

Primljen/ Recived on: 05.10.2015.  
 Revidiran/ Revised on: 26.10.2015.  
 Prihvaćen/ Accepted on: 09.11.2015.

KLINIČKI RAD  
 CLINICAL ARTICLE  
 doi:10.5937/asn15725040

## EFIKASNOST LASERA MALE SNAGE U TERAPIJI PARODONTOPATIJE

### LOW POWER LASER EFFICACY IN THE THERAPY OF PERIODONTITIS

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#### Sažetak

**Uvod.** Parodontopatija je inflamatorno oboljenje potpornog aparata zuba. Spada u najrasprostranjenija oboljenja od kojih ljudi boluju i predstavlja ogroman problem kojem se pridaje sve veći značaj. Savremena terapija parodontopatije obuhvata klasične metode lečenja, hirurške metode i najnoviju lasersku tehnologiju. Terapija laserima male snage je potpuno bezbolna, neinvazivna i bez štetnih efekata.

**Cilj rada** je bio ispitati efikasnost terapije laserima male snage kao dodatak bazičnoj terapiji parodontopatije.

**Materijal i metod.** Ispitivanje je sprovedeno na 50 ispitanika sa parodontopatijom i kliničkim simptomom inflamacije gingive. Pri prvoj poseti određeni su indeksi: plak indeks (PI), gingivalni indeks (GI), parodontalni indeks po Ramfjordu (PDI), uklonjene meke i čvrste naslage, obrađeni parodontalni džepovi. Zatim je na desnoj strani vilica (grupa A) primenjena terapija GaAlAs laserom (Mils 94, 670 nm, 5 mW, 14 min). Terapija laserom je izostavljena na levoj strani vilice svakog ispitanika (grupa B), radi upoređivanja efekata terapije sa i bez lasera. Nakon prve, treće i pete terapije određeni su GI i PI, a nakon mesec dana GI, PI i PDI. **Rezultati.** Poređenjem srednjih vrednosti indeksa u odnosu na vrednost pre terapije uočeno je značajno smanjenje izraženije na lasiranoj strani. Poređenjem grupa utvrđena je manja vrednost kod lasirane u odnosu na nelasiranu stranu.

**Zaključak.** Laseri male snage pokazali su se efikasnim u eliminaciji inflamacije gingive i unapređenju parodontalnog zdravlja, te se preporučuju kao dodatak bazičnoj terapiji parodontopatije.

**Cljučne reči:** laseri male snage, parodontopatija, parodontalna terapija

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#### Abstract

**Background.** Periodontitis is an inflammatory disease of periodontal tissues and is one of the most widespread diseases. It represents a huge problem with increasing importance. Modern therapy of periodontitis includes the classic treatment methods, surgery and the latest laser technology. Particularly important is that low level laser therapy is completely painless, non-invasive and without harmful effect.

**The aim of the study** was to investigate the efficacy of low level laser therapy as an adjunct to the basic treatment of periodontitis.

**Material and Method.** The study was conducted on 50 patients with periodontitis and clinical symptoms of gingival inflammation. During the first visit, periodontal indices were measured: plaque index (PI), gingival index (GI) periodontal Ramfjord index (PDI); dental plaque and tartar were removed and periodontal pockets were treated. Consequently, the right side of the jaws (group A) was treated with GaAlAs laser (Mils 94, 670 nm, 5 mW, 14 min). Laser therapy was left out on the left side the jaw of each patient (group B), in order to compare the effect of treatment with and without laser. After the first, third and fifth treatment, GI and PI were measured, and one month after finished therapy GI, PI and PDI were measured again.

**Results.** Comparing the mean values of indices in relation to the value before the therapy, the reduction was observed and was more pronounced on the lased side of the jaws. Comparing the mean indices values between groups, lower values were noticed on the lased compared to the non-lased side.

**Conclusion.** Low-power lasers are effective in the elimination of gingival inflammation and improvement of periodontal health. They can be recommended as an adjunct to the basic periodontal therapy.

**Key words:** low power lasers, periodontitis, periodontal therapy

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## Uvod

Parodontopatija predstavlja inflamatorno oboljenje potpornog aparata zuba izazvano dejstvom specifičnih bakterija oralnog biofilma<sup>1-3</sup>. Patološke promene su destruktivne prirode i vode postupnom oboljevanju parodonticijuma i njegovoj anatomskoj i funkcionalnoj dezintegraciji. Ona izaziva postepeno rasklaćenje, a kasnije gubitak jednog ili više zuba. Epidemiološka ispitivanja ukazuju da parodontopatija spada u najrasprostranjenija oboljenja od kojih ljudi boluju<sup>4,5</sup>. Zbog ovakvih medicinsko-socijalnih, pa i ekonomskih momenata, predstavlja ogroman problem kojem se pridaje sve veća pažnja.

Od velikog praktičnog značaja za utvrđivanje prognoze i plana terapije jeste utvrđivanje stepena aktivnosti parodontopatije. Klinička iskustva govore da je najčešći eksudativno-proliferativni tip inflamacije gingive uz degenerativno-atrofične procese koji se šire u dublje delove parodonticijuma.<sup>6</sup> Smatra se da intenzitet inflamacije gingive i nivo pripojnog epitela predstavljaju dobar pokazatelj aktivnosti i progresije oboljenja, pa se preporučuje upotreba kliničkih parametara kao što su gingivalni indeks (GI) koji određuje stepen inflamacije gingive i pokazuje mesta aktivne parodontopatije i parodontalni indeks (Periodontal Disease Index-PDI) koji pokazuje stepen destrukcije parodonticijuma i gubitak nivoa pripojnog epitela kao nivo težine parodontalne bolesti<sup>4</sup>. Nakon postavljanja dijagnoze i procene težine, pristupa se izradi plana lečenja koji ostaje strogo individualan i donosi se za svakog bolesnika posebno. Svaka terapija parodontopatije započinje uklanjanjem naslaga sa zuba i patološki izmenjenog tkiva u parodontalnim džepovima<sup>4</sup>.

Tendencija ka stalnom poboljšanju kvaliteta stomatološke parodontalne terapije usko je povezana sa novim dostignućima. Savremena terapija gingivitisa i parodontopatije obuhvata klasične metode lečenja, usavršene hirurške metode i najnoviju lasersku tehnologiju.<sup>7-14</sup> Terapija laserima male snage (LLLT) ima biostimulativno dejstvo, ubrzava zarastanje rana, smanjuje bol i otok, a gotovo da ne postoje kontraindikacije za njenu primenu. Posebno je od značaja činjenica da je LLLT potpuno bezbolna, neinvazivna i bez štetnih efekata.<sup>15-17</sup> Danas se u opticaju nalazi veliki broj laserskih aparata različitih tehničkih karakteristika i performansi.

## Introduction

Periodontitis is an inflammatory disease of periodontal tissues caused by the specific oral bacterial biofilm<sup>1-3</sup>. Pathological changes are destructive and lead to the progression of the disease and anatomical and functional disintegration of the periodontium. This leads to loosening and subsequently a loss of one or more teeth. Epidemiological studies suggest that periodontitis is one of the most widespread diseases<sup>4,5</sup>. Because of these medical-social and economic moments, it represents a huge problem with increasing attention.

Of great practical importance in determining the prognosis and treatment plan is to estimate the degree of periodontal disease activity. Clinical experience shows that the most common type is exudative-proliferative gingival inflammation with a degenerative-atrophic processes that spread into the deeper parts of the periodontal tissues.<sup>6</sup> It is believed that the intensity of gingival inflammation and attachment level are good indicators of disease activity and progression. However, the use of clinical parameters such as gingival index (GI), which determines the degree and location of gingival inflammation, and periodontal index (Periodontal Disease Index - PDI) which shows the degree of periodontal destruction and the loss of gingival attachment as an indicator of severity of periodontitis, are recommended<sup>4</sup>. After the diagnosis and assessment of disease severity are defined, an individual treatment plan for the each individual patient is made. Periodontal therapy begins by removing the plaque from teeth and pathological altered tissues from periodontal pockets<sup>4</sup>.

The tendency to constantly improve the quality of dental periodontal therapy is closely associated with new therapeutic developments. Modern therapy of gingivitis and periodontitis includes the classic treatment methods, improved surgery and the latest laser technology.<sup>7-14</sup> Low power laser therapy (LLLT) has biostimulative effect, improves wound healing, reduces pain and swelling, and there are almost no contraindications for its use. Particularly important is the fact that the use of LLLT is completely painless, non-invasive and without harmful effect<sup>15-17</sup>. Today, a large number of laser devices with different technical characteristics and performance are in use.

Najčešće se preporučuje primena energije od 1 do 10 J/cm<sup>2</sup> po tretmanu. U svakom slučaju, treba insistirati na usaglašavanju stavova, što bi omogućilo daleko masovnije i jednostavniju primenu LLLT.<sup>7,12</sup>

### **Cilj rada**

Cilj rada je bio ispitati efikasnost terapije laserima male snage kao dodatak bazičnoj terapiji parodontopatije.

### **Pacijenti i metode**

Ispitivanje je sprovedeno na Odeljenju za oralnu medicinu i parodontologiju Klinike za stomatologiju Medicinskog fakulteta u Nišu. Polazeći od postavljenih ciljeva, koncipirana je metodologija za njihovu realizaciju odobrena od strane Etičkog komiteta Medicinskog fakulteta u Nišu odlukom broj 01-2800-7. Osnovni kriterijumi za izbor ispitanika utvrđeni su pre pristupa ispitivanju, a zatim na Klinici za stomatologiju prikupljani potrebni anamnestički podaci i urađen stomatološki pregled. Izabrani bolesnici imali su parodontopatiju sa prisutnim kliničkim simptomom inflamacije gingive. U ispitivanje nisu uključeni bolesnici mlađi od 18 godina, trudnice, bolesnici sa krvnim i autoimunim oboljenjima, akutnim i hroničnim infekcijama, bolesnici na imunosupresivnoj ili fototerapiji, fotosenzitivne osobe i osobe koje su bile, iz bilo kog razloga, na antibiotskoj ili kortikosteroidnoj terapiji u poslednja tri meseca.

Od 50 ispitanika, 24 su bila muškog, a 26 ženskog pola, starosti od 22 do 83 godine (prosečna starost 44,6 godina). Urađena je procena stanja oralne higijene, gingive i parodontijuma uz pomoć odgovarajućih indeksa - plak indeksa (PI)<sup>4</sup>, gingivalnog indeksa (GI)<sup>4</sup> i parodontalnog indeksa po Ramfjordu (PDI)<sup>4</sup>.

Pri prvoj poseti meke naslage uklonjene su pomoću paste (Vantal, Galenika) i rotirajućih četkica, a čvrste (zubni kamenac i konkrementi) ultrazvučnim aparatom Woodpecker (UDS-J) i srpastim instrumentom. Dodatno, parodontalni džepovi su obrađeni parodontalnim kiretama i ispiranjem 3% vodonik peroksidom.

Zatim je na desnoj strani vilica (vrednosti predstavljene kao grupa A) primenjena terapija GaAlAs diodnim laserom

The most commonly recommended treatment dose is 1 to 10 J/cm<sup>2</sup> per treatment. It should be insisted on the coordinated stand points, which would allow far more widespread and easier application of LLLT.<sup>7,12</sup>

### **The aim of the study**

The aim of the study was to investigate the efficacy of low power laser therapy as an adjunct to the basic periodontitis treatment.

### **Patients and Methods**

The study was conducted at the Department of Oral Medicine and Periodontology, Dental Clinic, Faculty of Medicine in Niš. After establishing the aim of the study, the methodology was designed and then approved by the Faculty of Medicine Ethics Committee (No. 01-2800-7). The main criteria for selection of patients were determined before accessing the investigation. The necessary medical history was taken and dental examination was performed at the Dental Clinic. Selected patients had periodontitis with clinical symptoms of gingival inflammation. The study did not include the patients younger than 18 years of age, pregnant women, patients with blood diseases, acute and chronic infections, autoimmune diseases, patients on immunosuppressive therapy or phototherapy, photosensitivity and subjects that were, for whatever reason, on the antibiotic or corticosteroid therapy in the last three months.

Of the 50 patients, 24 were males and 26 females, aged 22 to 83 years (average age 44.6 years). The level of oral hygiene, gingival and periodontal measurements were made by using appropriate indices - plaque index (PI)<sup>4</sup>, gingival index (GI)<sup>4</sup> and periodontal Ramfjord index (PDI)<sup>4</sup>.

During the first visit, dental plaque was removed using a paste (Vantal, Galenika) and the rotating brush, and tartar was removed by the ultrasound Woodpecker (UDS-J) and manual instruments. In addition, periodontal pockets were treated using periodontal curettes and 3% hydrogen peroxide rinse.

Consequently, the right side of the jaws (values are presented as group A) was treated with GaAlAs low power diode laser (94 Mils), 670 nm, probe diameter 2 mm. Power output was 5 mW, continuous mode, treatment time 14 min on the gingiva around the teeth 17 to 11 and 47 to 41.

male snage (Mils 94), talasne dužine od 670 nm sa prečnikom sonde od 2 mm, izlazne snage 5 mW u kontinuiranom režimu rada, i ekspozicije 14 min po tretiranoj površini gingive oko zuba od 17 do 11, i 47 do 41. Terapija laserom je izostavljena na levoj strani vilice svakog ispitanika (vrednosti predstavljene kao grupa B), radi upoređivanja efekata terapije sa i bez lasera. U toku sledeća četiri dana, pri svakoj poseti, uklanjane su meke naslage i primenjena terapija laserom po istom protokolu. Nakon prve, treće i pete terapije, pri kontrolnoj poseti, sutradan, određen je GI i PI. Ispitanici su obučeni kako da pravilno održavaju oralnu higijenu, a kontrolni pregled je urađen mesec dana nakon poslednje posete, kada je određena vrednost GI, PI i PDI.

Parametri su predstavljeni srednjim vrednostima (X) i standardnim devijacijama (SD). Koeficijent varijacije određivan je kao mera homogenosti ispitivanih uzoraka u odnosu na ispitivane parametre. Studentovim t-testom nezavisnih uzoraka vršeno je testiranje statističke značajne razlike srednjih vrednosti dveju grupa (A i B). Unos i tabelarno prikazivanje rezultata obavljeno je korišćenjem MS Office Excel programa, a proračuni su vršeni programom SPSS, verzija 15.0.

## Rezultati

Poređenjem srednjih vrednosti PI u odnosu na vrednost pre terapije uočeno je kod lasirane (A) i nelasirane (B) strane, nakon svih perioda terapije, statistički značajno smanjenje vrednosti sa izraženijem smanjenjem na lasiranoj (B) strani ( $p < 0.001$ ). Vrednosti PI malo su veće mesec dana nakon terapije u odnosu na vrednosti posle završene pete terapije, što znači da se ponovo formirao plak (Tabela 1).

Srednje vrednosti GI kod lasirane (A) i nelasirane (B) strane ispitanika tokom terapije prikazane su u tabeli 2. Kod obe strane, nakon svih perioda terapije, u odnosu na vrednost pre terapije, došlo je do statistički značajnog smanjenja srednjih vrednosti ispitivanog indeksa ( $p < 0,001$ ). Vrednosti t-testa ukazuju na značajnije smanjenje srednjih vrednosti na lasiranoj strani u svakom ispitivanom periodu. Pri poređenju srednjih vrednosti između grupa A i B utvrđena je statistički znatno manja vrednost GI kod lasirane (A) u odnosu na nelasiranu (B) stranu nakon prve terapije ( $p < 0,001$ ).

Laser therapy was left out on the left side of the jaws of each patient (values are presented as group B), in order to compare the effect of treatment with and without laser. During the next four days at each visit, dental plaque was removed and the laser therapy was applied according to the same established protocol. After the first, third and fifth treatment during the control visit the next day, GI and PI were measured. Patients were educated how to maintain proper oral hygiene and one month after the therapy GI, PI and PDI were measured once again.

The parameters are presented as mean values (X) and standard deviations (SD). The coefficient of variation was determined as a measure of homogeneity of the samples with respect to the studied parameters. The statistically significant differences in the mean values between the two groups (A and B) were tested by the Student's t-test for independent samples. The calculations were performed by SPSS, version 15.0 and the results presented in tables using MS Office Excel program.

## Results

Comparing the mean values of PI in relation to the value before the therapy, the statistically significant reduction of investigated indices was observed on the lased (A) and non-lased (B) sides of the jaws in all treatment periods ( $p < 0,001$ ). Comparing the mean values between groups A and B, a statistically significant lower value of PI was noticed on the lased (A) compared to non-lased (B) side after the first treatment ( $p < 0,001$ ). The PI values were slightly higher a month after compared to the values the fifth day of therapy, which means that the plaque reformed again (Table 1).

Mean GI values on the lased (A) and non-lased (B) jaw sides during the therapy are shown in Table 2. There was a statistically significant decrease in mean values of the GI index ( $p < 0,001$ ), on the both jaw sides after each treatment period compared to the value before treatment. The t-test indicates a significant reduction in mean values on the lased side in each investigated time period. Comparing the mean values between groups A and B, a statistically significant lower GI value on the lased (A) compared to non-lased (B) side was noticed after the first treatment ( $p < 0,001$ ).

GI remains the same on the lased (A) side even one month after treatment.

Zapaža se da kod lasirane strane srednja vrednost GI ostaje ista i mesec dana nakon terapije, a na nelasiranoj (B) strani postoji pozitivan efekat i nakon treće terapije što se ogleda u dodatnom smanjenju srednjih vrednosti GI (Tabela 2).

On the non-lased (B) side, a positive side effect could be noticed even after the third therapy, which shows a further reduction of GI value (Table 2).

Tabela 1: Vrednosti PI ( $X \pm SD$ ) tokom terapije kod lasirane (A) i nelasirane (B) strane  
Table 1: PI values ( $X \pm SD$ ) during therapy on lased (A) and nonlased (B) side

	N	Lased (A)	vs before th		Non-lased (B)	vs before th		Between groups /	
		Lasirana (A)	vs pre th		Nelasirana (B)	vs pre th		Između grupa	
		X $\pm$ SD	t	p	X $\pm$ SD	t	p	t	p
Before therapy / Pre terapije	50	1.86 $\pm$ 0.76			1.86 $\pm$ 0.76			0.00	1.0000
After 1 <sup>st</sup> therapy / Posle 1 terapije	50	1.12 $\pm$ 0.72	9.92	0.0000	1.60 $\pm$ 0.57	2.65	0.0109	3.70	0.0004
After 3 <sup>rd</sup> therapy / Posle 3 terapije	50	0.26 $\pm$ 0.44	15.53	0.0000	0.26 $\pm$ 0.44	15.53	0.0000	0.00	1.0000
After 5 <sup>th</sup> therapy / Posle 5 terapije	50	0.14 $\pm$ 0.35	16.67	0.0000	0.18 $\pm$ 0.39	15.47	0.0000	0.54	0.5898
After a month / Posle mesec dana	50	0.30 $\pm$ 0.46	14.02	0.0000	0.30 $\pm$ 0.46	14.02	0.0000	0.00	1.0000

Tabela 2: Vrednosti GI ( $X \pm SD$ ) tokom terapije kod lasirane (A) i nelasirane (B) strane  
Table 2: GI values ( $X \pm SD$ ) during therapy on lased (A) and nonlased (B) side

	N	Lased (A)	vs before th		Non-lased (B)	vs before th		Between groups /	
		Lasirana(A)	vs pre th		Nelasirana (B)	vs pre th		Između grupa	
		X $\pm$ SD	t	p	X $\pm$ SD	t	p	t	p
Before therapy / Pre terapije	50	1.20 $\pm$ 0.45			1.20 $\pm$ 0.45			0.00	1.0000
After 1 <sup>st</sup> therapy / Posle 1 terapije	50	0.34 $\pm$ 0.48	15.03	0.0000	0.80 $\pm$ 0.40	4.95	0.0000	5.19	0.0000
After 3 <sup>rd</sup> therapy / Posle 3 terapije	50	0.12 $\pm$ 0.33	15.64	0.0000	0.32 $\pm$ 0.47	9.92	0.0000	2.46	0.0158
After 5 <sup>th</sup> therapy / Posle 5 terapije	50	0.12 $\pm$ 0.33	15.64	0.0000	0.20 $\pm$ 0.40	13.23	0.0000	1.09	0.2800
After a month / Posle mesec dana	50	0.12 $\pm$ 0.33	15.64	0.0000	0.12 $\pm$ 0.33	15.64	0.0000	0.00	1.0000

Tabela 3: Vrednosti PDI ( $X \pm SD$ ) tokom terapije kod lasirane (A) i nelasirane (B) strane  
 Table 3: PDI values ( $X \pm SD$ ) during therapy on lased (A) and nonlased (B) side

	Lased (A)		vs before th		Non-lased (B)		vs before th		Between groups /	
	Lasirana (A)		vs pre th		Nelansirana (B)		vs pre th		Između grupa	
	N	$X \pm SD$	t	p	$X \pm SD$	t	p	t	p	
Before therapy / Pre terapije	50	4.14 $\pm$ 1.05			4.14 $\pm$ 1.05			0.00	1.0000	
After a month / Posle mesec dana	50	2.46 $\pm$ 0.76	18.20	0.0000	2.76 $\pm$ 0.85	15.36	0.0000	1.86	0.0655	

U tabeli 3 prikazane su vrednosti PDI određivane pre terapije i mesec dana nakon terapije. Utvrđene su statistički znatno manje vrednosti ispitivanog parametra mesec dana nakon terapije u obe ispitivane grupe (A i B),  $p < 0,001$ . Poređenjem srednjih vrednosti mesec dana nakon terapije utvrđene su znatno manje srednje vrednosti PDI na lasiranoj strani (A) blizu nivoa statističke značajnosti od 0,05 ( $p = 0,0655$ ) (Tabela 3).

### Diskusija

Masovna pojava i česti recidivi parodontopatije čine ovo oboljenje pravim socijalnim problemom koji ističe sve veći značaj profilakse i terapije. Iz ovih razloga se javila potreba za traženjem novih, efikasnijih sredstava i metoda lečenja.<sup>1,4</sup>

Smatra se da u patogenezi većine, ako ne svih vrsta parodontopatije, bakterije igraju jednu od najznačajnijih etioloških uloga.<sup>3</sup> Zubni kamenac, oralni biofilm i parodontalni džepovi smatraju se generalno najznačajnijim mestom za razvoj parodontopatogenih bakterija a mehanička eliminacija predstavlja važnu terapijsku meru. U terapiji zuba zahvaćenih parodontopatijom, dosadašnji koncepti terapije obuhvatali su uklanjanje mekih naslaga (oralnog biofilma i ostataka hrane), konkremenata i kamenca, i kiretažu granulacionog tkiva u cilju eliminacije bakterijskih depozita i endotoksina. Tradicionalno se u terapijske svrhe koristi konvencionalna mehanička obrada površine korena zuba uz pomoć ručnih skalera, kireta i srpastih instrumenata.<sup>18</sup> Takođe, i u ovom istraživanju u skladu sa pomenutim konceptima primenjene su iste, već potvrđene terapijske procedure.

Table 3 shows PDI values before and one month after therapy. The statistically significantly lower values of investigated index was noticed a month after therapy in both groups (A and B),  $p < 0,001$ . One month after therapy, lower PDI mean values were noticed on the lased (A) side, close to the level of statistical significance of 0,05 ( $p = 0,0655$ ) (Table 3).

### Discussion

A mass occurrence and frequent periodontitis relapses makes this disease a real social problem that highlights the growing importance of prophylaxis and therapy. Therefore, there is a need to seek new, more efficient means and methods of treatment.<sup>1,4</sup>

It is believed that in the pathogenesis of most if not all types of periodontitis bacteria play one of the most important etiological roles.<sup>3,8</sup> Dental calculus, oral biofilm and periodontal pockets are generally considered the most important sites of bacterial accumulation. In this way, the therapeutic methods are directed towards the bacterial mechanical elimination. In periodontitis treatment, current concepts include the removal of soft plaque (oral biofilm and food debris) and calculus, and granulation tissue curettage in order to eliminate bacterial deposits and endotoxins. Traditionally, conventional mechanical treatment of root surface with the help of scalers, cures, sickles and other instruments is used.<sup>18</sup> In this investigation, in accordance with these concepts, we applied the same confirmed therapeutic procedures.

Poslednjih godina prisutan je sve veći interes za istraživanje novih terapijskih pristupa koji bi unapredili i pojednostavili mehaničku obradu korena zuba a istovremeno imali antibakterijske osobine.<sup>19</sup> Sa ovim ciljem, istraživači su pokrenuli ispitivanje mogućnosti primene laserskog zračenja različitih snaga i talasnih dužina, uključujući Neodymium:YAG (Nd:YAG), Helium-Neon (HeNe), Gallium-Arsenid (GaAs), Gallium-Aluminum-Arsenid (GaAlAs) i argon laser. Uočeno je da ukoliko se lasersko zračenje uvede u parodontalne džepove, dolazi do smanjenja broja bakterija na površini korena.<sup>18</sup> Terapija laserima male snage (LLLT) je postala veoma popularna u raznim kliničkim aplikacijama.<sup>20</sup> Pretpostavlja se da LLLT smanjuje bol, ubrzava zarastanje rana i ima pozitivan uticaj na inflamatorne procese. Usled nedostatka adekvatnih istraživanja nije uvek moguće odrediti optimalnu vrstu lasera i parametre za laseroterapiju.<sup>20</sup>

Veliki broj autora koristi doze u rasponu od 0,001-0,01J/cm<sup>2</sup> iako je još 1971. godine Mester sugerisao da je neophodna doza od 1-2 J/cm<sup>2</sup> za zarastanje rana.<sup>21-23</sup> U ovom istraživanju korišćene su doze približne terapijskim dozama Mestera. Primenjeni laser je imao izlaznu snagu od 5 mW, a ekspozicija je bila 6,5 minuta po svakom ispitivanom području.

Istraživači ističu da dodatna terapija laserom male snage nakon primene bazične parodontološke terapije redukuje gingivalnu inflamaciju.<sup>20,23</sup> Uočeno je da dodatno zračenje laserom male snage daje bolje terapijske rezultate nego samostalno uklanjanje kamenca i konkremenata uz kiretažu parodontalnih džepova.<sup>20</sup> Istraživači su istakli da je efekat LLLT bio najveći na nivou smanjenja gingivalnog indeksa i smanjenja dubine sondiranja.<sup>24,25</sup> Sličan nalaz je uočen i u ovom istraživanju, gde je nakon bazične terapije i primenjene laseroterapije laserom male snage došlo do znatnog smanjenja stepena inflamacije koji je dokumentovan merenjem gingivalnog indeksa. Pošto je kod svih ispitanika desna strana vilice podvrgnuta laserskom zračenju, a leva služila kao kontrola, praćene su vrednosti indeksa u toku terapije. I kod lasirane i nelasirane strane nakon svih perioda terapije u odnosu na vrednost pre terapije došlo je do statistički značajnih smanjenja srednjih vrednosti GI (p<0,001). Vrednosti t-testa pri poređenju nakon prve, treće i pete terapije

In recent years, there has been a growing interest in researching new therapeutic approaches that would be able to improve and simplify the mechanical debridement of root, which would also have antibacterial properties in order to reduce the number of bacteria associated with periodontitis.<sup>19</sup> Researchers are testing the application of laser irradiation with different output power and wavelengths including Neodymium:YAG (Nd:YAG), Helium-Neon (HeNe), Gallium arsenide (GaAs), Gallium-Aluminum-Arsenid (GaAlAs) and argon laser. It was noticed that, if the laser irradiation is applied into the periodontal pockets, there is a reduction in the number of bacteria on the root surface.<sup>18</sup> Low power laser therapy (LLLT) has become very popular in a variety of clinical applications.<sup>20</sup> It is assumed that LLLT reduces pain, accelerates wound healing and has a positive effect on inflammatory processes. Due to the lack of adequate research, it is not always possible to determine the optimum laser types and dose parameters.<sup>20</sup>

Many authors use a dose range of 0,001-0,01 J/cm<sup>2</sup>, although in 1971 Mester suggested that the required dose for wound healing is 1-2 J/cm<sup>2</sup>.<sup>21-23</sup> In this study, the used doses are close to therapeutic doses of Mester. Laser was applied with output power of 5 mW and the exposure time of 6,5 minutes for each investigated area.

The researchers state that additional low power laser therapy after the application of basic periodontal therapy reduces gingival inflammation.<sup>20,23</sup> It was noticed that additional low power laser irradiation yields better therapeutic results than only tartar removal and periodontal pockets curettage.<sup>20</sup> The researchers noticed that the LLLT induces the highest reduction of gingival index and probing depth.<sup>24,25</sup> A similar finding was observed in this study, where after the basic treatment and applied low power laser therapy, there was a significant inflammation reduction, which was measured by the gingival index. Indices were evaluated in all the patients during laser therapy. The right side of the jaws was subjected to laser irradiation, and the left one was the control side. Comparing the values before therapy with the values during the investigation period, on both sides of the jaws a statistically significant decrease of GI was noticed (p<0,001). When comparing the first, third and fifth day after therapy, a significant GI reduction was noticed on the lased side of the jaws.

ukazuju na značajnije smanjenje srednjih vrednosti na lasiranoj strani vilice u ispitanika.

Zapaža se da na lasiranoj strani GI ostaje isti i mesec dana nakon poslednje laseroterapije, što potvrđuje trajnije delovanje LLLT. Moguće da su neki od efekata terapije laserom posledica povećanja mikrocirkulacije u zračenom području. Schaffer i sar.<sup>26</sup> su ispitivali gingivalnu mikrocirkulaciju kod sistemski zdravih dobrovoljaca sa eksperimentalno izazvanim gingivitisom i nisu uočili ovakve efekte. Ipak, drugi autori su pokazali da LLLT utiče pozitivno na mikrocirkulaciju u srednje inflamiranoj gingivi, ali ne i u zdravoj i jako inflamiranoj.<sup>27</sup> Poznato je da je kod prisutne inflamacije gingive i aktivne parodontopatije povećano lučenje gingivalnog fluida.<sup>20</sup> Istraživanja su pokazala blagotvoran efekat lasera male snage na gingivalnu inflamaciju putem smanjenja volumena ekskretovanog gingivalnog fluida.<sup>20,26,27</sup>

U ovom istraživanju određivane su vrednosti PDI indeksa pre terapije i mesec dana nakon zadnje laseroterapije. Utvrđena je statistički značajno manja vrednost ispitivanog parametra mesec dana nakon poslednje laseroterapije u odnosu na vrednosti pre početka terapije ( $p < 0,001$ ) sa manjim vrednostima na lasiranoj strani ( $p = 0,0655$ ). Ove vrednosti ukazuju na blagotvorno dejstvo LLLT koja dopunjuje konvencionalnu terapiju parodontopatije i omogućava brže ozdravljenje parodontijuma koje se vidi u smanjenju vrednosti parodontalnog indeksa.

Smatra se da primenom LLLT dolazi i do smanjenja akumulacije oralnog biofilma.<sup>20</sup> Nije razjašnjeno da li se ovo javlja usled smanjenja stepena inflamacije ili usled samostalnog dejstva lasera. Evidentno je da je i na lasiranoj i nelasiranoj strani nakon svih perioda terapije došlo do statistički značajnih smanjenja srednjih vrednosti PI indeksa u odnosu na vrednost pre terapije, a na osnovu vrednosti t-testa jasno je da je smanjenje izraženije na lasiranoj strani ( $p < 0,001$ ). Poređenjem srednjih vrednosti utvrđena je statistički značajno manja vrednost PI indeksa lasirane u odnosu na nelasiranu stranu nakon prve terapije ( $p < 0,001$ ). Ono što takođe treba zapaziti jeste da su vrednosti PI indeksa mesec dana nakon završene laseroterapije malo veće u odnosu na vrednosti posle pete terapije, što znači da se ponovo formirao oralni biofilm. Neophodno je dobro i stalno motivisati pacijente da samostalno održavaju oralnu higijenu koja je osnova zdravlja parodontijuma.

GI value on the lased side remained the same even one month after the therapy, which indicates a long-lasting LLLT effect. It is supposed that some of the LLLT effects are due to an increased microcirculation of the treated area. Schaffer et al.<sup>26</sup> monitored gingival microcirculation in systemically healthy volunteers with experimentally induced gingivitis and have not observed these LLLT effects. Contrary, the other authors have shown that LLLT has a positive effects on the microcirculation of the moderately inflamed gingiva, but not in a healthy and very inflamed gingival tissue.<sup>27</sup> It is well known that gingival inflammation and active periodontitis increase the secretion of gingival fluid.<sup>20</sup> Studies have shown a beneficial effect of LLLT on gingival inflammation through the reduction of gingival fluid.<sup>20,26,27</sup>

In this study PDI index values were measured before and one month after the last laser therapy. There was a statistically significant lower value of the PDI one month after the laser therapy compared to values at baseline ( $p < 0,001$ ) with lower values on the lased side ( $p = 0,0655$ ). These values indicate a beneficial effect of LLLT which supplements conventional periodontal therapy and enables faster healing of periodontal tissues, which is noticed through the reduction of PDI.

It is believed that LLLT reduces the accumulation of oral biofilm.<sup>20</sup> It is not clear whether this occurs due to the decrease of inflammation or independent LLLT. It is evident that on the lased and non-lased jaw sides after all the treatment periods there was a statistically significant decrease in PI compared to the value before treatment. T-test showed a more pronounced decrease on the lased side ( $p < 0,001$ ). After the first investigated period, a statistically significant lower PI value on the lased jaw side compared to the non-lased side was noticed ( $p < 0,001$ ). It should be noticed that the PI value, a month after laser therapy, was slightly higher than the value after the fifth therapy, suggesting that the oral biofilm was reformed again. It is essential always to motivate patients to maintain oral hygiene at the high level, which is crucial for periodontal health maintenance.



## Zaključak

Na osnovu primenjene metodologije i dobijenih rezultata, uočeno je značajnije smanjenje aktivnosti parodontopatije i unapređenje parodontalnog zdravlja primenom kombinovane terapije laserima male snage i bazične terapije parodontopatije, u odnosu na primenu samo bazične terapije parodontopatije.

Laseri male snage su efikasni u eliminaciji inflamacije gingive i unapređenju parodontalnog zdravlja, pa se preporučuje njihova primena kao dodatak bazičnoj terapiji parodontopatije.

## Zahvalnost

Ovo istraživanje je urađeno pod pokroviteljstvom Ministarstva prosvete nauke i tehnološkog razvoja Republike Srbije (broj.175061.).

## Conclusion

Based on the applied methodology and obtained results, a significant decrease in periodontitis activity and improvement of periodontal health was observed when low power laser therapy was combined with the basic periodontal therapy, compared to the basic periodontal therapy alone.

Low-power lasers are effective in the elimination of gingival inflammation and improvement of periodontal health. They can be recommended as an adjunct to the basic periodontal therapy.

## Acknowledgments

This research was supported by the grant from the Serbian Ministry of Education and Science, (No.175061).

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