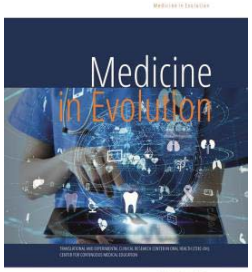
Testing the efficiency and versatility of Helbo photodynamic therapy in periodontal disease



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Abstract

Helbo photodynamic therapy is a treatment method that combines light and photosensitizers to eliminate specific cells. This therapy has gained interest as a possible treatment for various medical conditions, such as cancer, infections, and periodontal diseases. This study aims to demonstrate the effectiveness of Helbo photodynamic therapy in treating and reducing periodontal pockets, after the scaling and root planing procedure, if there is a noticeable difference in comparison to periodontal pockets treated solely by scaling and root planing.

Keywords: Helbo photodynamic therapy, periodontal disease, periodontal pocket

INTRODUCTION

Every year, multiple new technologies are being discovered and invented in the world of medical and dental science. Also, these technologies continue to be improved and evolve each year in order to treat patients more efficiently in the specific field. Either the technology is improved by being able to apply quicker and efficiently treatment for a specific disease and/or increase in overall versatility, being utilized in supplementary various situations. One such example can be viewed in the use of Helbo Photodynamic Therapy.

This approach has different applications in dentistry, designed as an alternative treatment for bacterial, fungal, and viral infections, as well as oral cancer [1]. Originally, photodynamic therapy (PDT) was used as an early method to aid in the elimination of cancer cells although it can be seen more frequently in disinfecting root canals, periodontal pockets and fungal infections like Candida [2]. In endodontics, both Candida albicans and Enterococcus faecalis are some of the most recurrent microbes that are able to cause an assortment of post treatment diseases [2]. Being a non-invasive and non thermal option, antimicrobial photodynamic therapy (aPDT) can be described as a local antibacterial procedure used to reduce bacterial contamination in oral infections. It is a two step process that firstly involves the application of a photosensitizer. Then It is followed by illumination with laser light on the sensitized tissues [1]. The photosensitizer is activated by an appropriate wavelength from the laser light [3]. This causes a toxic photochemistry reaction within targeted cells, resulting in the formation of reactive oxygen species, which can include hydroxyl radicals, singlet oxygen, and superoxide [4]. The resulting consequence is the apoptosis of these microorganisms. Depending on the target area that is being treated, such as root canals or periodontal pockets, aPDT is usually applied in combination with either other chemical antimicrobials or mechanical subgingival instrumentation [3]. Helbo photodynamic therapy appears to be an interesting alternative to the usage of antibiotics in treatments involving oral cavity diseases. Due to the nature of biofilms, bacteria and other microbes are able to evolve and become more resistant to antibiotic therapy [5]. Therefore, for the purpose of this study, the applications and mechanisms of Helbo photodynamic therapy will be explored in order to determine its efficiency and versatility when applied in periodontal disease therapy.

Aim and objectives

The aim of this study is to see the efficacy of Helbo photodynamic therapy application in of periodontal pockets reduction, after the scaling and root planing (SRP) procedure has been performed, in comparison to periodontal pockets that have been treated by scaling and root planing alone.

MATERIAL AND METHODS

A controlled clinical study was conducted at the Department of Oral Pathology of the University of Medicine and Pharmacy betwee 2019-2020. The study was conducted according to the guidelines provided by the Declaration of Helsinki regarding patient privacy and data protection and after receiving ethical approval from the Ethics Committees.

All participants were informed regarding the entire protocol of the study and prior to the study onset they completed consent forms as well as a medical questionnaire regarding the patient's general health. Thirty patient were included in the study, and randomly assigned in one of two groups: group (A): 15 patients received SRP plus Helbo photodynamic therapy, group (B); 15 patients that received SRP alone.

The inclusion criteria were: individuals, both male and female, age ranging between 18-70, with diagnosis of periodontitis, that at least 1 periodontal pocket with a probing depth 5mm. The exclusion criteria included individuals under the age of 18 or above the age of 70, as well as individuals that presented with sites of probing depth 3 mm. Other exclusion criteria were: pregnant women, autoimmune disease and/or tumors

After the inclusion in one of the groups, an initial periodontal clincial examination was performed using UNC-15 periodontal probe (Hu-Friedy, Chicago, IL, USA). Six sites on each tooth were evaluated and periodontal parameters were recorded on an online chart from available at http://www.periodontalchart-online.com/uk/[6].

The following parameters were recorded: probing depth, distance between gingival margin and cemento-enamel junction, clinical attachment level, the plaque index, bleeding on probing, and tooth mobility following the standard clinical definitions[7]. Once all the aforementioned information was entered, values for the mean probing depth, mean attachment loss and total percentages of the plaque and bleeding on probing were calculated for each case. Each patient received a treatment plan following the present guidelines [8].

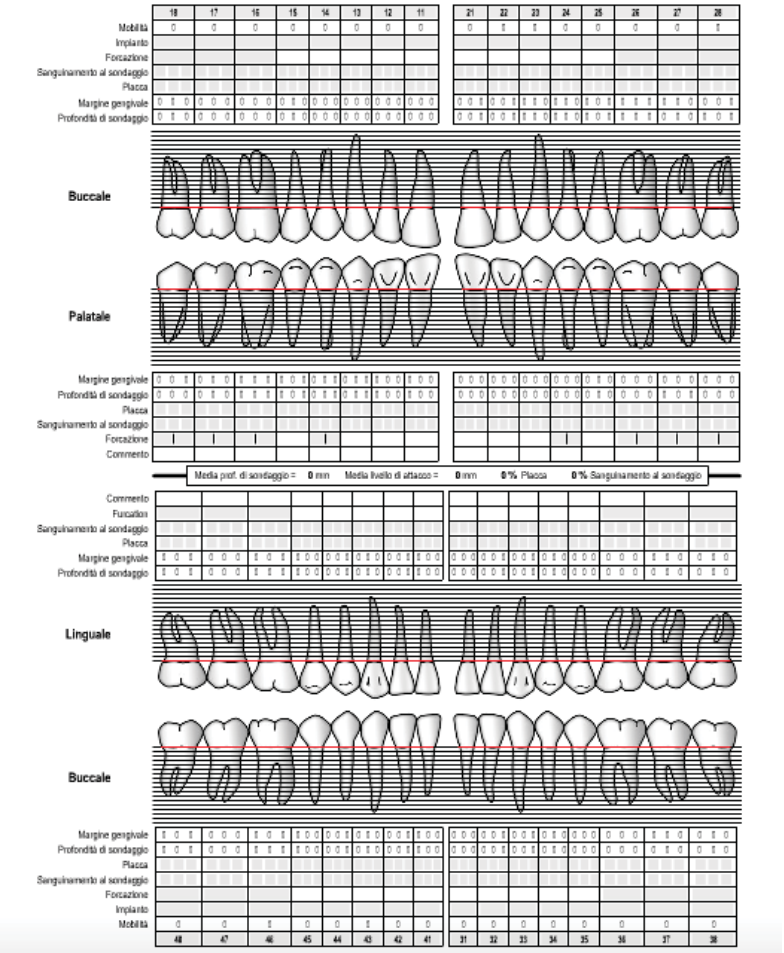


Figure 1. Copy of periodontal chart used for to record all periodontal parameters of each patient [6]

Patient underwent periodontal treatment. The first step of therapy consisted in a full mouth supragingival mechanical instrumentation using an ultrasonic dental scaler (Unit-P5 Booster Suprason - Satelec, Acteon, Mount Laurel, NJ, United States) followed by a professional brushing.

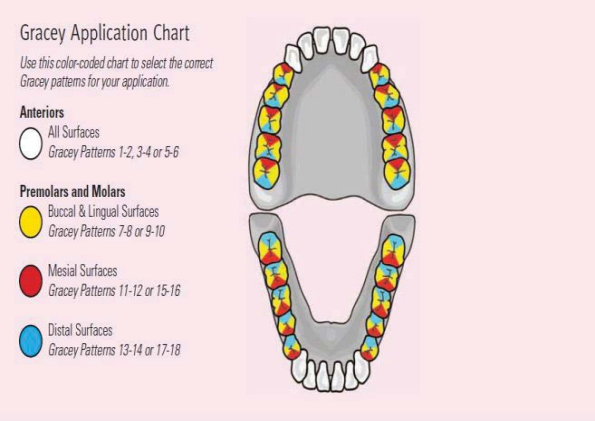


Figure 2. Gracey chart used to determine which type of curette is used for each particular area of each tooth during the root scaling procedure [9]

One week after, the subgingival mechanical instrumentation was performed.

Patients received a full mouth scaling and root planing. Each tooth that presented PD sites greater than 5 millimeters were anesthetized, and SRP was performed, using color-coded Gracey curettes (Hu-Friedy, Chicago, IL, United States and the following chart was implemented in order to target specific areas of each tooth.

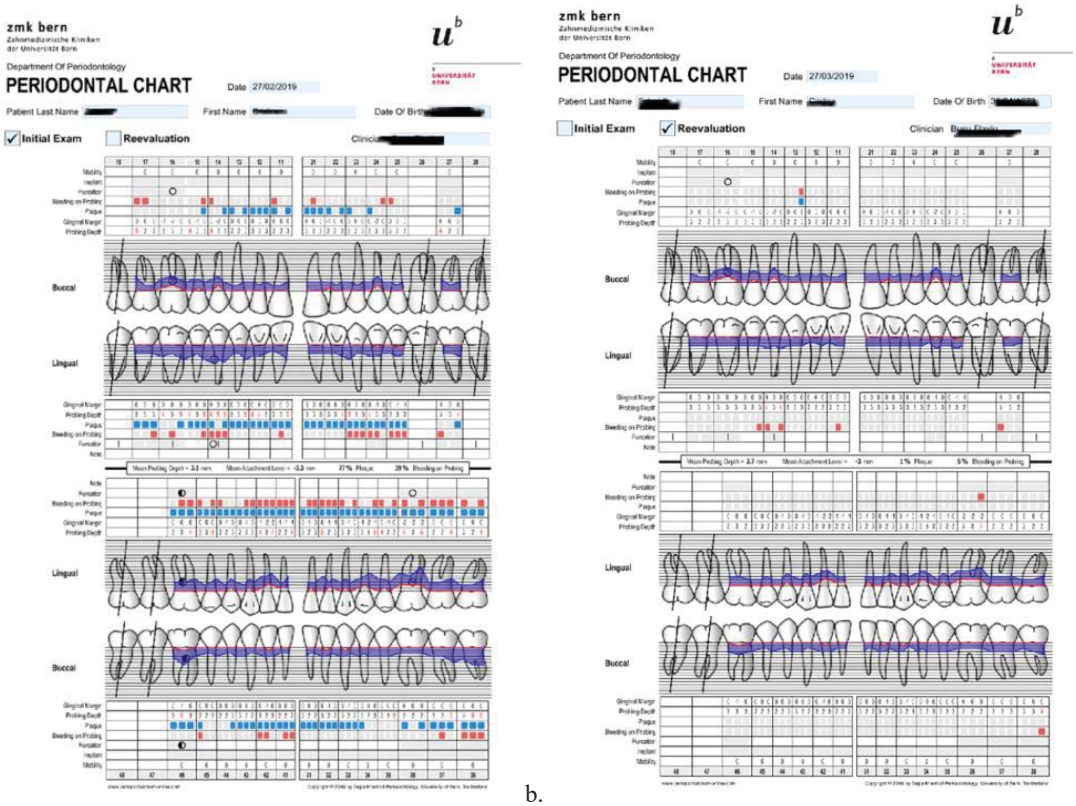
Within a period of 24 hours following SRP and oral irrigation, patients in group A underwent the application of the Helbo photodynamic therapy consisting in the following protocol

- Step 1: Helbo Blue photosensitizer [10], containing Methylene Blue (MB) was applied to the periodontal pockets with an endodontic needle, starting at the pocket fundus, as it is required to be applied from an apical to coronal direction [11]. In addition, MB was the chosen photosensitizer for this study due to its cationic nature, low molecular weight, and its ability to target both gram-positive and gram-negative bacteria [12].
- Step 2: The Helbo Blue photosensitizer was left for approximately 3 minutes to react within each periodontal pocket, after which the stained areas were rinsed with distilled water in order to remove excess MB. An excess layer of photosensitizer will not allow efficient light penetration from the accompanying laser [12].
- Step 3: Once dried, a handheld, battery operated, diode laser, (Theralite laser) [10] was used to illuminate the zones originally stained by the MB. By channeling the light through a fiber optic tip (3D Pocket Probe) [10], the tip of the laser was placed within each of the six sites of every affected tooth, for approximately one minute per site.

The recall phase was performed one month later and consisted in afull mouth reevaluation chart, recording again all the periodontal parameters.

RESULTS

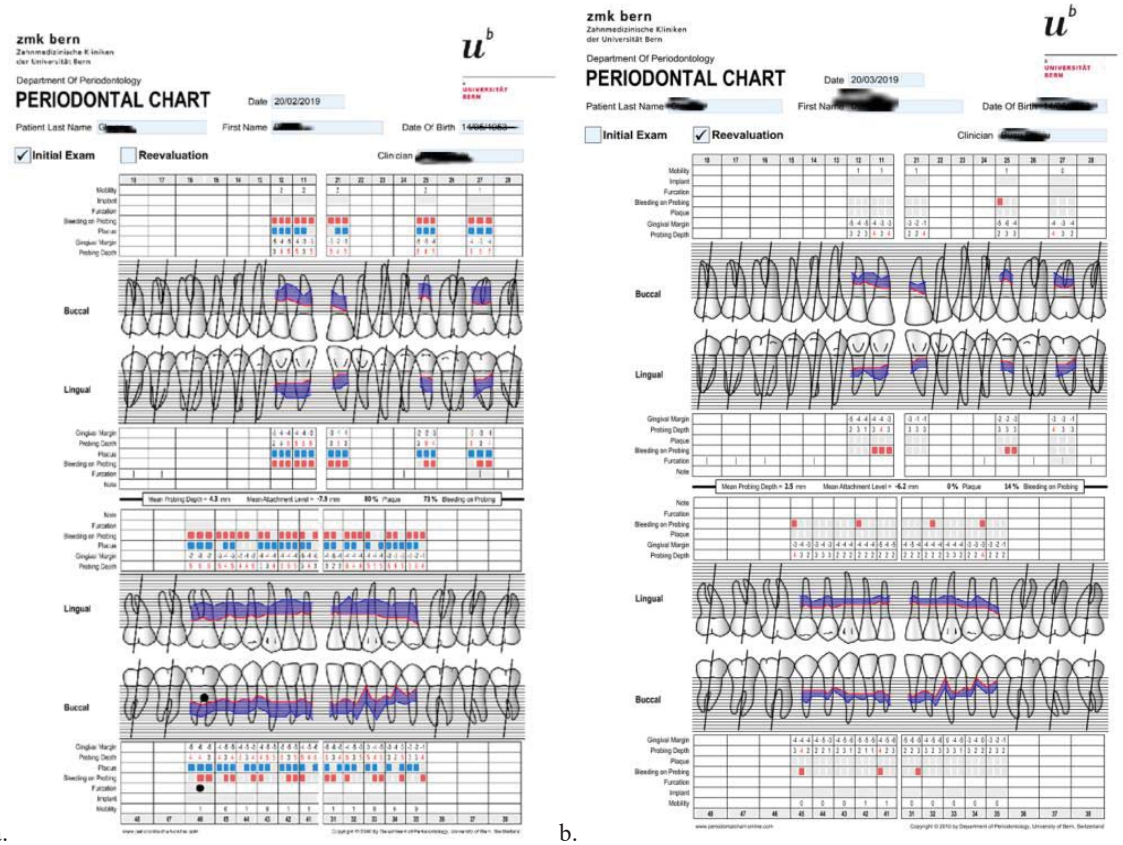
Case 1: Male patient of 65 years old with hypertension and rhinitis, former smoker, presented with 47 probing sites that were greater than or equal to 5 millimeters and 48 probing sites that were less than equal to 4 millimeters during the initial examination. For the reevaluation exam, the patient presented 0 probing sites that were greater than or equal to 5 millimeters and 90 probing sites that were less than or equal to 4 millimeters (Figure 3).



a. b.

Figure 3. (A) Initial panoramic image of patient's teeth; (B) Re-evaluation exam results of case 1

Case 2: Female patient of 45 years old with no general diseases, smoker, presented with 16 probing sites that were greater than or equal to 5 millimeters and 146 probing sites that were less than or equal to 4 millimeters during the initial examination. For the reevaluation exam, the patient presented 0 probing sites that were greater than or equal to 5 millimeters and 162 probing sites that were less than or equal to 4 millimeters (Figure 4).



a. b.

Figure 4. (A) Initial panoramic image of patient's teeth (B)Re-evaluation exam results of case 2

The minimum values of the mean probing depth, mean attachment level, plaque percentage and percentage of bleeding on probing for the initial exam of Group A are 2.1mm, 2.1mm. 0%, and 1% respectively. Correspondingly, the maximum values are 4.5mm, 7.9mm, 100%, and 73%. The average values of each parameter are 3.15mm, 3.95mm, 38.1% and 42.5%.

The minimum values of the mean probing depth, mean attachment level, plaque percentage and percentage of bleeding on probing for the reevaluation exam of Group A are 1.9mm, 1.9mm, 0%, and 0% respectively. Correspondingly, the maximum values are 2.8mm, 6.2mm, 4%, and 21%. The average values of each parameter are 2.47mm, 3.31mm, 1.27% and 6%.

The minimum values of the mean probing depth, mean attachment level, plaque percentage and percentage of bleeding on probing for the initial exam of Group B are 2.5mm, 2.5mm. 9%, and 13% respectively. Correspondingly, the maximum values are 4.8mm, 5.5mm, 76%, and 85%. The average values of each parameter are 3.59mm, 4.05mm, 32.3% and 50.9%.

The minimum values of the mean probing depth, mean attachment level, plaque percentage and percentage of bleeding on probing for the reevaluation exam of Group B are 2.2mm, -2.4mm, 0%, and 3% respectively. Correspondingly, the maximum values are 4.7mm, 5.3mm, 31%, and 39%. The average values of each parameter are 2.93mm, 3.77mm, 7.6% and 16.9%.

Shows the mean values of the recorded periodontal parameters at the the initial and reevaluation exams for Group A and Group B

Table 1. Average values of both Initial and Reevaluation exams of both groups

Group(Exam)	Mean Probing Depth Value (mm)	Mean Attachment Level Value (mm)	Mean Plaque Value	Mean Bleeding on Probing Value
Group A (Initial Exam)	3.15	3.95	38.1%	42.5%
Group A (Reevaluation Exam)	2.47	3.31	1.27%	6%
Group B (Initial Exam)	3.59	4.05	32.3%	50.9%
Group B (Reevaluation Exam)	2.93	3.77	7.6%	16.9%

DISCUSSIONS

After the initial therapy of patients with periodontitis, an improvement of periodontal parameters in terms of PD reduction, bleeding on probing is observed [8], photodynamic therapy used as an adjunctive therapy, could bring some supplementary benefits [8]. By analyzing the results obtained for this study, it could be noted that patients in Group A had an average reduction value of 0.68 mm for the reduction in mean probing depth and 0.64mm for the reduction of mean attachment loss, over a one month period. Furthermore, an overall reduction in the average value of plaque percentage and bleeding on probing were calculated at 36.83% and 36.5% respectively. Within Group B, the average reduction values of mean probing depth and mean attachment loss were 0.66 mm and 0.28 mm, whereas the average reduction values in plaque and bleeding on probing were 24.7% and 34%.

When comparing the two groups, it could be established that Group A had only a slightly greater reduction of 0.02mm in mean of probing depth. However, Group A had an average for attachment lossvalues reduction with 0.36 mm more than Group B. Better results were observed for the average plaque and bleeding on probing index: 12.13% and 2.5% more.

This study investigated the efficacy of photodynamic therapy as adjunctive therapy to SRP in terms of improvement of periodontal parameters. Our results showed the reduction of the mean values when comparing the test group with the control group, proving some clinical additional benefits of the Helbo therapy. The limitations of this study were the decreased number of participants, the constraints of patients in order to respect the date and time of each procedure executed during the study, and the patients oral hygiene habits that were diffcult to control during the study as instructed. One of the most important steps while obtaining the results for this study was the aspect of good reproducibility. A lack in this element could result in an overall inaccurate treatment procedure. Therefore, it is important to note that calibration is a key attribute when conducting clinical research, as well as having a trained supervisor overlooking all investigations and procedures.

Research on photodynamic therapy was conducted in a variety of other studies, focused on the periodontal disease and endodontic pathology treatment or even Candida and halitosis therapeutical approaches [13] [14]. One study that was done by Hokari T. et al, analyzed the effects of antimicrobial photodynamic therapy and minocycline ointment in patients with chronic periodontitis. Using 30 patients in their study, their results showed that the aPDT group only had significant improvements within clinical parameters [15].

Ahad A. et al analyzed the effect of aPDT in deep periodontal pockets, with a total of 30 patients diagnosed with chronic periodontitis. The patients were split into two groups and were checked at 1 month and 3 month intervals after the treatment procedures were carried out. They found that at the 1 month interval, there were significant differences in the parameters of each group, whereas at the 3 month interval, the difference in average values of all parameters were much smaller [16].

Furthermore, Grzech-Leśniak K et al performed a similar study, incorporating 84 patients into 3 groups, where a comparison was made between 3 different methods: scaling and root planing on its own, SRP in combination with PDT, and the use of an erbium-doped yttrium aluminum garnet laser (ERL). The results later showed that the values of bleeding on probing and the reduced percentage of certain bacteria after 3 months were greater when the ERL and PDT methods were implemented [17].

In a split mouth design study of ten patients diagnosed with aggressive periodontitis, the average values of probing depth, gingival margins, bleeding on probing, and plaque index obtained from both groups appeared to show similar clinical results over a 3 month period [18].

Other studies that utilized photodynamic therapy can be seen in the treatment research of candida and herpes simplex virus [19]. One study aimed to show the possibility of exploiting photodynamic inactivation as a possible option to Candida infections. In combination with caspofungin, the results showed a complete eradication of biofilms within the infections [20]. Within a similar study, there was evidence presented that PDT can be used as an effective and alternative therapy method to treat Candida tropicalis, which is known to be highly drug-resistant [21].

CONCLUSIONS

Given the limitations of this study, it could be concluded that although scaling and root planing alone can help to reduce certain parameters when it comes to the treatment of periodontal pockets, the supplementary use of Helbo photodynamic therapy brings supplementary clinical benefits in overall improving the periodontal parameters values.

Helbo photodynamic therapy is an alternative approach to antibiotic treatment and can provide effective elimination of bacteria and other microbes withoutserious side effects. The simplicity and efficiency of this additive treatment option can help to aid in the overall healing of patients with periodontal disease and, in turn, maybe even promote more motivation in the maintenance of good oral hygiene. because Further research on Helbo PDT in randomized clinical trials with a larger number of participants should be performed in order to clinically prove its efficacy as adjunctive treatment in periodontal therapy, and also to prove the utility in the treatment of other oral diseases.

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