LAHA magazine
Laser and Health Academy
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March, 2013 1

The Future of Dental Lasers is Now

Laser&Health ACADEMY

INTEGRATING **KNOWLEDGE**

TRANSFORMING **LIFE**

RESEARCH

LAHA® collaborates with industry, medical professionals and universities on projects aimed at developing new and improving existing laser applications

EDUCATION

LAHA® serves as a platform for continuous education, with a focus on practical instruction and the demonstration of laser techniques and procedures, delivered through a variety of workshops and seminars by experienced lecturers.

PUBLISHING

The Journal of the Laser and Health Academy is an international peer reviewed journal that follows new trends and progress proven practice in laser technology, in the use of lasers in medicine and in related sciences.

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Editorial

Dentistry has entered a new era

It may sound as a bold statement, yet the future of dental lasers has truly arrived — today. The latest generation of dental lasers has revolutionized dentistry with treatments that are faster, more effective and more satisfying to patients and practitioners than ever before.

LAHA, the Laser and Health Academy, has for many years served as a platform for exchanging ideas, leading to the development of new applications and value in using laser technology. It is our pleasure and privilege to introduce you to the latest state–of–the–art systems that are making the modern treatment process unrecognizable in comparison to the way classical treatments have long been conducted.

In this LAHA magazine we present how lasers have moved the boundaries in the dental treatment practice, through in–depth reports from LAHA members around the globe, interviews with some of the top experts in the field, and through a selection of clinical treatment guides. We also give you an inside peek into one of Fotona's latest laser prodigies, LightWalker®, winner of the 2012 'red dot' design award, together with a special interview with Matjaz Lukac, president of the company. Fotona has been developing lasers since almost the very beginning of the industry, so they know what they're talking about when they say that "modern dentistry without a laser is simply not modern dentistry".

Welcome to the new era!

dr. Masa Gorsic

News

CANADA TOUR

Er:YAG, Nd:YAG treatments spotlighted on LAHA Canada 2013 Educational tour

The Canadian dental laser distributor, National Dental Inc., in cooperation with the Laser and Health Academy, organized a highly successful educational tour to introduce the latest dental laser treatments in Canada. Starting in Vancouver on February 9th, the 7–day tour moved eastward to Edmonton and Toronto before a final stop in Montreal.

The scheduled events consisted of lectures on laser physics and dental applications by leading laser specialists, including Zurich doctor Kresimir Simunovic of the Laser and Health Academy. After the lecture portion of the events, attendees were also invited to participate in hands–on workshops demonstrating various laser procedures for minimally invasive hard/soft–tissue and endo treatments.

Feedback from participants at the workshops was extremely positive, with interest especially high in the topics of conservative treatments and oral surgery using Er:YAG and Nd:YAG lasers. In addition, there was also significant enthusiasm for the patented PIPS™ endodontic and TwinLight® periodontal procedures, which enable practitioners to treat a larger percentage of patients in–office that would otherwise be referred to an outside specialist.

CC BME

Successful completion of SmartMed X–Runner project

As a part of the SmartMed program of the Competency Center of Biomedical Engineering (CC BME; www.bmecenter.com), an R&D initiative supported by the European Regional Development Fund and coordinated by the Laser & Health Academy, Fotona has successfully completed development of the X–Runner project, the world's first digitally controlled dental laser handpiece.

The CC BME's SmartMed program focuses on the development of a wide range of innovative sensors that detect the effects of electromagnetic waves on human tissue. The objective of SmartMed research is to control the electromagnetic parameters and consequently ensure a highly selective treatment of the injured tissue, resulting in a less invasive impact on patients.

GREEN POINTER

Green laser pointer for enhanced visibility in oral surgery

Fotona's LightWalker AT laser systems are now being offered with an optional green laser pointer for enhanced visibility. Dental and maxillofacial surgeons have expressed strong interest in this option, which makes their use of tipless handpieces more comfortable during soft–tissue surgical procedures. Using a green pointer beam with a dental laser shows the exact cutting line that the Er:YAG laser beam will perform. Even in the exceptionally high brightness of the treatment area, a green pilot beam will clearly indicate the surgical cut.

PRINCE ALBERT AT IMAGINA

Prince Albert of Monaco among the first to see X–Runner

The Imagina Dental 2013 Congress in Monaco was the launching event for Fotona's X–Runner handpiece. X–Runner, the world's first digitally controlled dental laser handpiece, sparked keen interest among visitors at this year's congress. One well–known visitor to the Fotona booth was Prince Albert of Monaco, who's keen eye was drawn to the company's LightWalker laser system, which among other international recognitions received a highly prestigious red dot design award in 2012. The Prince spent a few moments at the booth with the Fotona staff and noted that his own personal dentist also uses a dental laser.

This year's Imagina congress included a large number of presentations about the use of lasers in dentistry, many of which featured Fotona systems.

QSP™

Superiority of LightWalker® QSP™ Mode confirmed

At the 2012 International Fotona Weekend in Portoroz, participants were introduced to LightWalker's unique QSP™ (Quantum Square Pulse) mode. At the time, there was also a hint about superior microleakage results and superior effectiveness in even the hardest dental tissues. Now, the latest research results have confirmed the precision and unmatched performance of LightWalker's QSP mode for hard–tissue surface preparation.

A detailed study at Bezmialem Vakif University in Istanbul, Turkey, on microleakage in premolars, has provided further support for the effectiveness of LightWalker's QSP mode. Research on the mean shear bond strength of brackets to etched enamel surfaces have shown a noticeable strength increase in QSP preparations in comparison with MSP mode, and an even higher increase in comparison with acid etching.

Other research concerning secondary bacterial contamination through filling borders has also confirmed the quality of filling margins with QSP preparations. Measurements of the time required for acids to open up the gaps for bacterial passage through the margin have confirmed the strongest degree of adhesion with the surfaces prepared by QSP.

X–RUNNER

X–Runner — the next generation handpiece

Dental treatments that require the removal of a large amount of hard dental tissue, such as a deep or broad surface area, become more precise, easy and elegant with the help of a unique laser handpiece that offers automatic guidance as well as adjustable spot size and shape. The X–Runner™ handpiece from Fotona allows practitioners to perform treatments involving otherwise unattainable patterns. Automatic guidance of the laser beam allows higher repetitions to be used and consequently procedures are significantly faster. Surface treatments like preparations for veneer bonding and orthodontic brackets in hard tissue, as well as lesion removal and deepithelisation in soft tissue, can be performed with a significantly higher degree of precision.

X–Runner™ , which works in conjunction with the LightWalker AT system, Fotona's latest generation of dental lasers, is an ideal tool whenever deep or extended cuts need to be made in hard or soft dental tissue. X–Runner's automation technology effectively helps the dentist to guide the laser light swiftly and accurately across the surface of treated tissues. Since it's a laser–based handpiece, all of the other well–known laser benefits still apply, such as non–contact, vibration–free, low–pain, minimally–invasive treatments — in fact the improvements are typically even more pronounced than with a classical laser handpiece.

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“Modern dentistry without a laser is simply not modern dentistry.”

Interview with Dr. Matjaz Lukac, Director of Fotona

By William Wagner & Edita Krajnovic

*Under the leadership of Dr. **Matjaz Lukac**, Fotona has been challenging the global laser market and profoundly influencing the way dentistry and medicine are conducted today. Fotona was Dr. Lukac’s first job when he started out as a young engineer of physics, and he has remained actively committed to the company’s success from the very beginning, with a few off periods such as when working on his PhD and later as a researcher in laser physics at the University of California at Berkeley. In this interview he discusses the evolution of laser dentistry and sheds light on some of the company’s recent technological developments.*

What you believe are Fotona’s key competitive strengths in the laser industry?

Dr. Lukac: Fotona has been in the business of making lasers since 1964, just four years after the invention of the first laser. This makes it one of the most experienced, if not the most experienced laser company in the world. These strong roots, accompanied with Fotona’s long–term focus on research and development, represent the company’s major strengths and provide a solid foundation for sustainable growth in the medical laser technology industry. These same core strengths also give us the know–how and expertise to offer medical practitioners no less than highest performance, best made lasers in the world.

How has laser technology evolved during the years you’ve been working in the industry?

Dr. Lukac: The huge potential of lasers in dentistry was recognized almost immediately after the invention of the first laser. However, the technological challenges were such that it has taken several decades before dental lasers have fulfilled, and recently even surpassed, the early expectations of the dental and medical community. Fotona has been one of the pioneers in this development. For example, we led the way by introducing Variable Square Pulse Technology, which has given practitioners greater control over the intensity and extent of any laser treatment to a degree that far exceeds what is possible using standard scalpels or drills.

Even though lasers were invented several decades ago, it is still considered to be an exciting and new technology, and I attribute this widely held perception to the fact that the laser is so different and unique compared to other technologies that it has inspired a continuous flow of innovation and technological developments till this day, and will undoubtedly continue to do so for quite some time to come.

From a practitioner’s perspective, what are some of the unique advantages that lasers can now offer the dental profession?

Dr. Lukac: As a result of the dramatic technological advances in recent years, lasers are playing an increasingly important role in modern dentistry and have achieved their original goal of replacing and supplementing mechanical tools with more precise and less–invasive optical technology. Dental lasers enhance and improve upon classical procedures and, as opposed to classical tools such as burrs or scalpels, offer a much wider range of treatment protocols and greater precision of control. With classical tools, the effect on the patient’s tissue is controlled mainly through tactile pressure on the dentist’s hand. With a laser, however, the dentist can precisely adjust and optimize the speed, finesse and thermal depth of any treatment at the touch of a button.

Fotona has been following a different approach, which is based on a disciplined focus on the highest performing laser technologies, and an almost fanatical commitment to the quality and reliability of our products.

Even more importantly, lasers enable new procedures that are simply not possible or even imaginable using classical dental tools. And laser treatments are also friendlier to patients and dentists. So the unique advantages of laser technology really speak for themselves, and the laser is the way to go, not just in dentistry, but in medicine in general. Laser light allows a practitioner to work selectively on different tissues, and in a minimally invasive, contact–free manner. Laser light is also “weightless”, and can thus be moved and positioned effortlessly in 3D space, making it an ideal match with the latest revolutionary technologies in medicine such as intelligent robotics.

What new developments or technological breakthroughs in laser dentistry can we expect to see from Fotona this year?

Dr. Lukac: This year Fotona will be introducing some of the company’s most advanced technological achievements. Our latest generation dental laser, the LightWalker®, will be shown to the public and professionals with two exciting new features: Quantum Square Pulse technology for extremely fine and fast minimally invasive laser ablation; and a revolutionary digitally controlled dental laser handpiece that offers unrivalled speed and precision.

One of the major advantages of our patented Quantum Square Pulse Technology mode is that it significantly reduces the undesirable effects of laser beam scattering and absorption in the debris cloud during hard–tissue ablation. Treatments with this new technology are significantly faster, less invasive and more precise.

Also this year, we are introducing a major breakthrough in laser medicine, a revolutionary handpiece for dental lasers with built–in “light–walking” technology that offers adjustable spot size and shape. The new X–Runner™ handpiece adds to the precision of laser treatments by helping the practitioner to guide the laser beam swiftly and accurately across the surface of treated tissues. In this way, the X–Runner™ is finally enabling dentists to take full advantage of the most important feature of laser light, its weightlessness.

Lasers are playing an increasingly important role in modern dentistry and have achieved their original goal of replacing and supplementing mechanical tools with more precise and less–invasive optical technology.

In terms of global competition, where do you see the future of the dental laser industry heading and how well is Fotona positioned for the future?

Dr. Lukac: We are aware that Fotona is not the only company that has recognized the great potential of laser technology in medicine and dentistry. There are several approaches to the ever–increasing global competition in the laser industry, one of which is consolidation. Fotona has been following a different approach, which is based on a disciplined focus on the highest performing laser technologies, and an almost fanatical commitment to the quality and reliability of our products.

It is our strategic decision to work globally through a network of independent regional distributors, and presently there is virtually no country where Fotona is not represented. We consider our distributors to be a very important part of Fotona. This view is best described by our slogan, "One Family, Together."

Our belief is that dental practitioners around the world will be as excited as we are with the recent technological breakthroughs in laser dentistry. Modern dentistry without a laser is simply not modern dentistry. With Fotona's LightWalker system, every dentist can finally "walk the light". ❋

X–RUNNER™: ADVANCED HANDPIECE TECHNOLOGY

In 2013, Fotona is introducing a major breakthrough in laser dentistry, a digitally controlled handpiece for dental lasers with instantly adjustable spot size and shape. The new X–Runner™ handpiece adds to the precision of laser treatments by helping the practitioner to guide the laser beam swiftly and accurately across the surface of treated tissues. What makes it very unique and practical is that by pressing a button on the screen, the size and shape of the treatment zone can be changed, unlike classical treatments where the dentist needs to switch between drills and saws of different sizes. It is essentially robotics on a miniature scale.

reddot design award
winner 2012

Highest–performance, best–made lasers in the world!

Red Dot Award 2012 for LightWalker®

By Mateja Princic

The LightWalker® dental laser, developed by the Slovenian company Fotona, one of the leading global manufacturers of medical lasers, was awarded one of the world's largest and most distinguished design awards, the "red dot award: product design 2012" for combining innovation, technological perfection and excellent design. The red dot award is considered one of the most distinguished international quality seals for exceptional design.

"The aesthetics of dental accessories play an important role. Because dental rooms are small and each piece is very noticeable, we decided to develop not only the best–made laser, but also the most beautiful one," explains dr. Marko Marincek, director of development at Fotona.

With the introduction of the LightWalker on the market in 2011, Fotona's R&D department, led by dr. Marincek, caused a revolution in dentistry. The system offers little–or–no–pain treatment of soft and hard tissues, with faster healing, bloodless and sutureless soft–tissue surgery, effective periodontal treatments, safe and efficient endodontic treatments and numerous cosmetic procedures.

It is notable that Fotona designed the LightWalker in collaboration with two different designers — the Slovenian industrial designer Bojan Klancar and the internationally recognized Italian design agency Creanova. "Collaboration with two different designers was not an easy job at all. Both of them had excellent ideas and I served as a moderator between. We sat down together for hours and hours developing the design that we ultimately decided for, and as you can see, the results turned out excellent and users are all highly satisfied," explains dr. Marincek.

Applications for LightWalker

LightWalker can be used for everything from oral surgery to cosmetic TouchWhite™ tooth whitening, offering the highest standard of dental treatment and simplicity of use. It has 40 different applications, such as

THE RESULTS SPEAK FOR THEMSELVES: THE LIGHTWALKER HAS REALLY EXCEEDED OUR EXPECTATIONS

Dr. Marianne Degerstrom, Tannklinikken in Narvik, Norway

"Surgery with the LightWalker is fantastic and post–op there is no pain or swelling. We also use the Nd:YAG for endo and we are excited to soon start with PIPS™ . It is almost like we do not believe the results we are seeing and the LightWalker has really exceeded our expectations! The patients are very positive towards this treatment as well and they accept laser treatment in a much higher degree compared to conventional therapy. I believe it has got to do with the different sound and non contact approach. The local newspaper found out about our LightWalker very quickly which resulted in a very positive article and new patients!

At first it felt a little bit confusing with completely new terminology, but after our 3–day course at ILSD in Stockholm, we felt very comfortable in offering this treatment to our patients. The three day course consisted of both theoretical and practical parts and it really gave us a great start. I already see so many clinical benefits. We have used the laser on different perio cases with excellent results. We are also very pleased with results in various carious treatments and abrasion defects where we have not needed to use anaesthetics so far."

LightWalker®

intra–oral soft–tissue surgery, removal of fibroma, leukoplakia, and also selected dermatology and plastic surgery indications (skin resurfacing, skin tags). “More and more dentists around the world are nowadays deciding to offer simple dermatological services, and LightWalker provides this capability,” dr. Marincek said.

It is obvious that laser dentistry is gentler, so procedures are quicker and simpler, and there is often no need for anesthetic. LightWalker lasers have the most comprehensive list of clinical applications of any dental laser in the world. With the availability of both tipped and tipless handpieces, easy–to–follow treatment protocols, and touch–of–a–button treatment settings, practitioners are able to perform every dental treatment with greater confidence and success, bringing in extra practice income along the way. The specially designed handpieces allow for easy access to hard–to–reach places and prevent cross contamination.

Because LightWalker offers the widest range of pulse durations, the spectrum of possible applications is virtually unlimited. In particular, Fotona’s unmatched pulsewidth technology provides a virtually limitless parameter range for hard–tissue ablation options.

“With its reputation for developing and manufacturing strictly high–performance laser systems for the global market and by maintaining a consistent marketing and communications strategy, Fotona has established itself as a recognized and respected global brand. And with the prestigious 2012 red dot design award, Fotona will undoubtedly further strengthen its position as the manufacturer of the most powerful, high–quality, user–friendly and professionally designed medical laser systems,” explains Fotona president, dr. Matjaz Lukac. ✻

Fotona
choose perfection

Fotona was founded in 1964, only four years after the invention of the very first laser. Today Fotona is one of the most experienced developers of high–technology laser systems, recognized as a world leader in the design, manufacture, and support of advanced solid–state laser systems for medicine (aesthetics, surgery, gynecology), dentistry, industry and defense. Fotona is the only major manufacturer of medical lasers that is fully committed to in–house production and stringent testing of all components. This long–term dedication to perfection sets the company apart from the competition and ensures that its laser systems are of the highest quality, reliability and durability.

reddot design award
winner 2012

The red dot award was LightWalker’s third prestigious international quality recognition. In 2011 the Pride Institute awarded the laser system the “Best of Class Technology Award”, and Dentistry Today, America’s leading clinical news magazine for dentists, recognized LightWalker as one of the “TOP 100 dental products of the year.”

Experts

The ‘magic beam’ changed my career as an orthodontist

Interview with Prof. Dr. Carlo Fornaini, MD, DDS, University of Parma

By Nina Malej Primc

How did you decide to become a dentist, and what influenced you to start using a laser?

Prof. Fornaini: Back when I was a university student (probably in the Middle Ages!) there still did not exist a dental school in my region, so I had to take a degree in Medicine and Surgery and then to specialize in Dentistry. This path has had a great influence in my daily practice, as I also frequently use my laser to treat vascular and dermatological diseases. I’ve always been technology–oriented, also in my private life, so when I heard about this new “magic beam” more than twelve years ago, I decided to look into it. And this rendezvous totally changed my working life, stimulating new areas of research, both fundamental and clinical, and generating new enthusiasm toward my job.

I think that laser utilization should be considered a new specialization of medicine, since it is one of the few fields where it is still possible to make major advancements in research — for most other fields it seems as if everything important has already been discovered. Unfortunately, the other side of the coin is that now, despite my age, I work a lot more than before, but also with greater enthusiasm, so it is not a burden!

What kind of treatments do you routinely perform with your Fotona laser, and what do you see are the main benefits with using a laser?

Prof. Fornaini: I think that today it is possible to use a laser in nearly all dental treatments. About the only procedure that I do not do with a laser is crown preparation. But I use my Fotona laser in about 75% of my daily practice and find it invaluable, especially due to the fact that the device offers a combination of two complementary wavelengths (1064 nm + 2940 nm) which provide the possibility of “360° utilization”. I have described this concept in several papers, as sometimes I find it very interesting and useful to employ both wavelengths in the different steps of the same treatment, i.e. in the exposure of a retained tooth or to re–contour the gingiva during a composite restoration.

But, to strictly answer to the question, I use my LightWalker in conservative treatments, for surgery of soft and hard tissues, perio, endo, ortho, prosthetics, bleaching and even for intra–oral metal welding. And last but not least, I like to use the laser for the treatment of perioral tissues: it is always wonderful, after a complex oral rehabilitation, to improve the aesthetics of a patient’s lips or to eliminate wrinkles — it is the “icing on the cake”.

ABOUT DR. CARLO FORNAINI

Prof. Fornaini is an eminent researcher and lecturer in the field of lasers in oral applications and dentistry. He currently holds a research position at the University of Nice Sophie Antipolis where he also coordinates the EMDOLA, European Master degree in Oral Laser Applications program. He is a faculty member at the Dental School of the Faculty of Medicine and Surgery of the University of Parma, a Visiting Professor at Liege University (Belgium) both of which run EMDOLA program, a scientific committee member of several international and national laser dentistry organizations and has lectured and published numerous times on various topics within laser dentistry. He currently practices laser dentistry in his own private practice in Fiorenzuola d’Arda (Italy) with a particular focus on pediatric dentistry. Prof. Fornaini is a LAHA Expert Clinical Lecturer.

I use my LightWalker in conservative treatments, for surgery of soft and hard tissues, perio, endo, ortho, prosthetics, bleaching and even for intra–oral metal welding.

You have published numerous academic articles on dentistry. What are some of the topics that you have recently been working on?

Prof. Fornaini: In the past four years I've been very busy on the topic of intra–oral laser welding with Fotona lasers, with several "in vitro", "ex vivo" and "in vivo" tests. I published ten papers on this matter. But my recent publications also regard Er:YAG surgery in soft tissues (i.e. oral lichen planus) and hard tissues (tori mandibularis and maxillaris) and also in conservative dentistry (i.e. restorations of traumatically fractured permanent incisors). Also very interesting, for its originality, was a study on customer satisfaction with Er:YAG conservative treatments, in which an 11–item questionnaire was given to 100 patients, with the results indicating a very high level of satisfaction (90 – 100%).

What is your impression of Fotona's new X–Runner™ dental handpiece, and where do you find it to be the most helpful at your practice?

Prof. Fornaini: Several years ago I began conducting tests with a modified Fotona dermatological scanner on human extracted teeth. The reason for doing this was that I thought, and still believe, that digitally controlled handpieces will be a great opportunity for dentists. It allows for reduced operating times, greater control of the depth of ablation, and a pre–defined treatment area.

I'm sure that this manner of working with Er:YAG will eventually replace the current practice of working strictly with the classic handpiece.

I believe that there are many clinical situations where instantly adjustable treatment shape and size may be of great benefit, and it should be considered as a significant upgrade to the classic handpiece during every moment of daily practice. In fact, even though it is possible to change from the X–Runner's digitally controlled automated modality to the classical handpiece modality with only a touch of the screen, I prefer to utilize the automated modality in nearly every clinical situation: from orthodontics to surgery and from conservative to pediatric dentistry. I'm sure that this manner of working with Er:YAG will eventually replace the current practice of working strictly with the classic handpiece. ✻

Also very interesting, for its originality, was a study on customer satisfaction with Er:YAG conservative treatments, in which an 11–item questionnaire was given to 100 patients, with the results indicating a very high level of satisfaction (90–100%).

Better, stronger and longer–lasting restorations

Interview with Prof. Dr. Aslihan Usumez DDS, PhD, Bezmialem Vakif University, Department of Prosthodontics, Istanbul, Turkey, on New Research on Bond Strength and Microleakage

By Nina Malej Primc

When did you first become interested in laser dentistry and what inspired you to make it the focus of your academic research?

Prof. Dr. Usumez: It began back in 1999 when I was working at the Oklahoma University Health Sciences Center. One day I attended a lecture by Charles Arcoria, who was in Oklahoma City speaking about dental lasers, and this topic immediately caught my interest. During my PhD, I planned to perform a study on dental lasers, and then decided to base my PhD thesis on a specific laser topic — about the etching of enamel surfaces and the bonding of Porcelain Laminate Veneers, which was later published in the *Journal of Prosthetic Dentistry*.

You've conducted some studies on the bond strength and microleakage of dental composites. Can you tell us something about how lasers may influence these factors with typical cavity preps?

Prof. Dr. Usumez: Firstly, when working with lasers on dental hard tissues, it is essential to choose the right parameter settings. This is the most important factor that will influence the final results, although other factors such as water spray will influence the results as well. We can also say that when performed in the right way, you will certainly achieve exceptionally good results in terms of bond strength and low microleakage between composite and hard dental tissues, and this will increase your level of proficiency with the Er:YAG laser for cavity preparation.

From your research, how do hard–tissue treatments with LightWalker's QSP Er:YAG mode compare to laser treatments using standard Er:YAG?

Prof. Dr. Usumez: We did several research projects with the QSP mode of LightWalker. I can say that we achieved outstanding results for the etching of enamel and the bond strength of orthodontic brackets to enamel. In another study, we also achieved especially good results for the etching of dentin. From studying atomic force microscopic pictures, we realized that the surface was perfect for bonding. Readers can find more details of this study in the one of the upcoming issues of the *Journal of Orthodontics*.

In your opinion, how would you summarize the main benefits of choosing a laser system that also includes a second complementary wavelength, such as Nd:YAG?

> **The quality of treatments in a dental clinic using a laser will forever surpass the quality in the same clinic before using the laser.**

Prof. Dr. Usumez: Being a prosthodontist as well as a laser dentist, I can list several advantages of a second complementary wavelength such as Nd:YAG. With the Nd:YAG laser I can perform: hypersensitivity treatment of dentin before or after crown cementation, gingival troughing before taking an impression, bleaching of enamel, soft–tissue surgeries with fast healing and without bleeding, treatment of hyperpigmented gingiva, and fast wound healing in mucosa and also aphthous lesions.

I would further add some specific applications for the prosthodontic area like intraoral welding of alloys as well as applications in the treatment of temporomandibular joint disorders. I can shortly summarize that the quality of treatments in a dental clinic using a laser will forever surpass the quality in the same clinic before using the laser. ✻

> **When performed in the right way, you will certainly achieve exceptionally good results in terms of bond strength and low microleakage between composite and hard dental tissues.**

ABOUT PROF. DR. ASLIHAN USUMEZ

Dr. Usumez is a 1996 graduate of Hacettepe University Faculty of Dentistry. In 1997 she started her PhD education in Prosthodontics and completed her PhD thesis "Evaluation of bonding Porcelain Laminate Veneers to acid etched or Er,Cr:YSGG laser etched teeth surfaces" in 2001. She was appointed as "Assistant Professor" in 2003, as "Associate Professor" in 2005 and as "Professor" in 2010. She completed her MSc in "Lasers in Dentistry" in RWTH Aachen University in 2012. She was awarded as the "Young Scientist of 2008" by The Turkish Dental Association. She has published over 60 scientific articles in journals, received oral and poster presentations awards and travel stipends from international congresses. She is currently the head of the Department of Prosthodontics in Bezmialem Vakif University, Faculty of Dentistry, Istanbul. She is married and has 2 children.

Magic in everyday dental practice

Interview with Hong Kong dentist Dr. Seto Siu Keung, BDS, on fast and effective procedures in dental surgery **By Darja Slebinger**

What was your first contact with a dental laser?

Dr. Seto: My first contact was thanks to my friend, Dr. Johnny Wong, who had been using Nd:YAG lasers since early 90's. On one occasion he had asked for my help to videotape a cavity preparation with an new Er:YAG laser, which was a demonstration unit. Later, when I studied acupuncture, an instructor had explained the therapeutic uses of a laser to me in Chinese. After I finished that course, I volunteered to treat some elderly people in a social welfare center, where I witnessed firsthand the power of lasers in clinical treatment. Now I understand that this was purely the effect of LLLT (Low Level Laser Therapy), but at the time laser treatments appeared to me as something magical.

When I first learned that there was master course offered at the Aachen Dental Laser Center, I immediately applied, and since then I've learned many more fascinating details and have truly become 'addicted'.

What do you appreciate the most about working with a laser?

Dr. Seto: I appreciate that it is based on simple physics, and that there are always new applications with lasers. It seems there is unlimited potential, and it always enhances the clinical results over conventional dentistry.

With lasers, we can broaden the scope of many services provided, and some procedures are not only possible but are indeed quite simple.

Once a dentist starts treating patients with a laser, he will most likely enjoy his everyday practice more than ever before.

ABOUT DR. SETO SIU KEUNG

Dr. Seto obtained his Bachelor of Dental Surgery degree (HK) in 1992 from the University of Hong Kong. After several years in general dental practice he obtained his Diploma of General Dental Practice (UK) from the Royal College of Surgeons of England in 1996. He has also enriched himself in Dental Radiology and gained a Post–Graduate Diploma in Dental Surgery (HK) in 1999 and an MSc (London) in 2001. Dr. Seto then switched to the cutting edge of technology, where he obtained his MSc (Lasers in Dentistry) with distinction from the RWTH Aachen University, Germany, in 2007. He is currently a part–time Clinical Lecturer and Honorary Assistant Professor at the University of Hong Kong's Faculty of Dentistry. Dr. Seto is a member of the World Federation of Laser Dentistry, Vice President of the LOC for the WFLD Congress 2008 Hong Kong and academic co–worker of AALZ – Aachen Dental Laser Center of RWTH Aachen University, Germany. Dr. Seto is a LAHA Expert Clinical Lecturer.

In cavity preparations, the need for local anesthesia is very much reduced and the laser avoids unnecessary pulpal exposure due to its selectivity characteristics in caries removal. However, the operator should be very familiar with the different parameters and laser settings to cope with each situation.

With periodontal treatments, patients are highly pleased with the minimal post–operative discomfort following laser treatments. With lasers, we can broaden the scope of many services provided, and some procedures such as gingival depigmentation, lip depigmentation, frenectomy or crown lengthening, are not only possible but are indeed quite simple.

What is your major indication?

Dr. Seto: Basically every discipline in general dentistry, i.e. cavity prep, periodontal treatment, oral surgery, and conservative dentistry, but my favorite is endodontic treatments. I will no longer do a root canal treatment without the assistance of a laser. When you fully understand the power of lasers in canal disinfection, you will be much more confident in performing endodontic treatments. I was very impressed by a case in which I had performed a root canal treatment in a lower premolar with the use of Er:YAG to assist irrigation. I could see that there were a total of five portal openings after obturations, however, they were not visible in my pre–op X–rays. To be frank, discovering apical delta or accessory canals was not very common before I began using lasers in my endodontic procedures.

Do you still think of the laser as a magical tool?

Dr. Seto: The laser is truly a magical tool, but it does takes time and commitment to learn the necessary knowledge and practice to developed the same speed, or even faster, compared to conventional mechanical methods. From a patient's perspective, comfort and clinical outcome are what matter the most. But the practitioner's perspective is also important. In my opinion, once a dentist starts treating patients with a laser, he will most likely enjoy his everyday practice more than ever before. ✻

The best treatment platform possible

Interview with Maryland dentist Steven Pohlhaus, DDS, FAGD on the advanced capabilities of LightWalker lasers in the field of dentistry

By Keith Bateman

Dr. Steven Pohlhaus, DDS, FAGD from Maryland, USA, has been using a LightWalker laser system for quite some time now, and is, overall, more than satisfied with its benefits. He recently shared his experiences as one of the main instructors at the Academy of Clinical Technology (ACT), a three day intensive LightWalker training session in Las Vegas, Nevada, between January 8th and 10th, 2013.

Dr. Steven Pohlhaus

LightWalker's PHAST™ technology allows me to perform less invasive endo efficiently and more effectively than traditional methods. This advanced system has also allowed me to perform many more root canals in my practice rather than referring these cases to specialists.

PHAST™ PHoto Acoustic Systems Technology

ABOUT DR. STEVEN POHLHAUS

Dr. Steven Pohlhaus, DDS, FAGD from Linthicum, Maryland, has been practicing dentistry for over twenty years and laser dentistry since 2004. He has devoted his career to introducing his patients and colleagues to the benefits of lasers. Dr. Pohlhaus has been lecturing on the topic of dental lasers since 2005 and is a trainer for Tecnology4Medicine's "Laser Essentials" course for new owners of the LightWalker Laser. He is a member of the faculty at the University of Maryland Dental School in the Department of Oncology and Diagnostic Sciences.

Dr. Chad Edwards instructing on LightWalker functions

The LightWalker allows me to rapidly and efficiently cut tooth structure, performing the large majority of my operative dentistry and cavity preparations without using a high speed drill and without having to give shots.

Drs Cho Nguyen & Lewandowski working in vitro

In what ways has working with the LightWalker laser system transformed your daily experience as a dentist?

Dr. Pohlhaus: The LightWalker allows me to rapidly and efficiently cut tooth structure, performing the large majority of my operative dentistry and cavity preparations without using a high speed drill and without having to give shots. Patients appreciate the lack of a drill and the reduced need for local anesthetics, and I and my staff appreciate the ability to perform minimally invasive dentistry on a daily basis. One of the unexpected benefits of the LightWalker is being able to quickly remove veneers. From a personal perspective, I would emphasize that after working with the LightWalker, I cannot imagine working again without a dental laser.

How would you describe your experience in using LightWalker for performing endodontic treatments?

Dr. Pohlhaus: LightWalker's PHAST™ technology allows me to perform less invasive endo efficiently and more effectively than traditional methods. This advanced system has also allowed me to perform many more root canals in my practice rather than referring these cases to specialists. The many technical and clinical advantages of LightWalker have given me the confidence that I am doing the best endo treatment possible.

Are you also performing periodontal treatments as well?

Dr. Pohlhaus: Since implementing the LightWalker into my practice we have significantly increased the treatment of periodontal disease. The unique capabilities of the Lightwalker's dual Nd:YAG and Er:YAG wavelengths provide the ability to comprehensively attack pathogens, and the photobiomodulation or LLLT effects of these two wavelengths work together to effectively treat this widespread disease.

How would you summarize the advantages of Lightwalker's advanced technology in a nutshell?

Dr. Pohlhaus: The precise pulse characteristics of the LightWalker allow me to pristinely cut dentin and enamel with amazing speed. LightWalker's PHAST™ technology is the combination of specific, unique advanced developments in dental laser technology. These include industry leading pulse durations, pulse shape, and preferred wavelengths effectively delivered to target tissues, combined with advanced and proven clinical protocols developed by leading visionary dentists. ❋

A smarter way of treating patients and building your practice

Interview with Dr. Kresimir Simunovic, DMD, MSc **By Ales Mrsa**

You have been involved in laser dentistry since the early 1990's. How would you compare the art of laser dentistry back then with the way things are now today?

Dr. Simunovic: Just two words: totally different! In the early 1990's we already had an efficient, but unfortunately anecdotal–based approach to laser dentistry. From this promising start the emerging field moved forward through many years of experimental approaches, leading to extraordinary and objective clinical outcomes. Today, we are living and working in a very privileged era of almost completely evidence–based laser–assisted dentistry, with an exceptionally wide application field. The scientific background and technology have progressed significantly in the past decade, with major impacts on our clinical applications, representing a true historical milestone. I consider it to be a totally new and exciting point of view for everyday clinical experience in the dental profession.

Today, there are no alternatives in dental medicine that are more efficient than the laser for oral hard– and soft–tissue removal and for decontamination. The harmony between settings, the fundamental play of pulse durations and the combination of two leading wavelengths, Er:YAG and Nd:YAG, offer a unique biological, minimally invasive approach to soft and hard oral tissue treatments.

You have given many presentations around the world on the topic of laser dentistry. What would you say are some of the most common misconceptions that dentists have about using lasers in dentistry?

Dr. Simunovic: The need for an investment in additional basic knowledge and a completely new and different perception of tactile and visual feedback create some degree of insecurity in dentists who are not yet experienced with a laser. Questions we often have to deal with include "Why should I change my in–office treatment protocols, which have worked very well in past decades?"

The goal of our presentations and workshops is to show a different way of treatment with laser dentistry. Once our colleagues commit to taking their first steps, they never go back. Seriously!

From a business perspective, how would you make the case that it's a smart financial decision for a dentist to invest in a laser system?

Dr. Simunovic: The decision is inherently smart, but it has to be considered as a long–term investment, both financially and in terms of personal education. This aspect is often the primary obstacle that has to be discussed and

ABOUT DR. KRESIMIR SIMUNOVIC

Dr. Simunovic is a graduate from the Faculty of Dentistry at the University of Zurich, Switzerland. After practicing general dentistry for 2 years in private practice he joined Zurich University's Faculty of Dentistry, focusing his studies on the effect of CO2 laser in hard dental tissues and common restorative materials. He received his Doctorate Degree from the same faculty in 1991. The following year he became an assistant at the Department of Oral Dental Surgery, being mainly responsible for radiotherapy and laser therapy patients. In 1997 he established his own dental office focusing mainly on laser–assisted general and aesthetic dentistry, periodontology and oral dental surgery. He is a Board Member for Dentistry of EMLA, an international associate member of the Chicago Dental Society, and member of various Swiss dental societies, among which the Swiss Society of Oral Laser Application. Dr. Simunovic is a LAHA Expert Clinical Lecturer.

The harmony between settings, the fundamental play of pulse durations and the combination of two leading wavelengths, Er:YAG and Nd:YAG, offer a unique biological, minimally invasive approach to soft and hard oral tissue treatments.

redefined. Dental office devices of this investment level require an almost immediate financial return from the point of view that most of our colleagues are very often both clinicians and entrepreneurs at the same time. Starting with a laser means, at first, a greater investment in time at chair side and in personal and team education, but with the benefit of receiving better, long–lasting profit and an enduring personal and professional enthusiasm in the near future.

What are some of the features of your Fotona LightWalker system that you appreciate the most?

Dr. Simunovic: The LightWalker generation represents a remarkable, and indeed a historical step forward in science and technology for laser–assisted dentistry. The ergonomic benefits, due to the completely new and easy–to–maneuver OPTOflex articulated arm, the interactive adjustable panel with fast menu access and easy, complete clinical guidance, and the choice of ready–to–use Nd:YAG fibers for both sizes at the same time, are truly unique features, which allow for comfortable and efficient chair–side work, fully focusing on the patient's need, considered as a pillar of evidence–based dentistry.

The improved quality of pulses, including QSP, and the extended range of settings, allow an even more precise and energetically optimized approach to treating tissue, as in PIPS™ , at very low, almost athermal energy levels, and in the extended TwinLight® protocols for endodontics and periodontology, as well as in other emerging protocols such as TouchWhite™ for bleaching and snoreplasty.

Where do you see the future headed with dental laser technology?

Dr. Simunovic: Actually, the future is now. The new LightWalker digitally controlled handpiece (X–Runner) brings a new dimension into the laser–assisted therapeutic tissue approach. It allows a faster, extremely precise and accurate ablation for more extensive hard– & soft–tissue preps, and marks the beginning of a new era of implant surgery, from complete guided implant settings in the near future to surgical release and maintenance.

Looking slightly further ahead, my father, one of the pioneers in LLLT (Low Level Laser Therapy), and I are both looking forward to more improved and evidence–based photobiomodulation and analgesia procedures with both Er:YAG and Nd:YAG. ✻

The future is now. The new LightWalker digitally controlled handpiece (X–Runner) brings a new dimension into the laser–assisted therapeutic tissue approach.

In-depth

X–Runner: the first handpiece that 'walks the light'

By Prof. Carlo Fornaini

In the field of dentistry, the vision of developing a digitally controlled laser handpiece has long been seen as an ideal means to enable a significantly higher degree of speed and precision with laser treatments.

With the increased power and performance of modern dental lasers, it was inevitably a question of how soon the first digitally controlled dental handpiece would emerge to take advantage of these advanced capabilities. Handheld Er:YAG laser scanners have been used for many years in the field of dermatology, where they have proven exceptionally effective for a wide range of skin treatments that demand high–precision surface ablation.

Digital laser handpieces — the logical next step

The introduction of the Er:YAG wavelength to dentistry in 1990 pioneered the ability to treat hard dental tissues with laser ablation. Over the years Er:YAG technology has been extensively refined and developed, with the most significant improvements due to greater control over pulse shape and power, thanks in large part to a number of proprietary technologies such as the VSP (variable square pulse) and QSP (quantum square pulse) modalities pioneered by Fotona. Today's Er:YAG lasers enable a highly selective ablation of carious tissue while preserving the maximum amount of healthy surrounding tissue to produce exceptionally efficient restorations.

The first digital laser handpiece to address the advanced performance requirements for the dental profession is the recently launched X–Runner handpiece from Fotona, which works in conjunction with the company's LightWalker AT laser system (Fig. 1). The "light–walking" beam–positioning mechanism of the new device is integrated inside a specially designed handpiece (Fig. 2), which for most purposes can be used in exactly the same way as a standard one–spot laser handpiece. What makes it very unique and practical is that by pressing a button on the screen, the size and shape of the treatment zone can be changed, unlike classical treatments where the dentist needs to switch between drills and saws of different sizes. In addition, the X–Runner can precisely cover a much larger surface area, without the need for tiring and repetitive hand movements (Fig. 3).

There are three primary treatment shapes (circular, rectangular, hexagonal) that can be selected with the new digital handpiece, and these can be set according to the size of the treatment area (width and length of the rectangle, or diameter in the case of the circle and hexagon) and the number of laser beam passages (to achieve the required ablation depth).

A versatile handpiece like no other

The new X–Runner handpiece can be used for a wide range of treatments, from cavity and veneer preparations to bracket bonding to applications in implantology and oral surgery. It can also be used to obtain a precise linear cut without moving the handpiece, for instance to cut the root apex during endodontic surgery or to perform an incision in soft–tissue surgery.

Digitally controlled laser handpieces are pushing the boundaries of dentistry and opening up many new treatment possibilities. Forward–thinking dental practitioners will be sure to notice that the future of laser dentistry is already here today, and it is small enough to hold comfortably in their hands. ✻

Fig. 1: LightWalker AT, Fotona d.d.

Fig. 2: X–Runner – digitally controlled laser handpiece

Fig. 3: X–Runner™ can cover much larger area

X–RUNNER HANDPIECE IN ACTION: 2 CASE STUDIES.

CASE 1: Treatment of "amelogenesis imperfecta" spots on permanent incisors.
In our daily practice we have worked with several young patients exhibiting zones of discoloration in their frontal teeth. Due to the impossibility of treating these cases with classical bleaching techniques, it was necessary to ablate the affected zones and to fill the cavities produced with composite resins. We have already described the use of the Er:YAG laser in this type of case as a good example of "minimally invasive dentistry" but the use of the X-Runner digital handpiece improves the precision of the ablation even further by programming the extent and depth of the zone in advance.

The case presented concerns an 18-year-old male who had enamel lesions in the right upper lateral incisor, canine, and the first premolar.

The treatment was performed without anaesthetic, with a total laser irradiation time of 186 sec.

For this case we used the following parameters:
250 mJ, 10 Hz, MSP mode, 4/6 air/water spray.
The ablation area was a 3.5 mm diameter circle and the number of passes was 15.

CASE 2: Enamel laser conditioning for orthodontic bracket bonding.
In addition to improving the strength of adhesion of composite resins, another advantage of Er:YAG laser utilization in orthodontics is the ability to prepare a very small surface area of enamel of the exact same dimensions as a bracket. By using the X–Runner handpiece, the bracket bonding procedure is fast, easy and precise.

This case presents a 14–year–old female receiving orthodontic fixed treatment of the upper arch. The parameters used were determined by SEM observation in order to give the best enamel conditioning coupled with minimal ablation.

The parameters used were: 55 mJ, 8 Hz, MSP mode, 4/6 air/water spray.
The ablation area was 2.5x3 mm and the number of passes was 15, once for each tooth.

Fig. 4: Case 1

Fig. 5: Case 2

High finesse? Low problem!

Fast, minimally invasive treatments requiring high finesse are finally possible thanks to Quantum Square Pulse™ (QSP™) mode Erbium dental laser technology. **By Dr. Evgeniy Mironov**

Recently, the range of treatment parameters of Variable Square Pulse (VSP) Er:YAG lasers has been significantly extended. [1] With the latest proprietary Quantum Square Pulse (QSP) technology, minimally invasive treatments that require extremely high finesse have now been made possible. With high finesse it is meant that the tissue is treated with high spatial precision and with small or moderate pulse energy and short duration laser pulses at high repetition rates.

Extremely high finesse of laser treatment is required, for example, when making hard tissue surface modifications before applying composite fillings. High finesse is also desirable when making fine cuts with controlled bleeding into the soft tissue.

Similarly to achieving high ablation speeds, obtaining high treatment finesse has represented a significant technological challenge. This is due to the fact that short pulses of low energy have suboptimal efficiency and are extremely difficult to generate at sufficiently high repetition rates.

In the QSP mode, a longer laser pulse is divided, i.e. quantized, into several short pulses (pulse quanta) that follow each other at an optimally fast rate. This enables the QSP mode to deliver short, high finesse pulses with the efficiency of long duration laser pulses without sacrificing the precision that is provided by short duration pulses.

One of the major advantages of the QSP mode is that it significantly reduces the undesirable effects of laser beam scattering and absorption in the debris cloud during hard tissue ablation.

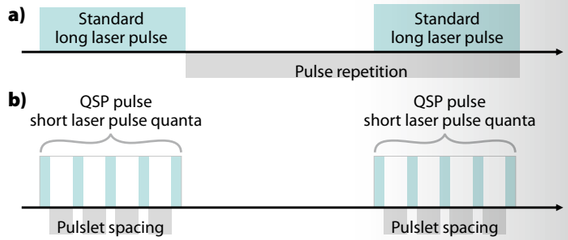
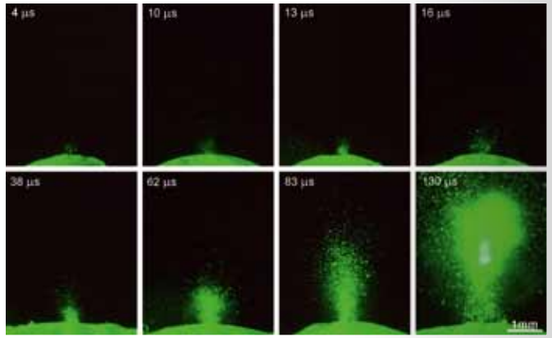


Fig. 1: a) Standard laser pulse; b) QSP pulse: a long laser pulse is quantized into several pulslets (pulse quanta).

One of the major advantages of the QSP mode is that it significantly reduces the undesirable effects of laser beam scattering and absorption in the debris cloud during hard tissue ablation. Namely, when an ablative laser light pulse is directed onto the tissue an ablation of the tissue starts that leads to the emission of ablated particles above the tissue surface, forming a debris cloud (Fig. 2).



Pulse energy 400 mJ, pulse duration 300 µsec

Fig. 2: Formation of a typical debris cloud.

The influence of beam scattering on the precision of hard–tissue ablation can be seen in Fig. 3, which shows laser ablated craters in enamel and dentin at two Er:YAG pulse durations. As a result of scattering, the ablated cavities do not have well defined edges. This effect is more pronounced at higher pulse energies and longer pulse durations.

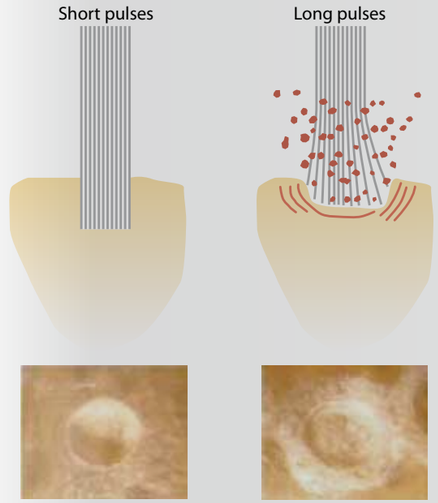


Fig. 3: The influence of beam scattering on hard–tissue ablation.

In order to avoid the effects of scattering, the pulse duration should be shorter than the time required for the ablation cloud to develop. At the same time, when using the QSP laser pulse technology, the pulslet spacing should be longer than the debris cloud decay time. This ensures that the second pulslet does not encounter any cloud remains from the previous pulslet (Fig. 4).

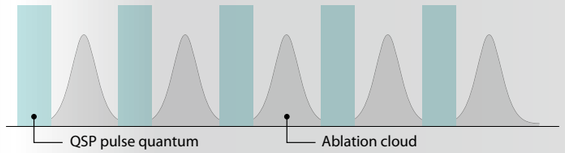


Fig. 4: Pulslet spacing with QSP mode.

With the QSP mode a compromise is found, whereby the temporal pulse spacing between pulslets is longer than the cloud decay time and shorter than the inversion population remaining time. A sufficiently short temporal pulslet spacing is required because there is some inversion population of the laser energy status remaining after the end of the laser pulse. In cases where the pumping for the second pulslet starts early enough, the threshold is reduced as the laser has already been pre–pumped from the previous pump pulse. This ensures an enhancement of lasing efficiency without significantly compromising the quality of laser ablation.

Clinical benefits from the new QSP mode are easily recognizable [2, 3]. The margins of preparations for fillings or for surface modification are clearer and sharper than with any other operational mode used to date. This is of primary importance when working close to the pulp or near the gingiva. QSP is also a safe and reliable mode in class II cavity preparations where the neighboring teeth should be kept intact.

According to SEM micrographs, QSP–treated surfaces appear to have the high quality required for high bond strength [4], in addition to being free of a smear layer. The dentin surface appears clean, regular and flat with wide–open tubules with no difference between inter–tubular and peri–tubular dentin. The enamel surface also appears clean and homogeneous with a well–defined micro–roughness.

As well as being an optimal mode for procedures that require high finesse (i.e. tissue treated with high spatial precision and with small or moderate pulse energy and short–duration laser pulses at high repetition rates), the QSP mode also guarantees a high speed with the procedure. The speed of cavity preparations is increased by a factor of up to 1.75 when compared to "single" (non–quantized) laser pulses at the same total energy setting. Since the QSP mode consists of a series of optimally spaced super–short pulses, it can be viewed also as a super–short pulse mode "on steroids". Speed of preparation is important in pediatric dentistry and with anxious patients, and QSP mode is the method of choice if we require short preparation times without sacrificing finesse. Also, the noise level generated with this mode is lower than in other currently available laser operating modes, which notably increases the level of comfort of the procedure.

In conclusion, the QSP mode excels in preparation of dental hard tissues. Working in QSP mode allows the dentist to perform procedures with an unprecedented level of finesse without sacrificing speed, and with the added advantage of decreasing the noise level of the procedures. ✻

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Laser induced photoacoustics: a root cause revolution

The photon–induced photoacoustic method represents a revolutionary solution for cleaning and disinfecting the root canal system, reaching almost 100% bacterial reduction. **By Prof. Giovanni Olivi**

The removal of vital and necrotic pulp tissue, microorganisms and their toxins, and the prevention of reinfection through a hermetic coronal and apical seal, are essential for endodontic success. Clinical experience and research have shown that the use of endodontic irrigants results in ineffective irrigation [Haapasalo, 2010]. Also, currently used instrumentation techniques left 35% or more of the canals' surface area unchanged [Peters, 2001] and only partially removed vital and necrotic tissues from the entrance of lateral canals and apical ramifications, leaving adjacent tissue inflamed, or infected and associated with periradicular disease [Ricucci and Siqueira, 2010].

The main problem of irrigation in endodontics is the fluid–dynamics properties of irrigants in the confined canal space. Because of the inherent taper seen within the canal morphology, deep penetrations of irrigants are more difficult because of the absence of turbulence over much of the canal volume [Gulabivala, 2010]. Both irrigant penetration and biofilm removal may be improved through canal fluid agitation using a close fitting instrument, sonic or ultrasonic activation, or laser. Consequently, the efficacy of NaOCl depends on the means by which free chlorine ions are readily available at the target tissue site.

Comparing passive ultrasonic irrigation (PUI) and laser–activated irrigation (LAI) it was found that tissue dissolution was more pronounced after the use of LAI with sodium hypochlorite and an Erbium:YAG (2940 nm) laser. [Macedo 2010]. Laser–activated irrigation by the PIPS™ technique was found to generate tremendous turbulence and 3D streaming within the root canals [DiVito and Olivi, 2011]. Laser–activation of NaOCl (PIPS™ technique — Fotona Er:YAG laser) with in vitro infected specimens generated more negative bacterial samples and left less apical bacteria/biofilm than ultrasonic activation (PUI) [Peters, 2011].

Another study confirmed that the combination of Er:YAG laser (PIPS™ technique — Fotona, LightWalker laser) and 6% sodium hypochlorite produced 100% elimination of Enterococcus faecali from ex vivo infected root canals [Jaramillo, 2011]. Also Laser–activation of EDTA (PIPS™ technique–Fotona Er:YAG laser) of chemomechanically prepared root canals resulted in more cleaning of the root–canal walls and a higher quantity of open tubules in comparison with the traditional irrigation method [DiVito, 2012].

The fact that the PIPS™ photon–induced photoacoustic steaming effectively travels 3–dimensionally in the root canal spaces also makes it advantageous as a treatment modality for removing biofilms associated with periodontal pockets that are in difficult–to–access furcation areas and interproximal vertical defects [DiVito and Lloyd 2012]. ✻

Laser–activated irrigation by the PIPS™ technique was found to generate tremendous turbulence and 3D streaming within the root canals.

Fig. 1: PIPS™ method

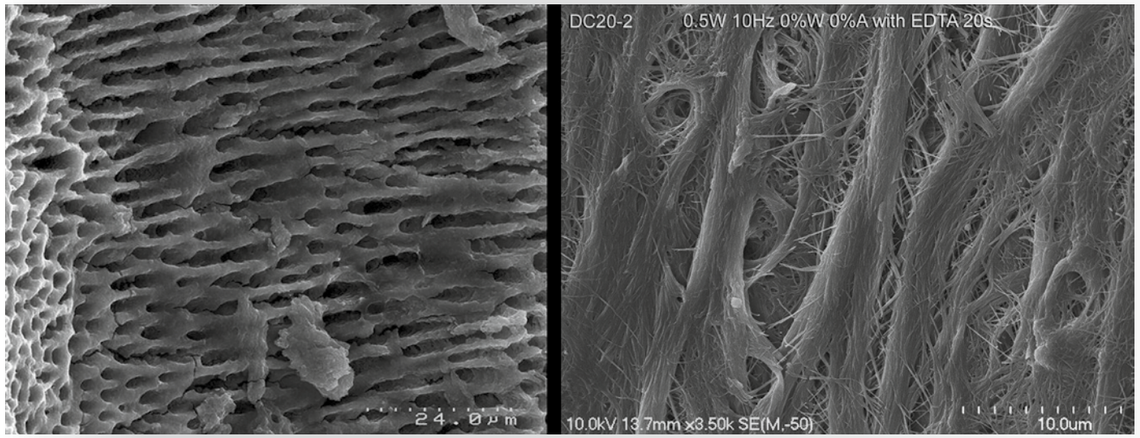

Fig. 2: Root canal dentinal walls irrigated with 17% EDTA and PIPS™

Fig. 3: Fotona LightWalker screen with PIPS™ preset

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Lower heat, more precise cutting and faster healing

Superiority of Er:YAG MAX mode over classical drill for osteotomies

By Prof. Dr. Dragana Gabric Panduric

A recent study of the performance of an Er:YAG laser compared to a surgical drill for osteotomy treatment in oral surgery proved beyond doubt that Er:YAG treatment in bone surgery at specific parameters (MAX mode, Fotona) assures lower heat generation, precise cutting, rapid osseous healing and osteoinduction. Compared to conventional mechanical drills and saws, it provides non–contact and low–vibration intervention, bacteriostasis, less traumatization and decreased bleeding.

The Fotona MAX mode is currently the fastest Er:YAG dental laser ablation mode available. Scanning electron microscopy analysis and chemical and crystallographical changes of the bone tissue after Er:YAG MAX mode laser ablation and drilling were reported at the EAO Annual Scientific Meetings [2, 3]. The complete study was published recently in the Journal for Oral and maxillofacial surgery [1].

Overcoming delayed healing and infection

The aim of the studies was to find out if it is possible to avoid the disadvantages associated with the conventional drill, such as extensive heat deposition, a necrotic surface zone, injury of the bone cells, and consequently, delayed healing, infections due to fragments left on the bone surface, and mechanical traumatization.

Holes for fixation screws were performed in 4.6 mm thick bone blocks from porcine ribs using a 1.0 mm wide surgical pilot drill (15000 rpm) and an Er:YAG laser (1000 mJ, 20 W, MAX mode, Fotona). The temperature during the preparation, the removed bone volume, and the time required for the preparation were compared in the study. The cortical and spongiose surfaces of the specimens were examined microscopically and histologically.

The results, which speak for themselves, are summarized below:

Er:YAG Advantages …	Compared to Surgical Drill …
Excellent cutting efficiency	**2.6 times** more bone tissue removed
Short preparation time	only **17%** of drilling time
Lower temperature	**3.8°C** lower final temperature
Regular shapes with clear, sharp edges	**Decreased risk** for infection caused by bony particles which remain after drill treatment
No smear layer	**Increased adhesion** of blood elements at the start of the healing process

Optical microscopic observations (10x) of the cortical appearance are shown in figures 1 and 2.

There was no change in the chemical composition of bone tissue and no thermal modification of hydroxyapatite crystals after Er:YAG ablation.

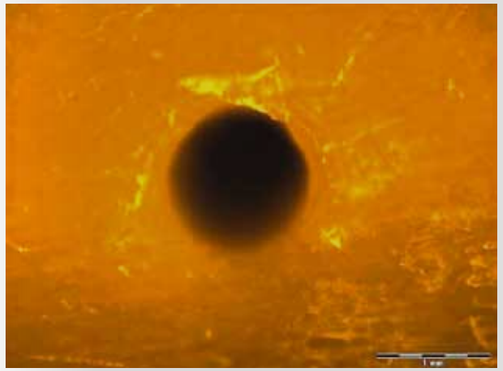

Fig 1: Laser preparation (MAX mode, Fotona)

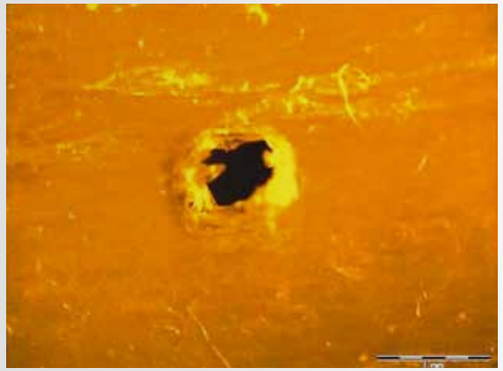

Fig 2: Drill preparation.

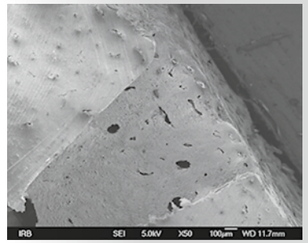

Fig 3: Laser groove; well–defined edges and surface.

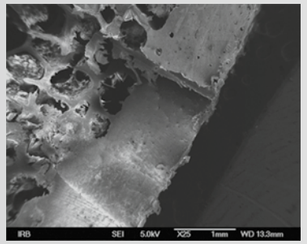

Fig 4: Drill groove; irregular edges with hair–like appearance.

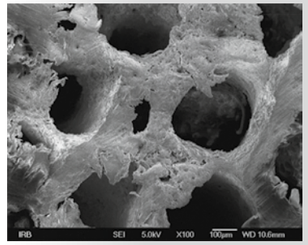

Fig 5: Spongiose bone (laser); empty spaces between trabecules due to vaporisation of the organic tissue.

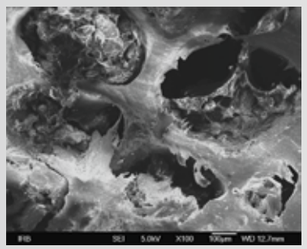

Fig 6: Spongiose bone (drill); organic tissue between bone trabecules.

The SEM pictures (figs. 3–6) show the differences between the bone surfaces produced by the Er:YAG laser and the drill.

Compared to conventional mechanical drills and saws, it provides non–contact and low–vibration intervention, bacteriostasis, less traumatization and decreased bleeding.

It was concluded that Er:YAG treatment in bone surgery at the specific parameters (MAX mode, Fotona) assures lower heat generation, precise cutting, rapid osseous healing and osteoinduction. Compared to conventional mechanical drills and saws, it provides non–contact and low–vibration intervention, bacteriostasis, less traumatization and decreased bleeding. ✻

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All photos courtesy of the authors.

Treatment Guides

X–Runner: a vision of minimally invasive conservative dentistry

Re–treatment of composite restoration

By Prof. Carlo Fornaini

Aging composite restorations may present discolorations and spots, particularly in patients who don't observe an adequate level of oral hygiene. Smile aesthetics is the main reason why several recent patients have come to our offices.

Our chosen method of treatment is the Er:YAG laser with a digitally controlled handpiece (Fotona X–Runner). Due to its wavelength (2940 nm) Er:YAG laser is well absorbed by Glycidyl methacrylate (GMA) and Silicon Dioxide, two important components of composite. It is very effective in the ablation of old restorations without thermal elevation and can produce a rough surface, very difficult to obtain with orthophosphoric acid, which is able to optimally bond the new coat of resin. The X–Runner handpiece is used to cover the total area of the composite for fast removal. If any tiny part of composite remains, the digital handpiece can also be used as a classical one–spot laser handpiece at the touch of a button.

This case presented here involves a 55–year–old female with an aging infiltrated and spotted cervical restoration on tooth 34. The treatment was performed without anaesthetic.

The case presented here involves a 55–year–old female with an aging infiltrated and spotted cervical restoration on tooth 34. The treatment was performed without anaesthetic.

The laser appliance used was a LightWalker AT device with X–Runner handpiece; the shape and size of the treatment area was adjusted to the composite size. The composite was removed in 30 seconds, and the surface was already rough and prepared for bonding to the new coat of resin. The patient was happy with the final aesthetic result and enthusiastic about the exceptionally short, vibration–free procedure without need for anaesthetic.

The recent introduction of a digitally controlled handpiece enables a higher precision of irradiation and depth of ablation as well as reduced treatment time, allowing laser technology to more fully realize the vision of "minimally invasive" conservative dentistry. ✻

Fig. 1: Old composite on tooth 34

Fig. 2: During X–Runner ablation

Fig. 3: Immediately after treatment

Fig. 4: Completed treatment

Parameters:	
Laser source:	Er:YAG
Wavelength:	2940 nm
X–Runner treatment shape and size:	circle, 4 mm of diameter
Beam passages:	15
Pulse duration:	MSP
Energy:	250 mJ
Frequency:	20 Hz

The recent introduction of a digitally controlled handpiece enables a higher precision of irradiation and depth of ablation as well as reduced treatment time, allowing laser technology to more fully realize the vision of "minimally invasive" conservative dentistry.

Veneer bonding: the attraction is now mutual

By Dr. Evgeniy Mironov

Fotona's LightWalker AT makes veneer bonding a brand new experience and takes the procedure onto a whole new level, both for a dentist as well as the patient. It's now as clean, fast, precise and painless as can possibly be.

A patient came to our office to improve the aesthetics of her smile. After the initial check–up and discussion of options, the patient decided to replace her 2–year old direct–made composite veneers with new ones. We made the decision to keep the enamel untouched and to work in the previous composite only.

Using our Fotona LightWalker AT, we started ablation with QSP mode, 150 mJ, 12 Hz — higher settings than for surface modification in enamel/dentine, because in this case we needed to remove more volume than in a laser surface modification procedure only. After we saw the material's response, we raised the energy to 180 mJ, while in areas with a thicker layer of the existing composite we switched over to 15 Hz. In QSP mode the effect of changing the energy or repetition rate is more notable than in MSP preparation modes — this helps us to work more quickly with the same level of precision. We went 0.3 mm into the old composite, but still had not reached the enamel. The preparation was very clean and a hi–adhesive surface for adding new material was achieved. The preparation took 1.5 — 2 minutes for each of the central incisors and one minute each for the laterals.

After a total time of an hour and a half, the patient was satisfied with her new look and felt very relaxed after the painless procedure.

After placing the rubber dam, direct adhesive restorations were made with a layer of Grandioso Heavy flow (Voco) placed first to establish a strong and uniform connection between the two types of composites. A brush was used to homogenize the material. After curing the flow material, the final shaping was done with Grandioso B1.

Finishing and polishing was performed with the Dimanto (Voco) polisher set. After a total time of an hour and a half, the patient was satisfied with her new look and felt very relaxed after the painless procedure. ✻

Fig. 1: Beginning of treatment

Fig. 2: After surface preparation

Fig. 3: Immediately after treatment

Parameters:	
Laser source:	Er:YAG
Wavelength:	2940 nm
Pulse duration:	QSP
Energy:	150 – 180 mJ
Frequency:	12 – 15 Hz
Handpiece:	H02–C

Taking endo–perio treatments to a whole new level

A difficult clinical case involving endo–perio treatment demonstrates the effectiveness of the photon induced photoacoustic streaming technique

By Prof. Giovanni Olivi

A patient asked for the option to save her teeth that were scheduled for extraction by another dentist. The lower–left first and second molars had high mobility (grade 2), were necrotic, with significant probing depths in the buccal aspect. The teeth were diagnosed for endo–perio treatment.

Difficulties with this case included complex radicular anatomy, long anatomical measurements (26 and 27 mm respectively for #36 and 37) and the presence of a deep vertical bone loss in the buccal aspect. After scaling and root planning, the teeth were scheduled for root–canal therapy.

Before each treatment the PIPS™ technique was applied into the periodontal pockets of each tooth for refining the debridement, removal of biofilm from the root surfaces and pocket disinfection. The root–canal treatments were performed using PIPS™–specific irrigation protocols with 5% NaOCl and 17% EDTA. The canals were obturated with a flowable resin sealer (Endoreze Ultradent, South Jordan, UT–USA) and gutta–percha points. A final treatment of the pockets using PIPS™ for disinfection was performed after completing each root canal therapy to remove any extruded sealer or residual biofilm. No post–op symptoms were reported and the mobility of the teeth progressively disappeared up to grade 0. The follow up X–rays performed after 1 and 4 months showed healing in progress for both the teeth.

LightWalker AT laser device with contact H14–C handpiece and PIPS™ fiber tip was used for the treatment. ✻

No post–op symptoms were reported and the mobility of the teeth progressively disappeared up to grade 0.

Parameters:	
Laser source:	Er:YAG
Wavelength:	2940 nm
Pulse duration:	SSP
Energy:	15 mJ
Frequency:	15 Hz

Fig. 1: Pre–op: Before the PIPS™ treatment

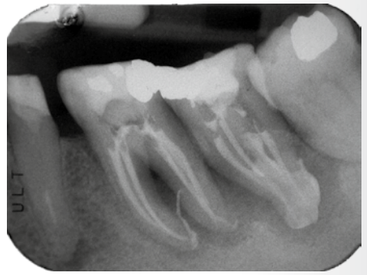


Fig. 2: Post–op: Immediately after the PIPS™ treatment

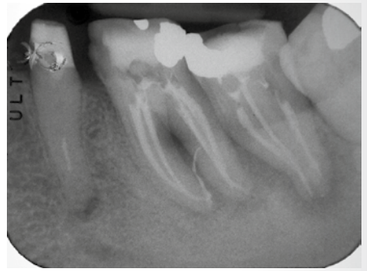


Fig. 3: 1 month post–op

Fig. 4: 4 months post–op

Buccal fibroma removal. In a minute. Literally.

By Dr. A. Kallis

In this case study we present a case of a patient who presented at our clinic with a buccal fibroma on the left interior cheek. The patient complained of frequent irritation and associated discomfort through repeatedly biting the lesion.

Usually a dental practice would refer this patient to an oral surgeon, since conventional treatment require the use of a scalpel or electrosurgery device with a consequent need for stitching and more specialized post–operative care.

In our dental practice we are able to remove fibromas using our Er:YAG laser after confirming the lesion is benign in nature. Using the treatment parameter set below we are able to plane down the fibroma to the level of the adjacent tissue, without any bleeding and in a matter of seconds No anesthesia was needed. No stitching is required and because the lesion is immediately closed to the environment due to the coagulation effect of the VLP pulses, the risk of complications is minimized. After the procedure we sent the fibroma to the istological laboratoty for further examination.

No stitching is required and because the lesion is immediately closed to the environment due to the coagulation effect of the VLP pulses, the risk of complications is minimized.

2 week complete recovery, thanks to Er:YAG laser

The procedure was comfortable for the patient and we needed approximately 1 minute to remove fibroma. If we used scarpel for the cutting, sutures would required and postoperative he would have oidima and other complications.

The patient was very satisfied because of no anesthesia needed, he did not require any further post–operative care and was able to continue with normal daily activities without any noteworthy problems. Through the formation of new fibrin, the wound healed within days, with virtual complete recovery within 2 weeks. ✻

Parameters:	
Laser source:	Er:YAG
Wavelength:	2940 nm
Mode:	VLP
Energy:	200 mJ
Frequency:	4 Hz
Handpiece:	R14
Fibertip:	conical 0.6 mm, 12 mm
Water/Air Spray Setting:	None

Fig. 1: Before treatment

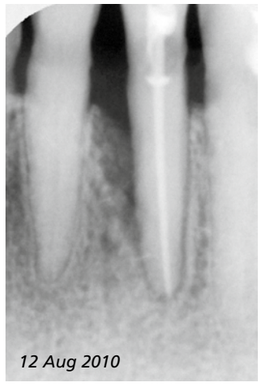
Fig. 2: During treatment

Fig. 3: After treatment

Fig. 4: 2 weeks after

Double treatment power with TwinLight® therapy

By Dr. Kresimir Simunovic



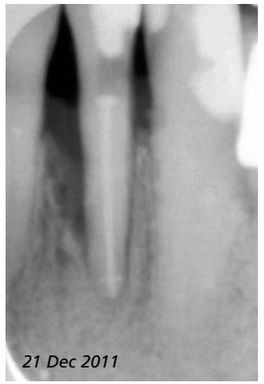


Fig. 1: X–ray follow ups from first visit to latest recall

A patient visited our office on 19 January 2010 with a buccal perio abscess on the lateral left inferior incisor with suppuration and bleeding, elevated mobility and pain. A TwinLight® perio procedure was performed with subsequent re–establishment of full function, normal physiological mobility and an absence of inflammation or infection.

On 19 July a relapse with endo involvement as a buccal combined perio/endo abscess was resolved with a double TwinLight® endo & perio treatment, followed by a second endo session on 3 August and laser–assisted filling on 12 August. The situation has been stable since 12 August 2010, with the patient on a three–month recall (Fig.1). Results of follow–up recalls and x–rays show clear new bone and soft–tissue regeneration, pocket reduction and disappearance of any inflammation. Full functionality is restored. ✻

Results of follow–up recalls and x–rays show clear new bone and soft–tissue regeneration, pocket reduction and disappearance of any inflammation.

TwinLight® perio parameters for pocket decontamination (Fig. 3a):	
Laser source:	Nd:YAG
Wavelength:	1064 nm
Mode:	MSP
Power:	2–4 W
Frequency:	20 Hz
Handpiece:	R21–C3

Fig. 3a: Nd:YAG step

TwinLight® endo parameters (PIPS™ protocol) for laser–assisted mechanical root–canal opening and instrumentation, cleansing and first decontamination (Fig. 2a):	
Laser source:	Er:YAG
Wavelength:	2940 nm
Mode:	SSP
Energy:	10 mJ
Frequency:	15 Hz
Handpiece:	H14–C
Water/Air Spray Settings:	none

Fig. 2a: Er:YAG step

TwinLight® endo parameters for final decontamination (Fig. 2b):	
Laser source:	Nd:YAG
Wavelength:	1064 nm
Mode:	MSP
Power:	1.5 W
Frequency:	15 Hz
Handpiece:	R21–C2
cycles per root canal:	3 to 5

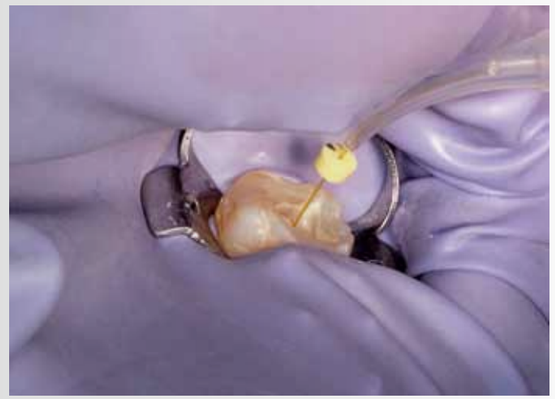


Fig. 2b: Nd:YAG step

TwinLight® perio parameters for debridement (Fig. 3b):	
Laser source:	Er:YAG
Wavelength:	2940 nm
Mode:	SP
Energy:	50 mJ
Frequency:	40 Hz
Handpiece:	H14–C with Varian 500/14
Water/Air Spray Settings:	5/2

Fig. 3b: Er:YAG step

TwinLight® perio parameters for final decontamination (Fig. 3c):	
Laser source:	Nd:YAG
Wavelength:	1064 nm
Mode:	VLP
Power:	2 – 4 W
Frequency:	20 Hz
Handpiece:	R21–C3

Fig. 3c: Nd:YAG step

The TwinLight approach to peri–implantitis

Peri–implantitis is one of the major complications in implantology. As the number of dental implants being placed increases, reported cases of peri–implantitis are becoming more frequent. **By Dr. Ilay Maden**

The most beneficial usage of the Er:YAG laser in implantology is for treatment of peri–implantitis; with Er:YAG, it is possible to clean the granulation tissues, both on the bone surface and implant surface. This is done through decontamination of the site, which is the main purpose of peri–implantitis treatments.

In this case, a removable prosthetic with two ball attachments was planned. Due to the patient's request the implants were immediately loaded, which most probably is the reason for the resorption seen around the implant on the right lower jaw (Fig. 1). The site was directly accessed to clean the granulation tissue and disinfect the implant surface with Er:YAG laser, while deep disinfection and biomodulation were executed with Nd:YAG laser (Fig. 2). The defect was augmented with synthetic bone substitute.

After 3 years of follow up with very good healing (Fig. 3), the patient demanded a fixed prosthetic, which was delivered with an additional placement of implants in both jaws. X–rays taken 5 years after the peri–implantitis treatment can be seen in Fig. 4. Two more implants were placed distally when the patient could afford more treatments after a year.

There are a number of advantages of using lasers in this type of case. One of them is that there is no mechanical, chemical or any other means of trauma while removing the granulation tissue around the implant – neither to the implant nor to the bone tissue. In addition to being safe, both wavelengths are known to promote healing by disinfecting and biomodulating the tissue. The erbium laser targets the water content to remove the granulation tissue selectively, due to its long chosen pulse duration and lower peak power while ablating the microorganisms on the surface of the bone. Shorter pulses are used on the surface of the implant to avoid thermal effects, but with lower energies, so as to not have a too high peak power and thereby damage the surface. With short pulses and higher peak power (higher energy), we can create bleeding spots on the bone to improve healing of the augmentation material.

The penetration of Nd:YAG through bone helps the achievement of deep disinfection and biomodulation. Care should be taken to avoid lasing the implant surface with Nd:YAG because the absorption is high in titanium and could cause a rise in temperature. It is also important to have a fast, sweeping motion with high suction to avoid heat accumulation on one spot. Too much bleeding would block the penetration of the Nd:YAG laser. Nd:YAG can also be used on the incision line, vestibular, the oral side of the surgical site and extra orally after suturing, and bi–daily for faster and better healing, with less pain and swelling. ✻

Settings	
Degranulation:	Er:YAG, 160 mJ, 10 HZ, LP, 1.3 mm cylindrical tip, H14–C handpiece, W/A: 6/4.
Implant surface disinfection:	Er:YAG, 80 mJ, 10 HZ, MSP, non–contact, H02–C handpiece, W/A: 6/4.
To create bleeding spots on the bone:	Er:YAG, 160 mJ, 15 Hz, non–contact, H02–C handpiece, W/A: 6/4.
Deep disinfection of the bone (no lasing of the implant with Nd:YAG):	Nd:YAG, 1.5 W, 15 Hz, MSP, non–contact, R21–C3 handpiece, 300 µm fiber.
Biomodulation:	Nd:YAG, 0.5 W, 10 HZ, VLP, non–contact, R21–C3 handpiece, 300 µm fiber.

In addition to being safe, both wavelengths are known to promote healing by disinfecting and biomodulating the tissue.

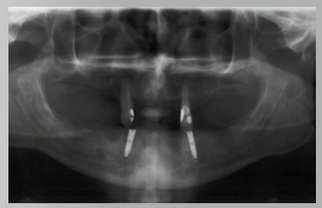


Fig. 1a: Pre–op X–ray

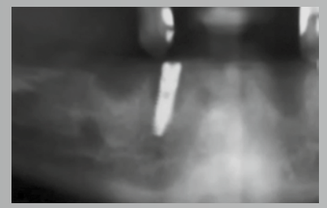


Fig. 1b: Pre–op X–ray zoomed

Fig. 1c: Pre–op Clinical

Fig. 2a: De–granulation and disinfection of the implant surface with Er:YAG

Fig. 2b: Deep disinfection and biomodulation on the bone with Nd:YAG

Fig. 3a: 3 years Post–op X–ray

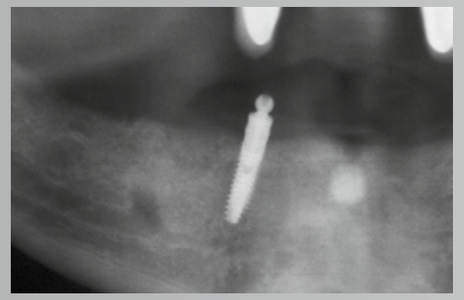


Fig. 3b: 3 years Post–op X–ray zoomed

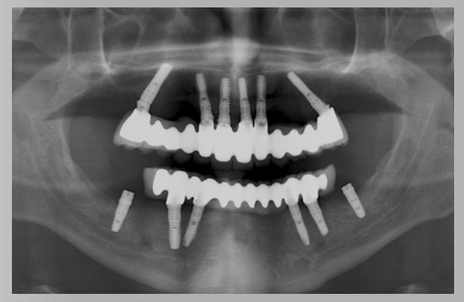


Fig. 4a: 5 years Post–op X–ray

Fig. 4b: 5 years Post–op Clinical

Fotona's Er:YAG laser vs. diode: 1:0!

By Dr. Anil Turem Dinc & Dr. Ozge Erbil Maden

When it comes to tooth whitening, Fotona TouchWhite Er:YAG whitening method is, again, the best choice. In our case, two patients came to our office to receive tooth whitening treatment and we decided to use different laser wavelengths, a diode 810 nm and a Er:YAG 2940 nm, for each patient in order to compare the efficiency of each treatment method. In both procedures the same bleaching gel — a 38% H_2O_2 bleaching gel — was used.

The first patient, a female in her early twenties, was treated using a standard 2 W 810 nm diode laser. Although diode lasers are widely used in tooth whitening treatments, the result was not as effective as we had hoped (see Figures 1 and 2 below). While a satisfactory whitening efficacy was achieved, there were miniature opaque white areas on the hard tissue surface, giving the teeth an artificial–looking uneven matt appearance.

In the second case a Fotona Er:YAG laser was used to treat a male patient in his twenties. In the so–called TouchWhite™ technique, the Er:YAG laser light is fully absorbed in the bleaching gel, resulting in faster and less invasive treatment. That is why the Er:YAG laser power in the TouchWhite technique can be utilized more effectively, and Dr. Maden was able to heat the gel to higher temperatures, without compromising the safety of the tooth or pulp.

The end result was effective whitening and an even, transparent natural shine on the tooth surface (see Figures 3 and 4 below). Additionally, the patient treated with the Er:YAG laser felt significantly less discomfort during the procedure.

These two cases demonstrate that in comparison with diode bleaching, the TouchWhite Er:YAG whitening method has proven to be faster, gentler and more effective in achieving natural whitening results and shine. ✻

In comparison with diode bleaching, the TouchWhite Er:YAG whitening method has proven to be faster, gentler and more effective in achieving natural whitening results and shine.

Parameters:		
Laser source:	Diode	Er:YAG
Wavelength:	810 nm	2940 nm
Spotsize:	N/A	7 mm
Pulse duration:	CW	VLP
Energy:	N/A	120 mJ
Power:	2 W	N/A
Frequency:	N/A	10 Hz

Fig 1: Diode Tooth Whitening Before

Fig 2: Diode Tooth Whitening After

Fig 3: Er:YAG TouchWhite Tx Before

Fig 4: Er:YAG TouchWhite Tx After

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