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## LASER ANALGEZIJA U TOKU ORTODONTSKE TERAPIJE

### LASER ANALGESIC DURING ORTHODONTIC THERAPY

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#### Sažetak

**Uvod:** Posebno je važno smanjiti bol nakon prvog postavljanja luka. Većina pacijenata oseća bol četiri sata nakon što se luk postavi, postiže najviši nivo nakon 24 sata i smanjuje se u narednih nekoliko dana. Podaci iz literature pokazuju da je strah od bola veoma važan razlog za obeshabrivanje pacijenata da prihvate ovakav ortodontski tretman.

**Cilj** ove studije bio je da se proceni efikasnost biostimulativnog laserskog tretmana u smanjenju bolova kod pacijenata sa fiksnim ortodontskim aparatima.

**Materijal i metode:** Petnaest pacijenata je tretirano biostimulativnim diodnim laserom, tokom dva minuta po kvadrantu, odmah nakon postavljanja fiksnih ortodontskih aparata i u naredna četiri dana. Kontrolna grupa od 15 pacijenata dobila je analgetsku terapiju u trajanju, od pet dana. Bol je subjektivno ocenjen kao jak, srednji ili bez bolova. Bol je nestao kod 20% ispitanika u ispitivanoj grupi nakon prvog dana, dok je kod 60% i 26,6% ispitanika srednja i izolovana bol bila prisutna drugog i trećeg dana. Bol je nestao kod svih pacijenata tretiranih laserom petog dana. Jak bol bio je prisutan kod svih ispitanika u kontrolnoj grupi prvog dana, dok je drugog dana smanjen na 60%, a 20% ispitanika sa srednjim intenzitetom bola. Nakon tri dana, kontrolna grupa je pokazala srednji lokalizovan bol u 40% slučajeva, koji se smanjio kod 26,6% nakon četvrtog dana, što ukazuje na kasnije smanjenje bola u odnosu na grupu koja se tretira laserom.

**Rezultati** ukazuju na to da se primena lasera sa niskom energijom može uspešno koristiti za smanjenje bolova tokom početnog nelagodnog perioda nakon postavljanja fiksnih ortodontskih aparata.

**Zaključak:** Niskoenergetski laseri mogu uspešno da smanje bol u početnom periodu posle postavljanja fiksnog ortodontskog aparata.

**Ključne reči:** terapija niskoenergetskim laserom, analgetici, bol, fiksni ortodontski aparati

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#### Abstract

**Introduction:** Most of the patients feel pain 4 hours after the arch applying, gaining the highest level after 24 hours and its lowering in the next few days. Literature reports show that the fear of pain is a very important reason for discouraging the patient to agree for this kind of orthodontic treatment

**The aim** of this study was to evaluate the effectiveness of the biostimulative laser treatment in pain reduction in patients with fixed orthodontic appliances.

**Materials and methods.** Fifteen patients were treated with low energy level biostimulative diode laser, used 2 minutes per quadrant immediately after placement of fixed orthodontic appliances and in the following four days. The control group of 15 patients received analgesic therapy for period of five days. The pain was assessed subjectively as strong, medium or no pain. The pain disappeared in 20% of the subjects in the examined group after the first day, while in 60% and 26.6% of the subjects medium and isolated pain was still present at day 2 and 3, respectively.

**Results.** The pain disappeared in all the patients treated with laser at day 5. In the control group, strong pain was present in all the subjects the first day, decreasing to 60% of strong pain and 20% medium pain the second day. After day three, the control group demonstrated medium localized pain in 40% of the cases, which dropped to 26.6% after the fourth day, suggesting delayed pain reduction, compared to the laser treated group.

**Conclusion.** Our results suggest that the low energy laser treatment can successfully be used for pain reduction during the initial discomfort period after placing fixed orthodontic appliances.

**Key words:** low level laser treatment, analgesics, pain, fixed orthodontic appliances

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## Uvod

Primena fiksnih ortodontskih aparata obično je razlog za pojavu neugodnosti i bola različitog stepena, koji mogu igrati ključnu ulogu ne samo za saradnju sa pacijentom već i za uspeh lečenja<sup>1,2,3</sup>. Podaci iz literature pokazuju da je strah od bola veoma važan razlog za obeshrabrivanje pacijenata da prihvate ovakav ortodontski tretman<sup>4</sup>. Posebno je važno smanjiti bol nakon prvog postavljanja luka. Većina pacijenata oseća bol četiri sata nakon što se luk postavi, postiže najviši nivo nakon 24 sata i smanjuje se u narednih nekoliko dana<sup>5</sup>.

Za terapiju bola ortodontskog porekla preporučuje se nekoliko različitih metoda: upotreba nesteroidnih antiinflamatornih lekova (NSAID), anestetičkih gelova, splinta, nisko-energetske laser terapije (LLLT), transkutane električne stimulacije nerva (TENS) i vibracione stimulacije<sup>6</sup>. Konvencionalni terapijski pristup u rešavanju ovog problema tokom fiksne ortodontske terapije je orijentisan ka upotrebi lekova koji imaju dominantno analgetičke i antiinflamatorne efekte, ali u isto vreme, inicijalni ortodontski luk treba da proizvede ograničenu snagu<sup>7</sup>. U velikom broju radova suočeni su stavovi o efikasnosti i neophodnosti NSAID-a tokom ortodontskog lečenja<sup>8,9,10</sup>. Uzimajući u obzir negativne efekte analgetika, neki istraživači traže sigurne alternativne metode za smanjenje bolova, kao što je LLLT<sup>11</sup>.

Postoji niz izvještaja o širokom spektru bioloških efekata lasera, uključujući analgetički efekat (koji nastaje zbog promena potencijala ćelijske membrane), aktiviranje mikrocirkulacije i ubrzani metabolizam, imunostimulacija, stimulacija epitelizacije, kao i antiinflamatorni efekat<sup>12-17</sup>.

Neka istraživanja potvrđuju pozitivne efekte u suočavanju s takvom vrstom bola<sup>18,19</sup>, dok neka ne<sup>20</sup>.

**Cilj** ove studije bio je da se proceni efikasnost biostimulativne laserske terapije u lečenju bola kod pacijenata sa fiksnim ortodontskim aparatima.

## Introduction

Applying fixed orthodontic appliances usually is a reason for some level of discomfort and pain, which can play a key role not only for the cooperation with the patient but for the treatment success as well<sup>1,2,3</sup>. Literature reports show that the fear of pain is a very important reason for discouraging the patient from this kind of orthodontic treatment<sup>4</sup>. Reducing the pain after the initial application of the arch is especially important. Most of the patients feel pain<sup>4</sup> hours after the arch application, gaining the highest level after 24 hours, which decreases in the next few days<sup>5</sup>.

For managing the pain of orthodontic origin, several different methods are recommended: the use of nonsteroidal anti-inflammatory drugs (NSAIDs), anesthetic gels, splints, low level laser therapy (LLLT), transcutaneous electrical nerve stimulation (TENS) and vibrational stimulation<sup>6</sup>. The conventional therapeutic approach in dealing with this problem during the fixed orthodontic therapy is oriented towards the usage of medicaments which dominantly have analgesic and anti-inflammatory effects, but at the same time the initial arch should produce a limited force<sup>7</sup>. Most of the reports have confronted views for the efficiency and the necessity of NSAIDs use during the orthodontic treatment<sup>8,9,10</sup>. Taking into consideration the negative effects of the analgesics, some researchers are seeking for safe alternative methods in reducing the pain, such as the LLLT<sup>11</sup>. There is a number of reports regarding the wide spectrum of biological effects of the laser, including the analgesic effect (due to changes in the cell membrane potential), activating the microcirculation and higher metabolism, immunostimulation, stimulation of the epithelization, as well as the anti-inflammatory effect<sup>12-17</sup>. Some reports approve the positive effects in dealing with this kind of pain<sup>18,19</sup>, while some do not<sup>20</sup>.

**The aim** of this study was to evaluate the effectiveness of the biostimulative laser therapy in the treatment of pain in patients with fixed orthodontic appliances.

## ***Materijal i metode***

Na Klinici za oralnu patologiju i parodontologiju u Skoplju pregledano je ukupno 30 pacijenata sa fiksnim aparatima, odmah nakon postavljanja ortodontskog luka. Kod 15 pacijenata koji su činili ispitivanu grupu, laser terapija je obavljena odmah nakon postavljanja ortodontskog aparata i u naredna četiri dana Korišćen je laserski uređaj Scorpion D-405 7A®, sa talasnom dužinom od 630-670 nm, sa 20 mV i intenzitetom od 220 mW/cm<sup>2</sup>.

Vreme lasiranja je trajalo dva minuta po polju, vestibularno ili oralno po vilici, koristeći optički produžetak sa uglom od 30°. Pacijenti iz kontrolne grupe (n = 15) primali su analgetičku terapiju sa dnevnom dozom od 0,5 g metamizol-natrijuma (Analgin®). Bol je svakodnevno evaluiran i subjektivno ocenjen kao potpuno odsustvo bola, umereni i snažni bol. Rezultati su statistički analizirani i grafički prikazani.

## ***Rezultati***

Dinamika bolova u kontrolnoj grupi tokom petodnevnog perioda prikazana je na grafikonu 1. Prvog dana, jak bol je potvrđen kod 100% pacijenata, koji se zadržao drugog dana kod 60%, dok je umeren bol bio dominantan subjektivni osećaj kod 40% pacijenata trećeg dana, da bi se četvrtog dana smanjio na 26,6%. Nijedan od pacijenata nije imao bol petog dana studije. Grafikon 2 prikazuje distribuciju bolova u ispitivanoj grupi. Bol je bio odsutan kod 20%<sup>3</sup> pacijenata prvog dana, dok je umereni i izolovani bol bio prisutan kod 60% i 20% pacijenata tokom drugog i trećeg dana.

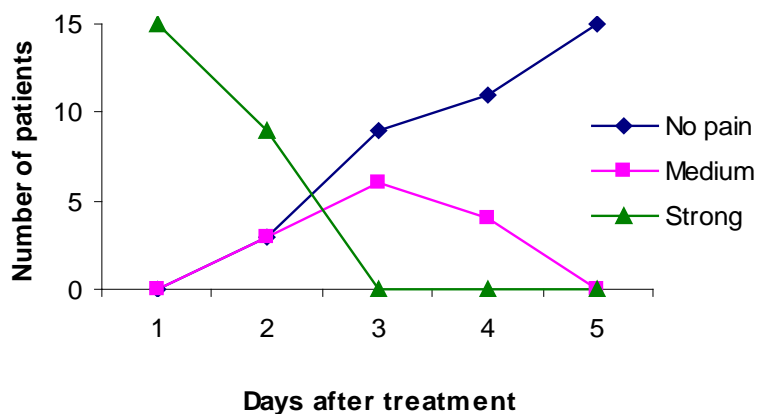
Tokom četvrtog i petog dana bol nije zabeležen ni kod jednog pacijenta tretiranog laserom. Poređenje podataka o ukupnom odsustvu bolova (grafikon 3) pokazuje da je niskointenzivna laserska terapija pokazala terapijski efekat odmah nakon prve posete i bila je razlog potpunog obezboljavanja kod 20% pacijenata, u poređenju sa analgetičkom terapijom koja nije imala efekta u ovom vremenu. Ovaj trend značajnog analgetičkog laserskog efekta nastavljen je tokom čitavog terapijskog perioda, što je dovelo do potpunog odsustva bolova kod svih pacijenata u ispitivanoj grupi četvrtog dana, u poređenju sa kontrolnom grupom, u kojoj je bol prisutan kod 11 (73,3%) pacijenata.

## ***Material and methods***

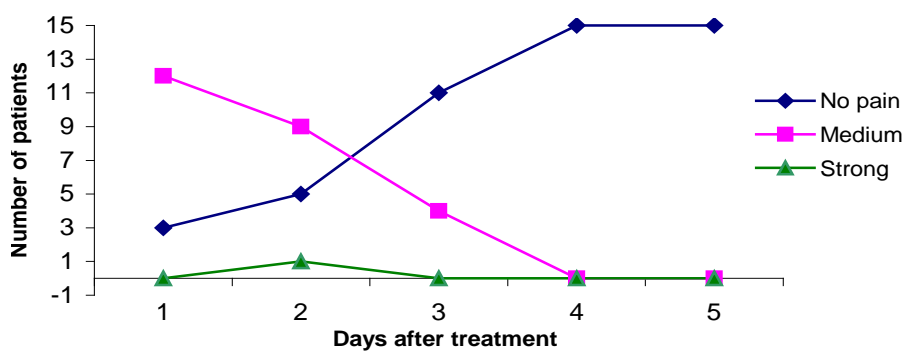
A total of 30 patients with fixed appliances were evaluated in the Clinic for Oral Pathology and Periodontology in Skopje immediately after the arch placing. In 15 patients representing the examined group, laser treatment was performed right after the setting of the orthodontic appliance, including the following 4 days as well. Scorpion D-405 7A® laser device was used, with wavelength of 630-670 nm, output of 20 mW, and intensity of 220 mW/cm<sup>2</sup>. The duration of each treatment was 2 minutes per area, with one area representing a buccal or oral side in one jaw quadrant and optical attachments with angle of 30° were used. The patients from the control group (n=15) received analgesic treatment with daily administration of 0.5 g metamizol sodium (Analgin®). Pain was evaluated daily and assessed subjectively as total absence of pain, moderate and strong pain. The results were statistically analyzed and graphically presented.

## ***Results***

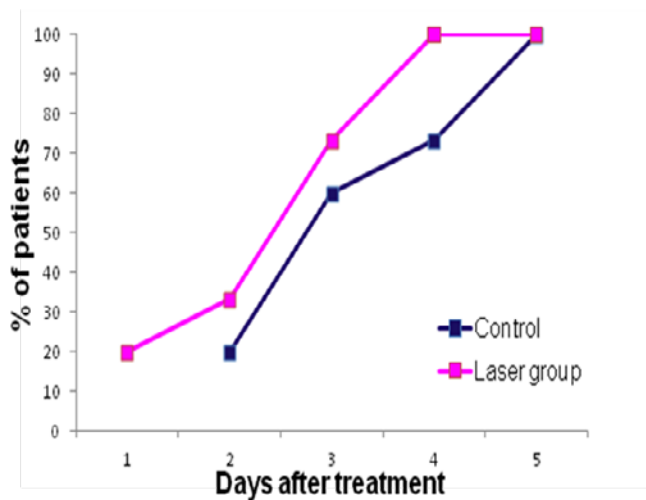
Dynamics of pain in the control group during the 5-day period is shown in Graph 1. On the first day, strong pain was verified in 100% of patients, which persisted during the second day in 60%, while moderate pain was a dominant subjective feeling in 40% of the patients on the third day, which lowered to 26,6% on the fourth day. None of the patients experienced pain on the fifth day of the study. Graph 2 shows the pain distribution in the examined group. The pain was absent in 20% (3) of patients on the first day, while moderate and isolated pain was present in 60% and 20% of the patients during the second and third day, respectively. During the fourth and fifth day, pain was detected in none of the patients treated with laser. Comparison between data for the total absence of pain (Graph 3) shows that the low level laser therapy demonstrated a therapeutic effect immediately after the first visit and was a reason for the total relief of pain in 20% of the patients, compared to the analgesic therapy which did not have effect during this period. This trend of notable analgesic effect of the laser continued during the entire therapeutic period, which led to the total absence of pain in all of the patients from the examined group on the fourth day, compared to the control group in which pain was present in 11 (73,3%) of the patients.



Grafikon 1. Smanjenje bola u kontrolnoj grupi  
Graph 1. Pain reduction in the control group



Grafikon 2. Smanjenje bola u grupi koja se tretira laserom  
Graph 2. Pain reduction in the laser-treated group



Grafikon 3. Potpuno smanjenje bola u obe grupe  
Graph 3. Complete pain reduction in both group

## Diskusija

Loša estetika, nelagodnost i bol koji se javlja usled pomeranja zuba nakon primene ortodontskih sila u fiksnoj tehnici dominantni su faktori u prihvatanju i prilagođavanju ovoj vrsti terapije.

Podaci u literaturi ukazuju na protivrečnost u procentu pacijenata koji se žale na pojavu i trajanje bolova nakon primene fiksnog ortodontskog aparata. U nekim radovima su evidentirane dnevne varijacije bolova sa najvišim nivoom bola u večernjim i noćnim satima. Obično bol traje 2-3 dana i postepeno se smanjuje nakon 5 do 6 dana<sup>5,6</sup>.

Rezultati ove studije, takođe, pokazali su značajno prisustvo bola prvog dana kod svih ispitanika u kontrolnoj grupi i umeren bol kod 80% pacijenata u ispitivanoj grupi, kao i trend njegovog postepenog smanjenja tokom sledećih dana.

Najverovatnije je da je bol uzrokovan akutnom inflamatornom reakcijom kao rezultat ne samo primene fiksnog ortodontskog aparata, već i zbog pokretanja zuba. Otok i povećani pritisak tkiva su drugi mehanički faktor u razvoju bola.

Brojni medijatori (serotonin, bradikinin, PGE) takođe su uključeni u mehanizam pojave bola, putem povećanja lokalne vazodilatacije i kapilarne propustljivosti, promenom senzitivnosti i receptivnosti receptora u određenoj oblasti. Ovim putem, granični prag postaje veoma nizak, tako da nociceptori postaju mnogo osetljiviji na stimulus, baš kao i mehanoreceptori. Za analgeziju, većina ortodontata propisuje NSAID koji sprečava proizvodnju prostaglandina.

Njegovo propisivanje u malim dozama prvog ili drugog dana tokom početne faze ortodontske terapije ne utiče značajno na proces pomeranja zuba. Ipak, većina ovih lekova ima neželjene efekte na pomeranje zuba ako se koristi u dužem vremenskom periodu (zbog efekta inhibicije prostaglandina)<sup>21</sup>.

Ne treba zanemarivati sistemske neželjene efekte<sup>22-24</sup>. Postoji mnogo izveštaja o korišćenju ovih analgetika u ortodontskoj praksi; kao i određeni stav za njihovo korišćenje kao lek izbora, bez obzira na vrstu (ibuprofen, acetaminophen ili aspirin), zbog nedostatka dokaza za efikasnost laserske terapije i drugih nefarmakoloških modaliteta<sup>11</sup>.

## Discussion

Bad aesthetics, discomfort and pain which occur due to tooth movements after the application of orthodontics forces with the fixed technique are the dominant factors in accepting and adapting to this type of therapy.

Literature data indicates inconsistency in the percent of patients who refer to the occurrence and lasting of the pain after applying a fixed orthodontic appliance. Daily pain variations with the highest level of pain in the evening and night hours have been previously reported. Usually, pain lasts for 2-3 days and gradually lowers after 5 to 6 days<sup>5,6</sup>.

The results in our study also showed a notable presence of pain on the first day in all the examinees in the control group and moderate pain in 80% of the patients in the examined group, as well as a decreasing trend in the next following days. It is most likely that pain is due to the acute inflammatory reaction as a result not only of the application of the fixed orthodontic appliance but because of the initial tooth movement as well. The swelling and increased tissue pressure are other mechanical factors in the development of pain. A number of mediators (serotonin, bradykinin, PGE) are also involved in the mechanism of pain occurrence by increasing the local vasodilatation and capillary permeability and by altering the sensitivity and receptivity of the receptors in the specific area. In this way, the pain threshold becomes very low that the nociceptors are much more sensitive to the stimulus, just like the mechanoreceptors. For pain relief, most of the orthodontists prescribe NSAIDs, which inhibit the prostaglandin production. Their administration in low doses on the first or second day of the initial phase would not considerably affect the process of tooth movement. Nevertheless, most of these medicaments have side effects on the teeth movement if used in a long period of time (due to the inhibition effect to the prostaglandins)<sup>21</sup>.

The systemic side effects should not be neglected as well<sup>22-24</sup>. There are lots of reports for using these analgesics in orthodontic practice; there is a view-point for their usage as a first choice medicament, regardless of the type (ibuprofen, acetaminophen or aspirin) because of the lack of evidence for the efficiency of the laser therapy and other non-pharmacological modalities<sup>11</sup>.

U ovom radu, ispitanicima iz kontrolne grupe preporučeno je da uzmu Analgin (0,5 g metamizol natrijuma), što je bio razlog za odsustvo jakih bolova nakon trećeg dana, ali je potpuno odsustvo zabeleženo nakon petog dana (Grafikon 1).

Ovo je u skladu sa izveštajima koji podržavaju efikasnost analgetičke terapije<sup>10,21,25</sup>. Pregled literature pokazuje da su najprepisivaniji analgetici NSAID, dok nema izveštaja o upotrebi lekova metamizola tokom ortodontskog tretmana. Metamizol spada u grupu neopioidnih analgetika.

Mehanizam njegovog delovanja još uvek nije dobro razjašnjen, ali smatra se da on i njegov metabolit (4-N-metilaminoantipirin) inhibiraju bol putem delovanja na prostaglandine, pa je verovatno to razlog njegovog sličnog efekta sa jednim od NSAID preparata. Smatramo da je sličnost u mehanizmu delovanja Analgina sa NSAID preparatima razlog za rezultate koji dokazuju njegov analgetički efekat u ovoj studiji.

Analgetički efekti niskoenergetskog laserskog svetla koristi se u različitim kliničkim stanjima. Laserska analgezija je terapijski modalitet koji koristi neinvazivni način, jednostavnu primenu i odsustvo negativnih tkivnih odgovora. Stoga vredi proceniti njegov potencijal za primenu u ortodontiji.

Dominantno pozitivna i verifikovana iskustva u smanjenju bolova prilikom fiksnog ortodontskog tretmana govore ne samo o anti-inflamatornom i analgetičkom efektu laserskog svetla, već i o bržem pomeranju zuba i remodeliranju alveolarne kosti, što smanjuje neugodnost i bol u početnoj fazi fiksnog ortodontskog tretmana i smanjivanju vremena tretmana.

Izuzetni klinički analgetički efekti lasera tokom inicijalnog pokretanja zuba u fiksnom ortodontskom tretmanu<sup>1,19</sup> su snažan razlog da klinička primena prevladava u odnosu na trend otkrivanja njegovih bioloških mehanizama. Mehanizam analgezije laserskom terapijom je rezultat direktnog dejstva lasera na nervna vlakna, tako što stabilizuje njihov depolarizacioni potencijal, ali i efekat na ćelijske i biohemijske procese tokom inflamatornog odgovora<sup>20,27</sup>.

Budući da nismo imali neposredni analgetički efekat koji se je pojavio 24-48 sati nakon primene lasera (grafikon 2), rezultati u ovoj studiji podržavaju hipotezu da je analgezija postignuta uglavnom zbog efekta lasera na inflamaciju. LLLT može imati pozitivan efekat kod ortodontskih pacijenata ne samo odmah nakon postavljanja inicijalnog ortodontskog luka, veću sprečavanju i lečenju bolova prilikom menjanja luka, korišćenja separatora itd.

In our study, the examinees from the control group were recommended to take Analgin (0,5 g metamizol sodium), which was the reason for the absence of strong pain after the third day, but the total absence was noted after the fifth day (Graph 1).

This is in accordance with the reports which support the efficiency of the analgesic therapy<sup>10,21,25</sup>. Literature review showed that the most prescribed analgesics are NSAIDs, while there are no reports for the usage of metamizole medicaments during the orthodontic treatment. Metamizole belongs to the group of non-opioid analgesics. The mechanism of its action is still not well elucidated, but it is thought that it and its metabolite (4-N-Methylaminoantipyrin) inhibit the pain through their effect on prostaglandins, so it is likely that this is the reason for its similar effect on the one of the NSAIDs. In our opinion, the similarity in the mechanism of action of the Analgin with the NSAIDs is the reason for the results which prove its analgesic effect in this study.

The analgesic effects of the low level laser light are used in different clinical conditions. Laser analgesia is a therapeutic modality the benefit of which is a non-invasive manner, easy application and absence of negative tissue responses. Thus, it is worth to review its potential for application in orthodontics. The dominantly positive and verified experiences in minimizing the pain during fixed orthodontic treatment demonstrate not only the anti-inflammatory and analgesic effect of the laser light but also a quicker tooth movement and alveolar bone remodeling, which minimizes the discomfort and pain in the initial phase of fixed orthodontic treatment and reduce the treatment time. The extraordinary clinical effects of the laser for pain relief during the initial tooth movement in the fixed orthodontic treatment<sup>1,19</sup> are strong reasons for the clinical application to overcome the trend for elucidation of its biological mechanisms.

The mechanism of analgesia of the laser therapy is due to the direct effect of the laser on the nerve fibers, in the way that it stabilizes their depolarization potential, but also of the effects on the cell and biochemical processes during the inflammatory response<sup>20,27</sup>. Because the immediate analgesic effect was not noted, but it was demonstrated 24-48 hours after the application (Graph 2), the results in this study support the hypothesis that the analgesics is mainly due to the laser effect on the inflammatory process.

Turhani i sar.<sup>1</sup> su pokazali da lasersko zračenje u jednoj sesiji odmah nakon postavljanja aparata smanjuje bol nakon 6 i 30 sati, što nije u skladu sa našim rezultatima. Tortamano i sar.<sup>19</sup> zaključuju da su laseri (GaAlAs, 830 nm, izlazna energija 30 mV) efikasni odmah nakon postavljanja luka, jer su pacijenti prijavili niži bol i intenzitet bolova tokom najbolnijeg dana. Tokom laserskog tretmana, bol se brže smanjivala.

Procena uticaja LLLT na bol u ortodontskom tretmanu u studijama<sup>26,27</sup> pokazala je da je intenzitet bolova u laserskoj grupi na nižem nivou, ali nije statistički značajan u odnosu na kontrolnu grupu. Won Tae Kim i sar.<sup>28</sup> su izvestili da efekat laserske terapije nije superioran, ali smanjuje pik bola, u poređenju sa grupama sa placebo i analgetikom. U drugoj studiji<sup>29</sup> utvrđene su značajne razlike između LLLT-a i placebo grupa, pri čemu LLLT grupa pokazuje niže prosečne vrednosti nivoa boli u čitavom vremenskom periodu.

Suprotno, Esper i sar.<sup>20</sup> obaveštavaju da nema značajnog smanjenja bola u laserskoj grupi u poređenju sa placebo grupom. Nedoslednost u ovim izveštajima je posledica modaliteta njegovog načina primenjivanja, kao što je jedna sesija<sup>1,19,30</sup> ili terapija sa više sesija tokom nekoliko dana<sup>18,26</sup>, što može biti razlog za različitu efikasnost laserske terapije.

Smatra se da češće lasersko zračenje u periodu nelagodnosti ili bola može dovesti do značajnog smanjenja percepcije bola kod pacijenata. Nakon terapije laserom, u ispitivanoj grupi uočeno je smanjenje bola u drugoj poseti, sa potpunim odsustvom bolova kod tri pacijenta (20%) (grafikon 2), što je u skladu sa rezultatima nekih autora<sup>27,29</sup>, koji takođe potvrđuju značajno smanjenje bolova kod pacijenata tretiranih laserom.

Činjenica da laser uzrokuje brzo oslobađanje bola nakon prve terapije i potpuno smanjenje bola posle četvrtog dana, u poređenju sa kontrolnom grupom gde se jak bol gubi posle trećeg dana kod 60% i potpuno odsustvo bolova nakon petog dana, još jedan je dokaz analgetičkog laserskog efekta (grafikon 1). Uzimajući u obzir ove nalaze, kao i to da je PGE2 jedan od najvažnijih hemijskih medijatora u akutnoj fazi upale, ali je takođe faktor odgovoran za pojavu bola, možemo pretpostaviti povezanost između laserski indukovane inhibicije PGE2 i blokade ciklooksigenaze sa smanjenjem bola<sup>31</sup> i u ovom kontekstu tumačimo rezultate.

Biomikroskopska istraživanja i stanje parodonta pokazuju da gingivalna cirkulacija postaje normalna nakon terapije laserom, dok se kapilarna propustljivost i venska kongestija smanjuju, što dovodi do brže korekcije upale i smanjenja bolova<sup>32</sup>.

LLLT may have a positive effect in orthodontic patients not only immediately after applying the initial arch, but generally in preventing and treating the pain during the treatment - changing of arch, use of separators etc. Turhani et al.<sup>1</sup> showed that laser irradiation in one session immediately after setting the appliance reduces the pain after 6 and 30 hours, which is not in accordance with our results. Tortamano et al.<sup>19</sup> concluded that lasers (GaAlAs, 830 nm, output energy 30 mW) are efficient right after the application of the arch, because the patients reported weaker pain and pain intensity during the most painful day. During the laser treatment, pain reduced in its intensity more quickly.

The evaluation of LLLT effect on pain in orthodontic treatment in the studies<sup>26,27</sup> showed that pain intensity in the laser group was lower, but not statistically significantly from the control group. Won Tae Kim et al.<sup>28</sup> reported that the effect of the laser therapy is not superior but reduces the highest level of pain, compared to the groups with placebo and analgesics. In another study<sup>29</sup>, significant differences were found between LLLT and placebo groups, with LLLT group showing lower average values of the pain level for the whole period of time. Contrary, Esper et al.<sup>20</sup> reported that there was no significant reduction of pain in the laser group compared to the placebo group. The inconsistency in these reports is due to the modalities in its application, like one-session<sup>1,19,30</sup>, or multiple-session therapy during a few days<sup>18,26</sup>, which can be the reason for the different efficiency of the laser therapy. It is thought that more frequent laser irradiation in the period of discomfort or pain may lead to significant reduction in the perception of pain. After the laser therapy, in the examined group, a reduction of pain was noted at the second visit, with complete absence of pain in 3 patients (20%) (Graph 2), which is in accordance with the results of some authors<sup>27,29</sup>, who also confirmed a considerable pain reduction in patients treated with laser. The fact that laser induces fast pain relief after the first therapy and a total reduction of pain after the fourth day, compared to the control group where the strong pain relief was noted after the third day in 60% of patients and complete absence of pain was noted after the fifth day, is another prove for the laser analgesic effect (Graph 1). Taking into consideration these findings and that PGE2 is one of the most important chemical mediators in the acute phase of inflammation, which is also a factor

Pozitivne efekte lasera na dinamiku cirkulacije potvrđuju mnoga istraživanja<sup>31,33,34</sup>. Složeni efekat LLLT je razlog za dobijene rezultate u ovoj studiji.

Potrebna su dalja istraživanja različitih načina laserske terapije u preciznijem određivanju modaliteta njegove upotrebe, doze i primene, tako da se može potvrditi kao efikasna klinička procedura koja će imati značajan doprinos u ortodonciji.

### ***Zaključak***

Niskointenzivna terapija laserom je neinvazivna i sigurna procedura koja se može uspešno koristiti za smanjivanje bola tokom fiksne ortodontske terapije. Potrebna su dalja istraživanja da bi se pojasnili i odredili mogući mehanizmi analgetskog delovanja.

responsible for pain production, we propose the connection between the laser-induced inhibition of PGE2 and block of the cyclooxygenase with the reduction of pain<sup>31</sup>, and we interpret our results in this context.

Biomicroscopic investigations and periodontal condition show that the gingival circulation becomes normal after the laser therapy, while the capillary permeability and venous congestion reduce, which lead to the quick correction of the inflammation and pain reduction<sup>32</sup>. The positive effects of the laser on the circulatory dynamics are approved by many researches<sup>31, 33, 34</sup>. The complex effect of LLLT is a reason for the results in this study. Further research for different manners of laser therapy in specifying the modality of its use, its dose and application are necessary, so it can be verified as efficient clinical procedure which will have a significant contribution in orthodontics.

### ***Conclusion***

The low level laser therapy is a non-invasive and safe procedure which can be successfully used for pain management during fixed orthodontics treatment. Further researches are necessary to elucidate and specify the possible mechanisms of pain reduction with laser therapy.



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