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JOURNAL OF LASER-ASSISTED DENTISTRY

LASER-ASSISTED ENDODONTIC DISINFECTION

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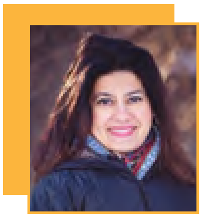

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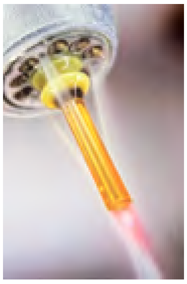

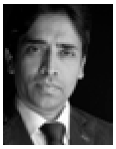

Dr. Santosh Patil
Whiteoak Dental Health
Essex, UK

@santoshpatildentalphotography

EDITORIAL

MY REFLECTIONS ON 2023-24

It is my pleasure to bring you another great issue of JLAD, a true product of collaboration and cooperation within our laser community. I am happy to say that the interest in reading this publication is growing, so is the desire in sharing the stories of clinical successes and new research from our colleagues in the field. This makes my life as an editor both easier and more rewarding.

2023-24 academic year saw an increased demand for WCLI Fellowship (15 new members) and Mastership (5 new members) certifications at the **Asia Pacific Symposium** in Kuala Lumpur. In May, we had our first ever **European Forum** in Prague focused specifically on endodontics and it was a huge success. CTC trainings are becoming a standard starting point in the training of new laser dentists all over the world. We are happy to offer this highly rated and sought after course in US, Asia, Europe and Middle East. Due to the increased demand, the number of CTC instructors and spoken languages is also increasing. Dr. Isaac Kably, Dr. Rosa Sanders and Dr. Ariel Savion have recently completed their CTC instructor training, and we congratulate them. Dr. Julia Kozlova, Dr. Lan Tran and Dr. Saleh Aria will complete their training soon, and we wish them good luck.

MY CONVERSATIONS WITH AI

I ask ChatGPT: "*What is Laser Dentistry?*" and the answer is "*Minimally invasive dental treatment that uses laser technology to perform surgical, restorative and cosmetic procedures*". Sounds Good! Then I ask: "*What are the benefits of Laser Dentistry?*" and the answer is "*Minimally invasive, Precise, Reduced Need for Anesthesia, Faster Healing, Reduced Anxiety*". This sounds even better. So, who would not want to used lasers in dentistry if they are so great? ChatGPT response was "*High cost of equipment, Learning curve and training requirements, Limited applications, Cost to patients, Variable effectiveness, Insurance coverage issues, Regulatory and safety concerns*". Next, I ask: "*Don't benefits outweigh the risk?*" There was a pause…AI was thinking, after a minute or so ChatGPT replied "*In many cases, the benefits of laser dentistry do outweigh the risks, which is why an increasing number of dentists are incorporating it into their practices*".

With this response, I wanted to expand on just how much exactly this increasing number is. Apparently, there was a **9% increase** from 2021 to 2022 in adoption of laser technology, from 36% to 45%, the numbers come from the survey conducted by Inside Dental Technology in 2022. Unfortunately, this survey does not specify if the lasers in question are soft tissue or hard tissue or both. I push on further and ask for the market penetration of hard tissue lasers into dental practices. And here is the beginning of the circular argument with no answer that satisfies me. ChatGPT responds "*The market penetration of hard tissue lasers in dental practices is relatively low compared to soft tissue lasers due to their broader applications, user-friendliness, affordability, portability. Hard tissue lasers are more dangerous, need more advanced training, cost more and lack insurance coverage*". Well, the only two things I can agree with is the portability and affordability of soft tissue lasers, <u>everything else is false</u>. An all tissue laser, like YSGG is more user friendly, safer for the patient and has broader applications. Proper training is essential for operating any type of laser and is not limited to hard tissue applications. And what does insurance coverage have to do this any of this? Laser dentistry is a way we choose to practice our craft, it gives us satisfaction at the end of every day for the job done better, sometimes faster and always to the benefit of the patient.

Marina Polonsky, DDS, MSc.

DR. MARINA POLONSKY
EDITOR

Dr. Polonsky holds a Mastership with WCLI, Master of Science in Lasers in Dentistry degree from RWTH University in Aachen, Germany. She is a recipient of a Mastership Certificate with ALD (Academy of Laser Dentistry), serves on the ALD Board of Directors, and is a recognized member of the ALD Speaker Bureau. She is a founder of the Canadian Dental Laser Institute (CDLI), ALD affiliated international study club.

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SAFE AND EFFECTIVE 3-D ENDODONTIC DISINFECTION

Laser Assisted Endodontic Irrigation

By Gary Glassman, DDS, FRCD & Fernando J. Meza, DMD

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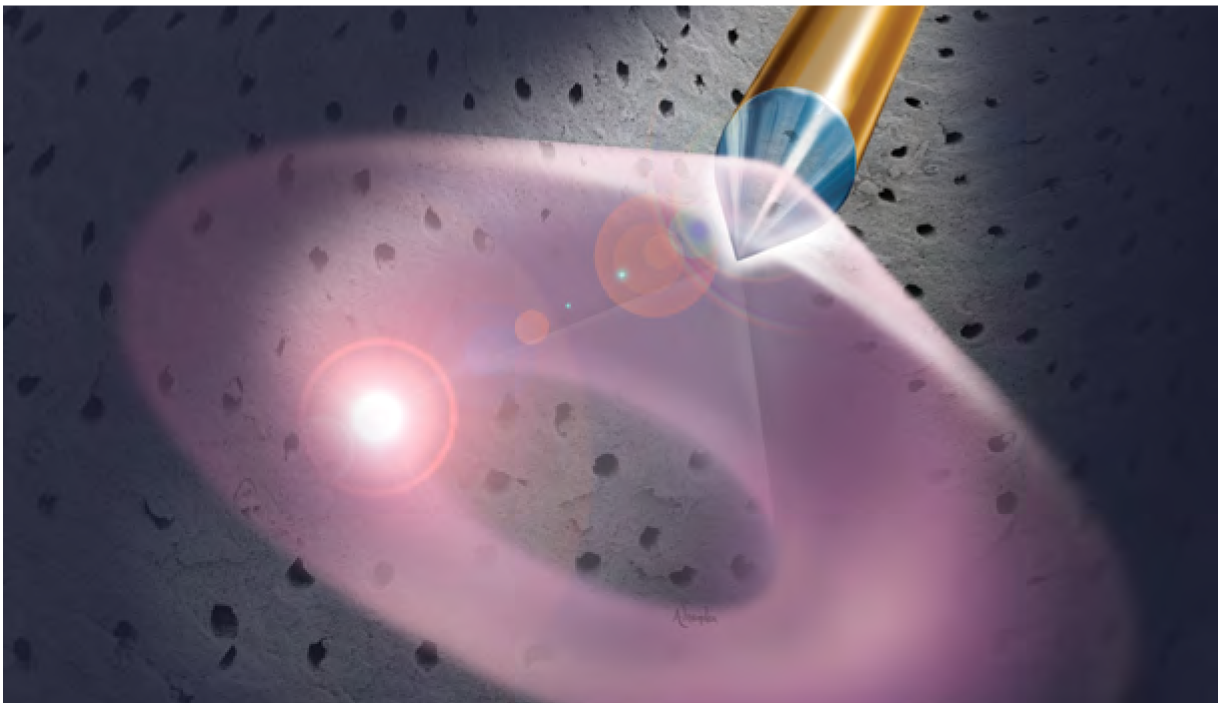


The ultimate goal of endodontic treatment is the prevention and/or treatment of apical periodontitis such that there is complete healing and absence of infection[1] while the overall long-term goal is the placement of a definitive, clinically successful restoration and preservation of tooth structure.

Successful endodontic treatment depends on a number of factors, including proper instrumentation, successful irrigation and decontamination of the root-canal system right to the apical terminus in addition to hard to reach areas such as isthmuses, and lateral and accessory canals.[2] (*Fig 1.*)

The challenge for successful endodontic treatment has always been the removal of vital and necrotic remnants of pulp tissue, debris generated during instrumentation, the smear layer (the organic and inorganic layer that is produced on the wall of the root canal during instrumentation), micro-organisms, and micro-toxins from the root-canal system.[3]

Even with the use of rotary instrumentation, the nickel-titanium instruments currently available only act on the central body of the root canal, resulting in a reliance on irrigation to clean beyond what may be achieved by these instruments.[4]

Dual irrigants such as NaOCl with EDTA are often used as initial and final rinses to circumvent the shortcomings of a single irrigant.[5-7] These irrigants must be brought into direct contact with the entire canal-wall surfaces for effective action,[8, 5, 9] particularly in the apical portions of small root canals where most of the lateral canals and canal ramifications exist.[9,10]

The combination of NaOCl and EDTA has been accepted as the “gold standard” and used worldwide for antisepsis of root-canal systems. The concentration of NaOCl used for root-canal irrigation ranges from 0.5 to 6%,[11] depending

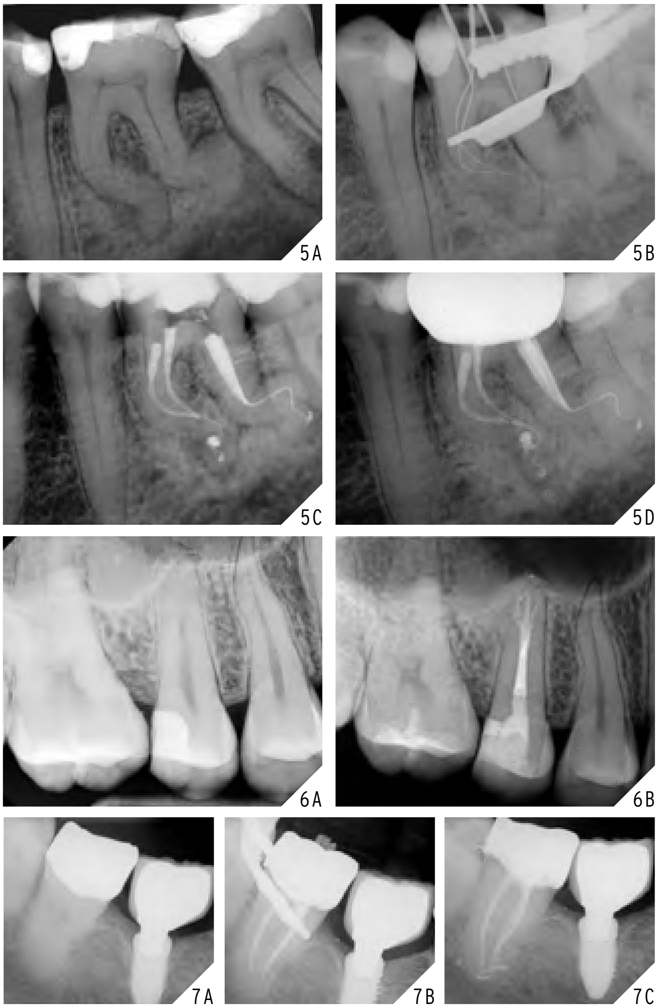
1. Micro-CT images of a maxillary molar demonstrate the root canal complexity. (Courtesy Dr. Ronald Ordinola Zapata, Brazil.) ***2A-2B.*** *The Endoactivator™ Smartlight Pro System (Dentsply Sirona) sonic activation system.* ***3.*** *The Master Delivery Tip (MDT) accommodates different sizes of syringes filled with irrigant, the macro cannula is attached to the autoclavable aluminium hand piece and the micro cannula is attached to an autoclavable aluminium finger piece. The macro cannula, the micro cannula and the MDT are connected via clear plastic tubing. The tubes are connected to the high volume suction of the dental chair via the Multi-Port Adaptor.* ***4.*** *Waterlase iPlus All Tissue Laser™ (Biolase, Inc.).*

on the country and local regulations; it has been shown, however, that tissue hydrolysation is greater at the higher end of this range, as demonstrated in a study by Hand et al. comparing 2.5 and 5.25% NaOCl. The higher concentration may also favour superior microbial outcomes.[10] NaOCl has a broad antimicrobial spectrum,[8] including E. faecalis. NaOCl is superior among irrigating agents that dissolve organic matter. EDTA is a chelating agent that aids in smear layer removal and increases dentine permeability,[12,13] which will allow further irrigation with NaOCl to penetrate deep into the dentinal tubules.[14]

IRRIGATION CHALLENGES-APICAL VAPOUR LOCK

Unless the root-canal foramen is wide open, the root canal behaves like a close-ended channel since the roots are surrounded by the periodontium. This produces an apical vapour lock, gas entrapment at the apical one third3 that resists displacement during instrumentation and final irrigation, thus preventing the flow of irrigant into the apical region and adequate debridement of the root-canal system.[15,16] During irrigation, NaOCl reacts with organic tissue in the root-canal system, and the resulting hydrolysis liberates abundant quantities of ammonia and carbon dioxide.[17] This gaseous mixture is trapped in the apical region and quickly forms a column of gas into which further fluid penetration is impossible. Extension of instruments into this vapour lock does not reduce or remove the gas bubble,[18] just as it does not enable adequate flow of irrigant. Equally important is the concept that IF the NaOCl irrigant is NOT exchanged, the organic pulpal tissue will consume the NaOCl very quickly during the reaction of hydrolysis and in very short order all that is left over is water, which has no tissue dissolving effects at all. The phenomenon of apical vapour lock has been confirmed in studies in which roots were embedded in a polyvinylsiloxane impression material to restrict fluid flow through the apical foramen, simulating a close-ended channel. The results of these studies was incomplete debridement of the apical part of the canal walls with the use of a positive-pressure syringe delivery technique.[19-22] Micro-CT scanning and histological tests conducted by Tay et al. have also confirmed the presence of apical vapour lock.[22] In fact, studies conducted without ensuring a close-ended channel cannot be regarded as conclusive on the efficacy of irrigants and the irrigant system.[23-25] The apical vapour lock may also explain why in a number of studies investigators were unable to demonstrate a clean apical third in sealed root canals.[21, 26-28]

In a paper published in 1983, Chow determined that traditional positivepressure irrigation had virtually no effect apical to the orifice of the irrigation needle in a closed root-canal system.[29] Fluid exchange and debris displacement were minimal. Equally important to his primary findings, Chow set



__5A.__ Preop radiograph of tooth #36 with very curved roots. Necrotic pulp with symptomatic apical periodontitis. __5B.__ Working radiograph with hand files only negotiating coronal half of root canal and inability to get to the apices. __5C.__ Obturation radiograph revealing complete fill of the root canals to their respective apices. __5D.__ 18 month re-assessment radiograph showing healing of the peri-radicular lesion. 6A. Pre operative radiograph of tooth #15, only one canal negotiated with files. Symptomatic irreversible pulpitis with symptomatic apical periodontitis. 6B. Final obturation radiograph with bonded core placed revealing trifurcation of the root canal system at the apical 1/3rd. __7A.__ Pre operative radiograph of tooth #47. Symptomatic irreversible pulpitis with symptomatic apical periodontitis. 7B. Cone fit radiograph showing canals negotiated several mm short of the apical termini. __7C.__ Final obturation radiograph with bonded core placed revealing "tree-like" branching' at the apical 1/3rd of the root canal system

forth an infallible paradigm (Chow's Paradigm) for endodontic irrigation: "For the solution to be mechanically effective in removing all the particles, it has to: (a) reach the apex; (b) create a current (force); and (c) carry the particles away.[29] The apical vapour lock and consideration for the patient's safety have always prevented the thorough cleaning of the apical 3 mm. It is critically important to determine which irrigation system will effectively irrigate the apical third, as well as isthmuses and lateral canals,[30] and do it in a safe manner that prevents the extrusion of irrigant.

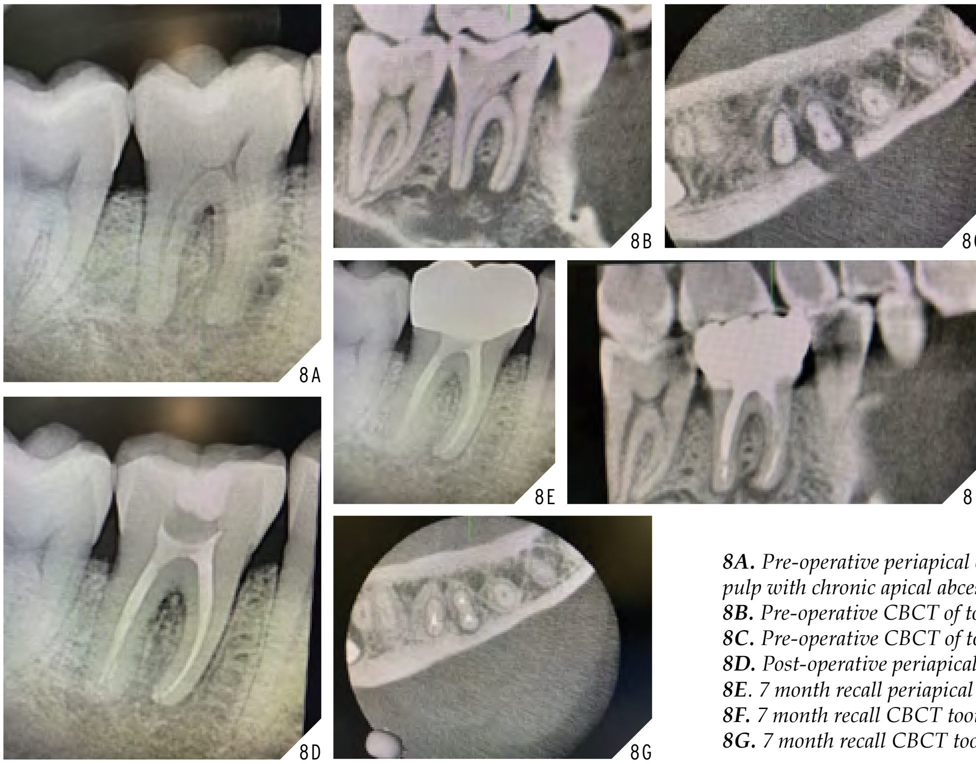
IRRIGANT DELIVERY AND ACTIVATION

The conundrum that the clinician faces is to SAFELY and effectively deliver the irrigants to the apical terminus, break the Apical Vapour Lock and allow constant exchange of irrigant and thereby continual hydrolysis of pulpal tissue by the NaOCl WITHOUT the risk of apical extrusion.

There are several ways to deliver NaOCL safely and effectively. The Endoactivator™ Smartlight Pro System (Dentsply Sirona) (*Fig. 2*) sonically driven system activates intracanal reagents and vigorously produces the hydrodynamic phenomenon, providing the ability to debride into the deep lateral anatomy, remove the smear layer, and dislodge simulated biofilm clumps within the curved canals of molar teeth.[31-33]

The EndoVacTM (KavoKerr) apical negative pressure system (*Fig. 3*) has the ability to suction, thereby drawing and delivering the irrigant passively to the apex[3] and positively addressing the problem of irrigation penetration past the apex into the periapical tissues which may result in treatment complications such as irrigation accidents.[34-37]

I have incorporated The Er,Cr:YSGG Waterlase iPlus All Tissue Laser (BIOLASE) (*Fig. 4*) for almost two years now in my practice for flushing out debris created during the shaping procedure and during the "main event" of endodontics, the final irrigation protocol. I have been amazed at the precision, accuracy and convenience of laser assisted endodontics, especially when treating complex root canal systems. (*Figs. 5, 6,7 & 8*) A combination of tips were used to treat #46 in a single visit. The MZ5-9 tip set at 1.0W/20Hz (50 mJ), with air/water OFF was used in the chamber for the coronal conditioning step using 3% NaOCl delivered continuously by the dental assistant at a rate of 6 mL/minute. In this step, the pulp



***8A.** Pre-operative periapical of tooth #46. Necrotic pulp with chronic apical abcess (buccal sinus tract.)*
***8B.** Pre-operative CBCT of tooth #46. Sagittal view.*
***8C.** Pre-operative CBCT of tooth #46. Axial view.*
***8D.** Post-operative periapical of tooth #46.*
***8E.** 7 month recall periapical of tooth #46.*
***8F.** 7 month recall CBCT tooth #46. Sagittal view.*
***8G.** 7 month recall CBCT tooth #46. Axial view.*

chamber is thoroughly debrided making the canals easier to locate in order to start instrumentation. At times during instrumentation, the RFT3 tip was positioned loosely at midroot in each canal and withdrawn at 1 mm/sec up to the orifice where it was held for an additional 5-8 seconds. After completion of instrumentation, the withdrawal motion described above was repeated three times per canal followed by a 30 second rest period first with 3% NaOCL, then with 17% EDTA, and lastly with 3% NaOCl. A setting of 1.00W/30Hz (33.3 mJ), air/water OFF with the above solutions was used in an intermittent fashion with syringe irrigation used to first flood the canals and then to flush them. The canals were then dried and obturated with gutta percha and sealer. Due to the presence of a sinus tract and visible buccal fenestration, the RFPT5 tip was used on the Repair Perio setting of 1.5W/30Hz with air/water set at 40%/50%. The tip was inserted into the sinus tract staying clear of vital structures and withdrawn slowly in circular motion three times. A 7 month post-op CBCT and PA image obtained demonstrates significant healing.

The failure rate of endodontic treatment is reported to be 2 to 14 percent.[38] Though many factors have been implicated, some of the most common include the persistence of bacteria, poorly cleaned and obturated canals, and complications of instrumentation such as ledges, blockages, and perforations.[39] The use of lasers as an adjunct in treatment minimizes failures by helping to ensure that the root canal system of the infected pulp tissue is thoroughly debrided and cleaned so that the canal space can be properly shaped and prepared for obturation. Dental lasers have been found to be effective for ablating hard tissues, opening dentinal tubules, eliminating biofilm and removing the smear layer more efficiently than syringe and needle irrigation.[40,41] In addition to the physical effect created by the turbulent motion of the irrigant, lasers produce a chemical effect by increasing the reaction rate of the irrigant.[41] The highspeed fluid motion created by dental lasers flushes out the debris attached to root canal walls, evacuates out debris coronally and does this right down to the apical terminus without apical extrusion, thereby satisfying “Chow’s Paradigm”.[29]

While the EndoActivator and Endo-Vac improve the delivery of irrigating solutions to the apex, they lack the power of laser derived photoacoustics. Due to the Waterlase’s wavelength of 2780 nm, water molecules are targeted for absorption of the light energy. The effect is a thermomechanical system that ablates dental hard and soft tissues and in endodontics, a hydrokinetic system that effectively agitates irrigating solutions.

Root canal therapy can be simplified into two phases: debridement and disinfection. Debridement of vital and necrotic tissue, and smear layer generated from mechanical instrumentation is performed in conjunction with irrigation of the pulp chamber and main canal(s). The Waterlase provides unparalleled debridement of the pulp chamber including the canal orifices. A higher energy is used for this initial debridement. Irrigating solutions are used in a continuous fashion with an irrigating syringe or for added simplicity, the Master Delivery Tip (MDT), from the EndoVac system.

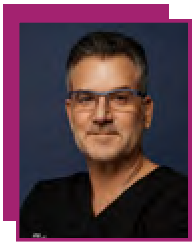
Disruption of pulp tissue and "pulp stones" are observed in this phase of topdown debridement. Isthmuses on the floor of the pulp chamber are cleared, all while allowing for better visibility of canal orifices including calcified ones. After the initial opening of the canal orifices with rotary NiTi and hand files, we continue on with our top-down approach and enter into the main canal(s). One of the major benefits of the Waterlase iPlus, is that it's design and protocols give you full control of photoacoustics throughout the root canal treatment; whether it's in the chamber or in the canal. As we begin instrumentation of the main canal(s), radial firing tips are introduced at lower energies bringing the photoacoustic effect safely and closer to the apex. Smaller tips such as the radial firing tip2 (RFT2) at 200 microns in diameter or approximately a size #20 hand file, allow for mid root placement in the canal(s) for the most conservative preparations or narrow canals. What follows is enhanced irrigation of the entire root canal system as we begin the disinfection phase. Irrigating solutions including NaOCl and EDTA are agitated and slightly warmed by the laser's mechanical and thermal effects.

This is all accomplished while eliminating the above mentioned vapour lock scenarios of traditional endodontics. Chamber and canal wall boundaries play a role in laser photoacoustics just as the size and walls of a concert hall are customized for maximal acoustics. The final shape of the pulp chamber, endodontics access, and final canal preparation influence the laser generated cavitation and streaming effects. By placing the tips into the chamber and canal(s), proper debridement and disinfection is achieved. While ultrasonic devices are much less expensive and capable of producing cavitation and streaming, their effect is greatly reduced and even eliminated in smaller canal preparations since the ultrasonic tips are prevented from oscillating freely as they touch the canal walls. This dampening effect does not occur in laser photoacoustics and therefore the ultimate goal of canal debridement and disinfection, while maximally conserving tooth structure is realized.[30]

We have entered into the dawn of tooth-focused treatment aimed at dentin conservation, and shrugged off file-focused treatment, where we sacrifice valuable tooth structure to satisfy our current methodologies. The future of endodontics has never been brighter! With the development of safe and effective protocols resulting in the proper agitation of irrigating solutions, lasers, like the Waterlase iPlus have the potential to remove 100% of the organic tissue and 100% of the microbial contaminants right to the apical terminus. Successful endodontic treatment may be taken to levels never seen before! ■

ABOUT THE AUTHORS

Dr. Gary Glassman



Dr. Glassman raduated from the University of Toronto, Faculty of Dentistry in 1984 and from the Endodontology Program at Temple University in 1987. The author of numerous awards and publications, Dr. Glassman lectures globally on endodontics, is on staff at the University of Toronto, Faculty of Dentistry in the graduate department of endodontics.

Dr. Fernando Meza

Dr. Meza is a 2002 graduate of the University of Connecticut School of Dental Medicine. Dr. Meza received his Certificate in Endodontics from Temple School of Dentistry in 2004. Dr. Meza has lectured for Biolase in hands-on courses and provided in-office training to endodontists in the USA and Canada.

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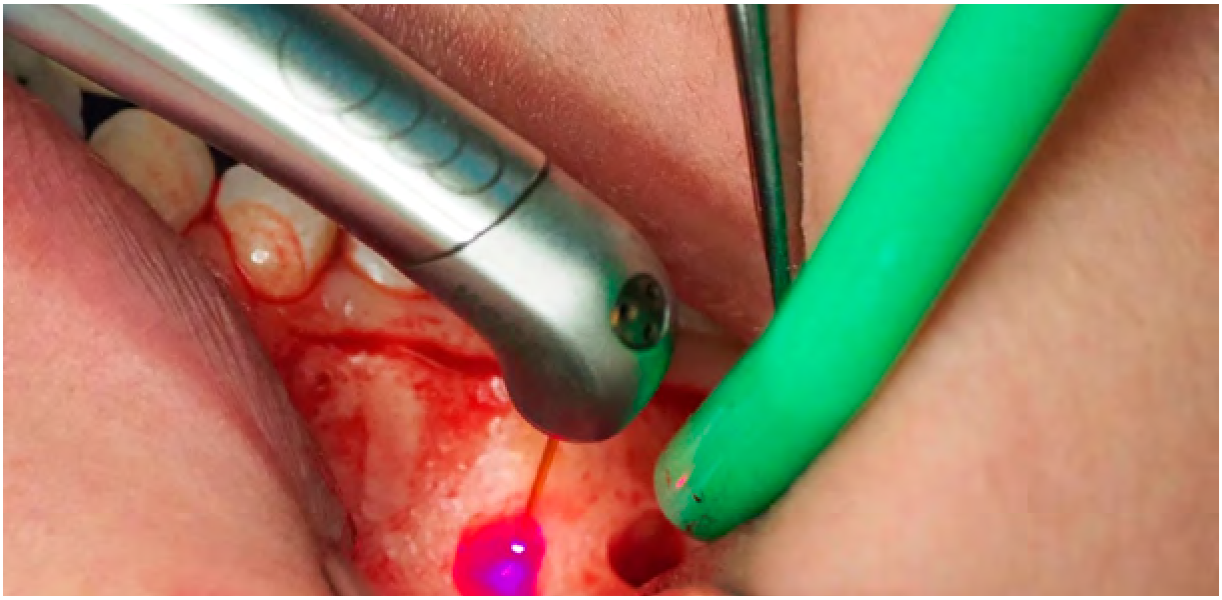


ER,CR:YSGG LASER-ASSISTED SURGICAL ENDODONTIC RETREATMENT

A Case Report

Cam Ngoc T. Dong, DDS, MS, FWCLI

INTRODUCTION

While endodontic procedures have a high success rate, there is always a possibility of failure.[1] Failures can arise from anatomy, instrumentation, or etiology.[2,3,4,5] In all of these cases, the necessary use of an Er,Cr:YSGG laser greatly enhances the success of an apicoectomy procedure. It can also be stated that without the use of the Er,Cr:YSGG laser, the apicoectomy procedure cannot be safely performed on the posterior teeth due to the anatomic structures, access, and visibility.

There are two possible treatment methods when dealing with a failed root canal treatment: nonsurgical endodontic retreatment or surgical endodontic retreatment. Endodontic microsurgery is typically the last resort due to its multitude of complications and high failure rate; however, advancements in modern microsurgical concepts have significantly improved these factors.[1]

The application of laser on apicoectomy treatment has been seen to have a very effective outcome with an 85-96.8% success rate.[1]

CASE REPORT

A 40-year-old Hispanic male came to my office for a limited examination of tooth #19 due to pain while chewing. Medical history revealed the patient having an ASA I status. The extra-oral exam revealed the patient to be within normal limits. Intra-oral examinations has revealed that tooth #19 had a previous root canal treatment done (*Fig. 1*) with an all porcelain crown coverage. The patient stated that the tooth was finished one & a half years ago in Mexico. The two periapical radiographs were taken at different angles and revealed radiolucent lesions around the mesial and distal roots. Additionally, limited Cone Beam Computed Tomography (Vatech, Korea) confirmed the radiolucency around the mesial & distal roots.

Probing depth was 1-2mm. Endo-ice was nonapplicable due to the previous root canal treatment. Articulating paper was used to further check the occlusal contacts, which confirmed that percussion, palpation, and mobility were all within the normal limits. No Temporomandibular Joint Dysfunction was found, and crown margin fits well. Pulpal and periodontal diagnosis is previous root canal treatment and symptomatic peri-radicular periodontitis. Two treatment options planned for tooth #19 includes nonsurgical endodontic retreatment with possible future endodontic microsurgery or laser-assisted surgical endodontic retreatment. The former option is more conservative and less aggressive but could be costly if an apicoectomy is needed after the retreatment, which would result in additional cost, recovery time, and compromised future health issues. The latter option is an aggressive treatment; however, it is less costly and saves much more of the patient's time soon after.

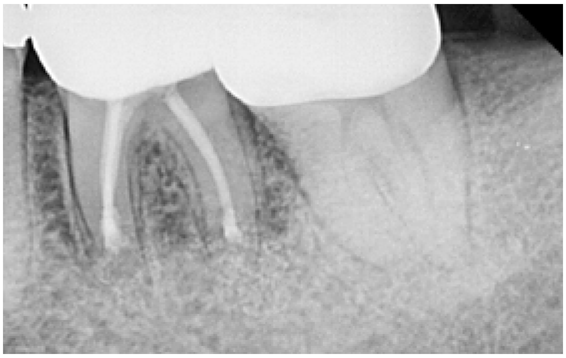
1. *Pre-op Treatment.*

The patient fully understood the choices and selected the latter option of laser assisted apicoectomy of 2 roots and 3 fills with Er,Cr:YSGG, and diode laser assisted due to his financial conditions.

An inferior alveolar nerve block with 1 carpule of 3% mepivacaine along with 1 carpule of 2% lidocaine (1:200k epinephrine) and buccal nerve infiltration with 1 carpule of 2% lidocaine (1:50k epinephrine) were given. All steps of the apicoectomy procedure were done using PromiseVision 3D microscope (Seiler, USA). The submarginal flap was made with vertical release on the mesial of tooth #21 using the Er,Cr:YSGG (Erbium Chromium Yttrium Scandium Gallium Garnet) Waterlase iPlus (Biolase, USA) with flap setting of H mode, 3 watts, 20 Hz, 40% air, 20% water; using a MZ5 tip. The MZ5 zip tip has a diameter of 500 µm, length of 14mm and a calibration factor of 0.95. The laser settings were root amputation, H mode, 6 watts, 25 Hz, 50% air, and 80% water to section 3 mm from apices of MB, ML & D roots.

Methylene blue (Vista BLUE) was used to dye the granulomatous tissues and were completely removed with the laser, MZ5 14mm tip, and to check 360 degrees of root contour, canal spaces and expectantly no cracks were visible.

2. *Immediate Post-op Treatment.*



4. *6 Months Post-Treatment.*

3. *1 Month Post-Treatment.*

5. *1 Year Post-Treatment.*

Retro preparations on MB, ML& D canals were completed with ultrasonic KiS tips (Obtura Spartan), to clear the isthmus between MB & ML canals. Racellet 2 with 1.9 mg epinephrine (Pascal) were used to achieve hemostasis. Paper points were used to dry the canals. A final pass with SFT8 for disinfection.

NeoPutty MTA (Avalon Biomed) was used to retro fill all three canals and the isthmus (*Fig. 2*). Before closing the wound, the surgical field was carefully checked and rinsed. Wound margin adaptation obtained and closed with 4.0 chromic gut suture. Slight compression with gauze helped bring the periosteal tissue into contact with the bone.

The 940nm wavelength Epic X (Biolase, USA) with a setting of continuous wave (CW) at 5 watts for 40 seconds (200 joules) was used for photobiomodulation. Post-op instructions given afterward.

DISCUSSION

Patient involvement and understanding of the procedure are necessary to facilitate a successful treatment—not necessarily a surgical one—but one of expectation and outcome. Once the patient understood the situation and the choices, surgical or extraction, he was less fearful and apprehensive given that the patient would be on the chair for around two hours.

The modern use of microscopes and lasers has greatly led to the increasing predictability and success rate of endodontic microsurgery, improving from 74% to 95%. [6,7,8,9] Being able to visualize the area of surgery cannot be understated. Previously, using a handpiece provides tactile feedback, but would result in reduced or absolutely no visibility within the working area. This dictates the usage of a microscope along with the use of laser to fully view the surgical area since it would not interfere by blocking visibility unlike a handpiece.

Being able to ablate both the soft and hard tissues result in less pain, faster healing via bio-stimulation, and control of the collateral damage of the surrounding tissue.[10,11,12] Laser ablation has demonstrated no cracking or fractures of the root's structure thus providing an additional benefit for its usage.[13] These benefits are the result of using the Er,Cr:YSGG laser in assisting with apicoectomy procedure, otherwise postoperative complications would mostly arise from using a handpiece.[14]

Von Arx et al. and Safi et al. both showed that MTA, mineral trioxide aggregate, used as a retro filling material has been seen to have better outcomes and fewer complications.[15,16] MTA is not only one of the most biocompatible materials, and has been utilized in cases demonstrating bone regeneration after endodontic microsurgery.[17,18,19]

A bur is absolutely unforgiving in this procedure since you would have to work extremely close to or on top of the fragile anatomic structures. There would be no visibility since the head of the handpiece has blocked all view, even with a microscope, especially on posterior teeth. Dental handpieces are well known for causing mechanical stress on tooth structure and increasing temperature.[20,21] Laser usage has allowed for precision and little to no collateral damages of the surrounding tissues.[22,23,24]

Incorporating both the microscope and Er,Cr:YSGG laser into the practice provides more choices for the patients, along with higher success rate. The previous treatment option would have only been extraction since successful and comfortable apicoectomy procedure would not have been viable.

During the entirety of the procedure, being able to position the patient comfortably and having visibility is the most important aspect of success. Just being able to see the work area is critical. The patient would mostly be on their side, with mouth closed so that their cheek would stretch out as large as possible, allowing access and bringing in the microscope.

After an hour and a half, your hand would ache from the retraction, and you would feel numbness throughout your hand. This feeling is a recurring issue for surgeons performing microsurgery in the posterior regions, much more so than in the anterior areas. If retraction could be achieved without the surgeon or assistant doing it manually, the procedure would be faster and less tiresome.

Another important aspect of endodontic microsurgery on the posterior area is it would be much harder to access the crypt if there is a lack of dehiscence. The presence of a dehiscence allows for immediate location and simpler access to the crypt, since it would be visible due to the exudate coming from the gingiva, and exposed after flapping. The posterior buccal cortical plate is thicker, and the surgeon would need to penetrate through several millimeters of dense bone to locate the crypt. While at the same time, care is needed to make sure that the location of the entry is correct, otherwise the chance of accessing an incorrect root would be high. A dehiscence, in this case, would be a blessing.

RESULT

The patient was seen for post-op at 1 month (*Fig. 3*), 6 months (*Fig. 4*) and 1 year (*Fig. 5*). Periapical radiographs revealed intact PDL & bone reattachments around apices of the mesial and distal roots. Throughout the 1-year time span, the patient is asymptomatic with periodontal probing depth of 1-2mm.

The results of the tooth #19 apicoectomy (*Fig. 5*) demonstrate that the Er,Cr:YSGG laser can be used effectively and safely. Where accessibility and visibility are the clinician's chief concerns, the Er,Cr:YSGG laser makes it possible to complete this procedure. New bone growth, faster healing, and little to no pain reported by the patient are all advantages to consider when integrating the laser into one's practice.■

ABOUT THE AUTHOR

Dr. Cam Ngoc T. Dong

Dr. Cam Ngoc T. Dong is a highly experienced and dedicated dentist with a successful practice located in Houston, Texas. Her passion for excellence in clinical dentistry has led her to teaching the next generation of dentists. Dr. Dong has a Doctorate of Dental Surgery from Ho Chi Minh City University of Medicine & Pharmacy in Vietnam, and the University of Texas Health Houston School of Dentistry. She received a Postgraduate Diploma in Advanced Restorative Dentistry from the University of Manchester School of Medical Sciences in the UK, and a Master of Science in Advanced Dental Studies (MADS), concentrating in Endodontics from the University of Pennsylvania School of Dental Medicine. Dr. Dong also has achieved a Fellowship from the World Clinical Laser Institute (WCLI), an Associate Fellowship from the International Congress of Oral Implantologists.

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A 3-YEAR UPDATE

Comparison Between Single and Multiple Adjunctive Er,Cr:YSGG Application to Scaling and Root Planing in Periodontal Maintenance Patients with Residual Periodontal Pockets

By Nuttha Watchanasanout and Thitiwan Teparat-Burana

M Dent J 2021; 41: 157-164 .

INTRODUCTON

Periodontal maintenance or supportive periodontal therapy (SPT) is necessary after the completion of active treatment to maintain periodontal health and prevent the recurrence of disease.[1] One of the risk indicators for tooth loss and progression of periodontitis during SPT is a residual probing pocket depth ≥ 6 mm.[2]

One recommended predictor of recurrent periodontitis is loss of attachment level of at least 2 mm.[3] During SPT, nonsurgical treatment should be the first choice for patients diagnosed with recurrent periodontitis, while further periodontal surgery may be necessary.[4]

Adjunctive laser treatment, in addition to conventional mechanical methods, promotes the healing process by removing the epithelial lining in residual periodontal pockets. This has a beneficial bactericidal effect and allows detoxification of the root surface without producing a smear layer.[5] An Er,Cr:YSGG laser with a 2,780 nm wavelength can penetrate energy into more shallow tissue as it has a higher absorption coefficient in water than other lasers.[6] Previous short-term studies showed that Er,Cr:YSGG lasers could be used as an alternative or assistant therapy to scaling and root planing (SRP), providing additional efficacy;[7-10] however, some studies indicated opposite results,[11-13] with controversial effectiveness of Er,Cr:YSGG lasers for periodontitis treatment.

Meta-analysis results indicated significant differences for probing depth (PD) reduction between Er,Cr:YSGG laser adjunct/substitute to SRP and SRP alone at 1 and 3 months after treatment. PD reduction 6 months after treatment also showed no significant differences. Clinical attachment level (CAL) change at 1 month after treatment was not significantly different between Er,Cr:YSGG laser adjunct/substitute to SRP

***Figure 1:** Group A (Single Er,Cr:YSGG + SRP), a. Pre-treatment b. 3 months after treatment. c. 6 months after treatment.*

and SRP alone. A significant difference in CAL was recorded at 3 months after treatment but with no significant difference at 6 months.[14]

Some previous clinical studies using an Er,Cr:YSGG laser involved a single application,[10,15] while others used multiple applications.[7,8] Only one short-term study compared the clinical results between single and multiple laser applications and indicated that both resulted in PD reduction. Single Er,Cr:YSGG applications achieved higher attachment level gain, while multiple applications resulted in increased gingival recession; however, no statistically significant differences were found between these two treatment modalities.[16] The purpose of this investigation was to identify long-term results after single or multiple adjunctive Er,Cr:YSGG applications to SRP in periodontal maintenance patients with residual periodontal pockets.

METHODS AND MATERIALS

This split-mouth, double-blinded, randomized clinical trial followed study protocol that was reviewed and approved by the Ethics Review Committee for Human Research at the Faculty of Dentistry and Faculty of Pharmacy, Mahidol University (MU-DT/PY-IRB 2021/002.0401) and the Thai Clinical Registry Committee (TCTR 20210216005). Seventeen subjects who had participated in a previous experiment[16] were invited to enroll in this study. Informed consent was obtained from all participants. Exclusion criteria included **(1)** the use of systemic antibiotics and anti-inflammatory drugs within the previous 3 months, and **(2)** exposure to previous periodontal surgery or extraction. Admission criteria and the experimental design were as previously reported.[16] In brief, 17 periodontal maintenance patients who had two single-rooted teeth with PD 5-9 mm, bleeding on probing (BOP), and full mouth plaque score <30% were enrolled. One blinded and calibrated examiner (NW) carried out all the measurements at the baseline, 3 months, and 6 months after treatment. The variables recorded were as follows: **1)** presence/absence of supragingival plaque at the gingival margin (PI 1/0); **2)** presence/absence of BOP (GBI 1/0).

Clinical parameters were measured using a personalized acrylic stent as **3)** PD; **4)** Relative probing attachment level (RPAL) measured from the apical border of the stent to the most apical part of the sulcus and 5) Relative gingival recession (RGR) measured from the apical border of the stent to the gingival margin. All studied teeth were treated under local anesthesia (2% mepivacaine, 1:100,000 epinephrine) by an experienced periodontist (TTB). An Er,Cr:YSGG device (Waterlase, BIOLASE, USA) with wavelength 2,780 nm was used to treat group A (single Er,Cr:YSGG application + SRP) and group B (multiple Er,Cr:YSGG applications + SRP).

Treatment methods were as previously reported.[16] In brief, the laser system was set to power output 1.5 W, pulse 30 Hz, 40% air, 50% water, and H-mode. Outer and inner gingival epithelial lining was removed by a radial firing periodontal tip (RFPT). Then, the laser system setting was changed to power output of 1.5 W, pulse 30 Hz, 10% air, 10% water and H-mode to induce blood coagulation. At the end of the 1st visit, studied teeth were divided

***Figure 2:** Group B (multiple Er,Cr:YSGG + SRP), a. Pre-treatment b. 3 months after treatment. c. 6 months after treatment.*

randomly into group A (single Er,Cr:YSGG application + SRP) and group B (multiple Er,Cr:YSGG applications + SRP) by a research assistant. For group B, the same procedures were performed for outer and inner epithelial lining removal at the 2nd, 3rd and 4th week, respectively. After 6 months, all patients were enrolled for a 3-month interval SPT course. Three years after the initial treatment, twelve patients agreed to participate in this study, while 5 patients dropped out. One was excluded because periodontal surgery was performed on the treated tooth, while the other 4 patients failed to attend the evaluation appointment (1 had brain surgery and 3 had moved to other cities) (*Figure 1*). All patients were re-assessed by the same examiner, with all variables recorded, and full mouth SRP was performed.

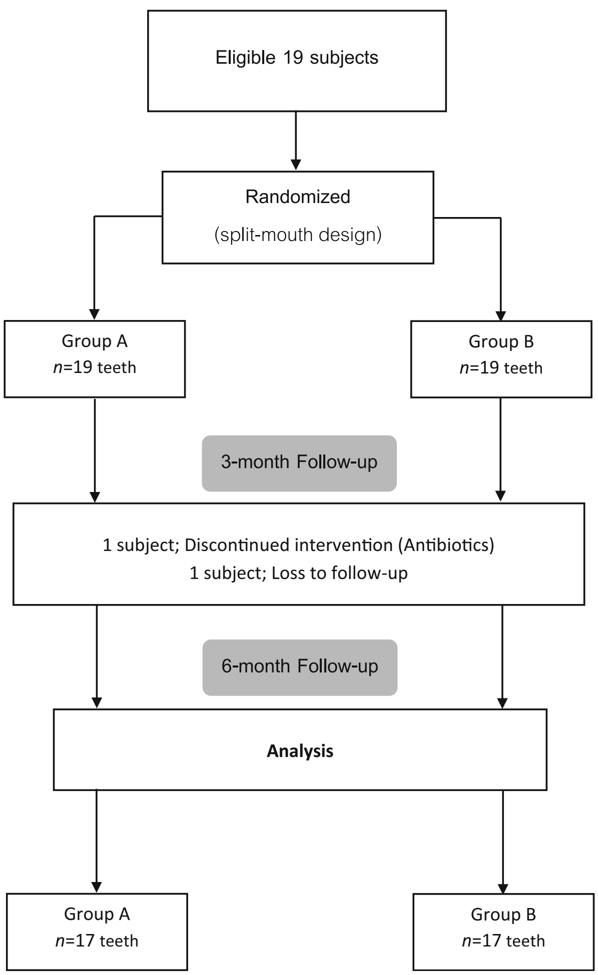

Figure 3: Flow Chart of Study Design

STATISTICAL ANALYSIS

Statistical analysis was conducted using SPSS for Windows version 23. The null hypothesis was rejected at a 0.05 level of significance. Intragroup differences of PD, RPAL and RGR were analyzed by the Friedman test. Intergroup differences of PD, RPAL, RGR and changes between groups were compared using the Wilcoxon matched-pairs signed-rank test. Both inter-group and intra-group GBI and PI were compared by the related sample McNemar's test.

For the remaining 12 patients (10 females, 2 males), mean age was 57.17 ± 9.15 years. PI at baseline showed no statistically significant differences ($p>0.05$) between the two groups (*Table 1*). Percentages of plaque presence sites (PI=1) in groups A and B were unchanged throughout the study with no statistically significant differences between groups (*Table 1*). Percentages of gingival bleeding sites (GBI=1) in both groups were lower at 3 years compared to the baseline and 6 months, with no statistically significant differences either at 6 months or 3 years between the two groups (*Table 2*).

PD at baseline showed no statistically significant differences ($p>0.05$) between the two groups (*Table 3*). Mean PD values at the 3-year follow-up in groups A and B were 3.83 ± 1.19 mm and 4.00 ± 1.04 mm, respectively. Mean PD reductions at the 3-year follow-up compared to 6 months were 0.58 ± 0.09 mm (group A) and 0.42 ± 1.08 mm (group B). Mean PD values at the 3-year follow-up were significantly different from the baseline ($p<0.05$) in both groups (group A 2.00 ± 1.35 mm, and B 1.33 ± 1.23 mm), with no statistically significant differences between groups at all time points ($p>0.05$) (*Tables 3 and 4*). RPAL values 3 years after treatment in groups A and B were 8.42 ± 2.11 mm and 9.58 ±1.78 mm, respectively. Group A had RPAL gain of 1.42 ± 1.56 mm, which was clinically significantly different from the baseline, while group B gained 0.50 ± 1.00 mm which was clinically insignificant (*Table 3*). No statistically significant differences were recorded between the two groups ($p>0.05$) (*Table 4*).

The RGR of group B significantly increased (0.75 ± 0.75 mm) from the baseline, while the RGR in group A increased insignificantly (0.58 ± 0.67 mm) (*Table 3*). No statistically significant differences were recorded between the two groups ($p>0.05$) (*Table 4*).

Differences in PD, RPAL and RGR at 6 months and 3 years after treatment were not found in either of the two groups, while mean change values were not statistically different between the two groups.

DISCUSSION

Previous clinical studies reported using the Er,Cr:YSGG laser for non-surgical periodontal treatment in both single and multiple applications.

Group	Baseline	3 months	6 months	p value 3 months vs. baseline	p value 6 months vs. baseline
A	11.76%	35.29%	23.50%	0.219	0.625
B	35.29%	35.29%	29.41%	1.00	1.00
p value	0.125	1.00	1.00		

Table 1: *Percentage of teeth with presence of plaque in groups A and B at baseline, 3 months and 6 months after treatment*

Group	Baseline	3 months	6 months	p value 3 months vs. 6 months
A	100%	58.82%	88.24%	0.125
B	100%	52.94%	76.47%	0.344
p value		1.00	0.687	

Table 2: *Percentage of teeth with bleeding on probing (BOP) in groups A and B at baseline, 3 months and 6 months after treatment*

Variables	Group	Baseline	3 months	Δ0–3 months	6 months	Δ0–6 months
PD (mm)	A	5.58 ± 0.71	4.53 ± 0.87	− 1.06 ± 1.09**	4.41 ± 1.06	− 1.18 ± 1.47**
	B	5.41 ± 0.71	4.41 ± 1.42	− 1.00 ± 1.12**	4.41 ± 1.37	− 1.00 ± 1.22**
Difference between groups		NS	NS		NS	
RPAL (mm)	A	9.65 ± 1.84	9.00 ± 1.54	− 0.65 ± 1.06**	8.82 ± 1.42	− 0.82 ± 1.29**
	B	10.24 ± 1.35	10.29 ± 1.49	0.06 ± 0.83*	9.94 ± 1.78	− 0.29 ± 1.10*
Difference between groups		NS	$p = 0.04$		NS	
RGR (mm)	A	4.06 ± 1.52	4.47 ± 1.50	0.41 ± 0.80*	4.41 ± 1.73	0.35 ± 1.22*
	B	4.82 ± 1.29	5.82 ± 1.63	1.00 ± 0.94**	5.53 ± 1.33	0.71 ± 0.69**
Difference between groups		NS	$p = 0.029$		NS	

* $p > 0.05$
** $p < 0.05$

Table 3: *Clinical parameters of groups A and B at baseline, 3 months and 6 months after treatment*

Change values	Group A	Group B	p value
PD reduction (mm)	1.18 ± 1.47	1.00 ± 1.22	0.512
RPAL gain (mm)	0.82 ± 1.29	0.29 ± 1.10	0.07
Increased RGR (mm)	0.35 ± 1.22	0.71 ± 0.69	0.506

Table 4: *Mean ± SD of change values of probing depth (PD), relative probing attachment level (RPAL), and realtive gingival recession (RGR) between baseline and 6 months after treatment in both groups.*

Adjunctive application of an Er,Cr:YSGG laser to SRP is a minimally invasive procedure. Only one study compared single and multiple laser applications[16] and presented short-term results.

This is the first study reporting long-term results comparing single and multiple laser applications. Percentages of sites with the presence of plaque in both groups were unchanged at all time points, and no statistically significant differences were recorded between the treatment modalities. This implied that the outcomes of laser treatment did not result from the patient's plaque control. Lower percentages of bleeding sites were found at the 3-year follow-up compared to the baseline in both groups, concurring with other short-term studies.[7-10]

Results demonstrated that mean PD reduction, attachment level gain and gingival recession were unchanged at 6 months and 3 years after treatment in both groups, with no statistically significant differences between groups at the long-term follow-up.

Some clinical studies reported using the Er,Cr:YSGG laser as an adjunct to SRP. Magaz et al.[15] conducted a comparative study between SRP by curette and SRP followed by Er,Cr:YSGG laser application. Six months after treatment, PD reduction and GR were recorded in both groups, with no statistically significant differences between groups but improved clinical attachment level (CAL) gain in the SRP group. By contrast, a study using Er,Cr:YSGG as an adjunct to SRP in SPT patients determined different results. SRP combined with Er,Cr:YSGG showed better PD reduction and CAL gain than SRP alone at 3 months after treatment.[10] A meta-analysis of randomized controlled trials reported additional effectiveness with Er,Cr:YSGG lasers in PD reduction and CAL gain at short-term follow-up (1-3 months).[14]

Multiple application Er,Cr:YSGG as an adjunct to SRP was reported in two studies. Kelbauskiene et al.[7] used Er,Cr:YSGG once a week for 3-4 weeks. Results showed PD reduction and CAL gain but gingival margin level did not change. Another study, that used three Er,Cr:YSGG cycles every third day, reported similar results.[9] Watchanasanout & Teparat-Burana were the first to compare single and multiple applications as an adjunct to SRP at the 6-month follow-up. Results showed PD reduction and increased RGR in both treatment modalities but with no significant differences. Single applications showed increased RPAL gain over multiple applications.[16] Our study evaluated results at 3 years after the initial treatment. Comparisons between single and multiple Er,Cr:YSGG laser application sites showed a trend toward greater attachment level gain at single application sites. However, differences between the two treatment modalities were not apparent in PD reduction, RPAL gain and increased RGR.

Decreased percentages of bleeding on probing in both groups were recorded at 3 years compared to the baseline and 6 months, with no significant differences between the two groups either at 6 months or 3 years, possibly as a result of the resolution of inflammation in periodontal tissue. Results in the literature suggest low GCF volume in healthy periodontal tissue[17] and this significantly decreased in the adjunctive Er,Cr:YSGG laser with SRP at up to 6 months after treatment, with no statistical significance between treatments with and without laser.[18] Some studies showed that the level of IL-1β, which directly regulates several gene expressions during inflammation,[19] decreased significantly at 6 months versus the baseline in both with and without adjunctive Er,Cr:YSGG laser treatment with SRP.[18, 20-21]

A histological study in bone and soft tissue of rabbit jaws after irradiation with Er,Cr:YSGG laser reported that the alveolar mucosa had completely healed by the seventh day but reconstruction of collagen fiber was not complete at 28 days.[22] The healing process of surrounding tissues may be disturbed by repeated laser applications. Further studies should investigate multiple laser applications only at the outer surface,without disturbing the healing process in the gingival sulcus. This might retard epithelial migration and result in better clinical outcomes.

The outcome variables in this study were clinically evaluated and no histologic samples were taken. A previous study evaluated the histological outcome of laser-assisted new attachment procedure (LANAP). Nine months after treatment, 10 teeth were extracted and histologically analyzed. The majority showed new cementum formation and insertion of collagen fiber, while the others presented a long junctional epithelium.[23]

Further histological evaluation in healing after non-surgical periodontal treatment by Er,Cr:YSGG should be conducted. Limitations of this study included the small number of participants and lack of a dedicated SRP group.

CONCLUSION

Results demonstrated that adjuncive single and multiple Er,Cr:YSGG laser applications improved clinical results, with decrease in BOP and PD but RPAL gain. However, no statistically significant differences were recorded between the two treatment modalities 3 years after the initial treatment. This laser procedure may be of benefit for recurrent periodontitis patients during periodontal maintenance. ■

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ABOUT THE AUTHORS

Nuttha Watchanasanout
Kalasin Hospital, Kalasin, Thailand

Thitiwan Teparat-Burana
Department of Oral Medicine and Periodontology, Faculty of Dentistry, Mahidol University, Bangkok, Thailand
EMAIL: thitiwan.tep@mahidol.ac.th

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Er,Cr:YSGG Laser in the Treatment of Gingival Proliferative Verrucous Leukoplakia

A Case Report

By Dr. Pavel Polenik

INTRODUCTION

Oral leukoplakia is defined by the World Health Organization (WHO) Collaborating Centre in 2020 as "White plaques of questionable risk having excluded (other) known diseases that carry no increased risk for cancer".[1] It is the most common oral pre-cancerous lesion and, by definition, oral leukoplakia excludes white lesions such as frictional keratoses, namely benign alveolar ridge keratosis, morsicatio buccarum, and other specific diagnoses such as leukoedema, oral hairy leukoplakia and candidiasis to name a few.[2]

The most common sites for oral leukoplakia are the tongue (36–50%), buccal mucosa (18–26%), floor of the mouth (8–22%), gingiva (6–22%), and mucosa of hard palate (7%).[3] Common sites for malignant transformation are the tongue, buccal mucosa, gingiva, and floor of the mouth, and 4–20% of gingival leukoplakias undergo malignant transformation.[4] Although the gingiva is not the most common site for leukoplakia, it is a site with a high recurrence rate of 42–53%.[5] Among oral leukoplakias, there is a distinct pathological entity first described by Hansen et al. in 1985: proliferative verrucous leukoplakia (PVL). Its malignant transformation rate is the highest of all potentially malignant lesions in the oral cavity.[6]

Most authors estimate a ratio of women to men of 4:1. Conversely, Palaia et al. found that women with PVL were 1.7 times more likely to experience malignant transformation and transformation to squamous cell carcinoma is estimated to be 3 times higher for women than for men.[7] The literature reports that PVL lesions are most commonly located in the gums and alveolar mucosa, followed by the jugal mucosa, the tongue, the palatal mucosa, the floor of the mouth and the lips. There is a sub-type of PVL called gingival PVL, which occurs around the marginal gingiva of teeth and is particularly common in the anterior region. The literature indicates that these lesions are multifocal in almost all patients. Most authors mention smoking habits in their cohort but seem to exclude smoking as a risk factor for developing PVL. The few studies reporting alcohol consumption in their patients agree it should be excluded from the etiological factors for the occurrence of PVL.

The abnormality of this lesion is its macroscopic variability according to its clinical stage and location. The different developmental stages of this disease can be observed at the same time, in the same patient and at different sites. The lesions tend to go through 4 main clinical stages. In the initial stages, we can see an isolated, homogeneous leukoplakia that is predominantly white or inhomogeneous, possibly with erythematous halo-like margins, thin or thick, with a smooth surface, non-protuberant, soft on palpation or verrucous and often asymptomatic. It does not disappear after removal of apparent traumatic causes, is persistent and does not detach when scraped. Gradually, the lesions multiply and become thick, exophytic, papillomatous and/or verrucous and hard upon palpation.[8,9]

Major and minor criteria have been proposed in connection with differential diagnosis of PVL.

Figure 1

PVL affecting vestibular gingiva of lower right quadrant

MAJOR CRITERIA:

- Lesion with at least 2 different sites in the oral cavity,
- Presence of verrucous area
- Changes in lesion size during the development
- Recurrence in previously treated area.

MINOR CRITERIA:

- All areas together occupying at least 3 cm2 ,
- Female patient,
- Non-smoking patient,
- Disease manifestation longer than 5 years.

Oral verrucous hyperplasia and verrucous carcinoma can be one of the intermediate stages of PVL but can also occur in isolation.

Given the fact that the proliferative verrucous hyperplasia is connected with high rate of malignant transformation, repeated histological examination and frequent re-evaluation, removal of complete lesion are the best prevention of possible complications. Surgical access includes classic use of scalpel, electrosurgery, cryotherapy and laser surgery. Surgical removal with scalpel seeks to totally remove lesions, which is rarely possible given the multifocality of the lesions and the tissue loss that this procedure involves. This procedure may often require additional treatments, advanced surgery with tissue flaps or skin grafts that cannot guarantee eradication of the disease. Excision of gingiva, especially presenting as extensive lesion, is very suitable for laser use. Lasers show advantages over classic surgery due to better visualization mediated by good hemostasis of surgical site and eliminating the need for sutures. Furthermore, universal is decontamination of surgical field and substantial reduction of postoperative pain and oedema.

There is insufficient scientific evidence to conclude that any treatment strategy is capable of reducing PVL recurrence rate.

CASE REPORT

A 62 year-old-patient was referred for evaluation and treatment of white lesions affecting free and attached gingiva in all four quadrants. Generally healthy person and also history of smoking and alcohol drinking was negative. Periodontal examination revealed mild chronic gingivitis with localized manifestations of initial chronic periodontitis. Vestibular areas of premolar and molar regions were covered by white, mostly homogenous, verrucous plaques firmly connected with epithelial base. Detail of specific surface quality in lower right quadrant is visible in Figure 1.

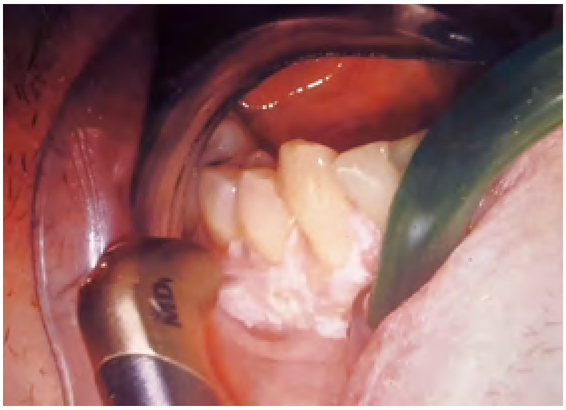

Figure 2

Ablation of gingival hyperkeratotic epithelium using the YSGG laser

Under the diagnostic hypothesis of PVL, an incisional biopsy was taken in the anterior region of the lesion by conventional surgical technique under local infiltrative anesthesia with Ultracaine D-S forte (Hoechst, Germany). Microscopic analysis showed typical corrugated hyperkeratosis with mild epithelial dysplasia. On the basis of the result of biological activity, the lesion was indicated for complete removal. For this purpose, 2780 nm Er,Cr:YSGG Waterlase iPlus (Biolase, CA, USA) was used with 2,50 W power, 75 Hz frequency, H-mode (60 µs pulse duration), 20% air, 40% water and MC3 -9 mm tip. The procedure was performed without anesthesia (*Fig.2*). The final result of laser therapeutical ablation is visible in Figure 3. The course of healing was asymptomatic and comfortable. Next examination after 3 months revealed specific recurrency of hyperkeratosis affecting marginal part of previously treated gingiva (*Fig.4*).

Figure 3

Affected region after laser ablation

Figure 4

Recurrency of proliferative leukoplakia affecting marginal gingiva

Figure 6

Ablation of intrasulcular hyperkeratosis using RFPT5.

Figure 7

Area of treated PVL after 2 years of follow-up.

Arrangement of new hyperkeratotic lesion gave rise to presumption, that the source of recurrency could be invisible and untreated sulcular epithelium. One possible explanation for recurrence is that the complete removal of such gingival leukoplakias is almost impossible if the associated teeth are not removed, because of involvement of the sulcular epithelium so that any remnant dysplastic cells repopulate the oral surface of adjacent gingiva (*Fig.5*). The subsequent

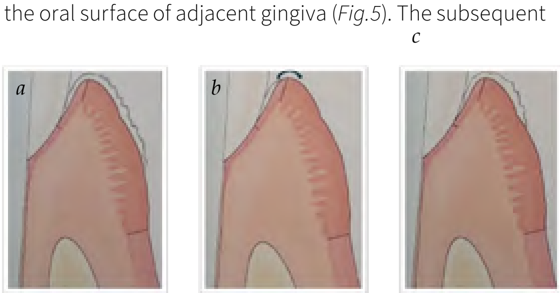

Figure 5

a- hyperkeratosis before treatment localized on the surface oral gingival and sulcular epithelium, b- rest of hyperkeratosis covering sulcular epithelium after removal of oral part, c- residual hyperkeratosis as a source of recurrency.

step of the treatment was directed to detailed removal of persistent hyperkeratotic layers. Visible oral part of the lesion was removed using the same laser, according to the parameters already mentioned. Intrasulcular ablation of hyperkeratotic epithelium was mediated by the same laser device, but at different settings and using periodontal radial firing tip RFPT5-14 specifically designed for intrasulcular applications. Settings were adjusted to 1,50 W power, 30 Hz frequency, H-mode (60 µs pulse duration), 40% air and 50% water. The tip movement inside gingival sulcus was continual at velocity of 2 mm/s. Healing process occurred normally, the patient has been under follow-up, and no clinical signs of recurrence of the lesion were observed during subsequent 2 years (*Fig.6*).

DISCUSSION

Different types of lasers have been described in connection with the treatment of oral hyperkeratotic lesions, such as CO_2, Nd:YAG, Er:YAG or diode lasers, with very good results.[10,11] But gingiva is specific oral region due to the very thin layer of soft tissue covering sensitive alveolar bone and especially marginal gingiva could be vulnerable in interaction with lasers showing deep penetration. Moreover, multiple layers of keratinized cells of leukoplakia are free of specific chromophores for diode lasers of NIR spectrum and hyperkeratotic tissue removal is not ablative but excisional which is connected with more significant loss of gingival tissue. This scenario could be unfavourable especially for thin gingival biotype. Er,Cr:YSGG laser is able to remove hyperkeratosis layer by layer without traumatic effect on underlying structures due to shallow penetration depth. This mechanism of laser ablation is also helpful for the visual control of tissue preparation. Complete removal of hyperkeratosis is essential step in succesful treatment and prevention of PVL recurrence.

It has been shown that the gingival connective tissue base will determine the characteristics of the overlying epithelium by carrying the genetic determinants for its specificity including keratinization.[12] Since there is no apparent difference between the connective tissues underlying the sulcular and the outer gingival epithelium, it seems reasonable to assume that both epithelia, under the influence of the same connective tissue, may carry the same intrinsic potential for keratinization. The research findings indicate that the sulcular epithelium has potential for keratinization and its deepithelization is a delicate procedure incorporating the positive therapeutical effect on the one hand and possible destructive potential affecting the rest of marginal gingiva on the other hand. Bandara et al.[13] described a case of PVL of the gingiva treated with CO_2 laser ablation and the lesion recurred twice within a short time despite the surgical resection following the first recurrence. According to the presented pictures, clinical manifestation was nearly the same as in the case of our patient after first laser treatment, but the targeted removal of sulcular epithelium has not been mentioned.

Hypoxia-inducible factor-1α (HIF-1α), a glycoprotein with tyrosine kinase activity, plays a crucial role in progression of oral leukoplakias and is connected to the recurrence of PVL lesions. Consequently, HIF-1α levels are a reliable predictor of postoperative recurrence after ablative surgery. Previous studies have shown that erbium laser irradiation significantly downregulates the expression of HIF-1α and pro-inflammatory cytokines and promotes keratinization.[14,15] By stimulating fibroblast proliferation, erbium laser irradiation enhances wound healing, ultimately reducing postoperative recurrence rates.[16]

CONCLUSION

In conclusion, Er,Cr:YSGG laser is efficient and safe device for ablative therapy of gingival PVL. Combined thermal and mechanical ablation mechanism constitutes rapid vaporization and micro-explosions due to pressure exceeding tissue structural integrity and achieving precise excision of the diseased tissue. The observed changes in the biochemical profile of treated tissue with subsequent inhibition of postoperative recurrence are promising, and require further investigation.

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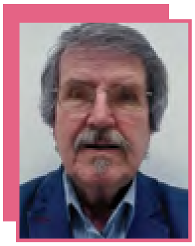

ABOUT THE AUTHOR

Dr. Pavel Polenik

Pavel Polenik graduated from the Charles University Prague, Czech Republic and started his professional life as Assistant Professor at Dept. of Periodontology of Charles University , Medical Faculty Pilsen. After research fellowship at Aarhus University (Danmark) founded laboratory of Oral Biology with significant impact on contemporary research in the field of laser therapeutical methods. In 1992 received degree Associate Professor and since 1995 parallel activities in private practice directed to periodontology and laser dentistry. 23 years user of laser technologies of many wavelengths. Member of European Federation of Periodontology, member of WFLD, member of former ESOLA, graduate of ESOLA Laser Academy (Vienna, 2007), president of CZESOLA, mentor of oral laser application for oral laser users in Czech Republic.

Currently, research directed to the application of nanotechnologies in the laser dentistry with significant response during world congresses in nanotechnologies.

The Use of Diode Laser for the Surgical Removal of Pyogenic Granuloma of the Dorsum of the Tongue:

A Case Report

By Lubna M. Al-Otaibi , Mohammed M. Al-Ali
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ABSTRACT

Pyogenic granuloma (PG) is a common reactive oral lesion predominantly involving the gingiva and rarely occurring on the dorsum of the tongue. It can develop at any age but more commonly in the second decade with a female predilection. Numerous factors are associated with its development, and surgical removal is the standard treatment.

Various surgical modalities have been used to excise it. Herein, we report a case of a female patient in her late 60s who presented with an exophytic lesion involving the dorsum of the tongue, which was excised using a 940 nm diode laser. In addition, it discusses the advantages of diode laser as a surgical modality and describes this lesion's clinical features and pathogenesis.

INTRODUCTION

Pyogenic granuloma (PG) is a common reactive exophytic pedunculated or sessile soft tissue growth that can occur in the oral cavity.[1,2] The etiology of PG still needs to be clarified. However, numerous factors have been reported to be associated with its development, such as local irritation, trauma, dental plaque, hormonal factors, and some medications.[2-4]

Although PG may develop at any age, the highest prevalence was in the second decade. Pyogenic granuloma occurs more commonly in females, which may be attributed to the vascular effects of female hormones.[1,5,6]

The prevalence of oral pyogenic granuloma is estimated to be around 1.85% among all oral hyperplastic lesions. It primarily affects the keratinized gingiva, with a higher incidence in the maxillary gingiva than the mandibular gingiva and a greater occurrence in the anterior rather than the posterior region. Involvement of extra-gingival areas, such as the buccal and labial mucosa, palate, and tongue, is rare.[7,8]

The standard treatment for oral PG includes eliminating the etiological factors and conservative surgical removal of the lesion. Various surgical modalities have been used to excise oral PG. Cryosurgery, cauterization with silver nitrate, sclerotherapy, injection of absolute ethanol, sodium tetradecyl sulfate and corticosteroids, and neodymium-doped yttrium aluminum garnet (Nd:YAG) and CO_2 laser, as well as laser photocoagulation, have all been proposed as treatment options.[2,3,5,6,9]

Oral PG has no potential for infiltrative growth or malignant transformation. The recurrence rate after conservative excision is approximately 16%, with a higher chance of recurrence when it involves the gingiva or appears in pregnant women. Incomplete surgical removal, failure to eliminate the cause, and new trauma to the area can lead to recurrence.[1,2,10]

Herein, we present a case of PG involving the dorsum of the tongue in a medically compromised female patient. The lesion was excised using a 940 nm diode laser, which resulted in a short healing period with no postoperative pain, ulceration, or scarring.

CASE PRESENTATION

A 69-year-old Saudi female patient presented to the oral medicine clinic in Prince Sultan Military Medical City in Saudi Arabia with a chief complaint of a lesion on her tongue. The patient had noticed this lesion about one year ago. It was painless and did not increase in size.

The patient was previously diagnosed with hypertension, hyperlipidemia, osteoarthritis, and osteoporosis. She was under medical care for these conditions and was on the following medications: atenolol, atorvastatin, and IV denosumab. The extraoral examination was unremarkable.

The intraoral examination revealed a painless, well-circumscribed, exophytic, sessile, red, nodular lesion with a pink base (approximately 2 mm in depth) located on the right side of the dorsum of the tongue. It was rubbery in consistency and measured about 0.5 × 0.6 cm. Our clinical differential diagnosis included pyogenic granuloma, hemangioma, vascular malformation, and foreign body granulomatosis. Differentiation between these lesions depending only on the clinical appearance is impossible. Thus, biopsy and histopathological assessment of the obtained biopsy are required to reach the final diagnosis.

Patient laboratory tests were within normal limits, including complete blood count with differential, blood coagulopathy, and general profile. The lesion was excised under local anesthesia (mepivacaine 2%, approximately 1 mL) using a 940 nm diode laser (Epic, Biolase, Irvine, CA, USA) with an initiated E4-4mm surgical tip. The tip was applied in contact mode with a focused beam using the circumferential incision technique to excise the tissue (3.5 W, continuous wave mode). Bleeding was then stopped using the hemostasis setting (0.5 W, continuous wave mode), and two interrupted 4/0 coated VICRYL sutures were placed to avoid food and debris entrapment and contamination of the surgical site (*Fig. 1A-1D*). No postoperative medications were prescribed.

The specimen was placed in 10% neutral buffered formalin and was sent for histopathological examination. Microscopic examination showed a parakeratinized stratified squamous surface epithelium. The underlying connective tissue stroma was fibrous with numerous and various shaped and sized engorged blood vessels with a central lobulated area of a highly vascular proliferation of granulation tissue and endothelial cells. The endothelial cells were positive for CD31 (Clone JC70, Ventana/Roche, Tucson, AZ, USA) and negative for human herpesvirus 8 (HHV8) and cytokeratin (CK) AE1/AE3. Accordingly, the diagnosis of pyogenic granuloma (lobulated capillary hemangioma) was reached (*Fig. 2A-2C*).

The patient reported no postoperative discomfort, pain, or complication. The lesion showed adequate healing after only two days post-surgery. The two-week follow-up visit observed complete healing without ulceration or scarring. The patient was seen again at a three-month post-surgery evaluation visit and was found to be doing well with no complaints or recurrence of the lesion (*Fig. 3A, 3B*).

DISCUSSION

Pyogenic granuloma is a reactive hyperplastic neoplasm involving the oral cavity. Some authors claimed that the condition was initially reported by Hullihen in 1844, and the term pyogenic granuloma was established by Hertzel in 1904. Others claimed that Poncet and Dor originally reported the condition in 1897 as botryomycosis hominis, as they had suspected a fungal cause, while Crocker later

Figure 1 - Intraoral Photographs

A: Preoperative photograph showing an exophytic, sessile, red, nodular mass with a pink base (0.5 × 0.6 cm). B: Excision of the lesion using a 940 nm diode laser (E4-4mm surgical tip). C: The surgical site immediately after excision and hemostasis achievement. D: The wound was closed using 4/0 coated VICRYL sutures.

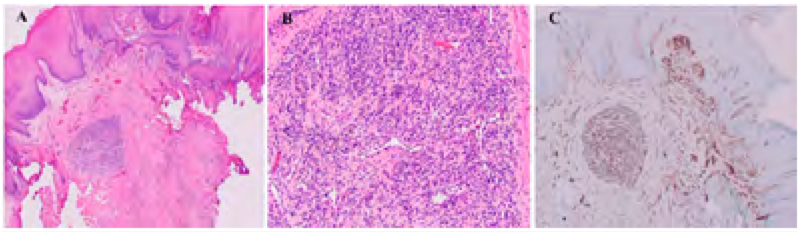

Figure 2 – Hematoxylin and eosin-stained and IHC microscopic photographs of the lesion

A: Low magnification shows fibrous connective tissue stroma with variable shaped and sized blood vessels with a central lobulated area (×4). B: Higher magnification of the lobulated area shows a highly vascular proliferation of granulation tissue and endothelial cells (×20). C: CD31 IHC stain highlights blood vessels and stained endothelial cells. IHC: immunohistochemistry, CD31: cluster of differentiation 31

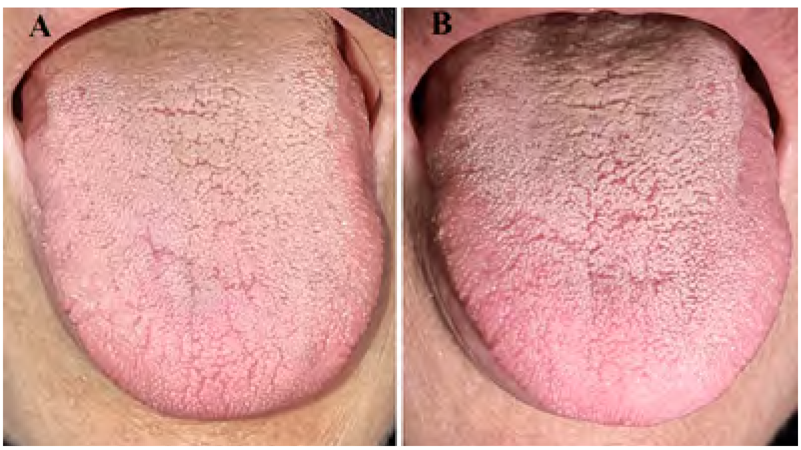

Figure 3 – Intraoral photographs of the operation site

A: Two weeks after the surgery. B: Three months after the surgery.

introduced the term pyogenic granuloma in 1903.[2,3,5,11] Hence, disagreement in the literature concerning PG's first report and nomenclature exists.

Various terms have been used in the literature for PG, such as granuloma pyogenicum, eruptive hemangioma, and granuloma gravidarum. The term pyogenic granuloma has also been considered inaccurate and misleading since this lesion is not accompanied by pus nor histologically resembles granuloma.[12,13] Clinically, PG usually manifests as a solitary, soft, exophytic, painless, pinkish-to-red mass with a pedunculated or sessile base that can be easily injured, causing bleeding.[3,14] However, in our clinical case, it was pinkish to red in color with a rubbery base. This may be due to the fact that it was a longstanding lesion in an easily injured location.

The highest prevalence of PG occurs in the second decade of life, with the gingiva being the most commonly involved intraoral site.[1,5,6] In our case, the lesion developed in an elderly female and on the dorsum of the tongue, which is considered rare.

The etiology of PG remains unclear, and numerous factors are associated with its development.[2-4] In this presented case, given the location of the lesion, trauma was suspected to have caused its development. However, the patient consistently denied any history of trauma or tongue-biting habit.

The clinical manifestation of PG can mimic other angiomatous intraoral lesions, presenting a significant obstacle to clinical diagnosis.[15] The differential diagnosis of PG involving the dorsum of the tongue includes hemangioma, vascular malformation, Kaposi sarcoma, angiosarcoma, and non-Hodgkin lymphoma.

The standard treatment of oral PG is conservative surgical removal and elimination of etiological factors.

Various surgical modalities have been used to excise oral PG.[2,3,5,6,9] During conventional scalpel blade surgery, PG may bleed easily and abundantly due to its high vascularity. This may restrict the surgeon's visibility, increase the operation time, and increase the chance of edema, hematoma, and postoperative pain.[16,17] Many advantages of using the diode laser compared to the scalpel blade have been discussed in the literature. These include decreasing the need for local anesthesia; hemostatic properties causing less intraoperative bleeding and need for sutures; shorter operation and healing time; microbial inhibition and destruction, thus maintaining a sterile condition; and reduction of postoperative pain and complications.[17-20] However, none of these studies included laser excision of a PG located on the tongue. Thus, to the best of our knowledge, this case represents the first to be reported.

In this reported case, where a 940 nm diode laser was used for the surgical excision, the procedure was found to be simple to perform with minimum bleeding and excellent precision. It was well accepted by the patient, who showed no signs of fear or discomfort during the procedure. She also reported no postoperative pain or complications. Optimum healing was achieved with no residual ulceration or scarring within two weeks. Moreover, the excised specimen was adequate for histopathological examination.

CONCLUSIONS

We presented a case of pyogenic granuloma, which was surgically removed using a 940 nm diode laser. The procedure was accomplished with minimum bleeding and discomfort. Postoperative healing occurred rapidly and without postoperative pain or scarring. Diode-assisted surgical excision provides a stress-free environment with a more comfortable experience for both the clinician and patient; thus, it should be considered as a practical alternative to the traditional surgical technique. ■

DISCLOSURES

Human subjects: All authors have confirmed that this study did not involve human participants or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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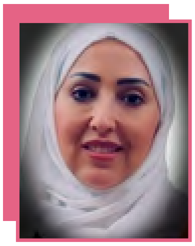

ABOUT THE AUTHOR

Dr. Lubna M. Al-Otaibi

Lubna Al-Otaibi has obtained her PhD degree from UCL, UK in 2008. She is a Consultant of Oral Medicine, Director of the Dental Center Education and Training Affairs and Head of Oral Medicine and Special Care Dentistry Department at Prince Sultan Military Medical City (PSMMC), Riyadh, Saudi Arabia. A member of multiple medical societies and committees, with many international publications and poster presentations. After obtaining a Fellowship in Laser Therapy in Dentistry from RWTH Aachen University in 2016, she has completed, presented and published many of her work related to this interesting field.

A CLINICAL LOOK

Using Photobiomodulation to Treat Orofacial Nerve Injury

Treating Nerve Injury after Endodontic Microsurgery Using Laser Photobiomodulation: A Report of 2 Cases

Austyn C. Grissom, DMD, MSD, I. Andrea Hernandez, DMD, et al.
J Endod. 2023 May;49(5):597-603. doi: 10.1016/j.joen.2023.01.011. Epub 2023 Mar 8. PMID: 36894023.

1. MATERIALS AND METHODS

This study is designed as a report of 2 cases of altered neurosensory sensation following endodontic microsurgery (EMS), treated postoperatively using photobiomodulation (PBM) therapy. The subjective assessment of neurosensory deficit was determined using a visual analog scale (VAS). The VAS scale was used in conjunction with 2 tests to determine the patient's ability to detect sensation, then marked and photographed. The areas of hypoesthesia were irradiated with a 940 nm diode laser (Epic X; Biolase, Inc, Foothill Ranch, CA) at a distance to the target tissue of 15mm, both extraorally and intraorally. The laser settings used were: power output of 0.6 W, time of 55 seconds, energy of 33 J, and an area of irradiation of 1.76 cm^2.

2. RESULTS

Patient number 1 was a healthy 45-year-old woman who initially presented to the Graduate Endodontic Clinic at The University of Texas Health Science Center at Houston School of Dentistry in June 2021 with a chief complaint of pain and swelling in the upper left quadrant. EMS was performed on tooth number 12 in July 2021. The patient presented with persistent facial hypoesthesia 2 months after surgery. It is suspected that the injury to the infraorbital nerve likely occurred because of a combination of direct trauma to the nerve during local anesthetic administration as well as a crushing injury during flap retraction. The report identifies this type of injury as a rare occurrance in periodontics. The patient reported she never regained sensation in her left upper lip extending up the left lateral border of the nose after the procedure; the area of hypoesthesia noted was concomitant with the infraorbital branch of the maxillary division of the trigeminal nerve (V2). The patient was treated with 1–2 sessions per week of PBM, performed in the Graduate Endodontic Clinic. The patient reported significant improvements after each visit to the clinic.

Patient number 2 was a healthy 45-year-old man who initially presented to the Graduate Endodontic Clinic at The University of Texas Health Science Center at Houston School of Dentistry in September

CASE REPORT/CLINICAL TECHNIQUES

Treating Nerve Injury after Endodontic Microsurgery Using Laser Photobiomodulation: A Report of 2 Cases

Austyn C. Grissom, DMD, MSD,*
I. Andrea Hernandez, DMD,*
Timothy C. Kirkpatrick, DDS,*
Shalizeh A. Patel, DDS, MEd,†
Juliana A. Barros, DDS, MS,†
and Eva Stanley, DDS, MS*

ABSTRACT

The purpose of this case report was to inform dentists and dental specialists about a noninvasive, viable treatment option that could aid in the recovery of patients who have experienced iatrogenic nerve injuries. Nerve injury is an inherent risk of many dental procedures and a complication that can negatively impact a patient's quality of life and activities of daily living. Managing neural injuries presents a challenge for clinicians because there are no standard protocols reported in the literature. Although spontaneous healing of these injuries can occur, the duration and degree of healing can vary greatly between individuals. Photobiomodulation (PBM) therapy is used as an adjunct in medicine for functional nerve recovery. Once target tissues are illuminated with a low-level laser during PBM, the light energy is absorbed by the mitochondria causing adenosine triphosphate production, modulation of reactive oxygen species, and the release of nitric oxide. These cellular changes explain why PBM has been shown to aid in cell repair, vasodilation, a reduction in inflammation, accelerated healing, and an improvement in postoperative pain. This case report presents 2 patients with neurosensory alterations after endodontic microsurgery with a significant improvement in their condition after PBM treatment using a 940-nm diode laser. *(J Endod 2023;49:597–603.)*

KEY WORDS

Diode laser; endodontic microsurgery; nerve injury; paresthesia; photobiomodulation

SIGNIFICANCE

This case report presents 2 patients with neurosensory alterations after endodontic microsurgery who both reported a significant improvement in the area of hypoesthesia after photobiomodulation treatment using a 940-nm diode laser.

Nerve injury is an inherent risk of many dental procedures and a complication that can result in neurosensory alterations for patients. The incidence of altered sensation events after endodontic microsurgery (EMS) of mandibular posterior teeth has been reported to be as high as 14%[1]. Additionally, iatrogenic errors during nonsurgical endodontic treatment can cause injury to adjacent neurovascular structures[2]. Neurosensory alterations resulting from dental treatment can be transient or permanent and may include the complete spectrum of anesthesia, hypoesthesia, dysesthesia, and paresthesia[3]. Although evidence suggests full or partial recovery can be expected in up to 91% of cases with altered sensation after endodontic treatment, these data have been extrapolated from multiple case reports and do not account for the variables contributing to the severity of each individual injury[4]. Regardless of the extent, any loss of sensation can negatively impact a patient's quality of life, and there is a paucity of information available to guide clinicians in evidence-based decision making after iatrogenic nerve injury.

This case series introduces laser photobiomodulation (PBM) to the endodontic literature as a noninvasive, feasible option to aid in the recovery of patients with neurosensory alterations resulting from dental treatments. The benefits of PBM were first described in the 1960s[5]. The wavelength used for PBM can range from 600–1000 nm[6]. When the laser light contacts the target tissue, the light is absorbed by the chromophores, cytochrome c oxidase, and porphyrins inside the mitochondria of the cell. These chromophores trigger adenosine triphosphate production, modulate reactive oxygen species, and cause the release of nitric oxide from the mitochondria. This process can result in cell repair, vasodilation, a reduction in inflammation, accelerated healing, and an improvement of postoperative pain[7]. For these reasons, PBM has been used as an adjunct for functional healing to reduce postoperative pain after root

From the Departments of *Endodontics and †Restorative Dentistry and Prosthodontics, The University of Texas Health Science Center at Houston School of Dentistry, Houston, Texas

Address requests for reprints to Dr Eva Stanley, 7500 Cambridge Street, Suite 6400, Houston, TX 77054.
E-mail address: Eva.Stanley@uth.tmc.edu
0099-2399/$ - see front matter

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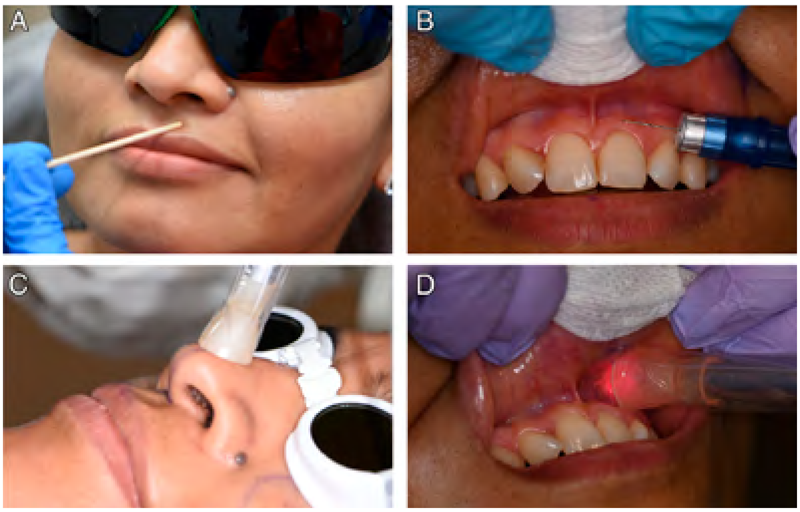
2019 for evaluation of tooth number 19 because of a history of spontaneous pain in the lower left quadrant. At the time of the evaluation, a diagnosis of previously treated with asymptomatic apical periodontitis was made for tooth number 19 and asymptomatic irreversible pulpitis with normal apical tissues for tooth number 20.



Patient 1: *(A) The static touch detection test using a cotton tip applicator. (B) The direction of movement test using the blunt end of a 30-G needle. (C) PBM treatment of the extraoral area of hypoesthesia. (D) PBM treatment of the intraoral area of the hypoesthesia.*

	PBM visit											
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
Extraoral	VAS score											
Bridge of nose	1	0	0	0	0	0	0	0	0	0	0	0
Dorsum of nose	3	3	0	0	0	0	0	0	0	0	0	0
Tip of nose	4	3	9	0	0	0	0	0	0	0	0	0
Columella	9	9	9	7	8	6	7	0	0	0	0	0
L side of nose	5	5	0	0	0	0	0	0	0	0	0	0
L Ala of the nose	9	9	8	0	0	0	0	0	0	0	0	0
Philtrum	10	10	9	8	8	7	7	8	7	7	7	7
Superior left lip	9	9	9	7	8	7	7	8	7	7	7	7
Upper lip midline	10	10	9	8	8	7	7	8	7	7	7	7
L corner of lip	10	10	9	0	0	0	0	0	0	0	0	0
Nasolabial sulcus	8	8	0	0	0	0	0	0	0	0	0	0
Intraoral	VAS score											
Gingiva #9	9	9	9	9	7	7	7	0	0	0	0	0
Vestibule #9	9	9	7	9	7	7	7	0	0	0	0	0
Gingiva #10	9	9	9	9	7	7	7	7	7	7	7	7
Vestibule #10	9	9	9	9	7	7	7	7	7	7	7	7
Gingiva #11	9	9	9	8	7	0	0	7	0	0	0	0
Vestibule #11	9	9	9	9	7	7	7	7	0	0	0	0
Gingiva #12	9	9	9	7	0	0	0	0	0	0	0	0
Vestibule #12	9	9	9	9	0	0	0	0	0	0	0	0
Gingiva #13	9	8	8	7	0	0	0	0	0	0	0	0
Vestibule #13	8	8	8	9	0	0	0	0	0	0	0	0

Table 1

Subjective Assessment (Visual Analog Scale [VAS]) of the Sensory Alteration in Every Photobiomodulation (PBM) Visit Assessment for the Patient in Case 1.

EMS was performed on tooth number 19 in April. The patient presented with persistent facial hypoesthesia and generalized soreness 6 days after the surgery. Corticosteroids were used to reduce acute inflammation surrounding the neural structures. One month later, the condition was unchanged. This injury may have occurred as a result of the tension placed on the mental nerve during flap retraction. The patient reported significant improvement after 4 sessions of PBM treatment.

OVERALL SUMMARY

The report states that Iatrogenic nerve injuries can occur after many dental treatments. Some of the most common theories for these injuries include direct trauma from local anesthetic needles, neurotoxicity of the local anesthetic solutions, damage to the neurovascular structures during flap retraction, and hematoma formation. Although spontaneous healing of these injuries can occur, the duration and degree of healing can vary greatly between individuals. PBM therapy is used as an adjunct in medicine for functional nerve recovery.

CLINICAL SIGNIFICANCE AND IMPACT

Target tissues are irradiated with a low-level laser during PBM. The light energy absorbed by the mitochondria causes adenosine triphosphate production, modulation of reactive oxygen species, and the release of nitric oxide. PBM has been shown to reduce inflammation, accelerate healing, and improve postoperative pain. The report authors believe PBM is a viable option to aid in the recovery and healing of patients who have experienced neural injuries as a result of dental treatment. Further research is needed with larger sample sizes to confirm the efficacy of PBM in dental patients. ■

MEET THE MASTERS
Dr. Preety Desai

I was a periodontist long before I became a "laser specialist". I purchased my first YSGG laser in 2015 when the gurus and mentors in Periodontics would shame and belittle laser technology and its benefits in the periodontics field. In those days, laser users in Canada were few and far between, separated by great geographic distances as well. It was difficult to discuss or collaborate with fellow colleagues and laser users. I was left to my own readings of the sparse literature available, not only to obtain a solid grounding and understanding of traditional periodontal techniques, but as a method to teach myself how to pivot and morph those to laser-based techniques. I have done this over the years to adapt and apply the laser into my everyday practice. It was not just simple replacement of the blade or the drill, but rather educating and advantaging myself of laser technology, experiencing the nuances firsthand to achieve the same and even **better results** compared with traditional techniques.

The integration of the laser into everyday use in my practice has evolved and changed by leaps and bounds because of this philosophy. I have personally pioneered and designed various MINIE™ Minimally Invasive erbium) laser techniques in my everyday practice of periodontal flap therapy, gingival grafting techniques, laser extractions/socket degranulation and of course peri-implantitis therapy. All these techniques evolved organically and were adapted and advanced over the years in my practice, resulting in me now rarely using the scalpel or drill or curettes!

I despise the often overused cliché in dentistry applied to the laser as it being "another tool in the toolbox." Simply because if it did the same thing as what you are already doing, then why would you spend tens of thousands of dollars to do the same thing? **Ludicrous!** From my perspective it is not just a "tool". It is the only technology in the periodontal practice worthy of mention today. Periodontics especially has not changed its "tools" in over a 100 years. It is silly to think that microsurgical blades and elevators could come close to the minimally invasive affects of the YSGG laser in periodontics and implants.

My learning and education evolution involved many different facets resulting in my Mastership with WCLI in 2018. But It was my MSc in laser dentistry with the late Dr Norbert Gutnechkt in Aachen which was pivotal and inspired my laser research and clinical education,

furthered by his influence. I have works published in multiple publications on laser techniques across peer- and non-peer- reviewed journals, and multiple opportunities to share the “light” with the *Spear* study group, *American Academy of Periodontology*, *Academy of Osseointegration,* as well as various dental societies and provincial conferences. Most importantly I enjoy my academic position at the University of BC as clinical associate professor in the Graduate and Undergraduate clinics, instructing the young students and residents that there is true evidence-based data promoting laser surgery. I prefer the smaller and more

intimate setting of University education the most. Exposing young minds that are open to learning early in their dental education, as opposed to changing the mind of an experienced practitioner who approaches a lecture with scepticism and criticism, because what they are doing works for them. The metrics of “improving things by production” is a poor but commonly held yardstick in North America and the rest of the world. Like Einstein said, “Insanity is doing the same thing over and over again and expecting different results”. We must change the way perio is done in order to improve the longevity of teeth, rather than replacing every tooth with an implant!

In my spare time I have many outdoor hobbies, and gain much pleasure from them and my two wonderful sons, who following in Einstein’s vision are trying to improve the world in their own respective fields, each in their own way! ■

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