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The Official Journal of
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Journal of Laser Dentistry

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The mission of the Journal of Laser Dentistry is to provide a professional journal that helps to fulfill the goal of information dissemination by the Academy of Laser Dentistry. The purpose of the Journal of Laser Dentistry is to present information about the use of lasers in dentistry. All articles are peer-reviewed. Issues include manuscripts on current indications for uses of lasers for dental applications, clinical case studies, reviews of topics relevant to laser dentistry, research articles, clinical studies, research abstracts detailing the scientific basis for the safety and efficacy of the devices, and articles about future and experimental procedures. In addition, featured columnists offer clinical insights, and editorials describe personal viewpoints.

Member Publication AADEJ American Association of Dental Editors & Journalists

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This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

CLINICAL CASE

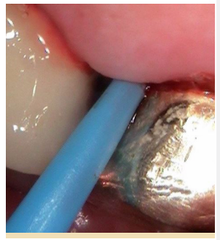
Nonsurgical Periodontal Infection Therapy with a 10,600-nm CO_2 Laser

Mary Lynn Smith, RDH

What are the techniques and precautions peculiar to the 10,600-nm CO_2 laser when it is used for nonsurgical periodontal infection therapy, and what treatment outcomes might be expected 6 months after treatment? Ms. Smith details her clinical experience.

CLINICAL CASE

Laser-Assisted Periodontal Therapy with an 810-nm Diode Laser for a Diabetic Patient with Class III Periodontal Disease



Heather Gill, RDH

What are the parameters and steps for performing laser bacterial reduction and laser-assisted periodontal therapy with a fiber-optic-delivered 810-nm diode laser? Ms. Gill provides her insights and findings for these two complementary procedures.

RESEARCH ABSTRACTS

The 10,600-nm CO_2 Laser in Periodontitis Treatment: Its Effectiveness in De-Epithelialization and in Reduction of Periodontal Pathogens

Laser-Assisted Treatment of Patients with Type 2 Diabetes Mellitus and Periodontal Disease

How effective are carbon dioxide lasers in the treatment of periodontitis? How do diabetic patients with periodontal disease respond to adjunctive diode laser therapy? An examination of the literature furnishes some of the evidence.

DENTAL EDUCATOR'S CORNER

A Call for Suggestions for Dental School Educators

P. Bradford Smith, DDS, FACD, FICD

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EDITORS VIEW: New Paths to Light-Based Exploration and Collaboration

Donald Patthoff, DDS, Martinsburg, West Virginia

J Laser Dent 2019;25(1):5-6

Welcome! This issue resumes the publication of the *Journal of Laser Dentistry*. The Academy of Laser Dentistry (ALD), like thousands of other health-care organizations over the past decade, has been scrutinizing the mission and effectiveness of its *Journal*. The causes are many and the reasons complex – most deal with our general cultural climate and issues of social justice – for example: improving evidence-based research to keep research information fair; recovering the original purpose of institutional review boards that aim to assure the well-being and safety of patients, persons, and society as a whole; keeping abreast of advancements in medical technology to help maintain fair market competition and to protect property rights; staying up with information and documentation management systems to simplify, enhance, and fairly transfer patient data across multiple health care-related disciplines; adapting to ever-changing communication methodologies that hope to help practitioners, patients, and the general public get equal access to relevant information; and bringing more humanitarian / narrative articles to journals to help keep science and scientific thinking in check and in balance with the many nonmeasurable aspects of life and health. And these are only a few of the issues at hand.

ALD changed its journal's name from the *Journal of the Academy of Laser Dentistry* to the *Journal of Laser Dentistry* more than a decade ago. At that time, other dental and medical journals were no longer able to keep up with the rapid developments of lasers and the many light-emitting diode devices and their uses in dentistry. A single journal for all of dentistry, and others interested in the use of lasers in dentistry, was needed; it needed to understand, respect, and work with the metrics underlying the various mechanisms of lasers and their uses; it needed to help its editorial team and reviewers organize and disseminate skills and knowledge from observed practical clinical applications and, equally, introduce the growing evidence of robust research in lasers.

Since the change of the *Journal*'s name, though, other advances in lasers, photonics, and phototherapeutics have occurred. As just some examples, those advances involving various photoacoustic effects, and a host of other mechanisms under what is now called photobiomodulation, have come to light. That is, the metrics and measurements of heat and wavelengths that so dominated early basic information about lasers and laser uses have revealed the need for more complex metrics and measurements dealing with light as photons – not only as energy and heat. Even laser physics – that once focused mostly on condensed matter physics – is now opening its doors to plasma physics which looks at matter and its interactions in different ways and with different tools. This opens new doors of explorations about light and its direct effects on stem cells, mitochondria, specific proteins, nerve conduction, vascular and lymphatic structures, and the vast and ever-growing information about the role of microbiomes and their use of light in both health and disease.

Donald E. Patthoff, DDS

ALD has been a pioneer in developing various kinds of partnerships with the U.S. Food and Drug Administration, the Academy of General Dentistry, the American Dental Association, and the American Dental Education Association. Within these partnerships ALD has helped to introduce lasers and current diode light devices and their uses to these organizations; ALD has been in a position to help frame discussions and consider how the policies and practices of different organizations either enhance or inhibit their missions, and whether patients, society, and professional development are being benefited or harmed. It is hoped that this *Journal* issue, then, will mark a quiet yet revolutionary turning point in our society's pill-for-every-ill habits.

It is also hoped that the *Journal of Laser Dentistry*'s new relationship with the journal *Photobiomodulation, Photomedicine, and Laser Surgery*, indexed and abstracted in the U.S. National Library of Medicine's MEDLINE® database, will allow ALD members to gain easier access to a more expansive scope of laser uses in health care and, at the same time, allow the *Journal of Laser Dentistry* to consider, discuss, and share the many nonscientific contributions that help make lasers and light uses practical and efficient. For example, not only will ALD members have use of its own dental- and case study-focused organizational journal, we will also have access to a broader health care-scoped MEDLINE resource. Many MEDLINE-indexed journals, because of their need to focus on meta-analytic articles, no longer have space for case studies. As a result, the ability for one practitioner to share procedures or cases of interest with other practitioners becomes less available. Both meta-analyses and cases studies have their place when used appropriately. The Journal's new partnerships have increased the ability for submissions to be more readily shared; authors are, therefore, better able to get their work to the most appropriate editorial teams. This is a new level of working together.

Now, with the resumption of publication of the *Journal of Laser Dentistry*, we are assembling a new and expanded Editorial Advisory Board to help guide its future as one of the premier voices advocating for the proper use of light-based technology in dentistry. Dr. Stuart Coleton, who has served as editor-in-chief of the *Journal* since 2012, has retired, and I was asked by the ALD Board of Directors to assume those responsibilities. It was Stu who called decades ago and asked me to serve as chair of the Academy's Ethics Committee. I was reluctant at first but Stu has his ways; I accepted his invitation then, and I am honored to continue in that capacity today. The Academy is deeply indebted to Dr. Coleton for his many years of service through his multiple roles in ALD, especially for his leadership as president and Board member and as editor-in-chief of the *Journal*. We are very pleased that he will continue to serve as a valued member of the *Journal*'s Editorial Advisory Board and look forward to his ongoing contributions.

In this issue, the *Journal* offers two case studies, a traditional feature format of the *Journal*. As with past issues, it also includes selected abstracts from the literature to help set a context for those cases, comparing the ways different lasers treat similar dental conditions. In addition, it offers a brief interview by one of ALD's Board members to help explore how applied ethics can help bring all of these elements together. Hopefully this will inspire new ways for individuals to think about how to write cases and bring their laser and diode use stories to life.

We welcome your thoughts, comments, and contributions.

Donald E. Patthoff, DDS

AUTHOR BIOGRAPHY

Dr. Don Patthoff practices general dentistry in Martinsburg, West Virginia. He was a clinical dentist and a principle research investigator at the Martinsburg Veterans Administration. He is a past president of the West Virginia Dental Association and the American Society for Dental Ethics (ASDE). He co-authored the Academy of General Dentistry's dental ethics column in *Impact* and is an ethics consultant to the American Dental Association's Council on Ethics Bylaws and Judicial Affairs. He co-authored *Dental Ethics at Chairside*, and was co-editor of the *Journal of Dental Education*'s special issue on Professional Promises: Hopes and Gaps in Access to Oral Health Care. Dr. Patthoff was a previous editor-in-chief of the *Journal of Laser Dentistry*. He chaired the dental sessions of the three Engineering Conferences International (ECI) conferences on light-activated tissue regeneration and two Photobiomodulation (PBM) incubators for the Optical Society of America (OSA). He initiated the Lasers in Dentistry Special Interest Group in the American Dental Education Association. He co-chairs the George Washington Institute of Living Ethics and the Foundation for Photobiomodulation Research and is the liaison to the International Dental Ethics and Law Society from ASDE. He is a Master of the Academy of Laser Dentistry (ALD) and the Academy of General Dentistry (AGD), and a Fellow of the American College of Dentists. He is also Certified Dental Editor (CDE) of the American Association of Dental Editors and Journalists (AADEJ). He is chair of ALD's Ethics Committee. Dr. Patthoff may be contacted at donaldpatthoff@gmail.com.

Disclosure: Dr. Patthoff has no laser-related commercial affiliations or personal conflicts of interest.

GUIDELINES FOR AUTHORS

Journal of Laser Dentistry: Guidelines for Authors

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What Is Professional and Business Ethics All About in Dentistry?

Editor's Note: *What is this professional and business ethics all about? Dr. Donald Patthoff, Dr. David Ozar, and Dr. David Sokol have recently published the third edition of* Dental Ethics at Chairside: Professional Obligations and Practical Applications *(Georgetown University Press, 2018). The Academy of Laser Dentistry takes a deeper dive into the ethical issues … what they are and what they are not. In a candid interview, ALD Board of Directors member Dr. James Carreiro asks Dr. Patthoff how ethics affects professions and professionals.*

Several popular news media articles have recently ranked dentistry as one of the best professions in terms of job satisfaction and security, compensation, and career flexibility. Unlike the medical profession, the dental field has been able to maintain relative independence from government influence and control. Dentists have the freedom to make patient care decisions without adhering to rigid algorithms and they have autonomy regarding their business practices.

With these freedoms, the dentist and his/her team faces daily ethical challenges in formulating the optimal treatment plan that is beneficial and cost-effective for each patient. Recently, we had the opportunity to discuss these challenges with Dr. Donald Patthoff, co-author of *Dental Ethics at Chairside*. The following questions are excerpts from an interview on his views on why ethics plays such a key role in the daily responsibilities of a dentist.

Dr. Carreiro: Dentistry today offers more opportunities and challenges to dentists, their teams and patients than could have been imagined 50 years ago. Your book, co-authored with Dr. David Ozar and Dr. David Sokol, comes at an interesting time in our profession. Do you see your book as a road map to assist both new and established dentists on their professional journey?

Dr. Patthoff: Wow, that's a big question. Two short answers. It depends and yes.

Dr. Carreiro: I was hoping that you could say more than that. What is your recent book really about?

Dr. Patthoff: It is about professions; why society invented them, why they are at serious risk today, and why society still needs them. It uses the dental profession, so to speak, to help sink our teeth into what professions are and are not, so as to get a taste of these issues for all professions.

Dr. Carreiro: Tell us, please, what are professions and what are they not, with the focus on dentistry? How can this book be a road map for students and dentists?

Dr. Patthoff: Most people have personal experiences with dentistry; they may sense that something isn't quite professional, but still can't put their finger on what should be better. This book shows what one profession looks like; it offers key ideas, actually tools that society and professions, as well as individuals and professionals, can use to make professional relationships work better.

So, in that sense, yes, this book aims to assist new dental students and established dentists and their teams in their lifelong journey to become better professionals, pursuing excellence, and using ethics as a practical tool – just like they use their office equipment and hand instruments.

If we think of maps as a tool, then, yes, this book is a useful tool. I would hesitate to call this the only map. It is very likely, though, the most practical and useful one. This is because it is much more than theory, codes, and etiquette.

Dr. Carreiro: Have you seen a rise in ethical challenges in the profession compared to 20 years ago due to the use of social media, mobile apps, and other forms of advertising?

Dr. Patthoff: The fact that the Georgetown University Press and its business team saw a need and an opportunity to update the first two editions of *Dental Ethics at Chairside* says something about the new challenges that have come along over at least the past 10 years, much of it already starting to grow 20 years ago. So, the book describes each of these challenges you mention with little stories that relate to both past dental practices and current ones.

Dr. Carreiro: Why are stories used to illustrate ethical issues and why are situations important in understanding behaviors?

Dr. Patthoff: Each chapter starts with a story. That story is then followed by an introduction to some well-grounded ethical thinking tool that most dentists intuitively know at some level, just from their practical experiences and common sense, but not yet in a refined enough way that can also be used in these new challenges. The book therefore identifies and clarifies these "idea tools" as dentistry's central practice values. These central practice values are more than principles of ethics and codes of conduct. They are actually ranked values that help dentists, patients, the profession, and society work together so they can individually and in groups better apply and interpret such things as ethical principles, codes of conduct, and State practice laws for a particular matter at hand. They are desired critical thinking and deliberation habits that professions and society want to nurture for the health and well-being of patients and society.

It takes a few pages to polish the core idea. After that, toward the end of each chapter we go back to the case and look at some of the questions raised in the stories when looked at through the lens of one of the central practice values. It's sort of a practice application to test its worth. It is also a way to have more solid footing to examine and define the next ranked core value.

Dr. Carreiro: Can you provide us with examples of how the challenges of introducing new technology such as lasers can have on treatment decisions that doctors and patients make?

Dr. Patthoff: There are many examples; just one involving lasers, though, is the ability of many devices to enhance our bodies' natural ability to repair and regenerate. Some of the mechanisms responsible for this are similar to photosynthesis in plants – a "mammalian photosynthesis," so to speak. Devices that have U.S. Food and Drug Administration marketing clearance for these effects, though, currently make these claims based on comparisons to heat lamps that have a long history of showing safety and effectiveness. The multiple standards for describing this "mammalian photosynthesis," then, have not yet been set in a way that various devices can be compared. This can confuse doctors, patients, product designers, and educators when they are deciding whether the clinical effects being observed are because of heat or photosynthesis. Some may say: "Why ask? It works and has worked for a long time." Others might counter with: "We need more evidence." Or, "Show me the evidence."

Dr. Carreiro: Where is the connection between scientifically controlled studies, clinical experience, and the impact on patient treatment decisions?

Dr. Patthoff: Dr. David Chambers wrote a classic article on that topic in 2002. It was republished in the *Journal of the American College of Dentists* in 2014. In short, he focuses on the role of practical wisdom and clinical experience as an important partner with scientific, well-controlled studies and rigorous experimentation. Blending them is more than just developing and obeying rules and standards that can be universally used in all cases. In fact, the overreliance on a narrow set of principles or rules of practice and claiming that something is either ethical or unethical accordingly is a very common temptation that is hard to defend. So, when what you do is something ethical or unethical, good or bad, I tend to think "it depends" is a more useful place to start. Making a little word like ethics or ethical carry all the work of a final judgment without describing a particular matter and then describing the particular ethical values involved in a way that everyone uses or understands is a real challenge. Perhaps even more important than the challenges of a new technology, like the use of lasers in dentistry, are patient treatment decisions that are based on current knowledge and scientific evidence for safety and efficacy for a specific clinical matter at hand.

I need to disclose here that I have chaired the Ethics Committee for the Academy of Laser Dentistry since its founding almost 25 years ago. I can tell you, then, without breaking any confidentiality, that there are ethical challenges surrounding laser use, but most of them are brought on by prioritizing commercial thinking about the dentist-patient relationship over professional ethical thinking.

Dr. Carreiro: What is one hurdle between professional, commercial, and political ethics?

Dr. Patthoff: Commercial and political ethics are based on trust in competition; professionals and families are built on trust in collaboration. When laser companies or laser users and promoters think and act as if professional ethics is just another form of competition, then getting the parties to come together under a common trust can be their major, if not the only, hurdle. In order to overcome this hurdle, they need to engage in professional collaboration, where most ethical challenges can be discussed and addressed together. Some patients, however, trust and value competition more. It is, after all, the basis of our free market and democratic political system that society also needs and trusts. In these cases, it becomes even more important to remain respectful and knowledgeable and skilled in professional ethical thinking and to reinforce the critical importance of the role of professional ethics and the trust it aims to bring about. This is the focus of the explanations and practical ethical tools offered in the book – to both the profession and society.

Dr. Carreiro: Introducing new technology and related treatment protocols presents challenges for continuing education and training. We are seeing educational and training programs that are at times promotional, manufacturer-supported, and, at times, lacking full disclosure. Some are even being bundled with an institute or study club offering certification and credentials. What are your feelings on the impact of these programs on continuing education?

Dr. Patthoff: Mixed. As far as I know, there have always been places for all kinds of promotional and manufacturer-created information-sharing forums. Even now they have merit. I mean, who else but the designers and manufacturers of technology know better how they work and how they might be used sometime, maybe even beyond some of the primary purposes for which they were initially designed? Most of the chief scientists and developers of these ideas have several, perhaps dozens of, professionals working with them – including what are sometimes called user groups. The important point here, though, is that what one professional does or even multiple professionals do and can do, does not make what they do something that should be adopted by the profession as a whole. A popular vote by a group doesn't trump scientific evidences, rational thinking, or common sense. They all have value and each should be taken in the limited and partial roles they play.

Dr. Carreiro: When technology like lasers is introduced to a health profession, how does the new technology fit with usual and customary treatment protocols for managing disease and improving overall health?

Dr. Patthoff: Technology is a mix of science and marketing; although some languages have common words to separate the device from its use, our common English language does not. Technology is considered the device AND its use. You say something very important and easily overlooked, though, when you so rightly separate technology from new treatment protocols. I want to be sure about what you might be asking, then, because I am concerned what is easily overlooked will be missed here.

What perks my ears first on this, then, is when technology is equated with pure science and progress, or when science is equated with reason. I also wonder if new protocols for a specific technological device are being equated with, substituted for, or prioritized over the usual and customary treatment protocols for managing disease. In short, we should see red flags when information and promotion are equated with education. Mixing and twisting these ideas and phrases can be great sales strategies, but they will just as easily confuse rather than educate many practitioners, professional board meetings, and ultimately patients and society.

Dr. Carreiro: What is your opinion of what you see happening in continuing education in the dental space and perhaps the silos being created currently?

Dr. Patthoff: My general feeling for what I actually see happening is not good. I say this from the sense that more professionals in society, as a whole, seem to prefer the marketplace for their continuing education. This is in contrast to going deeper – actually asking what it means to be a professional in their daily practice and then in their deliberations about how to address complex ethical questions; this thinking needs to be done in terms of self-formation, and also with a broad mix of colleagues rather than only with the special product groups who, in reality or because of their very nature, develop and promote their special niches primarily to get a return on their investments.

These information/technology groups can easily become special silos of knowledge and skill within an already larger special professional silo of knowledge and skills. As this happens, everyone must be aware that others always have something to offer, and that each of us, too, has something to offer about what it means to be a good professional. This must be done with respect and a willingness to sit back and look at what is common about what needs to be better done for the good of patients and society. Infomercials, info-seminars, info-organizations, info-centers of excellence, and info-credentials get their name, then, because they express what technology is: a mix of science and market. It is not a mix of science and professions or even a mix of science and government. People need to enter these spaces with open eyes, and not be confused by the glitter of light and harmony of sounds.

Dr. Carreiro: We are seeing more discussions in society regarding personal behavior accountability, respecting personal boundaries, and corporate values. How are these areas being addressed in dentistry? Include in your comments the private, corporate, academic, and manufacturing arenas.

Dr. Patthoff: The most exciting large-scale effort is one being facilitated through the American College of Dentists called the Professional Ethics Initiative (PEI)) (http://dentalethics.org/). It is a collaboration between the American Dental Association (ADA), Academy of General Dentistry (AGD), American College of Dentists (ACD), American Dental Education Association (ADEA), American Society for Dental Ethics (ASDE), and several other large dental organizations that have additional activities even beyond that of the PEI (https://acd.org/ethics/national-projects/). Some local societies and regional groups do continuing education and some organizations structure their organizational plans around ethics and professionalism. Unfortunately this is still in very early stages and not well understood. Our book aims to help explore why this is and what the profession itself needs to do about it – both as individual professionals and in the groups that shape and, in a certain sense, oversee where the profession is moving – especially the dental schools and the dental organizations. Our book claims that commercial thinking and commercial language often so dominate that the professional voice cannot be heard or is not offered an opportunity to contribute to society's ongoing discussions about health and health matters. The book offers reasons for that claim, and opportunities to renew professions.

Dr. Carreiro: There are probably some dentists that have not been exposed to the concepts and areas of ethics that your book discusses. What guidance would you give them before diving in?

Dr. Patthoff: Just dive in! Take the time, but do take your time. Ethics is a matter of both reactive habits and slow deliberations to decide which habits to change or keep. Ethical questions are about what ought or ought not to be done, what a professional ought or ought not to be. This is a constant; hundreds of ethical decisions are made every hour just by habit. We all need to step back, though, and look at those moments when we question what should or shouldn't be, both as individuals and as professionals. This book is not meant to be a straight read. It is a text that needs to be taken in as pieces and left to simmer in the back of your mind, and then be read again with deeper understanding. It is meant to be challenged and questioned and improved upon because it is not the last work, but a useful start in making growth in professionalism an important part of one's professional practice.

Dr. Carreiro: Despite all the challenges faced in our profession, do you feel we are in a great profession where ethics is at the forefront of dentists' decision-making, but they may not be aware of it? We all operate within a core value system that puts the needs of others first. For many of us, it is part of our makeup.

Dr. Patthoff: Yes. This is a great profession, but it was built by many others long ago before you and I decided to join it. And then the profession vetted us and said you have enough knowledge, skills, practice, and a professional attitude to start practicing all of this on your own and that society can now trust enough that you won't do too much harm and will help and work with your colleagues and learn from incidents that don't go as planned etc., etc. I agree that doing for others is part of our human and professional makeup. It is what makes living and the practice of dentistry so much fun. It is also what makes getting together with other dentists and professions so rewarding – when it is done with respect, deliberation, and understanding. That is exactly how professionalism grows and why this is a great profession.

Thank you for this opportunity.

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AUTHOR BIOGRAPHIES

James Carreiro received his bachelor of science from Fordham University and doctorate of dental medicine from Boston University. He holds Mastership in the Academy of Laser Dentistry (ALD) and Fellowship from the World Clinical Laser Institute (WCLI). He also holds ALD Standard Proficiency and Advanced Proficiency certifications. Dr. Carreiro has presented laser education programs at the University of Florida College of Dentistry Office of Continuing Dental Education, the College's general practice residency program in St. Petersburg, Florida, and the Nicklaus Children's Hospital Pediatric Residency Program in Miami, Florida. He has a general dentistry practice which incorporates diode, CO_2, Nd:YAG, and erbium laser wavelengths into almost every aspect of patient care. Dr. Carreiro may be contacted by e-mail at carreirojs7@gmail.com.

Disclosure: Dr. Carreiro provides educational training for Biolase for which he receives compensation. He also has financial relationships with PerioSciences and an advisory role with ProBiora Health and Florida Probe Corporation.

Biographical information for Dr. Don Patthoff may be found on page 6.

James Carreiro, DMD

Nonsurgical Periodontal Infection Therapy with a 10,600-nm CO_2 Laser

Mary Lynn Smith, RDH
Private Practice, McPherson, Kansas, USA

J Laser Dent 2019;25(1):18-37

PRETREATMENT

A. Outline of Case

1. Full Clinical Description

A 35-year-old healthy Caucasian female presented for routine dental prophylaxis and periodic examination. Her chief complaints were the dark line at the gum on tooth #8 and missing teeth affecting function (Figure 1). Her last dental visit was several years prior. During the hygiene appointment, the health history was reviewed and tissues were visually screened for signs of oral cancer. Comprehensive restorative, periodontal, and radiographic examinations were completed. Micro-ultrasonic scaling, biofilm removal, and coronal polishing were performed as well. The patient was educated concerning her oral health and probable progression of untreated disease.

She was taking no medications and had no known allergies. She had experienced seizures in the past. She reported having a cyst in her left ear and had pain associated with the cyst. There were no contraindications to treatment. Her occlusion is bilaterally Angles Class I with teeth #7, 26, and 27 edge-to-edge. Her temporomandibular joint (TMJ) had normal function. She was missing teeth #1, 3, 13, 16, 17, and 32. Restorations present included amalgam fillings on teeth #12, 14, 19 and 30. Tooth #8 had endodontic treatment and was restored with a porcelain-fused-to-metal (PFM) crown. Tooth #30 had significant fractures but no pain. Decay was present on the occlusal surfaces of teeth #2, 15, 18, and 31. Tissues were inflamed with the presence of plaque and calculus located both supra- and subgingivally. Periodontal pocketing ranged from 2 to 7 mm with bleeding on probing. There were areas of gingival recession ranging from 1 to 3 mm and furcation involvements of class I and II on molars. Periodontal disease was diagnosed during this appointment and the patient chose to pursue nonsurgical periodontal treatment.

Figure 1: Initial anterior view

2. Radiographic Examination

A panoramic radiograph (Figure 2) and vertical bitewings were taken at the initial hygiene appointment. Additional periapical radiographs were taken to further evaluate current bone loss and possible decay (Figure 3). Horizontal and vertical bone loss were noted with furcation involvement on teeth #2, 15, and 19. No areas of decay were detected radiographically.

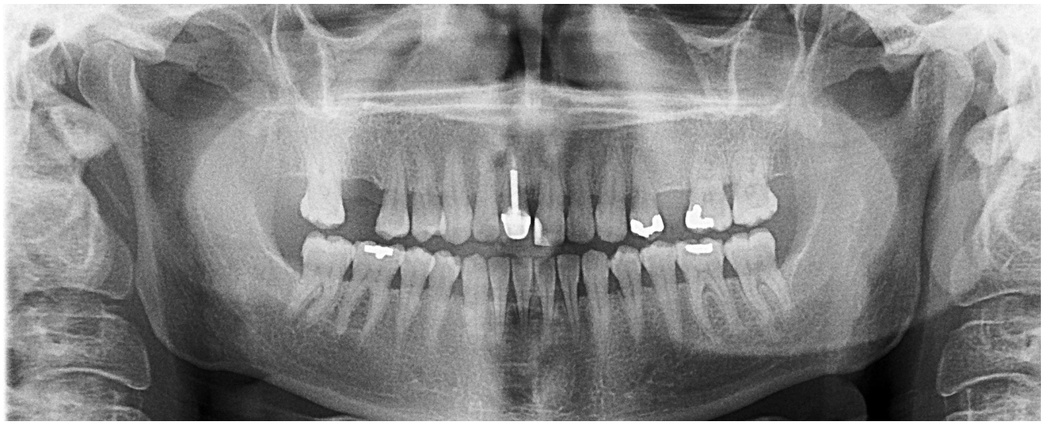

Figure 2: Panoramic radiograph of July 16, 2007

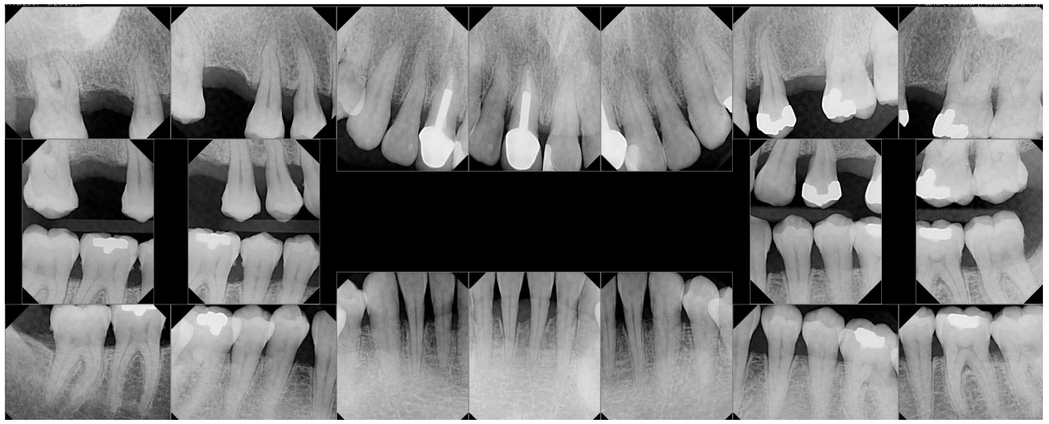

Figure 3: Full-mouth series of September 20, 2007

3. Soft Tissue Status

Tissues appeared inflamed and irritated with the presence of biofilm and calculus. A complete six-point periodontal probing was performed with 7 mm as the greatest pocket depth. Bleeding on probing was noted. Moderate-to-heavy subgingival calculus was present in posterior areas, as well as supragingivally on the lingual surfaces of the lower anterior teeth. Recession of 1-3 mm was present on all maxillary teeth and on a majority of mandibular teeth. Class I mobility was noted on teeth #8, 9, 11, and 12 and class II mobility on tooth #10. Furcation involvement of class I existed on teeth #2, 14, 15, and 30 and class II on teeth #18, 19, and 31 (Figure 4). A statistical summary of overall periodontal health showed 37 hemorrhaging sites upon probing, 106 periodontal pockets of 4 mm or greater, and all 26 teeth present exhibiting pocket depths beyond normal limits. The oral cancer screening was within normal limits.

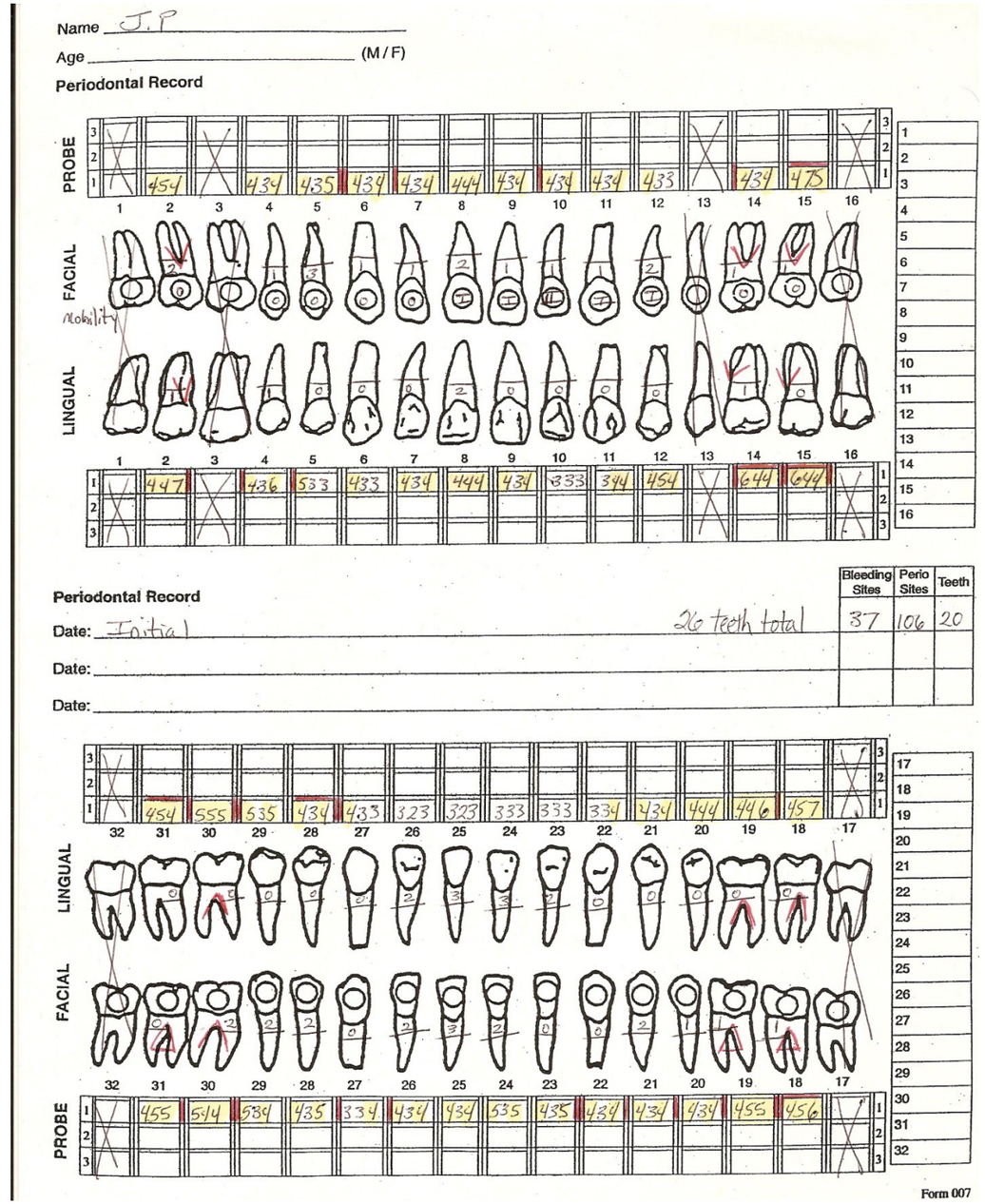

Figure 4: Initial periodontal chart

4. Hard Tissue Status

- Missing teeth: #1, 3, 13, 16, 17, 32
- No other teeth exhibited nonvital signs other than tooth #8
- Endodontic treatment on tooth #8 and existing PFM crown
- Decay noted on occlusal surfaces of teeth #2, 15, 18, and 31
- Occlusion classification is Angle's Class I, bilateral with teeth #7, 26 and 27 positioned edge-to-edge

5. Other Tests

TMJ was normal. The patient reported having a cyst in her left ear which was causing pain. She was scheduled to have the cyst surgically removed by an otolaryngologist within a month.

B. Diagnosis and Treatment Plan

1. Diagnosis

Provisional diagnosis included advanced chronic generalized periodontitis. The doctor's final diagnosis stated: severe generalized chronic periodontitis. Decay was present on teeth #2, 15, 18, and 31 and significant fractures were present on tooth #30.

2. Treatment Plan Outline

Restorative treatment to include: Composite fillings on the occlusal surfaces of teeth #2, 15, 18, and 31 and a build-up and crown to strengthen and protect tooth #30. Restorative treatment was planned after completion of active phase I periodontal infection therapy.

Active-phase I periodontal infection therapy:
Full-mouth treatment of left side then right side within 36 hours to include:

- assessment of patient's plaque management, refining techniques and continued motivation for thorough daily care
- full-mouth micro-ultrasonic instrumentation and hand instrumentation for definitive biofilm and calculus removal
- laser soft tissue decontamination and superficial coagulation for teeth exhibiting a pocket depth of ≤ 4 mm and/or bleeding on probing
- intraoral photographs

Laser decontamination appointments (3 in number) continue the process of reducing the pocket bacterial counts and supporting the body's healing process. These appointments include:

- assessment of patient's plaque management, refining techniques and continued motivation for thorough daily care
- micro-ultrasonic instrumentation at the cervical third of the tooth
- laser decontamination of previously treated teeth

Twelve-week post-therapy appointment to include:

- health history review
- oral cancer screening
- periodontal charting to assess rehabilitation
- assessment of patient's plaque management, refining techniques and continued motivation for thorough daily care
- micro-ultrasonic instrumentation for full-mouth bacterial decontamination and calculus removal
- coronal polishing
- laser decontamination of unresolved areas which present as a pocket depth of $\leq$ 4 mm and/or bleeding on probing
- intraoral photographs
- determination of re-care interval

3. Indications for Treatment

Treatment was indicated to halt the periodontal destruction and rehabilitate the affected tissues. Periodontal infection therapy must include removal of biofilm and calculus from the root surfaces through scaling. The CO_2 laser furthers decontamination of the pocket by addressing the periodontal pocket wall. The 10,600-nm wavelength is highly absorbed in water and hydroxyapatite. The chromophore, water, has a high percentage in inflamed tissue. Laser-tissue interaction reduces pathogens in the pocket and coagulates hemorrhaging sites, assisting the body's healing response.

4. Contraindications for Therapy and Precautions

There were no contraindications for this patient to receive laser-assisted treatment of periodontal disease with the CO_2 laser.

Laser safety precautions for protection of the patient and clinician included but were not limited to:

- wearing of 10,600-nm laser protective eyewear by all operatory personnel
- use of 0.1-micron filtration masks
- the environment secured to limit access
- the laser-in-use warning sign placed
- reflective surfaces minimized
- high-volume evacuation utilized for plume control and to cool the tissue

Because this wavelength is also absorbed into hydroxyapatite, the energy from the tip must be directed toward the soft tissue and *away* from the tooth and bone.

5. Treatment Alternatives

- No treatment and progression of disease, eventual tooth loss and systemic impact
- Conventional scaling and root planning
- Placement of localized antimicrobials or antibiotics with possible reactions
- Periodontal surgery

6. Informed Consent

After being educated in the progression of untreated periodontal disease and treatment options, the patient gave verbal and written consent for active phase I periodontal infection therapy. This was documented in the patient's record.

TREATMENT

A. Restorative

Restorative treatment to be scheduled following the completion of active phase I periodontal infection therapy.

B. Treatment Objectives

The treatment objectives are to halt the destruction of the periodontium due to disease processes. Laser-assisted periodontal treatment reduces bacterial load in the periodontal pocket wall, thereby reducing the related inflammatory response by the body. The 10,600-nm CO_2 laser wavelength is well absorbed in the water of inflamed tissue. Signs of healing, such as decreased probing depths, elimination of hemorrhaging, and normal tissue coloration and texture, are desired. The appointments were designed to allow the patient customized education in specific daily biofilm management techniques, ensuring maximum rehabilitation of the tissues. Beginning with the most infected teeth, each appointment provides debridement of root surfaces through scaling followed by tissue decontamination and superficial coagulation through lasing. At the three subsequent laser decontamination appointments, approximately 7 to 10 days later, the previously treated areas are revisited for ultrasonic biofilm removal from tooth surfaces and laser decontamination of tissues. This continues the reduction of bacterial load and enhances the body's healing response. It also allows reinforcement of behavior modification in daily biofilm management.

C. Laser Operating Parameters

A superpulsed CO_2 laser (PerioPulse manufactured by DEKA, a division of the El.En Group, Florence, Italy) was used in treatment. It is cleared by the U.S. FDA (K081181) for soft tissue use including the periodontal pocket. The 10,600-nm laser wavelength was used with a tapered tip yielding a 400-micron spot size. For bacterial reduction and coagulation, the laser parameters were level 5, 50 Hz and average power of 2.0 Watts. It was used in a noncontact technique with an average application duration of 26 seconds per tooth. The total laser emission duration for active phase I periodontal infection therapy was 29 minutes.

Please note: Level refers to emission cycle which, with this setting, would be on 5% and off 95% of the cycle. Also, the tapered tip reduces the power to the tissue by approximately 66%, so 2.0 W would be approximately 0.7 W received by the tissue.

D. Treatment Delivery Sequence

The treatment delivery sequence at each therapeutic appointment included:

- review of health history
- biofilm management assessment and instruction
- Topical anesthetic administered at the gingival margin and subgingivally (a compounded preparation called TAC, 20% lidocaine, 4% tetracaine, and 2% phenylephrine)
- Local anesthetic 2% lidocaine with 1:100,000 epinephrine
- micro-ultrasonic and hand instrument debridement of root surfaces
- laser decontamination and superficial coagulation
- postoperative care instructions given
- pre- and postoperative photographs

Laser safety measures included:

- use of 10,600-nm wavelength and OD +5 laser protective eyewear by all operatory personnel
- use of 0.1-micron filtration masks
- the environment secured to limit access
- the laser-in-use warning sign placed
- reflective surfaces minimized
- high-volume evacuation utilized for plume control and to cool the tissue

Chart documentation included laser and wavelength used, perio insert, operating parameters, and emission duration.

The laser tip patency was evaluated (Figure 5) and the laser test-fired immediately prior to patient care (Figure 6). To inhibit epithelial growth into the pocket and provide surface tissue decontamination, the tip was kept in noncontact mode at a distance of 1 mm from the moist gingival margin and the tissue was dehydrated to inhibit epithelial growth into the pocket and the surface tissue was decontaminated. Tissue interaction dictated the speed of this application. There was a light frosted appearance to the tissue. The tissue was rinsed with water. Next, internal pocket decontamination was accomplished by inserting the tip 1-2 mm within the pocket and guided slowly through the pocket from the distal col to the mesial col. (A large molar will take approximately 16 seconds and a smaller tooth, such as lower incisor, will take approximately 8 seconds.) The endpoint of treatment was determined both by tissue interaction and the amount of exposure duration. There may or may not be a "fresh bleed" as the CO_2 laser also dehydrates and coagulates during the application. The tip was always directed *away* from the root surface. Accumulated debris was wiped from the tip with a water-moistened gauze and patency was maintained (Figure 7). If the tip were to become obstructed, a 0.04-mm wire was used to remove debris from within the tip lumen. Once patency was confirmed, laser use within the pocket resumed.

Treatment was circumferential around each tooth rather than treating only the pocket site. This allowed decontamination of the crevicular fluid as well as the tissue wall since this laser wavelength is absorbed in water. Figure 8 shows the laser tip placement on tooth #30, which is featured in this case. Half of the mouth was treated one day and the following day the other half. Initial treatment is represented in Figures 9a through 9g.

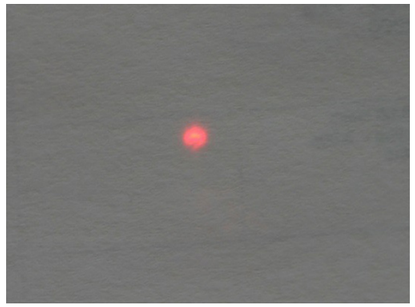

Figure 5: 633-nm diode laser aiming beam of the 10,600-nm CO_2 laser

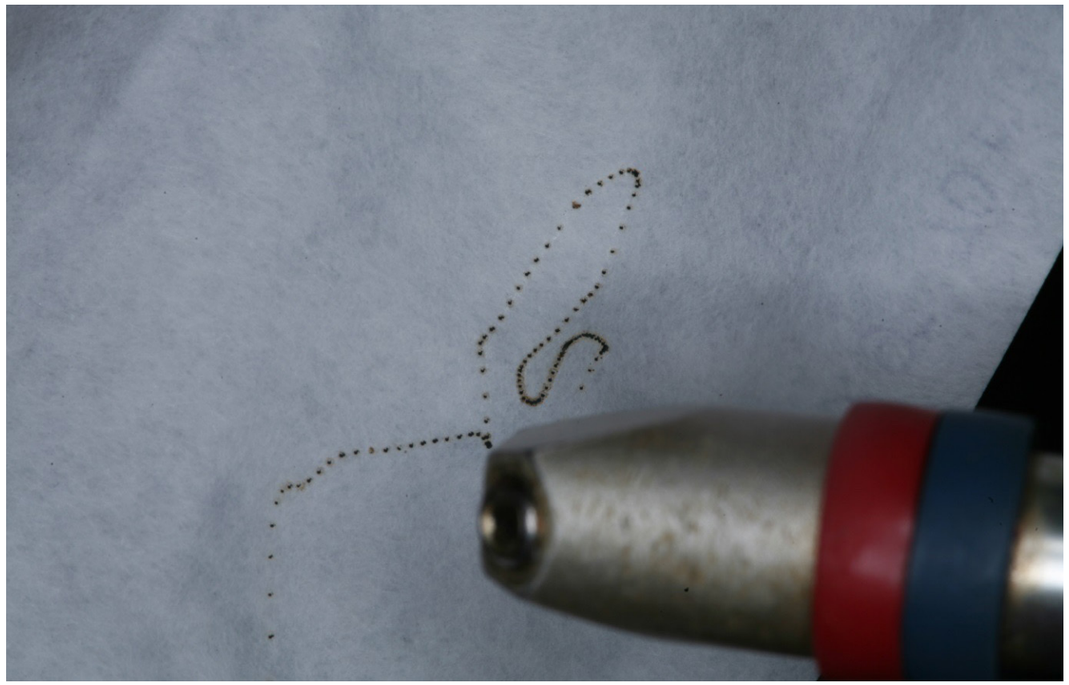

Figure 6: CO_2 laser test-fire on moist paper to detect appropriate interaction at low setting

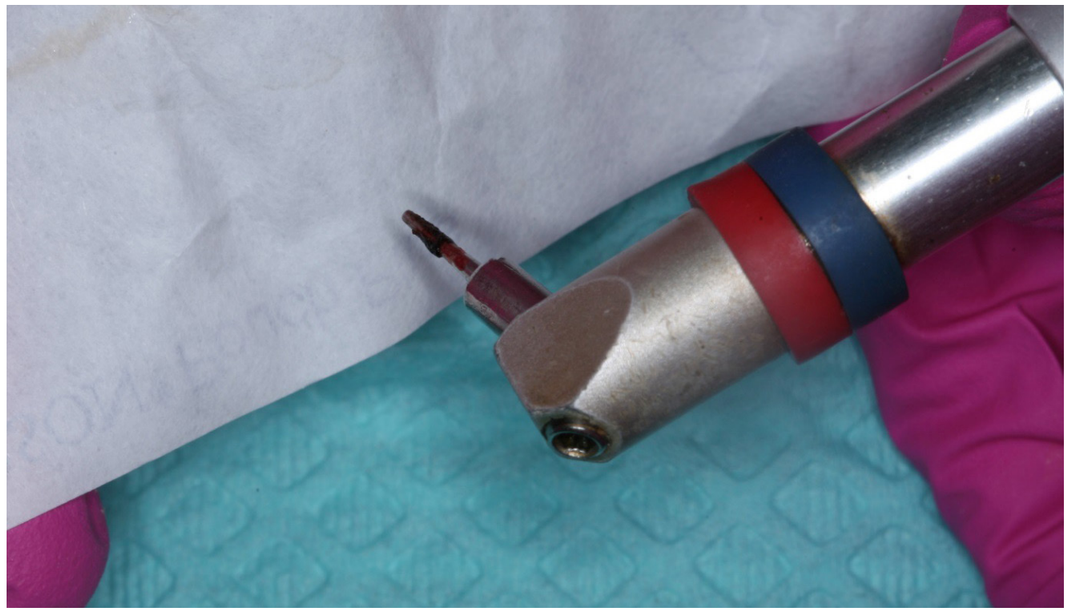

Figure 7: CO_2 laser tip with debris accumulated. No visible aiming beam indicates need for cleaning the inner portion of tip

Figure 8: Tooth #30 mesiolingual position of laser tip is parallel to the tooth structure directing energy onto soft tissue

Figure 9a: Tooth #30 mesiolingual view showing 5-mm initial probe. Scaling was then performed prior to laser use

Figure 9b: Tooth #30 mesiolingual view showing dehydration of gingival margin

Figure 9c: Tooth #30 mesiolingual view depicting laser decontamination treatment following scaling in the same appointment

Figure 9d: Tooth #30 mesiolingual view showing immediate post-laser decontamination of first appointment with scaling

Figure 9e: Tooth #30 mesiolingual view of first laser decontamination appointment that followed 1 week after scaling and laser decontamination appointment

Figure 9f: Tooth #30 mesiolingual view of second laser decontamination appointment that followed 2 weeks after scaling and laser decontamination appointment

Figure 9g: Tooth #30 mesiolingual view of third laser decontamination appointment that followed 3 weeks after scaling and laser decontamination appointment

E. Postoperative Instructions

Postoperative instructions were the same after each visit. The patient was instructed to avoid (for the first 24 hours) acidic, rough, or crunchy foods. Normal eating could resume following that period. Avoidance of seeds, husks, and other foods that may lodge between the gingiva and teeth was recommended for a week. Instructions and technique for use of oral hygiene aids were explained. In areas lased, subgingival flossing was to be avoided for several days. All other areas were to be cleaned as usual. If discomfort occurred, the patient was instructed to use warm salt water rinses and over-the-counter pain medication. The patient was informed that the most important aspect of the therapy was the healing process and minimizing biofilm at the gingival margin was critical in preventing re-infection.

F. Complications

The patient had no complications following therapy. The subsequent appointments had no complications during or after the laser treatments associated with them.

G. Prognosis

The patient's prognosis was fair overall. She was still smoking 1 pack per day of cigarettes which compromised her periodontal health. The furcations were of concern. Her biofilm management skills had improved throughout the therapy. It is critical she continue with supportive periodontal therapy to keep the disease closely monitored and controlled.

H. Documentation

All treatment and related information was recorded in the patient's treatment record.

FOLLOW-UP CARE

A. Assessment of Treatment Outcomes

The patient was assessed at 1 week, 12 weeks, and 6 months following active phase-I periodontal infection therapy. Periodontal charts show comparative data of initial state to 3 months post-therapy. Percentage of improvement at 3 months was seen with 57% in bleeding reduction, 93% in pocket site reduction, and 73% fewer teeth exhibiting periodontal pocketing.

The one-week examination revealed that the tissues were healing and the patient's skill in biofilm management was improving.

Twelve-week post-therapy appointment included:
Significant resolution was noted. Teeth #15 buccal and #2 mesiolingual showed 5 mm pocketing in furcations. Other tissues were showing signs of improved health: decreased probing depths and hemorrhaging, normal tissue coloration, firm texture, no mobility, and no recession.

- health history review
- oral cancer screening
- 6-point pocket and hemorrhaging periodontal charting to assess rehabilitation
- assessment of patient's biofilm management, refining techniques and continued motivation for thorough daily care
- micro-ultrasonic instrumentation for full-mouth bacterial decontamination and hand instrumentation as needed
- coronal polishing
- laser decontamination of unresolved areas which present as a pocket depth of $\leq$ 4 mm and/or bleeding on probing. The same laser parameters and techniques were used. No additional laser decontamination sessions were scheduled.
- determination of recare interval: 12 weeks with laser assistance planned for any areas presenting as $\leq$ 4 mm pockets and/or bleeding/inflamed areas

The previously mentioned CO_2 laser was used with the same style of tapered tip yielding a 400-micron spot size. For bacterial reduction and coagulation, the laser parameters were the same at previously noted, level 5, 50 Hz, average power of 2.0 Watts. It was used with the same noncontact technique with an average application duration of 26 seconds per tooth. Emission duration totaled 4 minutes for this appointment. Oral hygiene instructions were reviewed. A 12-week supportive periodontal therapy appointment was scheduled. Short-term follow-up is illustrated in Figure 10.

Figure 10: Tooth #30 mesiolingual view at 3 months post-treatment

At 6 months post-therapy:

- The patient experienced some relapse due to decline in consistent plaque management.
- Bleeding continued to improve but pocketing increased. Teeth #2 buccal and #15 buccal furcations still exhibited a pocket within the furcation.

Another therapeutic appointment was performed and included:

- health history review
- oral cancer screening
- 6-point pocket and hemorrhaging periodontal charting (Figure 11)
- assessment of patient's plaque management, refining techniques and continued motivation for thorough daily care
- micro-ultrasonic instrumentation for full-mouth bacterial decontamination and hand instrumentation as needed
- coronal polishing
- laser decontamination of unresolved areas which present as a pocket depth of $\leq$ 4 mm and/or bleeding on probing. The same laser parameters and techniques were used. No additional laser decontamination sessions were scheduled.
- determination of recare interval: 12 weeks with laser assistance planned for any areas presenting as $\leq$ 4 mm pockets and/or bleeding/inflamed areas.

The previously mentioned CO_2 laser was used with the same style tapered tip yielding a 400-micron spot size. For bacterial reduction and coagulation, the same laser parameters were level 5, 50 Hz, average power of 2.0 Watts. It was used with the same noncontact technique with an average application duration of 26 seconds per tooth. Emission duration totaled 6 minutes for this appointment. Oral hygiene instructions were reviewed. A 12-week supportive periodontal therapy appointment was scheduled. Long-term follow-up is illustrated in Figure 12.

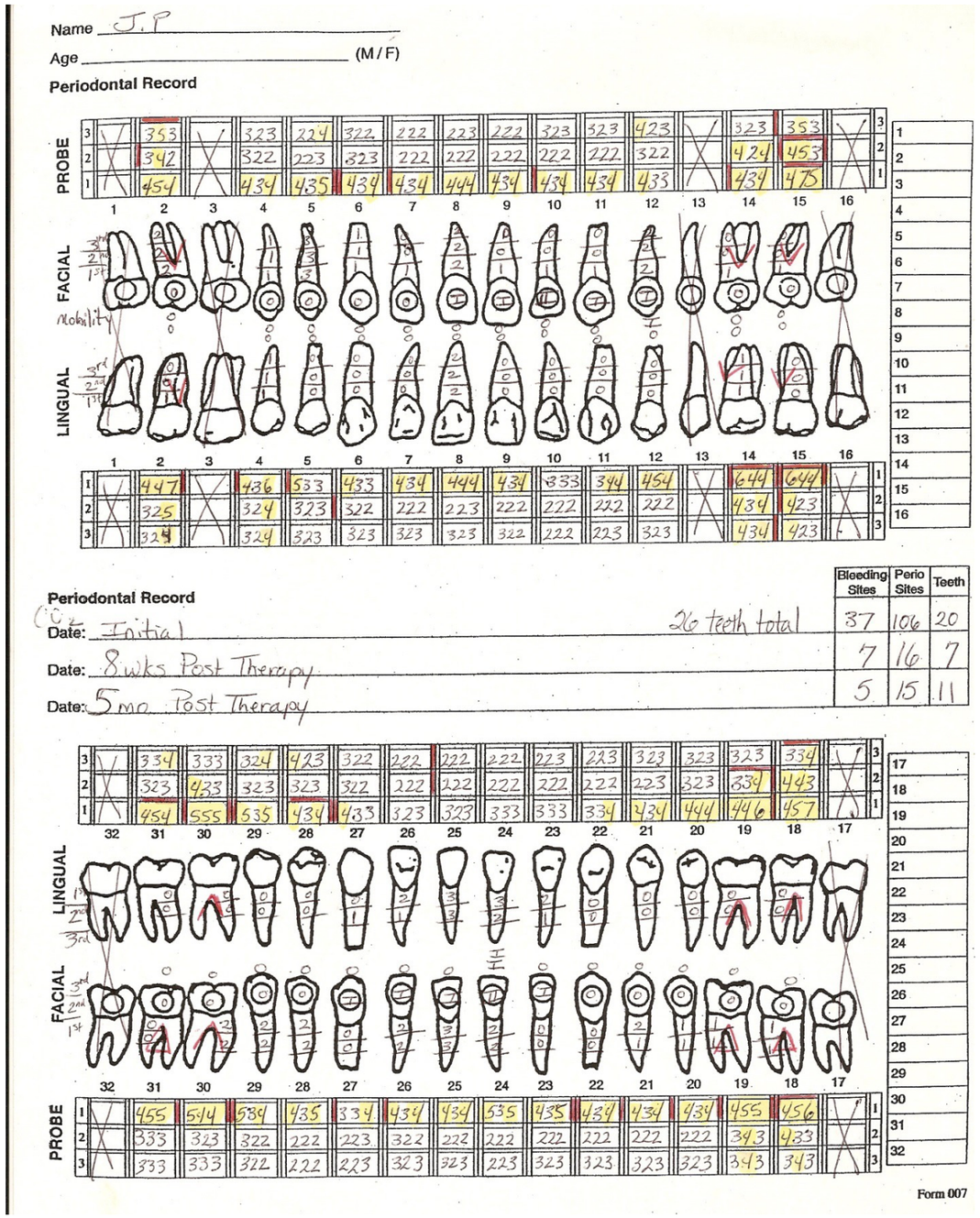

Figure 11: 6-month post-treatment periodontal chart

Figure 12: Tooth #30 mesiolingual view at 6 months post-treatment

B. Complications

The patient experienced no complications related to laser treatments. She had no soft or hard tissue damage, no sensitivity in any areas, and was pleased with the results from the therapy.

C. Long-Term Results

At 12 weeks post-therapy there was marked improvement. Hemorrhaging sites improved by 78% and number of perio sites by 85%. At 6 months post-therapy, the patient had an increase in perio sites due to decline in consistent daily plaque management. Comparing 6-month post-therapy to the initial state, improvement showed 87% in hemorrhaging and 86% in number of perio sites (Table 1). The periodontal chart shows comparison of initial, 3-month, and 6-month intervals (Figure 11). The patient was very pleased and highly motivated with the success. Figures 13a, 13b, 13c, and 14 show the comparison of tissues initially, 3 months and 6 months post-therapy.

Table 1: Comparison of Laser Therapy Over Time

Laser Treatment	Number of Teeth	Laser Emission Duration (minutes)
Initial*	26	29
3 Months	8	4
6 Months	13	6 minutes

Total laser emission duration over 6 months:39 minutes

*Initial exposure includes 3 laser decontamination appointments

Figure 13a: Tooth #30 mesiolingual view, initial probe

Figure 13b: Tooth #30 mesiolingual view at 3 months

Figure 13c: Tooth #30 mesiolingual view at 6 months

Figure 14: Final anterior view at 6 months

D. Long-Term Prognosis

The patient has a fair prognosis. Though she was compliant with appointments to the 6-month mark, furcation involvements and continued smoking are a challenge to the health gained in therapy. Effective oral hygiene and 12-week supportive therapy must continue. Smoking cessation was encouraged. It is critical to reinforce periodontal disease is site-specific and episodic in nature. It is not cured but managed through appropriate daily care and recommended professional care. Following customized recommendations will ensure the best results. Her restorative treatment has not been scheduled.

E. Discussion

The patient had successful removal of the cyst in her ear, however still had hearing loss. She completed 6 months of supportive periodontal therapy then discontinued dental care. Unfortunately she did not complete the recommended restorative work.

AUTHOR BIOGRAPHY

Mary Lynn Smith, RDH

Mary Lynn Smith is a registered dental hygienist, working clinically since 1994. Practicing with lasers daily since 2000, she has persisted in advancing her knowledge and expertise. She holds both Standard and Advanced Proficiencies in multiple laser wavelengths. She is currently a Recognized Course Provider with the Academy of Laser Dentistry. In April 2018, Ms. Smith was awarded ALD's Leon Goldman Award for Clinical Excellence in laser dentistry. She has contributed to the dental community through speaking at national conferences and small groups on care of implants, periodontal therapies, laser-assisted hygiene techniques and principles. She also provides consulting in private practices. She has authored published articles and a chapter on laser- assisted non-surgical periodontal therapy in the text book *Principles and Practices of Laser Dentistry* by Dr. Robert Convissar. Her passion for sharing her knowledge, developing other clinicians' skills, and inspiring them to work with excellence is evident in her teaching. Ms. Smith currently resides in McPherson, Kansas, where she is employed at McPherson Dental Care. She is the owner and CEO of Aspiring Dental Hygiene, LLC. Ms. Smith may be contacted by e-mail at *marylynnrdh@gmail.com*.

Disclosure: Ms. Smith has worked closely with DEKA from 2006 to 2014 and was compensated a modest amount as a consultant and educator. She currently has no financial or other relationships with any laser manufacturer

Laser-Assisted Periodontal Therapy with an 810-nm Diode Laser for a Diabetic Patient with Class III Periodontal Disease

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PRETREATMENT

A. Outline of Case

1. Full Clinical Description

A 70-year-old male patient presented for a new patient exam with the doctor and hygienist. Full periodontal probing along with a comprehensive oral examination was performed. The patient was from outside of the United States and did not speak English. Most of the communication came from his son. The patient did not care to see the dentist and rarely went to see his physician.

a. Medical History revealed type II diabetes. The patient believed he was taking metformin but was not certain. It was not clear whether his diabetes was controlled; glucose levels were not available. He also reported acid reflux with no medications for this condition and previous history of hospitalization for hernia.
b. Dental history revealed most posterior teeth with porcelain-fused-to-metal (PFM) and full gold crowns, root canal therapy on teeth #3, 4, 9, 25, 30 and 31. Several teeth had filings that needed to be replaced. Failing root canals were evident on #4 because of caries and on #30 because of advanced periodontal disease in the furcation.
c. Periodontal charting was completed during the periodontal therapy after the calculus was removed to obtain the most accurate readings possible (Figures 1-2). From the appearance of his tissue and the amount of radiographic calculus present, periodontal therapy was indicated even in the absence of periodontal charting at the initial visit. A preoperative view of tooth #15 is shown in Figure 3, imaged through an intraoral camera.

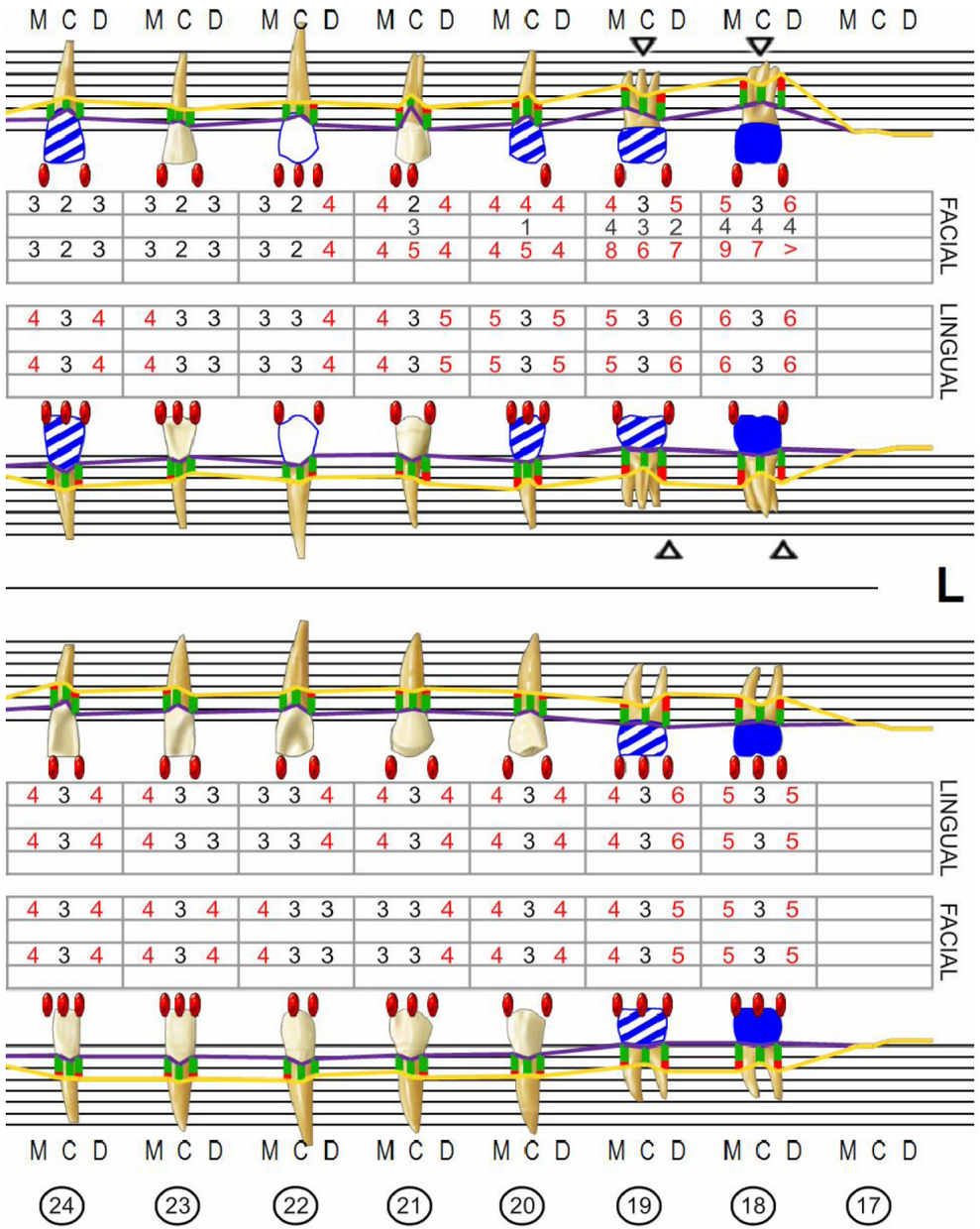


Figure 1: Left side periodontal chart, performed during initial therapy on left side

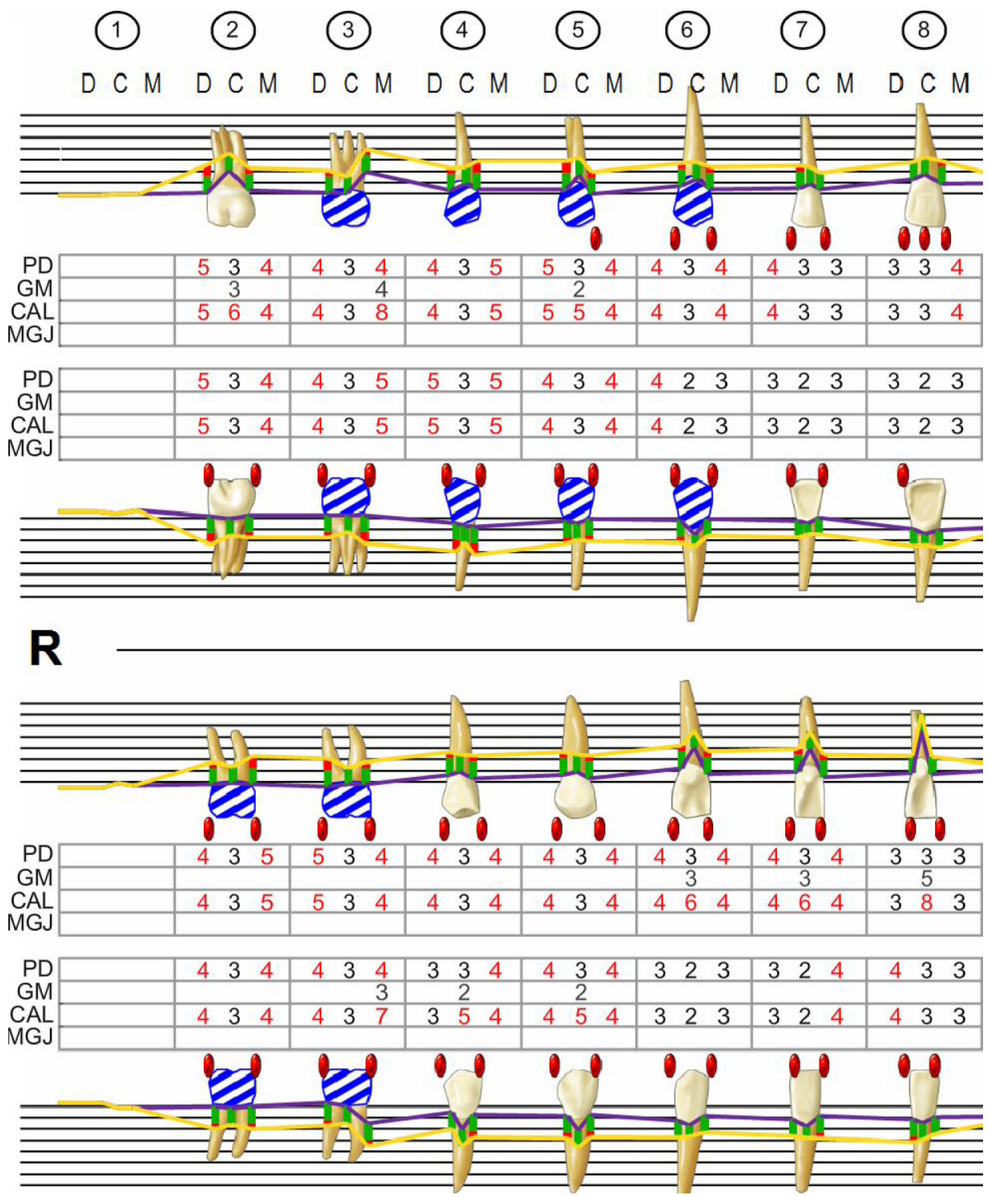


Figure 2: Right side periodontal chart, performed during initial therapy on right side

Figure 3: Tooth #15 buccal aspect with heavy plaque

2. Radiographic Examination

Radiographs revealed generalized class II/III interproximal horizontal cortical bone loss. Lower right was the most involved with class III bone loss. The radiographs also revealed caries on several teeth and generalized interproximal calculus (Figure 4).

Figure 4: Initial full-mouth series

3. Soft Tissue Status

Soft tissue appeared erythematous with bulbous papillae that bled easily particularly in areas with calculus trapped subgingivally. The rest of the tissue was inflamed at the margin.

4. Hard Tissue Status

Many areas presented with caries, particularly teeth #4, 11, 24, and 25. The prognosis of tooth #4 at the time of the initial examination was in question; the crown came off during the first periodontal therapy appointment and the doctor determined the tooth was not savable. Tooth #30 had advanced furcation involvement according to the radiograph, the probable cause was a crack. The doctor determined the tooth was not savable and the treatment plan called for removal of the tooth after periodontal therapy.

5. Other Tests

Occlusion examination revealed bilateral class I.

B. Diagnosis and Treatment Plan

1. Provisional Diagnosis

A provisional diagnosis was made: American Academy of Periodontology (AAP) class II bone and attachment loss. This classification is characterized by generalized inflammation with bleeding and early-to-moderate loss of attachment and interproximal cortical bone loss.

2. Final Diagnosis

A final diagnosis was determined to be AAP class III throughout most posterior regions. This was confirmed with the full periodontal examination upon calculus removal during periodontal therapy.

3. Treatment Plan Outline

The treatment plan outline consisted of two 2-hour periodontal therapy appointments with Laser-Assisted Periodontal Therapy (LAPT), followed by one 1-2 week postoperative evaluation and one 4-week postoperative evaluation.

a. The two periodontal therapy appointments comprised verbal health history update, blood pressure taken prior to injections, use of topical and local anesthetic, Laser Bacterial Reduction (LBR), traditional nonsurgical periodontal therapy followed by LAPT, and customized oral hygiene instructions as needed.
b. A prescription mouth rinse (OraCare, Dentist Select, Bridgeport, W. Va., USA), a two-part activated oral cleanser, was given to patient. This rinse was indicated for use during and after initial therapy because it contains the active ingredient chlorine dioxide, an antibacterial and antifungal agent,[1] that helps create an oral environment low in pathogens that could otherwise potentially hinder healing. Instructions for use included (1) pump 4 equal amounts from each of the two bottles into the cup provided, (2) allow the mixture to activate for 30 seconds, (3) thoroughly swish the mixed solution around for 30 seconds, (4) then spit; repeat every day, twice a day.

4. Indications for Treatment

Indications for treatment with a diode laser include the condition of the tissue. An 810-nm diode laser is useful in the presence of inflammation and disease because it is well absorbed in the hemoglobin and melanin present in the diseased tissue. Therefore it will work well to help reduce and slow the progression of the disease during the initial phase of treatment.

5. Contraindications for Treatment

There were no contraindications for the specified laser treatment.

6. Precautions

Precautions included strictly adhering to all safety requirements, knowledge of the particular laser wavelength and type of laser used, only using this laser within the practitioner's scope of practice, and managing the patient at all times during the procedure.

Safety measures included proper use of appropriate laser safety eyewear to protects the eyes of the patient and practitioner against 800-nm to 820-nm wavelength, with an optical density of 5+. All safety mechanisms associated with the laser unit were also observed. These included ensuring the emergency stop button was working properly, the foot pedal incorporated a guard, the laser performed an operational self-diagnostic routine upon start-up, proper signage was displayed to ensure others knew the laser was in use, all persons within the nominal hazard zone were properly protected with the correct safety eyewear, and high-volume evacuation was used during laser periodontal therapy.

The practitioner is required to have particular knowledge of this laser, how it operates, and what damage this laser can do if used improperly. The 810-nm diode laser can cause damage to the bone, periodontal ligament, and diseased as well as sound tooth structure. Particular care needs to be used around these structures and the beam should be pointed outward into the soft tissue and away from all of the above-mentioned structures. The tip of the fiber was measured to 1 mm less than the base of the pocket to ensure further protection of the vital periodontium. It is important to maintain a proper fiber cleave for optimal power delivery. Also the practitioner may not use the laser outside her particular scope of practice which in this instance is dental hygiene.

Management of the patient during the procedure included pain management with local anesthetic and proper postoperative pain control. This particular patient had had an addiction problem in the past; his son informed us of this after hydrocodone was prescribed. The hydrocodone was not dispensed. A flag was entered on his electronic chart stating he was not to be given narcotics of any kind. Ibuprofen was prescribed for any discomfort during and after the procedure. 800 mg were used at the start of each nonsurgical periodontal therapy visit and one tablet from a packet of 6-8 was to be taken every 4 hours or as needed.

7. Treatment Alternatives

Treatment alternatives included doing nothing, sending him to the periodontist for surgical scaling and root planing, or osseous surgery.

8. Informed Consent

Informed consent forms were given to the patient to take home with him after the first periodontal therapy visit as he could not read and understand the written forms. The hygienist reviewed the form with him in detail with props to show him and asked permission. The patient verbally agreed to proceed with nonsurgical periodontal therapy with LAPT. He took the forms home to have them signed in the presence of his son. His son was informed about the signature needed on these forms. Verbal consent was obtained to have him participate in a case study for educational purposes. The patient then brought the signed forms to his next periodontal therapy appointment.

TREATMENT

A. Treatment Objectives and Strategy

This treatment will benefit from the use of the laser because the 810-nm laser wavelength is well absorbed in diseased tissue due to its affinity for hemoglobin and melanin.

The 810-nm diode will absorb past water into the diseased portion of the tissue and help remove the diseased portion of the lining of the pocket, reduce the bacteria beyond the reach of traditional periodontal therapy instruments, and help speed healing because of the biostimulation it creates.

The expected outcome is healthier tissue that is easier for the patient to cleanse at home as well as slowing or halting the disease progression. When used with nonsurgical periodontal therapy, the laser will help to accomplish this by its mode of action described above.

Estimated outline of treatment:

1. Two 2-hour periodontal therapy with LAPT appointments no more than 2 weeks apart. Local anesthetic for pain control will be used during appointments and ibuprofen will be suggested postoperatively.
2. Then two postoperative appointments will follow, one 1-to-2-week visit and one 4-week visit from the finish of periodontal therapy. Each postoperative examination will include a verbal health history review, laser bacterial reduction, intraoperative photographs, monitoring of oral hygiene, deplaque as necessary, and detailed oral hygiene instruction. These visits will be followed by 3-month and 6-month periodontal maintenance.

B. Laser Operating Parameters

1. Laser Bacterial Reduction (LBR)

- Laser: Diode laser (Picasso, AMD Lasers, Indianapolis, Ind., USA)
- Wavelength: 810 nm
- Delivery system: Fiber-optic cable with disposable cannula. Beam diameter: 400 microns
- Emission mode: Continuous wave
- Power value for LBR: 0.3 W continuous with noninitiated tip. Total power: constant at 0.3 W. Duration: approximately 10 to 20 seconds per tooth. LBR will be used preoperatively during the periodontal therapy appointments and during all postoperative examinations and periodontal maintenance visits.

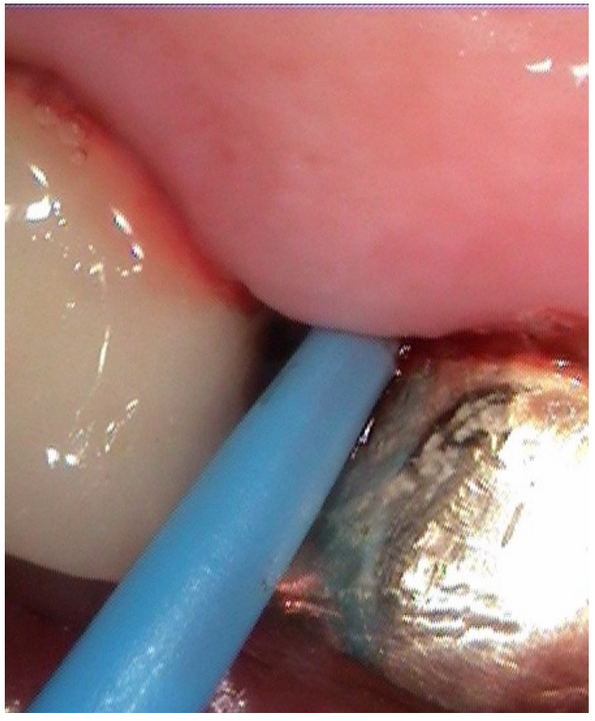
2. Laser Assisted Periodontal Therapy (LAPT)

- Laser: Diode laser (Picasso, AMD Lasers, Indianapolis, Ind., USA).
- Wavelength: 810 nm
- Delivery system: Fiber-optic cable on a spool with disposable cannula. Beam diameter: 400 microns
- Emission mode: Continuous wave
- Power value for LAPT: 0.6 W continuous with an initiated tip (initiated in the mouth) to facilitate removal of infected soft tissue. Total power: constant at 0.6 W. The total treatment time for each periodontal pocket will vary depending on the architecture of the individual pocket. The laser will be used until either a fresh bleed is seen or no more debris is collected at the tip of the fiber. Typical duration is up to 30 seconds per pocket. Treatment starts with lasing the most diseased and deepest pocket for 15 seconds, then progresses through the quadrant; most deeper areas require a second 15-second treatment.

C. Treatment Delivery Sequence

1. Periodontal therapy appointments 1 and 2:

a. Verbal health history was reviewed for changes, and blood pressure was taken prior to delivering local anesthetic. For each half of the mouth 2 carpules of 4% prilocaine (Cetanest® Plain) were administered for the anterior superior alveolar nerve block, posterior superior alveolar nerve block, and infraorbital nerve block, and 2 carpules of lidocaine with 1:100,000 epinephrine for the inferior alveolar nerve block.
b. The diode laser was test-fired safely away from the patient and LBR was then performed prior to starting the nonsurgical periodontal therapy. Precautions were taken to avoid laser exposure to the periodontal ligament, bone, and vital tooth structures.
c. During the periodontal therapy an ultrasonic scaler was used along with the Columbia 13/14 and Gracey 11/12 and 13/14 curettes and the Montana Jack sickle scaler. Probe measurements were reassessed after the bulk of the calculus was removed to ensure proper depths were recorded, and the explorer was used thoughout the procedure to ensure complete calculus removal was obtained.
d. The diode laser was then used in contact mode for LAPT. The fiber was measured to within 1 mm of the base of the sulcus and cleaved to that length. The cleave was tested for optimal delivery of the beam prior to use and a test-fire was performed. The fiber was inserted to proper depth of the pocket, pointed away from vital structures, and out into the soft tissue. A cross-hatch, multidirectional fiber movement was used in order to help assure all tissue was treated properly. A scooping motion was also applied to remove the granulated tissue and the fiber was wiped of debris often with a water-soaked gauze. The tip of the fiber was monitored for proper cleave and the tissue was assessed for proper laser-tissue interaction during the procedure. The patient was monitored for signs of discomfort which was managed with administration of additional anesthetic. The laser was also used for hemostasis where needed, with an uninitiated tip held 1-3 mm from the tissue, at 0.8 W continuous mode for 30-second intervals, being careful not to overtreat and stopping after 3 hemostatic assistance sessions.



Representative photographs of tooth #15 treatment are shown in Figures 5-6.

Figure 5: Tooth #15 mesiobuccal aspect, fiber inserted into pocket

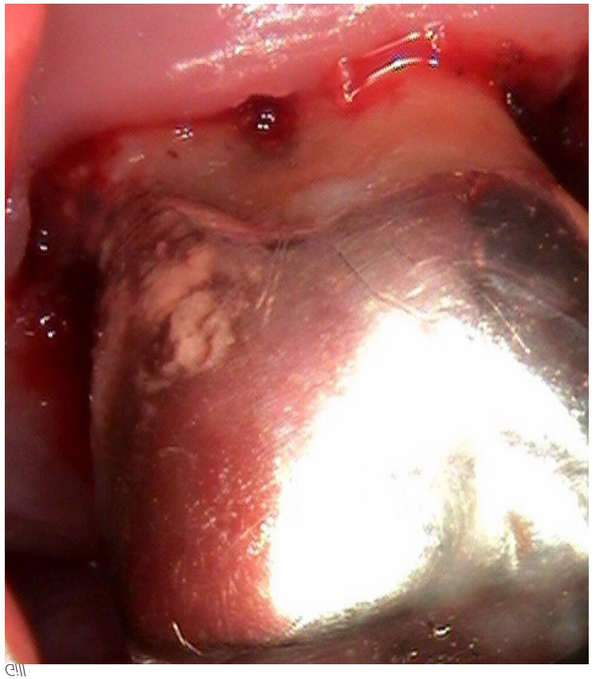


Figure 6: Tooth #15 buccal aspect, showing fresh bleeding immediately after laser use

Figure 7: Teeth #14 and 15 at the one-week evaluation, plaque present

2. Subsequent Assessments

Assessment of the final nonsurgical sequence was performed and success was monitored at the 1-to-2-week and 4-week evaluations.

These evaluations included verbal review of health history, addressing any concerns the patient expressed, LBR, deplaque as needed with ultrasonic scaler, polish, and light hand scale, assessment of oral hygiene, and oral hygiene instructions customized to the patient needs.

At the 1-week postoperative appointment heavy plaque was present, the tissue was mostly inflamed with bleeding present. An intraoral camera image of Teeth #14 and 15 at one week is shown in Figure 7. Customized oral hygiene instruction was given and specific adjunctive products (interproximal brush and electric toothbrush) were recommended.

At the 4-week postoperative visit there was little change in his oral hygiene. Teeth #14 and 15 at 4 weeks are shown in Figure 8. More oral hygiene instructions were given including demonstration of how to clean his teeth properly.

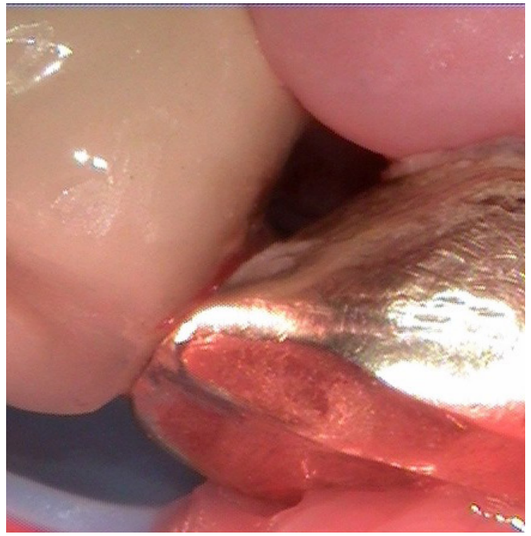


Figure 8*:* Teeth #14 and 15 at the four-week evaluation, plaque present

3 Assessment of Time Taken During Surgical Sequences

2 hours were utilized for the right and 2 hours for the left side for periodontal therapy. A total of 1 hour was used for the postoperative evaluations. Total time taken was 5 hours.

D. Postoperative Instructions

Instructions were given to the patient in both written and verbal form. A phone call to his son was made to ensure the patient fully understood how to care for his mouth after the therapy was complete. Included were oral hygiene instructions to brush gently and not floss for the first 48 hours; avoid eating foods with small seeds or skins like strawberries, nuts and popcorn for the first week. Ibuprofen was recommended for postoperative discomfort and the mouth rinse was recommended 2 times per day starting 48 hours after the procedure.

E. Complications

1. The patient asked for Vicodin®, but his son stated he was not to be given narcotics of any kind because of a past addiction problem.
2. During right side periodontal therapy the tooth #4 crown came off. It was not possible to re-cement it because of the extensive caries present and amount of tooth that broke off with the crown. The patient was disappointed and did not understand why it could not put it back on. The situation was explained to his son who stated that he would talk with his father about it.
3. The patient also indicated at the right side periodontal therapy appointment that his lower left side was sore. Upon examination an aphthous ulcer was observed on the attached gingiva on the buccal side between teeth #18 and #19. The 810-nm diode laser was used at 0.8 W continuous mode, defocused, for three applications of 30 seconds each to relieve the soreness and help healing. The patient indicated he felt no pain at the end of the treatment and the ulcer healed within 3 days.
4. A calcified duct on lower left floor of the mouth was also observed. The doctor examined the duct but was unable to remove the calcification. The patient was instructed to drink plenty of water to help the calcification come out on its own. It eventually resolved on its own.

F. Prognosis

The prognosis was good for the periodontal therapy. At his first and second postoperative examinations his tissue appeared more pink and healing was starting. His oral hygiene was not optimum and oral care instructions were again emphasized.

G. Treatment Records

Documentation was completed and recorded in the electronic chart.

FOLLOW-UP CARE

A. Assessment of Treatment Outcomes

The patient came back for both 3-month and 6-month periodontal maintenance visits. Each of these visits included taking full verbal health history, assessment of any concerns he had, visual oral cancer screening, restorative examination including assessment of caries risk, full periodontal records, intraoperative photographs, LBR, and cleaning all of his teeth with ultrasonic scaling, hand instrumentation, polish, and floss. Each visit also included oral hygiene instruction that was customized for his needs as well as a personalized bag that included samples of products to fit his at-home needs. The patient's supply of mouth rinse was monitored and refilled as needed. At the 6-month periodontal maintenance visit the doctor performed an examination and bitewing X-rays were taken.

1. Assessment of Periodontal Charting

At the 3-month periodontal maintenance visit, full periodontal probing was performed (Figure 9). The 810-nm diode laser was used to retreat teeth #14 distolingual and #15 mesiolingual.

- The upper right quadrant showed 20 sites with a 1-mm improvement and 20 fewer bleeding sites.
- The upper left quadrant showed a 1-mm improvement in 17 sites, 5 sites with pockets 2 mm shallower, and 24 fewer bleeding sites.
- The lower left quadrant showed 1-mm improvement in 27 pockets and tooth #19 distolingual showed 2-mm improvement and bleeding was reduced by 35 sites.
- The lower right showed 1-mm reduction in 22 sites, tooth #30 was removed in the time from initial phase treatment to this appointment, and bleeding was reduced by 25 sites.
- There was no change in recession recorded in any of the four quadrants.
- Overall there were 47 sites with pocketing over 3 mm and 15 bleeding sites. This was a 54% improvement in pocketing and 87% improvement in bleeding from start of initial therapy to this appointment.

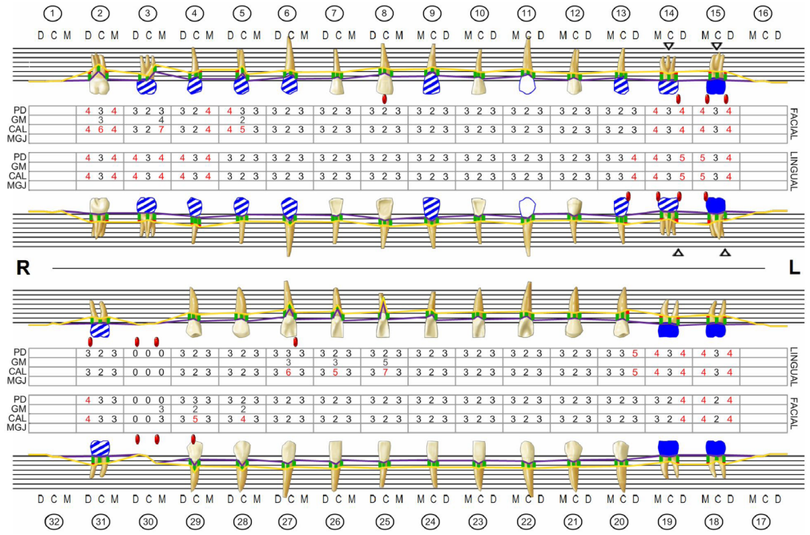


Figure 9: Three-month postoperative periodontal chart

2. Assessment of Oral Hygiene

Oral hygiene was improved, however he was still struggling to clean interproximally and was doing a marginal job with his toothbrush. A significant reduction in the amount of plaque indicated he was doing better than originally. Figure 10 shows tooth #14 at 3 months. Oral hygiene instruction focused on tooth brushing and flossing technique as well as continued daily mouth rinse.

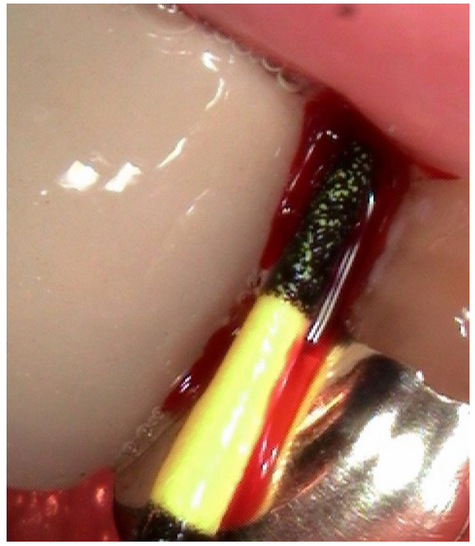


Figure 10: Tooth #14 buccal aspect, with 4-mm pocket 3 months after initial therapy

3. Assessment of Prognosis

Short-term assessment of the prognosis was deemed guarded at this time, given that he appeared to be less motivated to comply with home care instructions as time went on.

If the patient continued to improve on oral hygiene practices at home including the use of mouth rinse and daily flossing, and kept his 3-month periodontal maintenance appointments, there was a chance most of his teeth could be saved. With this said, the upper left molars, #14 and #15, still had AAP class III bone loss with class II furcations in all areas. This reduced the probability of a good prognosis in this quadrant. Evaluation of these areas in the future continued and referral to a periodontist was to occur if infection returned.

4. Assessment of Caries Risk

Caries risk was deemed moderate-to-high, however with improved oral hygiene the risk was less than at the initial visit. Fluoride varnish was applied during this visit. Future appointments monitored the condition and fluoride was recommended to help reduce risk.

B. Complications

At this time there were no complications reported by the patient or noted by the hygienist.

C. Long-Term Results

The patient returned for a 6-month periodontal visit and charting (Figure 11). Full assessment of final outcome and long-term prognosis was made. Images of tooth #15 at 6 months are shown in Figures 12 and 13.

1. Assessment of Periodontal Charting

- The upper right showed an additional 4 sites with pockets reduced by 1 mm and 1 site increased by 1 mm. Bleeding increased by 7 sites.
- The upper left showed improvement in an additional 1 site with 1-mm reduction in pocketing and 2 sites with increase in pocketing by 1 mm. Bleeding did not change.
- The lower left showed additional reduction in 5 pockets by 1 mm and 1 site increased by 1 mm. No change in bleeding was noted.
- The lower right showed no reduction in pocketing, 1 site increased by 1 mm. Bleeding also increased by 1 site.
- It is important to note that 25% of his mouth still had pocketing of greater than 4 mm with four 5-mm pockets remaining. 15% of the mouth was still bleeding. No new recession had occurred at this time. And the X-rays (Figure 14) were clear of caries or further bone loss per the doctor examination. The doctor attempted to present options for tooth #4, explaining this tooth needed to be extracted because it was becoming infected and could cause a problem with the surrounding teeth. The patient did not understand. We asked him to have his son call to make an appointment to discuss this further. The patient decided to wait on having this tooth removed and did not want to spend money on any teeth.

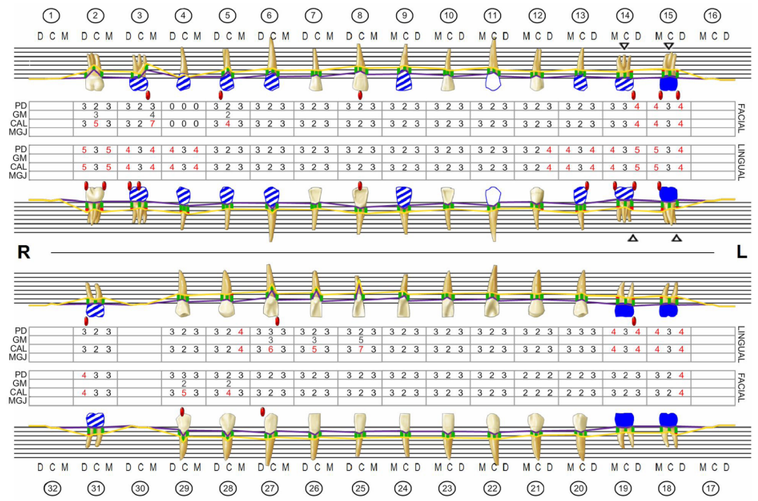


Figure 11: Periodontal chart at 6 months postoperative

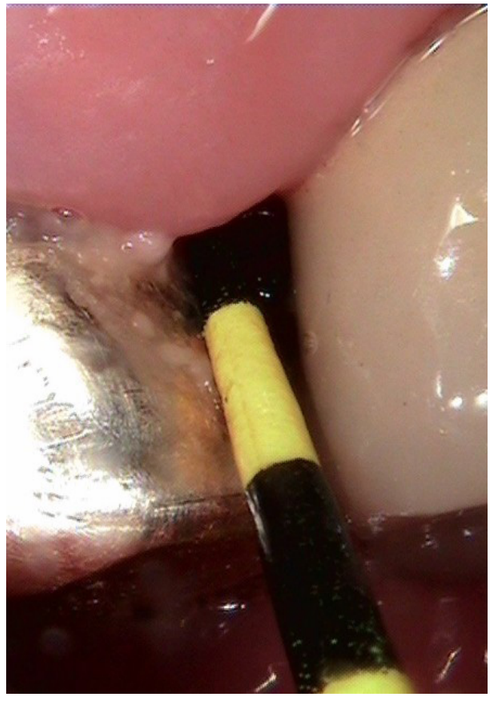


Figure 12: Tooth #15 lingual aspect, with 5-mm pocket 6 months after initial therapy

Figure 13: Tooth #15 buccal aspect, 6 months postoperative, with heavy plaque present

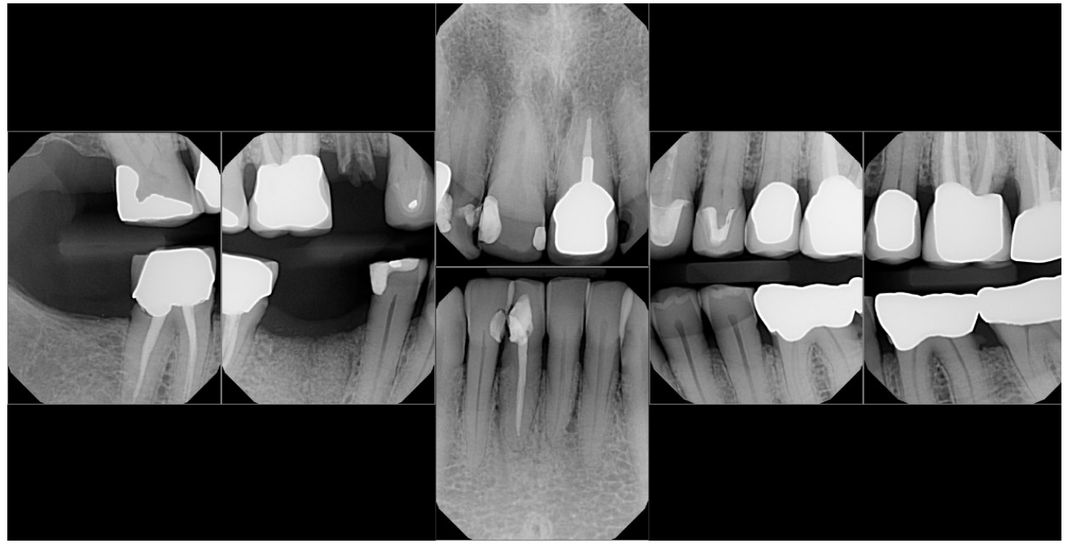


Figure 14: Final bitewings at 6 months post-therapy

2. Final Assessment of Oral Hygiene

In comparison to the 3-month and 6-month periodontal maintenance visits, there was very little change for the better. His oral hygiene did not improve but rather it deteriorated. He explained that he felt as though his hard work did not pay off because he continued to have problems. He stopped flossing and stopped using the mouth rinse. He was asked him to have his son call the office to have a treatment conference with the doctor for additional assistance.

3. Final Assessment of Caries Risk

Risk increased from moderate to high because of the lack of good home care. Fluoride varnish was applied during this visit. There were plans to speak to his son about fluoride trays in the future after treatment was complete.

4. Final Assessment of Long-Term Results

Before periodontal therapy with LAPT was started 53% of his mouth had pockets of greater than 3 mm and 68% bleeding. At the conclusion of the study he had 25% of the pockets of greater than 3 mm and 15% bleeding. This was a 53% improvement in pocketing and a 78% improvement in bleeding.

D. LONG-TERM PROGNOSIS

Long-term prognosis was guarded. This patient has a language barrier and he felt that working hard on his teeth will yield no results and he will continue to have problems. The patient indicated he preferred not to floss, brush, or use any tool. Unless we can help him understand that his cooperation in continuing oral care is necessary, then there will most likely be deterioration of his periodontium.

A treatment conference was scheduled with him and his son to discuss this. If the patient can come to understand how to keep from having further breakdown then his prognosis will be good with the exception of the maxillary left molars. Teeth #14 and 15 have poor prognosis due to the extent of bone and attachment loss. The doctor and hygienist will continue to monitor these areas and treat or refer accordingly.

REFERENCE

1. Banas JA. University of Iowa final report [on prototype mouth rinse]. March 10, 2012. https://www.oracareproducts.com/studies--scientific-research.html. Accessed August 13, 2019.

AUTHOR BIOGRAPHY

Heather Gill, RDH

Heather Gill has been a registered Dental Hygienist in Colorado since 2009. She started using an 810-nm diode laser at that time. Since then she has obtained both the standard and advanced proficiencies through the Academy of Laser Dentistry (ALD). Ms. Gill is the auxiliary chair board member of the ALD, member of the American Dental Hygienists' Association (ADHA) and an auxiliary member of the International Congress of Oral Implantologists (ICOI) and the Association of Dental Implant Auxiliaries (ADIA). Her passion in lasers started when she was a dental assistant when she saw how they had changed the way her dentist at the time treated patients. Ms. Gill has taken that same passion into her dental hygiene career. She plans to continue to learn from the excellent sources available by the ALD and also hopes to become a course provider so she can pass that same expertise to the coming generations of laser dental hygienists. Ms. Gill may be contacted by e-mail at hmangers1@yahoo.com.

Disclosure: Ms. Gill is an instructor for Advanced Dental Hygiene.

RESEARCH ABSTRACTS

Editor's Note: *The following 3 abstracts are offered as topics of current interest. Readers are invited to submit to the editor inquiries concerning laser-related scientific topics for possible inclusion in future issues. We'll scan the literature and present relevant abstracts.*

The 10,600-nm CO_2 Laser in Periodontitis Treatment: Its Effectiveness in De-Epithelialization and in Reduction of Periodontal Pathogens

In her clinical case "Nonsurgical Periodontal Infection Therapy with a 10,600-nm CO_2 Laser" (pages 18-37), Mary Lynn Smith relates a technique employing this laser to decontaminate surface tissue and dehydrate the gingival margin to inhibit epithelial growth into the pocket, without reflection of a flap. (Readers of the *Journal* will recall Smith described CO_2 laser decontamination in a previous issue: Smith ML. The pending zone: Managing the compromised periodontal patient. *J Laser Dent* 2009;17(2):94-99).

In 2017 Everett *et al.* described a similar technique, also without reflection of a gingival flap, using a continuous-wave CO_2 laser to decontaminate periodontal pockets and block epithelial down growth on the root surface. In their double-blind, randomized, clinical trial of split-mouth design involving 173 teeth in 14 patients with chronic periodontitis, they compared scaling and root planing only with scaling and root planing followed by carbon dioxide laser. The investigators used a 10,600-nm CO_2 laser equipped with an ablative prototype handpiece with an internal diameter of 0.762 mm. For the initial gingival margin decontamination and ablation procedure, the tip of the handpiece was kept parallel to the long axis of the tooth and "dragged along" the gingival sulcus. Power setting of 4 Watts in continuous mode (280 W/cm^2) was used. A second pass was then performed to decontaminate and ablate the periodontal pockets, at 8 Watts continuous mode (561 W/cm^2), with the tip placed into the pocket and "dragged" continuously along the depth of the pocket for a total irradiation time of 4 seconds per tooth. After the second pass, damp gauze was firmly placed on the gingiva to allow a clot to develop. Treatment was administered again every 10 days for three appointments. At 3 and 6 months, the laser-assisted nonsurgical procedure tended to show a greater decrease in probing depths and greater gains in clinical attachment levels, but the results were not statistically better than scaling and root planing alone.

Rossmann and Israel were among the first to describe the notion of using a carbon dioxide laser during gingival flap procedures to retard epithelial migration, first in an animal study and then in a pilot human study. Such controlled de-epithelialization is intended to increase the amount of connective tissue attachment through guided tissue regeneration wound healing.

In their 1992 study, Rossmann *et al.* performed open flap debridement on maxillary premolars and incisors of monkeys. On the experimental side, oral epithelium on the outer surfaces of re-adapted and sutured flaps was removed with a 10,600-nm CO_2 laser after exposure to impacts of 0.5-second duration at 10 Watts. The incident laser beam was held perpendicular to the tissue surface and focused to a 2-mm circular spot with a 400-mm focal length lens. Over 7 days, all specimens showed a trend toward less epithelium and more connective tissue attachment on the lased side, but no statistical analysis was possible for their histological study.

For the pilot histological human study by Israel *et al.* abstracted below, a 10,600-nm CO_2 laser was used to irradiate both the outer and inner aspects of reflected flaps. Laser parameters were 8 Watts in pulsed mode, 20 Hz, with an exposure of 20 msec, and 0.8-mm spot size in focus. As indicated below, their preliminary findings on laser de-epithelialization suggested that further controlled follow-up studies may be warranted.

Another related field of study involves the antimicrobial effect of 10,600-nm CO_2 laser irradiation in periodontal pockets. Reported results have been mixed.

In their examination of subgingival microbiologic effects of a CO_2 laser, Mullins *et al.* used DNA analysis of eight periodontal bacteria, prior to and immediately following treatment. Their laser technique involved use of a periodontal tip of 0.43-mm and 0.5-mm internal and external diameters, respectively, inserted into the periodontal pocket approximately 1 mm. Laser parameters were set at 2.2 W, 50 Hz, 80-millisecond pulse length, exposure rate of 1 mm per 5 seconds. The investigators reported that a one-time use of a 10,600-nm CO_2 laser in periodontal pockets did not substantially reduce subgingival bacterial populations compared to negative (untreated) controls.

The previously mentioned Everett group used bacterial sampling of 11 species and analysis via asymmetric multiplexed polymerase chain reaction to assess levels of periodontal pathogens. Results at baseline, 3 months, and 6 months after treatments showed a greater reduction is selected bacteria in sites treated with scaling and root planing in conjunction with laser irradiation, while scaling-and-root-planing-only sites showed a better result for other bacteria. However, no statistical significance was found between the groups.

For U.S. readers, certain carbon dioxide, Nd:YAG, argon, Ho:YAG, Er:YAG, Nd:YAP, Er,Cr:YSGG, diode, and frequency-doubled Nd:YAG lasers have been cleared by the U.S. Food and Drug Administration for intraoral soft tissue surgery.

As always, clinicians are advised to review the specific indications for use of their lasers and to review their operator manuals for guidance on operating parameters before attempting similar techniques on their patients.

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Use of the Carbon Dioxide Laser in Retarding Epithelial Migration: A Pilot Histological Human Study Utilizing Case Reports

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J Periodontol 1995 Mar;66(3):197-204

Predictable regeneration of tooth-supporting tissues lost to periodontal disease is the aim of periodontal therapy. Often the result of conventional treatment is healing with a long junctional epithelium along the root surface and little regeneration of the complete attachment apparatus. The purpose of this pilot study was to evaluate whether de-epithelialization with a CO_2 laser at the time of flap surgery and at 10-day intervals over the first 30 days of healing has the potential to enhance the formation of a connective tissue attachment. Six mandibular incisors in two patients were selected for the study. Each patient received oral hygiene instruction and initial therapy prior to surgery. The teeth were splinted together, open flap debridement was performed on all teeth, a notch was placed on the roots at the height of the crest of the alveolar bone, and the flaps were sutured in place. The test side received controlled de-epithelialization of the outer (oral) gingiva with the carbon dioxide laser, and the inner gingival flap. The de-epithelialization was repeated on the test side at 10, 20, and 30 days postsurgically. Controls received open debridement only. Block sections were taken at 90 days and processed for histologic analysis. The results showed that for both patients, junctional epithelium (JE) was formed on both test and control teeth. In all control teeth, the JE extended the entire length of the root to the base of the reference notch. On the test side (laser treated) in one patient, the notch was filled with connective tissue and limited repair cementum. This finding was not seen in any control teeth. This is the first reported observation of human histologic evaluation utilizing the CO_2 laser for de-epithelialization and may warrant further study.

Laser-Assisted Treatment of Patients with Type 2 Diabetes Mellitus and Periodontal Disease

In her clinical case "Laser-Assisted Periodontal Therapy with an 810-nm Diode Laser for a Diabetic Patient with Class III Periodontal Disease" (pages 38-54), Heather Gill describes a guarded long-term prognosis for a patient who had little interest in continuing his oral care.

Reports from the laser literature indicate varying degrees of success for laser-assisted periodontal therapy for patients with type 2 diabetes mellitus, compared to scaling and root planing treatment alone.

The Dengizek Eltas group studied 37 patients with chronic periodontitis and poorly controlled type 2 diabetes mellitus. Treatments consisted of scaling and root planing or scaling and root planing with laser. They used an 810-nm GaAlAs diode laser at 1 Watt power, in contact mode, along with a 400-µm fiber-optic tip. Laser treatment consisted of three sets of 15 seconds for each tooth if pocket depth was between 3 and 3.5 mm, and three sets of 20 seconds each per tooth if pocket depth was greater than 4 mm. The authors do not specify whether a continuous or pulsed emission mode was used. At 3 and 6 months post-treatment, laser-assisted treatment showed greater improvement in certain clinical parameters compared to scaling and root planing only; serum C-reactive protein levels and HbA1c levels were comparable for both groups. Their study is abstracted below.

Chandra and Shashikumar examined the effect of scaling and root planing alone vs. scaling and root planing following by diode laser irradiation in 40 patients with type 2 diabetes mellitus and chronic periodontitis. They utilized an 808-nm diode laser at power settings of 1.5 W-1.8 W in continuous, contact mode with a 320-micron fiber-optic cable. Duration of exposure in seconds corresponded to the depth of the periodontal pocket in millimeters. Results at 3 months showed a statistically significant greater improvement in clinical and microbiological parameters for the laser-treated group than scaling and root planing alone. Glycated hemoglobin level (HbA1c) levels decreased, but the intergroup difference was not significant.

In their investigation summarized below, Koçak *et al.* examined 60 patients with chronic periodontitis and type 2 diabetes mellitus. They compared scaling and root planing therapy to scaling and root planing followed by laser irradiation. They used a 940-nm indium-gallium-aluminum-phosphate diode laser equipped with a 300-µm fiber-optic delivery system at a setting of 1.5 W average power with a pulse interval of 20 ms and pulse length of 20 ms delivering 20 and 15 J/cm^2 of energy, respectively. The fiber was inserted into the periodontal pocket, oriented parallel with the root surface and slowly moved from apical to coronal in a sweeping motion, and the laser was activated for a total of 20 seconds for each tooth. After 3 months, clinical and glycemic outcomes were significantly better for the laser-assisted group than the scaling-and-root-planing-alone group.

Elavarasu *et al.* studied the effect of scaling and root planing alone compared to laser curettage as an adjunct to scaling and root planing on 10 patients with moderate chronic periodontitis and controlled type 2 diabetes mellitus. An 810-nm diode laser, set at 0.8 W in continuous mode, was used with an initiated fiber optic tip inserted into the periodontal pocket and

moved slowing in a apical direction until the bottom of the pocket was reached. Duration of laser irradiation was not specified. At 21 days, both treatments resulted in reductions in gingival inflammation and gains in clinical attachment level, and pocket depth reduction in the scaling and root planing + laser group showed significantly greater mean pocket depth reduction compared to the scaling-and-root-planing-alone group.

Javed and colleagues compared periodontal parameters (plaque index, bleeding on probing, and probing pocket depth) and hemoglobin A1c (HbA1c) levels in 22 patients with type 2 diabetes mellitus, periodontal inflammation, and at least 6 periodontal pockets 4 mm or greater in depth. Treatments included nonsurgical periodontal therapy (scaling and root planing), and scaling and root planing with adjunctive use of an Nd:YAG laser. They utilized a pulsed 1064-nm Nd:YAG laser, with an average output of 4 Watts, 80 mJ per pulse, 50 Hz repetition rate, pulse duration of 350 ms, and a 600-µm fiber. Laser treatment was accompanied by air and water cooling. Duration of laser exposure varied between 60 and 120 seconds, depending on accessibility. Laser energy was determined to be 240-480 J per treated site. After 3 months, improvements in clinical and glycemic outcomes were comparable for both groups.

For U.S. readers, certain carbon dioxide, Nd:YAG, argon, Ho:YAG, Er:YAG, Nd:YAP, Er,Cr:YSGG, diode, and frequency-doubled Nd:YAG lasers have been cleared by the U.S. Food and Drug Administration for intraoral soft tissue surgery.

As always, clinicians are advised to review the specific indications for use of their lasers and to review their operator manuals for guidance on operating parameters before attempting similar techniques on their patients.

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Evaluation of Long-Term Effects of Diode Laser Application in Periodontal Treatment of Poorly Controlled Type 2 Diabetic Patients with Chronic Periodontitis

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Purpose: This study aimed to investigate the effects of diode laser (DL) in addition to non-surgical periodontal treatment on periodontal parameters, systemic inflammatory response and serum haemoglobin A1c (HbA1c) level in patients with poorly controlled type 2 diabetes mellitus (T2DM) and chronic periodontitis.

Methods: Thirty-seven patients with poorly controlled T2DM and chronic periodontitis completed this study. The patients were divided into two groups. The individuals in the control group received placebo laser treatment in addition to scaling and root planing (SRP). The individuals in the study group received DL (1 watt) in addition to SRP. Clinical index measurements were performed before treatment (T0), 3 months after treatment (T1) and 6 months after treatment (T2). Plaque index, gingival index, bleeding on probing, clinical attachment level and probing depth were measured to determine periodontal status. HbA1c and C-reactive protein (CRP) levels were also analysed using blood samples.

Results: In both groups, clinical and laboratory parameters were significantly improved at T1 and T2 compared to baseline ($P < 0.05$). Gingival index, bleeding on probing and probing depth were more significantly reduced after treatment in the SRP+DL group than in the SRP group ($P < 0.05$). The serum CRP and HbA1c levels were similar between the groups ($P > 0.05$).

Conclusion: The use of DL in addition to SRP in periodontal treatment of T2DM individuals makes positive contribution to the reduction of local inflammation and to periodontal healing. On the other hand, it has no beneficial effects on systemic inflammatory response and glycaemic control.

Nonsurgical Periodontal Therapy with/without Diode Laser Modulates Metabolic Control of Type 2 Diabetics with Periodontitis: A Randomized Clinical Trial

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In order to evaluate whether nonsurgical periodontal treatment with/without diode laser (DL) decontamination improves clinical parameters, the levels of IL-1β, IL-6, IL-8, intercellular adhesion molecule (ICAM), and vascular cell adhesion molecule (VCAM) in gingival crevicular fluid and metabolic control (HbA1c) [were assessed] in chronic periodontitis (CP) patients with diabetes mellitus type 2 (DM2). Sixty patients with DM2 and CP were randomly assigned into two groups to receive scaling and root planing (SRP, n = 30) or SRP followed by diode laser application (SRP + DL, n = 30). Clinical periodontal and gingival crevicular fluid (GCF) parameters were assessed at baseline, 1, and 3 months after periodontal treatment. HbA1c levels were evaluated at baseline and 3 months post-therapy. Total amounts of cytokines and molecules were analyzed by ELISA. Nonsurgical periodontal treatment with/without DL appeared to improve clinical, biochemical parameters, and glycemic control in DM2 patients (BMI < 25 kg/m^2) with CP. The SRP + DL group provided better reductions in probing depth (PD) and clinical attachment level (CAL) parameters compared to the SRP group ($P < 0.05$). Significant reductions were found in the total amounts of GCF levels of IL-1, IL-6, IL-8, ICAM, and VCAM after treatment ($P < 0.05$). HbA1c levels decreased significantly at 3 months after treatment ($P < 0.05$). SRP + DL reduced HbA1c levels more significantly compared to SRP alone (0.41 vs. 0.22 %, $P < 0.05$). SRP, especially in combination with DL, shows improvement of glycemic control for DM2 patients with CP.

Academy of Laser Dentistry Dental Educators' Corner

A Call for Suggestions for Dental School Educators

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Dean, Midwestern University College of Dental Medicine, Glendale, Arizona

The Academy of Laser Dentistry and the American Dental Education Association (ADEA) have been working together to enhance awareness and education in the predoctoral student environment. We are looking for articles, clinical experiences, teaching tips, research and trends that have arisen in academia.

Through ADEA, the Lasers in Dentistry Special Interest Group has been discussing a myriad of aspects of laser education, clinical techniques, and clinical oversight. Over the last decade, the group has had many leaders in the laser arena help to guide educators and give them resources, including such things as educational teaching material (PDFs and PPTs), standards, rules, regulations, research, and names of regulatory agencies in the various states. We have discussed the types of lasers that could be used in a formal education setting, and types that might be problematic

We have a cadre of dentists that will be reviewing articles and adding content to the Educators Corner – individuals like Drs. Praveen Arany, Scott Benjamin, Juliana Barros, Shelly Patel, Sebastiano Andreanna, David Roshkind, and myself. I look forward to suggestions from the readership at large that would help in teaching and training the next generation of dentists. Ideas, suggestions, content, equipment, and clinical pearls would all be welcomed topics that could be disseminated to the great group of dental school educators that work daily with full-time dental and hygiene students. Please contact me with your ideas at bsmith@midwestern.edu.

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P. Bradford Smith is a graduate of the University of the Pacific (UoP) School of Dentistry. He was an adjunct professor/clinical instructor at the UoP extramural clinic for two years. He practiced for 22 years before accepting a position as an assistant professor at the Midwestern University College of Dental Medicine in 2008. Dr. Smith has worked in the Preclinical Sciences developing the curriculum since the inception of the program. He was asked to be the Preclinical Director of Oral Health Sciences in 2009 and the Assistant Dean for Preclinical Sciences in 2010, Associate Dean in 2011, and Dean in 2015. Dr. Smith wa the faculty advisor for the American Student Dental Association (ASDA) in 2008-09 where he enjoyed working with the ASDA executive council at Midwestern University. Dr. Smith completed scholarly work at the Costin Institute and graduated as a Costin Scholar in 2010. He is a Fellow of the American College of Dentists and International College of Dentists, and a member of Omicron Kappa Upsilon National Dental Honor Society. He has served in the Lasers in Dentistry Special Interest Group with ADEA, and as chair in 2015-16. Dr. Smith may be contacted by e-mail at bsmith@midwestern.edu.

Disclosure: Dr. Smith is the Dean of the Midwestern University College of Dental Medicine Arizona. He has received a grant in kind from Convergent Dental, Inc., for research utilizing the Solea CO_2 dental laser. He has no other commercial financial affiliations.

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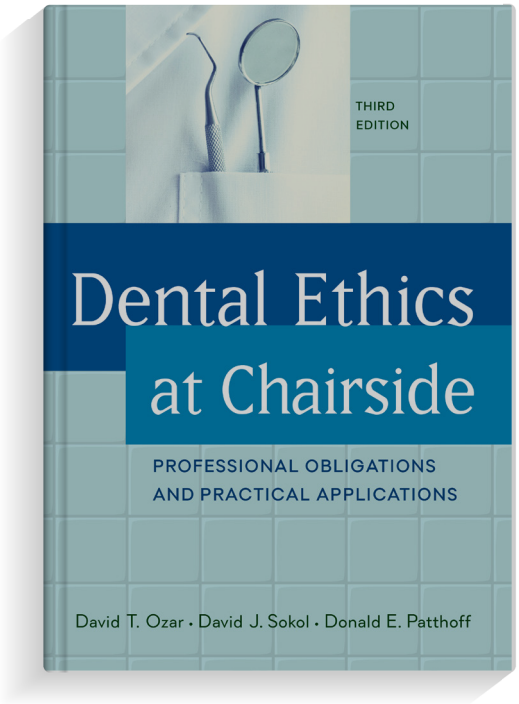

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