Soft-Tissue Lasers in Dental Hygiene
The use of lasers in dentistry today has evolved from its beginnings in 1960. In that year, Theodore H. Maiman (Figure 1.1) developed the first laser and called it Maser (Maiman 1960). Then he developed the first dental laser, the Ruby laser, which became the laser of choice for research and clinical applications. However, concerns soon arose whether the scattering of the Ruby’s laser beam damaged adjacent teeth. By the end of the 1960s, most researchers conceded that it was the high level of energy excessively emitted that was the biggest cause of severe thermal damage to the tooth (Taylor 1965).

Soon after Maiman’s Ruby laser, a Neodymium laser was produced by Snitzer and was known for its active medium, which helps it emit radiation. The Neodymium:yttrium-aluminum-garnet (ND:YAG) laser was produced, but it was not as popular as the Ruby laser. However, the use of the pulsed Ruby laser may have delayed the use and production lasers within dentistry as whole.

However in 1916, it was Albert Einstein (Figure 1.2) who postulated the theory of lasers (i.e., spontaneous and stimulated emission of radiation) in the Zur Quanten Theorie der Strahlung (Einstein 1916). He described it as a phenomenon wherein molecules, excited by a source of energy, ultimately create an organized pattern of energy that can be directed in a specific way (Goldman et al. 1964). Thus, based on this definition, LASER stands for light amplification stimulated emission of radiation. And it is an active medium that stimulates the radiation.

Active mediums are an element in the form of a mineral, gas, or liquid. For the laser to be stimulated, photons are produced according to Einstein’s
theory, which describes how radiation is stimulated or spontaneously emits itself. Photons are defined as an elemental quantity or quantum of radiant energy. The active medium allows each type of atom only to absorb photons of certain wavelengths, and each medium produces specific wavelengths for each individual laser, which seeks different target tissues. Light of differing wavelengths interacts distinctly based on its wavelength. In addition, each laser has different absorption qualities depending on where the laser is on the electromagnetic spectrum, from 300 nm to 10.6 microns (Miserendino et al. 1987). The two most common lasers used in dentistry for periodontics are the ND:YAG and diode lasers, and they will be discussed in great detail in this book.

To get a basic understanding of lasers, a brief discussion of their evolution is warranted. The first generation of lasers in dentistry were carbon dioxide (CO₂) lasers, which were big complicated machines (oral surgeons bought them), and they had no contact cut, meaning that whatever the laser was directed toward, it cut. This laser created a significant char layer and was thought to be a biological advantage in healing. But further research revealed that charring is not a biological bandage in the healing process.

The second generation of dental lasers was the ND:YAG laser. The ND:YAG laser is a crystal laser with a gentler cut and less charring.
It became popular for awhile because it had a delivery system much like an electrosurge, which is similar to what is currently used to cut soft tissue. This laser is still highly favored in the dental industry and used for many different applications; however, one of its major advantages is its use in soft-tissue periodontal procedures.

The one of the most popular laser used in dentistry today is the diode laser. This laser is a soft-tissue laser only, and the active medium is gallium-aluminum-arsenide and other combinations in the form of a chip, which is placed inside the laser itself. It specifically targets melanin and hemoglobin, and to a lesser extent, water during soft-tissue procedures (Figure 1.3).

After Maiman and Einstein, others began researching the use of lasers in dentistry, specifically in regard to the Ruby laser (Goldman et al. 1965; Stern and Sognnaes 1972). According to Goldman (1961), the principles of laser development were first reported by Arthur Schawlow and Charles Townes of the Massachusetts Institute of Technology in 1958, but the Nobel Prize for the development of the laser was awarded to Townes, Nikolay Basov, and Alexander Prokhorov in 1964. It was after this that others became interested in Einstein’s theory, but it was Maiman who first developed the
laser and began researching the use of lasers in dentistry, specifically with the introduction of the Ruby laser (Goldman 1965).

From the 1960 to 1990s, lasers were developed, tested, and unsuccessful for use in dentistry. In 1985, Myer and Myers wrote an article about the in vivo removal of dental caries using a modified ophthalmic Nd:YAG laser. Then in 1987, the US Food and Drug Administration (FDA) approved lasers to be used for oral soft tissues. This was a huge step forward in laser technology; however, those in the dental profession were still skeptical. In 1997, the use of lasers on hard tissues was approved; the laser is the Erbium:yttrium-aluminum-garnet (Er:YAG) (FDA 2006).

However, it was when the ND:YAG was approved four years later for soft-tissue removal that led to the initial process in treating periodontal disease. It was this final piece that solidified the relationship between lasers and clinical periodontics (Myers 1989).

The tools are now in place, but there is currently a need for lasers in periodontics as a result of the connection between systemic diseases and gum disease. Dental hygienists are on the frontline and need a higher standard of treatment for their patients using this type of low-level laser therapy (LLLT). The goal is to make these lasers a standard of care in dentistry across the world, while inspiring dental hygienists to become more aware of the available treatments and to base patient care on the overall health of the patient and not just their mouth.
REFERENCES
