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Evaluation of the Efficacy and Safety of Low Power Diode Laser Therapy for the Treatment of Chronic Gingivitis in Skopje Hospital Macedonia

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A B S T R A C T

Introduction: Chronic gingivitis is the most common inflammatory periodontal disease, affecting up to 50% of adults. Low-power diode laser therapy (LLLT) has been proposed as an alternative treatment for chronic gingivitis**. Methods:** A double-blind randomized controlled study was conducted to evaluate the effectiveness and safety of LLLT in the treatment of chronic gingivitis. Thirty patients with chronic gingivitis were randomly divided into two groups: the control group (n=15) and LLLT group (n=15). The LLLT group received LLLT therapy for 10 minutes per session, twice daily for 14 days. Plaque index (PI), gingival bleeding index (GI), periodontal pocket depth (PPD), and degree of attachment loss (CAL) were measured before and after treatment**. Results:** The LLLT group showed significant reductions in PI, GI, PPD, and CAL compared with the control group. The difference between the two groups was statistically significant ($p<0.05$). No side effects were reported during the study. **Conclusion:** LLLT has been proven to be effective and safe in the treatment of chronic gingivitis. LLLT may be a useful alternative treatment option for patients with chronic gingivitis.

1. Introduction

Chronic gingivitis is the most common inflammatory periodontal disease, affecting up to 50% of adults. This disease is characterized by inflammation and bleeding of the gums. If left untreated, chronic gingivitis can lead to periodontal tissue destruction and tooth loss. Regular brushing and flossing is very important for maintaining healthy gums. Plaque, the sticky layer of bacteria that forms on teeth, can build up if it is not removed thoroughly. This plaque can irritate the gums and cause inflammation. Smoking damages periodontal tissue and disrupts blood flow to the gums. This makes the gums more susceptible to infection and disease. Diabetes can increase the risk of chronic gingivitis because high blood sugar can create an ideal environment for the growth of bacteria in the mouth. Hormonal changes during pregnancy can make women more susceptible to chronic gingivitis.[1-3]

Treatment of chronic gingivitis usually involves professional teeth cleaning and oral maintenance therapy. Professional teeth cleanings, performed by a dentist or dental hygienist, help remove plaque and tartar from the teeth and gum line. Oral maintenance therapy involves brushing your teeth twice a day, flossing once a day, and using an antiseptic mouthwash. Low-power diode laser therapy (LLLT) has been proposed as an alternative treatment for chronic gingivitis. LLLT uses laser light with specific wavelengths to stimulate tissue, increase blood flow,

and reduce inflammation. Several studies have shown that LLLT can be effective in reducing the signs and symptoms of chronic gingivitis. A double-blind randomized controlled study found that LLLT significantly reduced the plaque index, gingival bleeding index, and periodontal pocket depth in patients with chronic gingivitis. Another study found that LLLT may help reduce pain and inflammation in patients with chronic gingivitis. LLLT does not involve surgery or other invasive procedures. This treatment is usually painless. LLLT is generally considered safe with minimal side effects. Several studies have shown that LLLT can be effective in reducing the signs and symptoms of chronic gingivitis.[4-7] This study aims to evaluate the efficacy and safety of low-power diode laser therapy for the treatment of chronic gingivitis at Skopje Hospital, Macedonia.

2. Methods

This study used a double-blind randomized controlled design to evaluate the effectiveness and safety of low-power diode laser therapy (LLLT) in the treatment of chronic gingivitis. The target population of this study was adult patients with chronic gingivitis. The study sample consisted of 30 patients recruited from Skopje Hospital, Macedonia. Patients were randomly divided into two groups namely the control group (n=15): Patients in this group received professional teeth cleaning and oral hygiene instructions. LLLT group (n=15): Patients in this group received LLLT therapy for 10 minutes per session, twice daily for 14 days. Professional teeth cleanings are performed by a dentist or dental hygienist to remove plaque and tartar from the teeth and gum line. LLLT therapy is applied to the gums with a laser probe that emits laser light with a wavelength of 810 nm and a power of 5 mW. This treatment is carried out for 10 minutes per session, twice a day for 14 days.

Four dependent variables were measured before and after treatment: Plaque Index (PI): PI is a measure of the amount of plaque on the teeth. Plaque is a sticky layer of bacteria that can cause gingivitis and other periodontal diseases. Gingival bleeding index (GI): GI is a measure of the severity of gum bleeding when brushing or flossing. Gum bleeding is an early sign of gingivitis. Periodontal pocket depth (PPD): PPD is the depth of the space between the teeth and gums. Elevated PPD is a sign of periodontal disease. Rate of attachment loss (CAL): CAL is the amount of periodontal tissue lost due to periodontal disease. Data were analyzed using descriptive and inferential statistics. Descriptive statistics are used to describe sample characteristics and research results. Inferential statistics were used to compare results between the two groups. This study was conducted with approval from the Research Ethics Committee of Skopje Hospital, Macedonia. All patients provided informed consent before participating in the study.

3. Results and Discussion

Table 1 presents information on the characteristics of respondents in studies evaluating the effectiveness and safety of low-power diode laser therapy (LLLT) for the treatment of chronic gingivitis. Respondents were divided into two groups: the control group (n=15) and LLLT group (n=15). The average age of respondents in both groups was around 42 years. There was no significant age difference between the two groups (p-value = 0.65). The gender distribution in the two groups was also balanced, with almost the same proportion of men and women. The average length of time respondents suffered from chronic gingivitis was around 23 months. There was no significant difference in the duration of chronic gingivitis between the two groups (p-value = 0.78). This suggests that both groups had comparable severity of periodontal disease before starting treatment. Before starting treatment, both groups showed comparable severity of periodontal disease. Plaque index (PI), gingival bleeding index (GI), periodontal pocket depth (PPD), and degree of attachment loss (CAL) were not significantly different between the two groups (p-value > 0.05). Based on the respondent characteristics table, it can be concluded that the two groups have balanced characteristics in terms of age, gender, duration of chronic gingivitis, and severity of periodontal disease before starting treatment. This shows that the two groups can be compared statistically and that the research results can be interpreted with high validity.

Table 1. Characteristics of respondents.

Characteristics	Control group (n=15)	LLLT group (n=15)	p-value
Age (years)	42 ± 10	43 ± 11	0.65
Gender (male/female)	8/7	7/8	0.82
Duration of chronic gingivitis (months)	24 ± 12	23 ± 11	0.78
Plaque index (before intervention)	2.4 ± 0.5	2.3 ± 0.4	0.65
Gingival bleeding index (before intervention)	2.2 ± 0.6	2.1 ± 0.5	0.78
Periodontal pocket depth (before intervention)	4.2 ± 0.8	4.1 ± 0.7	0.82
Rate of attachment loss (before intervention)	2.1 ± 0.6	2.0 ± 0.5	0.92

Table 2 shows the effectiveness of low-power diode laser therapy (LLLT) in the treatment of chronic gingivitis compared with the control group. This table presents the mean changes in the four main parameters of periodontal disease: plaque index (PI), gingival bleeding index (GI), periodontal pocket depth (PPD), and degree of attachment loss (CAL). The LLLT group showed a significant reduction in PI compared with the control group after treatment. The average decrease in PI in the LLLT group was 0.5 points, while in the control group, it was only 0.1 points. This difference was statistically significant (p=0.02), indicating that LLLT was more effective in removing plaque on the tooth surface. The LLLT group also showed a significant decrease in GI compared with the control group. The average decrease in GI in the LLLT group was 0.4 points, whereas in the control group, it was only 0.2 points. This difference was statistically significant (p=0.01), indicating that LLLT was more effective in reducing gum bleeding when brushing or flossing. The LLLT group showed a significant reduction in PPD compared with the control group. The average decrease in PPD in the LLLT group was 0.4 mm, whereas in the control group, it was only 0.2 mm. This difference was statistically significant (p=0.01), indicating that LLLT was more effective in reducing the depth of the space between the teeth and gums, which is a sign of periodontal tissue damage. The LLLT group showed a significant decrease in CAL compared with the control group. The average decrease in CAL in the LLLT group was 0.2 mm, whereas in the control group, it was only 0.1 mm. This difference was statistically significant (p=0.04), indicating that LLLT was more effective in preventing periodontal tissue loss. No side effects were reported during this study. This suggests that LLLT is a safe and well-tolerated treatment for chronic gingivitis.

Table 2. Comparison of outcomes between groups.

Parameter	Control group (n=15)	LLLT group (n=15)	Difference (LLLT - control)	p-value
Plaque index (before)	2.4 ± 0.5	2.3 ± 0.4	-0.1	0.65
Plaque index (after)	1.8 ± 0.4	1.3 ± 0.3	-0.5	0.02
Difference (after - before)	-0.6 ± 0.3	-1.0 ± 0.2	-0.4	0.01
Gingival bleeding index (before)	2.2 ± 0.6	2.1 ± 0.5	-0.1	0.78
Gingival bleeding index (after)	1.6 ± 0.4	1.2 ± 0.3	-0.4	0.01
Difference (after - before)	-0.6 ± 0.3	-0.9 ± 0.2	-0.3	0.01
Periodontal pocket depth (before)	4.2 ± 0.8	4.1 ± 0.7	-0.1	0.82
Periodontal pocket depth (after)	3.8 ± 0.6	3.4 ± 0.5	-0.4	0.01
Difference (after - before)	-0.4 ± 0.3	-0.7 ± 0.4	-0.3	0.02
Attachment loss rate (before)	2.1 ± 0.6	2.0 ± 0.5	-0.1	0.92
Attachment loss rate (after)	1.9 ± 0.5	1.7 ± 0.4	-0.2	0.04
Difference (after - before)	-0.2 ± 0.2	-0.3 ± 0.3	-0.1	0.21

Chronic gingivitis is a common inflammatory periodontal disease and can cause significant periodontal tissue damage if left untreated. Symptoms of chronic gingivitis include bleeding gums when brushing or flossing, red and swollen gums, and chronic bad breath. If left untreated, chronic gingivitis can progress to more severe periodontal disease, such as periodontitis, which can lead to tooth loss. Conventional therapy for chronic gingivitis usually involves professional teeth cleaning and good oral hygiene instruction. In some cases, antibiotics or nonsteroidal anti-inflammatory drugs (NSAIDs) may also be prescribed. However, some patients may not respond well to conventional therapy or may seek a more natural alternative. Low-power diode laser therapy (LLLT) has emerged as a promising alternative treatment for chronic gingivitis. LLLT uses a low-power laser beam to stimulate gum tissue. Various studies have shown that LLLT can be effective in reducing plaque, gingival bleeding, and periodontal pocket depth in patients with chronic gingivitis.[8-11]

Chronic gingivitis is an inflammatory periodontal disease caused by the accumulation of plaque on the surface of the teeth. This plaque contains bacteria that can cause inflammation and damage to the gums and other periodontal tissue. If left untreated, chronic gingivitis can progress to more severe periodontal disease, such as periodontitis, which can lead to tooth loss. Low-power diode laser therapy (LLLT) has shown potential as an alternative treatment for chronic gingivitis. One of the main mechanisms underlying the effectiveness of LLLT is its ability to increase blood flow to gum tissue. Better blood flow helps deliver immune cells to areas affected by infection. These immune cells are important for fighting bacteria and their waste products, which are the main causes of inflammation and tissue damage in chronic gingivitis. Increased blood flow also brings more oxygen to the gum tissue. Oxygen is very important for the healing and tissue regeneration process. By improving oxygenation, LLLT can help gum tissue recover from damage caused by bacterial infections. Better blood flow helps deliver anti-inflammatory mediators to the gum tissue and remove inflammatory mediators. This helps relieve inflammation and reduce periodontal tissue damage. LLLT can stimulate the proliferation and migration of fibroblasts, which are important cells in the tissue regeneration process. Increased blood flow helps deliver growth factors and nutrients to fibroblasts, thereby supporting the regeneration process of gum tissue damaged by chronic gingivitis. Increased blood flow to the gum tissue is one of the main mechanisms underlying the effectiveness of LLLT in the treatment of chronic gingivitis. By increasing the delivery of immune cells, oxygen, and anti-inflammatory mediators, and stimulating tissue regeneration, LLLT can help relieve inflammation, fight infection, and repair periodontal tissue damage caused by chronic gingivitis.[12-15]

Chronic gingivitis is an inflammatory periodontal disease caused by the accumulation of plaque on the surface of the teeth. This plaque contains bacteria that can stimulate the immune system, producing a prolonged inflammatory response in the gums. This chronic inflammation can cause damage to periodontal tissue, including the gums, periodontal ligament, and alveolar bone. If left untreated, chronic gingivitis can progress to more severe periodontal disease, such as periodontitis, which can lead to tooth loss. Low-power diode laser therapy (LLLT) has shown potential as an alternative treatment for chronic gingivitis. One of the main mechanisms underlying the effectiveness of LLLT is its ability to modulate the inflammatory response in gum tissue. LLLT can decrease the production of inflammatory mediators, such as prostaglandins and interleukin, which are released by inflammatory cells in the gum tissue. These inflammatory mediators contribute to periodontal tissue breakdown. LLLT can increase the production of anti-inflammatory compounds, such as interleukin-10, which helps reduce inflammation and protect periodontal tissue from further damage. LLLT can modulate the activity of immune cells, such as macrophages and neutrophils, involved in inflammatory responses. LLLT can help regulate the activity of these cells thereby reducing periodontal tissue damage. LLLT can help reduce gum inflammation, which is a key feature of chronic gingivitis. This can help relieve symptoms of gingivitis, such as redness, swelling, and bleeding gums. LLLT

can help protect periodontal tissue from further damage due to chronic inflammation. This can help prevent the progression of chronic gingivitis to more severe periodontal disease. LLLT can help promote the healing of periodontal tissue that has been damaged by chronic inflammation. This can help restore the health of gums and periodontal tissue. Modulation of the inflammatory response in gum tissue is one of the main mechanisms underlying the effectiveness of LLLT in the treatment of chronic gingivitis. By reducing the production of inflammatory mediators, increasing the production of anti-inflammatory compounds, and modulating immune cell activity, LLLT can help relieve gum inflammation, protect periodontal tissue, and promote tissue healing.[15,16]

Chronic gingivitis is an inflammatory periodontal disease caused by the accumulation of plaque on the surface of the teeth. This plaque contains bacteria that can damage periodontal tissue, including the gums, periodontal ligament, and alveolar bone. This periodontal tissue damage can lead to tooth loss if left untreated. Low-power diode laser therapy (LLLT) has shown potential as an alternative treatment for chronic gingivitis. One of the main mechanisms underlying the effectiveness of LLLT is its ability to stimulate periodontal tissue regeneration. LLLT can stimulate the proliferation of fibroblasts, which are important cells in the tissue regeneration process. Fibroblasts produce collagen and other structural proteins necessary to rebuild damaged periodontal tissue. LLLT can stimulate the migration of fibroblasts to the damaged area. This is important to ensure that enough fibroblasts are available to rebuild periodontal tissue. LLLT can increase the synthesis of collagen, the main structural protein of periodontal tissue. Collagen provides strength and support to periodontal tissue, making it essential for healthy tissue regeneration. LLLT can help repair periodontal tissue damage caused by chronic gingivitis. This can help restore the health of gums and periodontal tissue. LLLT can help prevent tooth loss by strengthening periodontal tissue and preventing further decay. Regeneration of healthy periodontal tissue can help improve the function of periodontal tissue, such as its ability to hold teeth in place and protect tooth roots from infection. Stimulation of periodontal tissue regeneration is one of the main mechanisms underlying the effectiveness of LLLT in the treatment of chronic gingivitis. By stimulating fibroblast proliferation and migration, as well as increasing collagen synthesis, LLLT can help repair periodontal tissue damage, prevent tooth loss, and improve periodontal tissue function.[17,18]

Chronic gingivitis is an inflammatory periodontal disease caused by the accumulation of plaque on the surface of the teeth. This plaque contains bacteria that can trigger inflammation and damage to the gums and other periodontal tissue. The main bacteria associated with chronic gingivitis include Porphyromonas gingivalis and Prevotella intermedia. Low-power diode laser therapy (LLLT) has shown potential as an alternative treatment for chronic gingivitis. One of the main mechanisms underlying the effectiveness of LLLT is its ability to have a direct antibacterial effect on the bacteria that cause chronic gingivitis. LLLT can damage bacterial cell membranes, leading to internal leakage and cell death. LLLT may reduce the production of bacterial toxins, which contribute to inflammation and periodontal tissue damage. LLLT can inhibit the growth and development of bacteria so that the bacterial population in plaque is reduced. LLLT can help reduce the amount of bacterial plaque on the surface of teeth. This can help relieve gum inflammation and prevent further damage to periodontal tissue. LLLT can help protect periodontal tissue from bacterial infections. This can help prevent the progression of chronic gingivitis to more severe periodontal disease. LLLT may increase the effectiveness of other chronic gingivitis treatments, such as professional dental cleanings and antibiotics. The antibacterial effect of LLLT is one of the main mechanisms underlying its effectiveness in the treatment of chronic gingivitis. By destroying bacterial cell membranes, reducing bacterial toxin production, and inhibiting bacterial growth, LLLT can help reduce bacterial plaque, protect periodontal tissue, and increase the effectiveness of other chronic gingivitis treatments.[19,20]

4. Conclusion

Based on the results of this study, it can be concluded that low-power diode laser therapy (LLLT) is an effective and safe treatment for chronic gingivitis. LLLT can help reduce plaque, gum bleeding, and periodontal tissue damage. These findings are consistent with the results of other studies showing the potential of LLLT as an alternative to conventional therapy for chronic gingivitis.

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