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The Advantages of Laser in the Treatment of Gingivitis

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Abstract

The term gingivitis refers to inflammation and infection of the gums. It is also termed non-destructive periodontal disease. In cases of periodontitis, the gums, the tissues connecting the tooth to the tooth socket (called the periodontal ligament) and the jaw bone containing the sockets of the teeth (called the alveolar bone) are affected. Untreated gingivitis can progress to gum disease that spreads to underlying tissue and bone (periodontitis), a much more serious condition that can lead to tooth loss. Lasers have revolutionized multiple industries, and oral care is no exception. Although laser periodontal therapy is still in its infancy – and not yet considered a proven method of treatment by the American Academy of Periodontology (AAP) – it shows promising results for eligible patients. Low-level laser therapy (LLLT) is a light source treatment that generates light of a single wavelength. The low-level lasers do not cause temperature elevation within the tissue, but rather produce their effects from photobiostimulation effect within the tissues. Low-level lasers do not cut or ablate the tissue. Some studies have analyzed the inflammatory aspects of periodontal tissue and have shown that patients who have undergone conventional periodontal treatment in combination with laser phototherapy (LPT) show better results. The futures of laser dentistry are bright as further researches are going on. The emergence of lasers for various applications in dentistry may influence the treatment planning of patients.

Keywords: Gingivitis; Periodontal Disease; Laser Therapy

Introduction

The term gingivitis refers to inflammation and infection of the gums. It is also termed non-destructive periodontal disease. In cases of periodontitis, the gums, the tissues connecting the tooth to the tooth socket (called the periodontal ligament) and the jaw bone containing the sockets of the teeth (called the alveolar bone) are affected. Gingivitis is an earlier and less severe form of periodontitis [1]. Gingivitis is one of the most common dental problems worldwide, with around 15 to 20% of the world population suffering from it at some point in their lives [2].

In recent years, tremendous strides have been made in understanding the etiology of gingivitis. This increase in knowledge has come, for the most part, from basic research in oral microbiology, immunology, histology and pathology [3]. Over the past decade, less progress has been made in further refining the epidemiological relationships between gingivitis and various host and environmental factors [4].

Causes and pathology of gingivitis

Gingivitis is commonly a result of dental plaque developing. Dental plaque is a sticky, thin and colorless biofilm of bacteria and food particles that forms over the teeth. The plaque sticks to the surfaces of the teeth and gums and the bacteria break down sugars or carbohydrate to produce the energy they need but at the same time produce acid. This acid then erodes the teeth and damages the gums. Plaque-induced gingivitis is one of the commonest forms of gingivitis [5,6]. The major cause of periodontal disease is the interaction between the bacteria found in plaque—the sticky, virtually invisible film that collects on teeth every day – and the body's response to that bacteria. These bacteria create toxins that irritate and inflame the gums [7].

This inflammatory process destroys the gum tissues and causes them to separate from the teeth. If left untreated, the disease advances to damage the underlying bone.9 When plaque is not removed from the teeth regularly, it forms a hard, porous substance called calculus, or tartar. If calculus forms on the roots of the teeth below the gum line, it irritates the gums even further and contributes to even more plaque collection and disease [10].

Once the bacteria in plaque have created inflammation and damage to the gum tissue occurs, a number of other factors can contribute to the severity of disease and the rate at which it progresses.

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Among them are:

- Smoking or chewing tobacco
- Poor oral hygiene
- Poorly fitting bridges
- Badly aligned teeth
- Defective fillings
- Food impacted between teeth
- Clenching or grinding teeth
- Poor diet
- Pregnancy or oral contraceptives
- Systemic diseases such as diabetes or AIDS
- Certain medications [11-13]

Complications of gingivitis

Untreated gingivitis can progress to gum disease that spreads to underlying tissue and bone (periodontitis), a much more serious condition that can lead to tooth loss. Chronic gingiva inflammation has been thought to be associated with some systemic diseases such as respiratory disease, diabetes, coronary artery disease, stroke and rheumatoid arthritis [14]. Some research suggests that the bacteria responsible for periodontitis can enter your bloodstream through gum tissue, possibly affecting your heart, lungs and other parts of body [15]. But more studies are needed to confirm a link. Trench mouth, also known as necrotizing ulcerative gingivitis (NUG), is a severe form of gingivitis that causes painful, infected, bleeding gums and ulcerations [16]. Trench mouth is rare today in developed nations, though it's common in developing countries that have poor nutrition and poor living conditions. Gum disease can also lead to tooth loss, gum inflammation, abscesses in the jaw bones or gums, and trench mouth. Trench mouth causes severe bacterial infection of the gums along with the formation of ulcers [17].

Symptoms of gingivitis

Toothache and gum swelling and pain are common symptoms. Gums may be red, tender to touch and recessing at the lower ends of the teeth. Teeth may also bleed on brushing.

Diagnosis and treatment

Diagnosing the organism causing the infection can be established using culture and microscopic examination. In the early stages, treatment is easier and more likely to save the tooth than when treatment is initiated at later stages of disease.

Mild cases of gum disease can be corrected by improving oral hygiene by brushing and flossing regularly and having the plaque removed by a dental surgeon. Severe gum disease may require treatment with antibiotics. Medication and sometimes surgery may be needed to treat advanced cases of gingivitis [18].

When gingivitis is not treated, it can advance to periodontal disease. Periodontal disease is a bacterial infection of the gums [19]. At this stage, the gums pull away from the teeth and form spaces (called "pockets") that become infected with bacteria.

Bacterial toxins and the body's natural response to infection start to break down the jaw bone and connective tissue that hold teeth in place. If not treated, the bones, gums, and tissue that support the teeth are destroyed. As the disease progresses, the pockets deepen and more gum tissue and bone are destroyed. Often, this destructive process has very mild symptoms. Eventually, teeth can become loose and may have to be removed. Periodontal disease is, by far, the number on reason why people lose their teeth [20].

Lasers have revolutionized multiple industries, and oral care is no exception. Although laser periodontal therapy is still in its infancy – and not yet considered a proven method of treatment by the American Academy of Periodontology (AAP) – it shows promising results for eligible patients [21].

Over the past half century, lasers have found their way into ophthalmology, oncology, cosmetic surgery, and many areas of medicine and biomedical research. The possibility of using light in treating illness has been known for thousands of years [22,23].

The ancient Greeks and Egyptians used sunlight as a therapy and the two ideas were even tied together in mythology, with the Greek god Apollo taking responsibility for both light and healing. However, it has only been since the invention of the laser 50 years ago, that the potential of light in medicine has really been revealed.

The special properties of lasers make them much better than sunlight or other light sources at targeting medical applications. Each laser operates within a very narrow wavelength range and the light emitted is coherent. They can also be very powerful. The beams can be focused to a very small point, giving them a high power density. These properties have led to lasers being used in many areas of medical diagnosis and treatment [24].

Lasers used in dental practice can be classified by various methods: According to the lasing medium used, such as, gas laser and solid laser; according to tissue applicability, hard tissue and soft tissue lasers; according to the range of wavelength, and of course the risk associated with laser application [25]. The light energy produced by a laser can have four different interactions with a target tissue: Reflection, Transmission, Scattering and Absorption. When a laser is absorbed, it elevates the temperature and produces photochemical effects depending on the water content of the tissues. When a temperature of 100°C is reached, vaporization of the water within the tissue occurs, a process called ablation. At temperatures below 100°C, but above approximately 60°C, proteins begin to denature, without vaporization of the underlying tissue. Conversely, at temperatures above 200°C, the tissue is dehydrated and then burned, resulting in an undesirable effect called carbonization [26]. The two main types of lasers dentists use during laser procedures are hard tissue and soft tissue lasers. Each laser uses a different wavelength that makes it appropriate for cutting into that specific type of tissue [27].

This works because each kind of tissue absorbs wavelengths of light in different ways. By altering the light's wavelength (and sometimes pulse) scientists have figured out how to craft lasers with light wavelengths compatible with the tissues in your mouth [28].

Dentists choose laser dentistry because of distinct benefits that make the procedures go more smoothly, and also reduce discomfort and healing time for patients:

- Patients are less likely to require sutures
- Anesthesia may not be necessary
- The laser will sterilize the gums, making infection less likely
- Less damage to gums shortens the healing time

- Patients lose less blood than traditional surgery

The soft tissue lasers use a light wavelength that hemoglobin and water absorb easily. Hemoglobin is the molecule found in blood, which makes soft tissue lasers ideal for gum work. Some soft tissue lasers are diode lasers, which is a type of continuous-wave laser. These lasers are ideal for cutting into soft tissue and sealing the exposed blood vessels at the same time. This is the reason you don't bleed very much during laser dentistry and why healing is quicker after laser dentistry. Soft tissue lasers are great for cosmetic procedures because you can begin to see results right away [29].

Laser treatment is a tissue-preserving, regenerative, and bone-building procedure. In general dentistry, the dentist uses a laser to access an infected pocket to kill the infected tissue and bacteria [30]. Once the infected tissue is removed and the root is exposed, the calculus is removed with an ultrasonic root cleaner instead of scraping with hand tools. Lastly, laser energy is used to warm the stem cell that contains blood in the pocket, which creates a seal of tissues against the tooth root [31].

Laser treatment ensures that no tissue is subtracted or gum tissue is reduced to a lower level on purpose. It also stimulates stem cells in the tissues to form new connective tissues, bone, and collagen. The body's healing process then regenerates the lost ligaments and bone around the tooth.

Benefits of Laser Technology for Gum Disease Treatment

Limits bleeding

Numerous gingivitis patients suffer from severe gum bleeding and bone loss. Therefore, it's critical to remove bacteria from the teeth and gingival pockets. Lasers provide the benefit of not only removing the bacteria but also killing them. This helps reduce bleeding and swelling of gums. It may even eliminate the need for further gum disease treatment such as gum surgery.

Shorter healing time

Laser treatment causes little trauma to the gum, tooth, and surrounding areas. This means healing time is drastically reduced compared to traditional surgery. Patients will recover quicker and the whole process will be much faster.

Minimizes risk of bacterial infection

Because there are not multiple tools in use for a procedure, lasers help in sterilizing the area you work in and lower the risk of bacterial infections. Laser therapy helps offer better clinical results with shorter treatment times while reducing discomfort and the need for more invasive therapies. You can do this treatment with traditional surgeries or as a stand-alone treatment. You can make this decision based on the type and extent of the periodontal disease.

Minimally invasive

Lasers are less invasive and eliminate the need for drills. This reduces the pressure that patients feel, which means there's little or no need for anesthesia. The overall result is less pain and discomfort for patients. With minimal discomfort, patients will feel less anxious and relaxed during treatment [32].

The Laser Therapy Procedure

During treatment, a dentist, periodontist, or other type of specialist will use a soft tissue laser to remove diseased tissue and bacteria within the pockets along the base of the teeth. The surrounding, healthy tissue will remain unaffected. Before treatment, a local anesthetic will be applied to numb the area [33].

Once the damaged tissue has been removed, a dental instrument known as a scaler will be used to smooth the surface of the dental roots. The doctor may also apply a gel or membrane containing platelets or similar material to promote healthy tissue generation. By reducing the size of the pocket depths, the gums can more securely attach to the base of the teeth and prevent bacteria from reentering. Treatment sessions generally take about two to three hours and can be completed in one office visit. In more complex cases, an additional office visit may be required [34].

After laser therapy, it is normal to experience slight tenderness or temperature sensitivity, in addition to some swelling. Taking an over-the-counter pain reliever and eating soft foods should help reduce this side effects [35].

Discussion

The dental literature contains 25 years of accumulated reports and clinical studies addressing the utility of lasers in the treatment of periodontitis, both as a monotherapy or as an adjunct to surgical and nonsurgical therapy.

The 13 studies selected evaluated lasers for root debridement, for periodontal epithelium removal, for bactericidal effects, and for periodontal regeneration. The lasers evaluated included diode lasers, CO_2 lasers, Er:YAG lasers, and Nd:YAG lasers. The following findings were within the limits of this systematic review: 1) lasers may be possible adjuncts to scaling and root planning; 2) the Er:YAG lasers may be used remove calculus; 3) the Diode lasers; CO_2 lasers and Nd:YAG laser may be used to remove gingival tissue; 4) the Nd:YAG laser may be used to selectively ablate diseased epithelium; 5) all the evaluated lasers can be used to eradicate periodontopathic bacteria in the short-term, and 6) the Nd:YAG laser may be the only laser associated with periodontal regeneration [36].

The healing after laser therapy is based largely on the activity of the fibroblasts, keratinocytes and immune cells; thus, a few days after the surgical procedure, the epithelial cells start to migrate towards the borders of the lesion, while the fibroblasts proliferate – consequently, a new junctional epithelium is formed. Meanwhile, the cytokines and growth factors expressed by the neutrophils and macrophages control and regulate the healing process [37]. Applying the laser technology can accelerate this process by in creasing the motility of the keratinocytes (with a consequent faster epithelization), increasing the proliferation of the fibroblasts (with consequent extracellular matrix synthesis) and by early Angiogenesis [38].

Some studies have analyzed the inflammatory aspects of periodontal tissue and have shown that patients who have undergone conventional periodontal treatment in combination with laser phototherapy (LPT) show better results. Ozawa et al. showed that LPT significantly inhibits the increase in plasminogen activity induced in human periodontal ligament cells in response to mechanical tensile force.39 Plasminogen activity is capable of activating latent collagenase, the enzyme responsible for cleaving collagen fibers. LPT also effectively inhibits PGE 2 synthesis. Marcos's et al. result shows that the bacterial reduction with Diode Laser therapy was significantly better than in the Control group [40].

Also according to Dukic (2012) the results of the two treatments

are similar in terms of plaque index, bleeding on probing and clinical attachment level: the addition of laser therapy showed a marked improvement in PD, but only in periodontal pockets of moderate depth (from 4 to 6 mm) [41]. In addition, Castro (2006) conducted a study on the histological evaluation of the use of the diode laser *in vivo* in addition to SRP procedures, analyzing the following parameters: residual debris, root surface morphology, thermal side effects; he concluded that the laser therapy does not cause any mechanical alteration or thermal damage to the cementum [42].

In regards to CAL, De Micheli et al. reported the significant impact of 808 nm diode laser on reducing CAL compared with control group; which can be due to application of a different protocol in terms of the times of laser irradiation (1 day and 1 week after completion of scaling) or use of a different wavelength.43 Also, Üstün et al. stated that the use of 810nm diode laser as an adjunct to SRP produced significant improvements in CAL [44].

Finally the use of laser is part of a non-surgical treatment of periodontal disease process, that must respect very specific steps, including the assessment of the patient's medical status, periodontal diagnosis and the development of a treatment plan, patient information and the collection of informed consent, application processing procedures such patient education (oral hygiene, fight against risk factors including tobacco and stress, taking additional charge of systemic diseases such as diabetes) and patient follow-up.

Conclusion

The results show the adjunctive benefits that diode laser treatment can provide when it is used as an adjunct to non surgical periodontal treatment. Diode lasers can promote periodontal health and can be a supplement to an accurate root debridement. Supplemented periodontal treatments lead to a significant reduction of periopathogens and thereby help maintain periodontal health. Understanding the application and safety of laser treatment methods provides higher treatment standards.

Considered the better clinical results, the laser diode can be routinely associated with the traditional mechanical non-surgical therapy (SRP) in the treatment of periodontal pockets of patients with moderate-to-severe chronic periodontitis.

The results of such studies encourage us in hoping that the use of complementary low power laser in the future will become a part of the standard protocol of non-surgical periodontal therapy. The futures of laser dentistry are bright as further researches are going on. The emergence of lasers for various applications in dentistry may influence the treatment planning of patients.

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