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Target in Smoking-Associated Periodontal Bone Loss: A Narrative Review

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Abstract

Periodontitis is a chronic inflammatory disease that destroys the tooth supporting tissues. In advanced stages, it causes alveolar bone loss and tooth loss. Smoking is a major modifiable risk factor linked to faster progression, poorer response to periodontal therapy, yet how it affects the molecular control of bone loss is unclear. Sclerostin is an osteocyte derived glycoprotein, inhibits canonical Wnt/β-catenin signaling, limits bone formation. It has been proposed as an indicator of bone remodeling activity. This narrative review examines its role as a therapeutic target in smoking associated periodontal bone loss.

Methods: A narrative literature review was conducted using PubMed/MEDLINE, Scopus, and Web of Science, till March 2026. Search terms are "sclerostin," "periodontitis," "smoking," "Wnt/β-catenin," and "periodontal regeneration," used in relevant combinations. Eligible publications included: human clinical studies, preclinical investigations, reviews addressing sclerostin in periodontal tissues or biological fluids, smoking associated periodontal changes, and potential therapeutic applications. Publications unrelated to periodontal biology or lacking relevant sclerostin findings were excluded.

Results: Human studies link higher sclerostin to periodontitis , but results differ by sample type (gingival tissue, GCF, saliva, and serum) and by study population. Few human studies compared sclerostin levels in smokers and non-smokers. The findings were inconsistent because of confounding by age. In animal models, sclerostin inhibition enhanced alveolar bone regeneration; this has not been tested in patients with periodontitis. In conclusion, Sclerostin is a promising candidate biomarker, potential therapeutic target in periodontal bone loss. Its specific role in smoking-associated periodontitis and the clinical effectiveness of sclerostin targeted therapy require further investigation.

Keywords: Sclerostin, Periodontitis, Smoking, Wnt/β-catenin signaling.

Introduction

Periodontitis is a multifactorial inflammatory disease that damages the tooth-supporting tissues and can lead to tooth loss. Smoking is a major modifiable risk factor. Smokers tend to show greater attachment loss, deeper probing pockets, and greater alveolar bone destruction, and they usually respond less well to periodontal therapy than nonsmokers (1–3).

The 2017 World Workshop classification, published in 2018, grades periodontitis by stage and grade (1,4). Stages I to IV capture disease severity and treatment complexity, running from initial and moderate disease (I and II) to advanced disease that is harder to manage (III and IV). Grades A to C estimate how quickly the disease is likely to progress and are adjusted for risk

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factors. Smoking is a modifier: smoking fewer than 10 cigarettes per day corresponds to Grade B, while smoking 10 or more cigarettes per day corresponds to Grade C, so smoking intensity is built into the assessment of progression risk (1,4). Sclerostin is produced mainly by osteocytes and encoded by the SOST gene. It restrains bone formation by inhibiting canonical Wnt/β-catenin signaling (5–8). It can be measured in gingival tissue, gingival crevicular fluid (GCF), and saliva, which has drawn attention to it as a possible marker of periodontal bone remodeling and a therapeutic target (5–10). Experimental and clinical work point to a role for sclerostin in inflammatory bone remodeling in periodontitis, yet whether it contributes to smoking-associated bone loss remains unclear (11–13). Furthermore, Wnt signaling and sclerostin are also established regulators of bone homeostasis and treatment targets in skeletal disease (14). This narrative review is about the evidences for the association between sclerostin, periodontitis and smoking, focusing on periodontal bone loss and the potential role of sclerostin as a therapeutic target.

Literature Search Approach

A narrative literature review was performed using PubMed/MEDLINE, Scopus, and Web of Science, with the final search performed in March 2026. Search terms included “sclerostin,” “periodontitis,” “smoking,” “Wnt/β-catenin,” and “periodontal regeneration,”. Eligible publications included human observational and clinical studies evaluating sclerostin in gingival tissue, gingival crevicular fluid (GCF), saliva, or serum; preclinical studies investigating its role in periodontal bone remodeling and regeneration; and relevant systematic reviews and mechanistic studies. Studies unrelated to periodontal findings on sclerostin were excluded. The selected literature was narratively synthesized to distinguish human clinical findings, smoking-related evidence, and experimental evidence concerning potential therapeutic applications.

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Table 1: Summary of human studies investigating sclerostin in periodontitis, including smoking-related findings.

Study	Population/design	Sample	Smoking status	Main finding	Relevance to this review
Napimoga et al. (15)	Periodontitis (n=15) and healthy controls (n=15)	Gingival tissue, serum	No	Gingival SOST expression and serum sclerostin were higher in periodontitis	Supports an association between sclerostin and periodontitis
Balli et al. (16)	Periodontitis (n=27) and healthy controls (n=27); treatment study	GCF	No	GCF sclerostin was higher in periodontitis and decreased after non-surgical periodontal therapy	Supports local sclerostin alterations and treatment responsiveness
Rezaei Esfahrood et al. (17)	Periodontitis and periodontal health	GCF	No	GCF sclerostin differed between periodontitis and periodontal health	Provides additional human GCF evidence
Chatzopoulos et al. (18)	Periodontitis (n=25) and periodontal health (n=25)	GCF	No	SOST was higher in the generalized moderate/severe periodontitis subgroup, but differences were not consistent across all comparisons	Demonstrates heterogeneity in GCF findings
Chatzopoulos et al. (19)	Periodontitis (n=20), gingivitis (n=10), and periodontal health (n=14)	GCF	Yes	SOST did not differ significantly across periodontal sites within diagnostic categories	Further demonstrates heterogeneity in GCF findings
Gür et al. (20)	Stage III Grade C periodontitis (n=23), gingivitis (n=24), and periodontal health (n=24)	GCF	No	Sclerostin was higher in periodontitis than in gingivitis and periodontal health	Supports an association with advanced periodontal disease
Ashifa et al. (21)	Periodontal health (n=10), Stage III Grade B (n=10), and Stage III Grade C periodontitis (n=10)	GCF	No	Sclerostin was higher in periodontitis, with no significant difference	Supports disease association but uncertain grade discrimination

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Study	Population/design	Sample	Smoking status	Main finding	Relevance to this review
				between Grades B and C	
Beiler et al. (22)	Periodontal treatment study	Saliva	No	Salivary sclerostin did not change significantly after non-surgical periodontal therapy	Reveals heterogeneity of salivary findings
Abdulkareem & Abbas (23)	Healthy (n=30), Grade B (n=30), and Grade C periodontitis (n=30)	Unstimulated saliva	Yes	Salivary sclerostin was higher in periodontitis than health and higher in Grade B than Grade C	Supports salivary biomarker potential while showing grade-related complexity
Miranda et al. (24)	Participants evaluated according to periodontitis, smoking, and type 2 diabetes	Gingival tissue, serum	**Yes**	Gingival SOST expression was higher in association with smoking and diabetes	Provides direct human evidence linking smoking with periodontal SOST expression
Krishna et al. (25)	Smokers and non-smokers with periodontitis before and after periodontal therapy	GCF	**Yes**	Baseline GCF sclerostin was higher in smokers; post-treatment reduction was more evident in non-smokers	Supports a smoking-related difference in GCF sclerostin
Ergin et al. (26)	Healthy and periodontitis groups stratified by smoking (n=18/group; N=72)	GCF	**Yes**	Unadjusted smoking-related sclerostin difference was not significant; a significant difference emerged when age was included in the analysis	Shows that smoking-specific evidence remains limited and sensitive to analytical adjustment

Sclerostin Biology and Periodontal Bone Remodeling

Osteocytes regulate bone remodeling by influencing both osteoblast-mediated bone formation and osteoclast-mediated resorption. Sclerostin, a glycoprotein encoded by the SOST gene and produced mainly by osteocytes, inhibits canonical Wnt/β-catenin signaling by binding to the LRP5/6 co-receptors, which suppresses osteoblast differentiation and bone formation (5-8). Osteocytes also express receptor activator of nuclear factor-κB ligand (RANKL), which promotes osteoclast differentiation. Osteoprotegerin (OPG), on the other hand, acts as a decoy

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receptor that blocks RANKL activity (7,11–13). In rat models of experimental periodontitis, osteocytes in alveolar bone showed increased expression of both sclerostin and RANKL, suggesting that these molecules take part in inflammation-associated periodontal bone remodeling (27,28). In diabetic rats with periodontitis, a TNF-α antagonist reduced osteocytic expression of both mediators (28). TNF-α has also been shown to upregulate sclerostin expression in obese mice (29), and interleukin-1β (IL-1β) promotes osteoclastogenesis and so contributes to inflammatory bone loss (30). Together, these findings suggest that inflammatory mediators may influence periodontal bone remodeling through pathways involving sclerostin and RANKL/OPG, although how these pathways interact in human periodontitis requires further investigation (Figure 1).

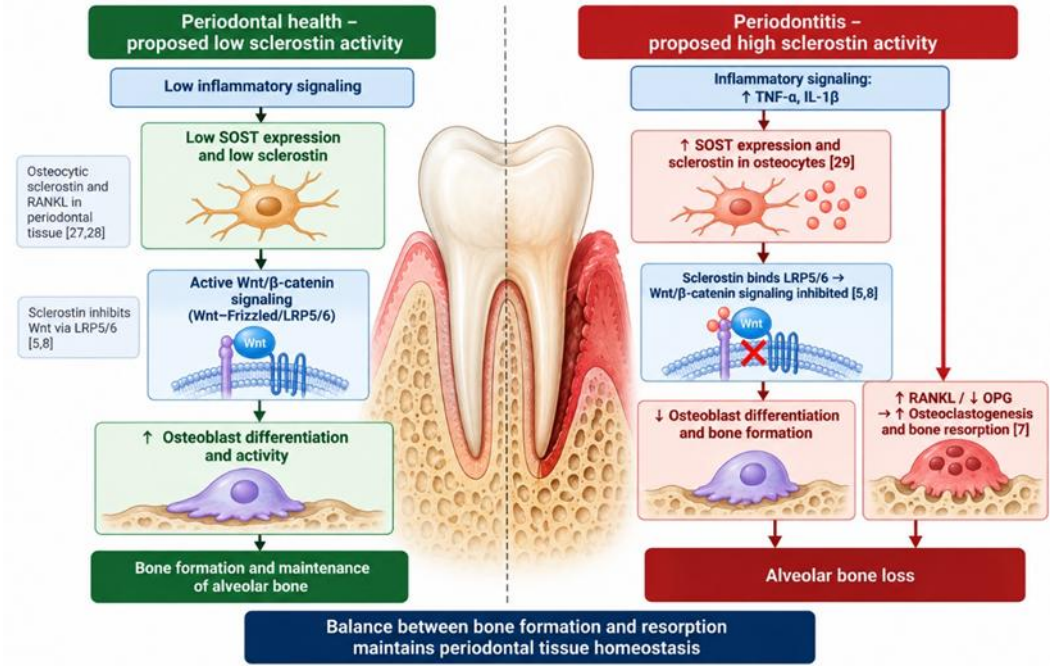


Figure. 1: Conceptual model of sclerostin-related regulation of alveolar bone.
Left, periodontal health: low inflammatory signaling and low sclerostin allow Wnt/β-catenin signaling, supporting osteoblast activity and alveolar bone maintenance (5,8,27,28). Right, periodontitis: inflammatory signaling (TNF-α, IL-1β) is proposed to increase osteocytic sclerostin (29,30). Sclerostin binds LRP5/6, inhibiting Wnt signaling and reducing bone formation (5,8), an increased RANKL/OPG ratio promotes osteoclastogenesis (7), resulting in alveolar bone loss. Human sclerostin findings in periodontitis are heterogeneous (15–21). Created by the authors based on (5,7,8,27–30). Abbreviations: LRP5/6, low-density lipoprotein receptor-related protein 5/6; OPG, osteoprotegerin; RANKL, receptor activator of nuclear factor-κB ligand; SOST, sclerostin gene**.**

Sclerostin in Human Periodontitis

Gingival Tissue and GCF

Gingival tissue. Napimoga et al. (15) found increased SOST gene and protein expression in the gingival tissue of patients with chronic periodontitis, together with higher expression of the Wnt antagonist Dickkopf-1 (DKK1). GCF. Most GCF studies report higher sclerostin in periodontitis than in periodontal health (16,17,20,21), though results are not uniform (18,19). Balli et al. (16) found that levels fell after non-surgical periodontal therapy, and a systematic review reported lower sclerostin after non-surgical therapy in three studies and correlations with

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periodontal clinical parameters in five (31). In Chatzopoulos et al. (18), total GCF sclerostin did not differ between periodontitis and healthy participants overall but was higher in a subgroup with generalized moderate/severe periodontitis. A later site-level study found similar sclerostin in periodontitis and healthy sites, with a trend toward higher levels in gingivitis sites, and its authors proposed that sclerostin and Wnt-5a levels depend on the inflammatory and osteoclastogenic activity of the tissues (19). In postmenopausal women, baseline GCF sclerostin and DKK1 differed significantly according to periodontal status. After treatment, total GCF sclerostin decreased in both periodontitis groups, with and without osteoporosis, whereas total DKK1 decreased in women with osteoporosis who received periodontal and bisphosphonate treatment but increased at 12 months in those with periodontitis alone (32). Studies that used the 2018 classification add detail. Gür et al. (20) found higher sclerostin, TNF-α, and PLAP-1, positively correlated with one another, in Stage III Grade C periodontitis than in gingivitis, which suggests an association with destructive disease. Ashifa et al. (21) reported higher sclerostin in periodontitis than in health, with no significant difference between Grades B and C. Overall, how sclerostin contributes to periodontal bone loss in humans is still incompletely understood (31).

Saliva

Saliva is easy to collect and noninvasive, which makes it attractive for periodontal diagnostics. The evidence for salivary sclerostin, is more limited than for GCF. In patients with periodontitis treated with non-surgical therapy, salivary sclerostin did not change significantly, whereas IL-1β, leptin, and TNF-α decreased significantly (22). Salivary sclerostin may respond less readily to treatment than these inflammatory markers. Abdulkareem and Abbas (23) reported higher salivary sclerostin in periodontitis than in healthy controls. Unexpectedly, levels were higher in Grade B than in Grade C periodontitis, which runs against the expectation that biomarker levels rise with disease severity and rate of progression. A GCF study also failed to separate the two grades, finding no significant difference in sclerostin between Grade B and Grade C (21). Sclerostin may reflect bone-remodeling activity at particular stages of disease rather than severity itself.

Serum

Serum sclerostin has been studied as a possible systemic marker of periodontitis, but whether smoking affects it remains unclear. Napimoga et al. (15) found higher serum sclerostin and TNF-α in patients with periodontitis than in periodontally healthy participants, and they related this to inflammatory and bone-remodeling activity. The study did not test how well serum sclerostin identifies disease. Miranda et al. (24) reported higher serum sclerostin in nonsmokers with periodontitis and type 2 diabetes than in nonsmokers without diabetes. Smoking-related differences appeared mainly in gingival sclerostin expression and not in serum. Serum levels of another Wnt antagonist, sFRP5, are also altered in periodontitis (33), suggesting broader dysregulation of Wnt/β-catenin signaling beyond sclerostin. Serum sclerostin may therefore be worth studying further as an adjunctive biomarker, but studies are needed to show whether it adds diagnostic or prognostic information in smoking-associated periodontal bone loss.

Smoking and Sclerostin Human Evidence

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Only three human studies compared sclerostin between smokers and non-smokers (24–26). Miranda et al. (24) linked smoking and type 2 diabetes to altered gingival expression of Wnt antagonists in patients with periodontitis, but with both exposures in the same participants, the independent contribution of smoking is hard to establish. Krishna et al. (25) followed smokers and non-smokers through non-surgical periodontal therapy. GCF sclerostin was significantly higher in smokers at baseline, and it fell more clearly after treatment in non-smokers. Ergin et al. (26) measured GCF sclerostin and TNF-α in 72 participants grouped by smoking and periodontal status. Smoking made no significant difference to sclerostin in the initial comparison, but a significant difference appeared once age was included in the analysis. Age and other participant characteristics may therefore shape the apparent effect of smoking. A genetic study of early-onset periodontitis found suggestive gene–smoking interaction signals at SOST, although sclerostin levels were not measured (34). Taken together, human evidence on smoking and periodontal sclerostin is limited and inconsistent (24–26). The studies differ in the sample analyzed, the population, how smoking was defined, and the statistical approach, and these differences may explain some of the disagreement. A smoking-specific effect on sclerostin therefore cannot yet be considered established.

Proposed Mechanistic Link Between Smoking, Sclerostin, and Alveolar Bone Loss

In experimental models, TNF-α increased SOST expression through NF-κB signaling (29). Rats with ligature induced periodontitis had higher osteocytic sclerostin and RANKL alongside alveolar bone remodeling (27,28). Sclerostin binds LRP5/6 and blocks canonical Wnt/β-catenin signaling, reducing osteoblast differentiation and bone formation (8). Resorption follows a separate route: the RANKL/OPG system governs osteoclast differentiation (7), and IL-1β promotes osteoclastogenesis and so adds to inflammatory bone loss (30). Smoking is linked to periodontal inflammation and alveolar bone destruction (2,3). A genetic study of early-onset periodontitis placed the SOST locus among the regions with suggestive gene–smoking interaction signals and expression-related variants. In the same study, exposing gingival fibroblasts to smoke extract changed the expression of two associated genes, SSH1 and ST8SIA1 (34). Sclerostin levels were not measured in that work. Taken together, these findings support a proposed pathway from smoking-associated inflammation through sclerostin-mediated Wnt inhibition to periodontal bone loss. This sequence has not been confirmed in humans with smoking-associated periodontitis (Figure 2). The mechanisms may help explain why smokers are more prone to periodontal bone loss (2,3), but how much sclerostin contributes to that susceptibility remains unclear (24–26).

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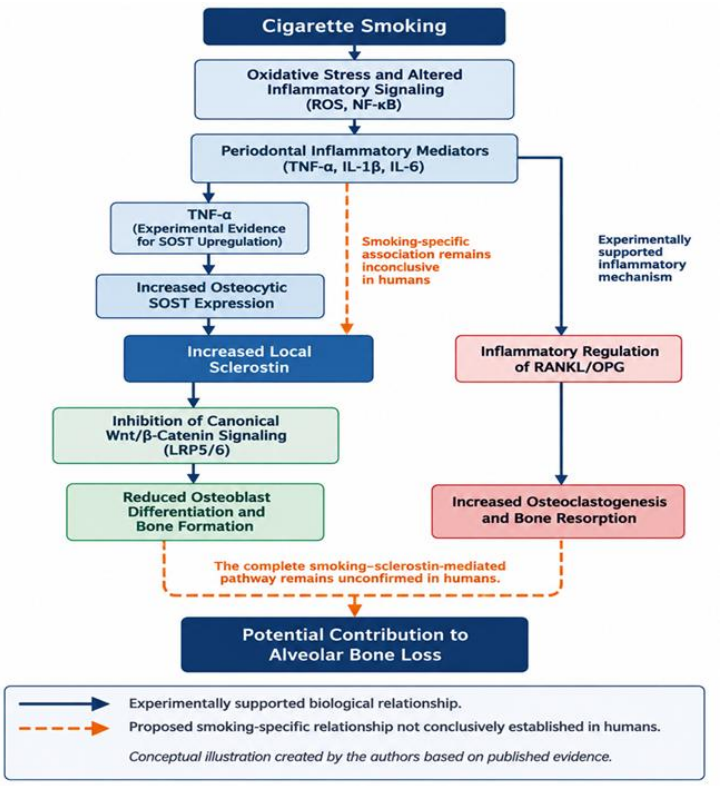


Figure. 2: Proposed mechanistic pathway linking cigarette smoking, inflammatory cytokines, sclerostin, and Wnt/β-catenin signaling. Conceptual illustration created by the authors based on previous studies (2,3,7,8,27–30,34); the smoking–sclerostin link is hypothetical rather than an established causal relationship in humans.

Preclinical Evidence and Therapeutic Implications

Animal studies suggest that sclerostin inhibition may support periodontal bone regeneration. Genetic deletion or pharmacological inhibition of sclerostin increased alveolar bone formation in experimental models (35–39). Combined inhibition of sclerostin and DKK1 also improved bone outcomes in animal studies (39,40). These findings have not been confirmed in patients with periodontitis, including smokers. Early studies on sclerostin deficient mice pointed to a change in the morphology of mineralized periodontal tissues such as (alveolar bone and cementum), thus representing the biological data on sclerostin as a modulator of periodontal tissues homeostasis (41). Romosozumab, an anti-sclerostin antibody, increases bone mineral density and reduces fracture risk in patients with osteoporosis (42,43). Its effectiveness in periodontal regeneration has not been established, and potential cardiovascular risks require consideration (42–45).

Limitations

Several limitations apply to this review. The human studies differ in design, sample size, and the fluid or tissue sampled, makes direct comparison difficult. Sclerostin was measured in gingival tissue, GCF, saliva, and serum. Smoking was handled unevenly. Few studies compared smokers with non-smokers. None had a design that could separate the effect of smoking from

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age, diabetes, or periodontal severity. Nearly all the clinical work is observational. The sclerostin evidence supports periodontal regeneration comes entirely from animal models. The search was not systematic. It did not assess risk of bias or pool effect estimates.

Knowledge Gaps and Future Research

It is still unclear whether smoking alters sclerostin levels and contributes to periodontal bone loss. Further studies should compare smokers and nonsmokers, accounting for smoking exposure, age, diabetes, and periodontal severity (24–26). Longitudinal studies are needed to assess the value of sclerostin in predicting disease progression and treatment response. Though animal studies support anti-sclerostin therapy (35–39), its safety and effectiveness in patients with periodontitis remain unknown.

Conclusion

Sclerostin is a promising candidate biomarker and potential therapeutic target in periodontal bone loss, but human evidence is largely associative. Its role in smoking-associated periodontitis remains unclear because clinical data are limited and may be confounded by factors such as age, and the clinical effectiveness of sclerostin-targeted therapy has not been established. Well-controlled longitudinal studies and clinical trials are needed.

Declarations

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None.

Ethics statement
This narrative review did not involve human participants or animals, so ethical approval was not required, in accordance with the journal's policy.

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Competing interests
The authors declare that they have no conflict of interest.

Author contributions
Israa Hameed Saleh and Omar Husham Ali provided the concept, data analysis, and writing of the manuscript; Israa Hameed Saleh worked with data collection and analysis; Omar Husham Ali revised the manuscript and analyzed the data Israa Hameed Saleh revised and approved the final version.

Data Availability
No new datasets were generated or analyzed in this narrative review.

References

1. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: framework and proposal of a new classification and case definition. J Periodontol. 2018;89 Suppl 1. S159–S172. doi:10.1002/JPER.18-0006.

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2. Apatzidou DA. The role of cigarette smoking in periodontal disease and treatment outcomes of dental implant therapy. Periodontol 2000. 2022;90(1):45–61. doi:10.1111/prd.12449.
3. Li B, Xia L, Liu C, Zhu Q, Chen Z. A study on the association between smoking, periodontal inflammation and alveolar bone resorption in patients with chronic periodontitis based on biomarkers: a meta-analysis. Front Med (Lausanne). 2025;12:1666722. doi:10.3389/fmed.2025.1666722.
4. Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, et al. A new classification scheme for periodontal and peri-implant diseases and conditions—introduction and key changes from the 1999 classification. J Clin Periodontol. 2018;45 Suppl 20:S1–S8. doi:10.1111/jcpe.12935.
5. Delgado-Calle J, Sato AY, Bellido T. Role and mechanism of action of sclerostin in bone. Bone. 2017;96:29–37. doi:10.1016/j.bone.2016.10.007.
6. Dreyer TJ, Keen JAC, Wells LM, Roberts SJ. Novel insights on the effect of sclerostin on bone and other organs. J Endocrinol. 2023;257(2). doi:10.1530/JOE-22-0209.
7. Udagawa N, Koide M, Nakamura M, Nakamichi Y, Yamashita T, Uehara S, et al. Osteoclast differentiation by RANKL and OPG signaling pathways. J Bone Miner Metab. 2021;39(1):19–26. doi:10.1007/s00774-020-01162-6.
8. Li X, Zhang Y, Kang H, Liu W, Liu P, Zhang J, et al. Sclerostin binds to LRP5/6 and antagonizes canonical Wnt signaling. J Biol Chem. 2005;280(20):19883–19887. doi:10.1074/jbc.M413274200.
9. Liao C, Liang S, Wang Y, Zhong T, Liu X. Sclerostin is a promising therapeutic target for oral inflammation and regenerative dentistry. J Transl Med. 2022;20:221. doi:10.1186/s12967-022-03417-4.
10. Jäger A, Götz W, Lossdörfer S, Rath-Deschner B. Localization of SOST/sclerostin in cementocytes in vivo and in mineralizing periodontal ligament cells in vitro. J Periodontal Res. 2010;45(2):246–254. doi:10.1111/j.1600-0765.2009.01227.x.
11. de Vries TJ, Huesa C. The osteocyte as a novel key player in understanding periodontitis through its expression of RANKL and sclerostin: a review. Curr Osteoporos Rep. 2019;17(3):116–121. doi:10.1007/s11914-019-00509-x.
12. Graves DT, Alshabab A, Albiero ML, Mattos M, Corrêa JD, Chen S, et al. Osteocytes play an important role in experimental periodontitis in healthy and diabetic mice through expression of RANKL. J Clin Periodontol. 2018;45(3):285–292. doi:10.1111/jcpe.12851.
13. Iwamoto R, Koide M, Udagawa N, Kobayashi Y. Positive and negative regulators of sclerostin expression. Int J Mol Sci. 2022;23(9):4895. doi:10.3390/ijms23094895.
14. Marini F, Giusti F, Palmini G, Brandi ML. Role of Wnt signaling and sclerostin in bone and as therapeutic targets in skeletal disorders. Osteoporos Int. 2023;34(2):213–238. doi:10.1007/s00198-022-06523-7.
15. Napimoga MH, Nametala C, da Silva FL, Miranda TS, Bossonaro JP, Demasi APD, et al. Involvement of the Wnt-β-catenin signalling antagonists, sclerostin and dickkopf-related protein 1, in chronic periodontitis. J Clin Periodontol. 2014;41(6):550–557. doi:10.1111/jcpe.12245.
16. Balli U, Aydogdu A, Dede FO, Turer CC, Guven B. Gingival crevicular fluid levels of sclerostin, osteoprotegerin, and receptor activator of nuclear factor-κB ligand in periodontitis. J Periodontol. 2015;86(12):1396–1404. doi:10.1902/jop.2015.150270.
17. Rezaei Esfahrood Z, Yadegari Z, Veysari SK, Kadkhodazadeh M. Gingival crevicular fluid levels of sclerostin in chronic periodontitis and healthy subjects. J Korean Assoc Oral Maxillofac Surg. 2018;44(6):289–292. doi:10.5125/jkaoms.2018.44.6.289.

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https://creativecommons.org/licenses/by-sa/4.0/

18. Chatzopoulos GS, Mansky KC, Lunos S, Costalonga M, Wolff LF. Sclerostin and WNT-5a gingival protein levels in chronic periodontitis and health. J Periodontal Res. 2019;54(5):555–565. doi:10.1111/jre.12659.
19. Chatzopoulos GS, Costalonga M, Mansky KC, Wolff LF. WNT-5a and SOST levels in gingival crevicular fluid depend on the inflammatory and osteoclastogenic activities of periodontal tissues. Medicina (Kaunas). 2021;57(8):788. doi:10.3390/medicina57080788.
20. Gür B, Afacan B, Çevik Ö, Köse T, Emingil G. Gingival crevicular fluid periodontal ligament-associated protein-1, sclerostin, and tumor necrosis factor-alpha levels in periodontitis. J Periodontol. 2023;94(10):1166–1175. doi:10.1002/JPER.22-0750.
21. Ashifa N, Viswanathan K, Srinivasan S, Kumar S, Sundaram R, Pavithran VK. Assessment of sclerostin levels in the gingival crevicular fluid of patients with periodontitis: a clinico-biochemical cross-sectional study. J Adv Periodontol Implant Dent. 2023;15(1):3–9. doi:10.34172/japid.2023.009.
22. Beiler TFCSB, de Mello Neto JM, Alves JC, Hamlet S, Ipe D, da Silva Figueredo CM. Impact of non-surgical periodontal treatment on salivary expression of cytokines related to bone metabolism. Odontology. 2020;108(4):646–652. doi:10.1007/s10266-020-00502-2.
23. Abdulkareem MA, Abbas RF. Salivary biomarkers for the prediction of Grade B and Grade C periodontitis: a case-control study. Dent Med Probl. 2026;63(2):335–347. doi:10.17219/dmp/202207.
24. Miranda TS, Napimoga MH, Feres M, Marins LM, da Cruz DF, da Silva HDP, et al. Antagonists of Wnt/β-catenin signalling in the periodontitis associated with type 2 diabetes and smoking. J Clin Periodontol. 2018;45(3):293–302. doi:10.1111/jcpe.12854.
25. Krishna G, Ravindran SK, Balu P, Muthu J, Sathiyaseelan S. Comparison of sclerostin levels in gingival crevicular fluid before and after nonsurgical therapy in smokers and nonsmokers with chronic periodontitis. World J Dent. 2021;12(5):363–366. doi:10.5005/jp-journals-10015-1853.
26. Ergin MO, Erciyas K, Tarakçıoğlu M, Ulusal H. The effect of smoking on gingival crevicular fluid sclerostin and TNF-α levels in patients with periodontitis. Eur J Ther. 2024;30(6):832–843. doi:10.58600/eurjther2370.
27. Kim JH, Lee DE, Cha JH, Bak EJ, Yoo YJ. Receptor activator of nuclear factor-κB ligand and sclerostin expression in osteocytes of alveolar bone in rats with ligature-induced periodontitis. J Periodontol. 2014;85(11):e370–e378. doi:10.1902/jop.2014.140230.
28. Kim JH, Kim AR, Choi YH, Jang S, Woo GH, Cha JH, et al. Tumor necrosis factor-α antagonist diminishes osteocytic RANKL and sclerostin expression in diabetes rats with periodontitis. PLoS One. 2017;12(12):e0189702. doi:10.1371/journal.pone.0189702.
29. Baek K, Hwang HR, Park HJ, Kwon A, Qadir AS, Ko SH, et al. TNF-α upregulates sclerostin expression in obese mice fed a high-fat diet. J Cell Physiol. 2014;229(5):640–650. doi:10.1002/jcp.24487.
30. Ruscitti P, Cipriani P, Carubbi F, Liakouli V, Zazzeroni F, Di Benedetto P, et al. The role of IL-1β in the bone loss during rheumatic diseases. Mediators Inflamm. 2015;2015:782382. doi:10.1155/2015/782382.
31. Chatzopoulos GS, Koidou VP, Wolff LF. Expression of Wnt signaling agonists and antagonists in periodontitis and healthy subjects, before and after non-surgical periodontal treatment: a systematic review. J Periodontal Res. 2022;57(4):698–710. doi:10.1111/jre.13029.
32. Ozden FO, Demir E, Lutfioglu M, Acarel EE, Bilgici B, Atmaca A. Effects of periodontal and bisphosphonate treatment on the gingival crevicular levels of sclerostin and dickkopf-1 in postmenopausal osteoporosis with and without periodontitis. J Periodontal Res. 2022;57(4):849–858. doi:10.1111/jre.13023.

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33. Schulz J, Knappe C, Graetz C, Mewes L, Türk K, Black AK, et al. Secreted frizzled-related protein 5 serum levels in human periodontitis—a nested case-control study. J Clin Periodontol. 2019;46(5):522–528. doi:10.1111/jcpe.13087.
34. Freitag-Wolf S, Munz M, Wiehe R, Junge O, Graetz C, Jockel-Schneider Y, et al. Smoking modifies the genetic risk for early-onset periodontitis. J Dent Res. 2019;98(12): doi:10.1177/0022034519875443.
35. Taut AD, Jin Q, Chung JH, Galindo-Moreno P, Yi ES, Sugai JV, et al. Sclerostin antibody stimulates bone regeneration after experimental periodontitis. J Bone Miner Res. 2013;28(11):2347–2356. doi:10.1002/jbmr.1984.
36. Ren Y, Han X, Ho SP, Harris SE, Cao Z, Economides AN, et al. Removal of SOST or blocking its product sclerostin rescues defects in the periodontitis mouse model. FASEB J. 2015;29(7):2702–2711. doi:10.1096/fj.14-265496.
37. Chen H, Xu X, Liu M, Zhang W, Ke HZ, Qin A, et al. Sclerostin antibody treatment causes greater alveolar crest height and bone mass in an ovariectomized rat model of localized periodontitis. Bone. 2015;76:141–148. doi:10.1016/j.bone.2015.04.002.
38. Yao Y, Kauffmann F, Maekawa S, Sarment LV, Sugai JV, Schmiedeler CA, et al. Sclerostin antibody stimulates periodontal regeneration in large alveolar bone defects. Sci Rep. 2020;10:16217. doi:10.1038/s41598-020-73026-y.
39. Liu M, Kurimoto P, Zhang J, Niu QT, Stolina M, Dechow PC, et al. Sclerostin and DKK1 inhibition preserves and augments alveolar bone volume and architecture in rats with alveolar bone loss. J Dent Res. 2018;97(9):1031–1038. doi:10.1177/0022034518766874.
40. Florio M, Gunasekaran K, Stolina M, Li X, Liu L, Tipton B, et al. A bispecific antibody targeting sclerostin and DKK-1 promotes bone mass accrual and fracture repair. Nat Commun. 2016;7:11505. doi:10.1038/ncomms11505.
41. Kuchler U, Schwarze UY, Dobsak T, Heimel P, Bosshardt DD, Kneissel M, et al. Dental and periodontal phenotype in sclerostin knockout mice. Int J Oral Sci. 2014;6(2):70–76. doi:10.1038/ijos.2014.12.
42. Cosman F, Crittenden DB, Adachi JD, Binkley N, Czerwinski E, Ferrari S, et al. Romosozumab treatment in postmenopausal women with osteoporosis. N Engl J Med. 2016;375(16):1532–1543. doi:10.1056/NEJMoa1607948.
43. Saag KG, Petersen J, Brandi ML, Karaplis AC, Lorentzon M, Thomas T, et al. Romosozumab or alendronate for fracture prevention in women with osteoporosis. N Engl J Med. 2017;377(15):1417–1427. doi:10.1056/NEJMoa1708322.
44. Li TJ, Wang R, Li QY, Li CY, Jiang L. Sclerostin regulation: a promising therapy for periodontitis by modulating alveolar bone. Chin Med J (Engl). 2020;133(12):1456–1461. doi:10.1097/CM9.0000000000000764.
45. Yu Y, Wang L, Ni S, Li D, Liu J, Chu HY, et al. Targeting loop3 of sclerostin preserves its cardiovascular protective action and promotes bone formation. Nat Commun. 2022;13:4241. doi:10.1038/s41467-022-31997-8.

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