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MARGINAL BONE LOSS AROUND CRESTAL AND SUB-CRESTAL IMPLANTS: A SYSTEMATIC REVIEW

Dental Science

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ABSTRACT

Marginal bone loss (MBL) is an important indicator of the long-term success and stability of dental implants. This systematic review aimed to evaluate and compare marginal bone loss around implants placed at crestal and subcrestal levels. A comprehensive search of PubMed/MEDLINE, Cochrane Library, and ScienceDirect databases was conducted for studies published between 2005 and 2025. Seven clinical studies involving 299 patients met the inclusion criteria and were included in the qualitative analysis. The findings showed conflicting results, with some studies reporting greater bone loss around subcrestal implants, while others demonstrated improved bone preservation or no significant differences compared with crestal placement. The available evidence suggests that implant placement depth alone does not determine peri-implant bone stability. Factors such as biological width formation, implant-abutment connection design, platform switching, and peri-implant soft tissue thickness also influence marginal bone remodeling. Within the limitations of the included studies, both crestal and subcrestal implant placement demonstrated favorable clinical outcomes and acceptable marginal bone preservatio

KEYWORDS

Dental Implants; Marginal Bone Loss; Crestal Implants; Subcrestal Implants; Peri-implant Bone Loss

INTRODUCTION

Dental implants have become a predictable and widely accepted treatment modality for the replacement of missing teeth, exhibiting long-term survival rates exceeding 95%. Preservation of peri-implant hard and soft tissues is essential for maintaining implant function, esthetics, and longevity. Among the various factors affecting peri-implant tissue stability, marginal bone loss remains one of the most important indicators of implant success.

The vertical position of implant placement has attracted considerable attention in contemporary implant dentistry. Traditionally, implants have been placed at the crestal bone level; however, subcrestal placement has been advocated to improve soft tissue adaptation, facilitate biological width establishment, and reduce implant-abutment interface exposure. Despite these theoretical advantages, the effect of implant placement depth on marginal bone preservation remains controversial.

Several clinical studies have reported conflicting results regarding the influence of crestal and subcrestal positioning on peri-implant bone remodeling. While some investigations suggest improved bone preservation with subcrestal placement, others demonstrate increased bone loss or no significant differences between the two approaches.

Therefore, this systematic review was conducted to evaluate the available evidence regarding marginal bone loss around implants placed at crestal and subcrestal levels and to determine whether one approach demonstrates superior peri-implant bone preservation.

MATERALS AND METHOD

The protocol for this systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number **CRD420251015320** prior to commencement of the review.

Focused Question

"Is there a difference in marginal bone loss between implants placed at crestal and subcrestal levels?"

PICO Framework

The review question was formulated according to the Population, Intervention, Comparison, and Outcome (PICO) framework.

Component	Description
Population	Completely or partially edentulous patients rehabilitated with dental implants
Intervention	Subcrestal implant placement
Comparison	Crestal implant placement
Outcome	Marginal bone loss

Eligibility Criteria

Inclusion Criteria

1. Human clinical studies.
2. Randomized controlled clinical trials.
3. Prospective clinical studies.
4. Studies comparing crestal and subcrestal implant placement.
5. Studies reporting marginal bone loss as an outcome measure.
6. Studies published in English language.
7. Studies published between 2005 and 2025.

Exclusion Criteria

1. Animal studies.
2. In vitro studies.
3. Literature reviews and systematic reviews.
4. Studies without a comparison group.
5. Studies not reporting marginal bone loss.
6. Patients with systemic conditions affecting bone metabolism.
7. Studies involving extensive bone grafting or sinus augmentation procedures.
8. Studies involving patients younger than 18 years.

Information Sources

A comprehensive electronic search was performed in the following databases:

- PubMed/MEDLINE
- Cochrane Library
- ScienceDirect

Additionally, manual searches of reference lists from relevant studies and review articles were performed to identify potentially eligible studies.

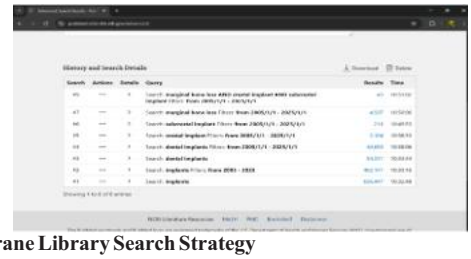
Search Strategy

The search strategy was developed using MeSH terms, free-text keywords, and Boolean operators (AND, OR).

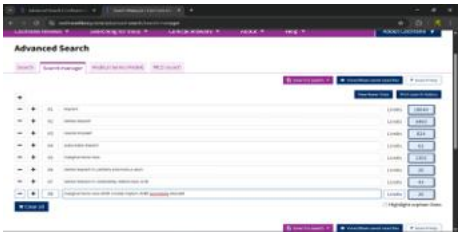
The primary search terms included:

- Dental implant
- Implant placement
- Crestal implant
- Subcrestal implant
- Marginal bone loss
- Peri-implant bone loss

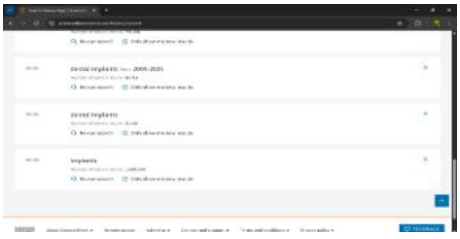
PubMed Search Strategy



Cochrane Library Search Strategy



ScienceDirect Search Strategy



Study Selection

The search process yielded a total of 123 articles from electronic databases.

- PubMed: 43 articles
- Cochrane Library: 21 articles
- ScienceDirect: 59 articles

Duplicate articles were identified and removed using Mendeley Desktop software.

Following removal of duplicates, 113 studies remained for title screening.

The selection process was carried out independently by two calibrated reviewers in three stages:

Stage 1: Title Screening

A total of 113 articles were screened based on titles.

- 79 articles were excluded.
- 34 articles remained for abstract screening.

Stage 2: Abstract Screening

Abstracts of 34 studies were reviewed.

- 19 articles were excluded.
- 15 studies were selected for full-text assessment.

Stage 3: Full-Text Assessment

Fifteen full-text articles were evaluated for eligibility.

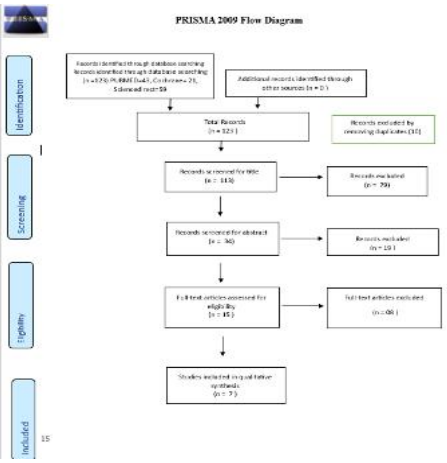
- 8 studies were excluded.
- 7 studies fulfilled all eligibility criteria and were included in the final qualitative synthesis.

Data Extraction

Data extraction was performed independently by two reviewers using a standardized extraction form.

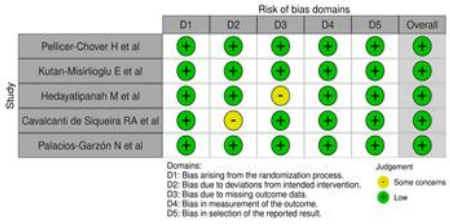
The following information was recorded:

- Author and year of publication
- Study design
- Number of participants
- Patient age
- Implant location
- Number of implants placed
- Implant placement depth
- Follow-up duration
- Marginal bone loss outcomes
- Clinical and radiographic findings



Risk of Bias Assessment

Risk of bias assessment was performed using the ROBINS-I tool.



DISCUSSION:

Marginal bone loss (MBL) is considered one of the most important parameters for evaluating the long-term success and stability of dental implants. Preservation of peri-implant bone is essential not only for implant survival but also for maintaining soft tissue architecture, esthetics, and functional outcomes.[1] [2] [3] Consequently, factors influencing peri-implant bone remodeling have become an important area of investigation in implant dentistry.

The present systematic review evaluated the influence of implant placement depth on marginal bone loss by comparing implants placed at crestal and subcrestal levels. Analysis of the included studies demonstrated conflicting findings, suggesting that implant placement depth alone may not be the primary determinant of peri-implant bone stability.[11] While some investigations reported increased bone loss around subcrestally placed implants, others demonstrated either improved bone preservation or no significant differences between the two approaches.

One of the principal biological concepts explaining peri-implant bone remodeling is the establishment of biological width around implants. Following implant placement, soft tissue adaptation occurs through formation of a peri-implant junctional epithelium and connective tissue attachment. This process is accompanied by physiologic remodeling of the crestal bone to create a stable soft tissue seal around the implant.[6] The extent of this remodeling may vary depending on implant position, implant-abutment connection design, and surrounding soft tissue characteristics.

Several studies included in the present review reported greater marginal bone loss around subcrestally placed implants. Such findings may be explained by the additional bone remodeling required to establish biological width around implants positioned below the alveolar crest.[6] [12] Furthermore, placement of the implant-abutment junction deeper within the bone may expose a larger volume of crestal bone to inflammatory changes associated with bacterial colonization of the microgap.[12,14]

The implant-abutment microgap has been identified as an important factor influencing peri-implant bone remodeling. Bacterial leakage and inflammatory cell infiltration at the implant-abutment interface may induce crestal bone resorption, particularly during the early healing phase.[6] [12] Animal studies have demonstrated that the position of the microgap relative to the crestal bone can influence the extent of

marginal bone remodeling.[12] [13] Therefore, the biological response to implant placement depth may be closely related to the location of the implant-abutment interface rather than the implant position itself.

Conversely, some studies included in this review demonstrated improved bone preservation around subcrestally placed implants.[4] [5] A possible explanation is that deeper implant positioning may provide additional vertical space for establishment of biological width without exposing the implant surface to the oral environment.[7] In addition, subcrestal placement may reduce the likelihood of implant thread exposure and improve long-term soft tissue adaptation, particularly in esthetically demanding areas.[4]

Platform switching represents another important factor that may influence the relationship between implant position and marginal bone loss. Platform switching involves the use of a narrower abutment on a wider implant platform, thereby shifting the inflammatory cell infiltrate away from the crestal bone.[9] Clinical studies have suggested that platform-switched implants may demonstrate reduced marginal bone loss regardless of placement depth.[9] As a result, favorable outcomes observed in some subcrestal implant studies may be attributable to the combined effect of platform switching and implant positioning rather than implant depth alone.

The thickness of peri-implant soft tissue has also emerged as a critical determinant of crestal bone stability. Linkevicius and co-workers demonstrated that implants surrounded by thin peri-implant mucosa exhibit significantly greater bone loss than those placed in sites with thicker soft tissues.[15] Insufficient soft tissue thickness may require additional crestal bone remodeling to establish an adequate biological width. Consequently, subcrestal placement may be advantageous in patients with thin soft tissue biotypes because it provides additional vertical space for soft tissue accommodation.[15]

The findings of the present review support the concept that peri-implant bone remodeling is multifactorial in nature. Although implant placement depth may influence marginal bone loss, its effect appears to be modified by several additional variables including biological width formation, microgap position, implant-abutment connection design, platform switching, and peri-implant soft tissue thickness.[6] [7] [9] [15] This may explain the contradictory findings observed among the included studies.

From a clinical perspective, both crestal and subcrestal implant placement can achieve favorable outcomes when appropriate surgical and prosthetic principles are followed. Crestal placement remains a predictable and widely accepted approach with documented long-term success.[1] [2] Subcrestal placement may offer additional advantages in selected clinical situations, particularly where soft tissue thickness is limited or enhanced esthetic outcomes are desired.[7,15] Therefore, implant placement depth should be selected according to individual patient anatomy, peri-implant tissue characteristics, and restorative requirements rather than a universal treatment protocol.

Several limitations must be acknowledged when interpreting the findings of this review. Considerable heterogeneity existed among the included studies with respect to implant systems, surgical protocols, implant-abutment connections, follow-up periods, and methods of radiographic assessment. These differences limited direct comparison of results and contributed to variability in reported outcomes. Furthermore, long-term randomized clinical trials evaluating standardized implant systems remain limited.

Within the limitations of the available evidence, neither crestal nor subcrestal implant placement can be considered unequivocally superior for preserving peri-implant bone. Current evidence suggests that successful maintenance of marginal bone levels depends on a complex interaction among implant positioning, biological width establishment, implant-abutment design, platform switching, and soft tissue characteristics. Further well-designed randomized clinical trials with long-term follow-up are required to establish definitive clinical guidelines regarding optimal implant placement depth.

CONCLUSION:

Within the limitations of this systematic review, both crestal and subcrestal implant placement protocols demonstrated favorable clinical outcomes and acceptable marginal bone preservation. Current evidence does not conclusively support the superiority of either placement position. Marginal bone loss appears to be influenced by multiple factors including implant-abutment connection design, soft tissue thickness, platform switching, and prosthetic considerations.

Clinicians should select implant placement depth based on individual patient anatomy, soft tissue characteristics, esthetic requirements, and restorative objectives. Further long-term randomized clinical trials with standardized methodologies are required to establish definitive clinical recommendations.

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