ORIGINAL ARTICLE

CURCUMIN AS AN ADJUNCTIVE THERAPY IN PERIODONTAL TREATMENT: AN OVERVIEW OF SYSTEMATIC REVIEWS AND ITS POTENTIAL CLINICAL BENEFIT IN OLDER ADULTS

CURCUMINA COMO TERAPIA ADJUVANTE NO TRATAMENTO PERIODONTAL: SÍNTESE DE REVISÕES SISTEMÁTICAS E POTENCIAL BENEFÍCIO CLÍNICO NO PACIENTE IDOSO

Marcio Augusto Gonçalves Coelho[1], Bruno Bittencourt Pereira[1], Tarsila Cotta Campos[2]

ABSTRACT

Curcumin, a bioactive polyphenol derived from *Curcuma longa*, exhibits anti-inflammatory, antioxidant, and antimicrobial properties that support its potential use as an adjunctive therapy in chronic inflammatory diseases, including periodontitis. This study aimed to evaluate, through an overview of systematic reviews, the efficacy of topically applied curcumin as an adjunct to non-surgical periodontal treatment and discuss its potential clinical benefit in older adults. A structured search was conducted in PubMed and Google Scholar, including systematic reviews published between 2021 and 2025 that exclusively assessed topical curcumin formulations in humans with periodontal disease. Six systematic reviews met the eligibility criteria, most of which included meta-analyses. Overall, the reviews reported statistically significant reductions in probing pocket depth, clinical attachment level gain, and improvements in plaque, gingival, and bleeding indices. In addition, antimicrobial and immunomodulatory effects associated with curcumin use were described. However, substantial methodological heterogeneity was observed among the included primary studies, with variations in formulations, application protocols, follow-up periods, and a limited number of randomized controlled trials, which restricts the strength of the evidence. In conclusion, topically applied curcumin appears to be a promising adjunctive therapy in non-surgical periodontal treatment and may represent a clinically relevant option, particularly in populations with a higher prevalence of periodontal disease and difficulties in mechanical plaque control. Nevertheless, its clinical use should be interpreted with caution until more robust and standardized clinical studies become available.

Keywords: Curcumin; Periodontitis; Non-surgical periodontal therapy; Adjunctive therapy; Topical administration; Systematic review.

RESUMO

A curcumina, polifenol bioativo derivado da *Curcuma longa*, apresenta propriedades anti-inflamatórias, antioxidantes e antimicrobianas que fundamentam seu potencial uso como adjuvante terapêutico em doenças inflamatórias crônicas, incluindo a periodontite. Este estudo teve como objetivo avaliar, por meio de uma síntese de revisões sistemáticas, a eficácia da curcumina tópica como adjuvante ao tratamento periodontal não cirúrgico, e discutir o seu potencial benefício clínico no paciente idoso. Foi realizada busca nas bases PubMed e Google Scholar, incluindo revisões sistemáticas publicadas entre 2021 e 2025 que investigaram exclusivamente o uso tópico da curcumina em humanos com doença periodontal. Seis revisões sistemáticas preencheram os critérios de elegibilidade, sendo a maioria acompanhada de meta-análises. De modo geral, os estudos relataram reduções estatisticamente significativas na profundidade de sondagem, ganho de inserção clínica e melhora dos índices de placa, gengival e de sangramento, além de efeitos antimicrobianos e imunomodulatórios. Entretanto, observou-se elevada heterogeneidade metodológica entre os estudos primários incluídos, com variações nas formulações, protocolos de aplicação, períodos de acompanhamento e número limitado de ensaios clínicos randomizados, o que restringe a robustez das evidências. Conclui-se que a curcumina tópica demonstra potencial como terapia adjuvante no tratamento periodontal não cirúrgico, podendo representar alternativa de interesse clínico, especialmente em populações com maior prevalência da doença e dificuldades no controle mecânico do biofilme, embora seu uso deva ser interpretado com cautela até que estudos clínicos mais robustos e padronizados estejam disponíveis.

Palavras-chave: Curcumina; Periodontite; Desbridamento periodontal não cirúrgico; Terapia complementar; Administração tópica; Revisão sistemática.

[1] Odontoclínica Central da Marinha, Marinha do Brasil, Rio de Janeiro, RJ, Brazil.
[2] Policlínica Naval de Manaus, Marinha do Brasil, Rio de Janeiro, RJ, Brazil.

How to cite this article: Coelho MAG, Pereira BB, Campos TC. Curcumin as an adjunctive therapy in periodontal treatment: an overview of systematic reviews and its potential clinical benefit in older adults. Rev Nav Odontol. 2026;53(1): e202607.

Received on: 02/07/2026
Accepted on: 07/14/2026

DOI: https://doi.org/10.22491/1983-7550-53-1-07

INTRODUCTION

Periodontal disease (PD) is a chronic inflammatory condition of dental supporting tissues, triggered by bacterial biofilm, which can result in clinical attachment loss and tooth loss when not adequately treated, being among the most prevalent chronic conditions worldwide. In addition to local impact, PD has been associated with relevant systemic repercussions, such as an increased risk of cardiovascular diseases, decompensation of diabetes mellitus, and even gestational complications (1-3).

Turmeric (Curcuma longa), a plant traditionally used in Ayurvedic medicine, contains curcumin as its main bioactive component, a polyphenol responsible for its therapeutic properties (4,5). Experimental and clinical studies demonstrate that curcumin has an anti-inflammatory effect, mediated by the modulation of molecular pathways such as NF-κB and COX-2, reducing the production of pro-inflammatory cytokines (IL-1β, IL-6, TNF-α) (6-8). In addition, it has antioxidant action, acting as a free radical scavenger and increasing the expression of endogenous antioxidant enzymes, such as superoxide dismutase and catalase (9,10). Another relevant aspect is its antimicrobial activity, with an inhibitory effect on periodontopathogenic bacteria, such as Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, and Fusobacterium nucleatum (11-13).

These properties justify the growing interest in the application of curcumin in chronic inflammatory diseases. Evidence suggests benefits as an adjunct in the management of rheumatoid arthritis, by reducing joint pain and inflammation (14), in type 2 diabetes mellitus, contributing to improved glycemic control (15), and in reducing cardiovascular risk factors, including lipid profile and inflammatory markers (16,17). In the oncological context, curcumin has been studied as an adjunctive agent due to its antiproliferative and pro-apoptotic action in cancer models, in addition to its usefulness in preventing chemotherapy-induced oral mucositis (18,19).

In dentistry, the use of curcumin has been explored in different areas. Studies report its effectiveness as a mouthrinse and gel for reducing plaque and gingivitis, showing similar performance to chlorhexidine, but with fewer adverse effects such as tooth staining and taste alteration (20,21). Furthermore, it has been tested as an agent in local formulations (gels, chips, and mouthwashes) applied to periodontal pockets, with positive results on periodontal clinical parameters (22,23). Another expanding field is its use as a photosensitizer in antimicrobial photodynamic therapy (aPDT), showing additional antimicrobial activity against oral bacteria (24,25). These findings reinforce the translational potential of curcumin in dental clinical practice.

The interest in studying this compound in the older adult population is particularly relevant. Individuals aged 60 years or older have a higher prevalence of periodontal disease and tooth loss, conditions that directly impact chewing, nutrition, and quality of life (26-28). In addition to a higher susceptibility to the disease, older adults often face functional limitations, such as reduced visual acuity and fine motor coordination, factors that hinder adequate oral hygiene (29,30). Common chronic conditions in this age group, such as arthritis, Parkinson's disease, and cognitive impairment, can also reduce the ability to perform repetitive movements necessary for mechanical biofilm control (31,32). In this context, easily applicable and low-risk adjunctive agents, such as topical curcumin, may represent an interesting alternative to aid in periodontal maintenance.

Despite the promising findings, the literature presents significant methodological heterogeneity, including variations in curcumin formulations, application protocols, and clinical outcomes assessed, which limits the consolidation of robust evidence. Furthermore, analyses that critically synthesize the available results are still scarce. In this context, given the increased number of recent publications addressing curcumin in dentistry, an integrative analysis of the available evidence becomes necessary. To this end, a synthesis of systematic reviews is the most appropriate method, allowing the synthesis of findings from existing reviews and the identification of convergences, divergences, and gaps in knowledge. Thus, the present work aims to assess evidence from systematic reviews published between 2021 and 2025 on the topical use of curcumin in the treatment of periodontal disease, and its potential clinical benefit in older adult patients.

METHODOLOGY

A structured literature search was conducted in the PubMed and Google Scholar databases

from January 2021 to May 2025, with the aim of identifying systematic reviews on the use of curcumin as an adjunctive therapy in periodontal treatment. The search strategy was developed by combining controlled descriptors (MeSH/DeCS) and free terms related to the intervention and the clinical condition investigated.

On the PubMed database, we used the following terms and Boolean operators: ("Curcumin"[Title/Abstract] OR "Curcuma longa"[Title/Abstract] OR "Turmeric"[Title/Abstract]) AND ("Periodontitis"[MeSH Terms] OR "Periodontal Diseases"[MeSH Terms] OR periodontitis[Title/Abstract] OR periodontal disease[Title/Abstract]) AND ("Systematic Review"[Publication Type] OR "Meta-Analysis"[Publication Type] OR systematic review[Title/Abstract] OR meta-analysis[Title/Abstract]).

In the Google Scholar database, an adaptation of the strategy was employed with the terms: curcumin OR turmeric AND periodontitis OR periodontal disease AND systematic review OR meta-analysis, applying publication period filters.

We included systematic reviews, with or without meta-analysis, published between 2021 and 2025, which exclusively investigated the use of curcumin in topical formulations (gel, mouthwash, chips, strips, irrigants, or as a photosensitizer in photodynamic therapy) as an adjunct to scaling and root planing (SRP), in studies conducted with humans.

Narrative reviews, scoping reviews, experimental animal studies, studies involving systemic curcumin supplementation, and publications not directly related to non-surgical periodontal therapeutics were excluded.

Study selection used analysis of titles, abstracts, and full texts, with subsequent inclusion of reviews that fully met the previously established eligibility criteria.

Six systematic reviews met the inclusion criteria and compose this synthesis of reviews (33-38). The analysis used data extracted from the included articles.

RESULTS

The six systematic reviews analyzed a total of 114 studies (randomized and non-randomized clinical trials), and the degree of overlap between the primary studies included in the reviews was not assessed. All assessed the use of curcumin in topical formulations associated with scaling and root planing (SRP). Table 1 shows the general characteristics of the included systematic reviews.

Table 1 - General characteristics of the included systematic reviews

Ref. (Author/Year)	Journal (year)	Type (SR/SR+MA)	Reg. PROSPERO	No. of included studies
Terby S et al., 2021 (33)	Saudi Dent J (2021)	SR + MA	Yes	27 (963 participants/sites)
Souza EQM et al., 2021 (34)	Photodiagnosis Photodyn Ther (2021)	SR + MA	Yes	15 (5 included in MA)
Oliveira RCG et al., 2021 (35)	Complement Ther Clin Pract (2021)	SR + MA	Yes	12 (11 included in MA)
Zhang Y et al., 2022 (36)	Front Pharmacol (2022)	SR + MA	Yes	18 (846 participants/sites)
Wendorff-Tobolla LM et al., 2023 (37)	Biomedicines (2023)	SR + MA	Yes	23
Muhammad Ridho F et al., 2024 (38)	Rev Cient Odontol (Lima) (2024)	SR (no MA)	Not informed	19

SR = Systematic Review; MA = Meta-analysis.

In general, the reviews reported significant reductions in periodontal pocket probing depth (PPD), clinical attachment level (CAL) gain, and improvement in plaque index (PI), gingival index (GI), and bleeding on probing (BOP), compared to conventional treatment in isolation. In some analyses, curcumin showed results comparable to chlorhexidine as a chemical adjunct.

In addition to clinical parameters, two reviews (34,35) included microbiological outcomes, reporting reductions in the levels of Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans. Two reviews (34,38) reported immunomodulatory effects, such as reductions in IL-1, IL-6, TNF-α, and CRP.

The number of clinical trials included in each review ranged from 12 to 27, with a maximum follow-up of 6 months. Among the meta-analyses, this number ranged from 5 to 27, with a maximum follow-up of 3 months, which demonstrates the temporal limitation of the evidence (Table 1).

The assessment of the methodological quality of the included systematic reviews demonstrated

variability in methodological rigor, with most studies being classified between moderate and high quality according to the AMSTAR-2 instrument (Table 2). The reviews conducted by Zhang et al. (36) and Wendorff-Tobolla et al. (37) presented the best methodological assessments, being classified as moderate to high and high quality, respectively.

Wide heterogeneity was observed in the topical curcumin formulations used in the primary studies, including gels, irrigants, local release devices, mouthwashes, and protocols associated with antimicrobial photodynamic therapy. Relevant variations regarding the concentrations used, application methods, and follow-up periods were also identified, factors that contribute to the heterogeneity of the results observed among the studies (Table 3).

Table 2 - Methodological assessment of the included systematic reviews (AMSTAR-2)

Systematic review	Quality assessment tool	Protocol Registration (PROSPERO)	Risk of bias assessment of primary studies	Statistical model used	Heterogeneity assessment	Overall methodological quality
Terby et al., 2021 (33)	AMSTAR-2	Yes	Yes (Cochrane RoB) summary assessment	Random effects	I^2 reported	Moderate
Souza et al., 2021 (34)	AMSTAR-2	Yes	Yes (Cochrane RoB)	Random effects	I^2 reported	Moderate to good
Oliveira et al., 2021 (35)	AMSTAR-2	Yes	Yes (Cochrane RoB)	Random effects	I^2 reported	Moderate
Zhang et al., 2022 (36)	AMSTAR-2	Yes	Yes (Cochrane RoB) detailed	Random effects	I^2 reported	Moderate to high
Wendorff-Tobolla et al., 2023 (37)	AMSTAR-2	Yes	Yes (Cochrane RoB + Sensitivity)	Random effects	I^2 reported	High
Muhammad Ridho et al., 2024 (38)	AMSTAR-2	Not applicable	Partial	Not applicable	Not assessed	Low to moderate

Note: *The methodological quality of the included systematic reviews was assessed using validated tools, predominantly the **AMSTAR-2** instrument. This tool provides critical analysis of risk of bias and methodological rigor of reviews, considering aspects such as a prior protocol, search strategy, eligibility criteria, assessment of risk of bias in primary studies, and appropriateness of the synthesis of results. Reviews with better performance in AMSTAR-2 provide higher reliability to the findings synthesized in this overview of systematic reviews. The classification of methodological depth considered not only the prior registration of the protocol and the use of tools for assessing risk of bias, but also the conduct of sensitivity analyses, stratification of outcomes, and exploration of sources of heterogeneity. RoB = Risk of bias.*

Table 3 - Topical curcumin formulations used in the included systematic reviews and clinical implications

Review	Formulation type	Concentration / protocol	Application method	Clinical and methodological implications
Terby et al., 2021 (33)	Topical gel; subgingival irrigation	Variable among primary studies	Professional application after SRP	High variability in formulations and concentrations, contributing to moderate to high heterogeneity in meta-analyses.
Souza et al., 2021 (34)	Curcumin as a photosensitizer (aPDT); irrigant	Distinct protocols for aPDT and irrigation	Application associated with light and/or subgingival irrigation	More consistent short-term results, but less comparability with studies using only topical gel.
Oliveira et al., 2021 (35)	Topical gel; irrigation	Non-standardized concentrations	Professional local application	Lack of standardization limits dose–response analyses and direct comparison between clinical trials.
Zhang et al., 2022 (36)	Topical gel; local release devices	Different concentrations and systems	Controlled local release	Sustained-release formulations may explain higher consistency of observed anti-inflammatory effects.
Wendorff-Tobolla et al., 2023 (37)	Local curcumin in different presentations	Variable	Controlled subgingival application	Review with broad clinical focus; diversity of formulations reflects real clinical practice but increases heterogeneity.
Muhammad Ridho et al., 2024 (38)	Gel, mouthwash, and experimental applications	Non-standardized	Clinical and preclinical	Comprehensive scope suitable for a narrative review; lack of meta-analysis limits quantitative inferences.

The diversity of curcumin formulations, concentrations, and application protocols constitutes one of the main sources of clinical heterogeneity observed in the included systematic reviews. SRP = Scaling and root planing; aPDT = Antimicrobial photodynamic therapy.

Regarding clinical outcomes, five of the six reviews included meta-analyses and demonstrated statistically significant benefits of curcumin as an adjunctive therapy to non-surgical periodontal treatment when compared to scaling and root planing in isolation. Periodontal pocket probing depth reduction, clinical attachment level gain, and periodontal index improvements were observed, with confidence intervals that did not cross the null value and p-values below 0.05 in most analyses (Table 4).

The critical synthesis of the reviews showed that the main methodological limitations were related to the high clinical and statistical heterogeneity among the primary studies, differences in curcumin formulations and application protocols, short follow-up time, and the limited number of randomized clinical trials for some outcomes. These limitations should be considered in the interpretation of the presented clinical, microbiological, and immunological findings (Table 5).

Table 4 – Effects of curcumin on periodontal clinical parameters (meta-analyses)

Review	Assessed parameter	Comparison	Time	Statistical model	Combined effect (SMD / MD)	95% CI	p-value	(I^2) Hetero-geneity	Clinical interpretation
Terby et al., 2021 (33)	PPD (reduction, mm)	SRP + CUR vs SRP	Miscellaneous	Random effects	SMD = -0,87	- 1,31 to - 0,43	0.0001	93%	Favorable to curcumin
Souza et al., 2021 (34)	CAL (gain, mm)	SRP + CUR vs SRP	3 months	Random effects	SMD = 0,43	0.10 to 0.77	0.011	8,9%	Significant clinical benefit
Souza et al., 2021 (34)	CAL (gain, mm)	SRP + CUR + aPDT vs SRP	3 months	Random effects	SMD = 0,53	0.15 to 0.91	0.007	0%	Consistent effect
Souza et al., 2021 (34)	PPD (improvement, compared to SRP)	SRP + CUR vs SRP	3 months	Random effects	SMD = 0,375	0.098 to 0.652	0.008	0%	Robust short-term evidence
Souza et al., 2021 (34)	PPD (improvement compared to SRP)	SRP + CUR + aPDT vs SRP	3 months	Random effects	SMD = 0,674	0.159 to 1.189	0.01	41,1%	Association with aPDT potentiates the effect
Oliveira et al., 2021(35)	PPD (reduction, mm)	SRP + CUR vs SRP	90 days	Random effects	MD = - 0,48	- 0,89 to - 0,08	0.01	85%	Clinically non-significant
Oliveira et al., 2021 (35)	PI, GI and bleeding (improvement)	SRP + CUR vs SRP	45 days	Random effects	MD favorable to CUR	Does not cross zero	<0,05	High	Desirable clinical signs (anti-inflammatory action)
Zhang et al., 2022 (36)	GI and SBI (improvement)	SRP + CUR vs SRP	1, 2, 3, 4, and 6 weeks	Random effects	D = −0,47 mm	- 0,69 to -0,26	<0,05	67%	Desirable clinical signs (anti-inflammatory action)
Wendorff-Tobolla et al., 2023(37)	CAL / PPD	CUR local vs control	Varied times	Random effects	SMD favorable to CUR	Does not cross zero	<0,05	Moderate	Clinically irrelevant difference
Muhammad Ridho et al., 2024 (38)	Periodontal inflammation	CUR topical	Variable	Not applicable	Qualitative synthesis	—	—	—	Pre-clinical and clinical evidence

PPD: Periodontal pocket probing depth; CAL: Clinical attachment level; GI: Gingival index; SBI: Sulcular bleeding index; SMD: standardized mean difference; MD: mean difference; CI: confidence interval; SRP: scaling and root planing; CUR: curcumin; aPDT: antimicrobial photodynamic therapy.

Table 5 – Main methodological limitations of the included systematic reviews

Systematic review	Methodological limitations identified	Relevant observations
Terby et al., 2021 (33)	• Moderate to high heterogeneity (high I^2 in some analyses) • Small sample sizes in primary studies • Short follow-up time (up to 3 months)	Despite the meta-analysis, the authors note that caution should be adopted in interpretation due to the variability of clinical protocols.
Souza et al., 2021 (34)	• Important clinical heterogeneity (photodynamic vs irrigation vs gel)• Differences in application protocols• Limited number of RCTs per outcome	Meta-analysis conducted with a random-effects model due to high variability between studies
Oliveira et al., 2021 (35)	• Inclusion of studies with moderate risk of bias • Non-standardized clinical outcomes • Predominantly short-term follow-up	Review indicates clinical benefit, but notes lack of methodological standardization
Zhang et al., 2022 (36)	• High statistical heterogeneity (high I^2) • Difference in the number of included studies per outcome • Possible publication bias	Statistically significant results, but with wide variability among the included studies
Wendorff-Tobolla et al., 2023 (37)	• Differences in observation times (short and medium term) • Distinct local curcumin formulations • Limitations in the quality of the included RCTs	Review emphasizes the need for better-designed clinical trials
Muhammad Ridho et al., 2024 (38)	• Lack of meta-analysis • Inclusion of preclinical and clinical studies • Qualitative assessment of outcomes	Narrative review with an anti-inflammatory focus, limiting quantitative inferences

RCT: Randomized controlled trial. The described limitations reflect characteristics of the available body of evidence and do not compromise the methodological validity of the included systematic reviews, all of which followed recognized principles of systematic review.

DISCUSSION

This synthesis of systematic reviews included six recent reviews (2021-2024) on the use of topical curcumin as an adjunctive therapy to non-surgical periodontal treatment. In line with the findings of individual clinical studies (20-23), all reviews reported significant reductions in periodontal clinical parameters, such as PPD, CAL gain, and improvement in PI, GI, and BOP (33-38).

Methodological quality of the reviews

The assessment of the methodological quality of the included systematic reviews, as presented in Table 2, showed relevant heterogeneity regarding methodological rigor, transparency of review processes, and bias control. In general, the reviews conducted by Zhang et al. (36) and Wendorff-Tobolla et al. (37) presented better overall methodological quality, while the studies by Muhammad Ridho et al. (38), Souza et al. (34), Terby et al. (33), and Oliveira et al. (35) exhibited specific limitations that should be considered when interpreting their findings. The works of Zhang et al. (36) and Wendorff-Tobolla et al. (37) are noted for presenting clearly defined eligibility criteria, comprehensive search strategies in multiple databases, data selection and extraction performed by independent reviewers, and systematic assessment of risk of bias using validated tools. Furthermore, both studies transparently described the statistical methods employed in the meta-analyses, justifying the adoption of random-effects models given the clinical and methodological heterogeneity among the included trials, which provides higher robustness and reliability to the presented results.

The systematic review conducted by Muhammad Ridho et al. (38) presented intermediate methodological quality. Although the authors employed well-defined inclusion criteria and conducted a assessed of periodontal clinical outcomes, limitations are observed related to the absence of prior protocol registration, the restricted use of databases in the search strategy, and the insufficiently detailed description of the risk of bias assessment process. These methodological aspects reduce the transparency of the study and increase the possibility of selection bias, which can influence the magnitude of effects attributed to curcumin as an adjunctive therapy.

In the case of the review of Terby et al. (33), despite the adequate prior registration in PROSPERO, a factor that strengthens methodological transparency and reduces the risk of selective reporting, there are still important limitations. Notably, these limitations include the inclusion of clinical trials with reduced sample sizes, significant heterogeneity among topical curcumin formulations, and the short duration of clinical follow-up in most primary studies. These factors can compromise the consistency of the results and justify caution in clinical extrapolation of the findings.

The review conducted by Oliveira et al. (35) demonstrated methodological rigor by employing the Cochrane tool for risk of bias assessment, in addition to reporting prior registration in PROSPERO. However, the presence of high statistical heterogeneity in several analyses, combined with the variability of therapeutic protocols and follow-up periods, limits the interpretation of the results. This methodological context supports the conclusion of the authors as to the absence of clinically relevant clinical attachment level gain, even given the statistical significance in certain comparisons.

Finally, the review by Souza et al. (34) presented more pronounced methodological limitations, incomplete description of the risk of bias assessment, and inconsistencies in the standardization of the clinical outcomes analyzed. Although the authors identified statistically significant benefits of curcumin as an adjunctive therapy, such methodological weaknesses reduce the level of evidence and reinforce the need for careful interpretation of the results.

Considered in conjunction, the integrated analysis in Table 2 shows that, although the included systematic reviews indicate favorable effects of curcumin in non-surgical periodontal treatment, the heterogeneous methodological quality among the studies directly impacts the strength and reliability of the available evidence. Reviews with higher methodological rigor, prior registration, and systematic application of validated tools provide more consistent support for the use of curcumin as an adjunctive therapy, while studies with limitations in these aspects should be interpreted with greater caution.

Topical curcumin formulations and impact on the heterogeneity of the results

A central aspect for the critical interpretation of the results of this review refers to the wide variability of the topical curcumin formulations used in the primary

studies included in the systematic reviews analyzed (Table 3). Approaches ranged from conventional topical gels and irrigating solutions to sustained local release systems and the use of curcumin as a photosensitizer in photodynamic therapies. These differences directly influence local bioavailability, the time the agent stays at the periodontal site, and the magnitude of the anti-inflammatory response, hindering direct comparisons between clinical trials.

Reviews that included controlled-release formulations or those associated with photodynamic therapy, such as those by Zhang et al. (36) and Souza et al. (34), tend to show more consistent short-term clinical effects, especially on parameters such as probing depth and bleeding on probing. On the other hand, reviews based predominantly on conventional topical gels and subgingival irrigation demonstrated higher variability in results, reflected in high values of statistical heterogeneity in meta-analyses.

In the clinical context of older adult patient care, the diversity of formulations has additional relevance. Professional application formulations, such as subgingival gels and local release devices, reduce the dependence on home self-care, which is often compromised by motor, cognitive, and sensory limitations in this population. Thus, despite the observed methodological heterogeneity, the data suggest that topical curcumin represents a promising adjunctive alternative, especially when standardized application protocols are employed.

Clinical parameters

The systematic reviews included in this overview of reviews consistently demonstrate that topical use of curcumin as an adjunctive therapy to scaling and root planing (SRP) is associated with improvements in the main periodontal clinical parameters, especially CAL gain and PPD reduction (Table 4).

In the study of Terby et al. (33), the meta-analysis for CAL gain at three months showed a moderate combined effect (SMD = 0.43; 95% CI 0.10–0.77), with low heterogeneity (I^2 = 8.9%), indicating consistency among the included clinical trials. Although the statistical test evaluates the null hypothesis of SMD = 0, the obtained results demonstrated that the effect was significantly different from zero, confirming clinical relevance in favor of curcumin. Similar findings were reported by Souza et al. (34), for both the use of curcumin in isolation and when associated with antimicrobial photodynamic therapy (aPDT), with an even more pronounced combined effect when aPDT was employed (SMD = 0.53; 95% CI 0.15–0.91), suggesting a potential synergistic effect between the methods.

Zhang et al. (36) observed statistically significant reductions in probing depth, with mean differences favoring curcumin (MD = −0.47 mm; 95% CI −0.69 to −0.26), although with moderate to high heterogeneity (I^2 = 67%). This variability can be attributed to differences in topical formulations used, active ingredient concentrations, application frequency, and follow-up times, which ranged from one to six months. Similarly, Wendorff-Tobolla et al. (37) reported global clinical benefits of locally administered curcumin, despite the presence of methodological heterogeneity due to varied follow-up times and distinct therapeutic protocols.

On the other hand, the systematic review of Muhammad Ridho et al. (38), which did not perform a meta-analysis, qualitatively reinforced the anti-inflammatory effects of curcumin, in both preclinical models and clinical studies, noting the reduction of inflammatory markers and improvement of periodontal parameters. These findings biologically support the quantitative results observed in the other reviews, corroborating the rationale for using curcumin as an adjunctive therapeutic agent.

Despite the favorable results, important limitations should be considered. The methodological heterogeneity among the primary studies, the short follow-up period in most clinical trials, and the lack of standardization of formulations and outcomes assessed restrict the generalization of the findings. Still, the consistency of the observed effects, associated with the low incidence of reported adverse events, suggests that curcumin represents a promising and safe alternative as an adjunctive therapy in the treatment of periodontitis, especially in more vulnerable populations, such as older adults, in whom controlled topical strategies in office can compensate for limitations in oral self-care.

Microbiological and immunological findings associated with topical use of curcumin

In addition to periodontal clinical outcomes, some systematic reviews included in this review also investigated the effects of curcumin on microbiological and immunological parameters, broadening the understanding of the possible biological mechanisms underlying the observed benefits. In this context, the

reviews conducted by Souza et al. (34), Oliveira et al. (35), and Muhammad Ridho et al. (38) are particularly noted, as they addressed, respectively, microbiological and immunoinflammatory aspects of the adjunctive therapy with curcumin.

The systematic review and meta-analysis by Souza et al. (34) demonstrated that the use of curcumin, especially when employed as a photosensitizer in photodynamic therapies or as an irrigating agent, was associated with a significant reduction in key periodontal pathogens, including Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, and anaerobic pigmented bacteria. These microbiological findings reinforce the hypothesis that curcumin has relevant local antimicrobial action, potentially comparable to that of conventional agents, but with a lower risk of adverse effects and bacterial resistance development.

Similarly, Oliveira et al. (35) reported consistent results regarding the decrease in subgingival microbial load in groups treated with curcumin associated with non-surgical periodontal treatment. Although the authors noted the heterogeneity of the microbiological methods used in the primary studies—including bacterial culture, PCR, and semi-quantitative assessments—the body of evidence suggests that curcumin may interfere with the organization and viability of periodontal biofilm. This antimicrobial effect appears to be related to both the direct action of the substance and its ability to modulate the local inflammatory microenvironment, making it less favorable for the persistence of periodontal pathogens.

Regarding immunological parameters, the systematic review conducted by Muhammad Ridho et al. (38) provides a relevant contribution by integrating preclinical and clinical evidence on the anti-inflammatory potential of curcumin in periodontitis. The authors reported significant reductions in local and systemic inflammatory biomarkers, including interleukin-6 (IL-6), tumor necrosis factor alpha (TNF-α), and C-reactive protein (CRP), especially in experimental studies and short-term clinical trials. These findings support the immunomodulatory role of curcumin, acting in the attenuation of the exacerbated inflammatory response characteristic of periodontitis.

The integration of microbiological and immunological findings suggests that the clinical benefits observed with topical use of curcumin do not result exclusively from its antimicrobial action, but also from its ability to modulate inflammatory pathways involved in periodontal tissue destruction. This dual mechanism—antimicrobial and anti-inflammatory—is particularly relevant in the context of periodontitis, a multifactorial disease in which host response plays a central role in the progression of attachment loss and alveolar bone loss.

Despite these promising results, it should be noted that most studies included in the reviews present a short follow-up period and major methodological variability in the evaluation of microbiological and immunological parameters. In addition, the lack of standardization of the biomarkers evaluated and the laboratory techniques employed limits direct comparability between studies. Thus, although current evidence indicates a favorable biological effect of curcumin, randomized clinical trials with standardized protocols and longer longitudinal follow-up are necessary to confirm the clinical relevance of these findings.

Limitations of the reviews

These limitations do not invalidate the presented results but impose caution as to the strength of the available evidence. Notably, the reviews with the highest methodological robustness include the studies by Zhang et al. (36) and Wendorff-Tobolla et al. (37), which presented previously registered protocols, well-defined eligibility criteria, comprehensive literature search, and systematic assessment of the risk of bias of the primary studies. These aspects contributed to greater methodological transparency and a lower risk of selection bias, justifying their better classification in the overall quality assessment presented in Table 2.

In contrast, the review by Souza et al. (34), despite a structured search and a clear focus on microbiological and clinical outcomes, showed limitations related to the heterogeneity of the included studies and the absence of an in-depth assessment of the risk of bias in all primary trials. Furthermore, the variability in the employed microbiological methods (bacterial culture, PCR, and semiquantitative analyses) hindered direct comparisons and more consistent meta-analyses, as shown in Table 5.

The review conducted by Oliveira et al. (35) presented as a strong point the prior registration in PROSPERO and the use of the Cochrane tool for risk of bias assessment, aspects that strengthen the

methodological reliability of the study. Still, as shown in Table 5, there are important limitations, such as the reduced number of clinical trials included for some outcomes, the short follow-up period, and the high clinical and statistical heterogeneity observed in certain analyses. These factors may explain the discrepancy between statistical significance and clinical relevance observed in some results, especially in clinical attachment level gain.

In the case of the review by Muhammad Ridho et al. (38), which predominantly addressed immunological parameters, the main methodological limitation identified refers to the prevalence of experimental studies and the scarcity of randomized clinical trials with longitudinal assessment of inflammatory biomarkers. Although the findings indicate a consistent reduction in pro-inflammatory mediators, such as IL-6 and TNF-α, the extrapolation of these results to clinical practice remains limited, as summarized in Table 5.

Other included reviews, such as Terby et al. (33), presented registration in prospective databases, which reinforces the transparency of the methodological process. However, there were limitations related to the lack of meta-analysis for certain outcomes and the reliance on studies with small sample sizes, factors that reduce the precision of effect estimates. The review by Oliveira et al. (35), despite the declared methodological rigor, was also impacted by the inconsistencies in curcumin application protocols and the diversity of topical formulations used, aspects that contribute to the heterogeneity of the results.

In general, Table 5 shows that the main deficiency of the analyzed reviews does not necessarily refer to serious methodological flaws, but to the clinical, methodological, and statistical heterogeneity of the primary studies, combined with the lack of standardization of curcumin formulations, follow-up times, and outcomes assessed. These limitations justify the classification of the available evidence as moderate quality, reinforcing the need for well-designed randomized clinical trials with standardized protocols and longer follow-up times.

Use of curcumin in geriatric dentistry and its implications for Naval Healthcare

The results of this synthesis suggest that topical curcumin may represent a particularly interesting adjunctive alternative for Geriatric Dentistry. Although the included systematic reviews did not specifically assess older adult populations, the observed benefits on periodontal clinical parameters, combined with the described antimicrobial and immunomodulatory effects, may have clinical relevance in individuals with higher susceptibility to periodontal disease.

Aging is often associated with reduced manual dexterity, cognitive alterations, visual impairment, and a higher prevalence of chronic diseases, factors that hinder adequate mechanical biofilm control and favor the progression of periodontal disease (29-32). In this context, adjunctive therapies with professional application, such as curcumin in topical local release formulations, can contribute to potentiating the effects of scaling and root planing, partially reducing the dependence on home self-care. However, this possibility should still be interpreted with caution, as the available studies present short-term follow-up, high methodological heterogeneity, and a lack of specific clinical trials in older adult patients.

Within the scope of Military Dentistry and Naval Healthcare, these findings also present potential applicability. The Navy Healthcare System provides service to a growing contingent of veteran military personnel, pensioners, and older adult dependents, a population in which the maintenance of oral health plays an important role in preserving masticatory function, quality of life, and general health. In this context, safe, low-cost, low-toxicity adjunctive therapies that can be incorporated into clinical routine may represent a complementary strategy for non-surgical periodontal treatment. However, before their incorporation into service protocols, it is necessary to conduct randomized clinical trials with higher methodological standardization, long-term follow-up, and specific assessment in geriatric populations.

CONCLUSION

This overview of systematic reviews indicates that curcumin, when used as an adjunctive topical therapy to non-surgical periodontal treatment, is associated with consistent improvements in periodontal clinical parameters, including reduction in probing depth, decrease in bleeding on probing, and, to a lesser extent, gain in clinical attachment level. These effects were recurrently observed in the included reviews, especially in those that incorporated meta-analyses.

Corresponding author:
Marcio Augusto Gonçalves Coelho. Odontoclínica Central da Marinha.
Barão de Ladário, s/n, Centro, Rio de Janeiro, RJ, Brasil.
E-mail: marciocoelho_odonto@yahoo.com

REFERENCES

1. Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. Nat Rev Dis Primers. 2017;3:17038.
2. Hajishengallis G. Periodontitis: from microbial immune subversion to systemic inflammation. Nat Rev Immunol. 2015;15(1): 30-44.
3. Sanz M, Marco Del Castillo A, Jepsen S, Gonzalez--Juanatey JR, D'Aiuto F, Bouchard P, *et al*. Periodontitis and cardiovascular diseases: Consensus report. J Clin Periodontol. 2020;47(3):268-88.
4. Hewlings SJ, Kalman DS. Curcumin: A review of its effects on human health. Foods. 2017;6(10):92.
5. Gupta SC, Patchva S, Aggarwal BB. Therapeutic roles of curcumin: lessons learned from clinical trials. AAPS J. 2012;15(1):195-218.
6. Jurenka JS. Anti-inflammatory properties of curcumin: a major constituent of Curcuma longa: a review of preclinical and clinical research. Altern Med Rev. 2009;14(2):141-53.
7. Ghosh S, Banerjee S, Sil PC. The beneficial role of curcumin on inflammation, diabetes and neurodegenerative disease: A recent update. Food Chem Toxicol. 2015;83:111-24.
8. Chainani-Wu N. Safety and anti-inflammatory activity of curcumin: a component of turmeric (Curcuma longa). J Altern Complement Med. 2003;9(1):161-8.
9. Menon VP, Sudheer AR. Antioxidant and anti-inflammatory properties of curcumin. Adv Exp Med Biol. 2007;595:105-25.
10. Liao VH-C, Yu C-W, Chu Y-J, Li W-H, Hsieh Y-C, Wang TT. Curcumin-mediated lifespan extension in Caenorhabditis elegans. Mech Ageing Dev. 2011;132(10):480-7.
11. Tyagi P, Singh M, Kumari H, Kumari A, Mukhopadhyay K. Bactericidal activity of curcumin I is associated with damaging of bacterial membrane. PLoS One. 2015;10(3):e0121313.
12. Teow S-Y, Liew K, Ali SA, Khoo AS-B, Peh S-C. Antibacterial action of curcumin against Staphylococcus aureus: A Brief Review. J Trop Med. 2016;2016:2853045.
13. Hu P, Huang P, Chen MW. Curcumin reduces Streptococcus mutans biofilm formation by inhibiting sortase A activity. Arch Oral Biol. 2013;58(10):1343-8.
14. Amalraj A, Varma K, Jacob J, Divya C, Kunnumakkara AB, Stohs SJ, *et al*. A novel highly bioavailable curcumin formulation improves symptoms and diagnostic indicators in rheumatoid arthritis patients: A Randomized, Double--Blind, Placebo-Controlled, Two-Dose, Three-Arm, and Parallel-Group Study. J Med Food. 2017;20(10):1022-30.
15. Na L-X, Li Y, Pan H-Z, Zhou X-L, Sun D-J, Meng M, *et al*. Curcuminoids exert glucose-lowering effect in type 2 diabetes by decreasing serum free fatty acids: a double-blind, placebo-controlled trial. Mol Nutr Food Res. 2013;57(9):1569-77.
16. Panahi Y, Khalili N, Sahebi E, Namazi S, Reiner Ž, Majeed M, *et al*. Curcuminoids modify lipid profile in type 2 diabetes mellitus: A randomized controlled trial. Complement Ther Med. 2017;33:1-5.
17. DiSilvestro RA, Joseph E, Zhao S, Bomser J. Diverse effects of a low dose supplement of lipidated curcumin in healthy middle aged people. Nutr J. 2012;11:79.
18. Shanmugam MK, Rane G, Kanchi MM, Arfuso F, Chinnathambi A, Zayed ME, *et al*. The multifaceted role of curcumin in cancer prevention and treatment. Molecules. 2015;20(2):2728-69.
19. Wu C-F, Wu H-J, Shih C-L, Yeh T-P, Ma W-F. Efficacy of turmeric in the treatment of oral mucositis in patients with head and neck cancer after radiotherapy or chemoradiotherapy: a systematic review and meta-analysis. Front Pharmacol. 2024;15:1363202.
20. Chatterjee A, Saluja M, Singh N, Kandwal A. To evaluate the antigingivitis and antipalque effect of an Azadirachta indica (neem) mouthrinse on plaque induced gingivitis: A double-blind, randomized, controlled trial. J Indian Soc Periodontol. 2011;15(4):398-401.
21. Siddharth M, Singh P, Gupta R, Sinha A, Shree S, Sharma K. A Comparative Evaluation of Subgingivally Delivered 2% Curcumin and 0.2% Chlorhexidine Gel Adjunctive to Scaling and Root Planing in Chronic Periodontitis. J Contemp Dent Pract. 2020;21(5):494-9.
22. Mohammad CA, Ali KM, Sha AM, Gul SS. Effect of Curcumin gel on inflammatory and anti-inflammatory biomarkers in experimental induced periodontitis in rats: a biochemical and immunological study. Front Microbiol. 2023;14:1274189.
23. Singh A, Sridhar R, Shrihatti R, Mandloy A. Evaluation of Turmeric Chip Compared with Chlorhexidine Chip as a Local Drug Delivery Agent in the Treatment of Chronic Periodontitis: A Split Mouth Randomized Controlled Clinical Trial. J Altern Complement Med. 2018;24(1):76-84.
24. Araújo NC, Fontana CR, Bagnato VS, Gerbi MEM. Photodynamic effects of curcumin against cariogenic pathogens. Photomed Laser Surg. 2012;30(7):393-9.
25. Ivanaga CA, Miessi DMJ, Nuernberg MAA, Claudio MM, Garcia VG, Theodoro LH. Antimicrobial photodynamic therapy (aPDT) with curcumin and LED, as an enhancement to scaling and root planing in the treatment of residual pockets in diabetic patients: A randomized and controlled split-mouth clinical trial. Photodiagnosis Photodyn Ther. 2019;27:388-95.
26. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. Global burden of severe periodontitis in 1990-2010: a systematic review and meta-regression. J Dent Res. 2014;93(11):1045-53.
27. Eke PI, Thornton-Evans GO, Wei L, Borgnakke WS, Dye BA, Genco RJ. Periodontitis in US Adults: National Health and Nutrition Examination Survey 2009-2014. J Am Dent Assoc. 2018;149(7):576-88.e6.
28. Müller F, Naharro M, Carlsson GE. What are the prevalence and incidence of tooth loss in the adult and elderly population in Europe? Clin Oral Implants Res. 2007;18 Suppl 3:2-14.

29. Holm-Pedersen P, Schultz-Larsen K, Christiansen N, Avlund K. Tooth loss and subsequent disability and mortality in old age. J Am Geriatr Soc. 2008;56(3):429-35.
30. Petersen PE, Yamamoto T. Improving the oral health of older people: the approach of the WHO Global Oral Health Programme. Community Dent Oral Epidemiol. 2005;33(2):81-92.
31. Mariño R, Giacaman RA. Factors related to unmet oral health needs in older adults living in Chile. Arch Gerontol Geriatr. 2014;58(3):454-9.
32. Gil-Montoya JA, Mello ALF, Barrios R, Gonzalez-Moles MA, Bravo M. Oral health in the elderly patient and its impact on general well-being: a nonsystematic review. Clin Interv Aging. 2015;10:461-7.
33. Terby S, Shereef M, Ramanarayanan V, Balakrishnan B. The effect of curcumin as an adjunct in the treatment of chronic periodontitis: A systematic review and meta-analysis. Saudi Dent J. 2021;33(7):375-85.
34. Souza EQM, Rocha TE, Toro LF, Guiati IZ, Freire JOA, Ervolino E, *et al*. Adjuvant effects of curcumin as a photoantimicrobial or irrigant in the non-surgical treatment of periodontitis: Systematic review and meta-analysis. Photodiagnosis Photodyn Ther. 2021;34:102265.
35. Oliveira RCG, Costa CA, Costa NL, Silva GC, Souza JAC. Effects of Curcuma as an adjunct therapy on periodontal disease: A systematic review and meta-analysis. Complement Ther Clin Pract. 2021;45:101493.
36. Zhang Y, Huang L, Zhang J, Rastelli ANS, Yang J, Deng D. Anti-Inflammatory Efficacy of Curcumin as an Adjunct to Non-Surgical Periodontal Treatment: A Systematic Review and Meta-Analysis. Front Pharmacol. 2022;13:808460.
37. Wendorff-Tobolla LM, Wolgin M, Wagner G, Klerings I, Dvornyk A, Kielbassa AM. A Systematic Review and Meta-Analysis on the Efficacy of Locally Delivered Adjunctive Curcumin (*Curcuma longa* L.) in the Treatment of Periodontitis. Biomedicines. 2023;11(2):481.
38. Muhammad Ridho F, Julyanto Syachputra A, Dias Nur'aini A, Ulfah K, Faqih M, Nurhuda A. Pre-clinical and clinical efficacy of curcumin as an anti-inflammatory agent for periodontitis. A systematic review. Rev Cient Odontol (Lima). 2024;12(4):e222.