DIODE LASER TREATMENT AS AN ALTERNATIVE TO ANTIBIOTIC PREMEDICATION

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Abstract

Lasers used in the treatment of periodontal therapy are becoming more prevalent in dental offices. Patients with periodontal disease see extensive improvements in their periodontal status and overall health with laser therapy. Studies have shown a decreased prevalence in oral bacteria following these treatments (Moritz et al., 1998). Dental lasers in the treatment of periodontal disease can reduce significantly the bacterial population in the gingival tissue, theoretically reducing the need for antibiotic premedication (Kamma, Vasdekis, & Romanos, 2006). Future research in this area can provide the groundwork for the advancement of laser therapy in all aspects of medicine as well.

Keywords: Laser Therapy, Pre-medication, Alternate Therapy

Introduction

Statement of the Problem

Dental hygienists treat numerous patients who require antibiotic premedication prior to treatment due to medical issues including prosthetic joint implants (PJI), and certain cardiovascular diseases("Infective Endocarditis," 2014). The medication is used to prevent or reduce infection at the site of the PJI resulting in replacement of the implant or bacterial invasion into heart tissue resulting in bacterial endocarditis. Such infections can increase both morbidity and mortality of an already medically compromised patient. Patients may acquire resistance to many medications, including antibiotics, if these drugs are needlessly taken and antibiotic premedication protocols have changed over the past three decades in order to prevent strains of antibiotic resistant bacteria. All health care providers including dental hygienists should search for new treatment methods that may reduce need for antibiotic use that present less risk to a patient's health.

Research has demonstrated the efficacy of dental lasers' ability to significantly reduce bacterial pathogen level in the oral cavity (Kamma,

Vasdekis, & Romanos, 2006). Many of the same pathogens responsible for periodontal disease are indirectly responsible for bacterial endocarditis. Further study is needed to provide conclusive evidence related to oral bacteria (mutans streptococci) and PJI infections. Diode laser therapy is a treatment highly recommended for patients regardless of their periodontal status. Laser bacterial reduction, or LBR reduces the number of bacterial pathogens present in a patient's mouth from billions to hundreds. Due to the increasing popularity of laser therapy, more research should be conducted regarding the efficacy of laser bacterial reduction and the necessity of antibiotic pre-medication.

Purpose of Study

The purpose of this research proposal is to establish whether diode lasers can be an effective alternate treatment that could reduce or replace use of antibiotic premedication for such patients prior to certain dental and medical procedures. Determination is needed to see that the efficacy of diode lasers are sufficient to kill or reduce the bacterial population in the periodontium, leaving little or no risk of bacterial endocarditis or bacteremia in patients. The level of pathogens required to cause these infections may be different from patient to patient depending on factors such as a patient's immune system and current health status.

Significance of Study

The significance of this study reaches beyond the boundaries of routine dental care. Patients are undergoing procedures such as scaling and root planing, tooth extractions, standard prophylaxis, root canal therapy, as well as major medical and surgical procedures. These procedures can indirectly have a negative affect on the condition of the patient's heart or artificial joint due to bacteria present in the oral cavity entering the bloodstream and attacking site-specific tissues.

This study can have many beneficial results for medical and dental communities alike. In proving that the diode laser can effectively eliminate bacteria in the oral cavity that could cause problems in other parts of the body, clinicians can offer patients a non-antibiotic therapeutic pre-surgical treatment in all aspects of medicine. The ability to use a non-invasive, non-antibiotic treatment to help patients reduce the risk of bacterial pathogens spreading from the oral cavity will be beneficial for the patient's overall health.

Theoretical Framework

This study will be based on similar studies that have been performed previously. I will attempt to prove that diode laser therapy has the ability to

reduce or eliminate thebacteria in the oral cavity that has the potential to cause endocarditis or infections in artificial joints.

Research Question

Experience and training over the years has allowed me to pose this question for consideration:

> Does the diode laser have the efficacy to kill or reduce oral bacterial levels so that patients would not be required to take antibiotics as a pre-treatment therapy to prevent bacterial endocarditis?

Hypothesis

Research will be conducted to establish the reliability of the hypothesis.

Hypothesis: The diode laser has the efficacy to kill or reduce bacteria responsible for endocarditis and joint infections prior to medical and dental procedures making antibiotic pre-medication unnecessary.

Limitations

This study will need to focus on the bacteria that can directly cause bacterial endocarditis. These pathogens will need to be sampled and measured in patients prior to any laser therapy to evaluate their prevalence in the oral cavity. Previous studies have focused on periodontal health and status leaving the patient reliant on antibiotic therapy to prevent endocarditis. This study could potentially cause undue risk to a patient's health. Treatments that offer reduced risk of patient harm must be implemented.

Financial limitations could also arise due to a need for research dollars.In order to have the proper research personnel and laboratory privileges, suitable funding must be available. Concerns with finances would be due to resource allocation. Without the proper funding, resources to complete the study may be difficult to acquire.

Patient population could possibly be a limitation. However, patients with moderate periodontal disease will be readily available for the study. An unknown factor present is finding patients who are willing to participate in the study.

One final limitation that comes to mind is acceptance. There have been some studies completed that do not agree with the efficacy of diode laser in the treatment of periodontal disease. This study will have to be complete in all aspects so as not to cast any doubt on it's validity.

Review of Literature

Introduction

Lasers used in the treatment of periodontal therapy are becoming increasingly prevalent in dental offices around the country. Patients with periodontal disease see extensive improvements in their periodontal status with laser therapy. Studies are showing a decreased prevalence in oral bacteria following these treatments (Moritz et al., 1998). This literature review will examine dental lasers in the treatment of periodontal disease and their ability to reduce significantly the bacterial population in the gingival tissue, theoretically reducing the need for antibiotic premedication (Kamma, Vasdekis, & Romanos, 2006). The goal is to show that diode laser therapy is sufficient enough to reduce the bacterial load in a patient's periodontal tissues so they would not require antibiotic medication prior to treatment.

Method

A literature review was conducted by accessing various electronic articles from the *Journal of Periodontal Research, Lasers in Surgery and Medicine, The Journal of Oral Laser Applications, and the Journal of Clinical Periodontology*. PubMed, Googlescholar.com, Google and the University of Tennessee library website was also utilized as database resources. The search topic related to the efficacy of diode lasers as an alternative to antibiotic premedication. The research was conducted using terms such as diode laser efficacy, laser periodontal therapy, laser bacteremia reduction, antibiotic premedication alternatives and laser bacterial reduction. The search was narrowed down to eleven relative articles from 1998-2014. The articles evaluate the efficacy of lasers in conjunction with periodontal treatment in an effort to offer patients an alternative to antibiotic premedication. Several articles researched were not used due to availability and cost. Articles that were readily available and free of any cost were used to compare and contrast other laser therapies.

Population Studied

The primary concern of the studies chosen was to analyze photodynamic and low-level laser therapies as they relate to bacterial reduction in periodontal patients (Lui, Corbett, & Jinn, 2010). One study focused on the diode lasers bactericidal effect on periodontal pathogens infers that the use of antibiotic premedication may be unnecessary when laser therapy is utilized (Goldstep, 2009). Another study examined the efficacy of an 810 nm diode laser as an adjunct to traditional periodontal therapy. The majority of the articles reviewed focused on laser therapy as an adjunct to traditional periodontal therapy. Diode lasers offer an effective treatment that significantly reduces the sub-gingival microbial population.

According to Ustun (2014), diode laser treatment can offer a significant reduction in the bacterial load found deep in the gingival sulcus. The reduction of this population should be sufficient to avoid any bacteremia from forming, thereby allowing treatment without any antibiotic premedication requirement.

The population of most of the articles consisted of patients with mild to moderate periodontal disease and the bactericidal effect the diode laser treatment can provide. There were a total of 206 patients in the studies reviewed. Age was not a factor in determining whether a patient was accepted into the study, although one study required the patients to be at least age 35. All of the subjects were randomly chosen based on their periodontal status. Patients had to present with untreated chronic periodontitis to be considered for these studies. The studies were conducted with periodontal patients from Austria, Hong Kong, Turkey, Sweden and the Netherlands. Only one study reviewed was conducted in the United States in New York. It is important to note that although these studies were similar in many ways, the majority of studies used lasers of varying wavelengths. This will become more apparent as the variable and findings are reviewed.

Survey Method

The reviewed literature had similar methods of data collection from collecting gingival crevicular fluid (GCF), measuring periodontal depth (PD), tracking a full mouth bleeding score (FMBS), clinical attachment level (CAL), and plaque score (PS). Pre-treatment levels of specific pathogens were also sampled and recorded. The recorded pathogens included Actinobacillus actinomycetemcomitans, Porphyomonas gingivalis, Prevotella intermedia, Tannerella forsythia, Campylobacter Rectus, Treponema denticola, Parvimonas micra, Fusobacterium nucleatum, Eubacterium nodatum, Eikenella corrodens and Capnocytophaga spp.

The first article reviewed recruited 30 patients into their study. They utilized a split-mouth, single masked, randomized controlled clinical trial (Qadri, Poddani, Javed, Turner, & Gustafsson, 2010). The second study acquired 24 subjects and randomly assigned them to a treatment group using the coin-flip method (Christodoulides et al., 2008). A third study from the *Journal of Clinical Periodontology* evaluated 17 patients diagnosed with moderate periodontitis. The patients were all in the same group, however, specific teeth were used as a test or control group (Qadri, Miranda, Turner, & Gustafsson, 2005). The fourth study utilized 36 patients that needed non-surgical periodontal therapy. The patients were randomly assigned to their respective groups via the flip of a coin by one of the investigators. Patients were excluded based on several criteria including antibiotic use in the last six months and pocket depths greater than 10mm (Aykol et al., 2011). The fifth

study used 30 patients under the age of 35 diagnosed with aggressive periodontitis (AgP). The patients were separated into smoking and non-smoking, and had a clinical attachment loss exceeding 5mm. Each quadrant of teeth in the patient pool was randomly assigned to one of four treatment modalities. Scaling and root planning alone (SRP), diode laser (980 nm) treatment alone (LAS), and SRP combined with LAS (SRP + LAS). One quadrant was not treated and served as a control (CRL) (Kamma et al., 2006). The sixth relevant study consisted of 24 non-smoking adults with untreated chronic periodontitis. The patients were randomly assigned into a split-mouth designed clinical study. Each of the patients received scaling and root planning with or without at least one treatment consisting of adjunctive photodynamic therapy and low-level laser therapy within five days (Lui et al., 2011). The final study reviewed was completed using 50 patients who were randomly assigned into two groups. The first 37patients were assigned to the group that was to undergo laser therapy. There were thirteen patients assigned as a control group. Three patients from the laser group and one patient from the control group were unable to complete the trial due to inadequate oral hygiene and sickness respectively (Moritz et al., 1998).

Variables

The researched articles contained several factors and variables that were similar in many ways. The reviewed clinical trials and literature reviews have focused mainly on the periodontium and the bacterial presence that most periodontal patients readily possess. The studies, variables, patients utilized and initial results are listed in the following table.

Table 1
Comparison of Studies

Author(s), Year	**Participants Research Method**	**Variables**	**Results**
• Gokce Aykol • Ulku Baser • Llay Maden • Zafer Kazak • Utku Onan • Sevda Tanrikulu-Kucuk • Evin Ademoglu • Halim Issever • Funda Yalcin • **(2011)**	• Volunteer Participants • Healthy Patients • Moderate to Advanced Periodontitis • Randomly assigned	• Smokers • Non-Smokers • Treatment Group • Control Group • Probing Depth • Gingival Index • Plaque Index	• The Low-Level Laser Therapy group showed significant improvement in bleeding, sulcus depth and probing depth. • Low-Level Laser Therapy as an Adjunct to Non-Surgical Periodontitis improves periodontal Healing.
Nicos Christodoulides Dimitris	• 24 Subjects with Chronic Periodontitis	• All subjects were treated within 24 hours	• A single treatment of photodynamic therapy when added to scaling

Nikolidakis Panagoitis Chondros Jurgen Becker Frank Schwarz Ralf Rossler Anton Sculean **(2008)**	• Patients were referred • No treatment of Periodontitis within 2 years • No systemic diseases • No pregnancy • No use of antibiotics for the past 12 months • Random Assignment by coin toss • Parallel Design	• Subjects were treated with SRP using hand instruments and Cavitron followed by a single treatment of Photodynamic Therapy • Control group was just SRP and Cavitron • Patients treated with PDT were also treated with a pre-treatment liquid to aid the Laser efficacy • Probing Depth • Gingival Index • Plaque Index	and root planning failed to result in improvement in periodontal depth or clinical attachment loss, but it resulted in a significantly higher reduction in bleeding. • The microbial levels from both groups decreased significantly.
Joanna J. Kamma Vassilis G. S. Vasdekis George Romanos **(2006)**	• 30 subjects • Smokers • Non-Smokers • Diagnose with Aggressive Periodontitis • Under age 35 • Exhibiting severe periodontal destruction • Clinical Attachment loss of 5mm or greater on 2 – 3 sites in more than 14 permanent teeth – At least 3 were not from first molars and incisors. • Freidman Tests	• Plaque Score • Bleeding on Probing • Suppuration • One site with > 5 mm pocket depth was selected in each quadrant for microbial sampling • Clinical measurements and sampling sited were selected 1 week before microbial sampling	• Age was not a factor between genders, nor was PPD, however CAL was greater for males. • Freidman tests showed no statistical difference in bacterial species • Scaling and root planning in conjunction with diode laser treatment was the most effective • SRP alone was not able to eliminate A. actinomycetemcomitans , while laser-assisted curettage succeeded in eliminating this bacterium
J. Lui E.F. Corbet L. Jin (2010)	• 24 non-smoking adults diagnosed with untreated chronic periodontitis • Randomly assigned • Slit-Mouth Design • Test teeth were matched to control teeth	• Scaling and root planing with our without one treatment of photodynamic therapy and low-level laser therapy within 5 days • Probing Depth • Gingival Index • Plaque Index	• The combined course of SRP along with PDT and LSR could be a beneficial adjunct to non-surgical treatment of periodontitis • It is shown that the use of diode laser could contribute to significant reduction in bacterial populations and control periodontal

			inflammation • Frequent use of antimicrobials could lead to an antimicrobial resistance. Laser therapy could provide a safe alternative for clinicians
Andres Moritz Ulrich Schoop Kawe Goharkhay Petra Schauer Orhun Doertbudak Johann Wernisch Wofgang Sperr **(1998)**	• 50 total patients • Random assignment • At least 1 periodontal pocket of 4mm had to be present in all 4 quadrants • All patients had all of their teeth • Wisdom teeth were excluded from the study • Patients were asked to brush 2 x daily after meals with a specific toothpaste to create comparable conditions • All patients underwent scaling at the first appointment • Laser treatments were performed at second appointment	• 37 patients underwent Laser Therapy • 13 patients used as control group • Laser duration in correlation to pocket depth • Probing Depth • Gingival Index • Plaque Index	• Long-term bacterial reduction was achieved in 100% of the lased patients. 58.4% of the controls showed improvements. • Long-term bactericidal effect on A. actinomycetemcomitans was achieved in 73.5% of the lased patients. The remaining 26.5% had not been contaminated • A reduction in Provella Intermedia was achieved in 85.3% of the lased patients and 58.35% of the control group • Laser treated patients recorded a bacterial reduction by one power of ten.
T. Qadri L. Miranda J. Turner A. Gustafsson **(2005)**	• 17 patients diagnosed with moderate chronic periodontitis • Split-Mouth • Double Blind Study • Must be 35 • No Ongoing general disease • Be on no medication • No antibiotic for the last 4 weeks • No mobility II or III • No pocket depths	• Probing Pocket Depth • Plaque Index • Gingival Index • Five patients were smokers	• Additional treatments of Low-Level lasers will reduce gingival inflammation • Post laser treatment probing depths decreased significantly on laser treated side. • According to this study, no difference in microbes was detected between laser and placebo sides • Additional low-level laser treatments produce better results than SRP alone

	greater than 7mm		
Talat Qadri Pavlina Poddani Fawad Javed Jan Turner Anders Gustafsson **(2010)**	• 30 patients selected via questionnaire about their systemic health, use of medications and tobacco use • Must have ≥6mm periodontal pockets of 4 to 8 mm on each side of the mandible • Exclusions due to history of systemic disease requiring medication, antibiotics within 12 weeks or exhibited class II or III mobility • Split-Mouth • Single Masked • Randomized	• Probing Depth • Gingival Index • Plaque Index	• SRP in conjunction with a single application of a water cooled Nd:YAG laser significantly improves the clinical signs associated with periodontal inflammation compared to SRP alone • Laser treated sites had enhanced healing • All clinical variables improved
Kemal Ustun Kamile Erciyas Ufuk Sezer Suleyman Z. Senyurt Hasen Gundoger Ozlem Ustun Serdar Oztuzcu **2014**	• 21 patients • Single Blinded • Split-Mouth • Age 26 to 55 • Diagnosed with Generalized Chronic Periodontitis • Use of 810 nm Diode Laser	• Probing Depth • Gingival Index • Plaque Index • Gingival Crevicular Fluid	• Both treatment modalities (SRP and SRP + LSR) resulted in significant improvements in all clinical parameters. • The use of the diode laser as an adjunct to SRP produce significant improvement in Clinical parameters as well as GCF IL-1B levels

Findings

The literature declaring the benefits of laser therapy as an adjunct to periodontal therapy is continuing to grow. Studies are showing similar results. "Diode lasers are very effective in soft tissue applications including incision, hemostasis and coagulation" (Goldstep, 2009, p. 44). Melanin and hemoglobin absorb the effects of a diode laser when treating periodontitis. The diode laser targets diseased or inflamed tissue and effectively treats them with precision. It is found that the ability of diode laser therapy to attack specific microorganisms such as A. actinomycetemcomitans is well documented. This microorganism is attached to diseased root surfaces as well as the surrounding gingival tissue. It can be difficult for traditional

treatment to remove this organism with mechanical instrumentation alone. Laser therapy offers a solution that does not require the patient to be inundated with antibiotics every time they need periodontal treatments. "With the diode laser, there is a reduced need for systemic or locally applied antimicrobials. This leads to fewer allergic reactions and antibiotic resistance" (Goldstep, 2009, p. 46). When considering laser therapy as an alternative to antibiotic pre-medication requirements for patients, clinicians can offer this treatment to their patients.

Kamma (2006) conducted another study and concluded the diode laser can target bacteria deep in the dentin, thereby increasing success rate in treatments such as endodontic therapy. This study examined 30 patients diagnosed with aggressive periodontitis. Clinical assessment of periodontal depth (PD), clinical attachment loss (CAL), plaque index (PI) and gingival index (GI) was recorded prior to treatment. Patients were randomly placed into one of the following treatment groups: scaling and root planing alone (SRP), diode laser treatment alone (LSR), scaling and root planing in conjunction with laser treatment (LAS + SRP) and one quadrant was not treated as a control. Mechanical instrumentation alone has been shown to be ineffective in controlling or reducing microbial levels in the gingiva and sulcus. "The clinical benefits are derived from the removal of subgingival plaque and disruption of subgingival biofilm leading to a decreased of bacterial counts" (Kamma et al., 2006, p. 119). Instrumentation alone has its limitations when treating periodontitis. Hand instrumentation without the added benefit of laser therapy can leave bacteria and debris deep in the periodontal pocket and on the root surface as well. The microorganisms left in the gingival tissue are left to multiply and continue to irritate the periodontium. This can lead to a faster relapse in periodontal issues including bone loss, tissue loss and eventually tooth loss.

Another study, focusing on the bacterial reduction the diode laser is capableof, examined 50 patients with at least one 4mm pocket in all quadrants. To be included in the study patients were required to have all of their teeth. "Long-term bacterial reduction was achieved on 100% of the laser treated patients, whereas 58.4% of the controls showed an improvement in the values…" (Moritz et al., 1998, p. 305). Some other publications and clinical trials examining the efficacy of dental lasers utilized the Nd:YAG laser, "however, we expect the diode laser to have similar properties as the Nd:YAG laser that emits radiation within the infrared range at a very similar wavelength." (Moritz et al., 1998, p. 308). The thermal effect of the diode laser on bacteria on root surfaces is considered to be one of the expectations of the diode laser. The diode laser radiation affects the bacteria in the gingival sulcus as well as penetrates into the superficial layers of tissue. This

ability allows the laser to have a high efficacy when dealing with the bacterial pathogens involved in periodontal disease.

"Laser light is supposed not only to eliminate bacteria, but also inactivate bacterial toxins diffused within the root cementum" (Moritz et al., 1998, p. 310). Diode lasers operated in pulsed mode are not expected to inflict injury to the pulp of the tooth or the surrounding tissues. It is also important to note that laser therapy is best designed to accompany scaling and root planing therapy. The treated sites in this study showed an increase of bacterial growth in the gingival sulcus because pathogens can still be present in the remaining calculus (Moritz et al., 1998).

Another study utilizing 17 patients diagnosed with moderate periodontitis was conducted in 2004. Patients were required to be 35 years of age, have no ongoing disease and they could not have been on medication, especially antibiotics, over the previous four weeks. All patients in the study received periodontal therapy and had baseline measurements taken. Several teeth in each patient were used as a control group. This study sampled and measured 12 microorganisms related to periodontal issues. The organisms were as follows: Prophyrmonas gingivalis, Prevotella intermedia, Prevotella nigrescens, Tennerella forsythensis, A. actinomycetemcomitans, Fusobacterium nuleatum, Treponema denticola, Peptostreptococcus micros, Campylobacter rectus, Eikeinella corredens, Selenomonas Noxia and Streptococcus intermedius. It was found that low-level laser treatment in addition to mechanical instrumentation would reduce gingival inflammation. "Low-level lasers have been used for more than 30 years and no adverse effects have been reported" (Qadri et al., 2005, p. 715). It is concluded that low-level laser treatments reduce the gingival inflammation, gingival crevicular fluid, periodontal pocket depths and bleeding on probing. This pocket depth reduction is due to the reduction of bacteria present in the gingival sulcus when periodontal inflammation begins.

Another trial utilized 30 patients and divided them randomly. They used a split-mouth, single masked, randomized controlled clinical trial. Selected patients were questioned regarding their health history, use of medications and any smoking habits. Patients selected were required to have at least six 4 to 8 mm pockets on each side of the mandible. Patients were excluded due to any history of systemic disease, antibiotic use within 12 weeks and any class II or III mobility. This clinical trial utilized an Nd:YAG laser. As previously stated, the diode laser is expected to have similar bactericidal properties with the same wavelength (Moritz et al., 1998, p. 308). The patients in this study exhibited "enhanced periodontal healing compared to sites treated by SRP alone" (Qadri et al., 2010, p. 1163).

In the last study reviewed, 21 patients diagnosed with generalized chronic periodontitis were placed in a single blind, randomly placed, split-

mouth clinical trial. "Inclusion criteria included the presence of at least two canines or incisors in two separate quadrants with periodontal pocket depths between 4 and 7mm". Exclusion criteria were a history of any systemic diseases that could affect the periodontal therapy outcome (e.g., diabetes mellitus, cancer or metabolic or endocrine disease), smoking, dental treatment in the past 6 months preceding the study and related teeth with restoration" (Ustun et al., 2014, p. 62). The study goes on to explain that laser therapy conducted with an 810 nm diode laser shows enhanced therapeutic results in the gingival tissue, as well as improved periodontal variables than treatment with SRP alone.

The literature reviewed had many of the same results and outcomes. Diode laser therapy is continuing to show improved healing in periodontal patients. One of the main questions that need to be answered is, "What is the best wavelength laser for periodontal treatment that can have the most beneficial effect on microbes and bacteria in the gingival sulcus?"

Limitation

The majority of clinical trials reviewed and utilized for this literature review concentrated on lasers in the use of periodontal therapy. It is well known that periodontal issues arise from bacterial pathogens in the gingival tissue that lead to inflammation and disease. However, the studies did not focus on the efficacy of the diode lasers in their ability to kill or reduce the bacteria responsible for bacterial endocarditis. There are also a few studies that reported no benefit to adding diode laser therapy to standard periodontal therapy. Although these studies reported a drastic improvement in periodontitis conditions, not enough attention was focused on the bacterial count itself. For scientific purposes, more informational studies need to be completed to ascertain the true benefit of diode laser therapy.

Conclusion

This literature review concludes that a diode laser does have the efficacy to be utilized in periodontal therapy as bactericidal treatment, which serves as an alternative to antibiotic therapy. It has been well documented that diode laser therapy in conjunction with scaling and root planing are producing excellent results in periodontal patients. "The purported benefits of diode laser periodontal therapy are based on the premise that subgingival curettage is an effective treatment and that significant reduction in subgingival microbial populations are predictably achieved" (Cobb, Low, & Coluzzi, 2010, p. 45). An important portion of diode laser therapy is laser curettage. Laser curettage is very effective in removing the affected tissue and leaving behind healthy gingiva. Gingival tissue infected with bacterial pathogens is removed, leaving only healthy tissue to re-attach to the tooth

surface. Conventional scaling and root planing can result in creating more damage in the periodontal tissue that is already inflamed (Aykol et al., 2011).

"The major objective of periodontal therapy is to remove soft and hard, supra- and subgingival deposits from the root surface and to stop disease progression" (Christodoulides et al., 2008, p. 1638). In order to stop disease, the pathogens creating the progression must be removed. Scaling and root planing alone can remove deposits from the tooth, but bacterial pathogens are left behind to fester. These pathogens can enter the bloodstream and create bacterial endocarditis or create problems with artificial joints. Diode laser therapy in conjunction with scaling and root planing kills the pathogens before they can enter the bloodstream. According to Goldstep (2009), diode lasers can provide a non-antibiotic therapy for patients. The goal is to avoid antibiotic treatments altogether. It has been well documented that one can develop a resistance to antibiotics. More studies need to be completed to show how diode laser therapy can replace antibiotic premedication treatments for patients.

"It has been shown that use of the diode laser could contribute to a significant reduction in bacterial population and control of periodontal inflammation" (Lui et al., 2011, p. 90). Lui (2011) also goes on to say that frequent use of antimicrobials may lead to resistance. Clinicians are searching for a non-surgical alternative to antibiotic therapy that has the same efficacy in dealing with bacterial pathogens. Diode laser therapy appears to be that treatment. Diode laser therapy can kill or significantly decrease the bacterial load in the periodontal tissue sufficient enough to avoid any bacteremia. The question remains, can the diode laser kill or reduce the bacterial level of the specific pathogens that lead to endocarditis? Could diode laser therapy become an integral part of pre-surgical care in medicine as a therapeutic treatment for patients before having any kind of surgery?

The clinical trials reviewed utilized different frequencies of diode laser and a few used an Nd:YAG laser. The best wavelength for periodontal treatment has not yet been identified. All of the studies reviewed showed benefits of conjunctional therapy. However, no one study had greater results than the others. According to Kamma (2006), diode lasers have the potential to kill bacteria and allow detoxification of the periodontal pocket.

The long-term bactericidal effects of laser therapy have been confirmed. However, more studies related specifically to endocarditis need to be conducted. The effects of low-level diode laser therapy are showing great results. It has been proven that diode laser therapy in conjunction with scaling and root planing are more beneficial than SRP alone. Now the task is to prove that diode laser therapy can help patients avoid taking antibiotics at every appointment.

The next study recommended would be to study the diode lasers efficacy on the specific bacterial pathogens that lead endocarditis or artificial joint problems. Test the diode laser at different wavelengths and sample and record the bacterial pathogen levels in the periodontium after treatments. Clinical trials evaluating specific pathogens would need to be conducted to evaluate the efficacy of diode lasers, reducing risk to patients. The goal would be to offer patients a non-antibiotic treatment for their periodontal disease.

Methodology

Research Design

A single-masked randomized controlled study for this trial will be utilized by randomly assigning treatment groups via a coin flip. Participants will be assigned to treatment, placebo and control groups.In the initial study, neither group needs to be a required to have antibiotic therapy prior to treatment, as we will simply try to determine if there is a statistically equivalent reduction in treatment induced bacteremia. Each group should be standardized, with respect to plaque index and gingival index scores. Participants can also be sub-grouped depending onperiodontal depth readings (1-3 mm, 4-7 mm and 7+ mm, for example). At a standardized point following exposure of 30 and 60 minutes, blood will be drawn to test for pathogen levels and markers of interest. No patients in this study will be put at risk and the results would allow the comparison of laser versus antibiotic therapy results with respect to bacterial pathogen reduction

Population Sample

Patient population will be initially selectedfrom individuals answering a questionnaire regarding overall health, smoking habits and periodontal status (Appendix A). Dental professionals trained and calibrated for accuracy will screen patientsfor evidence of moderate to chronic periodontitis. In order to be considered for this study, patients need to present with untreated chronic mild to moderate periodontal disease. Inclusion criteria will be based on information such as periodontal pocket depth, teeth mobility, bleeding on probing and clinical attachment loss. Patients will be excluded who affirm antibiotic use within the past six months, periodontal pocket depths greater than 10mm and any chronic health issues that may alter the final test results.

Data Collection Procedures

Clinicians will be calibrated prior to any data collection to assure the stability of the study. Patient’s samples will be measured and recorded at their first appointment and randomly assigned to one of two treatment

groups. After samples are measured and recorded, patients will undergo standard periodontal therapy, which includes ultrasonic scaling with a cavitron, scaling and root planing and tailored oral hygiene instructions (OHI). Patients will be required to follow strict home care instructions in order to maintain treatment variables. Patients who will be treated in the laser therapygroup will have treatments based on their initial periodontal pocket depth readings. Patients in the non-laser therapy group will only receive standard periodontal therapy as stated previously. Each patient will have oral samples and gingival measurements at recall appointments to evaluate the prevalence of specific bacterial pathogens and periodontal inflammatory issues. Patient's recall appointments will be at one month and three month and six month intervals for re-evaluating their periodontal status.

Data Collection Instruments

Initial data collection will be via a patient questionnaire and intraoral measurements of gingival status, bleeding, probing depths, teeth mobility and health history of each of the anticipated candidates. The periodontal risk assessment was created to find patients that may be interested in the study. The assessment form reviews the patient's health history including oral status, family history and notes any medications they have taken. After initial assessment, patients will have their gingival status examined and recorded to make sure they have the necessary findings to be part of the study. The questionnaire planned for this study will need to be field tested to assure the proper questions are addressed in order to locate appropriate candidates. Some questions may be omitted and changed due to the necessity of information.

Variables for this study will be measurements such as bleeding on probing (BOP), plaque index (PI), gingival index (GI), probing depth, and a minimal of one tooth with at least 5mm in depth or greater in the selected quadrant. Several wavelengths of diode lasers will be used to ascertain the best wavelength for pathogen reduction in the periodontal pockets.

Data Analysis

The researcher will evaluate the results of the study using quantitative methods. To help accomplish the goals and expectations of this study, the researcher will present the results in a variety of ways. First, the periodontal risk assessment of each of the participants will be tabulated. Then the periodontal samples and measurements from each of the patient visits will be recorded and analyzed. The researcher will have a statistician review the results to ensure reliability of results.

Ethical Behavior

Before conducting this study, participants will need to grant the author permission to collect specific data. The researcher will ensure the autonomy of participants in the study, and, protect them from any risk of harm.

Timeframe

The timeframe for this study will be approximately six months. Initial questionnaire will help to locate eligible and interested patients. Further testing will be required to assure patients fit into the desired specter of measurements. Patient samples and measurements will be taken at indicated intervals.

S.W.O.T. Analysis

Proposed Research Topic

What is the efficacy of lasers in regard to treating periodontal patients with laser periodontal therapy as an alternative to standard antibiotic pre-treatment therapy?

Abstract

The Efficacy of laser treatments as an alternative to antibiotics has not been established. The diode laser's ability to kill or reduce the level of specific oral pathogens that can lead to bacterial endocarditis has not been established.

Objective

To establish whether Diode Lasers can be an effective alternate treatment for
Immune compromised patients required to be pre-medicated when undergoing invasive dental treatments.

Background

Dental hygienists treat numerous patients who are required to be pre-medicated with antibiotics. Pre-medication is required for patients who have had any kind of joint replacement, heart surgery or a heart murmur with regurgitation. These patients are required to take medication prior to treatment to eliminate the possibility of having a bacteremia from the mouth invade the replaced joint or attach to a heart valve, thereby causing more damage to an already compromised patient.

Laser bacterial reduction therapy is a treatment highly recommended to patients regardless of their periodontal status. Laser Bacterial Reduction, or LBR reduces the bacterial load in a patient's mouth from billions to

hundreds. In performing Laser Bacterial Reduction, is antibiotic pre-medication necessary for patients? Can LBR be a sufficient treatment for our patients, or is the risk of patient infection still too great to avoid antibiotic pre-medication altogether.

Strengths

- Lasers are cutting edge technology and research in this department can be very beneficial to the dental community.
- The results of this study can show the dental community and laser companies alike the true benefits of laser therapy.
- Different Lasers available to use for study.
- Lasers are a fast growing technology
- Laser treatments are replacing antibiotic treatments in some offices.

Weaknesses

- The Research study could be considered risky if patients are subjected to dental treatment without antibiotic pre-medication.
- It may be difficult to find patients and doctors that are willing to be subjected to this research trial.
- Lasers are still costly.
- Testing should be done quickly to be accurate and reliable.
- Laser treatments may not be standardized.
- Clinical approval could be costly.

Oppurtunities

- This study can present the opportunity to show the dental community that lasers are as effective or better than subjecting a patient to numerous antibiotic treatments.
- This study can assist in showing how beneficial lasers can be to periodontal treatment.
- While being screened, patients can be diagnosed and treated during the research study.
- New Diode lasers are very compact.
- Besides the laser itself, the trials should be fairly inexpensive.
- There is a need to prove the lasers efficacy.

Threats

- The research community may not be willing to see the benefits of the trials.
- Previous laser research stating that there is only minimal benefit to laser therapy could adversely affect research approval.

- Clinical approval could take too much time.
- Lasers could have adverse effects.
- Lasers are a fairly new technology.

Discussion, Recommendations and Conclusions

Summary

The goal of the proposed study is to identify whether or not a diode laser can kill or reduce significantly the bacterial pathogens in the oral cavity responsible for bacterial endocarditis. The researcher will use periodontal risk assessments as well as samples and measurements from the oral cavities of selected participants.

Implications of Study

The implications of this study reach far beyond dentistry. In proving the hypothesis, the researcher will show how diode laser therapy can become a cornerstone treatment for all medical procedures. The efficacy of laser therapy can significantly affect a patient's health in all aspects of medicine by reducing or eliminating pathogens in the oral cavity that can possibly lead to bacterial endocarditis.

Conclusion

The researcher has provided a hypothesis, research question, SWOT analysis, and a literature review of peer reviewed articles that demonstrate the need for further research. The impact the proposed study will have on the health of patients in all aspects of medicine is profound. Additional research focusing on specific oral pathogens is warranted.

Recommendations

It is recommended that this study be implemented to further prove the efficacy of the diode lasers in its ability to kill or reduce significantly pathogens in the oral cavity responsible for bacterial endocarditis. In proving this hypothesis, non-antibiotic therapy can be offered to patients as a pre-treatment to any surgical procedures, thereby reducing the frequencyof antibiotic resistance. Clinician's commitment to patients included more than the treatment area they specialize in. It encompasses a whole body approach. Proving this hypothesis will allow clinicians to offer patients a non-antibiotic therapy that will not only help them attain and maintain optimal oral health, it will help them maintain optimum overall health.

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Appendix A

Periodontal Risk Assessment

When was your last professional tooth cleaning? _____

Have you ever been told you had gum disease? ____ Yes ____ No

If Yes, Approximate Year Gum Disease Was First Discovered: _____

If gum disease was diagnosed, has any treatment ever been done?

____ Yes ____ No

IF YES: My treatment was: Surgical / Non-Surgical

If Surgical, Were all teeth treated or just specific areas?

Full Mouth / Specific Areas

If Non-Surgical Describe Treatment:

Deep Cleaning / RootPlaning / Number of Visits___

Was anesthetic used? ____Yes ____ No

Has your gum disease been treated more than once? _____

Have you lost any teeth to gum disease?_____

How often do you brush each day?

1, 2, 3, 4 Times – Morning Afternoon Evening Bedtime

How often do you floss?

Frequently Occasionally Never

Have you taken Antibiotic Medication for any reason within the last 3 months?

If Yes, for what reason? (Sinus infection, ear infection, strep throat, etc.)

Type Of Antibiotic: _____

How Long Did You Take It?_____ _____

FAMILY HISTORY / GENETICS

Is there an immediate family member(s) who currently has or had gum problems in the past? (i.e., your mother, father or siblings)

_____***Yes*** _____***No***

TOBACCO USE

Tobacco use is the most significant risk factor for gum disease
Do you now or have you ever used the following:

	Y / N	Years of Usage	Years you Quit
Cigarettes	_____	_____	_____
Cigars	_____	_____	_____
Pipes	_____	_____	_____
Chewing Tobacco	_____	_____	_____

DIABETES

Gum Disease is a common complication associated with diabetes. Untreated gum disease makes it harder for patients with diabetes to control their blood sugar.

IF YOU ARE A PATIENT WHO HAS DIABETES:
Is your diabetes under control? _____Yes _____No
Are you prone to diabetic complications? _____Yes _____No
How do you monitor your blood sugar? _____
Who is your physician for diabetes? _____
IF YOU ARE A **NOT** A PATIENT WHO HAS DIABETES:
Do you have a family history of diabetes? _____Yes _____No
Have you had any of the following warning signs of diabetes?
Frequent urination _____Yes _____No
Excessive hunger _____Yes _____No
Slow healing of wounds _____Yes _____No
Excessive thirst _____Yes _____No
Weakness and fatigue _____Yes _____No
Unexplained weight loss _____Yes _____No

STRESS

High levels of stress can reduce your body's immune defense.

Are you under a lot of stress? _____Yes _____No

HEART ATTACK / STROKE

Do you have any risk factors for heart disease or stroke?

Tobacco Use _____Yes _____No
Obesity _____Yes _____No
High Cholesterol _____Yes _____No
High blood pressure _____Yes _____No
Family history of heart disease _____Yes _____No

MEDICATIONS

A side effect of some medications can cause changes in your gums.
Are you taking or have you ever taken any of the following medications:

Antiseizure medications. (i.e., Dilantin ®, Tegretol ®, Phenobarbital, etc.)

If you answered yes, are you still taking the anti-seizure medication

_____Yes _____No

Other medication:_____ _

_____ Calcium Channel Blocker blood pressure medications.
(i.e., Procardia ®, Cardizem ®, Norvasc ®, Verapamil ®, etc.)

Other medication:_____

_____ Immunosuppressant therapy (i.e., Prednisone, Azathioprine, Cyclosporins, Corticsteroids, (Asthma-Inhalers), etc.)

Other medication:_____

NUTRITION

Your diet has the potential to affect your periodontal health.

Do you find it difficult to maintain a well-balanced diet?

_____Yes _____No

HEART MURMER / ARTIFICIAL JOINT or PROSTHESIS

If you have even the slightest amount of gum inflammation, bacteria from the mouth can enter the bloodstream and may cause a serious infection of the heart or joints.

Do you have a heart murmur or artificial joints? ____Yes _____No

If yes, does your physician recommend antibiotics prior to dental visits?

_____Yes _____No

Name of physician:_____

**If you answered yes, it is especially important to always keep your gums as*

healthy and inflammation-free as possible to reduce the chance of bacterial infection originating from the mouth.

FEMALES

Females can be at increased risk for gum disease at different points in their lives.

The following factors can adversely affect your gums. Please check all that apply:

_____Pregnant _____Nursing ____Menopause ____Taking birth control pill
_____Infrequent care during previous pregnancies

Women with osteoporosis have a greater risk for periodontal bone loss.

Do you take any of the following?

_____Estrogen Replacement Therapy / Hormone Replacement Therapy (i.e., Prempro ®,
Premarin ®, Premphase ®, Fosamax ®
Actonel ®, Evista ®, Forteo ®, etc.)
Other(s):_____

EXTRA QUESTIONS

Please Complete The Following

Have you noticed any of the following signs of gum disease?
Bleeding Gums During Toothbrushing____ Pus Between Teeth and Gums
Red, Swollen or Tender Gums_____ Loose or Separating Teeth
Gums that have pulled away from the teeth _____Persistent Bad Breath
Change in the way your teeth fit together____ Food Catching between Teeth
Is it important to keep your teeth as long as possible?____ Yes ____ No
If you have missing teeth, why have you not had them replaced? _____
Do you like the appearance of your smile? ____ Yes ____ No
Do you like the color of your Teeth? ____Yes ____ No
Do your teeth keep you from eating specific foods? ____ Yes ____ No

Name_____Phone:_____
Address_____
_____