Lasers and Nonsurgical Periodontal Therapy

Denise M. Bowen, RDH, MS

The purpose of Linking Research to Clinical Practice is to present evidence based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application.

The Bottom Line

Lasers have been increasing in popularity in dental hygiene practice. Although traditional scaling and root planing (SRP) and daily self-care by the patient have been shown to be effective in reducing inflammation and probing depths and increasing clinical attachment, challenges associated with deeper pockets, root morphology and difficult access areas decrease the likelihood of healing following nonsurgical periodontal therapy (NSPT). Adjuncts such as antimicrobials and lasers have been advocated to overcome these limitations. Lasers may be used in the treatment of periodontitis as a monotherapy or as an adjunct to SRP during initial periodontal therapy, surgery, or periodontal maintenance therapy; however, this article addresses their use as an adjunct to SRP in NSPT.

Several types of lasers are used in the treatment of periodontal and peri-implant diseases: diode lasers (DLs) (809 to 980 nm), Nd:YAG (1064 nm), Er:YAG and Er,Cr:YSGG (2940 and 2780 nm, respectively) and the CO_2 laser (10,600 nm).[1] In NSPT, laser therapy is advocated for sulcular debridement, also known as soft tissue curettage, and for bactericidal effects within the periodontal pocket. Unlike other therapeutic procedures used by dental hygienists and dentists, there is no standard accepted protocol for the use of lasers. As a general rule, the performance of a given laser is governed by its absorption, or depth of penetration into the tissues, and the absorption depends on the wavelength.[2] Diode and Nd:YAG lasers are deeply penetrating whereas Er:YAG, Er,Cr:YSGG and CO_2 penetrate superficially. One exception to this general rule is the photodynamic therapy (PDT) diode laser (660 to 810 nm), a low-power laser used in combination with a photosensitizing agent for antimicrobial purposes only; therefore, this article does not address PDT. Also, the research findings presented in this article do not apply to the laser-assisted new attachment procedure (LANAP) using the Nd:YAG laser, as it is a specific protocol trademarked by one company, requiring a full year of training, and reserved as more of a definitive surgical procedure for dentists or dental specialists only.[2] Laser therapy, also known as periodontal phototherapy, used in conjunction with SRP in NSPT, is the focus of this article.

The research studies discussed in this article were designed to evaluate the effectiveness of diode and Nd:YAG lasers used in conjunction with SRP because of their potential to perform soft tissue curettage as well as to reduce periodontal pathogens in the periodontal pocket.[2] Neither of these types of lasers are used for calculus removal. Based on the findings of these 2 studies, the ensuing conclusions can be drawn:

- Clinicians need to distinguish the various types of lasers used in NSPT and consider the evidence regarding each type when evaluating the effectiveness of laser therapy, or phototherapy, in practice.
- Based on the systematic review and meta-analysis by Slot et al, the adjunctive use of the most commonly employed diode laser (809 to 980 nm) as an adjunct to traditional mechanical modalities of periodontal therapy in patients with periodontitis is questionable.
- The evidence analyzed in the Sgolastra et al meta-analysis indicates that Nd:YAG+SRP has potential for benefits beyond SRP alone due to the reduction in PD and GCF; however, the low number of studies eligible for inclusion and the risk of bias for studies included leads to the conclusion that insufficient evidence exists to support the effectiveness of Nd:YAG adjunctive to SRP.
- The findings of both of these studies support the findings of a 2015 systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts conducted and published by a panel of experts convened by the American Dental Association Council on Scientific Affairs.[3]
    - There was a low level of evidence supporting the non-PDT DL (809 to 980 nm) based on a small gain in CAL (0.21mm) compared with SRP alone, although the ADA found a moderate level evidence supported the use of the PDT DL in conjunction with a pho-

tosensitizing agent (0.53mm gain in CAL). Again, the difference between the non-PDT DL studied by Slot et al. and the DL used in conjunction with a photosensitizing agent for PDT should be noted.
    - Although the ND:YAG laser resulted in a 0.41 mm gain in attachment, compared with SRP alone, the overall level of certainty of the evidence was low. Only 3 studies could be included in the meta-analysis and the risk of bias was moderate to high.
- Moreover, the results of both of these systematic reviews and meta-analyses, as well as the ADA scientific panel's systematic review and meta-analysis, support the Statement on the Efficacy of Lasers in the Non-Surgical Treatment of Inflammatory Periodontal Disease published by the American Academy of Periodontology which states, in part, that there is minimal evidence to support use of a laser for the purpose of subgingival debridement, as an adjunct to SRP.[4]

Slot DE, Jorritsma KH, Cobb CM, Van der Weijden FA. The effect of the thermal diode laser (wavelength 808-980nm) in non-surgical periodontal therapy: a systematic review and meta-analysis. *J Clin Periodontol*. 2014;41(7):681-692.

Focused Question: What is the adjunctive effect of a diode laser (DL) following non-surgical periodontal debridement (SRP) during the initial phase of periodontal therapy on the clinical parameters of periodontal inflammation?

Material and Methods: The MEDLINE-PubMed, Cochrane-Central Register of Controlled Trials and EMBASE databases were searched up to September 2013. Probing pocket depth (PPD) and clinical attachment loss (CAL) were selected as outcome variables. Also plaque scores (PS), bleeding scores (BS) and the Gingival Index (GI) were considered outcome measures. Data were extracted and a meta-analysis (MA) was performed where appropriate.

Results: Independent screening of 416 unique papers resulted in nine eligible publications. The MA evaluating PPD, CAL, PS showed no significant effect. The only significance favouring adjunctive use of the DL was observed for the outcome parameters GI and BS.

Conclusion: The collective evidence regarding adjunctive use of the DL with SRP indicates that the combined treatment provides an effect comparable to that of SRP alone. That is for PPD and CAL. The body of evidence considering the adjunctive use of the DL is judged to be "moderate" for changes in PPD and CAL. With respect to BS, the results showed a small but significant effect favouring the DL, however, the clinical relevance of this difference remains a question. This systematic review questions the adjunctive use of DL with traditional mechanical modalities of periodontal therapy in patients with periodontitis.

Commentary

In this article, Slot et al reported the results of a systematic review and meta-analysis designed to evaluate the effect of the diode laser (DL, 809 to 980 nm) used as an adjunct to SRP during initial nonsurgical periodontal therapy on parameters of periodontitis and periodontal inflammation in patients with periodontitis. A systematic review is a study designed to answer a specific, focused research question by comprehensively collecting and evaluating published studies. All of the studies that meet pre-established criteria for the highest level of evidence are systematically identified, appraised and summarized according to a precise methodology. Meta-analysis adds an additional step by statistically combining results of some or all of the included studies. Studies that are similar enough statistically to combine, synthesize and analyze are merged as if the data were generated from one study. For research questions about therapies or preventive strategies, a systematic review or meta-analysis of randomized clinical trials (RCTs) is considered the highest level of evidence available.

As indicated in the abstract, only 9 of 419 studies reviewed were included in the systematic review and meta-analysis based on the 8 criteria set for quality and inclusion. Only RCTs comparing SRP alone with SRP+DL in initial periodontal therapy for patients with periodontitis were included. Also, only studies judged as having a low risk of bias were included. Seven studies used a split-mouth research design where sides of the mouth receiving each type of intervention are randomized, and 2 used a parallel design in which patients are randomized for assignment to different treatment groups. A separate analysis of these 2 types of designs showed no significant difference in findings. The impact of some of the studies having included smokers could not be analyzed due to inadequate reporting of details regarding tobacco use. The small number of studies (n=9) included in this systematic review and meta-analysis attests to the fact that much information in the literature regarding advantages of the DL as an adjunct to SRP for soft tissue curettage and antimicrobial effects might be based on lower quality evidence than the well-designed RCTs included in this systematic review. Dental hygienists are reminded to seek the highest quality of evidence when making decisions regarding patient care therapies and strategies for disease prevention.

The studies of DL varied in the approach to SRP employing hand, sonic and/or ultrasonic instruments and the DL parameters of energy setting, tip, procedures and contact time. This heterogenicity in the protocols underscores the need to establish clinical

guidelines or a standard, accepted protocol for laser therapy. The evidence included in this review indicates that use of the DL+SRP had no significant effect on probing pocket depth (PPD), clinical attachment loss (CAL) or plaque scores (PS) beyond SRP alone. The focus of this review was not intended to be reduced subgingival microbiota; however, of the 5 studies reporting these outcomes, only 1 showed a statistically significant reduction in bacterial load in favor of DL+SRP. Scores for bleeding (BS) and gingival inflammation (GI), however, did show a small, but statistically significant, advantage of the DL+SRP over SRP alone. These measures represent gingival inflammation. The magnitude of this difference in the means representing the outcomes of the 2 therapies was -5.34%; therefore, the clinical significance of this difference was questioned by the authors. One way clinicians can consider the issue of statistical vs. clinical significance is to think of the latter as clinical importance. Dental hygienists and other health professionals considering the evidence should ask themselves whether the difference reported between the new and old therapy based on the results of a study are large enough to alter their practice? For this reason, Slot et al have concluded, based on the collective evidence, that the adjunctive use of DL with traditional mechanical modalities of periodontal therapy in patients with periodontitis is questionable.

The findings of this study support the findings of a 2015 systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts conducted and published by a panel of experts convened by the American Dental Association Council on Scientific Affairs.[3] That study found that, although a moderate level evidence supported the use of the PDT DL (0.53 mm gain in CAL), there was a low level of evidence supporting the non-PDT DL (809 to 980 nm) based on a small gain in CAL (0.21 mm) compared with SRP alone. Again, the difference between the non-PDT DL studied by Slot et al and the DL used in conjunction with a photosensitizing agent for PDT should be noted.

Sgolastra F, Severino M, Petrucci A, Roberto Gatto, Annalisa M. Nd:YAG laser as an adjunctive treatment to nonsurgical periodontal therapy: A meta-analysis. *Lasers Med Sci*. 2014;29:887–895.

Abstract: A meta-analysis was conducted to investigate whether the use of Nd:YAG laser adjunctive to scaling root planing (SRP) could provide additional benefits compared to SRP alone in patients with chronic periodontitis. The meta-analysis was performed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) statement and the recommendations of the Cochrane Collaboration. A literature search was performed on seven databases, followed by a manual search. Weighted mean differences and 95% confidence intervals were calculated for the clinical attachment level (CAL), probing depth (PD), and changes in plaque index (PI) and gingival crevicular fluid (GCF). Inter-study heterogeneity was assessed by the I2 test, and publication bias was analyzed by the visual inspection of the funnel plot for asymmetry, Egger's regression test, and trim-and-fill method. All outcomes were evaluated from baseline to the end of follow-up. Significant differences in PD and GCF reduction were observed in favor of SRP+Nd:YAG; no significant differences were observed in CAL gain or PI change. The findings of this meta-analysis suggest that use of the Nd:YAG laser as an adjunctive therapy to conventional nonsurgical periodontal therapy could potentially provide additional benefits. However, all included studies were not at low risk of bias, and only three studies were included in the meta-analysis. As a result, the evidence is insufficient to support the effectiveness of adjunctive Nd:YAG to SRP. Future long-term well-designed parallel randomized clinical trials are required to assess the effectiveness of the adjunctive use of Nd:YAG laser. These trials should also include microbiological and adverse events analyses.

Commentary

This study was a well-designed systematic review and meta-analysis conducted to evaluate the use of a Nd:YAG laser as an adjunct to SCP in nonsurgical periodontal therapy for patients with chronic periodontitis. In addition to measuring clinical outcomes, the researchers also assessed the level of bias of the studies included in the review. Ten criteria were used for inclusion and exclusion in 2 phases to determine eligibility of studies included in the systematic review. Of 438 studies evaluated, only 3 studies could be included in the analysis. All of these studies were RCTs that used low-intensity Nd:YAG (1064 nm) laser therapy with fiber tips ranging from 0.2 to 0.6 mm; however, contact time, frequency, laser dosages and energy settings varied. Differences in the protocols for NSPT, variability in the definitions of chronic periodontitis, and the inclusion of smokers also contributed to heterogenicity of data included. The authors determined the risk of bias to be moderate for one study and high for 2 studies of the three studies analyzed.

All studies included in this review and meta-analysis used a split-mouth design. This design has the advantage of controlling for individual variations between subjects and allows for lower numbers of subjects in the clinical trial without a loss of statistical power. Within-patient comparisons made in split mouth designs, however, might be affected by differences in disease patterns on one side of the mouth versus the other unless randomized or controlled. Effects of the 2 treatments may also carry over from one side of the mouth to the other. A split-mouth design should

only be used when it is known that no such crossover exists. A lack of effect has been presumed for laser therapy.

A significant reduction in mean PD was found (0.55 mm) in favor of Nd:YAG+SRP compared to SRP alone; however, no significant difference was found for gain in CAL. The adjunctive use of Nd:YAG significantly reduced the amount of GCF, although no significant difference was observed in PI. GCF is a reflection of inflammation; thus, these results may support the ability of laser therapy adjunctive to SRP to reduce inflammation in periodontitis, like the outcomes of the Slot et al review for DL+SRP which indicated a difference in GI and bleeding. None of the studies included in the review by Sgolastra reported microbiological outcomes, although this claim is frequently made for laser therapy. As stated in the abstract, the evidence indicates, although the reduction in PD and GCF with Nd:YAG+SRP shows that this approach has potential for benefits beyond SRP alone, there is insufficient evidence to support the effectiveness of adjunctive Nd:YAG to SRP due to low number of studies eligible for inclusion and the risk if bias for studies included in the systematic review and meta-analysis.

This finding agrees with the findings of the 2015 systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts conducted and published by a panel of experts convened by the American Dental Association Council on Scientific Affairs.[3] The ADA review concluded that, although the ND:YAG laser resulted in a 0.41 mm gain in attachment, compared with SRP alone, the overall level of certainty of the evidence was low.

Summary

Dental hygienists are preventive professionals responsible for providing NSPT to address treatment needs of patients with periodontitis. Laser therapy used alone or as an adjunct to SRP has been increasing in popularity based on reported benefits in healing following NSPT. In fact, the evidence presented in these articles indicates that insufficient evidence exists to support use of DL+SRP or Nd:YAG+SRP when compared to SRP alone. Although laser therapy may show some promise in reducing inflammation in periodontitis, standard protocols for use in practice and research are needed. Robust, parallel studies are needed with consideration given to accepted definitions of the extent of periodontitis and the potential impact of smoking on treatment outcomes. Microbiologic outcomes also need to be evaluated in relation to clinical outcomes.

Denise M. Bowen, RDH, MS, is Professor Emeritus in Dental Hygiene at Idaho State University. She has served as a consultant to dental industry, as well as numerous government, university and private organizations and presently is a member of the National Advisory Panel for the National Center for Dental Hygiene Research in the U.S. She has served as Chair of the American Dental Hygienists' Association Council on Research and Chair of the Research Committee for the Institute for Oral Health and has received national awards for excellence in dental hygiene. Professor Bowen is widely known through her published articles and textbook chapters and dynamic continuing education programs related to nonsurgical periodontal therapy, preventive oral self-care, research methodology, and dental hygiene education.

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