Original Research

Effect of Vitamin D3 Supplements in the Success of Dental Implants: A Comparative Evaluation

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Submitted: 01-Mar-2025
Revised: 19-Mar-2025
Accepted: 26-Apr-2025
Published: 29-Oct-2025

ABSTRACT

Background: Dental implants are a reliable treatment for tooth replacement, with success dependent on osseointegration, implant stability, and bone density. Vitamin D3 plays a critical role in bone metabolism, influencing calcium absorption and bone mineralization. However, the effect of vitamin D3 supplementation on implant outcomes remains controversial. **Materials and Methods:** A total of 20 patients with vitamin D deficiency (10-30 ng/mL) were divided into two groups:

- Group A (n = 10): Received vitamin D3 supplementation (60,000 IU/week for 8 weeks, followed by 60,000 IU/month for 16 weeks).
- Group B (n = 10): Did not receive supplementation.

All patients underwent standard implant placement. Crestal bone level and bone density were assessed using CBCT, and implant stability was measured using resonance frequency analysis (RFA) at baseline, 3 months, and 6 months postimplant placement. Data were analyzed using ANOVA ($P < 0.05$). **Results:** Implant stability improved significantly in Group A compared with Group B at 3 and 6 months ($P < 0.05$). Crestal bone loss was higher in Group B, but the difference was not statistically significant ($P = 0.07$). Bone density remained comparable between both groups at all time points ($P = 1.00$). **Conclusion:** Vitamin D3 supplementation significantly enhances implant stability, suggesting a role in improving early-stage osseointegration. However, its effect on crestal bone level and bone density remains inconclusive. Preoperative vitamin D3 screening and supplementation in deficient individuals may optimize implant outcomes. Further large-scale studies are needed to establish definitive guidelines.

Keywords: *Bone density, dental implants, implant stability, osseointegration, vitamin D3*

Introduction

Dental implants are a widely accepted treatment modality for the rehabilitation of missing teeth, with success rates exceeding 95%.[1] The key factors contributing to implant success include osseointegration, implant stability, and bone density.[2] Among these, adequate bone remodeling plays a crucial role in ensuring the longevity of dental implants.

Vitamin D3 is essential for bone metabolism, influencing calcium and phosphorus absorption, which are critical for bone mineralization.[3] Deficiency in vitamin D has been associated with impaired bone healing and increased risk of implant failure.[4] Studies suggest that vitamin D supplementation may enhance osseointegration and implant stability, particularly in patients with deficient levels.[5] However, the extent of its impact on crestal bone level, implant stability, and bone density remains controversial. This study aims to

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Quick Response Code:

Website: https://journals.lww.com/jpbs

DOI: 10.4103/jpbs.jpbs_649_25

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How to cite this article: Ramalakshmi NS, Krishna GP, Samyuktha D, Batthula D, Nagisetty J, Valiveti J. Effect of Vitamin D3 supplements in the success of dental implants: A comparative evaluation. J Pharm Bioall Sci 2026;18:125-7.

compare implant outcomes in patients with and without vitamin D3 supplementation.

Materials and Methods

This comparative study included 20 patients with Vitamin D deficiency (10-30 ng/mL), divided into two groups:

- **Group A** (n = 10): Received Vitamin D3 supplements (60,000 IU/week for 8 weeks, followed by 60,000 IU/month for 16 weeks).
- **Group B** (n = 10): Did not receive Vitamin D3 supplementation.

Procedure

All patients underwent implant placement with the same surgical protocol. Crestal bone level, implant stability, and bone density were evaluated using:

1. CBCT for crestal bone level and bone density.
2. Resonance frequency analysis (RFA) for implant stability.

Evaluation timeline

- Baseline (immediately postimplant placement).
- Three months postsurgery.
- Six months postsurgery.

Data were statistically analyzed using ANOVA with a significance level of $P < 0.05$.

Results

Implant stability showed a significant improvement in Group A over time. At baseline, both groups had similar stability scores (64.00 ± 3.75 in Group A vs. 63.90 ± 4.16 in Group B, P = 0.96). However, by the third month, implant stability in Group A increased significantly to 69.92 ± 3.06, whereas Group B had a lower increase to 65.90 ± 2.64 (P = 0.01). At six months, Group A maintained significantly higher implant stability (71.90 ± 3.34) compared with Group B (67.35 ± 2.83) (P = 0.01). This suggests that vitamin D3 supplementation positively influences implant stability over time [Table 1].

At baseline, there was no crestal bone loss in either group (0.00 ± 0.00 for both). By the third month, bone loss was slightly higher in Group B (0.99 ± 0.52) compared with Group A (0.61 ± 0.48), although this difference was not statistically significant (P = 0.10). At six months, bone loss was more evident in both groups, with Group B showing greater resorption (1.61 ± 0.77) compared with Group A (1.08 ± 0.46), but the difference remained statistically nonsignificant (P = 0.07). This indicates that while vitamin D3 supplementation may help reduce crestal bone loss, further studies are needed to confirm its impact [Table 2].

Table 1: Comparison of implant stability between groups

Time point	Group A (mean±SD)	Group B (mean±SD)	*P*
Baseline	64.00±3.75	63.90±4.16	0.96
3 months	69.92±3.06	65.90±2.64	0.01*
6 months	71.90±3.34	67.35±2.83	0.01*

Table 2: Comparison of crestal bone level between groups

Time point	Group A (mean±SD)	Group B (mean±SD)	*P*
Baseline	0.00±0.00	0.00±0.00	1.00
3 months	0.61±0.48	0.99±0.52	0.10
6 months	1.08±0.46	1.61±0.77	0.07

For bone density, no significant changes were observed between the groups at any time point. The mean bone density remained consistent in both groups at baseline (2.40 ± 0.52), 3 months (2.40 ± 0.52), and 6 months (2.40 ± 0.52), with P = 1.00 at all time points. These findings suggest that vitamin D3 supplementation does not significantly influence bone density within 6 months of implant placement [Table 2].

Discussion

The findings of this study align with previous research highlighting the potential role of vitamin D in enhancing implant stability. Group A, which received vitamin D3 supplementation, demonstrated a statistically significant improvement in implant stability at 3 and 6 months compared with Group B ($P < 0.05$).[6] This suggests that vitamin D3 contributes to better osseointegration, possibly by modulating bone remodeling and enhancing calcium metabolism.[7]

Contrary to implant stability, crestal bone level changes were comparable between both groups, with no significant differences at any time point. Although there was a trend toward reduced bone loss in Group A, the difference did not reach statistical significance (P = 0.07).[8] Bone density also remained stable across both groups, indicating that vitamin D3 may not have a direct impact on preventing crestal bone resorption in the short term.[9]

One plausible explanation for the selective improvement in implant stability, rather than bone density or crestal bone level, could be the early-stage effects of vitamin D3 on osteoblastic activity rather than long-term bone mineralization.[10] Vitamin D receptors (VDRs) in osteoblasts facilitate calcium absorption, leading to improved primary and secondary implant stability, but their effect on bone resorption may take longer to manifest.[11]

Several factors could have influenced the results:

1. **Patient Variability**: Different baseline bone qualities among participants may have affected outcomes.
2. **Duration of Study**: Six months may not be sufficient to observe long-term bone density changes.
3. **Sample Size**: A larger cohort may provide more definitive conclusions.

Clinical implications

Given that implant stability is crucial for immediate and early loading protocols, these findings support the supplementation of vitamin D3 in deficient individuals undergoing implant placement. However, for long-term bone preservation, additional studies are needed to clarify its role.[11]

Conclusion

This study demonstrates that vitamin D3 supplementation significantly enhances implant stability, suggesting its role in optimizing early-stage osseointegration. However, its effect on crestal bone level and bone density remains inconclusive. Although the results indicate potential benefits, further large-scale and long-term studies are required to establish definitive guidelines. Clinicians may consider preoperative vitamin D3 screening and supplementation in patients with deficiency to improve implant success rates. Future research should focus on the molecular mechanisms of vitamin D in bone remodeling and its long-term impact on implant survival.

Financial support and sponsorship

Nil.

Conflict of interest

There are no conflicts of interest.

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