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LASERS IN IMPLANTOLOGY

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ABSTRACT The term "LASER" stands for "light amplification by stimulated emission of radiation". Which generate precise beam of light concentrated with energy. In this article we review that Lasers provides promising solutions in the treatment of dental implants and in the treatment of soft and hard tissue conditions. This article provides data that clear when, where, and what armamentarium to use in any given situation. Not all dental laser wavelengths are necessarily useful in every dental implant situation. Like prior to implant placement Er, Cr: YSGG laser can effectively and safely interact with soft tissue to remove granulation tissue and, in addition, can disinfect the extraction socket without fear of damage to bone and After Implant Placement low levels of laser therapeutical energy (LLLT) 655 to 810 nm range used for bio-stimulation (wound healing) bio-inhibition (pain decrease).

KEYWORDS : LASER, Er,Cr:YSGG, LLLT, Diode laser, 970 nm, implantology, surgery, vestibuloplasty, peri-implantitis, exposure of implants, haemostasis

Introduction

Now a days large number of endo-osseous implants are placed and require high survival rate. There are several clinical indication for Lasers in modern implant dentistry in improving the pre-surgical, surgical, post-surgical, and prosthetic phases of modern implant dentistry. The part of lasers in implantology was explored by Romanos et al[1], and they concluded that soft-tissue lasers could be of benefit in implant dentistry.[2] Light is emitted via laser primarily through stimulated emission. It may get transmitted, reflected, scattered, or absorbed on reaching the surrounding tissues. This light along with its antibacterial abilities may be absorbed by implants and surrounding tissues. The advantage of using lasers in implant dentistry includes haemostasis, decreased swelling, minimal damage to soft tissues, diminished infection, and reduced pain postoperatively. The role of lasers for implantology categorize according to *timing* or *stage* of the procedure. Effective use of laser energy can be beneficial at all stages of implantology, from prior to implant placement where lasers can be used to remove bacteria and granulation tissue, to during the procedure for flap incision, decortication, and ablation of excess soft tissue or bone. After-implant placement lasers can be beneficial for uncovering and soft-tissue re-contouring during the prosthetic phase. Finally, lasers are gaining an exciting and important role in the growing issue of peri-implantitis and mucositis during the healing phase.

LASER In Implant Dentistry					
Prior to implant placement	During implant placement	After implant placement	Uncovery	During Prosthetics	After Prosthetics
Disinfection of extraction socket	Flap incision	Low level laser therapy	'Man hole vs trap door' uncovery	Soft tissue peri-implant recovery	Treatment of peri-implantitis.
Degranulation of extraction socket	Lesor assisted osteotomy	Leveling of bone around fracture			Photodyna-mic therapy
Lateral Window for sinus lift	Decortications for bone grafting				

Laser Usage Prior to Implant Placement

With all other predisposing factors addressed, the fundamental key to success in implant placement is the apposition of normal healing bone onto the implant surface. there for after extraction of tooth surgical site with retained granulation tissue, after epithelium is removed with the Er,Cr:YSGG laser around the socket, and the socket is disinfected with the radially firing tips. Kusek[3] showed that the use of an erbium laser, through photoacoustic streaming, could reduce the bacteria in osteotomy sites that were infected by apical pathology.

With the use of the BIOLSE iPlus (Er,Cr:YSGG wavelength), the laser can effectively and safely interact with soft tissue to remove granulation tissue and, in addition, can disinfect the extraction socket without fear of damage to bone prior to socket preservation procedures . The effective use of radially firing tips where 85% of the energy fires laterally, combined with the microexplosive cavitation caused by rapid expansion of water particles when the laser wavelength interacts with water, allow for tremendous disinfection and cleaning of the infected extraction socket for prior to the socket grafting procedure.

All lasers are antibacterial in nature and can be used to varying degrees to disinfect a site. [4-5] Some soft-tissue lasers like diode lasers should be used with caution so as not to heat up the bone, but when used judiciously (power of one W or less continuous wave [CW], uninitiated tip), they can help disinfect a site prior to grafting. The preparation of the osteotomy site demands a technique whereby the local temperature does not exceed 47°C. The free-running pulsed emission mode can give rise to peak power values per pulse of >1,000 Watts. Research into the use of this laser as an adjunctive to implantology, drew conclusions that the penetrating and high peak heat energy effects produced during soft tissue and peri-implant treatment, caused damage to both the implant surface and surrounding bone.

Laser Usage During Implant Fixture Placement

Laser usage can be beneficial during the actual implant placement for creation of the flap incision, for the actual creation of the osteotomy, and for decortication for guided bone regeneration (GBR), amongst other items. The lasers offer great haemostasis compared to surgical blades, but do cut a larger incision in width due to their larger tip diameter. The lasers offer great haemostasis compared to surgical blades, but do cut a larger incision in width due to their larger tip diameter The wavelengths used vary in their depth of penetration into the tissue with some soft-tissue lasers such as diode lasers or Nd:YAG lasers penetrating further compared to CO_2 lasers. Also lateral thermal damage for lasers is much smaller than for electrosurgery units.

Wavelengths that offer water as a cooling mechanism to the photothermal ablation (erbium lasers and the new CO_2 9,300 nm wavelength) may allow for a decrease in unwanted thermal effects due to a low inflammatory response with minimal resulting damage to surrounding tissue.

One benefit of using the water-cooled erbium lasers is that the fine mist of air and water that is created helps keep the visual field clean and with very little bleeding when compared to a blade.

The speed of erbium laser is slow compared to a bur, the depth of penetration of the laser energy into surrounding tissues may be minimal, but the inability of the laser to selectively cut only bone can be an issue But the greatest benefit for using erbium lasers might be during the initial osteotomy guide hole, where burs might "slip" or "bounce" off irregular or sloped bony surfaces often seen during immediate implant procedures after extractions.

GBR used to create adequate bone for an area if it is deficient in either horizontal[6] or vertical[44] directions.

Four basic tenets must be followed for the creation of new bone:
1. Primary closure of the wound to promote undisturbed and uninterrupted healing 2.Angiogenesis to provide necessary blood supply and undifferentiated mesenchymal cells 3.space creation and maintenance to facilitate space for bone in-growth and, 4. The stability of the wound to induce blood clot formation, allowing uneventful healing.

Kesler et al[15] showed that the Er:YAG laser created higher levels of platelet-derived growth factor compared to a bur, and they proposed therefore that laser irradiation would likely enhance and improve the early healing of bone grafted areas when used for decortication. And wavelengths (2,780 and 2,940nm) are wonderful for GBR.

Laser Usage After Implant Fixture Placement

After the implant fixture has been placed, minor alterations in hard tissue and soft tissue may be needed. Erbium lasers, again due to their ability to precisely and safely remove bone and to trim soft tissue around healing abutments.

The value of low levels of laser therapeutical energy (LLLT) has gained greater awareness in the last decade and "cold" or "soft" lasers is in the 655 to 810 nm range used for bio-stimulation (wound healing) bio-inhibition (pain decrease) mostly diode lasers in the 810 nm range can be used at low energies (0.1 to 0.5 W CW) it also called laser phototherapy. The mechanism of action for low levels of near-infrared laser energy to have either a bio-stimulatory or bio-inhibitory effect lies in the energy being absorbed by cell mitochondria, which in turn produces a reactive oxygen species and releases nitric oxide in the cell. There is a corresponding increase in the release of ATP within the cell, and this leads to gene transcription that in turn causes the release of growth factors, cell proliferation, and cell motility with an increase in extracellular matrix. The result is that wound healing is improved through tissue repair, inflammation and oedema are reduced, providing pain relief. LLLT enhanced peri-implant bone repair, improving stability, BIC, and new bone formation when used every 48 hours for 2 weeks. LLLT provided clinical effects on injured nerves that revealed an increase in nerve function and improved capacity for myelin production.

LASER USAGE DURING IMPLANT UNCOVERY

If initial primary stability of implant is low, or less than 2 mm of soft tissue exists above the bony crest, or if bone grafting is done at the time of surgical placement of implant then 2-stage surgical approach require Wil cox et al[8] showed that monopolar electro surgery units could provide quickly localized heat effects above the critical 10°C range that could potentially damage the osseointegration of implants in bone. They suggested that monopolar electro surgery units not be used around implants.[8]

In contrast, studies show diode lasers, when used with lower settings, can be used safely around dental implants.10-12 Yeh et al [11] have shown that when diodes were used at settings of 0.5 to 1.0 W Continuous Wave that they could be used to uncover fixtures. Romanos et al showed that caution must be used with diode lasers, as heat build up can occur rapidly within 15 to 20 seconds, so the authors suggest stopping every 15 seconds or so and using water on the surgical site and a high-volume suction to control heat build up in the surgical site when using diode lasers to uncover fixtures.

In anterior region keratinise mucosa is less so Arnabat-Domín-guez et al,[14] in 2010, demonstrated a technique of using the Er,Cr:YSGG wavelength (BIOLASE) to uncover implants with a buccal roll technique to aid with augmenting tissue in situations where there was insufficient gingival attachment.

LASER USAGE DURING FINAL RESTORATIONS

Soft tissue can be a significant barrier to the ideal seating of final implant restorations. Soft tissue can impede the full complete seating of both screw-retained restorations. Soft tissue is easily removed with many lasers including diode lasers, CO_2 lasers, and the all-tissue erbium lasers. Since soft-tissue lasers are better absorbed by haemoglobin, they tend to be better from a haemostasis standpoint, but they do ablate through a photo-thermal effect without water, and this can lead to increased thermal damage if conservative settings are not utilized.[15]

All lasers can be used to modify soft tissue around both fixtures and abutments. Jin et al[10] showed that the Er,Cr:YSGG was superior to the diode laser in soft-tissue surgery when it came to thermal damage, and Ryu et al[17] demonstrated that the Er,Cr:YSGG laser has many advantages for oral surgery due to a low inflammatory response and minimal damage of the tissue compared to CO_2 lasers.

LASER USAGE AFTER IMPLANT PLACEMENT

There are still cases where inflammation in the peri-implant soft tissue (mucositis) or bone (peri-implantitis) causes significant problems such as persistent pain, bleeding, infection, bone loss, and (if left untreated) implant failure. Atieh et al[12] looked at the frequency of peri-implant diseases and found that the frequency of peri-implant mucositis was in 63.4% of participants and 30.7% of implants. The more serious disease of peri-implantitis was found in 18.8% of participants and 9.6% of implants. Etiological factors for peri-implantitis include poor oral hygiene, occlusal overload, lack of attached keratinized soft tissue, smoking, sub gingival cement, systemic factors (diabetes), and poor implant placement.[19,20]

Classification	Clinical Parameters	Treatment
Early	5 mm or less PD+ < 2 mm bone loss	Nonsurgical + Antibiotics
Moderate	6 to 7 mm PD, > 2 mm bone loss	, Surgical Flap + DD +/- GBR +/- CTG
Advanced	> 8 PD + > 50% bone loss	Implant Explanation + GBR

KEY: PD = probing depths, DD = degranulation and detoxification,
GBR = guided bone regeneration, CTG = connective tissue grafting

Yamamoto and Tanabe[13] have demonstrated that the erbium family of lasers is able to completely remove the contaminated titanium oxide layer (Ti-Unite) when optimal settings are used (100 mJ/mm2 + 20 Hz with water spray). In addition, there was a minimal 3°C rise in temperature with laser irradiation, and that the potential in beagle dogs existed for re-osseointegration to occur on the laser surfaces after 6 weeks was shown histologically. In a follow-up to this study, Nevins et al[14] demonstrated with animal research (foxhounds) that the Er:YAG laser (2,940 nm) could strip away the contaminated titanium oxide layer in artificially induced peri-implant lesions and that both hard- and soft-tissue inflammation progression was arrested.

Conclusion

Conclusion of literature is lasers have promising results in implant dentistry. With proper knowledge of basic laser physics, its properties, and its tissue interactions, appropriate wavelengths should know for its best outcome in implant dentistry.

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