижение обсемененности ПК и КК у пациентов с ЭПП после лазерной деконтаминации. Высокая технологичность использованных методик в сочетании с низкими рисками осложнений на этапах эндодонтического и пародонтологического лечения обеспечивает антибактериальный эффект и сокращает продолжительность воспалительных явлений. Результаты лечения пациентов с применением диодного лазера дают основание рекомендовать их использование в практике врача-стоматолога.

Ключевые слова: эндо-пародонтальные поражения, эндодонтическое лечение, пародонтологическое лечение, пародонтопатогены, диодный лазер.

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Introduction

Inflammatory periodontal diseases remain some of the most common human health problems. In recent years, their prevalence has been increasing, while the age of people who are found to have the first signs of periodontal diseases has gone down [1,2]. One of the most urgent problems of modern dentistry is combined lesions of periodontal and endodontic organs. According to some data, they account for 40% of all inflammatory periodontal diseases, representing the most difficult cases in terms of both diagnosis and treatment [3–6]. Quite often, such teeth undergo surgical treatment, and early tooth loss leads to gastrointestinal diseases and reduces the quality of life of patients.

Endo-periodontal lesions (EPL) are multifactorial diseases with various components such as microbial plaque and its waste products, the condition of the mouth that promotes the formation of dental plaque and increases the periodontopathogenic potential of the microflora, and general factors that support periodontal homeostasis [1,2,7]. The microbiocenosis of the mouth determines the development of pathological changes in the paradontium and periodontal tissues and may also indirectly reflect the somatic state of the patient, the insufficiency of their immune and endocrine systems. The main factor in the development of both periodontitis and caries complications is bacterial infection [8–10]. Although mixed anaerobic flora is typical for both pathologies, in their isolated presentation the species composition in the periodontal pocket (PP) and root canal (RC) differs. In case of combined EPL, the pathogenic anaerobic microflora detected in the PP and in the RC of the teeth is identical [4, 8, 10].

It is generally recognized that almost all microorganisms in the natural environment (95%) exist in the form of a biofilm [8–10], within which they use signaling molecules to transmit information. For example, *P. gingivalis* bacteria produce fatty acids that stimulate the growth of *T. denticola* spirochetes, which forms stable associations in periodontal diseases [1,8,10]. Therefore, it is an urgent task to find new effective means of diagnosing and treating these lesions. The molecular genetic method of research, which is based on the polymerase chain reaction (PCR), allowing to multiply a specific fragment of the pathogen's DNA molecule many times in a few hours and identify it in the test material even at minimal concentrations, creates great opportunities in the diagnosis of odontogenic infections. Timely PCR diagnostics makes it possible to start treatment and rehabilitation in the early stages of the disease development in the tissues damaged by periodontal pathogens [7, 9].

Many studies in different countries have been devoted to the clinical effectiveness of laser therapy in dentistry [11–13]. Diode lasers have a wide range of readings, are highly reliable and easy to use. Its effect is much milder than that of electrosurgery or scalpel. The diode laser radiation is well absorbed by pigmented tissue. Many researchers emphasize a high level of safety of diode lasers, which makes it possible to use them in periodontic and endodontics diseases treatment without the risk of damaging the tooth tissues structure [13–16].

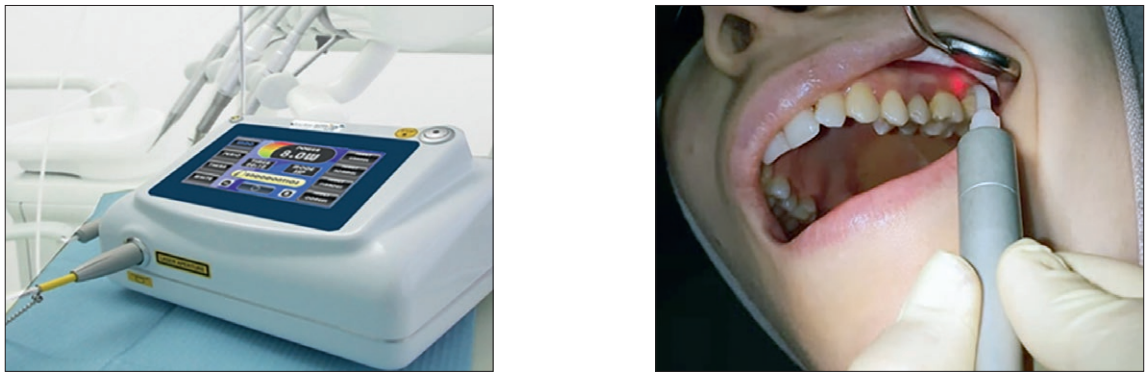
The mechanism of action of high-energy continuous wave laser radiation (radiation power over 1 W) is based on the local action of the hyperthermal factor. With a certain duration of thermal exposure, the tissue substrate «burns out,» forming a defect with the adjacent zone of coagulation necrosis [13]. Studies conducted in recent years have revealed the antibacterial potential of laser therapy. The results of the study by C. Beltes et al. (2017) showed the bacteriostatic and bactericidal effects of a diode laser [11]. R. Schulte-Lünzum et al. (2017) note that a 940 nm diode laser with a radial firing tip showed a satisfactory bactericidal effect, reducing the count of living *E. faecalis* cells without any thermal side effect on the tissue [17].

The aim of our study was to determine the effect of a diode laser on the pathogenic microflora of PP and RC in patients with EPL.

Materials and methods

Examination and treatment involved 110 patients with EPL without severe somatic pathology. The study was approved by the local Ethics Committee of the Kazan State Medical University (Minutes No. 6 of 28.06.2016). The patients who provided informed consent for the study and treatment were divided into two groups. In addition to the standard EPL treatment, which included professional oral hygiene, endodontic and periodontal treatment, the main group, which consisted of 54 patients, had RC treatment with a diode laser and PP laser curettage. 56 patients of the control group received only standard treatment: professional oral hygiene, endodontic treatment, and curettage.

The endodontic treatment protocol included instrumental treatment of RC with Reciproc, Mtwo (VDW) systems to the size of the apex of min 30-40 according to ISO, irrigation of RC with sodium hypochlorite (3%) and ethylenediaminetetraacetic acid (EDTA) (17%) solutions and passive ultrasonation. Patients of the main group had RC decontamination with laser radiation with the use of Dr. Smile, a high-intensity dental diode laser (wavelength: 980 nm, average power during the treatment: 1.25 W, peak power: 2.5 W, pulse mode), not reaching the apex by 1 mm, 5 seconds per channel, three times, with subsequent rinsing with sodium hypochlorite and EDTA solutions (Fig. 1). This procedure was not performed in patients of the control group. The final stage was RC obturation with guttapercha and epoxy-based sealer.



a b

Рис. 1. Лечение пародонтальных карманов стоматологическим диодным лазером
а – общий вид прибора;
б – процедура деконтаминации пародонтального кармана
Fig. 1. Treatment of periodontal pockets with a dental diode laser
a– general view of the device;
b – decontamination of the periodontal pocket

Periodontal treatment of patients of the main group was carried out according to the following protocol: three-time treatment of the PP with a diode laser, average power during the procedure: 0.75 W (maximum power: 2.5 W) in pulsed mode for 30 seconds for each PP. After the first and second treatment, the PP was rinsed with a 3% solution of hydrogen peroxide. The blood that appeared in the PP after the third treatment was not washed out of the pocket but left there as a biologically active dressing.

Patients in the control group underwent curettage with Gracey curettes and PP treatment with a 3% solution of hydrogen peroxide.

The material for the study in patients of the main group was the discharge in the RC and PP before treatment and after diode laser treatment; in the control group, it was the contents of the RC before treatment and after irrigation and the contents of the PP before treatment and after curettage.

Samples from the RC and PP were taken with a sterile paper pin, which was left in the corresponding position for 10 seconds. The pin was then transferred to an Eppendorf tube with 500 µl of saline solution, and the contents were mixed. To isolate the DNA from the biomaterial, Multident-5 set was used (produced by OOO NPF «GenLab» (Russia)), which allows identifying

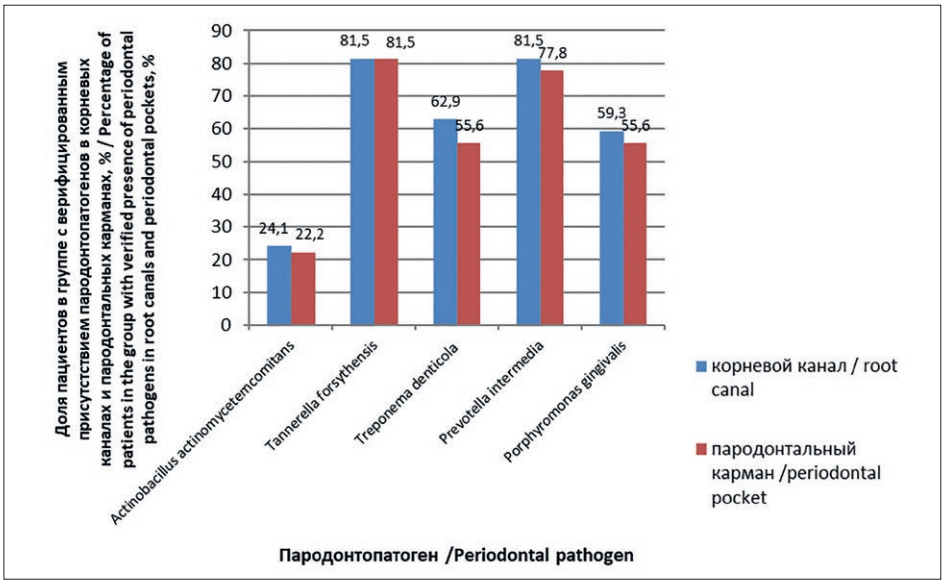


Рис. 2. Содержание пародонтопатогенов в корневых каналах и пародонтальных карманах у пациентов основной группы до лечения
Fig. 2. The content of periodontal pathogens in periodontal pockets and root canals in patients of the experimental group before treatment

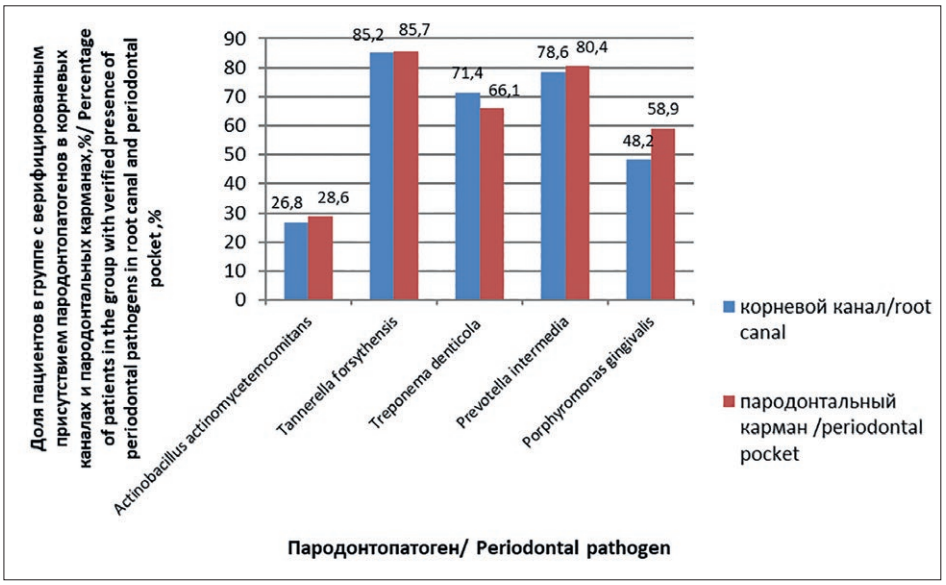


Рис. 3. Содержание пародонтопатогенов в корневых каналах и пародонтальных карманах у пациентов контрольной группы до лечения
Fig. 3. The content of periodontal pathogens in periodontal pockets and root canals in patients of the control group before treatment

Таблица 1
Содержание пародонтопатогенов в пародонтальном кармане у пациентов основной и контрольной групп до и после лечения
Table 1
The content of periodontopathogens in the periodontal pocket in patients of the experimental and control groups before and after treatment

Вид микроорганизма / Type of microorganism	Этап наблюдения / Observation stage	Число пациентов в группе с верифицированным присутствием пародонтопатогена в пародонтальных карманах / The number of patients in the group with verified presence of periodontal pathogen in periodontal pockets				p
		Основная группа / Experimental group (n=54)		Контрольная группа / Control group (n=56)		
		Абс.	%	Абс.	%	
Actinobacillus actinomycetemcomitans	До лечения / Before treatment	12	22,2	15	26,8	0,579
	После лечения / After treatment	0	0,0	12	21,4	<0,001*
	p	<0,001*		0,149		–
Tannerella forsythensis	До лечения / Before treatment	44	81,5	48	85,7	0,612
	После лечения / After treatment	5	9,3	32	57,1	<0,001*
	p	<0,001*		<0,001*		–
Treponema denticola	До лечения / Before treatment	30	55,6	40	71,4	0,577
	После лечения / After treatment	4	7,4	23	41,1	<0,001*
	p	<0,001*		<0,001*		–
Prevotella intermedia	До лечения / Before treatment	42	77,8	44	78,6	0,92
	После лечения / After treatment	6	11,1	37	66,1	<0,001*
	p	<0,001*		0,072		–
Porphyromonas gingivalis	До лечения / Before treatment	30	55,6	27	48,2	0,442
	После лечения / After treatment	6	11,1	22	39,3	<0,001*
	p	<0,001*		0,089		–

* – различия статистически значимы
* – differences are statistically significant

5 types of periodontal pathogens (*Actinobacillus actinomycetemcomitans (A.a.), Prevotella intermedia (P.in.), Treponema denticola (T.d.), Porphyromonas gingivalis (P.g.), Tannerella forsythensis (T.f.)*). Amplification of the isolated genetic material was performed in «Tertsik MS-2» thermal cycler («DNK-Tekhnologiya», Moscow) with a computer program for multiplex PCR recommended by the manufacturer. In the next step, the cloned DNA samples stained with ethidium bromide underwent electrophoresis analysis in 1.6% agarose.

Statistical processing was performed with the use of Microsoft Excel. The index of statistical significance was $p<0.05$.

Results and discussion

The study revealed that the content of periodontal pathogens in the PP and RC before treatment was almost the same in patients of both groups (Fig. 2, Fig. 3).

The genetic markers of *Tannerella forsythensis*, which is a representative of the «red complex» and, according to the available literature data, is responsible for bleeding gums in periodontitis and destruction of the alveolar bone, were often found in the examined individuals in both groups. *Prevotella intermedia* and *Treponema denticola* were the second most frequently detected species. These anaerobes increase the risk of periodon-

Таблица 2
Содержание пародонтопатогенов в корневом канале у пациентов основной и контрольной групп до и после лечения
Table 2
The content of periodontopathogens in the root canals in patients of the experimental and control groups before and after treatment

Вид микроорганизма Type of microorganism	Этап наблюдения Observation stage	Число пациентов в группе с верифицированным присутствием пародонтопатогена в корневых каналах The number of patients in the group with verified presence of periodontal pathogen in root canals				p
		Основная группа Experimental group (n=54)		Контрольная группа Control group (n=56)		
		Абс.	%	Абс.	%	
Actinobacillus actinomycetemcomitans	До лечения Before treatment	13	24,1	16	28,6	0,593
	После лечения After treatment	0	0,0	6	10,7	0,027*
	p		<0,001*		0,002*	–
Tannerella forsythensis	До лечения Before treatment	44	81,5	48	85,7	0,612
	После лечения After treatment	3	5,5	19	33,9	<0,001*
	p		<0,001*		<0,001*	–
Treponema denticola	До лечения Before treatment	34	62,9	37	66,1	0,734
	После лечения After treatment	2	3,7	14	25,0	0,002*
	p		<0,001*		<0,001*	–
Prevotella intermedia	До лечения Before treatment	44	81,5	45	80,4	0,881
	После лечения After treatment	3	5,5	15	26,8	0,004*
	p		<0,001*		<0,001*	–
Porphyromonas gingivalis	До лечения Before treatment	32	59,3	33	58,9	0,972
	После лечения After treatment	3	5,5	14	25,0	0,007*
	p		<0,001*		<0,001*	–

* – различия статистически значимы
* – differences are statistically significant

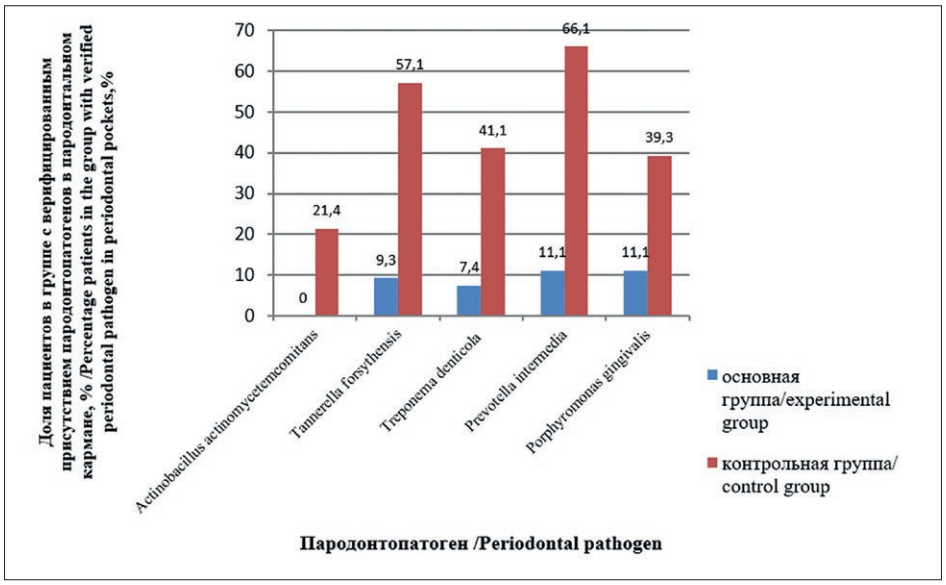


Рис. 4. Содержание пародонтопатогенов в пародонтальном кармане у пациентов основной и контрольной групп после лечения
Fig. 4. The content of periodontal pathogens in the periodontal pocket in patients of the experimental and control groups after treatment

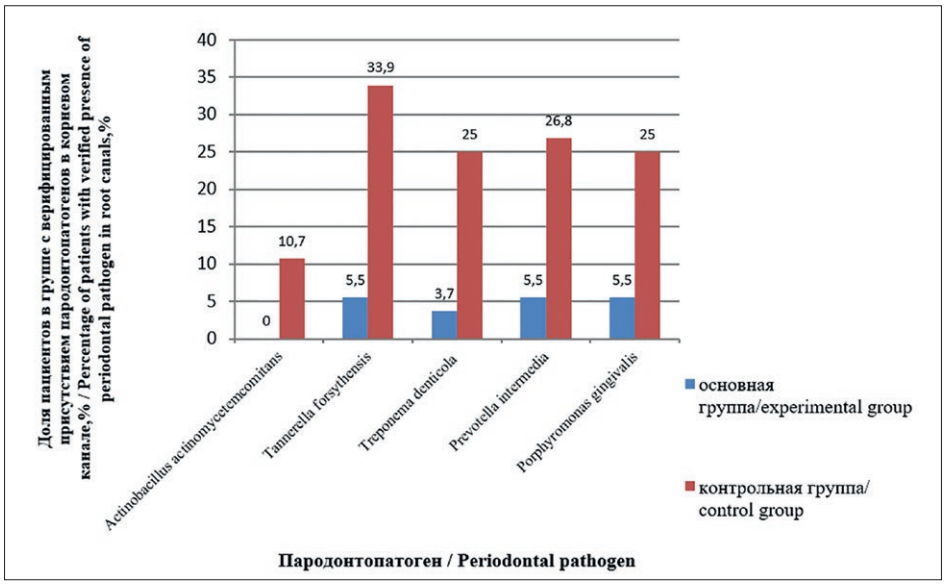


Рис. 5. Содержание пародонтопатогенов в корневых каналах у пациентов основной и контрольной групп после лечения
Fig. 5. The content of periodontal pathogens in root canals in patients of the experimental and control groups after treatment

titis development in their association with each other and other types of periodontal pathogens and have virulence factors that allow them to colonize the oral biofilm and cause purulent and inflammatory processes. Genetic markers of *Porphyromonas gingivalis*, correlated with the depth of PP, were detected in almost 50% of PP and RC in patients of the main and control groups. *Actinobacillus actinomycetemcomitans*, which is found in destructive forms of periodontal diseases, was isolated on average in 25% of cases. The results of the study of the PP microbial content in patients of both groups before and after treatment are presented in Table 1.

In the main group, there was a statistically significant decrease in the level of all studied periodontal pathogens ($p<0.001$). In the control group, the changes were less pronounced, the decrease was statistically significant only in respect of the change of *Tannerella fors*. ($p<0,001$) and *Treponema dent*. ($p<0.001$) count. Due to a significantly more pronounced decrease in the level of periodontal pathogens in the main group with comparable baseline values ($p>0.05$) after treatment, the content of all studied microorganisms was statistically significantly lower in the main group compared to the control group ($p<0.001$).

The results of the study of the RC microbial content in patients of the main and control groups before and after treatment are presented in Table 2.

After treatment, there was a statistically significant ($p<0.01$) decrease in the level of periodontal pathogens in the compared groups of patients. However, both in PP and RC, the changes were more pronounced in the main group than in the control group ($p<0.05$).

The structure of the identified periodontal pathogens in PP and RC in patients of the observed groups after treatment is shown in Fig. 4 and Fig. 5.

Thus, we found a statistically significant ($p<0.01$) decrease in PP and RC microbial content in patients with EPL after laser decontamination.

Conclusion

The results of our study confirm that decontamination with a high-intensity diode laser can reduce the bacterial count in PP and RC. The use of a diode laser in the complex treatment of patients with EPL can improve the quality of dental care and reduce the healing time of periodontal foci.

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