Chapter 15

LASER APPLICATIONS ON ORAL SOFT TISSUES

Ahu URAZ[1], Sıla Çağrı İŞLER[2], Burcu KARADUMAN[3], Deniz ÇETİNER[4]

Introduction

Laser involves light amplification by stimulated emission of radiation. In 1957, American Physicist Gordon Gould envisaged that light can be amplified by stimulating it like microwaves, and promulgated the light amplification theory that is abbreviated as LASER (Light Amplification by Stimulated Emission of Radiation). However, the first truly operational laser device could only be produced by American Physicist Theodore Herold Maiman in 1960 (Hecht, 2005). Laser started to be used in medicine and surgery in mid-1960s. The first use of laser in dentistry was for treatment of tooth decay and introduced by Goldman et al. (Goldman & et al., 1964). Later, Yamamoto and Sato used neodymium-doped yttrium aluminium garnet (Nd:YAG) laser, and Melcer et al. used carbon dioxide (CO2) laser on hard dental tissues (Yamamoto& Sato, 1980; Melcer & et al., 1985).

Lasers and Their Characteristics

Light is a form of electromagnetic energy that is composed of massless sub-atomic particles called photons and has electrical and magnetic field components. The most important properties of light are wavelength, frequency and intensity (Gribbin, 2000).

Warm white light generated by a source of light emits an unfocused, diffused radiation. It is visible to human eye and comprised of a combination of multiple colors in the color spectrum. On the other hand, lasers generate a narrow, intensive, inphase and monochromatic light, and the light emitted by a laser source is totally different from conventional light (Gribbin, 2000).

Its properties are as follows:

1. It is monochromatic (single color). It has a specific wavelength.
2. The beam is coherent. Each photon is synchronized with other photons and scatters a little in the medium.
3. The light is unidirectional.According to distance, the beam angle changes little.
4. Beams are small in diameter but hold a high amount of energy.

[1]Doç. Dr., Gazi Üniversitesi, Diş Hekimliği Fakültesi, ahuuraz@gazi.edu.tr
[2]Dr., Gazi Üniversitesi, Diş Hekimliği Fakültesi, silaisler@gazi.edu.tr
[3]Doç. Dr., Biruni Üniversitesi, Diş Hekimliği Fakültesi,bkaraduman@biruni.edu.tr
[4]Prof. Dr., Gazi Üniversitesi, Diş Hekimliği Fakültesi, fdeniz@gazi.edu.tr

mechanical periodontal treatment. In conclusion, this chapter reports potentially useful aspects of laser applications, which offer a fairly novel treatment option, with regard to periodontal regeneration. In this respect, large-scale clinical studies as well as studies for understanding the effect mechanisms are necessary.

References

Aoki, A., Sasaki, K. M., Watanabe, H., & Ishikawa, I. (2004). Lasers in nonsurgical periodontal therapy. *Periodontology 2000*, 36(1), 59-97.

Arora, S. A., Kalra, S., Mavi, S., & Gakhar, A. (2015). Laser Assisted Periodontal Therapy: A Case Series. *IJSS Case Reports & Reviews*, 1(10), 57.

Beer, A., & Beer, F. (2002). Laser Preparation Technique in Vestibuloplasty: A Case Report. *Journal of Oral Laser Applications*, 2(1), 51-55.

Behdin, S., Monje, A., Lin, G. H., Edwards, B., Othman, A., & Wang, H. L. (2015). Effectiveness of laser application for periodontal surgical therapy: systematic review and meta-analysis. *Journal of Periodontology*, 86(12), 1352-1363.

Berk, G., Atici, K., & Berk, N. (2005). Treatment of gingival pigmentation with Er, Cr: YSGG laser. *Journal of Oral Laser Applications*, 5(4), 249-253.

Convissar, R. A. (2004). The biologic rationale for the use of lasers in dentistry. *Dental Clinics*, 48(4), 771-794.

Convissar, R. A. (2016). Principles and Practice of Laser Dentistry. 2nd ed. St. Louis, Missouri: Elsevier Mosby Inc.

Dang, A. B., & Rallan, N. S. (2013). Role of lasers in periodontology: A Review. *Annals*, 1(01), 8.

Dean, D. B. (2005). Concepts in laser periodontal therapy using the Er, Cr: YSGG laser. *Academy of Dental Therapeutics and Stomatology*.

Deppe, H., & Horch, H. H. (2007). Laser applications in oral surgery and implant dentistry. *Lasers in Medical Science*, 22(4), 217-221.

Dilsiz, A., Aydin, T., & Yavuz, M. S. (2010). Root surface biomodification with an Er: YAG laser for the treatment of gingival recession with subepithelial connective tissue grafts. *Photomedicine and Laser Surgery*, 28(4), 511-517.

Dilsiz, A., Canakci, V., & Aydin, T. (2010). The combined use of Nd: YAG laser and enamel matrix proteins in the treatment of periodontal infrabony defects. *Journal of Periodontology*, 81(10), 1411-1418.

Dogan, G. E., Demir, T., & Orbak, R. (2014). Effect of Low-Level Laser on Guided Tissue Regeneration Performed with Equine Bone and Membrane in the Treatment of İntrabony Defects: A Clinical Study. *Photomedicine and Laser Surgery*, 32(4), 226-231.

Downs, J. C., Convissar, R. A., Anagnostaki, E., Sun, G., Hoopingarner, C. R. (2015). Lasers in fixed prosthetic and cosmetic reconstruction. In: Convissar RA, ed. *Principles and Practise of Laser Dentistry*. 2nd ed. Missouri: Elsevier.

Esen, E., Haytac, M. C., Öz, I. A., Erdoğan, Ö., & Karsli, E. D. (2004). Gingival melanin pigmentation and its treatment with the CO2 laser. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 98(5), 522-527.

Finkbeiner, R. L. (1995). Free autogenous soft tissue graft with the argon laser. *Journal of Clinical Laser Medicine & Surgery*, 13(1), 1-5.

Giannelli, M., Bani, D., Viti, C., Tani, A., Lorenzini, L., Zecchi-Orlandini, S., & Formigli, L. (2012). Comparative evaluation of the effects of different photoablative laser irradiation protocols on the gingiva of periodontopathic patients. *Photomedicine and Laser Surgery*, 30(4), 222-230.

Gokhale, S. R., Padhye, A. M., Byakod, G., Jain, S. A., Padbidri, V., & Shivaswamy, S. (2012). A comparative evaluation of the efficacy of diode laser as an adjunct to mechanical debridement versus conventional mechanical debridement in periodontal flap surgery: A clinical and microbiological study. *Photomedicine and Laser Surgery*, 30(10), 598-603.

Gold, S. I., & Vilardi, M. A. (1994). Pulsed laser beam effects on gingiva. *Journal of Clinical Periodontology*, 21(6), 391-396.

Goldman, L., Gray, J. A., Goldman, J., Goldman, B., & Meyer, R. (1965). Effect of laser beam impacts on teeth. *The Journal of the American Dental Association*, 70(3), 601-606.

Gribbin, J. R. (2000). Q is For Quantum: an Encyclopedia of Particle Physics. New York, Touchstone.

Haytac, M. C., & Ozcelik, O. (2006). Evaluation of patient perceptions after frenectomy operations: a comparison of carbon dioxide laser and scalpel techniques. *Journal of Periodontology*, 77(11), 1815-1819.

Hecht, J. (2005). Beam: the race to make the laser. New York, Oxford University Press.

Israel, M., Rossmann, J. A., & Froum, S. J. (1995). Use of the carbon dioxide laser in retarding epithelial migration: a pilot histological human study utilizing case reports. *Journal of Periodontology*, 66(3), 197-204.

Júnior, R. M., Gueiros, L. A., Silva, I. H., de Albuquerque Carvalho, A., & Leão, J. C. (2015). Labial frenectomy with Nd: YAG laser and conventional surgery: a comparative study. *Lasers in Medical Science*, 30(2), 851-856.

Kaya, G. Ş., Yavuz, G. Y., Sümbüllü, M. A., & Dayı, E. (2012). A comparison of diode laser and Er: YAG lasers in the treatment of gingival melanin pigmentation. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, 113(3), 293-299.

Knappe, V., Frank, F., & Rohde, E. (2004). Principles of lasers and biophotonic effects. *Photomedicine and Laser Surgery*, 22(5), 411-417.

Kumara Ajeya, E. G., Avinash, J. L., Rajiv, N. P., & Galgali Sushama, R. (2011). Split mouth gingival depigmentation using blade and diode laser–A case report. *Annals of Dental Research*, 1, 91-5.

Melcer, J., Chaumette, M. T., Melcer, F., Zeboulon, S., Hasson, R., Merard, R., Pinaudeau, Y., & Weill, R. (1985). Preliminary report on the effect of the CO2 laser beam on the dental pulp of the Macaca mulatta primate and the beagle dog. *Journal of Endodontics*, 11(1), 1-5.

Narang, S., Maytreyee, R., Singh, N., Khare, K., & Jain, P. (2015). Clinical application of soft tissue lasers in periodontics. *Journal of Orofacial Research*, 5(3), 94-98.

Naylor, F., Corrêaaranha, A. C., Eduardo, C. D. P., Arana-Chavez, V. E., & Sobral, M. A. P. (2006). Micromorphological analysis of dentinal structure after irradiation with Nd: YAG laser and immersion in acidic beverages. *Photomedicine and Laser Therapy*, 24(6), 745-752.

Neckel, C. P. (1999, May). Vestibuloplasty: a retrospective study on conventional and laser operation techniques. *In Lasers in Dentistry V. International Society for Optics and Photonics*, 3593, 76-81).

Oliveira, G. H., & Muncinelli, E. A. (2012). Efficacy of root surface biomodification in root coverage: a systematic review. *Journal Canadian Dental Association*, 78, c122.

Ozcelik, O., Haytac, M. C., & Seydaoglu, G. (2008). Enamel matrix derivative and low-level laser therapy in the treatment of intra-bony defects: a randomized placebo-controlled clinical trial. *Journal of Clinical Periodontology*, 35(2), 147-156.

Ozcelik, O., Seydaoglu, G., & Haytac, C. M. (2016). Diode laser for harvesting de-epithelialized palatal graft in the treatment of gingival recession defects: a randomized clinical trial. *Journal of Clinical Periodontology*, 43(1), 63-71.

Padma, R., Bhutani, N. (2010). Lasers in Periodontics. *Heal Talk*, 6, 32-38.

Parker, S. (2007). Lasers in dentistry. *London: British Dental Association*, 12-13.

Pick, R. M., & Colvard, M. D. (1993). Current status of lasers in soft tissue dental surgery. *Journal of Periodontology*, 64(7), 589-602.

Pié-Sánchez, J., España-Tost, A. J., Arnabat-Domínguez, J., & Gay-Escoda, C. (2012). Comparative study of upper lip frenectomy with the CO2 laser versus the Er, Cr: YSGG laser. *Medicina Oral, Patologia Oral, Cirugia Bucal*, 17(2), e228.

Ribeiro, F. V., Cavaller, C. P., Casarin, R. C., Casati, M. Z., Cirano, F. R., Dutra-Corrêa, M., & Pimentel, S. P. (2014). Esthetic treatment of gingival hyperpigmentation with Nd: YAG laser or scalpel technique: a 6-month RCT of patient and professional assessment. *Lasers in Medical Science*, 29(2), 537-544.

Sanz, I., Alonso, B., Carasol, M., Herrera, D., & Sanz, M. (2012). Nonsurgical treatment of periodontitis. *Journal of Evidence Based Dental Practice*, 12(3), 76-86.

Sanz-Moliner, J. D., Nart, J., Cohen, R. E., & Ciancio, S. G. (2013). The effect of an 810-nm diode laser on postoperative pain and tissue response after modified Widman flap surgery: a pilot study in humans. *Journal of Periodontology*, 84(2), 152-158.

Schwarz, F., Aoki, A., Sculean, A., & Becker, J. (2009). The impact of laser application on periodontal and peri-implant wound healing. *Periodontology 2000*, 51(1), 79-108.

Sculean, A., Schwarz, F., Berakdar, M., Windisch, P., Arweiler, N. B., & Romanos, G. E. (2004). Healing of intrabony defects following surgical treatment with or without an Er: YAG laser: a pilot study. *Journal of Clinical Periodontology*, 31(8), 604-608.

Trylovich, D. J., Cobb, C. M., Pippin, D. J., Spencer, P., & Killoy, W. J. (1992). The effects of the Nd: YAG laser on in vitro fibroblast attachment to endotoxin-treated root surfaces. *Journal of Periodontology*, 63(7), 626-632.

Türer, Ç. C., Ipek, H., Kirtiloğlu, T., & Açikgöz, G. (2015). Dimensional changes in free gingival grafts: scalpel versus Er: YAG laser—a preliminary study. *Lasers in Medical Science*, 30(2), 543-548.

Visser, H., & Mausberg, R. (1996). Free gingival grafts using a CO2 laser: results of a clinical study. *Journal of Clinical Laser Medicine & Surgery*, 14(2), 85-88.

Wilder-Smith, P., Arrastia, A. M. A., Schell, M. J., Liaw, L. H., Grill, G., & Berns, M. W. (1995). Effect of ND: YAG laser irradiation and root planing on the root surface: structural and thermal effects. *Journal of Periodontology*, 66(12), 1032-1039.

Yamamoto, H., & Sato, K. (1980). Prevention of dental caries by acousto-optically Q-switched Nd: YAG laser irradiation. *Journal of Dental Research*, 59(2), 137-137.

Yoshida, K. (2010). Efficacy of Laser treatment for lingual frenectomy. *Laser Therapy*, 19(3), 170-172.

Yung, F. (2009). The Use of an Er: YAG laser in periodontal surgery: clinical Cases with Long-Term Follow-Up. *Journal of Laser Dentistry*, 17(1), 13-20.