SHORT COMMUNICATIONS

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Comparative clinical evaluation of the therapeutic effects of low-level laser and hyaluronic acid on *gingivitis catarrhalis* in children

Komparativna klinička evaluacija terapijskih efekata lasera male snage i hijaluronske kiseline na kataralni gingivitis kod dece

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Abstract

Background/Aim. *Gingivitis catarrhalis* is the most common disease of the oral mucosa in children, representing an inflammation of the gingiva of an exudative nature. The aim of this study was to evaluate the effectiveness of low-level laser therapy and hyaluronic acid therapy on *gingivitis catarrhalis* in children using the appropriate clinical parameters. **Methods.** The study involved 100 children with permanent dentition in whom *gingivitis catarrhalis* had been diagnosed. The examinees were divided into two groups: the group I consisting of patients with gingival inflammation (50 examinees) in whom the therapy with hyaluronic acid was applied after the removal of soft and hard dental deposits, and the group II consisting of patients with gingival inflammation (50 examinees) in whom low-level laser therapy was applied after the removal of soft and hard dental deposits. Clinical evaluation of the therapeutic effects of low-level laser and hyaluronic acid on *gingivitis catarrhalis* was performed using the appropriate indices: the Greene-Vermillion Plaque Index (PI), Muhlemann bleeding index (BI), and Community Periodontal Index of Treatment Needs (CPITN). **Results.** Using the Student's *t*-test for dependent samples, a statistically significant difference was obtained ($p < 0.001$) between the PI, BI, and CPITN indices before and after the therapy in both examined groups. Moreover, the CPITN index after the therapy in the group II was statistically significantly lower ($p < 0.05$) than that obtained in the group I. **Conclusion.** The results demonstrated an exceptional effect of hyaluronic acid and low-level laser therapy, supplementing basic therapy, in the treatment of catarrhal gingivitis in children. Somewhat better results were achieved with the combination of basic therapy and low-level laser.

Key words:
adolescent; gingivitis; hyaluronic acid; low-level laser therapy; oral health; periodontal index; treatment outcome.

Apstrakt

Uvod/Cilj. Kataralni gingivitis je najčešće oboljenje oralne sluzokože kod dece i predstavlja inflamaciju gingive eksudativne prirode. Cilj rada je bio da se kliničkim parametrima oceni efikasnost lasera male snage i hijaluronske kiseline na kataralni gingivitis kod dece. **Metode.** Ispitivanjem je obuhvaćeno 100 dece sa stalnom denticijom, kojima je dijagnostikovan *gingivitis catarrhalis*. Ispitanici su podeljeni u dve grupe: I grupu su činili pacijenti sa inflamiranom gingivom (*gingivitis catarrhalis* – 50 ispitanika), kojima je nakon uklanjanja mekih i čvrstih naslaga primenjena terapija aplikovanjem hijaluronske kiseline; II grupu su činili pacijenti sa inflamiranom gingivom (*gingivitis catarrhalis* – 50 ispitanika), kod kojih je nakon uklanjanja mekih i čvrstih naslaga primenjena terapija laserom male snage. Klinička procena terapijskih efekata lasera male snage i hijaluronske kiseline na *gingivitis catarrhalis* vršena je uz pomoć odgovarajućih indeksa: plak indeks po Greene-Vermillion-u (PI), Muhlemannov indeks krvarenja (IKR) i *Community Periodontal Index of Treatment Needs* (CPITN). **Rezultati.** Studentovim *t*-testom zavisnih uzoraka dobijena je statistički značajna razlika ($p < 0{,}001$) između PI, IKR i CPITN indeksa pre i PI, IKR, i CPITN indeksa posle terapije u obe ispitivane grupe. Takođe CPITN indeks posle terapije ispitanika II grupe bio je statistički značajno niži ($p < 0{,}05$) u odnosu na ispitanike I grupe. **Zaključak.** Dobijeni rezultati pokazuju izuzetno dobar efekat hijaluronske kiseline i lasera male snage uz bazičnu terapiju u lečenju kataralnih gingivitisa kod dece. Nesto bolji rezultati dobijeni su u kombinaciji bazične terapije i lasera male snage.

Ključne reči:
adolescenti; gingivitis; hijaluronska kiselina; laser male snage; usta, zdravlje; periodontalni indeks; lečenje, ishod.

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Introduction

Gingivitis catarrhalis is the most common disease of the oral mucosa in children, representing an inflammation of the gingiva of an exudative nature. It occurs as the consequence of gingival tissue reaction to the stimuli produced by local factors. *Gingivitis catarrhalis* is characterized by bleeding from the gingiva upon provocation, and the intensity of bleeding is proportional to the severity of gingival inflammation.

The treatment of *gingivitis catarrhalis* involves primarily the standard (basic) therapy – removal of any causal agents and motivation and education of children to maintain adequate oral hygiene. The removal of causal agents involves the removal of any agents directly or indirectly involved in the onset of the disease. These are, above all, local factors, such as dental deposits (dental biofilm and calculus), then iatrogenic factors, caries, bad habits, and some dietary factors. Clinical improvements are directly related to the reduction or removal of subgingival biofilm [1, 2].

Gingivitis catarrhalis is most commonly caused by the bacteria present in the dental plaque. These bacteria produce some specific enzymes (proteinases and hyaluronidases) which destroy the structure of the connective tissue (above all, collagen types I and IV). Furthermore, they tend to depolymerize the structure of hyaluronic acid and thus damage the tissue of the tooth supporting structure. In further course of the disease, additional pathological changes usually appear, which, if left untreated, can ultimately lead to the loss of teeth.

The use of hyaluronic acid is a fundamentally new biological approach in dentistry in the prevention and treatment of lesions and inflammatory changes in the oral cavity. The substance has also been studied as a metabolite or inflammation marker present in the gingival fluid, and also as an important factor involved in growth, development and regeneration of tissue [3,4].

The beneficial effects of laser light in the therapy of gingivitis have also been a focus of attention. The first ruby laser was developed by Maiman in 1960. Soon after that, its possible use in dentistry was recognized. The interest in the development of this technology in all disciplines of dentistry has been on the rise ever since. The fact that the use of low-power laser is entirely painless, noninvasive and without any adverse effects is especially important in that regard [5–7]. Exceptionally good results are achieved with the use of low-level laser as an adjuvant to standard, basic therapy, in the treatment of periodontal inflammations [8,9].

Nowadays, it is a well known fact that the rays of low-level laser light can have both primary (photochemical, photoelectric, and photoenergetic) and secondary effects (stimulation of the cell metabolism and microcirculation), with the resultant therapeutic laser light effects, such as analgetic, biostimulative, antiinflammatory, and antiedematous effects [10–13].

The aim of this study was to evaluate, using clinical parameters, the effectiveness of low-level laser and hyaluronidase in *gingivitis catarrhalis* in children.

Methods

The study involved 100 children with permanent dentition (aged 13–17 years) diagnosed with catarrhal gingivitis. Their gender representation was balanced. The examinees were divided into two groups. The group I consisted of the patients with gingival inflammation (*gingivitis catarrhalis* – 50 examinees) in whom the therapy with hyaluronic acid was applied. Hyaluronic acid was administered by gently rubbing in the gel into the inflamed gingiva daily for a week. The group II included the patients with gingival inflammation (*gingivitis catarrhalis* – 50 examinees) in whom, after the removal of soft and hard dental deposits, the therapy with low-level laser was applied using the Scorpion-dental-Optima laser in 5 daily sessions (with 635 nm wavelength, initial power of 25 mV, and a 120 s exposure).

Clinical evaluation of the therapeutic effects of low-level laser and hyaluronic acid on *gingivitis catarrhalis* was performed using the appropriate indices. The following indices were determined for all patients, both before and after the therapy: Greene-Vermillion Plaque Index (PI), Muhlemann Bleeding Index (BI), and Community Periodontal Index of Treatment Needs (CPITN).

The study was approved by the Ethical Committee of the Faculty of Medicine, University of Niš (in accordance with the World Medical Association Declaration of Helsinki).

The examined parameters were represented with mean values and standard deviations (SD). The coefficient of variation was determined as the measure of homogeneity of the examined samples in relation to the examined parameters. The Student's *t*-test of independent samples was used to test statistically significant differences between the mean values of these two groups. The entry and tabular representation of results were done using the MS Office Excel, and calculations were performed using the SPSS ver. 15.0 software package.

Results

The values of PI, BI and CPITN were shown in Table 1. Student's *t*-test of independent samples detected a statistically significant difference ($p < 0.001$) between PI, BI and CPITN indices before and after therapy in both studied groups. Further, the CPITN value after the therapy in the group II was statistically significantly lower ($p < 0.05$) compared to that in the group I of examinees.

Discussion

Inflammation of the gingiva is common in children. Early diagnosis and treatment are very important, since if left untreated, the inflammation may involve other periodontal tissues and the process becomes irreversible. A complex etiopathogenesis of the disease which involve periodontal tissues, developing in a complex anatomical substratum, makes any monitoring of its course very difficult. The pathological processes involving the tissue of periodontium begin without any external manifestation, and initial reactions can not be at all detected. The stage of the disease is of key importance regarding the necessary treatment and prognosis. Each case of gingivitis has to be treated, so that the disease is prevented to progress and involve deeper periodontal tissues and, as a result, irreversible changes are avoided. Newer and more effective treatment tools and methods are therefore sought for.

Table 1

Mean values of dental indices in the studies grups before and after the therapy

Dental indices	Before terapy		After terapy	
	mean ± SD	CV	mean ± SD	CV
PI				
group I	1.68 ± 0.47	28.05	0.00 ± 0.00*	
group II	1.82 ± 0.39	31.32	0.00 ± 0.00*	
BI				
group I	1.74 ± 0.44	25.46	0.16 ± 0.37*	231.46
group II	1.00 ± 0.61	32.34	0.08 ± 0.27*	342.56
CPITN				
group I	1.50 ± 0.51	33.67	0.24 ± 0.43*	179.76
group II	1.60 ± 0.49	30.93	0.08 ± 0.27*†	342.56

Group I – patients treated with hyaluronic acid; Group II – patients treated with low-level laser (both groups had equal number of examinees, 50 each).
PI – Plaque Index; BI – Mulhemann Bleeding Index; CPITN – Community Periodontal Index of Treatment Needs; SD – standard deviation; CV – coefficient of variation.
***p* < 0.001 vs. before the therapy; †*p* < 0.05 vs. group I.**

In the group I of examinees, in addition to the usual, basic therapy of chronic gingivitis, hyaluronic acid was topically applied. The obtained posttreatment values of PI, BI and CPITN demonstrated that hyaluronic acid, owing to its antiinflammatory, antiinfective, antiedematous and regenerative actions help in the healing of chronic gingivitis in children. Hyaluronic acid is a natural biological substance in the gingival connective tissue [14, 15]. In chronic gingivites, under the action of bacterial enzymes (hyaluronidase), hyaluronic acid is decomposed. As a result, the structure of the gingival tissue is lost, with a resultant increased exchange of fluids between the tissue and the vascular system and consequential edema creation. Increased capillary permeability enables bacteria and their toxins to penetrate the tissue more easily, which further intensifies inflammation. Applied to the inflamed gingival tissue, hyaluronic acid exerts its antiinflammatory, antiedematous and antiproliferative effects [4, 16, 17]. The results of this study corroborate other findings that topical application of hyaluronic acid to gingival tissue, in the form of a gel or spray, is able to reduce bleeding and inflammation of the gingiva [16, 18]. It can be applied daily without any adverse effects [19]. A significant clinical improvement after the treatment of gingivitis with hyaluronic acid, manifested among other things as reduced gingival bleeding, has been reported by other authors as well [20–22].

In the group II of examinees, low-level laser therapy supplemented basic therapy. The obtained posttreatment values of PI, BI and CPITN showed that low-level laser, thanks to its antiinflammatory, antiedematous and biostimulation effects, was able to help in the healing of chronic gingivitis in children. Various researchers have reported that low-level laser therapy supplementing basic therapy is able to reduce gingival inflammation and that it can be successfully used in the therapy of gingivitis and parodontopathy [8, 23–25]. The results of some investigations have shown that laser therapy exerts analgetic effects only [26]. However, in recent decades, laser therapy has also been attributed with significant antiinflammatory properties. Low-level laser light reduces inflammation and produces clinically apparent antiinflammatory and antiedematous effects [27, 28]. Laser light provokes increased tissue regeneration. The action of low-level laser reduces blood vessel permeability and suppresses exudative processes, which in further course reduces gingival edema. Moreover, blood vessel permeability is normalized. By their biostimulation effect, low-level lasers increase cellular growth and proliferation, and induce changes in the circulation of lymph and blood (leading to a better blood supply and facilitated tissue drainage). Inflammatory response can be normalized or reduced by photochemical effects of laser radiation [29]. The similar was observed in this study too, where the applied basic therapy supplemented by low-level laser produced a significant downgrading of inflammation, as documented by the appropriate indices.

If it is not diagnosed timely, catarrhal gingivitis progresses and the pathological process involves other periodontal tissues, resulting in parodontopathy and subsequent loss of teeth. That is why it is important to intensify health education activities and prevent the onset and development of catarrhal gingivitis with all the available prevention and prophylactic measures and tests to establish the risk of the disease. This is essential bearing in mind that periodontal diseases can be the risk factor in the onset and development of other consecutive diseases, such as, for instance, cardiovascular, renal, and skin diseases.

Conclusion

Current dental health care, observed from the point of view of new technological advancements, is able to offer much more in the resolution of various dental problems than it has been in the relatively recent past. The results we obtained showed an exceptional effect of hyaluronic acid and low-level laser in the treatment of catarrhal gingivitis in children. Slightly better results were obtained with the combination of basic (standard) therapy and low-level laser.

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