Indian Journal of Dental Sciences.
October 2014 Supplementary Issue
Issue:4, Vol.:6

www.ijds.in

Review Article

Indian Journal
of Dental Sciences

E ISSN NO. 2231-2293 P ISSN NO. 0976-4003

Applications Of Laser In Endodontics And Periodontics - A Review

[1] Viniti Goel
[2] Harmandeep Singh Bedi
[3] Arvind Arora
[4] Kulwinder Kaur

[1] Assistant Professor, Dept. Of Periodontics & Implantology Luxmi Bai Institute Of Dental Sciences & Hospital, Patiala
[2] Professor And Head, Dept. Of Conservative & Endodontics Bjs Dental College, Ludhiana
[3] Proff And Head, Department Of Conservative & Endodontics Bhojia Dental College & Hospital, Nalagarh, HP
[4] Bds Lecturer ,Department Of Conservative And Endodontics Luxmi Bai Institute Of Dental Sciences & Hospital, Patiala

Address For Correspondence:
Dr. Harmandeep Singh Bedi
1489, Phase 1, Urban Estate, Dugri,
Ludhiana. Punjab.141001
EmailID : harmanbedi8874@gmail.com
MobileNo : +919815284273

Submission : 19th April 2013
Accepted : 1st May 2014

Quick Response Code

Abstract
Calcium hydroxide, aids NaOCI in dissolving organic debris, neutralises endotoxins, and further reduces the bacterial count; it is widely accepted as an intracanal dressing. However despite meticulous chemo mechanical cleaning, the entire root canal system cannot be rendered bacteria-free. The laser light is thought to be able to reach areas that are inaccessible to the traditional techniques. The use of lasers in physical disinfection of the rootcanal, alongsideof chemical disinfection also in initial periodontal therapy,surgery and in salvaging Implants opens up a wide range of lasers applications in Endodontics and Periodontics.

Key Words
Disinfection, Endodontics, Laser, Root Canal, Soft Tissue Lasers, Periodontology

Introduction

Traditionally, disinfection of root canal system is accomplished bychemomechanical cleaning. Most of microbes remaining in complexcanal system are inaccessible toconventional instrumentation.Thus, persistant microorganismhave been shown to be a cause of treatment failure. Additionaldisinfection measures arenecessary in order to eliminate & neutralize these microorganismsand their toxins.

Laser (Light amplification by stimulated emissionofradiation) has been examined as adjunct to current disinfectionmethod. The laser light is though able to reach inaccessible area of root canal; numerous studies have documented that CO2, ND-YAG,Argon, Eu, Cu. YAG & Er. YAGlaser irradiation has the ability to remove debris and smear layer. However, there are several limitations as laser beam travels in a straight line. So, microbes located in complex non geometricroot canal system andalso those in dentinal tubules are inaccessible.

Similarly the pathogenesis of periodontal disease and methods of treating it has changed radically over the past 30 years. There is a lot of host inflammatory response and host risk factor which contribute to the periodontal disease: however in such situations soft tissue lasers have proven to be a good choice for bacterial load reduction and coagulation in the periodontally involved sulcus having bacteria like P gingivalis and Aggregatibacteractinomycetemcomitans along with reduction of interleukins and pocket depths.

In short there are still concerns associated with theiruse mainly; lack of sufficient well designed clinical studies clearly demonstrates advantages of lasers over conventional methods.

Review Of Literature

The laser wavelength described for cleaning of root dentine are CO2, 9600 to 10,600 nm; Er ; YAG, 2949 nm ; Er, Cu : VSGG, 2790 nm,; Nd YAG, 1069 mm; Diode, 635 to 980nm & KTP, 532 nm. Matsumo et al[1] emphasized the possible limitations of the use of lasers in the root canal system. They suggested that" removal of smear layer and debris by laser is possible, however it is difficult to clean all root canal walls,because the laser beam is emittedstraight ahead, making it almost impossible to irradiate the lateral canal walls." They strongly recommended improving theendodontic tip to enable irradiate all areas of root canal walls.

Nd:YAG

Nd: YAG is the wavelength that has been most widely investigated in endodontics. Buregman et al; tried to define the role of laser as a disinfection tool by using Nd:YAGlaser irradiation on endodontic pathogens ex-view. They concluded that Nd:YAG laser irradiation is not an alternative but a possible supplement to existing protocols forcanal disinfections, as the properties of laser light may allow a bactericidal effect beyond 1mm of dentin. Endodontic pathogens that grow as biofilms are difficult to eradicate even upon direct laser exposure.

Klinke et al[2] the first to use the Nd:YAG to irradiate dentine samples of various thickness,infected with streptococus mutans.The maximal reduction was 95.7% & this number decreased with increasing dentine thickness. At1000 um, the mean reduction stillwas 84.8%. However considerablevariation in the resultwassupported.

Folwacgny et al. suggested that using laser in rootcanal walls leads to reduction in the number of opened tubules, promoting a decrease of apical permeability.This reduction in permeability of the dentine wall can ensure that therootcanal filling seals more effectively[3],[4],[5].

Hardee&colleagues[6] treated root canals of extracted teeth with the Nd:YAG .laser at an output power of 3W for 1-2 min (180 Or 360 J). They achieved a log 2 reduction of their test organismBacillus

stearoother, mophillus.However they reported that the tooth becametoo hot to touch.

Eu-YAG &Er, Cu: YSGG Lasers

Comparison of the Nd:YAGdevice to an erbium : Yttrium aluminum garnet (Er:YAG) laser (wide2.94 um wavelength) showed that the former had lessened radiculardentin permeability with various irrigation regimens.[7] The Er:YAGlaser has gained increasingpopularity among clinicians following its approval by the USfood and Drug administration for use on dental hard tissues.[8]

Schoopet al[9] usedtheinfected tooth model and reported adecisive bactericidal effect of theEr:YAG laser on all the investigated species. This effect was dependenton the applied output power andspecific for the different species ofbacteria.Themaximum temperature rise at the root surface was 4.50C.

Schoop et al[10] used infecteddentine species to investigate the action of Er:YAGvthrough 1 mm of dentine. They observed 4 log reduction for E. coli & a 2-4 log reduction for E faecalis.

Schoopet al.[10],[11] came toconclusion that Er, Cu: YSGG lasercould be suitable for disinfection ofeven deeper layers of dentine.

Co2

CO2 has gained wide acceptance in the field of dental surgery because of its ability to cut without bleeding, vapourise& coagulate tissue to decrease postoperative discomfort.

Zakarisasen et al[12] found that the CO2 laser light was limited in its effectivenesss for canal sterilization as this type of laser required direct visualization of the internal canal surface for complete exposure.

DIODE

Due to the compactness and low cost of diode laser, it has gainedincreasing importance. However use of diode lasers in endodonticshas only recently being proposed tothere are few data so far.[13] The penetration depth of diode laser which is lower in the case endodontics that that of the Nd:YAG laser, also reduces therisk of unwanted temperature rise[14],[15]. Kreisler et al[16], in this respect, found that the combinationofrinsing with NaOCl/H2O2 and diodebacterial irradiation resulted ina higher bacterial reduction compared in therinsing alone. The diode laser may close the dentinal tubules and, in thepresence of smear layer, this effectis more pronounced.[15],[16],[17].

KTP

KTP laser has been investigated for disinfection purposesin endodontic only in one study[11] Potassiumtitanyl phosphate (KTP, 532 nm) laser irradiation is able to removethe smear layer &debris from root canal systems.[18],[19].

Effect of Nd YAG Laser on smearlayer

A study was done on effect of Nd YAGLaser to evaluate the efficacy of NdYAG laser to remove debris &smear layer on the instrumentedroot canal walls in vitro.The result suggest that Nd YAGlaser is useful to remove debris andsmear layer and causes melting ofinternal structures on the instrumented root canal walls, at the parameters of 2 watt & 20 pps.[20].

Another comparative studyabout the removal of smear laser by three types of laser, Argon, Nd YAG &Er. YAG toremove the smear layer from the prepared root canal walls invitro was done. The results of the study show that argon laser and Nd-YAG laser are useful to remove the smear layer and that Er YAG laser irradiation is most effective to remove thesmear layer on root canalwalls.[21].

Xiager Wang and Yichao Sun, did a study on 66 extracted human single rooted teeth to investigate the rise intemperature in root surface during laser irradiations and to observe morphological changesof theroot canal wall.

The study indicated that the diode laser is useful in removing smear layer and debris from the root canal wall and reducing apical leakage after obturation in vitro

Er

YAG laser was comparedwith a CO2laser for ability to remove the smear layer[22]. TheEr;YAG laser was found to be the most effective at removing smearlayer. A study modification of rootcanal dentine found by varying the electro magnetic wave length, Er:YAG energy induced differentmedication to the root canalsurface, which may have some utility in preperation procedure.[23]

Applications of lasers in periodontal treatment

Lasers can be used for initial periodontal therapy and surgical procedures. This usage becomes more complicated because the periodontium consists of both hard and soft tissues. Among the many lasers available, high power lasers such as CO2, ND: YAG and diode lasers can be used in periodontics because of their excellent soft tissue ablation and hemostatic characteristics. However when they are applied to the root surface or alveolar bone , carbonization and thermal damage have been reported.[24] Therefore the use of these lasers is limited to gingivectomy, gingivoplasty, deepithelisation of reflected periodontal flaps, removal of granulation tissue, second stage exposure of dental implants, coagulation of free gingival graft donor sites,gingival depigmentation.[25]

1) Initial Periodontal Therapy

Scaling and root planing

Initial Periodontal therapy now includes nonsurgical debridement of tooth surface, host modulators , reduction in sulcular bacteria and localised antimicrobials in and around the periodontium. In this context , soft tissue lasers ate good choice for bacterial reduction and coagulation.[26] Since these lasers such as argon ,diode and ND:YAG , are well absorbed by both melanin and hemoglobin as well as other chemophores, they are an excellant choice to use in periodontally involved sulcus that has dark inflamed tissue and pigmented bacteria[27]. The Erbium family of lasers demonstrated significant bactericidal activity on both Porphyromonas gingivalis and Actinobacillus Actinomy cetamcomitans, considered to be the primary components of bacterial infection[28]. Lasers also have the potential to reach sites that conventional mechanical instrumentation cannot[29]. While reduction in the inter-leukin (IE) 1 beta[30] and pocket depth[31] have been noted with laser therapy, it is essential to note that most studies summarize the use of lasers as an adjunct and not as a substitute to scaling and root planing in

periodontal theapy.

2)Surgical Procedures

Lasers are effectively used to perform gingivectomies and gingivoplasties.CO2 laser uses only light impinging on the tissue with surgical time reduced to one fourth of the conventional method [32].

While this denies the operator any tactile feedback, ND: YAG laser maintais contact with the tissue [33]. Potential for damage to underlying bone remains a concern, particularly when used on thin soft tissues[34]. These properties come handy in mucogingival procedures like frenectomy and frenotomy which can be performed in less than 3 to 4 minutes with CO2 laser and with added advantages of bloodless,painless and sutureless procedure[32].

Recently, laser ablation has been recognised as a most effective,pleasant and reliable technique[35] for gingival depigmentation where excessive gingival pigmentation is a major esthetic concern. ER: YAG laser in defocused mode with brush technique[36] or contact mode mostly requiring only topical anaesthesia was followed by uneventful healing with no recurrences at 3 and 6 months check-up respectively an entirely new dimension in smile design.

3) Laser Assisted New Attachment Procedure (Lanap)

In terms of esthetic dentistry,the use of Erbium laser in crown lenthening in the anterior has created ports which suggest that LANAP can be associated with cementum mediated new connective tissue attachment and apparent periodontal regeneration of diseased root surface in humans.

4) Lasers And Implants

Gingival enlargement is relatively common around implants when they are loaded with removable prosthesis. Lasers can be used for Hyperplasia removal as well as in the treatment for peri-implantitis.ER: YAGlaser, due to its bactericidal and decontamination effect, can be used in the maintenance of implants. It has high bactericidal effect without heat generation around implants[37].

Conclusion

Several laser system such as Argon, He-Ne, Nd-YAG, ER-YAG, CO2 and so on are commercially available for therapeutic and research purposes. There are several uses of lasers in endodontics like diagnosis-laser Doppler flowmetry, pulp capping, pulpotomy, modification of root canal walls, sterilization of root canals, root canal shaping. But still there areseveral limitationsassociated with the intracanal usage of lasers.

Unlike ordinary lights a laser beam is very intense but non spreading or far less spreading.As such the emitted laser beam travels in a straight line for long distance so most of the microbes in complex canal system remain inaccessible.A strong recommendation to improve the endodontic tip to enable irradiation of all the areas of root canal walls has been emphasized.

Currently, different types of lasers has shown promising results in periodontal procedures due to its dual ability to ablate soft tissues and hard tissues with minimal damage which are Er:YAG and Er,Cr:YSGG lasers.Complete access and disinfection may not be achieved during the treatment of periodontal pockets with conventional mechanical instruments where lasers have the potential advantages of bactericidal effect, detoxification effect and removal of the epithelium lining and granulation tissue apart from calculus removal.

References

1. Matsumoto K. Lasers in endodontics. Dent Clin of North Am 2000; 44:889-906.
2. KlinkeT, Klimm W, Gutknecht N.Antibacterial effects of Nd:YAG laserirradiation within root canal dentin. JClin Laser Med Surg 1997; 15:29-31.
3. FolwacznyM, MehlA, Jordan C,HickelR. Antibacterial effects ofpulsed Nd:YAG laser radiation atdifferent energy settings in rootcanals. J Endod2002; 28:24-29.
4. Park DS, Lee HJ, YooHM, OhTS.Effect of ND: YAG Laser irradiation on the apical leakage of obturated root canals: an electrochemical study. Int. Endod J.2001; 34:318-321.
5. Moriyama EH, Zangaro RA, VillaverdlAB,LoboPD,MuninE,Watenahl IS. Dentin evaluation after ND: YAG Laser irradiation using short & long pulses. J Clin Laser Med Surg 2004; 22:43-50.
6. Hardee MW, Miserendino LJ, Kos W,Walia H.Evaluation of the antibacterial effects of intracanal ND:YAG Laser irradiation.J Endod 1994; 20:377-80.
7. BergneraA ,Zanin f, Barbin EL, Spano.JC. Santana R, Pewua JD. Effects of Er:YAG& ND:YAG laser irradiation on radicular dentin permeability using different irrigating solutions , Lasers Surg Med 2003;33(4):256-9.
8. CozeanC,ArcoriaCJ,Pelagalli J. Dentistry for the 21st century? Erbium:YAG laser for teeth.J Am Dent Assoc 1997; 128:1080-7.
9. SchoopU,MoritzA, KlugerW, Patruta S , S, Goharkhay K, Sperr W. The Er:YAG laserinendodontics: resultsofan in vitro study. LasersSurgMed2002; 30:360-364.
10. Schoop U, KLugerW,MoritzA,Nedjelik N, Georgopoulos A, Sperr WBactericidal effect of different laser systems in the deep layers of dentin.LasersSurg Med2004; 35: 111-6.
11. Schoop U, Kluger W, Dervisbegovic S,Goharkay K, WernischJ, GeorgopoulosA et al. Innovative wavelengths inendodontic treatment. Laser Surg Med2006; 38:624-630.
12. Zakariasen KL, Boran T, Mac Donald R. The emerging role of lasers in endodontics and other areas of dentistry .Alpha Omegan. 1990; 83(4):65-7.
13. De Moura-Netto C, De FreitasCarvalho C,Moura AA, Davidowicz H, Antoniazzi JH. Influence of ND:YAG& diode laser irradiation on apical sealing when associated with AH Plus &EndoREZ endodontic cements. Photomed laser Surg.2007,5:413-417.
14. Moritz A, Gutknecht N ,Goharkay K, Schoop U ,Sperr W ,Doertbudak O. Irradiation of infected root canals with a diode laser in vivo :results of microbiological examinations. Lasers Surg Med 1997;21:221-226.
15. Moritz A, Gutknecht N ,Goharkay K, Schoop U ,Wernisch J, Sperr W. In vitro radiation of infected root canals with a diode laser; result of microbiologic, infrared spectrometric & stain penetration examinations.Quientessence Int.1997; 28:205-209.
16. Kreisler M, Kohnen W ,Beck M , Al Haj H ,Christoffers AB ,Gotz H et al .

Efficacy of NaOCL /H2O2 .irrigation and GaAlAslaser in decontamination of root canals in vitro. Lasers Surg Med 2003; 32:189-196
17. da CastoRibeiro A, Nogreira GEC,Antoniazzi JH,Moritz A ,Zezell DM. Effects of diode laser (810 nm) irradiation on root canal walls : thermographic and morphologic studies . J Endod 2007; 33:252-255.
18. Tewfik HM, Pashley DH, HornerJA,Sharaway MM. Structural&functional changes in root dentinfollowing exposuretoKTP/532 laser.JEndod 1993;19:492-497.
19. Machida T, Wilder Smith P, ArrastiaAM, Liaw LH, Berns MW.Root canalpreparation using the second harmonic KTP: YAGlaser: a thermographic&scanning electron microscopy study. JEndod 1995; 21(2):88-91
20. Harashima T, Takeda FH, Kilura Y, Matsumoto K. Effect of Nd:YAG Laser irradiation for removal of intracanal debris and smear layer in extracted human teeth. J Clin laser Med Surgery1997;15:131-135.
21. Takeda FH, Harashima T, Kilura Y, Matsumoto K. J Clin Laser Med Surg1998;16:117-122.
22. Takeda FH, Harashima T, Kimura Y,Matsumoto K. Efficacy of Er:YAG laserirradiation in removing debris andsmear layer on root canal walls.J Endodon1998; 24(8):548-51.
23. EbiharaA, MajaronB, Liaw LH,KrasievaTB, Wilder Smith P. Er:YAG lasermodification of root canal dentin:influence of pulse duration, repetitiveirradiation and water spray. LasersMedSci2002;17(3):198-207.
24. kreisler M, Al Haj H, Daublander M, Goltz H, DuschnerH,Willershausen B,D Hoedt B. Effect of diode laser irradiation on root surfaces in vitro. J Clin Laser Med Surg. 2002; 20 (2):63-69.
25. Cobb CM. Lasers In periodontics; a review of the literature.J Periodontol 2006; 77 (4):545-64.
26. Kreisler M, Meyer C,Strender E.Effect of diode laser irradiation on attachment rate of periodontal ligament cells.An in vitro study. J periodontol.2001; 72(10):1312-7.
27. Raffeto N. lasers for initial periodontal therapy. Dent Clin North Am 2004; 48 (4): 923-36.
28. Ando Y, Aoki A.Bactericidal effect of erbium YAG laser on periodontopathic bacteria. Lasers Surg Med. 1996; 19(2):190-200.
29. Aoki A, Sasaki KM, Watanabe H, Ishikawa I. Laser in non surgical periodontal therapy. Periodontol2000.2004; 36:59-97.
30. Liu CM, Hou LT, Wong MY, LanWH.Comparison of Nd: YAG laser versus scaling and root planing in periodontal therapy. J periodontal. 1999; 70(11): 1276-82.
31. Finkbeine RL. The results of 1328 periodontal pockets treated with argon laser: selective pocket thermolysis. J Clin Laser Med Surg 1995:13 (4): 237-81.
32. Pick RM, PecaroBC,Silberman CJ. The use of the CO2 laser for the removal of phenytoin hyperplasia. J periodontal 1985; 56 (8): 492-96.
33. Romonos GE. Clinical applications of the ND: YAG laser in oral soft tissue surgery and periodontology. J Clin laser Med Surg 1994; 12(2):103-08.
34. Gimble CB. Hard tissue laser procedures. Dent Clin North Am 2000; 44 (4), 931-53.
35. Tal H, OegiesserD,Tal. Gingival depigmentation by erbium:YAG laser: clinical observations and patient responses. J Periodontal 2003 Nov; 74 (11): 1660-67.
36. Azzeh MM. Treatment of hyperpigmentation by ER: YAG laser for esthetic purposes. J periodontol 2007; 78 (1): 177-84.
37. Schwarz F, Aoki A, Sculean A, Becker J. The impact of laser application on periodontal and peri-implant wound healing.Periodontology 2000.2009; 51:79-108.

Source of Support : Nill, Conflict of Interest : None declared