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POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 3/2021 (21) KWARTALNIK ISSN 1642-0136

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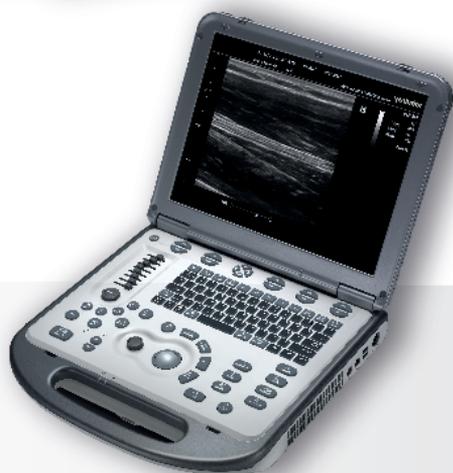
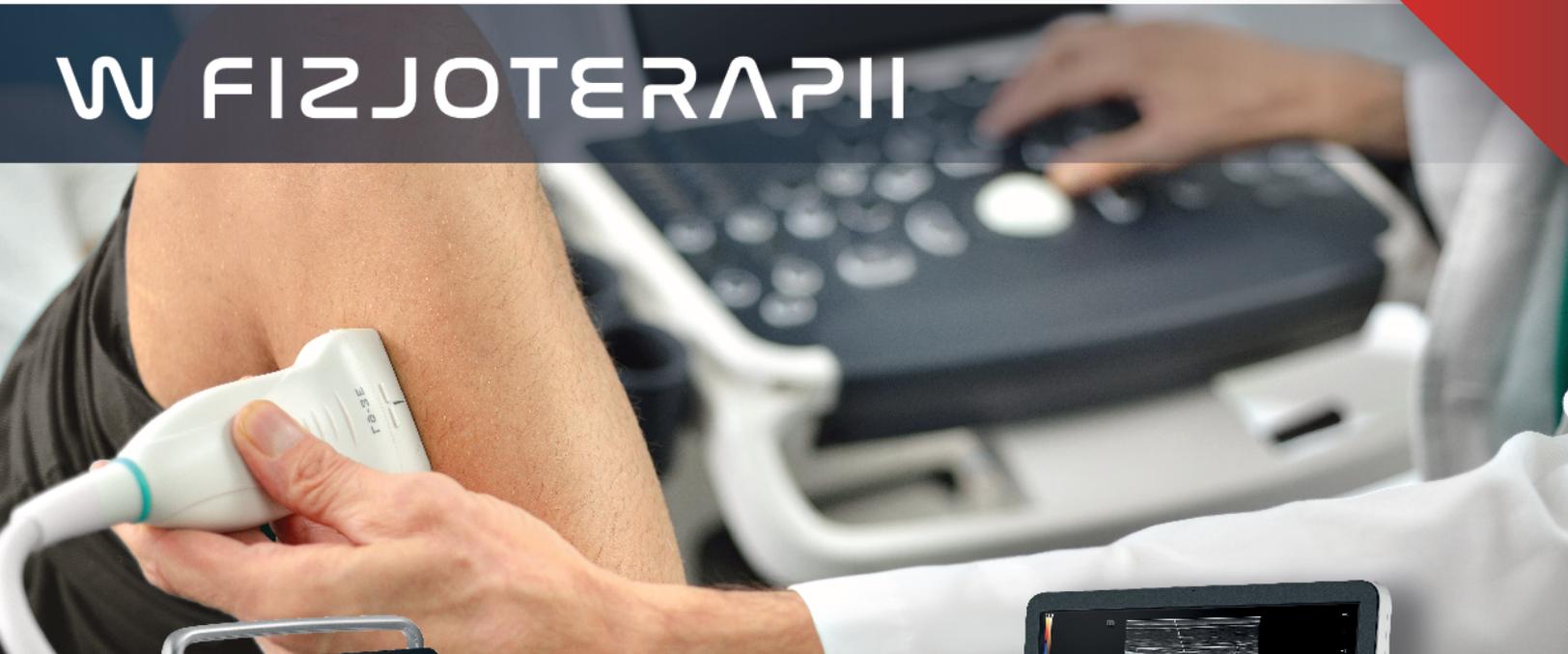
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- aparaty do terapii falą uderzeniową,
- aparaty do terapii wibracyjnej.



Pełna oferta:



# Effect of polarized light therapy on oral gingivitis in type I diabetic adolescents

*Wpływ terapii światłem spolaryzowanym na zapalenie dziąseł u nastolatków z cukrzycą typu I*

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## Abstract

Background. studying effects of polarized light therapy on gingivitis in type I diabetic adolescents is a strategy for determining its efficacy in healing effect on gingival ulceration. Objective: to evaluate the efficacy of polarized light therapy on gingivitis in type I diabetic adolescents.

Methods. Thirty type I diabetic adolescents receiving insulin therapy (Males and Females) who had gingivitis, ulceration pain and their ages ranged from 12 to 17 years were divided into two groups. Group (A) composed of 15 patients received the Bioptron light therapy (BLT) in addition to the routine medical care of gingivitis and insulin therapy. Group (B) received only the routine medical care of gingivitis and insulin therapy, duration of the BLT application was 10 minutes applied daily for 30 days. Results. Results showed that application of the BLT had a valuable healing effects on gingival ulceration and decrease pain in type I diabetic adolescents as evidenced by the highly decreases of the WHO oral mucositis scale, the common toxicity criteria scale and visual analogue scale. Conclusion. BLT is an effective additional tool for physical therapy program in treatment of gingivitis in type I diabetic adolescents as it plays an important role in healing effect on gingival ulceration and decrease pain.

## Key words:

Type 1 diabetic adolescents, Bioptron light therapy, gingivitis, WHO oral mucositis scale, Common toxicity criteria scale and visual analogue scale

## Streszczenie

Informacje wprowadzające. Badanie wpływu terapii światłem spolaryzowanym na zapalenie dziąseł u nastolatków z cukrzycą typu I to strategia określania skuteczności tej terapii w leczeniu owrzodzeń dziąseł. Cel: ocena skuteczności terapii światłem spolaryzowanym w zapaleniu dziąseł u nastolatków z cukrzycą typu I. Metody. Trzydziestu nastoletnich pacjentów chorych na cukrzycę typu I poddawanych insulinoterapii (mężczyźni i kobiety) z zapaleniem dziąseł, bólem związanym z owrzodzeniem, w wieku od 12 do 17 lat podzielono na dwie grupy. Grupa (A) składająca się z 15 pacjentów była poddawana terapii światłem Bioptron (BLT) oprócz rutynowej opieki medycznej stosowanej w przypadku zapalenia dziąseł i insulinoterapii. Grupa (B) była objęta jedynie rutynową opieką medyczną stosowaną w przypadku zapalenia dziąseł i insulinoterapią; czas stosowania BLT wynosił 10 minut, codziennie przez 30 dni. Wyniki. Wyniki wykazały, że zastosowanie BLT miało korzystny wpływ na gojenie owrzodzeń dziąseł i zmniejszało ból u nastolatków z cukrzycą typu I, o czym świadczą znaczące spadki w skali zapalenia błony śluzowej jamy ustnej WHO, powszechnej skali kryteriów toksyczności i wizualnej skali analogowej. Wniosek. BLT jest skutecznym dodatkowym narzędziem programu fizjoterapeutycznego w leczeniu zapalenia dziąseł u nastolatków z cukrzycą typu I, ponieważ odgrywa ważną rolę w leczeniu owrzodzeń dziąseł i zmniejszaniu bólu.

## Słowa kluczowe

Młodzież z cukrzycą typu 1, terapia światłem Bioptron, zapalenie dziąseł, skala zapalenia błony śluzowej jamy ustnej WHO, skala kryteriów toksyczności i wizualna skala analogowa

## Introduction

Diabetes mellitus [DM] is a chronic metabolic disease characterized by hyperglycemia due to either a deficiency of insulin secretion or resistance to the action of insulin or both. Chronic hyperglycemia leads to different complications in various regions of the body including the oral cavity, so blood glucose control is very critical [1]. Type 1 diabetes mellitus [DM] is a systemic disease which causes a number of complications which reduce the quality of life of the affected individuals. Gingivitis and periodontitis are local inflammatory diseases of the supporting tooth structures [periodontium] which can have an influence on other organs and organic systems [2].

Type 1 diabetes mellitus is a significant etiopathogenic factor responsible for the development of diabetic periodontitis. [3]. Many studies indicate a higher incidence and severity of gingivitis and periodontitis in children and adolescents with type 1 DM compared to healthy children [4].

Gingival inflammation was significantly more common in children and adolescents with type 1 DM compared to the systemically healthy subjects of the same age group [5]. Children with type 1 DM were in high risk of developing gingivitis, while the incidence of gingivitis in children and adolescents was almost double compared to adults [6]. Presence of elevated levels of proinflammatory mediators in the gingival crevicular fluid of periodontal pockets of poorly controlled diabetics, compared to non diabetics or well-controlled diabetics, resulting in significant periodontal destruction with an equivalent bacterial challenge has been shown [7].

Gingivitis is an inflammation which affects only the gingiva, whereas periodontitis is an inflammation of the deeper periodontal tissues [8].

Diabetes mellitus frequently predisposes to oral complications. DM has been associated with higher prevalence and severity of periodontal disease, fungal infections, alterations in salivary flow rates, and composition or dental caries [9, 10]. Disorders of the oral mucosa commonly occurring in diabetic patients include atrophy of the mucosa, candidiasis [thrush], and lichen planus or lichenoid mucositis. These disorders are related to chronic salivary hypofunction and to the generalized immune dysfunction seen in diabetic patients [11].

Patients with diabetes are more susceptible to the development of various oral infections including fungal and bacterial infections [12]. The oral manifestations and complications related to DM include dry mouth [xerostomia], tooth decay [including root caries], gingivitis, periodontal disease, burning mouth [especially glossodynia], and defective wound healing. The intensity of diabetic complications is usually proportional to the degree and duration of hyperglycemia [13].

Biopton light therapy [BLT] system is a medical device, with expanding clinically proved efficacy both in the treatment of wounds and pain conditions as well as in the treatment of selective skin disorders. [14]. Polarized light from low power lasers and non-laser devices has been used as a non-invasive therapy in the treatment of various musculoskeletal disorders, acceleration of wound healing and treatment of skin ulcers. The available non-laser optical devices are the Biopton products which emit a wide beam of polari-

zed, non-coherent, polychromatic, low energy light that contain wavelengths from the visible spectrum [480-700nm] and infrared radiation [700-3400nm]; this range provides optimal penetration and stimulation of the tissues without the risk of DNA damage. Ultimately it was revealed that Orange filtered polarized light has a special and beneficial effect on decreasing post burn pediatric scar [15,16]. Biopton light therapy system provides new insight into the management of leg ulcers, diabetic foot ulcers, burns, pressure ulcers and wounds following operation and injury. Biopton light therapy could offer significant support in conjunction with standard wound-care [17]. There is limited research studying the effect of polarized light therapy on gingivitis in type I diabetic adolescents receiving insulin therapy and there is no research studying its intermediate effect. Therefore, the current study aimed to determine the effectiveness of polarized light therapy on gingival ulceration in type I diabetic adolescents receiving insulin therapy is a strategy for determining its efficacy in healing effect on gingival ulceration and consequently accelerate gingival wound healing.

## Materials and Methods

### Study design

The design of the study was pre-test post-test randomized controlled trial design. The procedures followed agreed with the Institutional Ethical Committee Clearance, and written informed consent was taken from their legal guardians of the children.

### Participants

This study was conducted in faculty of physical therapy center from November 2020 to January 2021 with simple random sample. Thirty type I diabetic adolescents receiving insulin therapy with ages ranged from 12 to 17 years old of both sexes (16 Boys, 14 Girls) were randomly selected from outpatient clinic in national institute of diabetes and endocrinology and Abu el Rish hospital for children assigned randomly into two equal groups (15 children each).

To be included in the study, participants were suffering from gingival ulceration, swollen and tender gums and gums that bleed easily when you brush. Participants were excluded from this study if they had any life threatening disease (e.g. cardiac disease or tumors), circulatory problems, psychological problems, mental retardation, convulsions, involuntary movements and anemia.

### Randomization

A written form of informed consent was taken before participation of the singers in this study, in a way that ensures their confidentiality. Informed consent was obtained from each participant after explaining the study's nature, purpose and benefits, informing them of their right to refuse or withdraw at any time, and about the confidentiality of any obtained information. Anonymity was assured through coding of all data. Participants were randomly divided into 2 groups (control and study) using computer generated random numbers. Distribution was hidden in sequentially numbered opaque envelopes (Figure 1).

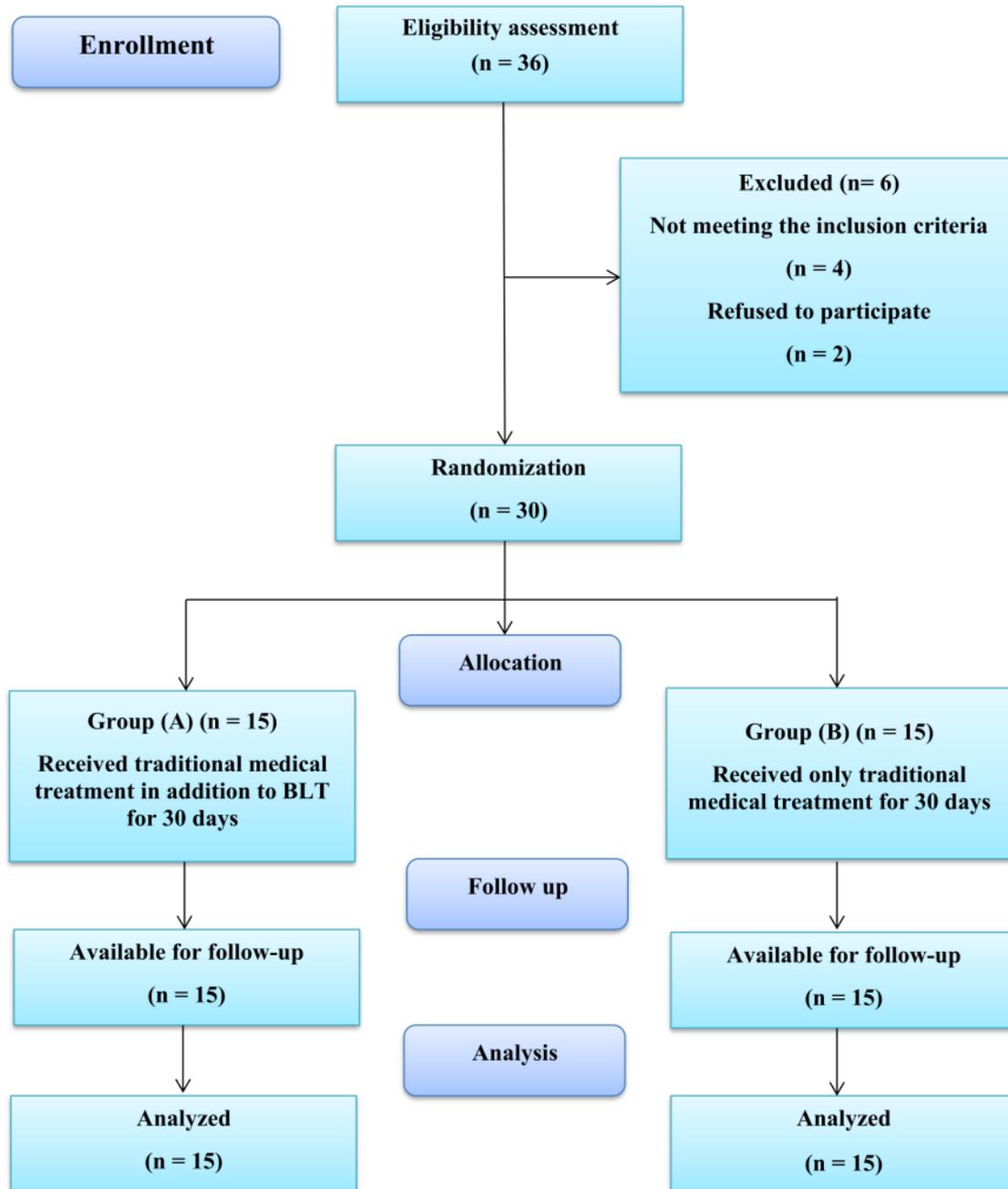


Figure 1. Flow chart of study participants

**Intervention**

The study group (A) consisted of 15 participants who received the BLT for 10 minutes applied daily for 30 days in addition to the medical care of gingival ulceration (Miconazole oral gel) and insulin therapy for diabetes. The control group (b) who received only the medical care of gingival ulceration and insulin therapy for diabetes.

**Procedures**

*a. Assessment procedures:*

The assessors were blinded folded to group allocation.

*I. weight and height assessment:* The weight and height of both groups were measured by the Hanson professional scale before the intervention [18].

*II. Visual analogue scale:* Visual analogue scale is considered the ‘gold standard’ technique and is used particularly in pain related research. It is consisted of a 10-cm line marked ‘no pain at one end and ‘pain as bad as it could be’ at the other [19]. Horizontal line, 100 mm in length anchored by word descriptors at each end. The VAS score is determined by measuring in millimeters from the left-hand end of the line to the point that the patient marks [20]. Each patient was asked to mark on the line at the point that they feel represents their perception of the current state. Assessment was done before and after one month of treatment.

*III. WHO oral mucositis scale (OMS)* (Table 1): where grade 0 means none, grade 1 (mild grade) means soreness +/- erythema

with no ulceration, grade 2 (moderate grade) means erythema and ulcers but patient can swallow solid diet, grade 3 (severe grade) means ulcers and extensive erythema but patient cannot swallow solid diet only liquid diet is possible and grade 4 (life-threatening grade) means mucositis to the extent that alim-entation is not possible [21].

*IV. Common toxicity criteria scale (CTCS) (Table 2):* where grade 0 means none, grade 1 (mild grade) means painless ulcers, erythema or mild soreness in the absence of lesions,

grade 2 (moderate grade) means painful erythema or ulcers but eating or swallowing possible, grade 3 (severe grade) means painful erythema, oedema or ulcers requiring intravenous hy-dration, grade 4 (life-threatening grade) means severe ulcerations or requiring parenteral or enteral nutritional support or prophylactic intubation and grade 5 (death) means death related to the toxicity [22].

These tools of measurement were used before treatment (First record) and after the second month of treatment (Second final record) to measure improvement in the oral gingivitis [23].

**Table 1. WHO oral mucositis scale (OMS) (Adapted from Wingard et al., 2009)**

Grades	Description
0	None.
1	Mild grade means soreness+/- erythema with no ulceration.
2	Moderate grade means erythema and ulcers but patient can swallow solid diet.
3	Severe grade means ulcers and extensive erythema but patient cannot swallow solid diet only liquid diet is possible.
4	Life-threatening grade means mucositis to the extent that alim-entation is not possible.

**Table 2. Common toxicity criteria scale (CTCS) (Adapted from Zerbe et al., 2012)**

Grades	Description
0	None.
1	Mild grade means painless ulcers, erythema or mild soreness in the absence of lesions.
2	Moderate grade means painful erythema or ulcers but eating or swallowing possible.
3	Severe grade means painful erythema, oedema or ulcers requiring intravenous hydration.
4	Life-threatening grade means severe ulcerations or requiring parenteral or enteral nutritional support or prophylactic intubation.
5	Means death related to the toxicity.

**b. Treatment procedures**

*I. Group A (study group):* This group was composed of 15 participant [10 B and 5G] who received the BLT for 10 minutes applied daily for 30 days in addition to the medical care of gingival ulceration [Miconazole gel ] and insulin therapy for diabetes [24].

*II-Group B (Control group):* This group was composed of 15 participant [6 B and 9G] who received only the medical care of gingival ulceration [Miconazole oral gel ] and insulin therapy for diabetes

**Treatment procedures**

In this study the treatment protocol was presented under the following:

- Patients were given information about the measurement and treatment procedures as well as about the BLT device before the beginning of the treatment.
- Patients were asked to follow the endocrinologist and physical therapist instructions.
- Measurement procedures were applied for each patient as they were mentioned in the measurement section.
- Before therapy all patients were given their written informed consent form for the BLT device.

- Place the patient in suitable comfortable position.
- Before the beginning of the treatment check the device to be sure that it is switched off.
- Patients were given information about the measurement and treatment procedures as well as about the BLT device before the beginning of the treatment.
- The treated area was cleaned at first by saline rinse and betadine.

**BLT device preparation:** the plug of the BLT unit was inserted into the main current supply; the on/off switch was switched on. Then set the treatment parameters of BLT.

**BLT application:** point the light beam at the area to be treated, holding the device at right angle (90°) perpendicular to the surface of the treated area and maintaining a distance of 10 cm from the surface of it [gingival ulceration] and applying the BLT for about 10 minutes. Frequency of application: applied daily for one month [24].

After the end of the treatment switch the device off, and then check the treated area.

The selected treatment points were the following: considered as 1 cm<sup>2</sup>/application point: one point in the right jugal mucosa, one point in the left jugal mucosa, one point in the internal mucosa of inferior lip, one point on sublingual caruncles and one point on the tongue (5 points multiplied in 2 minutes for each point = 10 minutes) [25].

**Statistical analysis**

The statistical package for social science Windows (IBM SPSS, Chicago, IL, USA) was utilized for data analysis and the level of significance was set at the 0.05 level. The mean and the standard deviation were used as a primary source of connecting facts about each parameter to measure central tendency. Age was compared between both groups using Unpaired t-test. Before data analysis, Shapiro–Wilk test was used for checking the normality of data and Levene’s test for homogeneity of variances was performed to check the homogeneity among four groups. Within and between group comparison were carried out using mixed design MANOVA. Post-hoc tests using the Bonferroni correction were performed for subsequent multiple comparison.

**Results**

This study is concerned in determining the effectiveness of BLT in improving healing effect on gingival ulceration and decrease ulceration pain. Clinical, functional and laboratory assessment data were collected from the study group (A) who received the BLT in addition to the medical care of gingival ulceration and insulin therapy for diabetes, and the control group (B) who received medical care of gingival ulceration and insulin therapy for diabetes only. This study compromised thirty participants which were randomly divided into group A (study group) and group B (control group), both were equal in number. The analysis of baseline values between two groups as shown in table 3. revealed that there were no statistically significant differences between both groups in the mean age distribution ( $p > 0.05$ ).

**Table 3. mean and standard deviation of age in both groups**

P-value	Group B	Group A	Characteristics
0.32 <sup>NS</sup>	15.1 ± 2.4	14.9 ± 2.6	Age [year]

Data expressed by mean ± SD, NS: Non-significant

Mixed MANOVA showed that there was a significant interaction of treatment and time ( $p = 0.001$ ). There was a significant main effect of time ( $p = 0.001$ ). There was a significant main effect of treatment ( $p = 0.001$ ). Within groups, Multipairwise comparisons test revealed that there was a statistical significant reduction ( $p < 0.05$ ) in OMS, CTCS, and VAS at the end of the study compared to the beginning of the study regarding Group A. It also revealed insignificant reduction ( $p > 0.05$ ) in OMS,

and CTCS while there was significant reduction ( $p < 0.05$ ) in VAS at the end of the study compared to the beginning of the study regarding group B. However, between groups, Multipairwise comparisons test showed that there was no statistical difference between the two groups in their all variables ( $p > 0.05$ ) pre treatment, while there was a statistical significant reduction ( $p < 0.05$ ) in all variables at post treatment in favors of group A in comparison to group B ( $p < 0.05$ ) (table 4).

**Table 4. Comparison between pre and post-treatment mean scores of OMS, CTCS and VAS in the both groups**

		Group (A) (n = 15)	Group (B) (n = 15)	P value*
OMS	Pre treatment	2.87 ± 0.35	2.8 ± 0.41	0.64 <sup>NS</sup>
	Post treatment	1.07 ± 0.46	2.73 ± 0.46	0.001 <sup>S</sup>
	% of change	62.71%	2.5%	
	P value**	0.001 <sup>S</sup>	0.33 <sup>NS</sup>	
CTCS	Pre treatment	3.53 ± 0.52	3.67 ± 0.49	0.47 <sup>NS</sup>
	Post treatment	1.33 ± 0.62	3.60 ± 0.51	0.001 <sup>S</sup>
	% of change	62.3%	1.9%	
	P value**	0.001 <sup>S</sup>	0.34 <sup>NS</sup>	
VAS	Pre treatment	6 ± 0.73	6 ± 0.92	0.98 <sup>NS</sup>
	Post treatment	4.55 ± 1.05	5.5 ± 1.15	0.384 <sup>NS</sup>
	% of change	19.16%	8.33%	
	P value**	0.001 <sup>S</sup>	0.02 <sup>S</sup>	

\* Inter-group comparison; \*\* intra-group comparison of the results pre and post treatment. NS  $P > 0.05$  = non-significant, S  $P < 0.05$  = significant, P = Probability, OMS: Oral Mucositis Scale, CTCS: Common Toxicity Criteria Scale, VAS: Visual analogue scale.

## Discussion

The current study was conducted to explore the effect of polarized light therapy on gingivitis in type I diabetic participants after one month of treatment. The results obtained from this study clearly demonstrated the positive effects of using BLT in addition to the medical care of gingival ulceration (Miconazole oral gel) and insulin therapy for diabetes more than the medical care of gingival ulceration and insulin therapy for diabetes alone.

This observation come in agreement with Skamagas et al., [26] who stated that higher prevalence of oral mucosal disorders was found in patients with DM compared to non-DM patients. This prevalence ranged from 45–88% in T2DM patients to 38.3–45% in non-DM groups and from 44.7% in T1DM patients to 25% in non-DM population. This increased prevalence of oral disorders in DM groups may be due to an inadequate metabolic control of DM or a slow healing process [26]. Mohsin et al., concluded that Changes of the tongue are more frequent in DM patients than in controls, such as fissured tongue, migratory glossitis, or coated tongue. There is a strong association between migratory glossitis and fissured tongue [27].

Jose et al., demonstrated that the prevalence of oral mucosal disorders in DM patients is statistically higher than that in non-DM individuals. Fungal infections related to dentures (denture stomatitis) and tongue alterations such as coated tongue and fissured tongue or migratory glossitis were the most frequent disorders in the oral cavity [28]. In addition, it comes in agreement with Simic et al., [17] who reported that bioptron light therapy system provides new insight into the management of leg ulcers, diabetic foot ulcers, burns, pressure ulcers and wounds following operation and injury.

Clinical studies by Medenica and Lens, [29] had demonstrated the effectiveness of polarized light therapy in healing of the 1st, 2nd, and 3rd grade pressure ulcers (decubitus). When polarized light treatment was added to the conventional ulcer therapy, rapid changes in appearance and size with complete healing in half of the cases and accelerated partial healing in the remaining cases appeared within 1-2 weeks. Bioptron light therapy has been used to treat the diabetic foot ulcers and clinical results have confirmed its positive influence on the affected and treated area. The ulcers gradually cleared, granulated and epithelialized during treatment. Healing time was substantially shortened and ulcer pain was lower compared to treatment without Bioptron irradiation. Also Bioptron light therapy is a very simple effective additional therapy in the treatment of surgical wounds [29].

The use of polarized light in the treatment of wounds has provided conflicting data, with some studies reporting accelerated wound closure and increased tensile strength of scars while others have found no such improvement. A study by Hoeksema et al., [30] investigate the efficacy of polarized light therapy in the conservative treatment of deep dermal burns, they concluded that the conservative treatment of deep dermal burns with polarized light therapy resulted in significant acceleration of wound healing, low incidence of hypertrophic scarring and optimal functional and aesthetic results. So they claimed that the polarized light therapy reduces the need for surgery in the treatment of deep dermal burns [30]. Kubasova et al., [16] re-

vealed that bioptron light therapy is ideally suited as a complementary treatment in rehabilitation. It is often required with standard physiotherapeutic procedures and it can be successfully used as an integral part of complex physiotherapeutic procedures for sports injuries, burns, ankle and knee injuries, shoulder and elbow problems, bruises and stretching of tendons.

Monstrey et al., [25] concluded that light is a form of energy and has wave-like properties; the difference between the various colours of light is determined by their wavelength. Light has been used as a healing tool since ancient times. Scientists now have a better understanding of which components of natural light are useful in the stimulation of healing. This has led to the development of optical devices to produce various types of medically useful light such as the Bioptron light therapy (BLT) system. BLT devices emit light containing a range of wavelengths that correspond to visible light plus infrared radiation, both of which have been reported to stimulate the biological reactions and importantly no harmful ultraviolet radiation is present in the BLT [25]. Monstrey et al., [31] concluded that When the BLT device is held over the skin surface, energy from the emitted light penetrates the underlying tissues. This produces a biological response, called photo-biostimulation, causing various reactions within these tissues that may result in the reduction of pain and promotion of healing [31].

Sakurai et al., [32] showed that BLT is not the same as laser therapy, BLT contains light from a wide range of wavelengths, and it emits light that is of low-energy so there is only a minimal heating effect, making the treatment safer. BLT devices emit light with a wide beam to allow exposure of larger treatment area. BLT is cost-effective and to date, there are no known adverse effects associated with it. Light has been used as a therapy for many medical conditions, including wound healing and treatment of autoimmune diseases; BLT is best used in the prevention of health problems [32].

Elias et al., [33] mentioned that the pain associated with ulcerative mucositis can inhibit patients from eating, drinking, or taking oral medications. The presence of mucositis has been associated with decreasing absolute neutrophil count (ANC) levels. A likely explanation for this observation is that neutrophils and mucosal basal cells are actively reproducing cells that tend to be damaged by chemotherapeutic agents and recover in parallel. These lesions tend to resolve when the ANC return to normal, indicating normal mitotic activity of basal cells. Healing of mucosal tissue is not dependent on the return of ANC levels [33]. Kubasova et al., [34] conducted that Clinical studies have shown that the routine use of Bioptron light therapy may significantly reduce the time necessary for complete epithelialization of the damaged skin, reducing the risk for the formation of the functionally and esthetically unacceptable scars.

Eventually, after the discussion of the results and according to reports of the previous investigators in fields related to this study, it can be claimed that the application of the polarized light therapy (BLT) on gengivitis in type I diabetic participants receiving insulin therapy had a valuable healing effects as manifested by the highly decreases in OMS, CTCS and visual analogue scale. The study was limited for high cost of Bioptron light therapy (BLT) device and limited number of cases for the study.

## Conclusion

Polarized Light Therapy is a favorable effective additional tool to the medical care of gingival ulceration and insulin therapy for type I diabetic adolescent as it plays an important role in healing effect on gingival ulceration, decrease pain and accelerate wound healing

## Recommendations

We recommend that new studies analyzing the prevalence of oral mucosal disorders in DM population should use more precise and current definitions concerning the determination

and diagnosis of DM patients and oral mucosal disorders. New studies should also specify the relationship between the presence of oral disorders and risk factors such as smoking, dentures, and drugs taken by DM patients.

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