History of the laser

Who knew Albert Einstein would have his hand in dentistry? In 1917, Albert Einstein gave birth to the idea of lasers when he discovered that he could introduce a photon to an excited molecule that would then emit a second photon with the same frequency, direction, phase and polarization as the first. The result was a stimulation of light possessing significant amounts of usable energy. In 1960, building on the foundation laid by Einstein and physicists Charles Hard Townes and Arthur Leonard Schawlow, the engineer and physicist Theodore Maiman built the first functional laser at Hughes Laboratory.

The term LASER is an acronym for “light amplification by stimulated emission of radiation.” This new technology ushered in a completely new form of usable energy. Since its birth, tremendous advances in the technology have occurred, and we are now seeing lasers used in dentistry for both hard- and soft-tissue applications.

Lasers differ from ordinary light in that they are coherent and their beams can be focused and concentrated into a small spot, generating significant amounts of energy on a small area. Laser light does not expand in a cone as normal light does, but stays in a column over the entire distance it is projected. This significantly decreases the attenuation of the energy received at the target, compared with that of normal light. Depending on the function of the laser, more or less energy is concentrated on the target to generate the desired effect.

In the field of orthodontics, lasers have evolved into remarkable tools that offer an extremely precise, pain-free method for manipulating oral tissues. At today’s top orthodontic practices, doctors use lasers to manage common soft-tissue problems associated with patients in braces.

Four types of lasers used in dentistry

Erbium laser: This laser can be used on hard tissue for cavity preparation or bone cutting, using short pulses of 50-100 microseconds. It can also be used on soft tissue, using longer pulses of 300-1000 microseconds. In this mode it can be used for periodontal procedures, gingival contouring, frenectomies, facial resurfacing or biopsies. The benefits of using this type of laser include minimal heat penetration, rapid healing and minimal postoperative pain. However, these lasers are large and expensive and have significantly more capability than an orthodontist generally would use in everyday cases.

Nd:YAG laser: This was the first laser designed for dentists, and was introduced in 1990. A pulse laser with a wavelength of 1064nm, the Nd:YAG laser has the unique ability to penetrate deep into the tissue, and can even stimulate fibrin formation, aiding in the coagulation of operative sites. This laser has been used in the periodontal field for disinfection and debridement of periodontal pockets.

CO2 laser: Introduced in the 1970s, this laser has a wavelength of 10600nm and is highly absorbed by water. It is very good at hemostasis but can be used on soft tissue only. It is useful for cutting soft tissue with reduced charring, and is used most frequently for biopsies. Sutures are
seldom needed since hemostasis is exceptionally good.

**Diode laser:** Compact and affordable, this laser is used most frequently by orthodontists for soft-tissue management. The diode laser’s wavelengths range from 805-1064nm, which means it can only be used on soft tissue. A wavelength of 940nm represents peaks for the absorption of laser energy by hemoglobin, oxyhemoglobin and water, making the 940nm diode laser very effective as an instrument to incise gingival tissue.

A diode laser uses heat as the energy source to incise the tissue, and it can be used quite effectively for frenectomies, biopsies, canine exposure, gingival recontouring and gingivectomies. Minor charring is very common around the surgical site, but resolves within a three- to five-day window under normal circumstances.

**Diode laser techniques and applications**

The 940nm diode laser has many useful functions in orthodontics, and its unique characteristics make it the instrument of choice when it comes to gingival management. The laser has the ability to cut the gingiva while sealing the blood vessels and nerve fibers. This means minimal trauma to the tissue and less scarring, with reduced postoperative swelling and pain.

A pulsed laser is the most effective, since it delivers a pulse of energy followed by a rest interval. This gives the gum tissue time to cool slightly before being hit by the next pulse, thus reducing pain and scarring. The total amount of energy transmitted from the laser to the tissue is a function of the laser beam’s diameter, power, pulse length and pulse interval, all of which can be adjusted. The exact settings a provider prefers for each procedure are determined by experience. As the clinician becomes more familiar with the laser and its cutting capability through different procedures, small adjustments can—and should—be made.

In my orthodontic practice, I find this laser most useful in recontouring the gingiva to gain access to the gingival portion of the clinical crown in cases where there is gingival overgrowth preventing the proper positioning of a bracket. While performing any procedures with the laser, it is important to maintain the 2mm biological width of the tooth (consisting of 1mm of epithelial attachment and 1mm of connective tissue attachment). This means that the gingival removal should never leave less than 2mm of attached gingiva on any tooth.

With these limits in mind, the orthodontist may find the laser gingivectomy becomes as easy as moving the laser across the gingiva at the desired depth until the laser tip has incised all the way through the tissue and is in contact with the enamel. Bleeding is virtually nonexistent, and therefore does not obscure the field of view. Using the same technique, a provider can expose a canine that has not yet erupted through the gingiva so that it can be bracketed and orthodontically erupted. Having the ability to manipulate the soft tissue on and around the clinical crown of a tooth gives the orthodontist much more control over the positioning of the teeth. Instead of...
placing the bracket in a less-than-ideal spot on the tooth (or not placing it at all), the provider who has a soft-tissue laser and the ability to use it can remove the redundant tissue, place the bracket where it belongs and more effectively move the tooth to its correct position.

While patients occasionally show some hesitation at the mention of a laser in their treatment plan, patients treated with selectable-pulse-mode lasers regularly report that they experience no discomfort with soft-tissue laser procedures. The dental laser delivers pulses of energy too short to trigger a neural response. An orthodontist will find little to no evidence of thermal damage when performing soft-tissue procedures with this technology. Most soft-tissue laser procedures can be performed with only topical anesthesia. When a topical anesthetic is inadequate, a local anesthetic may be needed, but this is rarely necessary. The laser stops any bleeding and seals lymphatic and nerve endings, thereby avoiding tissue inflammation and the usual discomfort that is associated with inflammation.

With good patient communication regarding the use of lasers in orthodontic treatment, the patient truly benefits from improved gingival aesthetics and potentially faster treatment times resulting from well-placed brackets. In the words of Albert Einstein, “Excellence is doing a common thing in an uncommon way.” With dental laser technology’s advances, orthodontists can provide their patients with the best possible outcomes.