

Laser Therapy for Soft Tissue Management in Orthodontics

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Abstract

Context: In recent years, lasers have numerous applications in orthodontics as an important field of dentistry. The purpose of this article is to review some of the major applications of laser in the field of soft tissue management in orthodontics.

Evidence Acquisition: No single laser wavelength can be used to optimally treat all dental diseases. However, the needs of the orthodontic clinician are unique and selection of the most appropriate laser for orthodontic applications is essential to achieve optimal results.

Results: Light emitted from diode lasers is poorly absorbed by dental hard tissues, these lasers can be safely used for soft tissue surgery applications, including gingival recontouring, crown lengthening, removal of hypertrophic tissue and frenectomies close to the enamel, dentine and cement. Considering beam safety, most of the lasers used for medical and dental purposes are in the Class IV category, so it is necessary to take appropriate safety measures.

Conclusions: In the near future, with the clarification of laser exposure protocols and a decrease in device cost and, Dental lasers may play an increasingly important role in soft tissue management during orthodontic treatment.

Keywords: Laser, Orthodontics

1. Context

The basic theory of laser was first explained in an article by Albert Einstein 1; however, it took relatively a long time till industry and technology could provide the grounds for manufacturing the first laser tool. Based on the theories put forward by Einstein, the first instrument for producing laser beams was invented by Maiman (1). In the 1960s, laser was used for its coagulating effects in retina. In fact, the ophthalmologists were the pioneers in utilizing laser. Since then, much improvement was observed in laser use.

In general, lasers are composed of the three principal parts: An energy source, an active medium and a set of different number of mirrors that form a resonator. Properties such as wavelength are determined primarily by the active medium, which can be a gas, crystal or solid state conductor (2,3).

No single laser wavelength can be used to optimally treat all dental diseases. However, the needs of the orthodontic clinician are unique and selection of the most appropriate laser for orthodontic applications is ideally determined by examining four important factors: type of procedure, ease of operation, cost and portability (4).

In recent years, lasers have numerous applications in orthodontics as an important field of dentistry. The pur-

pose of this article is to review some of the major applications of laser in the field of soft tissue management in orthodontics.

2. Evidence Acquisition

2.1. Laser Type Selection

CO₂ and Nd: YAG lasers are not ideally suited for orthodontic applications and are hampered by their large size and high cost. Erbium lasers are very popular in hard tissue and soft tissue dental practice today (4, 5). However, it is diode laser that seems most ideal for orthodontic specialty practice. Due to procedure specificity, the diode lasers sole purpose is soft tissue energy (5, 6). Diode laser can remove tissue without any risk to adjacent tooth. It can provide proper hemostasis. In soft tissue surgery erbium laser require careful attention to avoid damage to tooth structure and has inferior bleeding control (5).

Many practitioners prefer the diode lasers dry field operation and very good proprioceptive feedback provided by the gentle contact of the fiber tip by tissue during treatment. Erbium beams are operated in a noncontact mode with a necessary cooling water spray (7).

2.2. Diode Laser

Diode lasers use a semiconductor as the source for emission. Gallium aluminum arsenide (Ga Al As) and helium neon (He-Ne) are two examples of semiconductor lasers (8). The active medium of the Ga-Al-As is solid; consisting of Ga, Ar and Al. The wavelength of Diode lasers used in dentistry vary between approximately 800 nm and 980 nm. Although light in this range is highly absorbed by pigmented tissues and has a great penetration depth in soft tissues, it is poorly absorbed by dental hard tissues and water (2). It is not as effective as the Argon laser for hemostasis.

2.3. Clinical Applications

2.3.1. Esthetic Gingivectomy

The gingival esthetics plays a major role in this regard (9). Disproportionate dentogingival relationships might negatively affect the outcome of treatment, even if the teeth are perfectly aligned (10).

Orthodontic treatment might affect gingival health (11). In certain cases, the gingival margin needs recontouring by means of gingivectomy (12). However, the costs and postsurgical pain of this treatment might discourage patients, unless in severe cases (13). As a rule, aesthetic gingival recontouring is most beneficial in the upper arch from cuspid to cuspid. Ideally the gingival margins of upper anterior teeth are positioned at or very near the inferior border of the upper lip in full smile. Display of gingival tissue in excess of 2 mm is generally considered to be undesirable (9, 10).

Pain is one of the most important and common postoperative complications, which can discourage patients from seeking treatment; and its proper control, might leave a good impression on the patient regarding the quality of surgery.

With the introduction of soft tissue diode lasers, which might be economic and less painful than conventional methods, the gingivectomy treatment became a routine part of orthodontic treatment. Diode lasers might provide proper hemostasis, reduce the infection risk, and prevent damage to the teeth and bone because of their effect range which is limited to soft tissue (14). They also might improve esthetics while improving soft tissue healing (15). Minor edema, less swelling, and faster healing are the advantages of laser usage in soft tissue management (15, 16).

2.4. Exposure of Unerupted Teeth

Extended orthodontic treatment times are often the result of delayed eruption of teeth or compromised bracket positioning due to excessive gingival interference. Prior to exposure of an unerupted tooth it must be determined

that tissue removal will take place entirely in attached gingival and no bone cutting will be required during exposure (17). Typically, the impacted teeth is located by radiographic approach, clinical examination and palpation. After the patient is anesthetized we can determine if any bone is covering the crown by using a scaler to puncture the soft tissue. Enamel will feel very smooth, whereas bone will seem more rough. For tooth exposure, conservative tissue removal will be recommended, excision only allow for precise positioning of bracket or button and other bonded attachments (18-20).

2.5. Adjunct Procedure for Periodontal Therapy

Fixed orthodontic appliance therapy (FOAT) is frequently associated with pathological changes in the periodontal tissues (21-24). The presence of fixed appliances can increase plaque stagnation, impede oral hygiene, and cause a shift in the oral microbial ecosystem to more pathogenic oral biofilms (25).

Clinical studies have frequently reported on the development of chronic periodontal inflammation, loss of clinical attachment, and gingival enlargement among orthodontic patients (26, 27). Gingival enlargement is one of the most common soft tissue problems associated with FOAT, with a reported prevalence of almost 10% (23). Gingival enlargement further impedes the maintenance of oral hygiene (thereby resulting in further damage to periodontal tissues), causes aesthetic and functional problems, and has been reported to compromise orthodontic tooth movement (28).

In the management of gingival enlargement, self-care oral hygiene is the first line of defense for orthodontic patients, but motivation to maintain oral hygiene can be inadequate in some patients; thus, this approach has limited success (27, 28). The use of mouth rinses is a useful adjunctive self-care approach to the management of gingival enlargement, but it, too, relies on patient compliance; in addition, there can be some side effects with long-term use (29). Nonsurgical periodontal treatment (including oral hygiene instruction, scaling, root planing, and prophylaxis) is the conventional management approach for gingival enlargement but is not always effective when gingival enlargement is extensive and self-care is compromised (30).

This in turn has led to surgical approaches to the management of gingival enlargement. However, this is considered by many as very invasive and may not be effective if self-care oral hygiene practices remain poor (12). In recent decades, considerable attention has focused on the use of lasers (diode, erbium: yttriumaluminum- garnet, neodymium:yttrium-aluminum-garnet) as adjunct management approaches to enhance nonsurgical periodontal

treatment, as they offer a less invasive surgical approach (7, 31-35). The diode laser has been used for gingivectomy procedures and involved the removal of gingival soft tissues only. Adjunct use of diode laser gingivectomy can be effective over time in the management of gingival health problems (36, 37).

2.6. Frenectomy

A midline diastema is often complicated by the insertion of the labial frenum into a notch in the alveolar bone, so that a band of heavy fibrous tissue lies between the central incisors.

The frenectomy must be carried out in a way that will produce a good esthetic result and must be properly coordinated with orthodontic treatment (11).

It is better to align the teeth before frenectomy. A laser assisted labial frenectomy is a simple procedure that is best performed after the diastema is closed as much as possible. Ankyloglossia is a developmental anomaly of the tongue characterized by a short, large lingual frenum resulting in limitation of tongue function (11). This abnormal condition can lead to speech difficulty, malocclusions and periodontal problems. Lingual frenum ablation can be easily performed by diode laser.

2.7. Tissue Removal

Placement of a miniscrew temporary anchorage device in loose nonkeratinized tissue typically requires placement of access opening using a surgical punch. In contrast with, the diode laser performs the same function with excellent hemostasis and bactericidal disinfection (38).

2.8. Beam Safety

According to the standards of American national standards institute and occupational safety and health administration, lasers are classified into four different classes based on potential danger, as follows (39):

Class I: These are low powered lasers that are safe to view.

Class IIa: These are low powered visible lasers. They do not cause damage unless one looks directly along the beam for longer than 1 second.

Class IIb: These are low powered visible lasers. They are dangerous when viewed along the beam for longer than 0.25 second.

Class IIIa: These are medium powered lasers that are not dangerous when viewed for less than 0.25 second.

Class IIIb: These are medium powered lasers that are dangerous when viewed directly along the beam for any length of time.

Class IV: These are dangerous high powered lasers that can cause damage to the skin and eyes. Even the reflected or radiated beams are dangerous. It is necessary to take appropriate safety measures. Most of the lasers used for medical and dental purposes are in this category.

In addition, the inhalation of laser deposits consisting of organic materials, water vapor, carbon monoxide, carbon dioxide and hydrocarbon gas can be dangerous.

3. Results

Because light emitted from diode lasers is poorly absorbed by dental hard tissues, these lasers can be safely used for soft tissue surgery applications, including gingival recontouring, crown lengthening, removal of hypertrophic tissue and frenectomies close to the enamel, dentine and cement (40).

Gingivectomy can be performed by different means such as scalpels, electrosurgery, chemosurgery, and laser (20). The conventional surgery performed by a small scalpel has

been considered the most common method. However, the advent of diode lasers highly absorbable by melanin and hemoglobin allows soft-tissue manipulations such as gingival recontouring, operculectomy, or frenectomy accompanied by improved epithelization and wound healing (14, 15, 41).

Soft tissue Lasers can incise the soft tissue to a depth of 2 to 6 mm (14). The localized heat causes coagulation, protein denaturation, drying, vaporization, and carbonization at the site of the energy absorption. This might seal blood vessels and inhibit pain receptors at the incision location (11, 14, 41-46). Therefore, using diode lasers might be useful because of better control, potentially lower pain and inflammation, and improved wound healing.

By using the diode laser both unerupted and partially erupted teeth can be exposed for attachment bonding and excess tissue interfering with proper bracket placement can be removed (18, 47, 48).

In Cases with isolated hypertrophic and inflamed tissues we can excise and remove tissues easily by diode laser. In addition to removing inflamed area with less pain and bleeding by laser beam, the laser also contributes to gingival health by sterilizing the area adjacent to ablated tissue (15).

Frenectomies with a laser permit excision of frenum painlessly, without bleeding, no need of sutures and any postoperative care (17, 20, 37).

The diode laser is very good and popular for several isolated applications during orthodontic therapy. We can ablate tissue that has overgrown on temporary anchorage mini implants, orthodontic springs and coils, buccal tube

and bands. By using laser we can do these excision without pain and patient discomfort (15, 17, 20).

It is known that lasers operating at wavelengths below 400 nm (although not typically used in dentistry) have a detrimental effect to the skin. Lasers operating at non visible wavelengths (ultraviolet and infrared) and reflection of laser light from various surfaces can also increase potential danger. Because the biggest risk is for the eyes, protective glasses must be worn by the patient and the practitioner during laser therapy.

4. Conclusions

Currently, lasers are predominantly used for orthodontic researches. In the near future, with the clarification of laser exposure protocols and a decrease in device cost and, dental lasers may play an increasingly important role in soft tissue management during orthodontic treatment.

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