ADA CE Program ARTICLE 2

Systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts

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ABSTRACT

Background. Conduct a systematic review and meta-analysis on nonsurgical treatment of patients with chronic periodontitis by means of scaling and root planing (SRP) with or without adjuncts.

Methods. A panel of experts convened by the American Dental Association Council on Scientific Affairs conducted a search of PubMed (MEDLINE) and Embase for randomized controlled trials of SRP with or without the use of adjuncts with clinical attachment level (CAL) outcomes in trials at least 6 months in duration and published in English through July 2014. The authors assessed individual study bias by using the Cochrane Risk of Bias Tool and conducted meta-analyses to obtain the summary effect estimates and their precision and to assess heterogeneity. The authors used funnel plots and Egger tests to assess publication bias when there were more than 10 studies. The authors used a modified version of the US Preventive Services Task Force methods to assess the overall level of certainty in the evidence.

Results. The panel included 72 articles on the effectiveness of SRP with or without the following: systemic antimicrobials, a systemic host modulator (subantimicrobial-dose doxycycline), locally delivered antimicrobials (chlorhexidine chips, doxycycline hyclate gel, and minocycline microspheres), and a variety of nonsurgical lasers (photodynamic therapy with a diode laser, a diode laser, neodymium:yttrium-aluminum-garnet lasers, and erbium lasers).

Conclusions and Practical Implications. With a moderate level of certainty, the panel found approximately a 0.5-millimeter average improvement in CAL with SRP. Combinations of SRP with assorted adjuncts resulted in a range of average CAL improvements between 0.2 and 0.6 mm over SRP alone. The panel judged the following 4 adjunctive therapies as beneficial with a moderate level of certainty: systemic subantimicrobial-dose doxycycline, systemic antimicrobials, chlorhexidine chips, and photodynamic therapy with a diode laser. There was a low level of certainty in the benefits of the other included adjunctive therapies. The panel provides clinical recommendations in the associated clinical practice guideline.

Key Words. Antibiotics; chlorhexidine; evidence-based dentistry; lasers; MEDLINE; minocycline; periodontitis; root planing.

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Chronic periodontitis is a prevalent condition, affecting 47.2% of the adult US population aged 30 years or older.[1] Chronic periodontitis results in the loss of tooth-supporting connective tissue and alveolar bone and, if untreated, is a major cause of tooth loss in adults.[2] According to the Centers for Disease Control and Prevention and American Academy of Periodontology case definitions,[3] the prevalences of moderate and severe periodontitis are estimated as 30.0% and 8.5%, respectively, among US adults.[4]

Supplemental material is available online.

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Clinicians are challenged daily with managing patients with periodontitis of varying extent and severity. Treatment options range from scaling and root planing (SRP) to SRP with adjunctive treatments to surgical interventions. In 2011, the Council on Scientific Affairs of the American Dental Association (ADA) resolved to develop a clinical practice guideline for the nonsurgical treatment of chronic periodontitis with SRP with or without adjuncts on the basis of a systematic review of the literature. This report summarizes the systematic review results and is intended to aid the clinician in making evidence-based treatment decisions regarding the nonsurgical management of chronic periodontitis and provides the evidence base for the companion clinical practice guideline.[5] An unabridged version of this systematic review is available online.[6]

We evaluated the effect of SRP alone and in combination with adjuncts. Clinical attachment level (CAL) was the sole outcome on which we compared the various treatments. We evaluated the following professionally applied or prescribed medical adjuncts: locally applied antimicrobials (chlorhexidine chips, doxycycline hyclate [DH] gel, and minocycline microspheres), nonsurgical use of lasers (diode, both photodynamic therapy [PDT] and non-PDT; neodymium:yttrium-aluminum-garnet [Nd:YAG]; and erbium), systemic antimicrobials, and systemic subantimicrobial-dose doxycycline (SDD). We considered systemic antimicrobials and systemic SDD separately because the latter appears to inhibit mammalian collagenase activity (matrix metalloproteinase 8) and not function as an antibiotic.[7,8] We did not consider experimental adjuncts, adjuncts not currently available in the United States, nonprescription (over-the-counter) adjuncts, or surgical treatments.

We addressed the following clinical questions, formatted in the Patient-Intervention-Comparator-Outcome style:

- Question 1: In patients with chronic periodontitis, does SRP (hand or ultrasonic), when compared with no treatment, supragingival scaling and polish (prophylaxis), or debridement, result in greater improvement of CAL?
- Question 2: In patients with chronic periodontitis, does the use of local antibiotics or antimicrobials, systemic antibiotics, combinations of local and systemic antibiotics, agents for biomodification or host modulation, or nonsurgical lasers as adjuncts to SRP, compared with SRP alone, result in greater improvement of CAL?

METHODS

Our group of authors, consisting of a multidisciplinary panel of subject matter experts and ADA staff methodologists convened by the ADA Council on Scientific Affairs, followed modified US Preventive Services Task Force methods to conduct this systematic review.[9] Details regarding methods specific to this review, including the full search strategy and inclusion and exclusion criteria, are presented elsewhere.[6] We searched 2 electronic databases (PubMed and Embase) and reviewed the references of selected systematic reviews to identify missed references. The search was first conducted in October 2012 and updated in July 2014.

We developed study inclusion and exclusion criteria through consensus. Briefly, we included randomized controlled trials if they were published after 1960, written in English, and reported changes in CAL at least 6 months after randomization. We chose CAL as a primary outcome because probing depth changes fail to capture the effect of nonsurgical treatment.[10-14] We included both parallel-arm and split-mouth studies. We excluded studies of aggressive periodontitis, as well as studies in which the adjunct was administered more than 1 week after SRP or was reapplied to progressing (worsening) tooth sites. We screened all citations and full-text articles independently and in duplicate (S.L.T., J.F.H., C.E., and N.H.). In cases of discrepancies, we made decisions via discussion with the rest of the panel.

Definitions. We defined SRP according to the Code on Dental Procedures and Nomenclature[15]:

- D4341, Periodontal scaling and root planing: "Root planing is the definitive procedure designed for the removal of cementum and dentin that is rough and/or permeated by calculus or contaminated with toxins or microorganisms."

SRP should be differentiated from supra- or subgingival debridement, again as defined in the Code on Dental Procedures and Nomenclature:

- D4355, Full mouth debridement: "The gross removal of calculus that interferes with the ability of the dentist to perform a comprehensive oral evaluation. This preliminary procedure does not preclude the need for additional procedures."

We excluded studies on debridement as the experimental treatment as well as studies using the terms *instrumentation*, *ultrasonic instrumentation*, *ultrasonic scaling*, or *subgingival scaling* to mean *debridement*.

Data extraction and critical appraisal of individual studies. In groups of 2 (1 ADA staff member and 1 panelist for each paper), the authors independently reviewed and extracted the relevant data from included studies and appraised each study with the Cochrane Risk of Bias Tool.[16] Details on the tool and summaries of the extracted data and critical appraisals are presented elsewhere.[6] In short, 6 domains are assessed and judged as

ABBREVIATION KEY. **ADA:** American Dental Association. **CAL:** Clinical attachment level. **CHX:** Chlorhexidine. **DH:** Doxycycline hyclate. **MM:** Minocycline microspheres. **Nd:YAG:** Neodymium:yttrium-aluminum-garnet. **Non-PDT:** Nonphotodynamic therapy. **PDT:** Photodynamic therapy. **RCT:** Randomized controlled trial. **SDD:** Subantimicrobial-dose doxycycline. **SRP:** Scaling and root planing.

TABLE 1

Level of certainty in the body of evidence included within the systematic review.*

LEVEL OF CERTAINTY IN EFFECT ESTIMATE	DESCRIPTION
High	**The body of evidence usually includes consistent results from well-designed, well-conducted studies in representative populations. This conclusion is unlikely to be affected strongly by the results of future studies.** This statement is established strongly by the best available evidence.
Moderate	**As more information becomes available, the magnitude or direction of the observed effect could change, and this change could be large enough to alter the conclusion.** This statement is based on preliminary determinations from the current best available evidence, but confidence in the estimate is constrained by 1 or more factors, such as the following: - Limited number or size of studies - Plausible bias that raises some doubt about the results - Inconsistency of findings across individual studies - Imprecision in the summary estimate - Limited applicability because of the populations of interest - Evidence of publication bias - Lack of coherence in the chain of evidence
Low	**More information could allow a reliable estimation of effects on health outcomes.** The available evidence is insufficient to support the statement, or the statement is based on extrapolation from the best available evidence. The evidence is judged to be insufficient, or the reliability of estimated effects is limited by factors such as the following: - Limited number or size of studies - Plausible bias that seriously weakens confidence in the results - Inconsistency of findings across individual studies - Imprecision in the summary estimate - Gaps in the chain of evidence - Findings not applicable to the populations of interest - Evidence of publication bias - Lack of information on important health outcomes

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low, unclear, or high risk of bias. Furthermore, a summary assessment risk of bias of the outcome across domains and across studies was conducted according to the Cochrane Handbook.[17] We extracted information concerning adverse effects, which are described fully in the clinical practice guideline[5] associated with this systematic review and in the unabridged version.[6]

Data synthesis and meta-analysis: evaluating the effect of the intervention. We decided to use CAL as the primary outcome to compare the effectiveness of various periodontal therapies. We chose to subgroup results on the basis of trial design. We chose not to stratify the studies according to levels of disease at baseline. In assessing the effectiveness of SRP alone (question 1), we compared mean change in CAL between SRP and controls. To assess adjuncts (question 2), we compared mean changes between groups receiving SRP and those receiving SRP plus an adjunct. We conducted meta-analyses by using the random effects model.

We noted inconsistency among studies regarding the number of tooth sites and teeth assessed. Investigators in some studies reported data for periodontal sites, whereas others reported data at the tooth level and whole-mouth averages. Whole-mouth measurements may lead to underestimation of the treatment effect by including healthy sites in the computation of teeth or mouth averages or of changes over time. The estimates in the meta-analyses include studies in which the investigators reported at these different levels of assessment.

Determining the level of certainty in the evidence. We reviewed overall results for each treatment or adjunct and assessed the level of certainty in the evidence as *high*, *moderate*, or *low* (Table 1).[9]

RESULTS

Literature search and screening. The initial search yielded 1,681 unique records after duplicates were removed. After the updated search, we screened 1,944 records by title and abstract and 483 by full text. We included 72 studies in the final analyses. We found no additional citations through reviewing references of relevant systematic reviews. Characteristics of included and excluded studies, including reasons for exclusion, are available elsewhere.[6] Figure 1 shows the study flow diagram.

Evidence summary. Tables 2 and 3 present evidence profile summaries from the 72 included studies of 10 nonsurgical treatments. Further detailed information regarding the critical appraisals and extracted study information is available elsewhere.[6]

SRP. ***General description of studies.*** Eleven studies met the inclusion criteria for reporting the effect of SRP compared with no treatment, supragingival scaling, or debridement on chronic periodontitis.[18-28] Six were split-mouth studies,[18-23] and 5 were parallel-group studies.[24-28] All studies were small (from 7 to 43 per group). The studies were published between 1983 and 2014. One study[24] included only participants with type 2 diabetes, and another[28] only participants with chronic obstructive pulmonary disease.

Critical appraisal. Figure 2 depicts the judgments of bias according to domain. We judged the overall risk of bias from this body of evidence as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with no treatment,

SRP treatment resulted in a 0.49-millimeter gain in CAL (95% confidence interval [CI], 0.36-0.62 mm) (Figure 3).[18-28] Two of the observations were outliers, with 1 study[20] having a large benefit and 1 study[25] having a small standard error; however, when we removed these 2 studies, the result remained statistically significant (0.43; 95% CI, 0.19-0.67). We judged the overall level of certainty in the evidence to be *moderate* on the basis of the evidence profile in Table 2.

Systemic SDD and SRP. ***General description of studies.*** SDD (Periostat, CollaGenex Pharmaceuticals) is considered a host-modulating agent. Specifically, it inhibits host collagen-degrading enzymes.[29,30] Eleven studies[31-42] in 12 publications met the inclusion criteria for reporting the effect of SRP plus SDD versus SRP alone. All were parallel-group trials. Sample sizes ranged from 7 to 133 per treatment group. The studies were published between 2000 and 2011. With respect to participants, investigators in 1 study included only institutionalized geriatric patients,[40] and investigators in 2 included adults with diabetes.[31,33]

Critical appraisal. eFigure 1 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias from this body of evidence as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus SDD resulted in a 0.35-mm mean gain in CAL (95% CI, 0.15-0.56) (Figure 4).[31-42] We judged the overall level of certainty in the evidence to be *moderate* on the basis of the evidence profile in Table 3.

Systemic antimicrobials and SRP. ***General description of studies.*** Twenty-four studies[18,20,22,39,43-62] met the inclusion criteria for reporting the effect of SRP plus a systemic antimicrobial versus SRP alone. All were parallel-group trials. The sample sizes were relatively small, ranging from 7 to 46 per treatment group. The studies were published between 1983 and 2014. Investigators in 2 studies included only patients with diabetes,[60,62] and investigators in 1 study[52] reported results subgrouped according to smoking status.

We decided to combine all antimicrobials into 1 treatment class for an overall analysis and 1 evidence profile. The study investigators reported on 6 major groups of antimicrobials: amoxicillin and metronidazole combination therapy,[18,44,45,47,50,55,60] metronidazole,[39,52,61] erythromycin analogues (azithromycin[39,46,49,51,56-59] and clarithromycin[53]), moxifloxacin[48] (a fourth-generation fluoroquinolone antibacterial agent), and others (for example, tetracycline[20,43,54] and doxycycline[22,48,62] as the antimicrobial dose of doxycycline, not to be confused with SDD, which is covered in a separate section). The variety of dosing regimens used for each systemic antimicrobial drug is described elsewhere.[6]

Critical appraisal. eFigure 2 (available online at the end of this article) depicts the judgments of bias

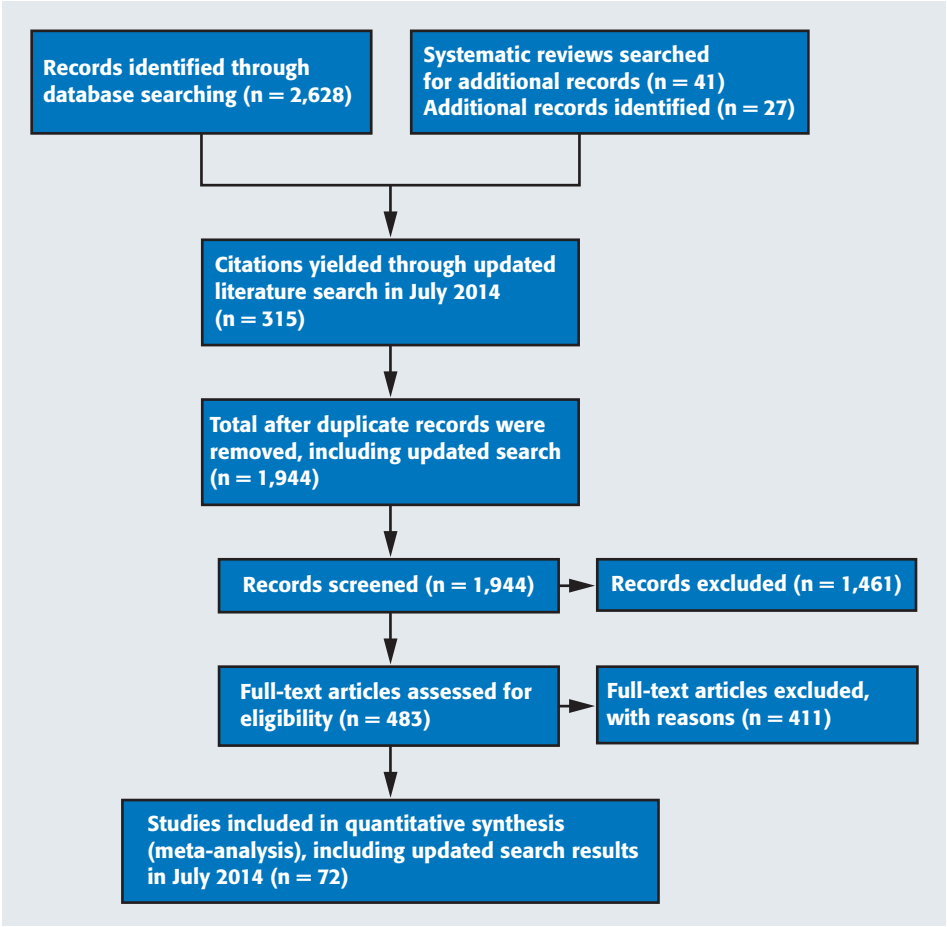

Figure 1. Flow diagram of literature search and screening process.

TABLE 2

Evidence profile summary: scaling and root planing versus no treatment, supragingival scaling, or debridement.

THERAPY	LEVEL OF CERTAINTY ASSESSMENT CRITERIA							LEVEL OF CERTAINTY	BENEFIT,‡ MILLIMETERS
	Quantity of Evidence		Risk of Bias	Consistency	Applicability†	Precision	Publication Bias		
	No. of RCTs*	No. of participants							
Scaling and Root Planing Versus No Treatment, Supragingival Scaling, or Debridement	11	331	Unclear	Consistent	Yes	No serious imprecision	None detected ($P = .707$)§	Moderate	0.49 (0.36-0.62)

* RCT: Randomized controlled trial.
† Applicability refers to whether the study results are applicable to populations of interest in real-world circumstances.
‡ Benefit is mean difference (95% confidence interval) in clinical attachment level.
§ When there were 10 or more studies for a treatment, the authors undertook an assessment of publication bias by means of visual inspection and an Egger test for funnel plot asymmetry. See the complete article for further details.

according to domain. We judged the overall risk of bias as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus systemic antimicrobials resulted in a 0.35-mm mean gain in CAL (95% CI, 0.20-0.51) (Figure 5).[18,20,22,39,43-62] We judged the overall level of certainty in the evidence to be *moderate* on the basis of the evidence profile in Table 3.

Locally delivered antimicrobials and SRP. ***Chlorhexidine chips and SRP.*** *General description of studies.* Investigators in 6 studies compared the effects of SRP plus the local delivery of chlorhexidine chips with SRP alone on chronic periodontitis.[63-68] Four were split-mouth studies,[63,65-67] and 2 were parallel-group studies.[64,68] All but 2 trials[66,67] had small sample sizes (ranging from 12 to 25 participants per group); the larger studies included between 82 and 116 participants per treatment arm. The studies were conducted from 2001 through 2011.

Critical appraisal. eFigure 3 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus chlorhexidine chips resulted in a 0.40-mm mean gain in CAL (95% CI, 0.24-0.56) (Figure 6).[63-68] We judged the overall level of certainty in the evidence to be *moderate* on the basis of the evidence profile in Table 3.

DH gel and SRP. *General description of studies.* Three small studies met the inclusion criteria for reporting the effect of SRP plus the local delivery of DH gel compared with SRP alone.[69-71] Two were split-mouth studies,[69,71] and 1 study[70] was a parallel-group trial. The sample sizes ranged from 10 to 22 participants per group. The studies were conducted between 2004 and 2006. All participants in the study by Martorelli de Lima and colleagues[71] had type 1 diabetes mellitus.

Critical appraisal. eFigure 4 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus DH gel resulted in a 0.64-mm mean gain in CAL (95% CI, 0.00-1.28) (Figure 7).[69-71] We judged the overall level of certainty in the evidence to be *low* on the basis of the evidence profile in Table 3.

Minocycline microspheres and SRP. *General description of studies.* Three small[27,72,73] and 2 relatively large and unpublished new drug application studies (Study 103A and Study 103B available in 1 document[74]) met the inclusion criteria for reporting the effect of SRP plus the local delivery of minocycline microspheres compared with SRP alone. The sample sizes in the small studies ranged from 10 to 15 participants per group, whereas the unpublished study sample sizes ranged from 121 to 128 per group. One study had a split-mouth design,[72] whereas the others were parallel-group studies. The studies were conducted between 2000 and 2004. All participants in the study by Skaleric and colleagues[73] had type 1 diabetes.

Critical appraisal. eFigure 5 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus minocycline microspheres resulted in a 0.24-mm mean gain in CAL (95% CI, −0.06 to 0.55) in Figure 8.[27,72-74] We judged the overall level of certainty

TABLE 3

Evidence profile summary: scaling and root planing with adjuncts versus scaling and root planing alone.

THERAPY	LEVEL OF CERTAINTY ASSESSMENT CRITERIA							LEVEL OF CERTAINTY	BENEFIT,‡ MILLIMETERS
	Quantity of Evidence		Risk of Bias	Consistency	Applicability†	Precision	Publication Bias		
	No. of RCTs*	No. of participants							
SRP§ and Systemic Subantimicrobial-Dose Doxycycline	11	813	Unclear	Moderate inconsistency	Yes	No serious imprecision	None detected ($P = .121$)¶	Moderate	0.35 (0.15-0.56)
SRP and Systemic Antimicrobials	24	1,086	Unclear	Substantial inconsistency	Yes	No serious imprecision	None detected ($P = .803$)¶	Moderate	0.35 (0.20-0.51)
SRP and Chlorhexidine Chips	6	316	Unclear	Consistent	Yes	No serious imprecision	Too few studies to assess	Moderate	0.40 (0.24-0.56)
SRP and Doxycycline Hyclate Gel	3	64	Unclear	Moderate inconsistency	Yes	Serious imprecision	Too few studies to assess	Low	0.64 (0.00-1.28)
SRP and Minocycline Microspheres	5	572	Unclear	Moderate inconsistency	Yes	Serious imprecision	Too few studies to assess	Low	0.24 (−0.06 to 0.55)
SRP and Diode Laser (PDT#)	10	306	Low	Inconsistent	Yes	Serious imprecision	None detected ($P = 0.679$)¶	Moderate	0.53 (0.06-1.00)
SRP and Diode Laser (non-PDT)	4	98	Unclear	Substantial inconsistency	Yes	Serious imprecision	Too few studies to assess	Low	0.21 (−0.23 to 0.64)
SRP and Nd:YAG** Laser	3	82	Unclear	Moderate inconsistency	Yes	Serious imprecision	Too few studies to assess	Low	0.41 (−0.12 to 0.94)
SRP and Erbium Laser	3	82	Low	Inconsistent	Yes	Serious imprecision	Too few studies to assess	Low	0.18 (−0.63 to 0.98)

* RCT: Randomized controlled trial.
† Applicability refers to whether the study results are applicable to populations of interest in real-world circumstances.
‡ Benefit is mean difference (95% confidence interval) in clinical attachment level.
§ SRP: Scaling and root planing.
¶ When there were 10 or more studies for a treatment, the authors undertook an assessment of publication bias by means of visual inspection and an Egger test for funnel plot asymmetry. See the complete article for further details.
# PDT: Photodynamic therapy.
** Nd:YAG: Neodymium:yttrium-aluminum-garnet.

in the evidence to be *low* on the basis of the evidence profile in Table 3.

Nonsurgical use of lasers and SRP. We analyzed all studies that met the inclusion criteria of nonsurgical application of a laser (pocket disinfection), and we did not consider studies in which the investigators used lasers for alternative surgical therapy. Several types of lasers are used nonsurgically as adjunctive treatments with SRP. The lasers are categorized primarily by the wavelength of the emitted light. Five categories of lasers are included and described here. One laser type was not available in the United States (potassium titanyl phosphate),[75] and we did not include that laser. There are no standard operating protocols (such as power intensity and density, power, spot size, energy, repetition rate, tip size, pulsing versus continuous mode, mean energy loss, or time of application) for the lasers.

PDT diode laser and SRP. *General description of studies.* Ten studies[75-84] published between 2008 and 2014 met the inclusion criteria for reporting the effect of SRP plus a PDT diode laser (wavelength, 660-810 nanometers) versus SRP alone. Six studies[75,76,79-82] were split-mouth trials, and 4 studies[77,78,83,84] were parallel-group trials. The sample sizes were relatively small, ranging from 12 to 44 per treatment group.

Critical appraisal. eFigure 6 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *low*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus PDT diode laser resulted in a 0.53-mm mean gain in

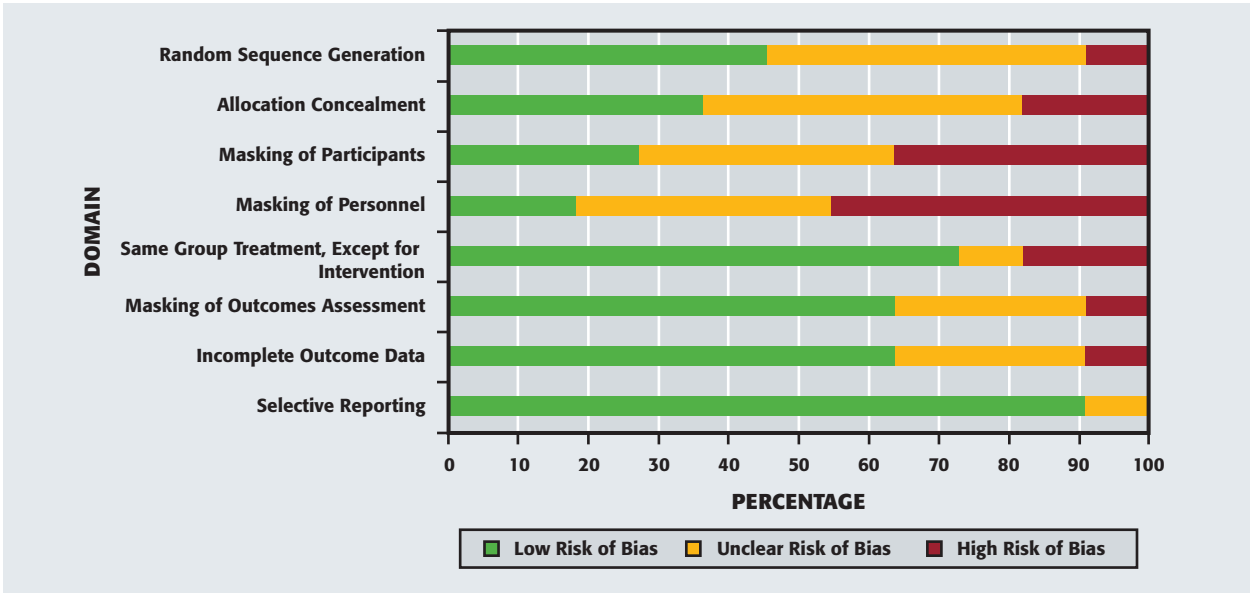

Figure 2. Risk of bias as a percentage of included studies for scaling and root planing according to domain.

Study or Subgroup	Mean Difference	SE	SRP Total	No Treatment Total	Weight	Mean Difference IV, Random, 95% CI
1.1.1 Split mouth						
Lindhe and Colleagues,[20] 1983	1.8	0.63	7	7	1.1%	1.80 (0.57-3.03)
Neill and Mellonig,[21] 1997	0.8	0.59	10	10	1.3%	0.80 (−0.36 to 1.96)
Ng and Bissada,[22] 1998	0.5	0.29	8	8	5.2%	0.50 (−0.07 to 1.07)
Berglundh and Colleagues,[18] 1998	1	0.63	8	8	1.1%	1.00 (−0.23 to 2.23)
Kahl and Colleagues,[19] 2007	0.65	0.39	20	20	2.9%	0.65 (−0.11 to 1.41)
Rotundo and Colleagues,[23] 2010	0.3	0.51	26	26	1.7%	0.30 (−0.70 to 1.30)
Subtotal (95% CI)			79	79	13.3%	0.69 (0.33-1.04)
Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 4.41$, $df = 5$, $P = .49$; $I^2 = 0\%$						
Test for overall effect: $z = 3.77$ ($P = .0002$)						
1.1.2 Parallel group						
Jones and Colleagues,[25] 1994	0.5	0.08	6	10	68.8%	0.50 (0.34-0.66)
Van Dyke and Colleagues,[27] 2002	0.3	0.3	12	13	4.9%	0.30 (−0.29 to 0.89)
Ribeiro and Colleagues,[26] 2008	−0.15	0.45	13	12	2.2%	−0.15 (−1.03 to 0.73)
Chen and Colleagues,[24] 2012 (versus debridement)	0.41	0.34	42	20	3.8%	0.41 (−0.26 to 1.08)
Chen and Colleagues,[24] 2012 (versus polish)	0.44	0.32	43	21	4.3%	0.44 (−0.19 to 1.07)
Zhou and Colleagues,[28] 2014 (versus no treatment)	0.88	0.62	10	20	1.1%	0.88 (−0.34 to 2.10)
Zhou and Colleagues,[28] 2014 (versus scale)	0.08	0.54	10	20	1.5%	0.08 (−0.98 to 1.14)
Subtotal (95% CI)			136	116	86.7%	0.46 (0.32-0.60)
Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 3.35$, $df = 6$, $P = .76$; $I^2 = 0\%$						
Test for overall effect: $z = 6.50$ ($P < .00001$)						
Total (95% CI)			215	195	100%	0.49 (0.36-0.62)
Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 9.05$, $df = 12$, $P = .70$; $I^2 = 0\%$						
Test for overall effect: $z = 7.42$ ($P < .00001$)						
Test for subgroup differences: $\chi^2 = 1.30$, $df = 1$, $P = .25$; $I^2 = 23.0\%$						

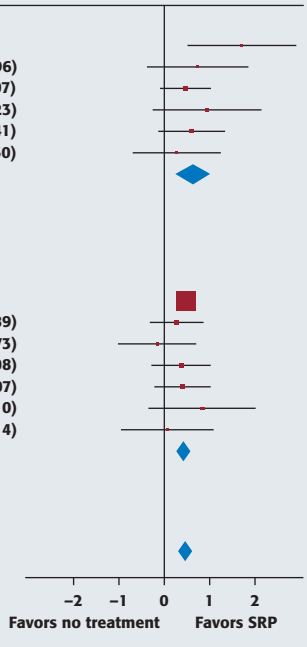

Figure 3. Meta-analysis of studies on scaling and root planing (SRP) grouped according to study design; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV, Inverse-variance; I. SE: Standard error.

CAL (95% CI, 0.06-1.00) (Figure 9).[75-84] We judged the overall level of certainty in the evidence to be *moderate* on the basis of the evidence profile in Table 3.

Non-PDT diode laser and SRP. *General description of studies.* Four studies[85-88] published between 2008 and 2014 met the inclusion criteria for reporting the effect

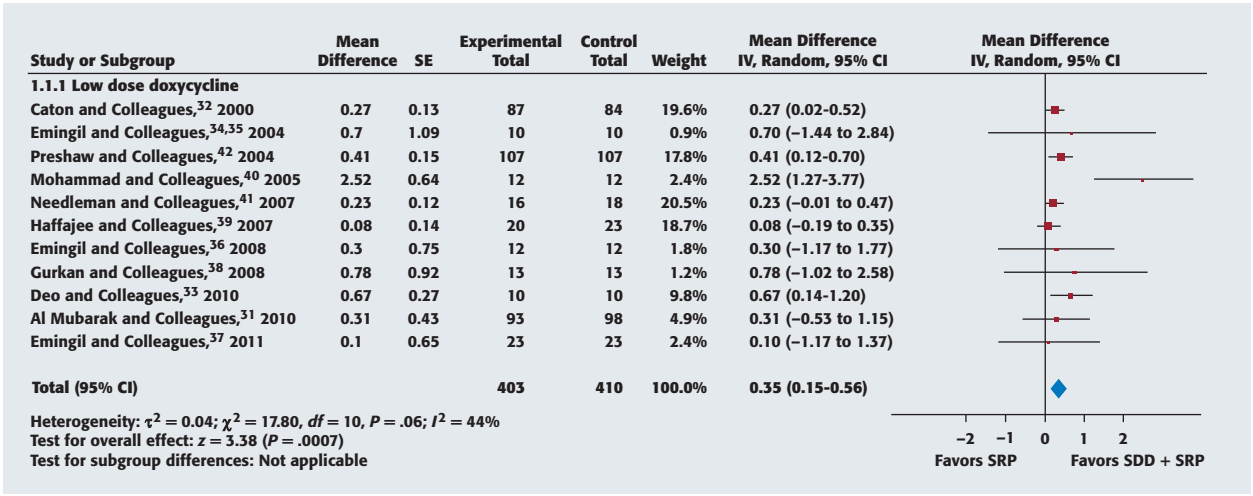

Figure 4. Meta-analysis of studies on scaling and root planing (SRP) plus subantimicrobial-dose doxycycline (SDD) versus SRP alone; mean difference in clinical attachment level is in millimeters. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

of SRP plus a non-PDT diode laser (wavelength, 808-980 nm). Three were split-mouth studies,[85,87,88] and 1 study[86] was a parallel-group study. Euzebio Alves and colleagues[85] tested only 1 site per mouth with each treatment. The sample sizes were relatively small, between 13 and 36.

Critical appraisal. eFigure 7 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus non-PDT diode laser resulted in a 0.21-mm mean gain in CAL (95% CI, −0.23 to 0.64) (Figure 10).[85-88] We judged the overall level of certainty in the evidence to be *low* on the basis of the evidence profile in Table 3.

Nd:YAG laser and SRP. *General description of studies.* Three studies[21,89,90] met the inclusion criteria for reporting the effect of SRP plus an Nd:YAG laser (wavelength, 1,064 nm). All were split-mouth studies with small sample sizes (10 to 26 participants). Investigators in 1 study[90] compared the effects of the addition of Nd:YAG lasers to SRP in smokers versus nonsmokers in 2 arms of the study.

Critical appraisal. eFigure 8 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *unclear*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus Nd:YAG laser resulted in a 0.41-mm mean gain in CAL (95% CI, −0.12 to 0.94) (Figure 11).[21,89,90] We judged the overall level of certainty in the evidence to be *low* on the basis of the evidence profile in Table 3.

Erbium laser and SRP. *General description of studies.* Three studies[23,91,92] published in 2010 and 2011 met the inclusion criteria for reporting the effect of SRP plus an erbium laser (either erbium,chromium:yttrium-scandium-gallium-garnet[91] or erbium:yttrium-aluminum-garnet,[23,92] with wavelengths of 2.79 and 2.94 µm, respectively). All were split-mouth studies with small sample sizes (19 to 33 participants).

Critical appraisal. eFigure 9 (available online at the end of this article) depicts the judgments of bias according to domain. We judged the overall risk of bias as *low*.

Results of intervention and assessment of the level of certainty in the evidence. Compared with SRP alone, SRP plus erbium laser resulted in a 0.18-mm mean gain in CAL (95% CI, −0.63 to 0.98) (Figure 12).[23,91,92] We judged the overall level of certainty in the evidence to be *low* on the basis of the evidence profile in Table 3.

Summary statements on nonsurgical use of lasers. Unlike other instruments, lasers have no defined and accepted protocols for standard usage. Because every operator determines his or her own protocol on the basis of anecdotal rules or experiences, the potential for adverse events to the tooth and patient is higher than it is with other local delivery systems. Also, every laser wavelength is different and affects the hard and soft tissues differently, making comparisons between lasers unpredictable and often incorrect. Common protocols are needed for each laser used in nonsurgical therapy of chronic periodontitis to allow for repeatable results and comparisons among studies in the literature. The wide ranges found in the few studies considered for CAL gain or loss demonstrate the need for larger sample sizes and additional studies to evaluate properly the potential benefits of laser use as an adjunct to SRP. At this time, on the basis of the criteria set in this systematic review, there is insufficient evidence with any laser wavelength except PDT diode lasers to define accurately the benefits for adjunctive nonsurgical therapy of periodontitis with evidence-based literature.

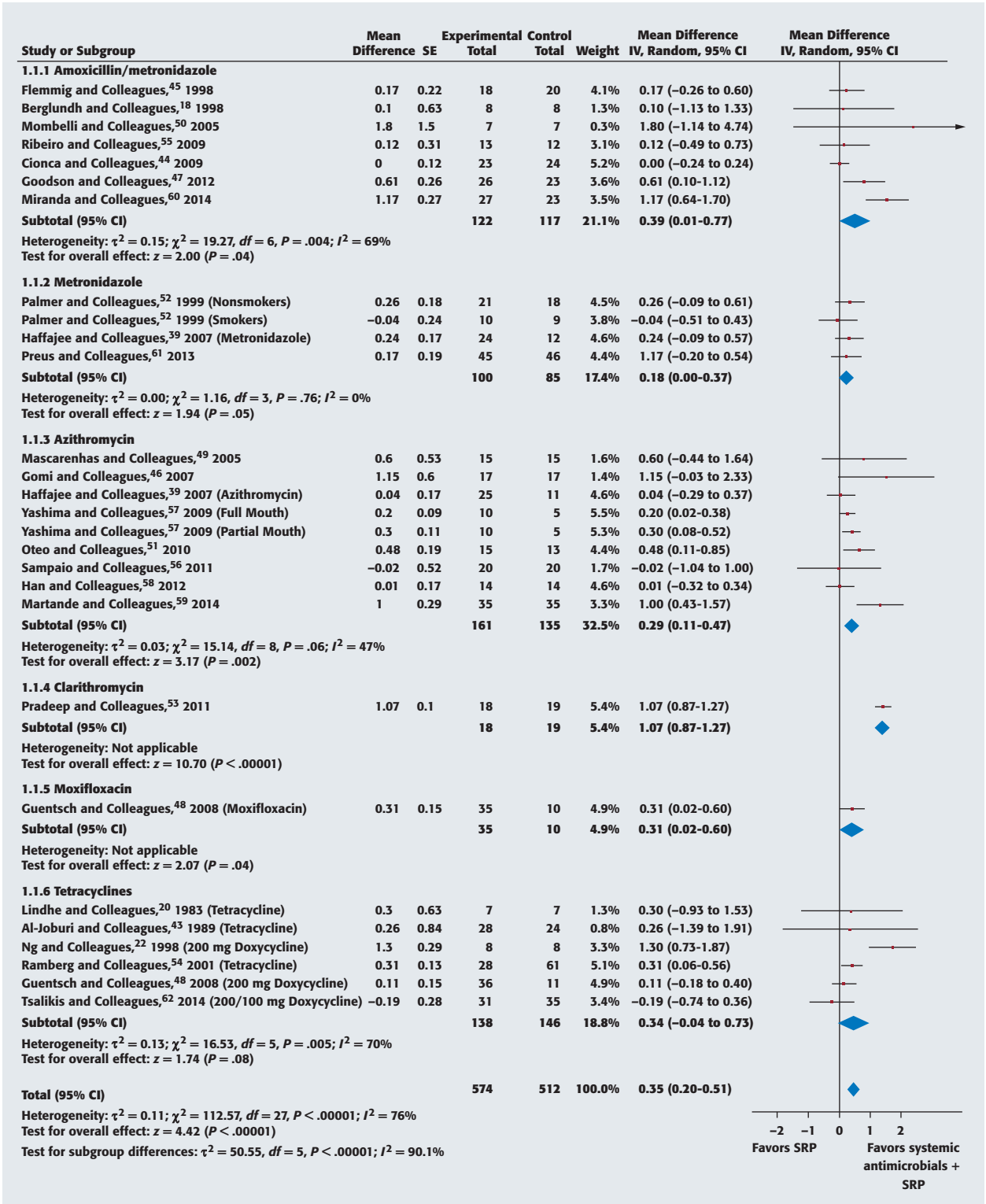

Figure 5. Meta-analysis of studies on scaling and root planing (SRP) plus systemic antimicrobials versus SRP alone, subgrouped according to antimicrobial type; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. mg: Milligrams. SE: Standard error.

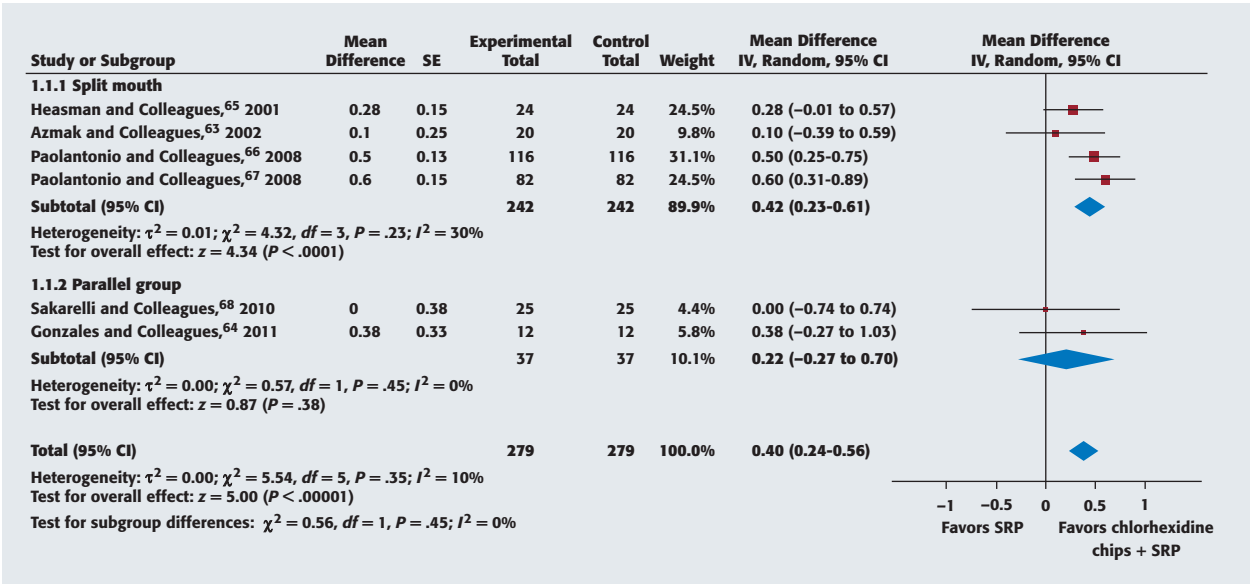

Figure 6. Meta-analysis of studies on scaling and root planing (SRP) plus chlorhexidine chips versus SRP alone, grouped according to study design; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

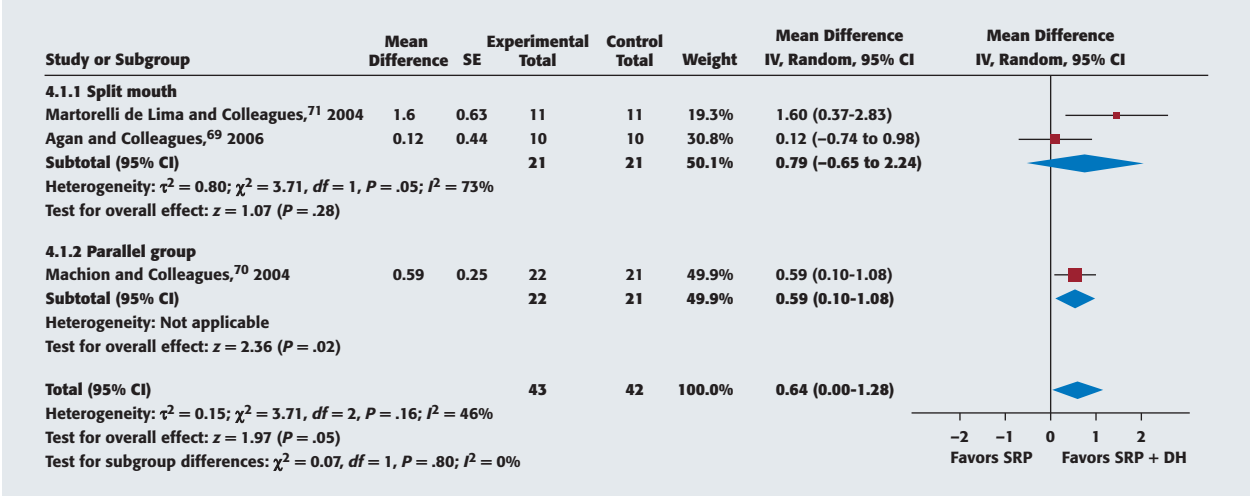

Figure 7. Meta-analysis of studies on scaling and root planing (SRP) plus doxycycline hyclate (DH) gel versus SRP alone, subgrouped according to study design; mean difference in clinical attachment level is in millimeters. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

DISCUSSION

As an expert panel, we critically appraised 72 randomized controlled trials and summarized the information for 10 nonsurgical treatments for chronic periodontitis. On average, SRP compared with no treatment resulted in a 0.5-mm improvement in CAL; we reached this conclusion with a moderate level of certainty because there were few trials.

We also assessed a variety of adjunctive therapies in addition to SRP treatment. Adjuncts comprised both systemic and locally applied modalities. The average improvements in CAL with adjunctive use (over SRP as a sole treatment) averaged between 0.2 and 0.6 mm. The level of certainty in the evidence for all adjuncts was either moderate or low.

We found 11 trials for SDD. With moderate certainty, SDD showed a small and statistically significant adjunctive benefit. We found 24 trials using a variety of systemic antimicrobials and regimens. With moderate certainty, we found a statistically significant but small

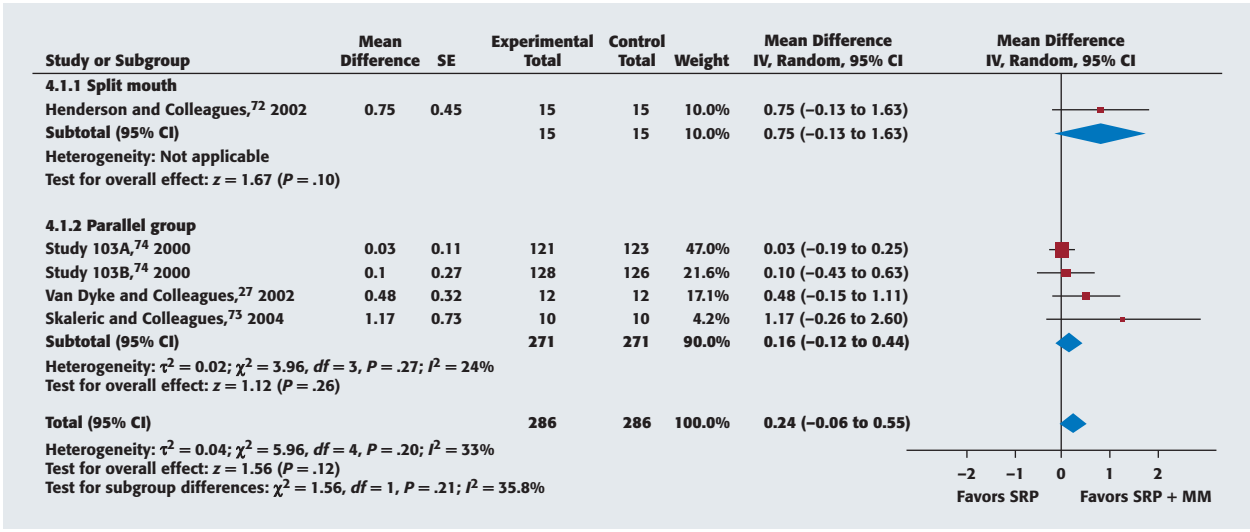

Figure 8. Meta-analysis of studies on scaling and root planing (SRP) plus minocycline microspheres (MM) versus SRP alone, subgrouped according to study design; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

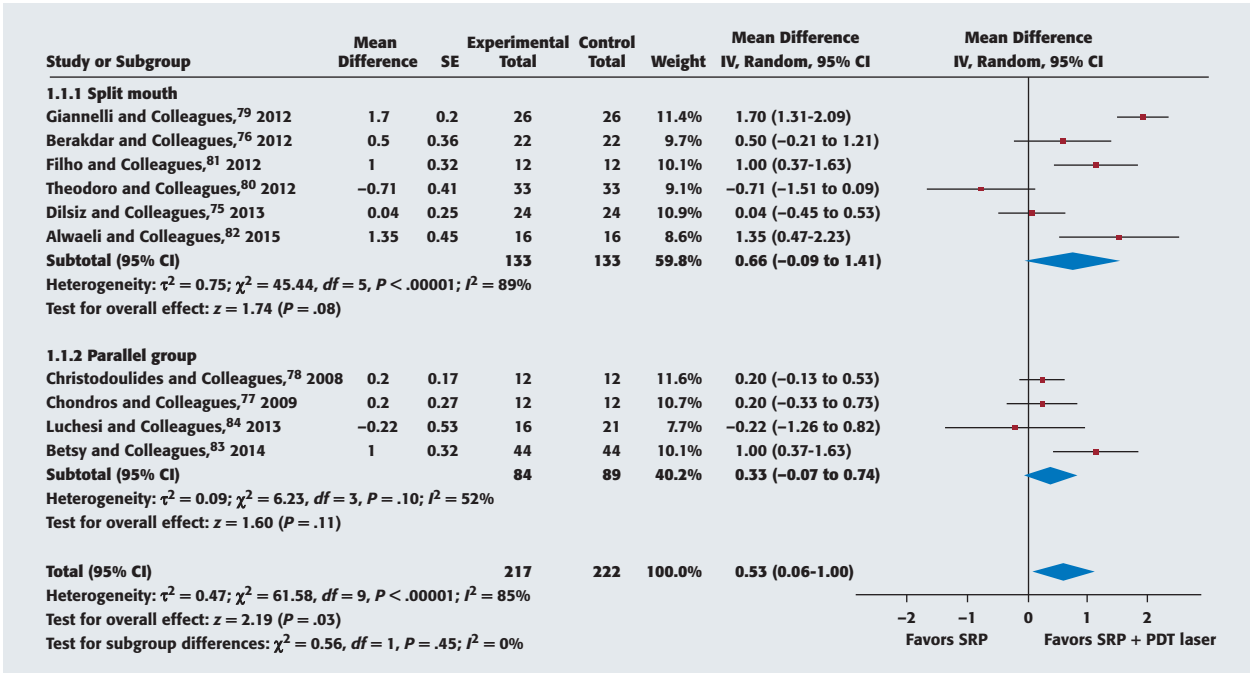

Figure 9. Meta-analysis of studies on scaling and root planing (SRP) plus photodynamic therapy (PDT) diode laser versus SRP alone, grouped according to study design; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

benefit from systemic antimicrobials in aggregate. With moderate certainty, we observed a statistically significant, moderate benefit with the adjunctive use of chlorhexidine chips.

Clinicians should bear in mind the ambiguity of the adjunctive benefits of DH gel and minocycline microspheres before recommending their use as part of the nonsurgical treatment of periodontitis. We found

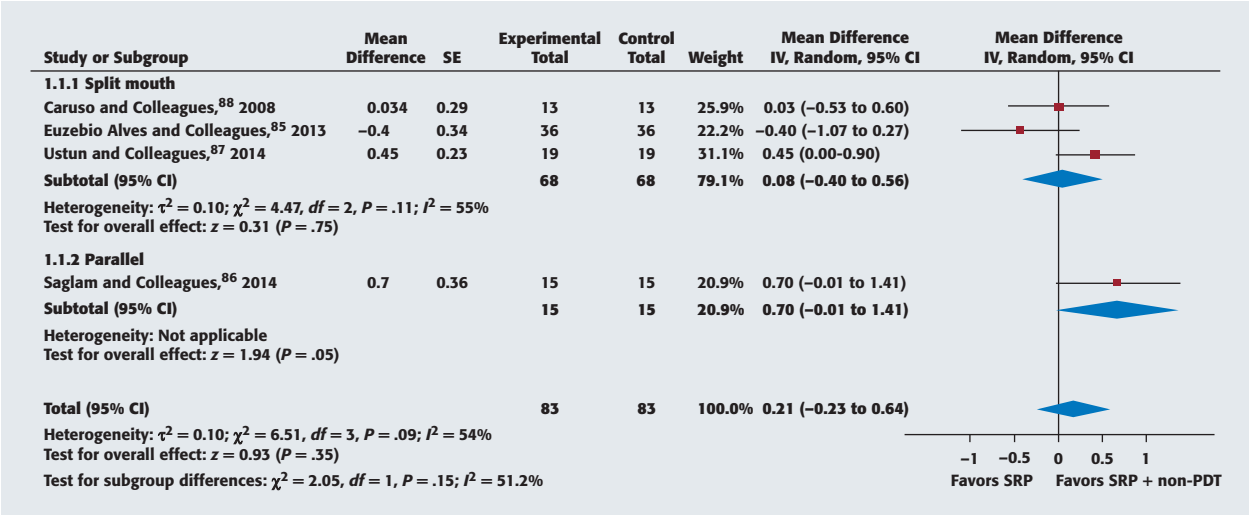

Figure 10. Meta-analysis of studies on scaling and root planing (SRP) plus nonphotodynamic therapy (non-PDT) laser versus SRP alone; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

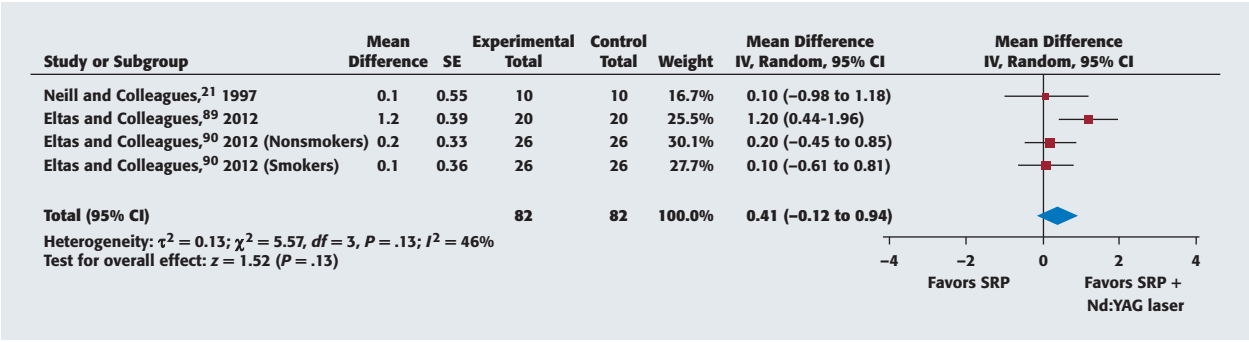

Figure 11. Meta-analysis of studies on scaling and root planing (SRP) plus neodymium:yttrium-aluminum-garnet (Nd:YAG) laser versus SRP alone; mean difference in clinical attachment level is in millimeters. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

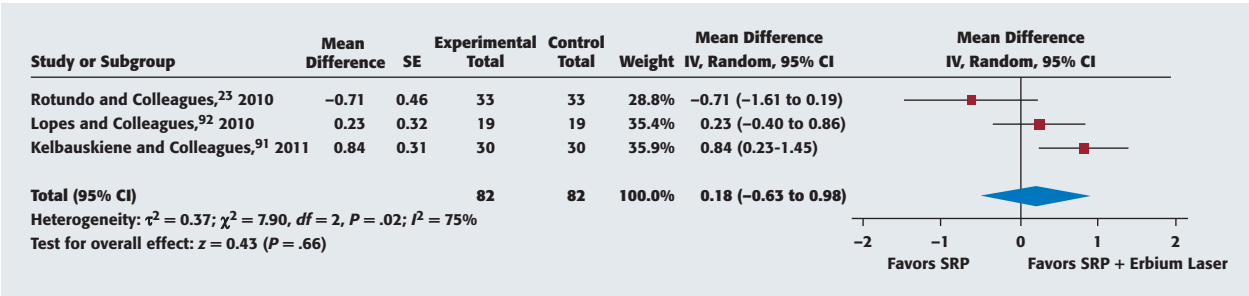

Figure 12. Meta-analysis of studies on scaling and root planing (SRP) plus erbium laser versus SRP alone; mean difference in clinical attachment level is in millimeters. Weighted percentages may not add up due to rounding and significant figures reported. CI: Confidence interval. df: Degrees of freedom. IV: Inverse-variance. SE: Standard error.

low certainty in the evidence for both of these treatments.

For DH gel, we observed a substantial adjunctive benefit; however, because of a wide CI around the estimated benefit, the data were also compatible with no benefit. DH gel was developed and approved by the US Food and Drug Administration as a stand-alone product (that is, used without SRP). We did not include use of

DH gel as a stand-alone product in this review. Garret and colleagues[93,94] did not find statistically significant differences between DH gel and SRP.

For minocycline microspheres, we observed a small adjunctive benefit. On the basis of the width of the CI, the data for the microspheres also were compatible with no benefit. The US Food and Drug Administration approved minocycline microspheres on the basis of their beneficial effect on probing depth, not CAL.

Unlike other instruments, lasers have no defined and accepted protocols for standard usage. Many dental providers establish their own protocol on the basis of anecdotal rules or experiences. However, the potential for adverse events was considered to be higher than for other adjunctive treatment systems. Also, every laser type and wavelength is different and affects the hard and soft tissues differently, making comparisons between lasers virtually impossible. We concluded that there are no benefits for any laser type or wavelength except PDT diode lasers.

Diabetes is a risk factor for chronic periodontitis.[95] Five of the 72 studies included exclusively patients with diabetes. We included these studies on patients with diabetes with other studies of the same treatment. Investigators in 1 study[24] tested SRP alone versus no treatment and supragingival prophylaxis, investigators in 2 studies[31,33] tested SRP plus SDD versus SRP alone, investigators in 1 study[71] tested SRP plus DH gel versus SRP alone, and investigators in 1 study[73] tested SRP plus minocycline microspheres versus SRP alone. Because there are only 1 or 2 studies per treatment exclusively on patients with diabetes, we could not draw any conclusion regarding the effect of SRP and adjuncts on chronic periodontitis among patients with diabetes.

Smoking is a risk factor for chronic periodontitis.[96] Investigators in only 2 studies[52,90] compared the effect of treatment between smokers and nonsmokers: 1 study of systemic antibiotics and 1 study of using an Nd:YAG laser as adjunctive treatment. Investigators in 1 study performed post hoc analyses comparing smokers with nonsmokers; however, we rejected this study on the basis of methodological concerns. Investigators in no other studies compared results in smokers with those in nonsmokers. Therefore, we were unable to reach a general conclusion regarding the effect of SRP or any of the adjuncts in smokers versus nonsmokers.

LIMITATIONS

Of the evidence. There is an abundance of published studies on the nonsurgical treatment of chronic periodontitis. However, in this systematic review, we could use only a reduced number of studies because of the ambiguity in describing the tested treatment. For example, investigators in many studies did not specify clearly that root planing was performed or used terms such as *debridement*.

The literature is also inconsistent on what is a clinically relevant outcome. Investigators in some studies defined clinical relevance in attachment gain as low as 0.2 mm.

Another limiting factor was the lack of uniformity in assigning levels of severity to chronic periodontitis. This finding is a reflection on the lack of agreement and multiple changes in the last 30 years in cutoff points to categorize severity occurring. We strongly urge researchers to report the numerical cutoffs used to describe disease severity.

Investigators in many otherwise rigorous studies reported changes in probing depth and not CAL. Although probing depths are the routine clinical measure used in most day-to-day treatment of patients, probing depths do not distinguish the role of recession in the treatment of periodontal diseases. Impressive reductions in probing depth can be obtained through treatment-induced recession. With the use of CAL, the reader can gauge the magnitude of clinical improvement due to gain in soft-tissue attachment to the root surface. In contrast, probing depths can be reduced as a result of both soft-tissue reattachment and gingival recession.

Most of the included studies were small in terms of the number of participants. Small studies can have a problem with low statistical power. Investigators in several of the included studies tested only 1 site per patient per treatment, whereas others provided measures for the entire mouth.

A major concern in judging the reliability of the results is participant attrition. Many studies did not include data on retention of participants and whether there were differences in different treatment arms; this ambiguity in turn influenced our ability to judge the strength of the study's findings. Also, investigators often did not report issues regarding safety and adverse events.

Of the systematic review. For this systematic review, we selected articles only in the English language. These choices could lead to bias in the results and interpretations if important studies published in languages other than English exist because we did not capture them.

Although we captured the disease severity information during the data abstraction process, we did not assess the results across degrees of disease severity at baseline. Also, because we chose to rely on CAL, we did not review studies that provided results only in terms of probing depth.

The competitive environment in which clinical trials are financed and conducted, as well as the nonreporting of negative results by some investigators or publications, fosters publication bias.[97] As a rule of thumb, quantitative analysis of publication bias should only be conducted when there are 10 or more studies in the meta-analysis.[98] Only 3 treatments in this systematic review met this criterion; therefore, the presence of publication bias for the other treatments is unknown.

CONCLUSIONS

On average, treatment of chronic periodontitis with SRP was associated with a 0.5-mm improvement in CAL against no treatment at a moderate level of certainty. We found benefits in 4 adjunctive therapies as compared with SRP alone: systemic SDD, systemic antimicrobials, chlorhexidine chips, and PDT with a diode laser at a moderate level of certainty. We had a low level of certainty on the benefits of the other 5 adjunctive therapies. Combinations of SRP with these assorted adjuncts resulted in a range of average CAL improvements between 0.2 and 0.6 mm over SRP alone. We also assessed the balance between the benefits and potential for adverse events from each treatment. We make clinical recommendations in a companion clinical practice guideline.[5] ■

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: http://dx.doi.org/10.1016/j.adaj.2015.01.028.

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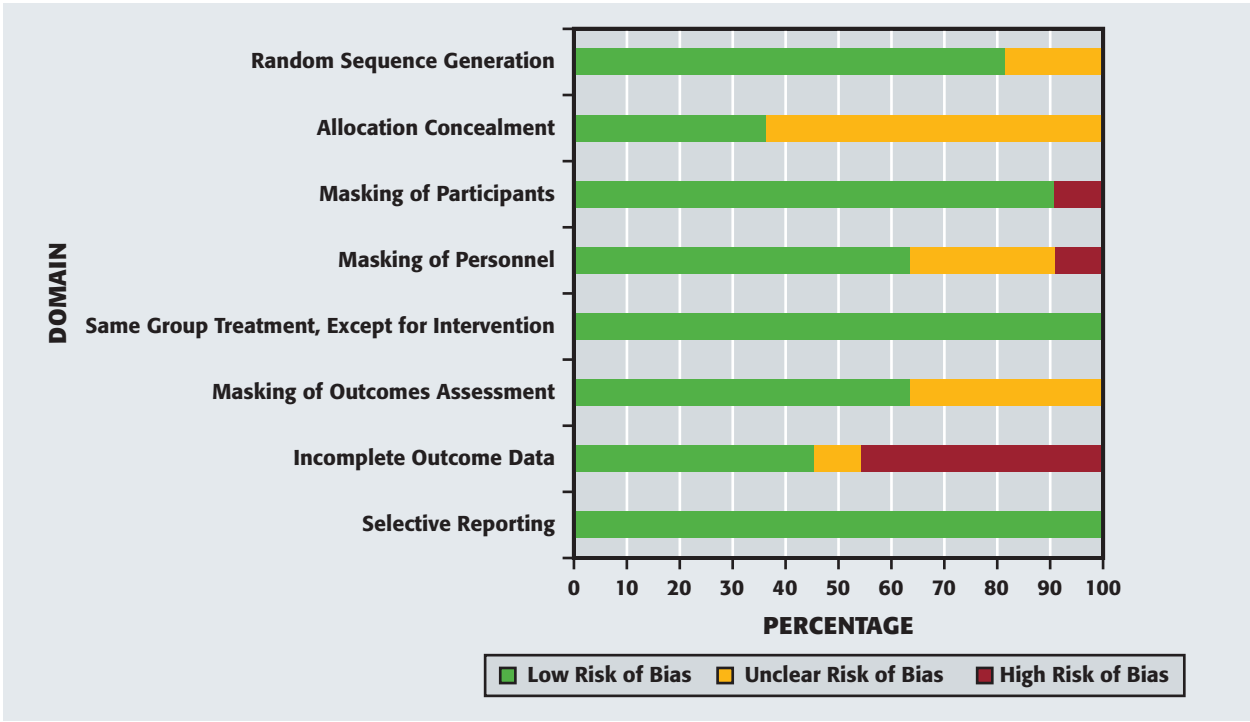
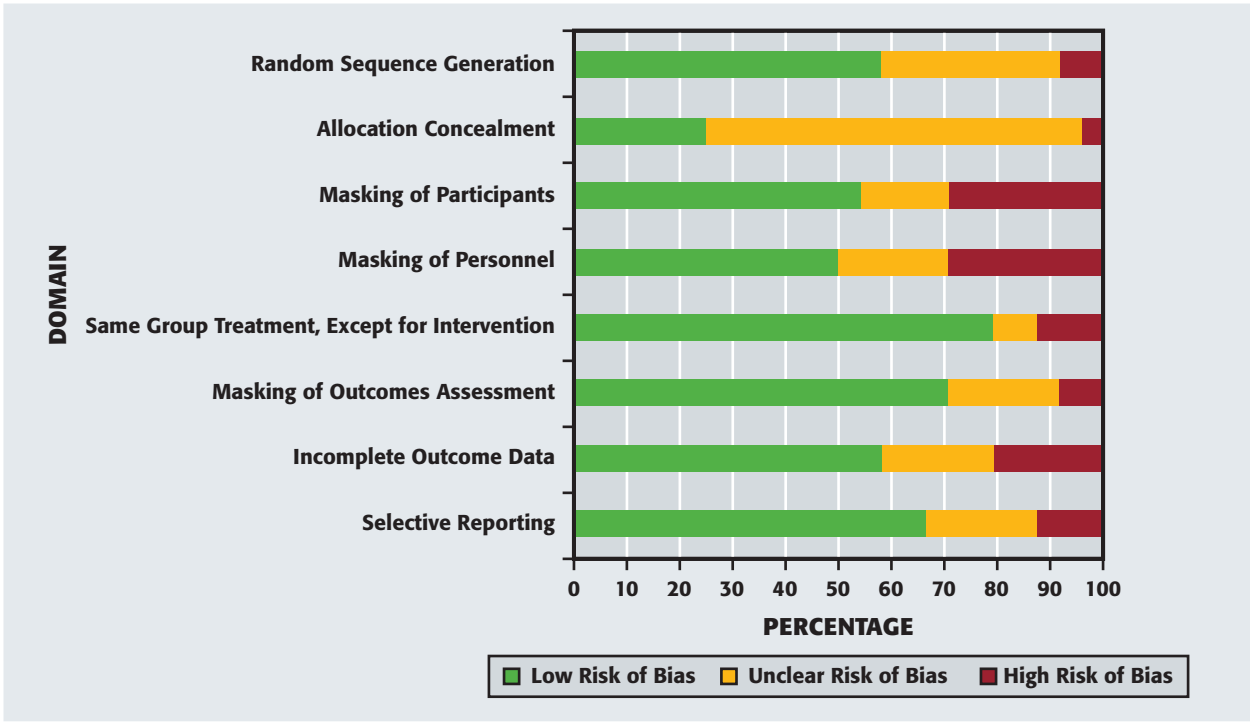
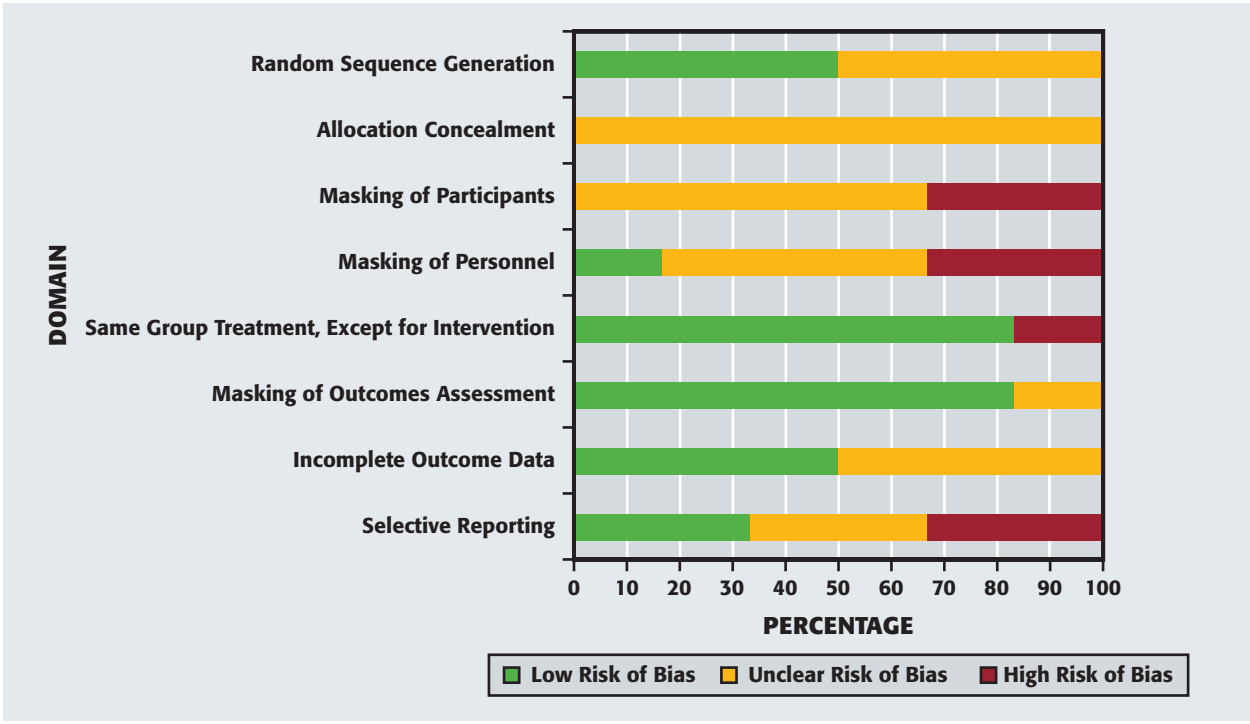


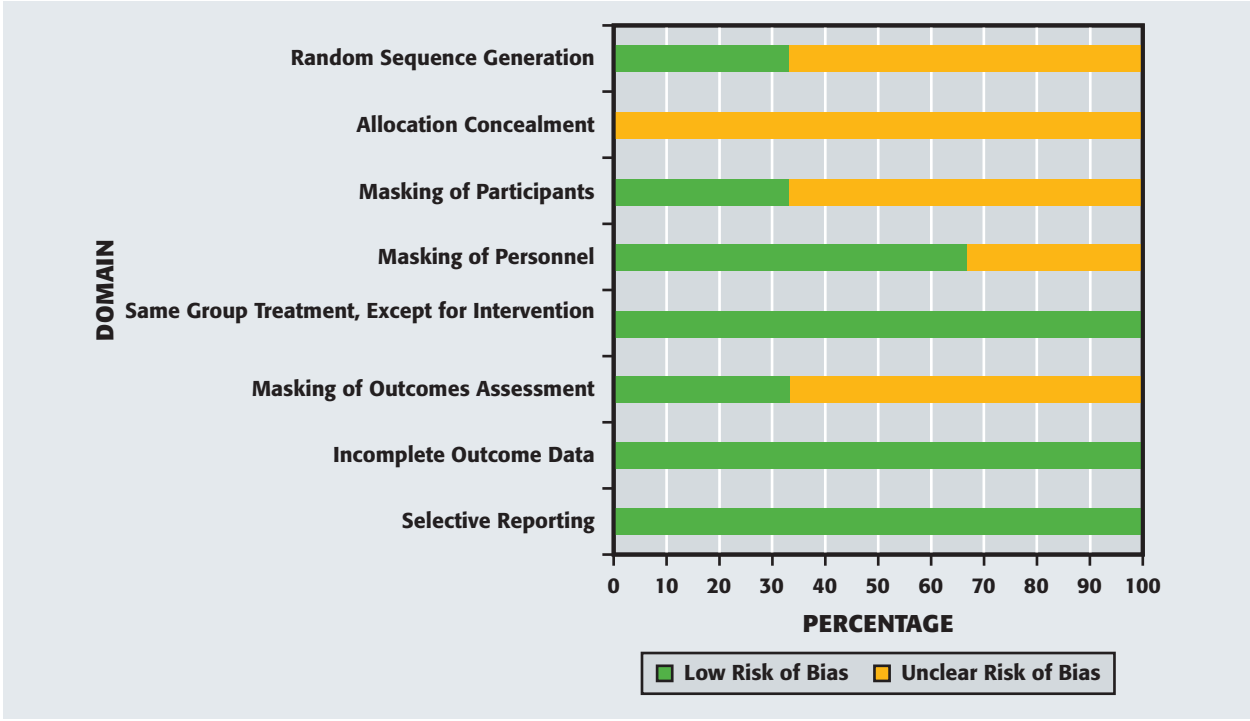
eFigure 1. Risk of bias as a percentage of included studies for scaling and root planing plus subantimicrobial-dose doxycycline, according to domain.



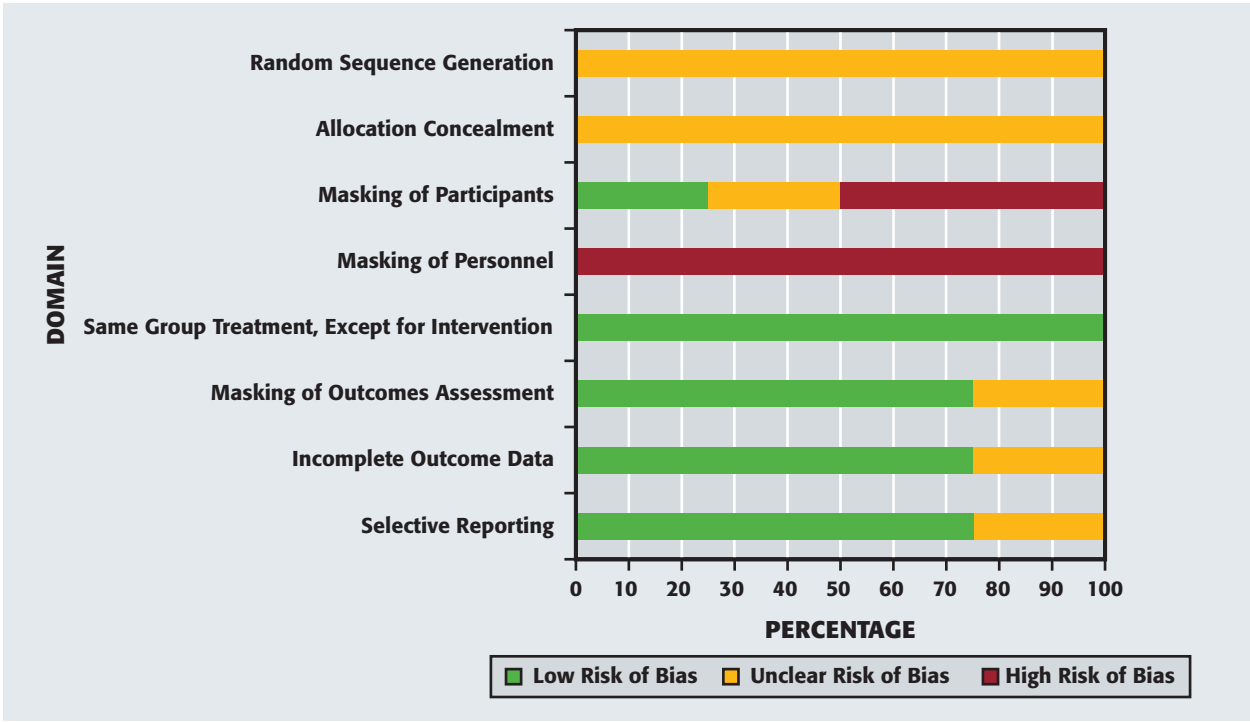
eFigure 2. Risk of bias as a percentage of included studies for scaling and root planing plus systemic antimicrobials, according to domain.



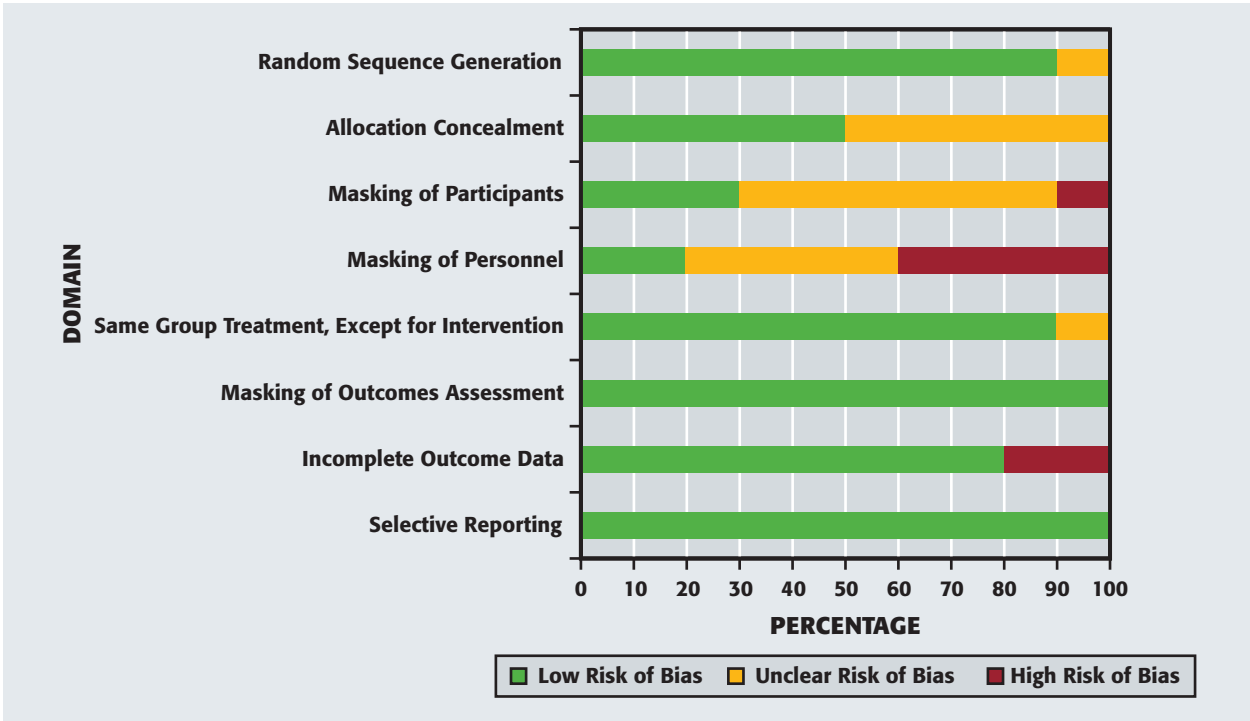
eFigure 3. Risk of bias as a percentage of included studies for scaling and root planing plus chlorhexidine chips, according to domain.



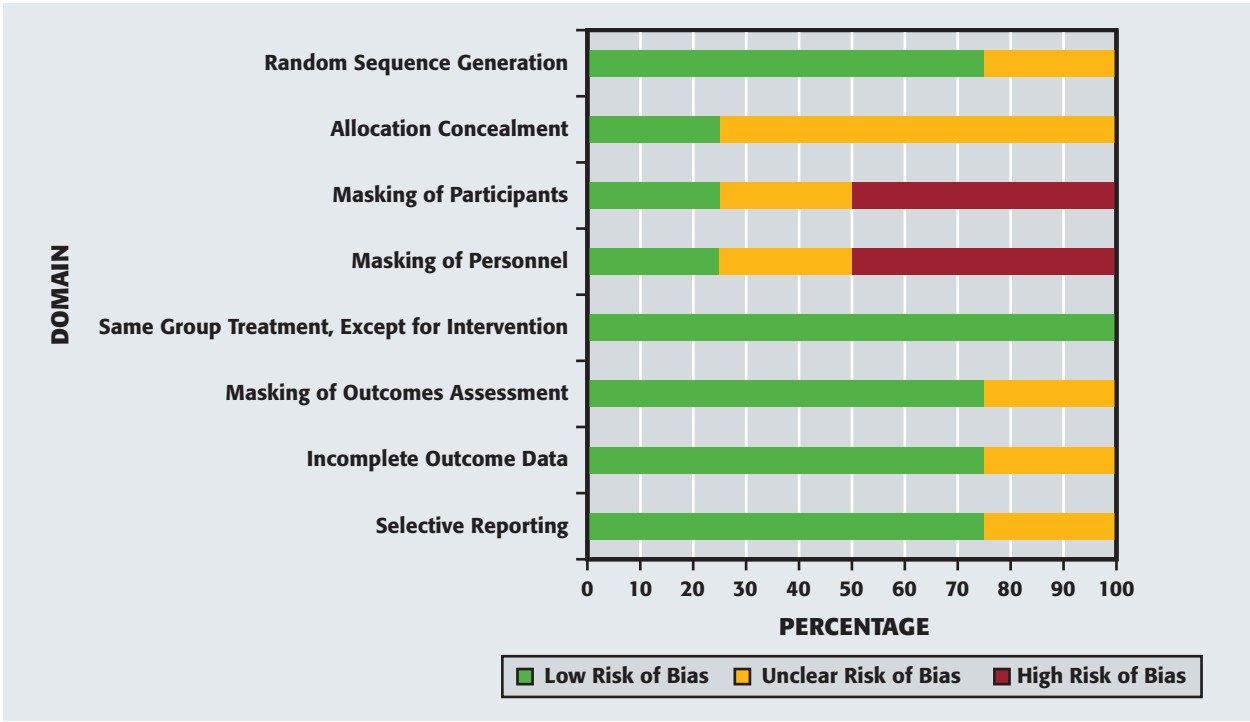
eFigure 4. Risk of bias as a percentage of included studies for scaling and root planing plus doxycycline hyclate gel, according to domain. There were 3 studies.



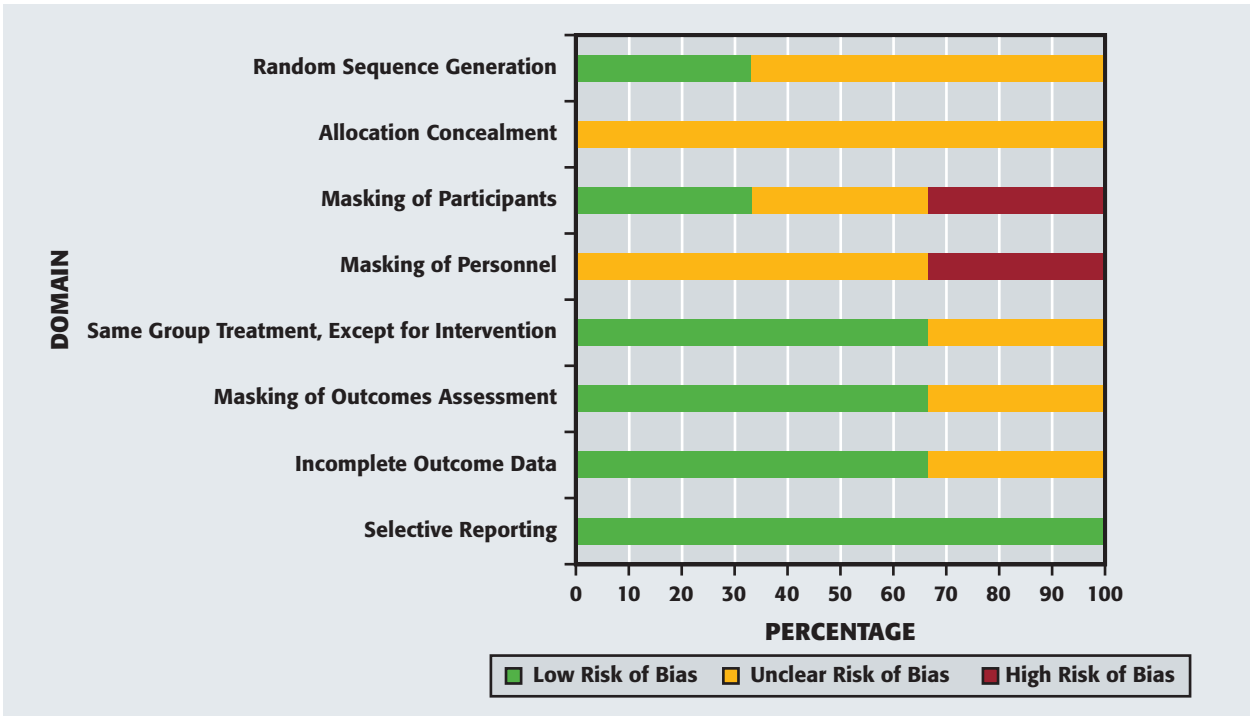
eFigure 5. Risk of bias as a percentage of 4 included studies for scaling and root planing plus minocycline microspheres, according to domain.



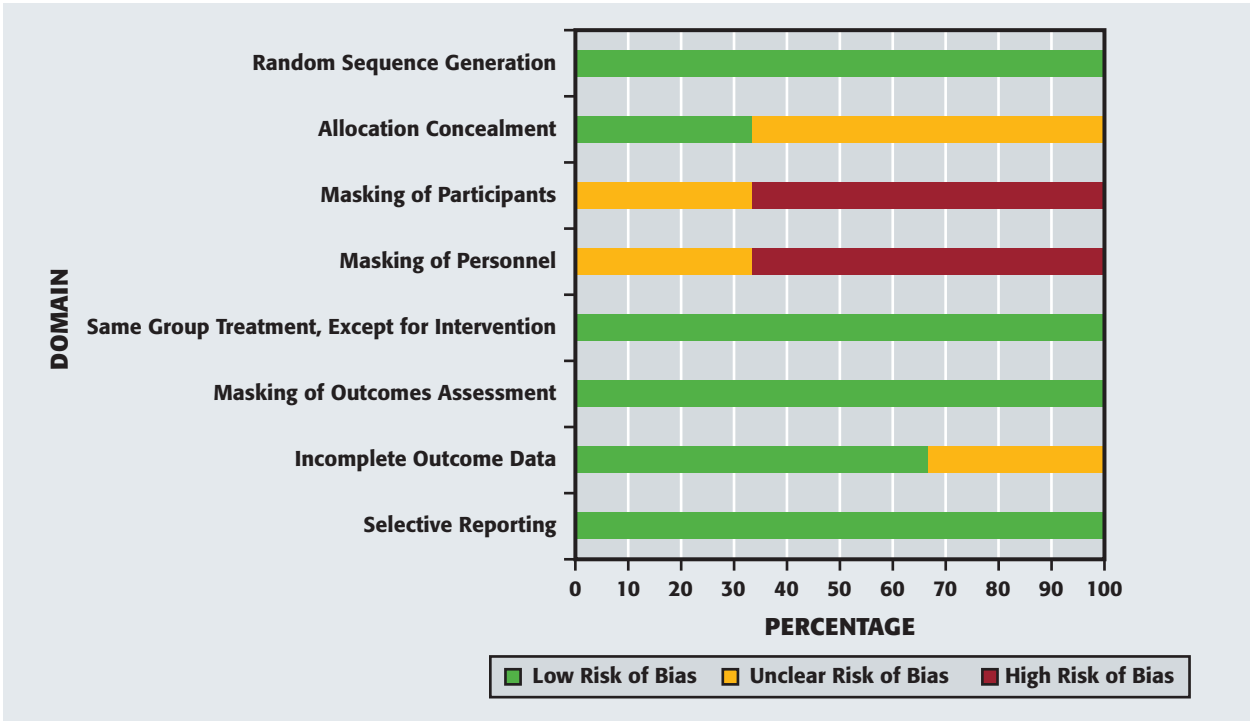
eFigure 6. Risk of bias as a percentage of included studies for scaling and root planing plus a photodynamic therapy diode laser, according to domain.



eFigure 7. Risk of bias as a percentage of included studies for scaling and root planing plus a non-photodynamic therapy diode laser, according to domain.



eFigure 8. Risk of bias as a percentage of included studies for scaling and root planing plus a neodymium:yttrium-aluminum-garnet laser, according to domain.



eFigure 9. Risk of bias as a percentage of included studies for scaling and root planing plus an erbium laser, according to domain.

Periodontal Treatment Protocol (PTP) for the General Dental Practice

Larry A. Sweeting, DDS; Karen Davis, RDH, BSDH; Charles M. Cobb, DDS, PhD

Abstract

A sequence of interrelated steps is inherent to effective periodontal treatment: early and accurate diagnosis, comprehensive treatment, and continued periodontal maintenance and monitoring. A primary goal of periodontal therapy is to reduce the burden of pathogenic bacteria and thereby reduce the potential for progressive inflammation and recurrence of disease. Emerging evidence of possible perio-systemic links further reinforces the need for good periodontal health. In the private practice setting, the treatment of patients with periodontal disease is best accomplished within the structure of a uniform and consistent Periodontal Treatment Protocol (PTP). Such a protocol would reinforce accurate and timely diagnosis, treatment needs based on a specific diagnosis, and continual assessment and monitoring of outcomes. This is best achieved if everyone in the practice setting has a general understanding of the etiology of periodontal diseases, the benefits of treatment, and potential consequences of nontreatment. Communication skills and patient education are vital components of effective therapy since slight and even moderate stages of the disease often have few noticeable symptoms to the patient. Accurate documentation and reporting of procedures for dental insurance reimbursement, coupled with scheduling considerations, assist general practice settings in effectively managing the increasing volume of patients that can benefit from early diagnosis and treatment of periodontal diseases. This article presents the essential elements of a PTP including diagnosis, treatment planning, implementation of therapy, assessment and monitoring of therapy, insurance coding, introduction of the patient to periodontal therapy, and enhanced verbal skills. In addition, considerations for implementation of adjunctive local delivery antimicrobials is presented.

Key Words: periodontal diseases, periodontal diagnosis, treatment protocol, periodontal maintenance, periodontal assessment, patient education

Introduction

Hujoel et al[1] estimated a 31% decrease in the prevalence of periodontitis between the years 1955 and 2000. Further, these authors estimate an additional 8% decrease by the year 2020. In spite of the decreased use of smoking tobacco,[2] better understanding of the pathogenesis of periodontal diseases, and more refined and goal directed therapies, there remains evidence that dentistry is not consistently achieving a timely diagnosis and appropriate and timely treatment of existing periodontitis.[3,4] Although the evidence is limited, there is a strong suggestion that use of a periodontal probe for diagnosis and recording of periodontal status in treatment records in general dental practices has yet to achieve the level of a routine and consistent habit.[5-9] Indeed, McFall et al[8] determined that except for radiographs, most private practice patient records were so deficient in diagnostic information that periodontal status could not be established. It should be self-evident that treatment requires a definitive diagnosis, ie, a disease cannot be adequately treated unless first diagnosed. In this regard, it is interesting to note that at least one study has reported a disconnect between dentists' perception of treatment rendered and actual treatment as recorded in patient records.[10] As an example, prophylactic procedures outnumber periodontal procedures by a ratio of 20:1[11,12] and yet the prevalence of chronic periodontitis (slight, moderate, and severe) is estimated to range from a low of 7% (aged $\geq$ 18 years)[13] up to 35% (aged $\geq$ 30-90 years)[14] of the US adult population.

Cobb et al.[3] compared the pattern of referral of periodontitis patients in 1980 vs 2000 using patient record data from 3 geographically-diverse private periodontal practices. Results showed the following trends occurring over the 20-year time span: decreased use of tobacco; increase in the percentage of cases exhibiting advanced chronic periodontitis with a concomitant decrease in the percentage of mild-moderate disease cases; increase in the average number of missing teeth per patient; and increase in the average number of teeth scheduled for extraction per patient. A similar study by Docktor et al[4] based on patient records from 3 private periodontal practices located within a major metropolitan area reported the following: 74% of referred cases were considered advanced periodontitis, of which 30% were treatment planned for extraction of 2 or more teeth; periodontal treatment provided by the general dental office did not vary because of disease severity; and the average number of periodontal maintenance visits/patient/year in the general dental office was less than the standard of care according to severity of disease, eg, 68% of advanced periodontitis cases reported between 0 and 2 periodontal maintenance visits per year rather than the recommended every 3 months. Viewed in aggregate, the trends reported by Cobb et al[3] and Docktor et al[4] support the assertion that timely diagnosis and appropriate and timely treatment of chronic periodontitis have

not significantly improved over time. A major reason for the reported scarcity of timely diagnosis and appropriate treatment may be the lack of a well-established office protocol for the diagnosis, treatment, maintenance, and monitoring of periodontal disease, and involvement of the patient through education. Obviously, this requires dedication of energy, resources, effective communication skills, and a change in practice philosophy.

The Periodontal Treatment Protocol (PTP)

Diagnosis

Regardless of recent advances in our understanding of the etiology and pathogenesis of the periodontal diseases, the assessment of traditional clinical parameters remain the foundation for periodontal diagnosis.[15] Generally, such clinical parameters include probing depth (PD), bleeding on probing (BOP), clinical attachment level (CAL), degree of furcation involvement, extent of gingival recession, tooth mobility, and plaque score. Clinicians typically utilize the results from the periodontal exam, radiographs, and the patient's medical and dental histories to establish a diagnosis and evolve a goal/diagnosis-directed treatment plan. It has been clearly demonstrated that different interpretations of the same diagnostic information can have a dramatic impact on treatment decisions.[16] For this reason, a standardized approach to periodontal assessments and a working protocol as to treatment parameters would fill a logical need in the average general practice setting. However, due to extensive overlaps in most classification systems, any standardized approach is subject to variations in both clinical assessments (eg, variations in probing depth among clinicians) as well as the interpretation thereof.

All effective treatment protocols begin with a thorough and timely diagnosis. Six-point probing to measure PD and BOP is the standard of care. Based on the needs of the patient, current radiographs should be evaluated to determine the location and percentage of bone loss. The presence, location, and extent of furcation invasions should be noted, as well as the location of the gingival margin or CAL. Also, the patient's age is an important factor, especially in cases of rapidly progressing disease and determining overall long-term prognosis.

A modified version of the American Academy of Periodontology (AAP) proposed guidelines for a comprehensive periodontal examination is presented in Table 1.[17] However, with respect to a functional PTP for the general dental practice, only the following principal diagnostic criteria can be addressed: age, PD, CAL, BOP, tooth mobility, furcation involvement, and percentage of radiographic bone loss. It must be emphasized that these criteria represent the minimal parameters for determining a periodontal diagnosis. There are many other important risk and modifying factors that will impact development and progression of disease and all such factors must be taken into consideration when establishing a defin-

Table 1. Modified Version of the American Academy of Periodontology Suggested Guidelines for a Comprehensive Periodontal Examination.[18]

Assessment of medical history
Assessment of dental history
Assessment of periodontal risk factors 1. Age 2. Gender 3. Medications 4. Presence of plaque and calculus (quantity and distribution) 5. Smoking 6. Race/Ethnicity 7. Systemic disease (eg, diabetes) 8. Oral hygiene 9. Socioeconomic status and level of education
Assessment of extraoral and intraoral structures and tissues
Assessment of teeth 1. Mobility 2. Caries 3. Furcation involvement 4. Position in dental arch and within alveolus 5. Occlusal relationships 6. Evidence of trauma from occlusion
Assessment of periodontal soft tissues including peri-implant tissues 1. Color 2. Contour 3. Consistency (fibrotic or edematous) 4. Presence of purulence (suppuration) 5. Amount of keratinized and attached tissue gingiva 6. Probing depths 7. Bleeding on probing 8. Clinical attachment levels 9. Presence and severity of gingival recession
Radiographic evaluation of alveolar bone loss, bone density, furcations, root shape, and proximity, etc.

itive diagnosis and a diagnosis-driven treatment plan.[18]

Age is of relative value in that advanced amounts of periodontal destruction at an earlier age tend to indicate a more aggressive form of periodontitis. In contrast, chronic periodontitis may slowly progress towards severity over several years or decades. Young age combined with moderate to severe bone loss presents a tenuous long-term prognosis and requires more aggressive therapy compared to the older patient presenting with a chronic form of periodontitis.[19]

Probing depth (PD) is defined as the distance from the gingival margin to the base of the gingival crevice.[20] The periodontal pocket, represented by a probing depth > 3 mm, is the principle habitat for gram-negative, anaerobic pathogenic bacteria.[20] Deeper pockets tend to represent more extensive destruction of the underlying periodontium and, therefore, a potentially greater pathenogenic burden.

Clinical Attachment Level (CAL) is defined as the distance from the CEJ to the base of the probable crevice/pocket. In cases of gingival recession, the amount of recession is added to the PD to yield the total amount of CAL. Although more difficult to obtain, it is a better measure of the total extent of damage to the underlying periodontium.[20-22]

Mobility is best measured by the blunt end of 2 instruments alternating pressure in a facial-lingual direction and an apical direction to assess abnormal movement of the tooth. Simply assessed: Grade I mobility is slightly more than normal; Grade II is moderately more than normal; Grade III is severe mobility facial-lingually plus apical displacement.[23] Mobility patterns are suggestive of possible occlusal trauma, severe inflammation, and/or loss of supporting alveolar bone.

Furcations represent bone loss between the roots of multi-rooted teeth. A deeply invasive furcation lesion is the equivalent of a poor long-term prognosis for the involved tooth. Simply put, a Grade 1 furcation involvement is incipient bone loss only; a Grade 2 is partial loss of bone producing a cul-de-sac; a Grade 3 is total bone loss with through-and-through opening of the furcation; and a Grade 4 is similar to a Grade 3, but with gingival recession that visually exposes the furcation opening.[24]

Radiographic Evidence of Bone Loss is best determined with adequate and current radiographs,[17] most typically a full-mouth periapical survey, including vertical bite-wings, or a panographic radiograph supplemented with vertical bite-wings and selected periapical films. By definition, true periodontitis does not begin until bone loss occurs.[25] Radiographic evaluation of the distribution and severity of bone loss, bone density, root anatomy, and approximation to other teeth provides specific information that will help in determining a proper diagnosis, treatment plan, and prognosis.

Bleeding on Probing (BOP) is a simple assessment of the inflammatory status of the gingiva.[15,26] In patients with deeper pockets and/or loss of clinical attachment, the chances of disease progression are greater as the percentage of bleeding sites increase.[27] Conversely, lack of BOP is highly correlated with stability and a lack of inflammation.[28] This latter statement, however, does not apply to smokers as they tend to bleed less when compared to nonsmokers with equal amounts of disease.[29]

In addition to the usual clinical parameters, the clinician is well advised to consider other risk factors and their potential impact on the development and progression of plaque-induced periodontal diseases.[18] Risk factors that are sometimes overlooked in the diagnosis, treatment plan, and prognosis equation include, among others: diabetes, smoking, osteoporosis, compromised immune system, drug-induced gingival conditions, hormonal changes, and genetics. Patients at risk for periodontal disease are often allowed to "slip between the cracks" during a routine visit because they may be in the early stages of the disease. Risk factors increase a patient's chance of developing periodontitis. The presence of one or more of these risk factors may also indicate a benefit from specialty referral in some patients.

Case Types and Periodontal Diagnosis

As part of a PTP it is necessary to establish diagnostic guidelines that will provide a framework for organizing the treatment needs of the patient. Guidelines are not meant to replace clinical knowledge or skills, nor do they imply a one-size-fits-all treatment plan for periodontal disease. It is recognized that each dental practice setting is different. Consequently, guidelines are intended to be used in a manner that best meets the needs of the specific patient.

Generally speaking, plaque-induced periodontal diseases have historically been categorized into gingivitis versus periodontitis based upon whether attachment loss has occurred. The 1999 International Workshop for Classification of Periodontal Diseases[21] reclassified the plaque-induced periodontal diseases into 7 different classifications. In consideration of a working PTP that addresses only the common periodontal diseases, this paper will address health, gingivitis, chronic periodontitis (formerly adult periodontitis), and aggressive periodontitis (formerly early-onset periodontitis). The first 7 entries in Table 2 (see back cover) constitute a set of clinical criteria (PD, BOP, percent bone loss, tooth mobility, degree of furcation involvement, and CAL) that will facilitate differentiation of health from gingivitis and between the various levels of severity of chronic periodontitis. Further, Table 2 can aid the clinician in differentiating between chronic and aggressive periodontitis.

Some practice settings may prefer a system of "Periodontal Case Types" for purposes of diagnosis and record keeping. Table 3 presents the diagnostic clinical criteria as applied to Case Types for health, gingivitis, chronic periodontitis (slight, moderate, and severe), and aggressive periodontitis. These criteria and Case Types are generally appropriate but should be considered as guidelines only and not as a definitive diagnosis. As mentioned before, there are numerous modifying and risk factors to consider prior to evolving a diagnosis and a diagnosis-driven treatment plan.

Treatment Planning

Development of a logical and properly sequenced treatment plan is a derivative of the periodontal assessment and diagnosis. Periodontal therapy is diagnosis-driven and, to the extent possible, should address all modifying factors and risk factors that impact development and progression of plaque-induced periodontal disease. An overview of a typical periodontal treatment plan is presented in Table 4.[30]

Table 3. Clinical Criteria Assigned to Periodontal Case Types of Health, Gingivitis, Chronic Periodontitis (slight, moderate, and severe), and Aggressive Periodontitis.

Case Type		PD (mm)	BOP (Yes/No)	Bone Loss (%)	Mobility (Grade)	Furcations (Grade)	CAL (mm)	Visual Inflammation
0	(Health)	0-3	No	0	None	None	0	No
I	(Gingivitis)	0-4	Yes	0	None	None	0	Yes (localized or generalized)*
II	(Slight Chronic Periodontitis)†	4-5	Yes	10	I	1	1-2	Yes (localized or generalized)*
III	(Moderate Chronic Periodontitis)†	5-6	Yes	33	I and II	1 and 2	3-4	Yes (localized or generalized)*
IV	(Severe Chronic Periodontitis)†	≥ 6	Yes	> 33	I, II, or III	1, 2, 3, or 4	≥ 5	Yes (localized or generalized)*
V	(Aggressive Periodontitis)‡ (age is significant factor)	≥ 6	Yes	> 33	I, II, or III	1, 2, 3, or 4	≥ 5	Yes (localized or generalized)*

* Localized disease is defined as ≤ 30% of sites are involved; and generalized disease infers >30% of sites are involved.[21]

† Specialty referral may be indicated for additional treatment beyond initial therapy.

‡ Specialty referral should be considered.

Table 4. General Overview of the Major Steps in a Typical Periodontal Treatment Plan.[3]

Sequence of Major Phases
1. Address acute periodontal problems and/or pain
2. Review and update medical and dental histories
3. Assessment of systemic risk factors and refer for medical consultation as needed
4. Extraoral examination
5. Oral cancer evaluation
6. Assessment of periodontal risk and modifying factors
7. Periodontal examination to include dental implants
8. Dental examination to include occlusal relationships and dental implants
9. Radiographic examination
10. Establish a definitive diagnosis
11 Generate a diagnosis-driven periodontal treatment plan and sequence of treatment
12. Determine required adjunctive restorative, prosthetic, orthodontic, and/or endodontic treatments and sequence
13. Execute Phase I therapy (aka anti-infective or nonsurgical therapy) with consideration given to adjunctive use of chemotherapeutic agents
14. Re-evaluation (assessment) of Phase I therapy
15. If end-points are not achieved, consider selective retreatment, need for surgical therapy, specialty referral, or use of adjunctive diagnostic aides, eg, microbial, genetic, medical lab tests, etc.
16. Determine interval for periodontal maintenance and continued assessment of periodontal status

Implementation of Therapy

There are a wide variety of treatment options to be considered when confronted with gingivitis or chronic or aggressive periodontitis. However, thorough scaling and root planing (SRP) is still considered the gold standard in periodontal therapy. Beyond SRP, no one treatment modality is the answer in every case. However, the clinician must have specific endpoints or goals that therapy should achieve. If such endpoints are not achieved, then therapy must be re-evaluated and a decision made concerning retreatment or specialty referral for consideration of more advanced therapy options. Treatment options that should be considered include:[30]

- Patient education including plaque control and counseling in management of periodontal and systemic risk factors
- Scaling and root planing
- Consideration of adjunctive chemotherapeutic agents, eg, locally or systemically administered antibiotics and host response modification agents.
- Re-evaluation
- Consideration of referral to a specialist is an option that must be considered for both legal and ethical reasons.[31] There are a variety of reasons to consider referral to a periodontist, such as, SRP in the presence of extreme amounts of dental calculus or SRP with complications of systemic disease, gingival overgrowth and/or inflammatory hyperplasia, resective surgery, regenerative procedures for soft and hard tissues, periodontal plastic surgery, occlusal therapy, pre-prosthetic surgery, dental implants, management of perio-systemic complications, phobic patients requiring conscious sedation, etc.

Periodontal Maintenance Therapy and Continual Assessment

In general, data suggests that patients who have undergone definitive therapy for either localized or generalized periodontitis should be managed by periodontal maintenance (PM), performed at an interval of 3 months for an indefinite period of time following active therapy.[32] The 3-month interval is critical (and the standard of care for moderate and severe chronic periodontitis and aggressive periodontitis) as it has been repeatedly shown to be effective in reducing disease progression, preserving teeth, and controlling the subgingival bacterial burden.[33-35] Nonetheless, the PM schedule should be individualized and tailored to meet the needs of each patient. Factors such as home care, previous level of disease, tendency toward refraction, stability indicators, etc, should be used in making this assessment. More fragile patients may need intervals of 2 months or less, and conversely, patients intercepted in early disease states who demonstrate consistent stability may need less frequent intervals of 4-6 months. Regardless of the interval between appointments, the periodontal status of each patient should be re-evaluated at every maintenance appointment. Only through close monitoring can disease recurrence be detected and the maintenance interval adjusted accordingly. Continual assessment of the periodontium during maintenance affords the best opportunity for assuring long-term stability or providing interceptive care.[34,35]

Insurance Coding

The American Academy of Periodontology's Parameters of Care 2000[36] and the American Dental Association's Current Dental Terminology[37] are available to clinicians to guide decision-making related to providing therapeutic periodontal treatment and subsequent reporting of services for insurance reimbursement. In terms of nonsurgical periodontal therapy, familiarity with dental insurance codes provides a clear method to document treatment and select appropriate procedures to maximize insurance reimbursement for the patient.

Table 5 presents a modified description of the ADA insurance codes most commonly used in Phase I periodontal therapy (aka anti-infective therapy or nonsurgical therapy). The descriptions are intended to reveal distinctive differences between procedures, and guide the clinician in reimbursement procedures.

To simplify decisions made by patients, dental insurance should be referred to as "reimbursement," "benefit," or "assistance" by the clinician and other staff members rather than "coverage" since the word implies complete. Most patients with dental insurance will find it necessary to supplement whatever insurance benefit they receive toward lifetime periodontal care, as many plans have contract limitations for the percentage of reimbursement associated with various procedures and/or the length of time those benefits apply. For example, limitations of some insurance plans assign benefits for PM following SRP but only for 24 months following active therapy. As another example, exclusions found in other insurance plans assign benefits for SRP for generalized periodontal disease but not for localized infection. Many patients are reticent to proceed with treatment unless their insurance will "pay for it." Consequently, it is advantageous for practices to have clear explanations about the reality of dental insurance. Figure 2 presents a sample explanation of dental insurance that can

Understanding Dental Insurance

1. Dental insurance is a contractual agreement between the employer and insurance company. The percentage of reimbursement varies greatly dependent upon the premiums paid for a particular plan and limitations of the agreement.
2. Maximum payable benefits around $1000 - $1500 commonly found today with dental insurance plans are almost identical to the annual maximum benefit of dental insurance plans 40 years ago.
3. Dental insurance is a benefit designed to help defray the costs of quality dental care, but is not all-inclusive of what an individual may need or desire to obtain optimal dental health for a lifetime.

Figure 2. Facts about dental insurance to share with patients.

Table 5. Modified Description of ADA Insurance Codes Commonly Used for Phase I Periodontal Therapy (aka anti-infective therapy or nonsurgical therapy).

Code Number	Treatment Procedure	Description
D0180	Comprehensive Periodontal Evaluation	Indicated for new or established patients showing signs or symptoms of periodontal disease and for patients with risk factors such as smoking or diabetes. It includes evaluation of periodontal conditions, probing and charting, evaluation and recording of the patient's dental and medical history and general health assessment. It may include the evaluation and recording of dental caries, missing or unerupted teeth, restorations, occlusal relationships and oral cancer evaluation.
D1110	Adult Prophylaxis	Includes the removal of plaque, stain and calculus from tooth structures and is intended to control local irritation to gingival tissues, thereby preventing disease initiation.
D4355	Full Mouth Debridement to Enable Comprehensive Evaluation and Diagnosis	Initial removal of plaque and calculus that interfere with the ability to perform a comprehensive oral evaluation. This preliminary procedure is generally followed by a comprehensive periodontal evaluation for diagnosis and subsequent therapeutic periodontal procedures.
D4341	Scaling and Root Planing Generalized per Quadrant	Involves therapeutic treatment of 4 or more periodontally involved teeth per quadrant through definitive removal of subgingival plaque biofilm and root preparation in order to halt the disease from progressing, thereby creating an opportunity for healing. To be reported per quadrant inclusive of updated periodontal charting and radiographs for reimbursement.
D4342	Scaling and Root Planing Localized per Quadrant	Involves therapeutic treatment of 1 to 3 periodontally involved teeth per quadrant through definitive removal of subgingival plaque biofilm and root preparation in order to halt the disease from progressing, thereby creating an opportunity for healing. To be reported per quadrant with identification of specific teeth being treated inclusive of updated periodontal charting and radiographs for reimbursement.
D4381	Localized Delivery of Antimicrobial Agents via a Controlled Release Vehicle into Diseased Crevicular Tissue	Subgingival insertion of antimicrobial medications of a therapeutic concentration into periodontal pockets that are released over a sufficient length of time in order to suppress the pathogenic burden, and are intended to enhance the clinical results of scaling and root planing alone. To be reported per tooth, identifying multiple treatment sites per tooth, if indicated, inclusive of a narrative describing systemic considerations for reimbursement such as tobacco usage, diabetes, or heart disease.
D4999	Unspecified Periodontal Procedure, by Report	In the absence of a specific ADA code for complete periodontal re-assessment following definitive periodontal therapy, this procedure code is being utilized to determine healing response and future treatment recommendations.
D4910	Periodontal Maintenance	Follows the completion of active therapy to treat periodontal infection for the lifetime of the dentition or implant replacements and includes removal of plaque biofilm and calculus from supra and subgingival surfaces. It may also include site specific scaling and root planing for areas of localized disease recurrence. It is intended to keep periodontal diseases under control; therefore a patient may move from active therapy to periodontal maintenance and back to active therapy and/or referral during the lifetime of the dentition or implant replacements. It is not synonymous with prophylaxis, and is required at varying intervals to manage periodontal diseases and modify risk factors. To be reported by both general and periodontal practices on patients having undergone active therapy irrespective of where the procedure is performed. Current periodontal charting documenting the patient's on-going periodontal status should be submitted for reimbursement.

be shared with patients, assisting them in making independent decisions about treatment, regardless of the insurance reimbursement schedule.

Patient Education and Introduction to Periodontal Therapy

Effective implementation of the aforementioned concepts requires expertise in effective patient education and introduction of periodontal therapy so that patients are prepared to make wise health decisions. Being proficient in SRP procedures has little value to the patient who assumes they are visiting the dental hygienist for a "routine cleaning." This is particularly true if the patient already has a developing or existing periodontal infection and does not understand the need for therapeutic intervention. Chronic periodontal diseases often provide few noticeable symptoms, especially in earlier stages of development. Thus, the need for effective communication, education, and listening skills are of particular importance to today's dental patient.

The incidence of moderate and severe generalized chronic periodontitis in the US appears to affect only 5% to 15% of the adult population, whereas slight disease affects approximately 35% of the adult population.[13,14,38] Thus, most new patients and even many existing patients will ultimately be diagnosed with periodontal diseases. To be effective at enrolling patients into active therapy everyone in the practice setting must have a basic understanding of the etiology of periodontal diseases, treatment options, consequences of nontreatment, and direct benefits of therapy. Patients are more motivated to accept treatment recommendations when a clear diagnosis has been established, they are given the opportunity to see infection in their own mouths, their questions have been answered, and they understand the value of treating periodontal infection in relation to their overall health.

Many clinicians inform patients of their periodontal status while working in their mouths with sharp instruments, or give a summary of findings at the end of the visit. Most patients are visual learners. Consequently, patients need to see the condition of their own mouth. At the beginning of every appointment, during data collection and tissue assessment, the patient should be provided a mirror to visualize with the clinician the evidence of periodontal disease, caries, gingival recession, tooth mobility, furcation involvement, etc. (Figure 1). During periodontal probing, the patient should hear the pocket measurements as data is being collected and recorded. In a similar manner, during examination of the radiographs, the patient should be shown evidence of permanent bone loss, and contrast that to areas without bone loss. Involving the patient in the discovery process visually and audibly is a powerful tool to help patients take ownership in their own health.

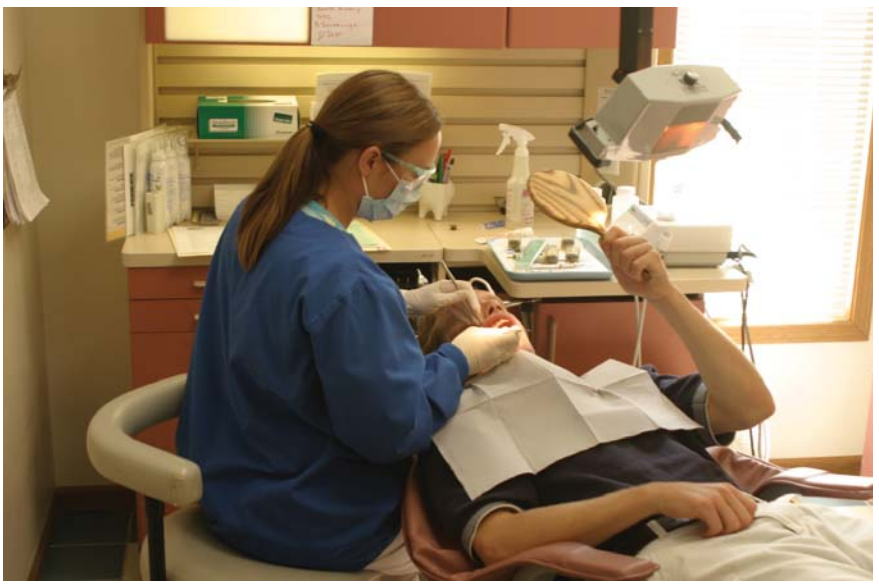


Figure 1. Dental hygienist showing patient periodontal conditions in patient's own mouth.

This is also an opportune time for the clinician to introduce adjunctive therapies to the patient such as the use of locally delivered antimicrobials and other agents. For example, the clinician can communicate that locally delivered antimicrobials have been on the US market for many years and have been shown to be a safe, effective treatment option. Important information to convey includes the ease of application; the high potency of the drug at levels that will kill bacteria; it does not affect the rest of the body; and there is no need for an additional appointment to remove the product since the agent biodegrades. Educating the patient to all of their treatment options is vital to clear and evidence-based communication.

Enhanced Communication Skills

Each clinician will develop his/her own style of case presentation for periodontal therapy and will individualize the message to different patients. However, there is significant advantage if the entire office staff has continuity in key words that are used when discussing periodontal therapy with patients. Equally important is the avoidance of minimizing messages such as "just a little bit of bleeding," or "a little bone loss," or "just a little bit of plaque." It is advisable to use language that does not trivialize conditions that are not yet severe. Terms such as "slight bleeding," "early bone loss," or "slight plaque" accurately describe findings without overstating them. Periodontal disease is a bacterial infection leading to a host immune response that is characterized by inflammation and degradation of periodontal tissues.[22] When informing patients of periodontal disease, using the word "infection" is more powerful than "gum inflammation" and can create a sense of urgency regarding treatment. The word "hemorrhage" indicates heavy bleeding and implies a condition outside healthy parameters. When the patient's gingival tissues hemorrhage easily upon provocation, "hemorrhage" rather than "bleeding gum tissue" should be verbalized to the patient. The words "scaling and root

Guide for Use of Locally Delivered Antimicrobials

Where to use locally delivered antimicrobials:

- Pockets ≥ 5 mm with bleeding on probing (BOP).
  - The locally delivered antimicrobial may be used at the time of scaling and root planing (SRP) or at the re-evaluation appointment 4-6 weeks following SRP. If used first at the re-evaluation appointment, the site must have additional SRP to remove biofilm and hard deposits that may have re-accumulated.
- Residual pockets of ≥ 5 mm with BOP or any site ≥ 6 mm following initial SRP.
  - Determined at re-evaluation appointment.
  - If ≥ 4 residual pockets in a given quadrant then consider either retreatment (SRP) with locally delivered antimicrobial or surgical intervention.
- Sites treatment planned for osseous grafting.
  - Locally delivered antimicrobial placed 3 weeks prior to surgical procedure.
- Periodontal abscess
- Probing depth at the distal-facial line-angle of 2nd molars related to 3rd molar extractions where surgical intervention will yield a compromised result.
- Ailing/failing dental implants (peri-implantitis) where surgical intervention is not indicated or will yield a compromised result.
- Grade II furcation involvements (shallow or deep) when surgical intervention is not planned.

Who might benefit from use of locally delivered antimicrobials:

- Periodontal maintenance patients with isolated probing depths of ≥ 5 mm that exhibit BOP or any pocket ≥ 6 mm (Figure 3).
- Patients wanting to avoid periodontal surgery.
- High risk surgery patients.
  - Poorly controlled (brittle) diabetic patients
  - Patients with a history of recent or recurrent coronary or cerebrovascular events.
  - Patients with a compromised immune system due to disease or medications.
  - Kidney dialysis patients.
  - Heavy smokers (>½ pack/day)
  - Patients with physical disability that impacts oral hygiene efficiency
  - Mentally handicapped patients
- Patient's with marginal oral hygiene that is not likely to improve and thereby represent a poor surgical risk.
- Please note that locally applied antimicrobials may need to be placed more than one time to achieve the desired result.

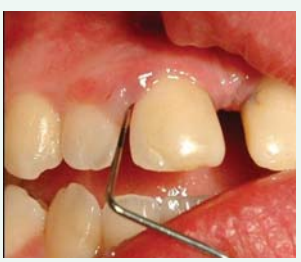


Figure 3. Pre-treatment clinical presentation showing PD of 6 mm

How to apply locally delivered antimicrobials:

- For optimal effect from locally delivered antimicrobials the following must be achieved:
  - Oral hygiene instructions and patient compliance regarding the necessary oral hygiene procedures, ie, tooth brushing, use of interdental hygiene aids such as dental floss and proxabrushes, and use of antimicrobial oral rinses.
  - Supragingival scaling and polishing.
  - Definitive subgingival SRP (generally under local anesthesia).
  - Place locally delivered antimicrobial according to manufacturer's directions. For example, in the case of minocycline microspheres, place one pre-measured dose per pocket. If the tooth has 2 pockets that need local delivery, 2 full doses should be administered.
  - The pocket should be as biofilm and deposit free as possible prior to insertion.
  - Insert the locally delivery product to the base of the pocket. In the case of minocycline microspheres, the tip should be placed as far into the pocket as possible before activating the syringe/handle (Figures 4 and 5).

Addendum:

- If probing depths are ≤ 4 mm, the clinician should consider a conventional adult prophylaxis coupled with oral hygiene recommendations and/or reinforcement.
  - If the patient exhibits multiple probing depths of 4 mm a periodontal maintenance interval of 3-4 months should be considered until it can be determined if the patient's periodontal status is stable and/or improving.

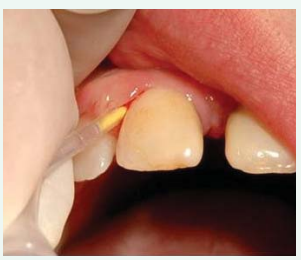


Figure 4. Initial Insertion of the pre-measured tip for administration of minocycline microspheres

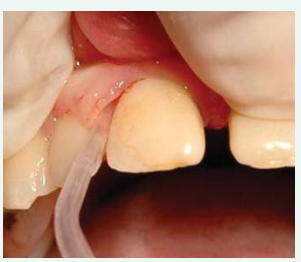


Figure 5. Tip placement to base of pocket for administration of minocycline microspheres.

planing" may sound confusing to patients or imply discomfort. The words "periodontal therapy" are effective semantic choices when informing patients about necessary periodontal treatment. "We now know" are words that can introduce patients to new ideas or treatment options to explain why information may be different than what they have heard in the past, or expected to hear at their current visit. "Halting" or "arresting disease" can be used to describe a measurable goal for treating periodontal diseases that should be obtained through intervention. "Daily disease control" communicates to the patient that they share in the role in the effective removal of plaque bacteria beyond what it achieve through periodontal treatment.

Even though some states require written consent, effective communication between the clinician and the patient is the important consideration of informed consent,[39] not the completion of a form. Therefore, deliberate semantic choices should be shared by all members of the office staff to optimize patient understanding of their periodontal conditions.

Suggestions for Implementation of a Periodontal Treatment Protocol in the General Practice Setting

- General dentists and dental hygienists should schedule a meeting with referring periodontists and their dental hygienists to share philosophies of periodontal treatment and establish clarity for referrals.
- Schedule a team meeting workshop to bring all office staff up-to-date regarding periodontal assessments, diagnosis, case types, periodontal risk factors, individualized treatment of periodontal diseases, consequences of nontreatment (tooth loss and possible systemic involvement), and the value of periodontal maintenance.
- Establish continuity of the verbal skills and terminology the office staff will utilize to communicate effectively to patients about periodontal conditions.
- Include assessments and diagnosis of periodontal diseases in all new patient visits, routine prophylaxis appointments, and ongoing periodontal maintenance to insure no patient is overlooked regarding diagnosis of developing periodontal disease or recurring disease.
- Select appropriate ADA Insurance Procedure Codes for reporting periodontal procedures in order to maximize the patient's benefit.
- Share insurance information with patients to assist them in reducing their dependence on dental insurance benefits, thereby enabling them to make independent health decisions related to treatment of periodontal diseases.

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Table 2. Periodontal Diagnostic Guidelines.

Case Indicator	Healthy	Gingivitis	Slight Periodontitis	Moderate Periodontitis	Advanced Periodontitis	Aggressive/Refractory
Pocket Depth[a]	≤ 3 mm	≤ 4 mm	4 - 5 mm	5 -6 mm	≥ 6mm	≥ 6mm
Bleeding Upon Probing	No	Yes[b]	Yes[b]	Yes[b]	Yes[b]	Yes[b]
Six-Point Probing	Yes	Yes	Yes	Yes	Yes	Yes
Bone Loss	None	None	≤ 10%	≤ 33%	≥ 33%	≥ 33%
Tooth Mobility[c]	None	None	None	≤ Grade II	≤ Grade III	≤ Grade III
Furcation[d]	None	None	≤ Grade I	≤ Grade II	≤ Grade III/IV	≤ Grade III/IV
Clinical Attachment Loss (CAL)[e]	None	None	1 - 2 mm CAL	3 - 4 mm CAL	≥ 5 mm CAL	≥ 5 mm CAL
Other	No inflammation	Only gingival tissues affected by the inflammatory process • No alveolar bone loss • Localized or generalized	Signs of inflammation may be present, including • Edema • Redness • Suppuration • Alveolar bone level is 3 - 4 mm from CEJ • Radiographic bone loss present • Localized or generalized	Signs of inflammation may be present, including • Edema • Redness • Suppuration • • Alveolar bone level is 4 - 6 mm from CEJ • • Radiographic bone loss present • Localized or generalized	Signs of inflammation may be present, including • Edema • Redness Suppuration • Alveolar bone level is ≥ 6 mm from CEJ • Radiographic bone loss present • Localized or generalized	Signs of inflammation may be present, including • Edema • Redness • Suppuration • Same clinical signs as advanced but includes adolescents or young adults • Localized or generalized • Rapid cycles of disease progression
Assessment	• Prophy • OHI	• Prophy • OHI	• Comp. Oral Eval D0150 • Comp. Perio Eval D0180 • Four bitewings D0274 • Eight bitewings D0277 • FMX D0210 • Panoramic Film D0330	• Comp. Oral Eval D0150 • Comp. Perio Eval D0180 • Four bitewings D0274 • Eight bitewings D0277 • FMX D0210 • Panoramic Film D0330 • Full Mouth Debride D4355 • Occlusal Analysis D9950	• Comp. Oral Eval D0150 • Comp. Perio Eval D0180 • Four bitewings D0274 • Eight bitewings D0277 • FMX D0210 • Panoramic Film D0330 • Full Mouth Debride D4355 • Occlusal Analysis D9950 • Specialty Referral	• Comp. Oral Eval D0150 • Comp. Perio Eval D0180 • Four bitewings D0274 • Eight bitewings D0277 • FMX D0210 • Panoramic Film D0330 • Full Mouth Debride D4355 • Occlusal Analysis D9950 • Specialty Referral
Active Therapy	• Prophy • OHI	• Prophy • OHI	• Quadrant SRP D4341 - UR, UL, LR, LL • Localized SRP D4342 - UR, UL, LR, LL • Locally Administered Antimicrobials D4381 • OHI D1330 • Specialty Referral • Other Treatments	• Quadrant SRP D4341 - UR, UL, LR, LL • Localized SRP D4342 - UR, UL, LR, LL • Locally Administered Antimicrobials D4381 • OHI D1330 • Specialty Referral • Other Treatments	• Quadrant SRP D4341 - UR, UL, LR, LL • Localized SRP D4342 - UR, UL, LR, LL • Locally Administered Antimicrobials D4381 • OHI D1330 • Specialty Referral • Other Treatments	• Specialty Referral
Ongoing Maintenance	6 Months • Prophy • OHI	6 Months • Prophy • OHI	• Perio Maintenance D4910 - 3/4/6 months • OHI D1330 • Locally Administered Antimicrobials D4381 • Localized SRP D4342 - UR, UL, LR, LL • Other Treatments	• Perio Maintenance D4910 - 3/4/6 months • OHI D1330 • Locally Administered Antimicrobials D4381 • Localized SRP D4342 - UR, UL, LR, LL • Other Treatments	• Perio Maintenance D4910 - 3/4/6 months • OHI D1330 • Locally Administered Antimicrobials D4381 • Localized SRP D4342 - UR, UL, LR, LL • Other Treatments	• Perio Maintenance D4910 - 3/4/6 months • OHI D1330 • Locally Administered Antimicrobials D4381 • Localized SRP D4342 - UR, UL, LR, LL • Host Modulation

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[a] Excluding gingival overgrowth and recession

[b] Bleeding upon probing may not be present in individuals with periodontal disease who are smokers.

[c] **Tooth Mobility**: *Grade I:* Slightly more than normal; *Grade II:* Moderately more than normal; *Grade III:* Severe mobility faciolingually and mesiodistally, combined with vertical displacement. Adapted from Newman MG, Takei H, Klokkevold PR, Carranza FA. *Carranza's Clinical Periodontology* 10th ed. Philadelphia, PA: Elsevier; 2006.

[d] **Furcation Grades**: *Grade I:* Initial attachment loss with most of the bone still intact in the furcation. No radiographic changes seen; *Grade II:* The bone defect is definite horizontal bone loss that does not extend all the way through. Vertical bone loss may also be present. There is an opening into the furca with a bony wall at the deepest portion. *Grade III:* Bone is lost across the whole width of the furcation so no bone is attached to the furcation roof; *Grade IV:* Bone loss across the furcation, accompanied with gingival recession at the furcation, is clinically visible. Adapted from Newman MG, Takei H, Klokkevold PR, Carranza FA. *Carranza's Clinical Periodontology* 10th ed. Philadelphia, PA: Elsevier; 2006.

[e] Adapted from Armitage GC. Development of a classification system for periodontal diseases and conditions. Ann Periodontol 1999; 4(l):1-6

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