



Evaluation of Herbal Chip as an Adjunct to Scaling and Root Planing in the Management of Chronic Periodontitis: A Systematic Review

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<p>KEYWORDS</p> <p>Local Drug Delivery, Herbs, Periodontitis</p>	<p>ABSTRACT:</p> <p>Background: Chronic periodontitis represents a biofilm-mediated inflammatory disease characterized by the slow and continuous destruction of periodontal supporting tissues. Scaling and root planing (SRP) is the primary approach in nonsurgical periodontal treatment, however, complete eradication of subgingival pathogens is often not achieved. Herbal chips have emerged as a promising adjunctive local drug delivery system offering antimicrobial benefits.</p> <p>Aim: To assess efficacy of herbal chips as adjuncts to SRP in improving clinical periodontal parameters compared to SRP alone.</p> <p>Methods This systematic review was carried out following the PRISMA 2020 statement and the Cochrane Hand book guidelines. Electronic and manual searches were conducted across Pub Med, Scopus, Google Scholar, and Cochrane Library databases to identify randomized controlled trials (RCTs) evaluating herbal chips as adjuncts to SRP. The outcomes assessed were Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) with primary importance for PPD and CAL. The risk of bias for the included studies was appraised using the Cochrane Risk of Bias 2.0 tool.</p> <p>Results: 356 RCTs published between 2010 and 2025 are recorded, out of which 10 RCTs were included. Across all studies, adjunctive use of herbal chips demonstrated marked reductions in Plaque Index (PI), Gingival Index (GI), and Probing Pocket Depth (PPD), along with gains in Clinical Attachment Level (CAL), relative to SRP alone.</p> <p>Conclusion: Herbal chips improve the clinical efficacy of Scaling and root planning. Neem-based chips were the most extensively studied and showed consistent clinical benefits. Other herbal agents such as Turmeric, Thymoquinone, Mimulus elengi, <i>Salvadora persica</i> <i>Achyranthes aspera</i> also demonstrated favourable results.</p>
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1. INTRODUCTION

Periodontitis is a multifactorial inflammatory disease affecting the supporting structures of the teeth, leading to gradual loss of attachment and alveolar bone. The primary etiologic factor is dental plaque biofilm, but the host inflammatory response also plays crucial roles.¹ Periodontal diseases increase the body's overall inflammatory burden by modulating and amplifying the immune-inflammatory response.²

The primary approach for managing periodontal disease is SRP, which remains cornerstone of treatment as it to reduce or eliminate subgingival pathogenic microorganisms.^{3,4} SRP, the main component in nonsurgical periodontal therapy (NSPT) show improvement in clinical periodontal parameters.⁵ However, conventional SRP cannot remove pathogenic microorganisms completely, particularly in inaccessible areas such as furcations, deep pockets, and root concavities. To address these limitations, drug delivery systems have been developed to enhance therapeutic outcomes by incorporating agents that promote bone and tissue regeneration.⁶

Drug delivery can be achieved through either systemic or local administration. Systemic administration requires high doses to reach effective concentrations at the target site, which may cause adverse effects such as gastrointestinal disturbances, microbial dysbiosis, drug resistance, and poor biodistribution.⁷

To overcome these drawbacks, *Dr. Max Goodson* introduced the concept of local drug delivery (LDD) systems in 1979. LDD aims to deliver antimicrobial agents directly into the periodontal pocket, allowing for immediate or sustained drug release. This method offers several advantages, including minimal invasiveness, targeted drug application, improved therapeutic efficacy, reduced dosage and frequency, and the absence of systemic side effects or first-pass metabolism.⁸ Several locally delivered agents have been successfully used in periodontal therapy, including tetracycline fibers,⁹ 10% doxycycline,^{10,11} 2% minocycline, metronidazole,^{12,13} and chlorhexidine gluconate,¹⁴ although none are completely free of side effects. Herbal medicine utilizes plant-derived constituents with proven therapeutic properties. Unlike synthetic antimicrobial agents that often lead to resistance, natural phytochemicals are considered safer and biocompatible alternatives for periodontal therapy.¹⁵

Herbal chips offer distinct advantages over gel-based local drug delivery (LDD) systems in periodontal therapy. Unlike gels, which may be easily washed away by saliva or gingival crevicular fluid, chips provide prolonged retention in the periodontal pocket, allowing for sustained and controlled drug release over days to weeks. This results in improved bioavailability of the active agents at the target site and enhanced clinical efficacy in reducing dental plaque, inflammation of gingiva, pocket depth, and promoting clinical attachment gain.¹⁶ Herbal chips are often biocompatible, biodegradable, and minimally invasive, eliminating the need for repeated applications and reducing patient discomfort. Additionally, the use of natural phytochemicals in chips minimizes the risk of antimicrobial resistance and systemic side effects, which are sometimes associated with synthetic gels. Finally, chips can be precisely dosed and easily standardized, offering predictable therapeutic outcomes compared to gels, whose distribution and retention can be unpredictable. Thus, the present review conducted to evaluate the efficacy of herbal chips as adjunct to scaling and root planing in the management of chronic periodontitis.

2. MATERIALS AND METHODS

Protocol registration

The protocol for this systematic review was documented in the PROSPERO registry (CRD420251167193) and was conducted with respect to the PRISMA 2020 recommendations.

Focused Question and Null Hypothesis

This systematic review was based on the main question: *Are herbal chips effective as local drug delivery agents when used adjunctively with SRP compared to SRP alone or with placebo.* The null hypothesis assumed no significant variation in clinical parameters including PI, GI, PPD, CAL between patients treated with herbal chips adjunctive to SRP and those treated with SRP alone or with placebo.

PICO Framework

The PICO framework for this systematic review was defined as follows: **Population (P):** patients with chronic periodontitis; **Intervention (I):** herbal chips as local drug delivery agents adjunctive to SRP; **Comparison (C):** SRP alone or with placebo; **Outcome (O):** improvement in PI, GI, PPD, CAL



Search Strategy

An electronic search was conducted by using Mesh terms with Boolean Operators in Pub Med, Scopus, Google Scholar, and Cochrane Library databases up to May 2025 using keywords with Boolean operators: “herbal chip,” “local drug delivery,” and “scaling and root planing.” Reference lists of retrieved articles and relevant journals were manually searched to identify additional studies.

Eligibility Criteria

Randomized controlled trials (RCTs) assessing herbal chips as an adjunct to scaling and root planing (SRP) in chronic periodontitis were included in this systematic review, involving subjects for a minimum follow-up period of three weeks. Included studies were required to report either of these clinical periodontal parameters, including PI, GI, PPD, CAL with primary importance related to PPD, CAL. Animal or in vitro studies, investigations involving non-herbal chips or systemic herbal medications, and exclude non-original research articles.

Data Extraction and Synthesis

Based on author, year, study type, sample size, study groups, intervention, duration, and outcome parameters data was extracted. A qualitative synthesis was carried out, with outcomes compared descriptively among different herbal agents.

Characteristics of the study outcomes

The included studies primarily evaluated clinical periodontal outcomes following the use of herbal chips as adjuncts to scaling and root planing (SRP). The most commonly assessed parameters were PI, GI, PPD, CAL. Some studies additionally reported bleeding on probing (BOP) and gingival bleeding indices, reflecting improvements in soft tissue inflammation and overall periodontal health. Follow-up periods among the trials ranged from 3 weeks to 3 months, with noticeable improvements reported as early as 3–4 weeks after intervention.

Quality Assessment

The included randomized controlled trials were evaluated for methodological quality using the Cochrane Risk of Bias 2.0 (RoB 2.0) tool, which examines five primary domains of bias.

3. RESULTS

Study Screening and Selection

According to prisma guidelines an initial electronic search in databases were recorded in PubMed, Scopus, Google Scholar, and Cochrane Library databases. 356 randomized controlled trials published between 2010 and 2025 are analyzed, 264 duplicates were excluded and 19 full text articles were screened for eligibility of which 9 not included due to lack of clinical parameters and nonchip formulations. Finally, 10 articles were analyzed encompassing 897 periodontal sites. Figure 1 shows PRISMA flow chart.¹⁷

Included studies durations ranged from 21 days to 3 months. Herbal chips evaluated included Neem, Turmeric, Thymoquinone, *Achyranthes aspera*, *Mimusopselengi*, and *Salvadora persica*. Table 1 presents summary of the included studies.

Several herbal chips have demonstrated consistent benefits as adjunct to scaling and root planing (SRP) in managing chronic periodontitis.

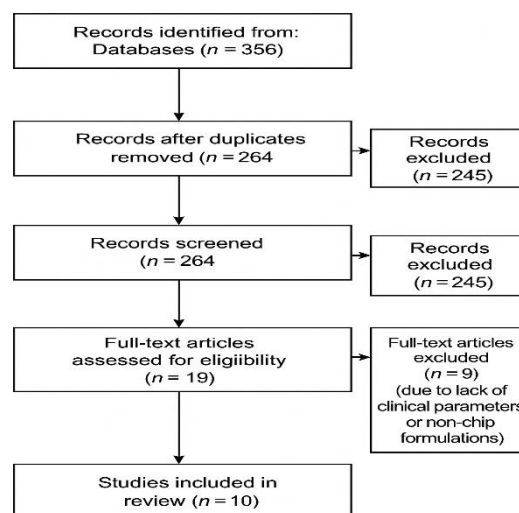


Figure 1 shows PRISMA flow chart

Neem chips showed significant and consistent improvements across multiple studies in PI, GI, PPD, CAL compared to SRP alone (Sanjeev Jain et al.¹⁸ (2012), Vineela K et al.²⁰ (2016); Saini et al.²²(2021), Ganvir et al.²³ (2022), Prasanna et al.²⁷ (2025). Turmeric chips similarly produced favorable outcomes, particularly in reducing gingival inflammation and pocket depth, with effect sizes comparable to those observed with neem (Abhilasha Singh et al.²¹ (2017) Saini et al. (2021). Thymoquinone chips demonstrated



superior reductions in PPD and greater CAL gain relative to both SRP alone and plain chitosan chips (Bayaty et al.¹⁹ (2013). *Achyranthes aspera* (Jishna Arora et al.²⁴ (2023) and *Mimusops elengi* chips (Udhya A.S. et al.²⁵ (2024) achieved clinical improvements similar to other herbal agents, indicating reproducible

efficacy across different phytochemicals. Additionally, *Salvadora persica* and benzyl isothiocyanate (BITC) chips showed marked reductions in gingival inflammation and bleeding indices (Bayaty et al.²⁶ (2024). Across all studies, adjunctive herbal chips led to statistically significant improvements in PPD

Table 1: General Characteristics of Included Studies

Author and Year	Type of Study	Sample Size	Study Groups	Intervention	Study Duration	Parameters
Sanjeev Jain et al., 2012	RCT	60 sites	2 Group I SRP Group II SRP +Neem chip	SRP +Neem chip	Baseline, 6 weeks, 3 months	Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), Clinical Attachment Level (RAL)
Bayaty et al., 2013	RCT	180 sites	3 Group one- SRP Group two -SRP+ Plain chitosan chips Group three - SRP+ Thymoquinone	SRP+ Thymoquinone Chip	Baseline 60 days	Gingival Index (GI), Probing Pocket Depth (PPD), Relative Attachment Level (RAL)
Vineela K et al., 2016	RCT	40 Sites	2 Group I SRP Group II SRP +Neem chip	SRP +Neem chip	Baseline, 7 th day, and 21 st day.	Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), Relative Attachment Level (RAL), Sulcus Bleeding Index (SBI)
Abhilasha Singh et al., 2017	RCT	120 sites	3 Group A Chlorhexidine Group B SRP+ Turmeric chip Group C SRP	SRP+ Turmeric chip	Baseline, 1 Month, 3 Months	Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), Relative Attachment Level (RAL)
Saini K et al., 2021	RCT	90 sites	3 Group I with SRP + neem chip Group II with SRP + turmeric chip Group III received SRP only.	SRP+ Neem chip + SRP Turmeric chip + SRP	Baseline, 1 Month, 3 Months	Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), Relative Attachment Level (RAL)
Ganvir et al., 2022	RCT	42 Sites	3 Group I with SRP Group II with SRP + Neem chip Group III SRP + Laser	SRP + Neem chip	Baseline, 21 days 30 days	Plaque Index (PI), Papillary Bleeding Index (PBI), Probing Pocket Depth (PPD), Relative Attachment Level (RAL)
Jishna Arora et al., 2023	RCT	60 sites	2 Group A <i>Achyranthes</i>	SRP+ <i>Achyranthes aspera</i> chip + SRP	Baseline 3 Months	Gingival Index (GI), Probing Pocket Depth



			aspera chip + SRP Group B Only SRP			(PPD) Relative Attachment Level (RAL)
Udhya A S et al., 2024	RCT	60 Sites	2 Test Group SRP + Mimusopelengi herbal chip Control Group Only SRP	SRP + Mimusopelengi herbal chip	Baseline, 21 days 45 days	Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD) Clinical Attachment Level (RAL)
Bayaty et al., 2024	RCT	240 sites	4 the control group; group 2 (plain chitosan chip); group 3 (S. persica extract); and group 4 (BITC extract).	SRP+ Salvadora persica	Baseline, 60 days	Plaque Index (PI), Bleeding Index , Probing Pocket Depth (PPD) Clinical Attachment Level (RAL)
Prassanna et al., 2025	RCT	45 Sites	3 Group I–SRP alone, Group II–SRP and CHXC, and Group III–SRP and Neem Chip	SRP and Neem Chip	Baseline, 10 th days 1 month	Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD) Clinical Attachment Level (RAL)

and CAL compared to SRP alone, indicating enhanced periodontal healing.

The risk of bias assessment results done by Cochrane Risk of Bias tool (RoB 2.0), and presented in Figure 2. All studies exhibited a less risk of bias in **Domain 1** indicating appropriate randomization procedures and adequate allocation concealment. Minor risks are observed in **Domain 2** studies (Sanjeev Jain et al., 2012; Abhilasha Singh et al., 2017; Ganvir et al., 2022; Prasanna et al., 2025), possibly due to incomplete blinding or uncertainties regarding adherence to the assigned interventions.

In **Domain 3** all studies except *Vineela K et al. (2016)* were rated as low risk, with this study showing a major risk of bias because of incomplete or selectively reported factors. **Domain 4** showed consistently low risk across all trials, indicating objective outcome measurement and proper blinding of outcome assessors. For **Domain 5** most studies demonstrated low risk, although *Sanjeev Jain et al. (2012)* and *Vineela K et al. (2016)* with minor concerns, suggesting possible selective reporting.

Overall, eight studies showed less risk of bias, *Sanjeev Jain et al., 2012 study* is having some concerns, and one study (*Vineela K et al., 2016*) with major risk of bias. Collectively, these findings indicate that the studies included in present systematic review is methodologically robust, with only minimal limitations

that are unlikely to substantially affect the reliability of the conclusions.(Figure 2)

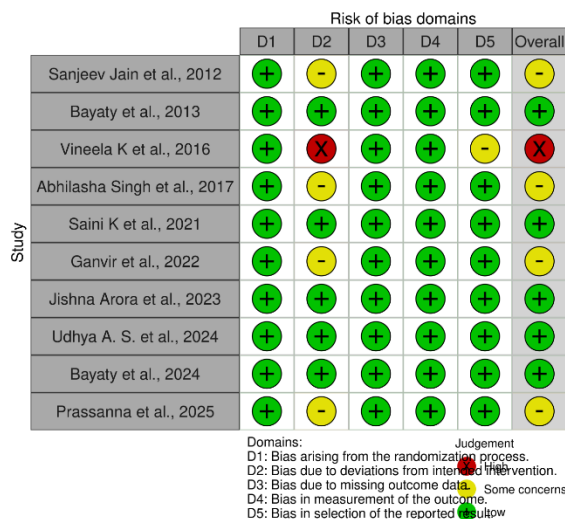


Figure 2: Quality assessment

4. DISCUSSION

Medicinal plants and herbal products have been reported to improve a variety of clinical outcomes in oral health, including reductions in gingival inflammation, probing pocket depth, and microbial load. Consistent with this, the majority of included studies demonstrated that herbal chips as



adjuncts to SRP produced significant improvements in gingival index, plaque index, probing depth reduction, and clinical attachment gain, compared to SRP alone or placebo.

The overall methodological quality of the included studies, as assessed using the Cochrane Risk of Bias 2.0 tool, ranged from low to moderate risk of bias. Specifically, 6 studies (60%) were judged to have a low risk of bias, while 4 studies (40%) demonstrated some concerns, primarily related to deviations from intended interventions or incomplete reporting of blinding and allocation concealment.

Phytotherapy or herbal medicine has gained increasing attention as alternative therapeutic approaches in the management of periodontal diseases. Phytotherapy has been adopted to reduce symptoms and improve patient's quality of life, offering advantages such as low cost, accessibility, and minimal adverse effects. Similarly, the incorporation of herbal agents into local delivery systems has provided a biologically acceptable and cost-effective approach to managing periodontal inflammation.

Systemic drug administration remains a conventional route for antimicrobial therapy but often carries disadvantages such as antibiotic resistance, gastrointestinal disturbances, dysbiosis, and limited drug concentration at the periodontal site. In contrast, local drug delivery systems including herbal chips offer the benefit of sustained and site-specific release of active agents with minimal systemic exposure. Results of present study emphasize topical herbal formulations as safe and effective alternatives to systemic drugs in periodontal therapy.

Total of 10 RCTs, encompassing 897 periodontal sites, were included in the qualitative synthesis in the present study. No prior systematic reviews have comprehensively assessed focusing specifically on herbal chip formulations based on medicinal plants for periodontal therapy.

A wide range of herbal plants have been explored for chip formulation, including *Azadirachta indica* (Neem), *Curcuma longa* (Turmeric), *Nigella sativa* (Thymoquinone), *Achyranthes aspera*, *Mimusops elengi*, and *Salvadora persica*. These plants exhibit diverse pharmacological activities antimicrobial, antioxidant, and anti-inflammatory wound-healing effects that synergistically contribute to periodontal tissue health. Despite variations in

formulation, dosage, and evaluation period, the overall clinical trend favored the adjunctive use of herbal chips with SRP in managing chronic periodontitis.

This systematic review consolidates the evidence supporting herbal chips as effective adjuncts to SRP in managing chronic periodontitis. Neem (*Azadirachta indica*) was the most frequently evaluated herbal agent due to its well-established antibacterial, anti-inflammatory, and antioxidant properties. The bioactive components including azadirachtin, nimbidin, and quercetin exhibit broad-spectrum antimicrobial activity against periodontal pathogens such as *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*,

Several in vitro and in vivo studies have demonstrated the antimicrobial and anti-inflammatory potential of the herbal plants used as adjuncts in periodontal therapy. *Neem* (*Azadirachta indica*) exhibits antibacterial activity against *Porphyromonas gingivalis* and *Fusobacterium nucleatum* and reduces oxidative stress in periodontal tissues.²⁹ *Turmeric* (*Curcuma longa*) and its active compound curcumin inhibit key periodontal pathogens and reduce local inflammation when applied as gels.³⁰ *Achyranthes aspera* shows antibacterial effects against oral pathogens and anti-inflammatory activity in animal models.³¹ *Mimusops elengi* extracts have demonstrated both antimicrobial and anti-inflammatory properties, supporting their use in periodontal management.³² *Salvadora persica* (miswak) exhibits significant antibacterial activity against oral and periodontal pathogens and improves clinical outcomes when delivered locally.³³ These laboratory and preclinical findings provide a biological rationale for the clinical efficacy observed in the RCTs included in this review.

Herbal plants have been reported to improve a variety of clinical outcomes in oral health, including reductions in gingival inflammation, probing pocket depth, and microbial load. Amanpour S et al conducted a systematic review to assess the effectiveness of medicinal plants and herbal products in promoting oral health among adolescents. They concluded herbal interventions demonstrated beneficial outcomes with minimal adverse effects, supporting their potential role in preventive and therapeutic oral health care. Consistent with Amanpour S et al systematic review, the majority of present included studies demonstrated that herbal chips adjuncts to SRP produced significant improvements in PI, GI, PPD, CAL compared to SRP alone.³⁴



The consistent reduction in plaque accumulation, gingival inflammation, probing depth, clinical attachment level across different herbal agents underscores the multifactorial benefits of herbal chips. The biodegradable chitosan or gelatin-based carriers further facilitate sustained release and better pocket retention, improving therapeutic outcomes.

However, the reviewed studies vary in sample size, duration, and formulation methods, which may limit direct comparison. Few studies included microbiological analysis or long-term follow-up, and none evaluated adverse effects systematically. Standardization of herbal concentration, chip composition, and clinical evaluation periods is necessary for future research.

5. CONCLUSION

Herbal chips used as adjuncts to SRP demonstrate significant improvement in clinical parameters compared to SRP alone. Among the various agents, Neem and Turmeric chips exhibit the most consistent benefits, followed by Thymoquinone, *Mimusopselengi*, *Achyranthes aspera*, and *Salvadora persica*. The findings suggest that herbal chips are promising, safe, and cost-effective alternatives to conventional local drug delivery systems. Long-term, multicenter RCTs with standardized formulations and microbiological assessments are recommended to establish clinical guidelines for their use.

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