Laser in Dentistry

The first dental laser, which was introduced in 1989, was a 3W neodymium-doped. Today, there is a wide variety of lasers available on the market. This section serves as an introduction to the fundamentals of laser application in Dentistry.

How does laser light differ from ordinary light?

Laser beams are monochromatic in that they are of only one colour, which may sometimes be invisible.

Laser light is coherent - identical and physical in size and shape.

How does the dental laser work?

Within a laser device, there is an optical cavity which is a central core containing an active medium in the form of gas (CO\textsubscript{2}), crystals, or solid-state semiconductors (metal rods of garnet crystals). The active medium is surrounded by a pumping mechanism that supplies photon energy via a lamp or electrical current. The photons become stimulated and amplified by reflection through a lens to transmit a laser light beam.

Two basic modes of wavelength emission for dental lasers:

**Continuous wave emission:** Laser energy is emitted continuously and produces constant tissue interaction. Carbon dioxide, Ar; and diode lasers operate like this. They may produce residual thermal damage.

**Free-running pulse mission:** Short bursts of laser energy emitted every few tens of thousands of a second. Use of a pulse emission gives target tissues time to cool (thermal relaxation time). Nd:YAG, Er:YAG are some of the laser types that operate in this manner.

Both types of laser emission may produce an unwanted thermal effect on the target, and therefore strict control and attention are required regarding the temperature by the operator in order to prevent thermal damage.

Types of dental laser:

The wavelengths used in dental laser instruments range on average between 488 and 10600 nm.

The type of laser emitted by dental laser instruments is a non-ionising form of radiation that is not mutagenic to DNA in cells.

Different lasers produce different wavelengths and have different effects on dental structures. Different tissues will have different extents of absorption for lasers; some lasers will only be absorbed by soft tissues while others will be absorbed by harder tissues such as enamel or bone.

**Hard Tissue Lasers:**

Hard tissue lasers have wavelengths that could be absorbed by hydroxyapatite and water present in bone, and teeth. These groups of dental lasers include Neodymium YAG (Nd:YAG) and diode; argon lasers and carbon-dioxide lasers. Soft tissue lasers penetrate soft tissue while sealing blood vessels and nerve endings. This process allows the soft tissue to heal more quickly and explains why some patients experience less or no postoperative pain following the use of a laser.

In the oral cavity, where there are both hard tissues and soft tissues, dentists must choose the best laser according to the treatment that they are providing.

Scope of laser application in Dentistry:

**Periodontal procedures:** Laser can be used to treat periodontal pockets by decreasing the microbial population and removing the diseased part of the epithelium, thereby allowing healthy tissue to be restored. Some applications include frenectomy, gingivectomy and gingival graft.

**Implant dentistry:** Laser can be used to exposing an implant for placement, implant placement using an Er:YAG to ablate soft tissue and to create pilot holes in the alveolar bone. For osteous preparation, only the Er family of lasers can be used during the treatment of peri-implantitis.

**Operative dentistry:** Some lasers are used for caries removal and tooth preparation. Carious tooth substance will have a larger percentage of water than healthy tissue structure and absorb more laser energy; hence, lower levels of laser energy can be used to remove carious tissue.

**Prosthodontics/aesthetic dentistry:** Laser can be useful in dental aesthetics, for example, gingival retraction for impression taking, recontouring of gingival margin for crown lengthening, torus reduction and laser-activated tooth whitening.

**Endodontics:** Lasers can be used in many steps of endodontic therapy, from opening of the access to the root canal to the final stage of obturation. The most beneficial property of lasers in endodontic therapy is the ability to eliminate microbial pathogens from the root canal system. Laser can also be used in apicoectomy, prior to retrograde restorations.

**Oral surgery, pathology and others:** The main advantage of using laser in oral surgery is its haemostatic property, which gives a cleaner surgical field to provide better visibility for dental surgeons. Along with bactericidal properties, laser also minimises the chance of postoperative infection and causes minimal mechanical trauma to the surgical opening, so as to reduce scarring and wound contraction.

Other procedures involving laser include exposure of unerupted teeth, removal of drug-induced hyperplastic gingiva, drainage of abscess, tissue biopsy; and treatment of recurrent aphthous ulcer (RAU), herpetic lesions, lichen planus and Kaposi sarcoma lesions.
Advantages:
- Aids as a disinfectant due to its bactericidal effect, producing a cleaner surgical field
- Achieves haemostasis and reduces the need for suturing in soft tissue procedures
- Removes osseous tissue and recontours may proceed more easily with Erbium lasers
- May reduce the pain in some procedures and the need for anesthesia in selective cases
- May reduce the anxiety of patients that have a phobia to the sound of dental rotary instruments

Disadvantages:
- Relatively costly
- Requires extensive training
- Procedures that require side cutting and shaping may not be performed with laser since most dental instruments are both side and end cutting; lasers may require modification in clinical techniques
- No single laser wavelength can be used to optimally treat all dental diseases; conventional hand pieces may still be required to finish procedures
- The choice of wavelength is important in determining success and in setting the right joule setting, pulse duration and hertz setting for different procedures and different patients; most figures given are averages by the manufacturers
- Practitioner skills are required

Conclusion

Before using lasers, practitioners must let themselves be familiar with how lasers work, have clinical experience and receive proper laser training. The use of laser is different from conventional dental instrumentation, and knowledge and experience is required in order to benefit the patient. As with all laser procedures, laser cannot replace conventional instruments but should rather be used in conjunction with conventional instruments.

References:
http://www.laserdentistry.org (2009 Apr 1)