

Original article

Vitamin D Deficiency as a Potential Systemic Risk Indicator for Periodontal Disease and Fixed Dental Prosthesis Failure: A Systematic Literature Review

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Abstract

Vitamin D has an important role in calcium metabolism, bone remodeling, immune regulation, and control of inflammatory responses. These functions are closely related to periodontal health, alveolar bone stability, and the biological support of teeth carrying fixed dental prostheses. Previous studies have suggested that vitamin D deficiency may be associated with periodontal inflammation, clinical attachment loss, alveolar bone loss, and impaired oral tissue healing. However, the relationship between vitamin D deficiency and failure of fixed dental prostheses remains less clearly established, especially when prosthetic failure is linked to periodontal deterioration around abutment teeth. This systematic literature review aimed to evaluate the available evidence on the association between vitamin D deficiency, periodontal disease, and fixed dental prosthesis failure. A structured literature search was conducted in PubMed, Scopus, Web of Science, ScienceDirect, Cochrane Library, and Google Scholar for studies published between 2020 and 2026. The search used combinations of terms related to vitamin D deficiency, serum 25-hydroxyvitamin D, periodontal disease, periodontitis, alveolar bone loss, fixed dental prosthesis, crowns, bridges, abutment teeth, and prosthetic complications. Studies were selected according to predefined inclusion and exclusion criteria. Data were extracted regarding study design, vitamin D assessment, periodontal outcomes, prosthetic outcomes, and main findings. The methodological quality of the included evidence was assessed according to study design, and the findings were summarized narratively because of differences in study methods and outcomes. The reviewed evidence showed a consistent association between low serum vitamin D levels and poorer periodontal outcomes, including increased gingival inflammation, deeper periodontal pockets, clinical attachment loss, and alveolar bone loss. The direct evidence linking vitamin D deficiency to fixed dental prosthesis failure was limited. However, available periodontal, prosthodontic, and implant-related studies suggest that vitamin D deficiency may contribute indirectly to fixed prosthesis complications through periodontal inflammation, reduced alveolar bone support, impaired healing, and compromised abutment tooth stability. Vitamin D deficiency may be considered a potential systemic risk indicator for periodontal disease. Its relationship with fixed dental prosthesis failure appears to be indirect rather than direct, mainly through periodontal breakdown, alveolar bone loss, and abutment tooth compromise. Further longitudinal clinical studies are needed to clarify whether correction of vitamin D deficiency can improve periodontal stability and reduce biological complications around fixed dental prostheses.

Keywords: Vitamin D Deficiency, Periodontal Disease, Periodontitis, Fixed Dental Prosthesis, Crowns.

Introduction

Periodontal disease is a chronic inflammatory condition affecting the supporting structures of the teeth, including the gingiva, periodontal ligament, cementum, and alveolar bone. It usually begins with gingival inflammation and may progress to periodontitis when the inflammatory process causes clinical attachment loss, periodontal pocket formation, bone loss, tooth mobility, and eventually tooth loss. Although dental plaque is the main initiating factor, the severity and progression of periodontal disease are strongly influenced by the host immune response and general systemic health [1].

Vitamin D is a fat-soluble vitamin that has essential functions in calcium and phosphate regulation, bone mineralization, immune modulation, and inflammatory control [2]. These functions are highly relevant to oral and periodontal health because periodontal tissues depend on a balanced relationship between microbial challenge, immune defense, inflammation, and bone remodeling [3]. When serum vitamin D levels are low, this balance may be disturbed, leading to increased inflammatory activity, weaker antimicrobial defense, and reduced ability of periodontal tissues to heal properly [4-7].

Several clinical studies and reviews have reported that vitamin D deficiency may be associated with periodontal disease. Low serum 25-hydroxyvitamin D [25(OH)D] levels have been linked with gingival inflammation, bleeding on probing, increased probing pocket depth, clinical attachment loss, and alveolar bone loss [8]. This relationship may be explained by the role of vitamin D in controlling inflammatory mediators, supporting immune defense, and maintaining bone density. Therefore, vitamin D deficiency may not be the only cause of periodontal disease, but it may increase periodontal tissue destruction in the presence of plaque, smoking, diabetes, poor oral hygiene, or other risk factors [9,10].

Fixed dental prostheses, such as crowns and bridges, are commonly used to restore damaged or missing teeth and improve function, esthetics, and patient comfort. Their long-term success depends on both technical and biological factors [11]. Technical factors include marginal adaptation, cementation, prosthetic material, occlusion, and design.

Biological factors include gingival health, periodontal support, alveolar bone stability, and the condition of abutment teeth. Poor marginal fit, plaque accumulation, recurrent caries, gingival inflammation, periodontal pocketing, and bone loss around abutment teeth may contribute to biological failure of fixed dental prostheses [12,13].

The direct relationship between vitamin D deficiency and fixed dental prosthesis failure has not been sufficiently investigated. Most available studies focus either on vitamin D and periodontal disease or on vitamin D and dental implant osseointegration. However, fixed tooth-supported prostheses depend heavily on healthy periodontal tissues and stable abutment teeth. Therefore, vitamin D deficiency may indirectly affect prosthetic outcomes by worsening periodontal inflammation, alveolar bone loss, and abutment tooth mobility [14,16]. Accordingly, this systematic literature review aimed to evaluate the available evidence on the association between vitamin D deficiency, periodontal disease, and fixed dental prosthesis failure. It also aimed to clarify whether vitamin D deficiency may be considered a systemic risk indicator for biological complications around fixed dental prostheses.

Methods

Study Design

This study was designed as a systematic literature review with narrative synthesis of published evidence. The review was conducted to summarize and critically evaluate available evidence regarding the relationship between vitamin D deficiency, periodontal disease, and fixed dental prosthesis failure.

The review followed the general principles of systematic review methodology, including a clear research question, structured search strategy, eligibility criteria, study selection, data extraction, quality assessment, and narrative synthesis of findings. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines.

Review Question

The central review question was formulated as: Is vitamin D deficiency associated with periodontal disease severity and fixed dental prosthesis failure? This question was structured according to the PECO framework to ensure clarity and methodological rigor. The Population comprised adult dental patients undergoing periodontal assessment or those with fixed dental prostheses, including crowns, bridges, or abutment teeth. The Exposure was defined as vitamin D deficiency, specifically low serum 25-hydroxyvitamin D [25(OH)D] levels. The Comparison group included individuals with sufficient or higher vitamin D levels. The Outcomes encompassed a wide spectrum of clinical parameters, including periodontal disease severity, gingival inflammation, probing pocket depth, clinical attachment loss, alveolar bone loss, tooth mobility, abutment periodontal deterioration, and complications or failure of fixed dental prostheses.

Protocol and Registration

A review protocol was prepared before conducting the literature search. The protocol included the review question, search strategy, eligibility criteria, outcomes of interest, method of study selection, data extraction items, quality assessment approach, and synthesis plan. The protocol of this systematic literature review was not registered in PROSPERO. However, the review process and manuscript reporting were conducted in accordance with the PRISMA 2020 reporting guidelines.

Search Strategy

A comprehensive search strategy was employed to identify relevant studies addressing the association between vitamin D deficiency, periodontal disease severity, and fixed dental prosthesis failure. The search was conducted across six major electronic databases: PubMed, Scopus, Web of Science, ScienceDirect, Cochrane Library, and Google Scholar. The time frame was restricted to publications between January 2020 and June 2026, with inclusion limited to English-language articles.

To ensure precision, search terms were organized into three thematic categories. The vitamin D-related terms included "vitamin D deficiency," "25-hydroxyvitamin D," "25(OH)D," "serum vitamin D," and "vitamin D status." The periodontal terms encompassed "periodontal disease," "periodontitis," "gingivitis," "clinical attachment loss," "probing pocket depth," "alveolar bone loss," and "periodontal inflammation." The prosthodontic terms comprised "fixed dental prosthesis," "fixed partial denture," "dental crown," "dental bridge," "abutment teeth," "prosthesis failure," "prosthetic complications," "decementation," "marginal discrepancy," and "recurrent caries."

An example of the PubMed search strategy was: ("vitamin D deficiency" OR "25-hydroxyvitamin D" OR "25(OH)D" OR "serum vitamin D") AND ("periodontal disease" OR "periodontitis" OR "clinical attachment loss" OR "alveolar bone loss") AND ("fixed dental prosthesis" OR "dental crown" OR "dental bridge" OR "abutment teeth" OR "prosthesis failure").

In addition to database searches, the reference lists of relevant articles and reviews were screened manually to capture additional studies. The database-specific strategies, including applied filters and Boolean combinations, are summarized in Table 1, ensuring transparency and reproducibility of the search process.

Table 1. Search Strategy Used in Different Databases

Database	Search terms	Filters
PubMed	Vitamin D deficiency AND periodontitis AND fixed dental prosthesis	English, human studies, 2020–2026
Scopus	25(OH)D AND periodontal disease AND prosthesis failure	English, 2020–2026
Web of Science	Vitamin D AND alveolar bone loss AND crowns OR bridges	English, 2020–2026
ScienceDirect	Vitamin D deficiency AND periodontal inflammation AND dental prosthesis	English, 2020–2026
Google Scholar	Vitamin D deficiency, periodontal disease, and fixed dental prosthesis failure	English, relevant articles
Cochrane Library	Vitamin D AND periodontitis	English, 2020–2026

Inclusion Criteria

Studies were selected for inclusion based on predefined eligibility criteria to ensure relevance and methodological rigor. Only publications in the English language were considered. Eligible studies were restricted to human research or reviews grounded in human clinical evidence. To address the exposure of interest, studies were required to assess serum vitamin D status, specifically serum 25-hydroxyvitamin D [25(OH)D] levels. Regarding outcomes, studies had to evaluate periodontal parameters such as periodontal disease, gingival inflammation, probing pocket depth, clinical attachment loss, or alveolar bone loss. In addition, studies discussing fixed dental prostheses—including crowns, bridges, abutment teeth—and reporting prosthetic complications or prosthesis failure were included.

A wide range of study designs was accepted to capture the breadth of available evidence. These encompassed observational studies, clinical studies, cohort studies, case-control studies, cross-sectional studies, randomized clinical trials, systematic reviews, and relevant narrative reviews. This inclusive approach allowed for a comprehensive synthesis of both primary data and secondary analyses, thereby strengthening the evidence base for evaluating the relationship between vitamin D deficiency, periodontal disease severity, and fixed dental prosthesis outcomes. The inclusion and exclusion criteria applied during study selection are summarized in Table 2.

Table 2. Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Human studies or human-based reviews	Animal studies
English-language publications	In vitro studies
Studies assessing vitamin D or serum 25(OH)D	Studies not assessing vitamin D
Studies evaluating periodontal disease or periodontal outcomes	Studies unrelated to periodontal outcomes
Studies discussing fixed prostheses, crowns, bridges, abutments, or prosthetic outcomes	Articles without an available full text
Clinical, observational, and review studies relevant to the review question	Editorials, letters, and conference abstracts without sufficient data

Exclusion Criteria

Studies were excluded if they met any of the following criteria:

- Animal studies.
- In vitro studies.
- Case reports with very limited clinical relevance.
- Studies not assessing vitamin D status.
- Studies unrelated to periodontal disease or prosthetic dental outcomes.
- Articles with unavailable full text.
- Non-English publications.
- Editorials, opinion articles, letters, and conference abstracts without sufficient data.

Study Selection

All identified records were screened according to title and abstract. Clearly, irrelevant records were excluded. Full-text articles were then assessed according to the inclusion and exclusion criteria. Studies were selected if they provided evidence related to one or more of the following areas: vitamin D and periodontal disease, vitamin D and alveolar bone or oral tissue healing, vitamin D and implant-related bone outcomes, or fixed dental prosthesis complications related to periodontal or abutment tooth deterioration.

Disagreements during study selection were resolved by rechecking the full text and reviewing the relevance of each article to the review question. The study selection process, including record identification, duplicate removal, title and abstract screening, full-text assessment, exclusions, and final inclusion, is presented in the PRISMA Flow Diagram (Figure 1).

Figure 1. PRISMA-Style Summary of the Reported Study Selection Data

Based only on the counts explicitly reported in the manuscript

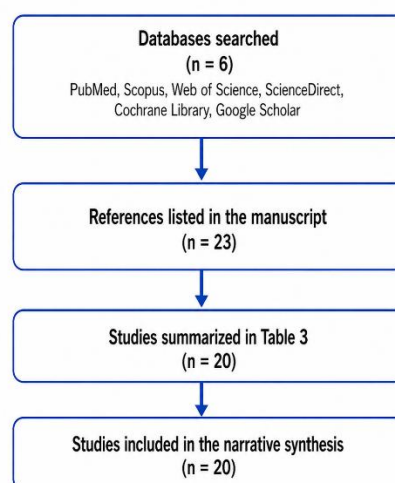


Figure 1. PRISMA Flow Diagram

Data Extraction

Data were extracted using a structured data extraction form. The following information was collected from each relevant study:

- Author name and year of publication.
- Study design.
- Study population or type of evidence.
- Method of vitamin D assessment.
- Periodontal outcomes assessed.
- Prosthodontic or bone-related outcomes assessed.
- Main findings.
- Main limitations.

The extracted data were carefully reviewed to ensure consistency and avoid overinterpreting indirect evidence.

Quality Assessment

The methodological quality of the included evidence was assessed according to study design. Observational and clinical studies were assessed for clarity of objectives, sample selection, measurement of vitamin D levels, definition of periodontal outcomes, control of confounding factors, and appropriateness of statistical analyses. Systematic reviews and meta-analyses were assessed according to clarity of search strategy, eligibility criteria, study selection process, risk-of-bias assessment, and consistency of conclusions. Narrative reviews were used only as supporting background evidence and were not treated as strong primary evidence. The overall strength of evidence was interpreted as strong, moderate, limited, or weak depending on consistency of findings, study design, directness of evidence, and control of confounding variables.

Data Synthesis

The findings were grouped into three main themes:

1. Vitamin D deficiency and periodontal disease.
2. Vitamin D deficiency and bone-related oral outcomes.
3. Possible indirect relationship between vitamin D deficiency and fixed dental prosthesis failure.

A meta-analysis was not performed because of methodological differences between the available studies and the limited number of studies directly assessing fixed dental prosthesis failure in relation to serum vitamin D status.

Results

Characteristics of the Reviewed Evidence

The reviewed literature included systematic reviews, meta-analyses, clinical studies, case-control studies, cross-sectional studies, prospective studies, and narrative reviews. Most of the available evidence focused on the relationship between vitamin D status and periodontal disease. Fewer studies directly examined vitamin D in relation to prosthodontic outcomes, and most prosthetic evidence was indirect, focusing on periodontal health, abutment teeth, or implant-related bone outcomes.

Serum 25-hydroxyvitamin D [25(OH)D] was the most commonly used marker for vitamin D status. Periodontal outcomes included gingival inflammation, bleeding on probing, probing pocket depth, clinical attachment loss, and alveolar bone loss. Prosthodontic outcomes included prosthesis complications, abutment tooth periodontal status, prosthesis success, and biological factors affecting prosthetic prognosis. The main characteristics and relevance of the reviewed literature are presented in Table 3.

Table 3. Characteristics of the Reviewed Literature

Author/year	Study type	Main focus	Relevance to the present review
Botelho et al., 2020	Comprehensive review	Vitamin D deficiency and oral health	Supports the biological link between vitamin D and oral tissues
Machado et al., 2020	Systematic review and meta-analysis	Vitamin D and periodontitis	Provides evidence of the association between vitamin D and periodontal disease
Alzahrani et al., 2021	Case-control study	Periodontitis and vitamin D status	Supports the clinical association between low vitamin D and periodontitis
Madi et al., 2021	Preliminary clinical study	Vitamin D level and periodontal disease	Provides regional clinical evidence on vitamin D and periodontal disease
Perić et al., 2020	Randomized clinical study	Vitamin D supplementation and periodontitis treatment	Supports the possible role of vitamin D in periodontal management
Sllamniku Dalipi & Dragidella, 2022	Literature review	Calcium/vitamin D and periodontal therapy	Supports the adjunctive role of vitamin D in periodontal health
Alsulaimani et al., 2022	Systematic review	Vitamin D and early dental implant failure	Provides indirect prosthetic relevance through bone healing
Koppolu et al., 2023	Cross-sectional study	Vitamin D levels in gingivitis and periodontitis	Supports the association between vitamin D and periodontal inflammation
Shah et al., 2023	Systematic review	Vitamin D and periodontal health	Summarizes clinical evidence on vitamin D and periodontal outcomes
Liang et al., 2023	Systematic review and meta-analysis	Vitamin D in periodontitis	Provides updated evidence on the vitamin D-periodontitis association
Meghil & Cutler, 2023	Review	Vitamin D and periodontal inflammation	Explains inflammatory mechanisms
Cristea et al., 2023	Clinical/prosthetic study	Prosthetic success and periodontal risk factors	Supports the role of periodontal health in prosthetic prognosis
Dragomir et al., 2023	Narrative review	Fixed dental prostheses and periodontal status	Supports the link between prostheses and periodontal inflammation
Hussein et al., 2024	Systematic review	Vitamin D deficiency and oral diseases	Supports the relevance of vitamin D to periodontitis and oral health
Crnić & Kašaj, 2024	Comprehensive review	Vitamin D level and periodontitis	Supports biological and clinical association
Buzatu et al., 2024	Systematic review	Vitamin D and dental implant osseointegration	Provides indirect evidence on vitamin D and oral bone healing
Mohsen et al., 2024	Prospective study	Vitamin D deficiency and implant osseointegration	Supports the possible role of vitamin D in oral bone outcomes
Al-Quisi et al., 2024	Prospective clinical study	Vitamin D3 deficiency and osseointegration	Supports the biological plausibility of vitamin D in prosthetic dentistry
Tallon et al., 2024	Umbrella review	Vitamin D, bone metabolism, and implants	Provides broader evidence on vitamin D and bone-related oral outcomes
Ziada et al., 2025	Systematic review	Vitamin D deficiency and oral health	Supports the overall relationship between vitamin D and oral health

The direction and strength of evidence according to the evaluated outcomes are summarized in Table 4, while the quality and directness of evidence are presented in Table 5.

Table 4. Summary of Evidence According to Outcome

Outcome	Direction of evidence	Strength of evidence	Comment
Gingival inflammation	Positive association with vitamin D deficiency	Moderate	Lower vitamin D is commonly linked with more inflammation
Periodontitis severity	Positive association	Moderate	Supported by several reviews and clinical studies
Clinical attachment loss	Positive association	Moderate	Often reported with a poorer periodontal status
Alveolar bone loss	Positive association	Moderate	Biologically plausible through bone metabolism
Fixed prosthesis failure	Indirect association	Weak	Few direct studies are available
Abutment periodontal failure	Possible indirect association	Weak to moderate	May occur through periodontal breakdown
Implant osseointegration	Possible association	Limited to moderate	Relevant biologically but not identical to tooth-supported prostheses

Table 5. Quality and Directness of Evidence

Evidence area	Directness of evidence	Overall strength	Interpretation
Vitamin D and periodontal disease	Direct	Moderate	Evidence is relatively consistent
Vitamin D and gingival inflammation	Direct	Moderate	Supported by the inflammatory mechanism and clinical findings
Vitamin D and alveolar bone loss	Direct/indirect	Moderate	Biologically plausible
Vitamin D and fixed dental prosthesis failure	Indirect	Weak	Requires more direct clinical studies
Vitamin D and abutment tooth deterioration	Indirect	Weak to moderate	Likely mediated through periodontal disease
Vitamin D and implant outcomes	Indirect to the prosthesis topic	Limited to moderate	Useful supportive evidence for bone healing

Vitamin D Deficiency and Periodontal Disease

The reviewed evidence generally supported an association between vitamin D deficiency and poorer periodontal health. Several studies reported that patients with periodontitis had lower serum vitamin D levels compared with periodontally healthy individuals. Vitamin D deficiency was also linked with increased gingival inflammation, bleeding on probing, deeper periodontal pockets, clinical attachment loss, and alveolar bone loss.

This association appears biologically plausible. Vitamin D contributes to immune regulation, antimicrobial defense, and bone metabolism. When vitamin D levels are low, periodontal tissues may become more vulnerable to destructive inflammation and impaired healing. However, vitamin D deficiency should not be considered the only cause of periodontal disease. Periodontitis remains a multifactorial disease influenced by bacterial plaque, smoking, diabetes, oral hygiene, age, genetic susceptibility, and other systemic factors.

Vitamin D Deficiency and Fixed Dental Prosthesis Failure

The direct evidence linking vitamin D deficiency to fixed dental prosthesis failure was limited. Few studies examined tooth-supported crowns or bridges in direct relation to serum vitamin D status. However, prosthodontic studies showed that the success of fixed dental prostheses depends strongly on periodontal health, abutment tooth stability, marginal adaptation, plaque control, and absence of biological complications.

Based on the available evidence, vitamin D deficiency may be indirectly related to fixed prosthesis failure through its negative effect on periodontal tissues. If vitamin D deficiency contributes to periodontal inflammation, attachment loss, bone loss, and tooth mobility, it may also increase the risk of complications around abutment teeth. These complications may include gingival inflammation around prosthetic margins, periodontal pocketing, abutment mobility, radiographic bone loss, recurrent caries risk due to poor periodontal environment, and eventual need for repair or replacement.

Vitamin D and Bone-Related Prosthetic Outcomes

Evidence from dental implant studies provides additional biological support for the possible role of vitamin D in prosthetic dentistry. Some studies have suggested that vitamin D may influence bone metabolism, bone healing, and osseointegration. Although dental implants are different from tooth-supported fixed prostheses, both depend on healthy

oral bone and soft tissues. Therefore, the implant literature supports the idea that vitamin D deficiency may be relevant to prosthetic outcomes where bone support and tissue healing are important.

Strength of Evidence

The evidence linking vitamin D deficiency with periodontal disease was stronger and more consistent than the evidence linking vitamin D deficiency directly with fixed dental prosthesis failure. Most periodontal studies and reviews supported a relationship between low vitamin D levels and worse periodontal outcomes. In contrast, the evidence related to fixed dental prostheses was indirect and mainly explained through periodontal deterioration around abutment teeth.

Therefore, vitamin D deficiency can be considered a potential systemic risk indicator for periodontal deterioration. Its role in fixed dental prosthesis failure should be interpreted cautiously as an indirect relationship rather than a proven direct cause.

Discussion

This systematic literature review evaluated the available evidence on the relationship between vitamin D deficiency, periodontal disease, and fixed dental prosthesis failure. The main finding was that vitamin D deficiency is more consistently associated with periodontal disease than with fixed dental prosthesis failure. Most reviewed studies indicated that low serum vitamin D levels may be linked with poorer periodontal outcomes, including gingival inflammation, periodontal pocketing, clinical attachment loss, and alveolar bone loss.

The relationship between vitamin D and periodontal health can be explained through immune and bone-related mechanisms [19]. Periodontitis is not only a bacterial infection but also a host-mediated inflammatory disease. Vitamin D may help regulate inflammatory responses and support antimicrobial activity within periodontal tissues. When vitamin D levels are deficient, the inflammatory response may become more destructive, which can contribute to periodontal breakdown.

The evidence regarding fixed dental prosthesis failure is less direct. Fixed prostheses may fail because of many technical and biological causes, including poor marginal adaptation, recurrent caries, loss of retention, fracture, occlusal overload, poor oral hygiene, and periodontal disease around abutment teeth. Vitamin D deficiency is not expected to cause mechanical prosthesis failure directly. However, it may contribute biologically by worsening periodontal inflammation and reducing alveolar bone support around abutment teeth [20].

This indirect pathway is clinically important. A crown or bridge may be technically acceptable, but its prognosis may become poor if the supporting periodontal tissues are inflamed or weakened. In patients with vitamin D deficiency, periodontal inflammation and alveolar bone loss may increase the risk of abutment tooth mobility and biological complications around the prosthesis [21]. Therefore, vitamin D status may be considered during comprehensive periodontal and prosthodontic assessment, especially in patients with repeated prosthetic complications or unexplained periodontal deterioration.

The reviewed implant-related studies also support the biological importance of vitamin D in oral bone health. Dental implants differ from tooth-supported fixed prostheses, but both require healthy bone and soft tissue conditions. The association between vitamin D and osseointegration suggests that vitamin D may have a role in oral bone healing and maintenance, which may also be relevant in patients with fixed prosthetic restorations supported by compromised periodontal tissues. However, the findings of this review should be interpreted carefully. The available evidence does not prove that vitamin D deficiency directly causes fixed dental prosthesis failure. Many of the available studies are observational, and several confounding factors may influence both periodontal disease and prosthetic outcomes. These include age, smoking, diabetes mellitus, oral hygiene, sunlight exposure, diet, prosthesis age, and prosthetic design quality. More longitudinal and interventional studies are needed to determine whether correction of vitamin D deficiency can improve periodontal stability or reduce prosthetic complications [22,23].

Limitations

This review has some limitations. First, the number of studies directly linking vitamin D deficiency with fixed dental prosthesis failure is limited. Most available evidence focuses on vitamin D and periodontal disease or on vitamin D and dental implant outcomes. Second, the reviewed studies varied in design, sample size, vitamin D cut-off values, periodontal measurements, and outcome definitions, which made quantitative pooling difficult. Third, many studies were observational, so causal conclusions cannot be made. Fourth, important confounding factors such as smoking, diabetes, oral hygiene, prosthesis age, and prosthetic design were not consistently controlled across studies. Finally, the lack of a standardized definition of fixed dental prosthesis failure limits the strength of conclusions in this area.

Conclusion

This systematic literature review suggests that vitamin D deficiency may be associated with poorer periodontal health, including increased gingival inflammation, probing pocket depth, clinical attachment loss, and alveolar bone loss. The evidence supporting the association between vitamin D deficiency and periodontal disease is stronger than the evidence linking vitamin D deficiency directly to fixed dental prosthesis failure. The relationship between vitamin D deficiency and fixed dental prosthesis failure appears to be mainly indirect. Vitamin D deficiency may contribute to prosthetic

complications by increasing periodontal inflammation, reducing alveolar bone support, and compromising abutment tooth stability. Therefore, vitamin D deficiency may be considered a potential systemic risk indicator rather than a direct cause of fixed dental prosthesis failure. Further well-designed clinical studies are needed to investigate this relationship more clearly. Future research should include standardized vitamin D assessment, clear definitions of prosthesis failure, periodontal measurements around abutment teeth, and adjustment for important confounding factors such as smoking, diabetes, oral hygiene, prosthesis duration, and prosthesis quality.

Ethical Approval

Ethical approval was not required because this study was a review of previously published studies and did not involve direct contact with human participants or the collection of new patient data.

Conflict of Interest

The author declares no conflict of interest.

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This study received no external funding.

Data Availability

All data used in this review were obtained from published studies.

References

- Alenezi A, Aloqayli S. Technical complications with tooth-supported fixed dental prostheses of different span lengths: An up to 15-year retrospective study. *BMC Oral Health*. 2023;23:393. doi: 10.1186/s12903-023-03121-9.
- Al-Quisi AF, Jamil FA, Al-Anee AM, Jassim Muhsen S. Relationship between the level of vitamin D3 deficiency and successful osseointegration: A prospective clinical study. *Sci World J*. 2024;2024:9933646. doi: 10.1155/2024/9933646.
- Alsaggaf AU, Almuwallad A, Mirza L. The impact of fixed and removable dental prostheses on the periodontal health of abutment teeth: A retro-prospective comparative study. *Saudi Dent J*. 2024. doi: 10.1016/j.sdentj.2024.11.010. [Epub ahead of print].
- Alsulaimani L, Alqarni A, Almarghlani A, Hassoubah M. The relationship between low serum vitamin D level and early dental implant failure: A systematic review. *Cureus*. 2022;14(1):e21264. doi: 10.7759/cureus.21264.
- Alzahrani AAH, Alharbi RA, Alzahrani MSA, et al. Association between periodontitis and vitamin D status: A case-control study. *Saudi J Biol Sci*. 2021;28(7):4016–4021. doi: 10.1016/j.sjbs.2021.04.006.
- Botelho J, Machado V, Proença L, Delgado AS, Mendes JJ. Vitamin D deficiency and oral health: A comprehensive review. *Nutrients*. 2020;12(5):1471. doi: 10.3390/nu12051471.
- Buzatu BLR, Buzatu R, Luca MM. Impact of vitamin D on osseointegration in dental implants: A systematic review of human studies. *Nutrients*. 2024;16:209. doi: 10.3390/nu16010209.
- Cristea I, et al. Oral and periodontal risk factors of prosthetic success for 3-unit natural tooth-supported bridges versus implant-supported fixed dental prostheses. *Diagnostics*. 2023;13(5):852. doi: 10.3390/diagnostics13050852.
- Crnić T, Kašaj A. Association of vitamin D level and periodontitis: A comprehensive review. *Periodontal Implant Res*. 2024;8:14. doi: 10.1007/s41894-024-00143-6.
- Dragomir LP, et al. The influence of fixed dental prostheses on the expression of inflammatory markers and periodontal status: Narrative review. *Medicina*. 2023;59(5):941. doi: 10.3390/medicina59050941.
- Hussein AS, Rosli RA, Ramle RS, Khor GH. The impact of vitamin D deficiency on caries, periodontitis, and oral cancer: A systematic review. *Saudi Dent J*. 2024;36(7):970–979. doi: 10.1016/j.sdentj.2024.04.012.
- Koppolu P, Alshahrani AMA, Ghawas MAY, Almuqbil MSA, Swapna LA, Almuhaydib AKH. Estimation of vitamin D levels using a chairside diagnostic test kit in patients with gingivitis and periodontitis: A cross-sectional study. *J Int Soc Prev Community Dent*. 2023;13(5):402–409. doi: 10.4103/jispcd.JISPCD_50_23.
- Liang F, Zhou Y, Zhang Z, Zhang Z, Shen J. Association of vitamin D in individuals with periodontitis: An updated systematic review and meta-analysis. *BMC Oral Health*. 2023;23:387. doi: 10.1186/s12903-023-03120-w.
- Machado V, Lobo S, Proença L, Mendes JJ, Botelho J. Vitamin D and periodontitis: A systematic review and meta-analysis. *Nutrients*. 2020;12(8):2177. doi: 10.3390/nu12082177.
- Madi M, Pavlic V, Alammam SM, Alsulaimi LM, Alotaibi RS, Alotaibi GM, Zakaria O. The association between vitamin D level and periodontal disease in Saudi population: A preliminary study. *Saudi Dent J*. 2021;33(7):595–600. doi: 10.1016/j.sdentj.2020.08.002.
- Meghil MM, Cutler CW. Influence of vitamin D on periodontal inflammation: A review. *Pathogens*. 2023;12(9):1180. doi: 10.3390/pathogens12091180.
- Mohsen KA, Abdel-Raouf MN, Makram K, ElKassaby M, Khairy M, AbdelAziz M, El-Messiry H, Gaber R. Is vitamin D deficiency a risk factor for osseointegration of dental implants? A prospective study. *Ann Maxillofac Surg*. 2024;14(1):21–26. doi: 10.4103/ams.ams_165_23.
- Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi: 10.1136/bmj.n71.
- Perić M, Maiter D, Cavalier E, Lasserre JF, Toma S. The effects of 6-month vitamin D supplementation during the non-surgical treatment of periodontitis in vitamin-D-deficient patients: A randomized double-blind placebo-controlled study. *Nutrients*. 2020;12(10):2940. doi: 10.3390/nu12102940.

20. Shah M, Poojari M, Nadig P, et al. Vitamin D and periodontal health: A systematic review. *Cureus*. 2023;15(10):e47773. doi: 10.7759/cureus.47773.
21. Sllamniku Dalipi Z, Dragidella F. Calcium and vitamin D supplementation as non-surgical treatment for periodontal disease with a focus on female patients: Literature review. *Dent J*. 2022;10(7):120. doi: 10.3390/dj10070120.
22. Tallon E, Macedo JP, Faria A, Tallon JM, Pinto M, Pereira J. Can vitamin D levels influence bone metabolism and osseointegration of dental implants? An umbrella review. *Healthcare*. 2024;12(8):1867. doi: 10.3390/healthcare12181867.
23. Ziada S, Wishah A, Mabrouk N, Sahtout S. Vitamin D deficiency and oral health: A systematic review of literature. *BMC Oral Health*. 2025;25:468. doi: 10.1186/s12903-025-05883-w.