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MANAGEMENT OF CHRONIC PERIODONTITIS IN GENERAL DENTAL OFFICE - CURRENT TRENDS

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ABSTRACT
Periodontal disease is an inflammatory condition that involves a complex interaction between pathogenic bacteria, environmental and acquired factors and host related factors. Till recently periodontal treatment was directed primarily towards reduction of bacterial load by subgingival debridement of root surfaces and modification of environmental risk factors. The current paradigm of periodontal disease stresses greater role of host-mediated inflammatory response in tissue destruction characteristic of periodontal disease. Various therapeutic modalities have been developed adjuvant to mechanical periodontal therapy. The use of laser and photodynamic therapy show great promise but their effectiveness has still not been conclusively proven. Chemotherapeutic agents, either systemic and local antimicrobials or host modulating drugs, played pivotal role in better and more predictable management of periodontal disease. The present review focuses on the best available evidence, for the current management of the chronic periodontal patients, gathered from systematic reviews and meta-analysis of mechanical non surgical periodontal therapy (NSPT) (subgingival debridement, laser therapy and photodynamic therapy) and the adjunctive chemotherapeutic approaches such as systematic and local antibiotics and antiseptics, subgingival pocket irrigation and host modulation therapies. The review also attempts to briefly introduce future developments in some of these modalities. At the end, the review summarizes the analysis of the current evidence that suggests that thorough subgingival debridement remains the mainstay of NSPT and that adjunct use of chemotherapeutic agents may offer better management of clinical parameters in periodontitis patients.

KEYWORDS: subgingival debridement, laser therapy and photodynamic therapy.

INTRODUCTION
Periodontal diseases are biofilm-mediated, chronic infectious diseases and are the most common cause of tooth loss in the modern world. According to data from the World Health Organization report gingival bleeding and calculus, which primarily reflects poor oral hygiene, are most prevalent in adults from all regions of the world while advanced disease with deep periodontal pockets (≥ 6 mm) affects approximately 10% to 15% of the adult population.[1]

Periodontitis involves a complex interaction between environmental (such as specific bacteria) and host (genetic and immunological) factors that leads to loss of periodontal attachment apparatus. The current paradigm of etiopathogenesis for periodontitis suggests that though periodontal diseases are pathogen and site specific, the host- microbial interactions leading to overproduction of destructive enzymes and pro-inflammatory mediators determine the extent and severity of tissue destruction.[2,3] This shift in paradigm has led to better understanding of the underlying host immune responses and to development of novel treatment strategies that may improve therapeutic outcomes and overall clinical management of periodontitis patients.

Treatment of periodontitis is directed primarily towards the reduction of pathogens embedded in the subgingival biofilm.[4] Non surgical periodontal therapy (NSPT) has been shown to improve probing pocket depths (PPD) and clinical attachment levels (CAL) in mild to moderate periodontitis cases with probing pocket depths of less than 6 mm.[5] In the treatment of deep pockets (> 6 mm) surgical periodontal therapy results in greater PPD reduction and clinical attachment gain.[5] Chronic periodontal disease can be successfully treated by NSPT provided adequate plaque control is maintained throughout the supportive phase of treatment.[6]

NSPT includes both mechanical and chemotherapeutic approaches to minimize or eliminate microbial plaque associated with the periodontal tissues, tooth surfaces and within other niches in the oral cavity[4,7], and to alter host immune-inflammatory response in the periodontal tissues.

Mechanical therapy refers to both supragingival and subgingival scaling and debridement of the roots by use of hand or power-driven scalers to remove local deposits such as plaque, calculus, endotoxins, and other plaque-retentive local factors.[8]

Chemotherapeutic approaches includes antimicrobial therapies that can be used systemically or locally to address changes in the microflora and host modulatory therapy that can be used to address altered host immune response consisting of excessive levels of pro-inflammatory enzymes, cytokines, and prostanoids and excessive osteoclast function that may be related to certain risk factors.[9]

Once the active bacterial challenge and host inflammatory reactions are controlled by surgical or nonsurgical therapy, it is imperative for the patient to maintain periodontal health with daily plaque control at home and periodic professional maintenance by the dentist or dental hygienist.[10,11]

Manual vs sonic or ultrasonic instrumentation

Manual instrumentation and sonic or ultrasonic scalers have been shown to be very effective in reducing the risk of tooth loss, slow down the rate of periodontal disease progression, reduce bleeding on probing and probing pocket depths and improve gingival health.[6,10] Us of hand scalers has been referred to as "gold standard" in mechanical periodontal therapy[16] but it is more time consuming, requires more skill, and is tiring for dentist and patients alike. On contrary, ultrasonic instrumentation improves patient compliance and requires less time for thorough debridement.

A systematic review of efficacy of machine-driven and manual subgingival debridement in chronic periodontitis concluded that ultrasonic/sonic subgingival debridement can be completed in less time compared to hand instruments, though the clinical efficacy remained similar. It further reported no major difference in the frequency and severity of adverse effects following the two treatment modalities.[17] Ultrasonic instrumentation when used on medium power settings has shown comparatively lesser root surface alteration and found to be more effective in furcation areas.[18] A new pain free ultrasonic system, Vector®, has been introduced few years back. It's a linear oscillating device that result in the parallel movement of the instrument tip to the root surface.[19] A systematic review concluded that clinical and microbiological effects of the Vector® system is comparable to power-driven and manual instrumentation in moderately deep pockets. However the system was found to be is less effective in deep pockets and was considerably more time consuming.[19]

A thorough review of nonsurgical periodontal therapy by Cobb *et al*[23] reported mean PPD reductions of 1.29 mm to 2.16 mm and CAL gains of 0.55 mm to 1.19 mm for initial probing depths of 4 mm to 6 mm or more than 6 mm before treatment in chronic periodontitis patients receiving sungingival debridement.[23,24]

Laser (Light amplification by stimulated emission of radiation)

The use of lasers has been advocated for past few years within the periodontal pocket for subginigival debridement, reduction of subgingival bacterial loads and scaling and root planing (SRP). But its clinical effectiveness in the treatment of periodontal diseases remains debatable among clinicians and there is dearth of clinical evidence for their benefit over traditional mechanical therapy.[28]

Among the different wavelengths of lasers compared with traditional mechanical therapy involving manual and sonic and ultrasonic instrumentation, the erbium-doped: yttrium-aluminum garnet (Er:YAG) laser is reported to be the most effective.[29] However, current evidence suggests that the clinical effectiveness of the Neodinium doped: yttrium-aluminum garnet (Nd:YAG)[30] or Er:YAG[31] laser was comparable to SRP in terms of clinical attachment gain, PPD reduction or change in gingival recession and that there was no added advantage of using lasers as a standalone therapy in treatment of chronic periodontitis.[30-32] Even in terms of reduction in subgingival putative pathogens use of the Nd:YAG or Er:YAG wavelengths was found to be equivalent and not superior to SRP.[33]

Photodynamic therapy

Antimicrobial photodynamic therapy (PDT) is a non-invasive therapeutic modality, which relies upon an oxygen-dependent photochemical reaction that occurs upon light mediated activation of a photosensitizing compound bound to the target cell. This reaction leads to the generation of cytotoxic reactive oxygen species, predominantly singlet oxygen[34,35] and hence can be very effective in anaerobic infections like periodontitis. The light source could be a low-power laser[36,37] or light emitting diodes.[38]

There are very few systematic reviews and well designed research published on clinical effectiveness of PDT over conventional periodontal therapy. A recent systematic review of seven randomized controlled trials (RCTs)[39] and another with five trials[40] concluded that the use of photodynamic therapy as a standalone therapy does not produce any beneficial clinical effect as compared to SRP. The review further noted that PDT as an adjunctive to SRP provides only short-term benefits. Finally both reviews recommended well-designed, long term RCTs as currently there is an insufficient evidence to suggest that PDT is superior to the conventional periodontal therapy.

CHEMOTHERAPEUTIC APPROACHES IN NON-SURGICAL PERIODONTAL THERAPY

Although mechanical non-surgical and surgical therapy continues to dominate other treatment approaches in the treatment of periodontal disease, its inability to

completely eliminate periodontal pathogens from the soft tissues and hard tissue surfaces and within other niches in the oral cavity may cause recolonization of these pathogens leading to reinfection.[1,2] To overcome these deficiencies in traditional periodontal therapy, adjunctive use of chemotherapeutic agents either systemically, locally or topically becomes an indispensible treatment modality.[2,8,9]

As the current paradigms in the etiopathogenesis of periodontal disease suggests greater role of host immune reaction to bacterial challenge in the ensuing periodontal tissue destruction, the newer chemotherapeutic approaches are focused on how to effectively modulate these host responses and lessen the degree of tissue destruction as well as help periodontal tissue regenerate and repair to a healthy state.[41]

Various chemotherapeutic approaches include use of antimicrobials and antiseptics via topical application, subgingival pocket irrigation, local delivery into the periodontal pocket and systemic administration.

Systemic antibiotic therapy

Systemic antimicrobials therapy as an adjunct to mechanical debridement has been advocated in past few decades, the rationale for their use being the suppression of periodontal pathogens persisting in biofilms in deep pockets, root furcations and concavities or residing within the periodontal tissues or other oral niches where mechanical therapy alone may prove to be ineffective. In particular the periodontal pathogen *A. Actinomycetemcomitans*, *Porphyromonas gingivalis* (*P. gingivalis*), *Prevotella intermedia* (*P. intermedia*), *Bacteroides forsythus* (*B. forsythus*), staphylococci and enteric rods has been reported to be difficult to eradicate with nonsurgical therapy alone.[42] While more than 500 bacterial species may be present in the gingival sulcus[43], it is clear that only a subset of bacterial species are consistently found to be associated with diseased sites.[44] These findings suggest that systemic antimicrobial therapy may prove an indispensible adjunct to mechanical therapy for efficient management of periodontal conditions that cannot be managed with mechanical therapy alone. These conditions may include severe or acute infections, aggressive periodontitis, and recurrent or refractory cases[45], (Table 2).

Common antibiotic regimens for the treatment of periodontitis are included in Table 3. Early approaches to systemic antibiotic therapy for periodontal treatment involved monotherapy with metronidazole, tetracyclines, doxycycline, amoxicillin (with or without clavulanic acid), spiramycin, clindamycin, and azithromycin.[45,46]

Since periodontitis is a polymicrobial infection, the heterogeneity of pathogenic bacteria necessitates use of drug combination therapies that can also be effective to overcome drug protective effects of biofilm.[47] Combination therapy should involve drugs with complementary but different mechanisms of action and synergistic or additive effect.[45] *In-vitro* experiments have reported synergistic effect of amoxicillin with metronidazole and ciprofloxacin with metronidazole against *A. actinomycetemcomitans* and other periodontal pathogens.[48,49] Combination therapy of amoxicillin with metronidazole has been the most well documented for adjunctive treatment of chronic and aggressive periodontitis.

Herrera *et al*[50] in a systemic review of 25 studies concluded that systemic antimicrobials in conjunction with SRP, can offer an additional benefit over SRP alone in the treatment of periodontitis, in terms of CAL and PPD change, and reduced risk of additional CAL loss. They further noted that patients with deep pockets, progressive or active disease, or specific microbiological profile, can benefit more from this adjunctive therapy. Haffaji *et al*[51] in a systematic review of 29 studies concluded that systemically administered antimicrobials were uniformly beneficial in providing an improvement in clinical attachment gain when used as adjuncts to scaling and root planing.

In a large multicenter randomized controlled trial, Goodson *et al*[52] reported that adjunctive systemic antimicrobial therapy with amoxicillin and metronidazole resulted in significantly more clinical attachment gain and PPD reduction in deep periodontal pockets (probing depth $\geq$ 5 mm) compared to SRP alone in chronic periodontitis patients. The results of recent systematic reviews involving aggressive periodontitis[53,54] and chronic periodontitis[53,55,56] also corroborate earlier findings of significant clinical attachment gain and reduction in PPD when systemic amoxicillin with metronidazole was administered with conventional periodontal therapy. Another recent systematic review of 43 studies utilizing different antibiotic regimens concluded that systemic antibiotics combined with SRP resulted in significant PPD reduction for initially moderate pockets at 3 mo (0.27 ± 0.09 mm), at 6 mo (0.23 ± 0.10 mm) and at 12 mo (0.25 ± 0.27 mm) and deep pockets at 3 mo (0.62 ± 0.17 mm), at 6 mo (0.58 ± 0.16 mm) and at 12 mo (0.74 ± 0.30 mm) though there was a trend that the magnitude of the clinical benefit became smaller over period of time (1 year).[56] The authors further conclude that clinical effects of metronidazole or metronidazole combined with amoxicillin resulted in clinical improvements that were more pronounced over doxycycline or azithromycin, though the difference was not statistically significant.[56]

The best available evidence indicates that systemic antimicrobials used in conjunction with SRP, can offer an additional benefit over SRP alone, in terms of CAL, and PPD change, especially in deep periodontal pockets. However it should be remembered that systemic antibiotics are an adjunct to mechanical periodontal therapy and should not be used as monotherapy. Their use should be restricted in severe or acute infections, aggressive periodontitis, and recurrent or refractory cases

that cannot be managed with other therapeutic modalities. The indiscriminate use of systemic antimicrobials can lead to development of antibiotic resistance among human pathogens. To reduce this risk, microbiological analysis and antimicrobial susceptibility testing is suggested for selecting the optimal antimicrobial therapy.[47]

Local antimicrobial delivery

Limited indications of systemic antimicrobial therapy and the risk-benefit ratio of their use led to development of local delivery of antimicrobial and antiseptics (LAD) directly in the periodontal pocket. The rationale of using LAD in periodontal disease is to chemically kill or reduce the plaques within the biofilm in the pocket by placing high concentrations of an antibiotic or antiseptic in direct contact with the root surface without noticeable systemic effect, which may not be always possible with systemic antibiotics. Sakellari *et al*[57] reported that gingival crevice fluid concentration of systemically administered antimicrobials tetracyclines was less than that of plasma concentration and vary widely among individuals (between 0 and 8 Lg/mL), with approximately 50% of samples not achieving a level of 1 Lg/mL. This possibly explains variable clinical response to systemic tetracyclines observed in clinical practice.

Various non-resorbable and resorbable intrapocket delivery systems have been developed. The first LAD agent developed for periodontitis was Actisite™, supplied as hollow, non-resorbable fibers filled with tetracycline (12.7 mg/9 inch fiber).[58] Though very effective, the non-absorbable fibers were tedious to insert in the deep pockets and required a second visit for retrieval from pocket. These deficiencies fuelled the development of absorbable systems for LAD.

Among the first absorbable system to be developed was Atridox™, which is a 10% formulation of doxycycline (50 mg in a bioresorbable gel system).The polymer gel fills and conforms to pocket morphology, then solidifies to a wax-like consistency upon contact with gingival crevicular fluid. Doxycycline is released at effective concentrations over 7 d, and significant reductions (60%) in anaerobic pathogens are sustained for up to 6 mo post treatment.[59]

The early success of Atridox™ led to development of other absorbable LAD systems such as minocycline microspheres (Arestin™), chlorhexidine gluconate chips (PerioChip™) and gel (Chlosite™), and metronidazol gel (Elyzol™).

Hanes *et al*[60] in a meta-analysis of 19 studies compared SRP and adjunctive local sustained-release agents with SRP alone. The authors concluded that local anti-infective agents resulted in significant adjunctive PPD reduction or CAL gain for minocycline gel, microencapsulated minocycline, CHX chip and doxycycline gel during SRP compared to SRP alone.

Bonito *et al*[61] in a subsequent systematic review, reported most positive results for tetracycline, minocycline, metronidazole, and CHX with modest but statistically significant improvements in PPD reductions compared with scaling and root planing alone. The authors did not report any significant changes in clinical attachment gain and questioned the clinical significance of these small improvements though they were statistically significant.

Subgingival pocket irrigation

Sub gingival irrigation of agents such as chlorhexidine digluconate, 10% povidone iodine (PI), and 0.1% sodium hypochlorite has been advocated in periodontal disease as they show excellent antibacterial and antiviral properties and are readily available.[65,66] They are also more effective in flushing out the bacteria and reducing gingivitis scores as it penetrates much deeper in to the pocket when compared to mouth rinses or suprgingival irrigation.[67]

Systematic reviews analysing the effect of subgingival irrigation with CHX[51] and PI[68] observed no additional clinical benefit to mechanical debridement for CHX irrigation[51] and a small but statistically significant effect of PI in probing depth reduction.[68] Consensus report of 6th European workshop on periodontal disease also concluded that the use of antiseptic irrigants has not shown any advantage over conventional periodontal therapy in periodontal diseases.[69] Current evidence suggests that subgingival irrigation is never intended to be used as a standalone therapy; rather it is meant to be used as an adjunct to professional debridement, but one that simplifies home-care oral hygiene for the patient.[70]

Topical antiseptic application

Topical application of antiseptics such CHX, povidone iodoine, phenolic compounds and sodium hypochlorite, with anti-plaque or anti-gingivitis action, has been suggested as useful oral hygiene aids to complement mechanical periodontal therapy. Though topical application seems to be of limited value, since it does not appreciably penetrate into the gingival crevice, they are useful adjuncts to control gingival inflammation, especially in acute conditions, post-surgically and during periods of interrupted hygiene.[71]

A recently published meta-analysis of 50 studies, of atleast 6 mo duration, reported clinically and statistically significant antiplaque and antigingivitis effect of dentrifices containing triclosan/copolymer formulations and mouthrinses with 0.12% CHX and essential oils-containing formulations [menthol (0.042%), thymol (0.064%), methyl salicylate (0.060%), and eucalyptol (0.092%)]. Statistically and clinically significant antigingivitis effect was reported with dentifrices containing stannous fluoride. The author concluded that the meta-analysis provided strong evidence in favor of the use of antimicrobial agents as adjuncts to mechanical plaque control.[72]

Certain disadvantages associated with long term use of mouthrinses include staining of teeth, mucositis and reversible epithelial desquamation, alteration of taste, and increased supragingival calculus.[73] Another important aspect of using topical antiseptics is that drugs should be in contact with periodontal pathogens at optimal concentration for optimal time period to exert bactericidal activity. For example, CHX must be in contact with *P. gingivalis* for 10 min at concentrations of 0.5% to 2%.[74] While povidone iodine, active against most bacteria, viruses, fungi and some spores, must be in contact with these pathogens for at least 5 min at concentrations between 0.5% and 10% to reach bactericidal activity/[75]

Full mouth disinfection

The full mouth disinfection (FMD) protocol was first proposed by Quirynen *et al*[76] in 1995 as a new therapeutic approach to eradicate or at least suppress all periodontal pathogens in a short time not only from the periodontal pockets but also the entire oropharyngeal cavity so that the recolonization of the pockets by bacteria residing at non-treated pockets and other oral sites is prevented. The purported advantages of the FMD approach include significant additional clinical and microbiological improvements, better outcome of the mechanical debridement, reduced need for surgery and more efficient treatment and time management with less overall chair-side time and less travelling or absence from work for the patient.[77]

Full-mouth disinfection involves removal of all plaque and calculus in two visits within 24 h. In addition, at each of these visits, the tongue was brushed with a 1% CHX gel for one minute, CHX spraying on tonsils and the mouth rinsed with a 0.2% CHX solution for two minutes. Furthermore, subgingival CHX (1%) irrigation was performed in all pockets. The recolonization of the pockets was retarded by oral hygiene and 0.2% CHX rinses during two weeks.[76]

Two systematic reviews of 7 studies each, comparing full-mouth scaling and root planing within 24 h with antiseptics (FMD) or without (FMS) the adjunctive use of an antiseptic (chlorhexidine) with conventional quadrant scaling and root planning as control, concluded that in patients with chronic periodontitis, only minor differences in reduction in PD and CAL were observed in moderately deep pockets between the treatment strategies.[78,79]

CONCLUSION

Non-surgical periodontal therapy continues to evolve and newer therapeutic modalities are being developed to make the outcomes more predictable and last longer. Past two decades have witnessed publication of some excellent systematic reviews on NSPT that has helped formulate novel treatment regimens to combat periodontal infection and restore tissue homeostasis. Current best evidence suggest that: (1) NSPT results in superior clinical outcomes as compared to surgical therapy in periodontitis patients with moderate pocket depth (≤ 5 mm); (2) Thorough mechanical periodontal therapy (manual and ultrasonic debridement) remains a gold standard resulting in significant resolution of periodontal inflammation leading to improvement in the clinical signs and symptoms of active disease. But it may be insufficient for complete elimination of putative pathogens that may cause reinfection; (3) Adjunctive use of lasers or photodynamic therapy in the treatment of periodontitis does not result in superior clinical effects compared to that achieved by conventional mechanical therapy alone; (4) Systemic and local antimicrobials used in conjunction with SRP offer additional benefits in terms of CAL and PPD change, especially in patients with deep periodontal pockets, and aggressive or refractory periodontitis. The clinical effects are modest with LAD; (5) Full mouth disinfection result in clinical benefits comparable to that achieved by full mouth scaling without antiseptics and conventional staged debridement; (6) Host modulation therapy specifically with SDD results in better clinical effects when used as an adjunct to mechanical therapy. Development of newer formulations and novel therapeutic strategies may result in faster resolution of periodontal inflammation and help in regeneration of periodontal attachment apparatus; and (7) Daily oral hygiene maintenance coupled with frequent recall visits by patients is vital for long-term success of NSPT.

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