International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Beneficence of Er:YAG Laser in Periodontal Procedures: A Case Series

Dr. Arnav Mukherji[1], Dr. VS Parmar[2], Dr. Sinthiya Bose Mukherji[3]

[1]Classified Specialist (Periodontics), Department of Periodontology, MDC, Varanasi, Uttar Pradesh, India

[2]Senior Consultant (Periodontics), CMDC, SWC, Rajasthan, India

[3]Medical Officer (MBBS), Private practitioner, Varanasi, Uttar Pradesh, India

Corresponding Author Tele: 9041287941

Abstract: ***Er:YAG laser are designed to handle both hard and soft tissues unlike their contemporaries. Apart from conventional techniques, ER:YAG laser adds cutting edge expertise in various surgical procedures. Successful outcomes achieved by Er:YAG laser makes it an important ingredient for achieving optimal clinical results.***

Keywords: Er:YAG laser; crown lengthening; periimplantitis

1. Introduction

Laser is the new kid on block, in terms of recent addition in the field of dentistry. It has made ingress in various fields of dental sciences. Conventional periodontal therapy like scaling and root planning, gingivectomy, flap surgery, gingival depigmentation and management of peri-implantitis cases have been validated in numerous clinical studies. However, to overcome handicap of conventional treatment, laser treatment became an important arsenal.

This case series attempts to highlight the efficacy of Erbium-doped yttrium-aluminum-garnet (Er:YAG) laser in various periodontal procedures.

Case 1: Gingival Enlargement

One of the most commonly encountered periodontal problem is chronic inflammatory gingival enlargement which warrants surgical intervention. A male patient aged 38 reported with the complaint of bleeding from gums while brushing and foul odour since last 6 months. On examination gingival enlargement in lower anterior region of jaw was evident (Fig. 1a). Enlargement was confined to 43, 42 and 32-36 region. Bleeding on probing was evident (Fig. 1b). No relevant medical history was attributable to gingival enlargement. After phase 1 therapy and subsidence of inflammatory component it was decided for surgical intervention. After taking patient's consent, gingivectomy using Er:YAG laser was decided. Tip utilized was of dimension 0.4x17mm, energy setting used was; laser energy 100-200mj; pulse frequency 10-20hz and 0-4 water level spray. External bevel incision was given and enlarged tissues were removed with the help of curettes (Fig. 1c). Wherever necessary, gingivolasty was carried out. Patient was given post op instructions. Analgesics were prescribed, Tab Paracetamol 500mg for a day. Patient didn't experience any pain thereafter. Chlorhexidine mouth wash 0.2% daily twice for 14 days. Review after 3 months showed satisfactory healing and rounded knife edge gingival margin (Fig. 1d).

Case 2: Gingival Depigmentation

Gingival hyperpigmentation (GHP), "black gum," is considered one of the most important elements affecting the appearance of an individual's smile [1]. GHP is due to the excessive release of melanin pigments in the gingival epithelium [2]. A patient reported with chief complaint of excessive pigmentation in upper and lower anterior region of gums (Fig. 2a). After phase 1 therapy, depigmentation using Er:YAG laser was decided upon. No local anesthesia was used. Laser tip of the dimension 1.3x17mm with energy setting of 100mj, pulse frequency 10-20 hz and 0-4 water supply was used in light brushing strokes (Fig. 2b). After depigmentation, coe pack was placed (Fig. 2c). Post op instructions was given. Review after 9 months showed no signs of repigmentation (Fig. 2d).

Case 3: Crown Lengthening

The junctional epithelium and the connective tissue attachment together constitute what is known as biologic width [3]. Keeping the margins of prosthesis within this important zone encroaches on biologic width resulting in gingival inflammation, periodontal pocket formation and ultimately alveolar bone loss. Thus, periodontal intervention namely surgical crown lengthening is a must in dentition with short clinical crown.

A 36 year old male patient reported with chief complaint of difficulty in chewing from upper right back region of the jaw. The crown structure of 15 was found to be inadequate for prosthetic crown preparation (Fig. 3a) Endodontic treatment of the above teeth had already been completed by the patient earlier. The treatment plan included phase 1 therapy followed by crown lengthening and osteoplasty/ostectomy. Routine haemogram investigations were normal. Patient consent was taken for treatment. Surgical technique was performed with Er:YAG laser (Lite Touch, Light Instruments, Yokneam Illit, Israel). Lasing was done using contact mode; laser energy was set at 100-200 mj; pulse frequency 10-20 Hz; tip diameter used was 0.4x 17mm and water spray level set at 3-4. Internal bevel and crevicular incisions were performed with laser (Fig. 3b). A full thickness mucoperiosteal flap was raised till two to three mm of healthy bone was visible. Severed gingival tissue was removed to gain access to underlying alveolar bone and the roots. Using curettes granulation tissues and tissue tags were removed. The amount of osteoplasty and/or osteotectomy required was to be estimated keeping in mind the dimensions of biologic width of future reconstructions. Bone remodelling was carried out using non contact mode (Fig. 3c) using following settings, laser energy 200-300mj; pulse frequency 20-25 Hz; tip diameter used was 1.0mm x17mm and water level set at 6-8. Abundant irrigation was carried out to remove debris from surgical site. Suturing was done to achieve primary closure. Post surgery necessary directives were told to the patient. Non steroidal anti-inflammatory drug was too prescribed. Chlorhexidine mouth wash 0.2% was also prescribed for two weeks. Healing was uneventful. Post and core build up was done, followed by composite restoration. Porcelain fused metal crown was fabricated and cemented (Fig. 3d & 3e). Follow up of one year showed no undesirable observations.

Case 4: Flap Surgery

Chronic periodontitis has been defined as an infectious disease resulting in inflammation within supporting tissues of the teeth, progressive attachment loss, and bone loss [4]. Flap surgery in deeper pockets results in greater immediate pocket reduction and attachment gain [5]. A female patient presented with the complaint of bleeding gums, foul odour and spacing in front region of jaw. On examination, bleeding on probing periodontal pockets 5-7mm, clinical attachment loss of 5-7mm were evident at 16-22 region (Fig. 4a & 4b). Opg showed horizontal bone loss. After phase 1 therapy, surgical intervention was decided. Open flap debridement with papilla preservation wherever indicated was done. Flap debridement and pocket disinfection was done using Er:YAG laser. Laser tip orientation was degree towards root surface. Granulation tissue ablation was in contact mode with following setting; laser energy 100-200 mJ, pulse 20 Hz, tip size 1.3x17mm, water spray level 3-4 (Fig. 4c & 4d). Pocket debridement was done in non contact mode using tip size 0.6x 17mm, laser energy 50-100mj, pulse frequency 20 hz, water spray level 6. Sutures, coe pack and post op instructions were given. Antibiotic and analgesic were prescribed. Post op review findings after 6 weeks included no bleeding on probing, reduced pocket depth (3mm) and clinical attachment gain of 2mm (Fig. 4e). Healing was satisfactory.

Case 5: Periimplantitis

Peri-implantitis or Periimplantitis is characterized as an inflammatory reaction that affects the hard and soft tissue, which results in loss of supporting bone and pocket formation surrounding the functioning osseointegrated implant [6].

A young female patient had undergone implant placement in 11 regions around 3 years back. She came with the complaint of bleeding, redness, suppuration from implant site for last 4 months (Fig. 5a & 5b). However there was no mobility in implant, medical history was non contributory. RVG revealed bone loss till 4 screws (Fig. 5c). Thorough phase 1 therapy was carried out. Antibiotic regimen was also prescribed. After review, periodontal pocket of 7mm still persisted, however total reduction in suppuration and decreased bleeding on probing was achieved. Since vertical bone loss on both surfaces was evident, surgical intervention was carried out. Crevicular incision was given in 11 and 12 region; papilla preservation was done in 11 and 12 region. After reflection of mucoperiosteal flap, vertical bone loss on either side of implant was observed. Flap incision using laser in contact mode was with following settings: tip dimension 0.4 × 17 mm tip, laser energy 200 mJ, pulse frequency 20 Hz and water level spray at 5-6. Granulation tissue ablation in Non contact mode with following setting was done: 1.3 × 17 mm tip, laser energy 100-200 mJ, pulse frequency 20 Hz and water level at 6. Implant decontamination in Noncontact mode with following settings, 1.3 × 17 mm tip, laser energy 20-40 mJ, pulse frequency at 20Hz and water spray level at 6-8 (Fig. 5d). Bone augmentation was done using Geistlich Bio-Oss Small granules (0.25 - 1 mm) (Fig. 5e) this was followed by placement of GTR membrane over the defect (Fig. 5f) (Haliguide bioresorbable gtr membrane). Flap was coronally advanced, sutures were placed and postop instructions were given (Fig. 5g). Patient was recalled after 10 days for suture removal. Healing was satisfactory. Patient was recalled every month at 1st, 3rd, 6th and 9th month for review. After 9 months, reduced probing depth 3mm, absence of bleeding from the site and absence of suppuration was observed (Fig. 5h). RVG showed complete bone formation, coverage of previously exposed screws was achieved (Fig. 5i)

2. Discussion

First laser approved by the FDA on May 7, 1997 for use in dental cavity preparation. Er:YAG laser has the efficiency to cut or ablate dental hard tissue [7]. Bone ablation and soft tissue surgeries can also be performed where coagulation effect is not required [8].

High absorption by water is the hallmark of er yg laser, thus removing the thermal denaturation of the laser-treated tissue and achieving early wound healing following [9]. Hence, Er:YAG laser adds cuting edge in various periodontal procedures.

A randomized controlled clinical study observed that Nd: YAG laser and electrosurgery caused more pain compared to the Er:YAG laser during gingivectomy [10]. Similar result was observed by Fekrazad et al [11]. Our patient too didn't experience any pain after gingivectomy. Extreme laser temperatures cause dehydration and carbonization. It is proven that shorter wave penetration by Er:YAG laser causes minimal thermal damage to tissues [12]. This finding is commensurate with Monzavi et al.'s report indicating a fast temperature recovery after Er:YAG laser treatment compared to Nd: YAG laser [13].

Er:YAG lasers have been utilized for different osseous procedures including crown lengthening. Bactericidal effectiveness, less agony and vibrations to the patient, no tissue damage and healing complications, effectiveness in osseous manipulation are advantages over other laser system [14]. In our case Er:YAG laser was equally effective in removing soft as well as hard tissue with no adverse outcomes.

For new attachment to occur, root surfaces should be biocompatible after flap surgery.

An in vitro study reported that irradiating diseased root surfaces with Er:YAG laser accelerated attachment and growth of human gingival fibroblast [15]. Additionally, laser treatment produces prostaglandin E2 through increased expression of cyclooxygenase-2, which forms a regulatory pathway in accelerated wound healing [16].

Another study proved that laser radiation removed endotoxin from root surfaces in a dosage-dependent manner [17]. In our patient reduced pocket depth, gain in clinical attachment and satisfactory healing was achieved, findings were synchronous with above studies proving the efficacy of Er:YAG laser.

Er:YAG laser is new addition to various treatment modalities of periimplantitis. Er:YAG laser irradiation is effective for decontaminating implant surface because it has upper hand than other methods in terms of dental calculus removal, high bactericidal activity, excellent tissue ablation, and promoting new bone formation [18]. Er:YAG laser irradiations has been reported to be efficient in plaque biofilm removal over a wide range of powers, from 30 to 500 mJ/pulse [19]. In treating our patient energy setting of 20-40mJ was used for decontaminating implant surface. Another study [20] observed that after Er:YAG decontamination, there was high adhesion rate of osteoblast like cells on titanium surfaces. Recent studies [21, 22] employed Er:YAG laser in implant decontamination and exhibited reduced gingival inflammation, bleeding on probing, probing depth and suppuration. Bone gain was also reported. Results in our patient showed positive response to Er:YAG laser and achieved excellent results as found in above studies.

3. Conclusion

Er:YAG laser has proved its mettle in various periodontal procedures. It is an added advantage which can suppress the handicap of conventional periodontal techniques. Less postoperative pain, enhanced healing, optimum periodontal health is the ultimate goal which is desired by the clinician. In various procedures done using Er:YAG laser above goals were achieved successfully.

Conflict of Interest: None

Funding Status: No funds were provided for the study

Acknowledgement: The Authors would like to thank Col (Retd) MK Mukherji, Mrs Sumita Mukherji and Dr. Siddharth Mukherji for their valuable support.

References

[1] Jnaid Harb ZK, El-Sayed W, Alkhabuli J. Gingival Depigmentation Using Diode 980 nm and Erbium-YAG 2940 nm Lasers: A Split-Mouth Clinical Comparative Study. Int J Dent. 2021 Dec 28; 2021: 9424793. doi: 10.1155/2021/9424793. PMID: 34992657; PMCID: PMC8727139.

[2] N. Attar, B. Gupta, A. Deshmukh, S. Shahabe, S. Zope, and Y. Waykole. Pigmentation on gingiva: a diagnostic dilemma. International Journal of Periodontics and Restorative Dentistry. 2018; 38 (1): 137-140.

[3] Newman MG, Takei HH, Klokkevold PR. Carranza-Carranza's Clinical periodontology 10th ed. Amsterdam: Saunders-Elsevier Publication; 2006; 1044-66.

[4] Flemmig TF: Periodontitis, Ann Periodontol 4: 32, 1999.

[5] Boris Gaspirc and Uros Skaleric. Clinical Evaluation of Periodontal Surgical Treatment With an Er:YAG Laser: 5-Year Results. J Periodontol 2007: 10; 1864-71.

[6] Mc Crea SJ. Advanced peri-implantitis cases with radical surgical treatment. J Periodontal Implant Sci 44 (1): 39-47.

[7] Karic V, Mulder R, Melman G. Cavity preparation using hard tissue lasers in operative dentistry. South Africa Dent J 2017; 72 (4): 182-83.

[8] Bahrololoomi Z, Kabudan M, Gholami L. Effect of Er:YAG laser on shear bond strenght of composite to enamel and dentin of primary teeth. J Dent (Tehran) 2015; 12 (3): 163-70.

[9] Sawabe M, Aoki A, Komaki M, Iwasaki K, Ogita M, Izumi Y. Gingival tissue healing following Er:YAG laser ablation compared to electrosurgery in rats. Lasers Med Sci. 2015; 30 (2): 875-83.

[10] Mehmet Murat Taskan, Ilker Keskiner and Ahmet Aydogdu**.** Evaluation of temperature and healing in treatment of gingival enlargement using different gingivectomy techniques: A randomized controlled clinical study. Ann Med Res 2020; 27 (4): 1043-50

[11] Fekrazad R, Nokhbatolfoghahaei H, Khoei F, et al. Pyogenic Granuloma: Surgical Treatment with Er:YAG Laser. J Laser Med Sci 2014; 5: 199-205

[12] Cobb CM. Lasers in periodontics: a review of the literature. J Periodontol 2006; 77: 545-64.

[13] Monzavi A, Fekrazad R, Chinipardaz Z, et al. Effect of Various Laser Wavelengths on Temperature Changes During Periimplantitis Treatment: An in vitro Study. Implant Dent 2018; 27: 311-6.

[14] Pecheva A, Yaneva B. Aesthetic rehabilitation through crown lengthening laser surgery and zirconium CAD/CAM veneers: a multidisciplinary case report. Health Technol 2021; 5: 1-6.

[15] Feist IS, De Micheli G, Carneiro SR, Eduardo CP, Miyagi S, Marques MM. Adhesion and growth of cultured human gingival fibroblasts on periodontally involved root surfaces treated by Er:YAG laser. J Periodontol 2003; 74: 1368-1375.

[16] Pourzarandian A, Watanabe H, Ruwanpura SM, Aoki A, Noguchi K, Ishikawa I. Er:YAG laser irradiation increases prostaglandin E production via the induction of cyclooxygenase-2 mRNA in human gingival fibroblasts. J Periodontal Res 2005; 40: 182-186.

[17] Folwaczny M, Aggstaller H, Mehl A, Hickel R. Removal of bacterial endotoxin from root surface with Er:YAG laser. Am J Dent 2003; 16: 3-5.

[18] Schwarz F, Aoki A, Sculean A, Becker J. The impact of laser application on periodontal and peri-implant wound healing. Periodontol 2000. 2009; 51: 79-108. implant

[19] Hauser-Gerspach I, Mauth C, Waltimo T, Meyer J, Stübinger S. Effects of Er:YAG laser on bacteria

associated with titanium surfaces and cellular response in vitro. Lasers Med Sci. 2014; 29 (4): 1329-37.
[20] Eick S, Meier I, Spoerlé F, et al. In vitro-activity of Er:YAG laser in comparison with other treatment modalities on biofilm ablation from implant and tooth surfaces. PLoS ONE. 2017; 12 (1): e0171086.
[21] Norton, M. R. Efficacy of Er:YAG Laser in the Decontamination of Peri-Implant Disease: A One-Year Prospective Closed Cohort Study. Int. J. Periodontics Restor. Dent. 2017, 37, 781-788.
[22] Wang, C. W. ; Ashnagar, S. ; Gianfilippo, R. D. ; Arnett, M. ; Kinney, J. ; Wang, H. L. Laser-Assisted Regenerative Surgical Therapy for Peri-Implantitis: A Randomized Controlled Clinical Trial. J. Periodontol. 2021, 92, 378-388.