Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/7426
DOI URL: http://dx.doi.org/10.21474/IJAR01/7426
ISSN NO. 2320-5407

RESEARCH ARTICLE

ERBIUM LASERS IN PERI IMPLANTITIS – A REVIEW.

Dr. Rohit Raghavan, Dr. Shajahan P A and Dr. Ratheesh N.

1. Professor & Head, Dept of Prosthodontics, Royal Dental College.
2. Professor, Dept of Prosthodontics, Royal Dental College.
3. Post Graduate Student, Dept of Prosthodontics, Royal Dental College.

Manuscript Info

Manuscript History

Received: 16 May 2018
Final Accepted: 18 June 2018
Published: July 2018

Abstract

Peri-implantitis represents an inflammatory disease of hard and soft tissues gaining significance with the advent of implant dentistry. Conventional periodontal therapy can be augmented by use of cutting edge advances in laser dentistry. This article sheds light on the use of Erbium lasers in the management of peri implantitis.

Introduction:-

Dental implants are a well-established and reliable option for the treatment of complete and partial edentulism and has been associated with high survival rates both in immaculate and augmented/regenerated bone. Unforeseen complications in implant therapy can create uncomfortable and possibly irreversible conditions for patients. Peri-implant inflammations after dental implant treatment poses a serious threat affecting both the surrounding hard and soft tissue. In analogy to gingivitis and periodontitis affecting the periodontium of natural teeth, an inflammation and destruction of soft tissues is termed as mucositis and hard tissues surrounding dental implants is termed peri-implantitis, transitions are often fluent and not clinically separable.

Infra-bony defects consistent in appearance with peri-implantitis

Etiology:-

The epithelium and the interface between the dentogingival unit differ from the interface of the supra-alveolar connective tissue and the titanium surface of an implant. The outer surface of the peri-implant mucosa is lined by a stratified keratinized oral epithelium that is continuous with a junctional epithelium attached to the implant surface by a basal lamina and by hemidesmosomes. The 2 mm long non keratinized junctional epithelium is only a few cells

Corresponding Author:-Ratheesh N.
Address:-Dept of Prosthodontics, Royal Dental College, Challisery, Palakkad, Kerala.

thick in the apical portion and separated from the alveolar bone by 1 to 2 mm of collagen rich connective tissue. This 3 to 4 mm "biological barrier" protects the zone of osseointegration from byproducts released from plaque and the oral cavity.

The chief predisposing factor in the etiology of peri-implantitis is microbial colonization. Subgingival microbes (such as Aggregatibacter actinomycetemcomitans, Prevotella intermedia, Porphyromonas gingivalis, and Treponema denticola) associated with the etiology of periodontitis are akin to those of peri-implantitis. In contrast to periodontitis, peri-implantitis lesions harbor some bacteria that are not part of the typical periodontopathic microbiota.

In particular, Staphylococcus aureus plays a predominant role for the development of a peri-implantitis and shows a high affinity to titanium surfaces. In addition, it also has been reported that patterns of plaque formation and accumulation on implant surfaces are comparable to those seen on teeth.

Pathogenesis:-

The pathogenesis of peri-implantitis is similar to that of periodontitis. Microbes in plaque stagnated on implant surfaces release chemotactic peptides that attract neutrophils toward the peri-implant pockets. Moreover, cytokines are released into the peri-implant crevicular fluid as a result of microbial damage to epithelial cells, which attract more leukocytes (predominantly neutrophils) toward the affected site. If neutrophils become overloaded with microbes, they degranulate and the toxic enzymes released from neutrophils cause tissue damage and gingival inflammation.

If the inflammation persists, it may progress to marginal gingiva and ultimately cause bone loss, a classical feature of peri-implantitis. Stromal cells (such as granulation tissue fibroblasts) also may participate in the pathogenesis of peri-implantitis by upregulating vascularity and matrix breakdown, thereby promoting migration/maintenance of infiltrates (proinflammatory cytokines) into the inflamed site.

Risk Factors:-

Risk factors of peri-implant mucositis and peri-implantitis are comparable to those of gingivitis and periodontitis. The following risk factors have been associated with the etiology of peri-implant diseases.

1. Poor Plaque Control
2. Previous History of Periodontal Disease.
3. Stagnation of Residual Material in/Around the Gingivae Following Implant Prosthesis Cementation
4. Occlusal Overloading
5. Implant/Abutment design
6. Habitual Tobacco Smoking
7. Diabetes
8. Genetic Factors

Laser Therapy:-

The use of laser technology in dentistry has grown since its introduction in the 1960s. Lasers are now a commonplace in most dental practices and used as an adjunctive treatment as well as for stand-alone procedures in dentistry.

Laser — an acronym for light amplification by stimulated emission of radiation — is used in a medical device capable of delivering energy to a target. When the laser energy reaches human tissue, it selectively interacts with components of human tissue and kills microbes based on wavelength, power and exposure time.

TYPES OF ERBIUM LASERS	Wavelength	Chromophore	Classification
Erbium: Yttrium Aluminum Garnet or Er:YAG	2940nm	Water, Hydroxyapatite	Cold; Hard or All Tissue
Erbium, Chromium:Yttrium-Scandium Gallium-Garnet or Er,Cr:YSGG	2780nm	Water, Hydroxyapatite	Cold; Hard or All Tissue

WATERLASE EXPRESS™ Er,Cr:YSGG laser
Biolase™ Inc. USA

LiteTouch™ Er:YAG laser
AMD LASERS Inc. USA

Because lasers use unidirectional light beams, it should be assumed that they gain better access to all surfaces of the implant, compared with manual curettes or ultrasonic tips, which could not reach all parts of screw type implants. In addition, Erbium lasers laser beams used with the recommended energy range do not cause major detrimental alterations of the implant surface compared to diode lasers.

Erbium lasers are available in two wavelengths: 2780 nm (erbium, chromium:yttrium-scandiumgallium-garnet or Er,Cr:YSGG), and 2940 nm (erbium: yttrium aluminum garnet or Er:YAG). Both have solid crystal mediums. These lasers are primarily absorbed in water, and can work both as both hard tissue and soft tissue lasers (but with reduced hemostatic ability relative to diode and CO2 lasers). The penetration is shallow due to the high absorption in water. Energy is delivered in a pulsed mode via a flexible fiber, usually with a handpiece.

The research has shown that these wavelengths are effective in both flap and flapless surgical protocols for the treatment of periodontitis and peri-implantitis. Many preclinical and clinical studies have reported the possibility of using the Erbium lasers for debridement/decontamination of implant surface.

Treatment Protocol:-

One of protocols for Er,Cr:YSGG laser treatment consists of three phases: pre-surgical, surgical and post-surgical.

Phase I treatment is implemented for removal of supra- and subgingival biofilm and calculus through scaling and root planning and the initiation and evaluation of oral hygiene compliance. Remove the crown and abutment, when possible, and a healing cap should be placed on the affected implant body. This allows for vertical laser tip access to the implant. Flap reflection may be necessary for complete access to threads in moderate to severe cases.

Phase II surgical treatment plan is developed based on the re-evaluation of periodontal inflammation and oral hygiene compliance. The surgical plan can be for a single implant or multiple sites.

1. OUTER POCKET DE-EPITHELIALIZATION: Outer pocket gingival epithelium is removed from the free gingival margin down to a width at least equal to the pocket depth.
2. GINGIVECTOMY (IF NEEDED): A gingivectomy should only be performed if pseudo-pocketing is present. Adequate attached gingivae should not be compromised.
3. SULCULAR DEBRIDEMENT / DEGRANULATION: The epithelium should be removed and should be completed apically, from the free gingival margin down to the osseous level. All granulation tissue is removed. Gingival margin can be retracted as a mini-flap for access.
4. DEBRIDEMENT OF IMPLANT: Conventional treatment with implant-safe ultrasonic tips to osseous levels. Upon completion, a radial firing tip is placed circumferentially beginning at the coronal surface of the first thread exposed and moved apically.

5. BONE DECORTICATION: Re-contour osseous defects and stimulate bone regeneration. Tip is held parallel to implant surface and gently tap all the way down to and into bone, retracting slightly and repeating all the way around the implant. If necessary, angle of laser tip is changed to treat into the walls of infrabony defects.
6. SULCULAR DEBRIDEMENT: Residual debris is removed and blood coagulation is induced.
7. COMPRESS WITH GAUZE: Compress surgical site with wet 2x2 gauze for 3-5 minutes.

Phase III:-Post-Surgical Phase

1. **Immediate Post-Operative:-**Brush teeth lightly with soft brush and use mouth rinse to supplement brushing if discomfort exists.
2. **One Week After Laser Treatment:-**Gently clean between teeth using an interproximal brush dipped in mouthwash.
3. NO PROBING for at least 3 months, at which time a supragingival scaling is completed.

Literature Review: -

Erbium lasers can be safely used on root surfaces and implants if strict protocols are followed. They can remove calculus and granulation tissue and detoxify titanium. The penetration is shallow and the absorption in water reduces any thermal damage or heating. The 2940 nm erbium laser is absorbed three times better in water than the 2780 nm version, yet there is only a slight difference in absorption in water between the two erbium wavelengths in high-fluence, hard tissue ablative procedures.

In a prospective preclinical study investigating the use of the Er:YAG laser to decontaminate the surface of a compromised dental implant with a rough surface done on foxhounds, Histomorphometric analysis revealed the capability of the Er:YAG laser to decontaminate the implant surface by removing the contaminated oxide layer to provide a fresh surface for regeneration. It has also been demonstrated that there is a minimal rise in temperature and, therefore, no visible damage to adjoining bone. The use of the Er:YAG laser for implant surface treatment allowed for regeneration and improved Bone Implant Contact in this preclinical study. New Bone Implant Contact and arrest of the inflammatory process in the soft tissues were observed.

Alterations in implant surface characteristics have been reported when using lasers with energies exceeding 140–180 mJ/pulse. However, the Er:YAG laser has been shown to be safe for use on implant surfaces when used at 100 mJ/pulse and 10 pulses/s for 60 s.

In a pilot study done in patients with advanced peri implantitis to compare the effectiveness of an Er:YAG laser to that of mechanical debridement using plastic curettes and antiseptic therapy, it was concluded that at 6 months following treatment both therapies led to significant improvements of the investigated clinical parameters like Plaque index, bleeding on probing, probing depth, gingival recession and clinical attachment level. They also concluded that Er:YAG lasers resulted in a statistically significant higher reduction of bleeding on probing than mechanical debridement

Regenerative osseous surgery was performed using an Er,Cr:YSGG laser at different settings to open the flap, remove the granulation tissues, decorticate the bone, and clean the implant surface. This exploratory study enabled regenerative osseous surgery around an implant with no complications and high patient and clinician satisfaction and confidence.

Er:YAG laser on 42 patients with 100 implant of which 30 were rough surface and 70 smooth surface. 100 mj/Pulse of 10 HZ (12.7J/cm2) were administered. Air abrasion or Laser irradiation were compared and over a period of 6 months 42.4 % reduction in bleeding on probing was observed, but was not significant. 0.9±0.8mm reduction in probing depth was observed which was also not significant Although there were some bactericidal effects in Laser group, at 6 months, there was no bacterial reduction.

Significant Bleeding on probing reduction was observed in a study covering around 100 implants over a 6 month period using Er:YAG lasers at 100mJ and 10 hz but the pocket probing depth reduction was not significant.

Conclusion:-

Erbium lasers have been around for the past four decades but its accessibility to dentists was bolstered in the past decade or so with the advent of cheaper equipment and better patient and operator acceptance. In a world where minimally invasive procedures are all the rage, a closed flap approach inflicting minimal trauma is surely a blessing. Evidence for the efficacy of erbium lasers in periodontal diseases is well documented and its application in peri implantitis is the next logical step. Literature suggests the use of lasers as an adjuvant to conventional treatment protocol rather than a standalone option nevertheless the therapy is more predictable and inspires confidence in doctors and patients.

References:-

1. Peri-implant mucositis and peri-implantitis. A current understanding of their diagnosis and clinical implications. J Periodontol 2013;84:436–443.
2. Lambert F E, Weber H P, Susarla S M, Belser U C, Gallucci G O. Descriptive analysis of implant and prosthodontic survival rates with fixed implant-supported rehabilitations in the edentulous maxilla. J Periodontol 2009; 80: 1220–1230.
3. Mombelli A, Van Oosten MA, Schurch E Jr. Et al. The microbiota associated with successful or failing osseointegrated titanium implants. Oral MicrobiolImmunol 1987;2;145-151.
4. Sussman HI, Moss SS. Localized osteomyelitis secondary to endodontic-implant pathosis. A case report. J Periodontol 1993: 4: 306–310.
5. Figure 4, Norton M. Dental implants: Potential relationship with cancer. British Dental Journal. 2017;222(4):224-224.
6. https://www.biolase.com/products/dental-lasers-all-tissue/waterlase-express/
7. http://www.amdlasers.com/?pages=litetouch#indications
8. https://www.biolase.com/Documents/REPaiR_brochure_FINAL_112114.pdf
9. Clementini M, Morlupi A, Canullo L, Agrestini C, Barlattani A. Success rate of dental implants inserted in horizontal and vertical guided bone regenerated areas: a systematic review. Int J Oral Maxillofac Surg 2012; 41: 847–852.
10. Retzepi M, Donos N. Guided Bone Regeneration: biological principle and therapeutic applications. Clin Oral Impl Res 2010; 21: 567–576.
11. Lin S, Liu Q, Peng Q, Lin M, Zhan Z, Zhang Z. Ablation threshold of Er:YAG and Er,Cr:YSGG laser in dental dentin, Scientific Research and Essays, 2010, Vol. 5(16): 2128-2135.
12. Schwarz, F., Sculean, A., Rothamel, D., Schwenzer, K., Georg, T. and Becker, J. (2005), Clinical evaluation of an Er:YAG laser for nonsurgical treatment of peri-implantitis: a pilot study. Clinical Oral Implants Research, 16: 44–52. doi:10.1111/j.1600-0501.2004.01051.x
13. Er,Cr:YSGG Laser-Assisted Surgical Treatment of Peri-Implantitis With 1-Year Reentry and 18-Month Follow-Up Manal M. Azzeh Journal of Periodontology 2008 79:10, 2000-2005
14. Gutknecht N, Van Betteray C, Ozturan S, Vanweersch L, Franzen R. Laser Supported Reduction of Specific Microorganisms in the Periodontal Pocket with the Aid of an Er,Cr:YSGG Laser: A Pilot Study. 2015.
15. Badran Z, Bories C, Struillou X, Saffarzadeh A, Verner C, Soueidan A. Er: YAG laser in the clinical management of severe peri-implantitis: a case report. Journal of Oral Implantology. 2011;37(sp1):212-7.
16. Persson GR, Roos-Jansåker A-M, Lindahl C, Renvert S. Microbiologic results after non-surgical erbium-doped: yttrium, aluminum, and garnet laser or air-abrasive treatment of peri-implantitis: a randomized clinical trial. Journal of periodontology. 2011;82(9):1267-78.
17. Renvert S, Lindahl C, Roos Jansåker AM, Persson GR. Treatment of peri-implantitis using an Er: YAG laser or an air-abrasive device: a randomized clinical trial. Journal of clinical periodontology. 2011;38(1):65-73.
18. Schwarz F, John G, Mainusch S, Sahm N, Becker J. Combined surgical therapy of peri-implantitis evaluating two methods of surface debridement and decontamination. A two-year clinical follow up report. Journal of clinical periodontology. 2012;39(8):789-97.
19. Schwarz F, Nuesry E, Bieling K, Herten M, Becker J. Influence of an erbium, chromium-doped yttrium, scandium, gallium, and garnet (Er, Cr: YSGG) laser on the reestablishment of the biocompatibility of contaminated titanium implant surfaces. Journal of periodontology. 2006;77(11):1820-7.
20. Nevins, M., Nevins, M., Yamamoto, A., Yoshino, T., Ono, Y., Wang, C. and Kim, D. (2014). Use of Er:YAG Laser to Decontaminate Infected Dental Implant Surface in Preparation for Reestablishment of Bone-to-Implant Contact. International Journal of Periodontics & Restorative Dentistry, 34(4), pp.461-466.