



Assessing the Impact of Vitamin D Levels on Osseointegration in Dental Implants: A Study

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KEYWORDS

Vit D, Implants, Osseointegration, Deficiency.

ABSTRACT:

Introduction: As a fat-soluble vitamin, vitamin D is essential for both bone growth and calcium metabolism. The levels of vit D in the body are important for bones and surgery recovery that includes placement of dental implants. There has been a connection of vit D insufficiency to bone diseases, poor healing of bones, and an increased chance of failure of the implant. There is a clear gap in the literature concerning the impact of vit D levels in enhancing or inhibiting the osseointegration of dental implants. We can determine the function of vitamin D in the integration process and, in turn, the success of dental implants due to this difference in the sample group.

Methods: Partially edentulous patients with D2 type of bone requiring dental implant restoration with different serum levels of vit D were undertaken for this study. The enrolled patients were selected considering their medical and dental history after taking ethical clearance. All diagnostic tests were done along with Serum vit D test. The sample size had been computed to be 12 in each group (n).

Results: The findings of the study demonstrated a favorable relationship between successful osseointegration and adequate vitamin D levels, underscoring the possible necessity of preoperative evaluation and treatment of vitamin D deficiency in patients who choose to undergo dental implant treatments.

Conclusions: This study emphasizes the value of a comprehensive strategy in dental implantology, where systemic health parameters, including vitamin D level, are taken into consideration to maximize implant success and patient care.

1. Introduction

In the 20th century, vita D was recognized to be used in the body as an active molecule that can be synthesized. In addition it, vitamin A, Vitamin E and Vitamin K are the other four which belong to the group of fat-soluble vitamins. It's important for tooth and bone formation. It is made up of two physiologically active compounds called vitamin D3, cholecalciferol, and vitamin D2, ergosterol. Although they have structural similarities, their chemistry is different.¹

As a lipid-soluble hormone synthesized and activated primarily in the liver and kidneys, vit D has a significant role maintaining the appropriate calcium and phosphorus levels within the blood, which in turn is critical for normal bone remodeling². For both cosmetic and functional restoration of patients with missing teeth partially or in full, Dental implants are now the most feasible Option, this has been proven by longitudinal

clinical studies, which have survival percentages greater than 95%. The vit D impact on properties and functions of bone and metabolism has led to speculation if its deficiency could affect dental implants integration, however, this effect remains largely unexamined. Most of these works were done on animal models, only few were carried out on humans³.

Status of host bone bed along with its natural self-healing, biomechanical stability along with loading of implant, additional or adjuvant treatment approaches such as use of bone graft, osteogenic biological coating as well as stimulation biophysically along with application of pharmaceutical drugs including simvastatin and bisphosphates. Various factors improve the process of osseointegration along with these following, as others-: Those are classified on the basis of whether or not it is dependent upon an implanted device.



It has been shown that supplementation with cholecalciferol (vit D3) improves bone mineral density⁴. Considering how common vitamin D insufficiency is throughout the world, understanding how it affects osseointegration is crucial to maximizing the results of dental implants. This study's goal is to examine how vitamin D levels affect the osseointegration of dental implants in order to gain knowledge that could improve patient care and clinical practice. By explaining the role of Vit D, we hope to contribute toward better strategy development that ensures better success rates for dental implants while furthering bone health as well. In comparison to the mandible, the maxilla contains less bone fill. In fact, the anterior mandible is the most filled by bone, while the posterior maxilla is the least filled. It has been observed that maxillary bone with low density has high implant failure rates. Similarly, there is a link between implant failure and insufficient bone density⁵. Smith and Zarb proposed less than 0.2mm of alveolar bone loss each year after the first year as the criterion for implant success. However, relatively fewer studies have been made on the initial three to six months, when the period of bone loss is highly aggressive.

A prosthodontist places much emphasis on post-operative examination of the bone since bone level maintenance forms the very core element that one should consider in the perspective of implant prosthodontics⁶. Serum 25-hydroxyvitamin D [25(OH)D] concentrations are graded to indicate their effectiveness in health. Vitamin D insufficiency is associated with concentrations below 12ng/mL, which can cause osteomalacia in adults and rickets in infants and children. For healthy people, concentrations between 30 and less than 50nmol/L (12 to less than 20ng/mL) are considered insufficient for good bone and overall health. Levels of 50nmol/L (20ng/mL) or higher usually protect bone and health. Levels above 125nmol/L (50ng/mL) may increase the risk of serious ramifications, particularly at levels above 150nmol/L (60ng/mL).⁷

2. Objectives

The aim and objectives of this study are:

- To assess the impact of Vitamin D levels on the process of Osseointegration in individuals undergoing dental implant procedures.
- To observe crestal bone height in participants with borderline levels of vitamin D after

placement of implant, not supplemented with vitamin D.

- To observe crestal bone height in participants with borderline levels of vitamin D after placement of implant, supplemented with vitamin D.
- To compare and evaluate the crestal bone height in participants with borderline level of vitamin D without supplements vs with borderline levels of vitamin D with supplements of Vitamin D.

3. Methods

The goal of this prospective cohort research is to assess how vitamin D levels affect the osseointegration process in patients undergoing dental implant procedures. The study was carried out at Seema Dental College and Hospital Rishikesh, Uttarakhand.

• Inclusion criteria

1. Male patients who are conscious of their oral hygiene and are willing to undergo restoration treatments with dental implants.
2. Patients who possessed partially edentulous with D2 type of mandible posterior bone.
3. Patients aged between 25 to 45 years.
4. Patients who have completely healed alveolar socket.
5. Healthy patients with no systemic diseases present so as to ensure uneventful healing and osseointegration of implants following the treatment.
6. Patients who possessed good periodontal health status in the remaining dentition

• Exclusion criteria

1. Patients who are male and unwilling to participate in research.
2. Patients with any known history of systemic diseases or conditions or taking any medications which could interfere with the wound healing or the surgical implant procedures.
3. Patients presented with allergy to any drug or any material used in the study.
4. Patients present with any parafunction habits like bruxism, clenching etc.



5. Patients with a five-year history of drug abuse or alcoholism.
6. Patients undergoing any chemotherapy or radiation treatment.
7. Patients who are unable to maintain adequate oral hygiene due to some dexterity or physical status.

The chosen participants were included in the study based on their dental and medical histories. The study comprised patients with variable serum vitamin D levels who were partially edentulous and in need of active dental implants. Intraoral periapical radiographs with grids were used to evaluate the bone both before and after surgery (two groups A, B). Three- and six-months following implant placement, the post-operative assessment of this study is conducted on bone (groups A, B). Alpha-Bio Tec's Spiral, an active tapered internal hex implant, was the implant used in the study.

Vitamin D oral supplements—Calcirol; calcirol contains 60000 IU of cholecalciferol-Vitamin D3 in 1 gm granules—was prescribed only after proper consultation with the general physician and taking into account all the health assessment, evaluation, and medical history of the patient. Only group B patients were prescribed the drug as per their deficiency range and based on clinical need (one sachet per week).

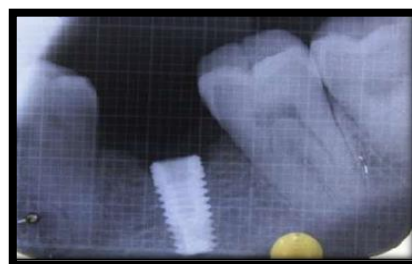
Grouping and Vitamin D Assessment: Prior to implant implantation, the participants' serum vitamin D levels were measured and divided into two groups:

Group A: Participants with borderline vitamin D levels without supplements.

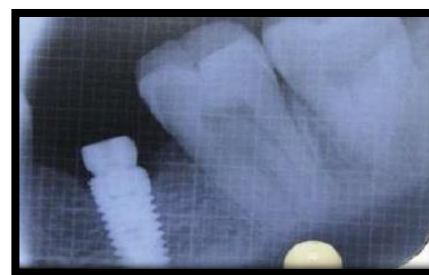
Group B: Participants with borderline vitamin D levels with supplements.



Case 1(a): IOPA with grid immediately after Implant placement.



Case 1(b): IOPA with grid after 3 months of implant placement.



Case 1(c): IOPA with grid after 6 months of Implant placement

4. Results

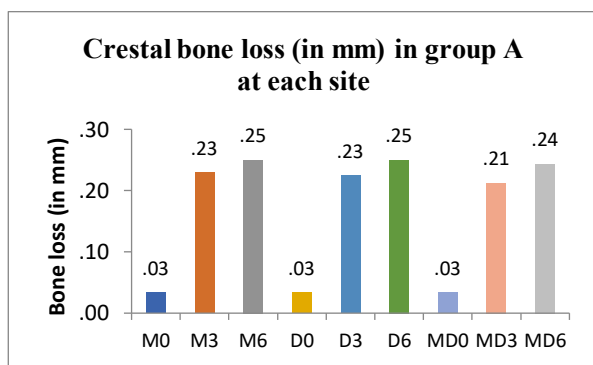
24 patients who had dental implant surgery participated in research; Two groups were formed based on preoperative vitamin D levels.:

1. **Borderline Vitamin D level without supplement (Group A):** As shown in graph 1, 8 (75%) of the twelve patients in the group with borderline vitamin D levels had effective osseointegration. Only 4 patients (10%) faced minor complications, primarily related to slight delays in bone healing but with significant impact on overall implant osseointegration.
2. **Borderline Vitamin D level with supplement (Group B):** Of the 12 patients with borderline Vitamin D levels with supplements, 10 (90%) showed successful osseointegration (as given in graph 2). This group had a minor rate of complications, with 2 patients (25%) experiencing issues related to implant osseointegration.

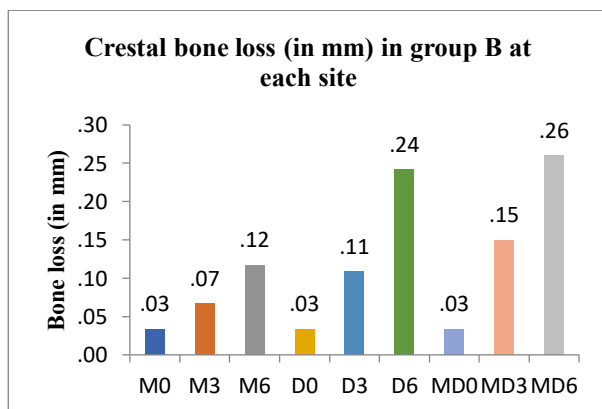


Higher vitamin D levels were significantly related to effective osseointegration, according to statistical analysis ($p < 0.01$). Patients achieving Vitamin D levels sufficient for some reason showed significantly higher success rates and fewer complications than patients whose levels were either deficient or insufficient. Patients with adequate vitamin D levels had greater bone growth surrounding the implants, according to radiographic examinations.

Group A exhibited slightly higher bone loss compared to Group B. For example, at M3, Group A had a bone loss of 0.23 mm compared to Group B's 0.07 mm. However, by M6, both groups showed an increase in bone loss, with Group A showing 0.25 mm and Group B 0.12 mm. Similar trends are observed at D3 and D6, where Group A consistently showed more bone loss than Group B. This trend continued at MD3 and MD6, where Group A again showed slightly higher bone loss. Overall, Group A consistently experienced more bone loss at each time point compared to Group B, although the differences were relatively small (graph 3).



Graph 1: Bone loss in group A

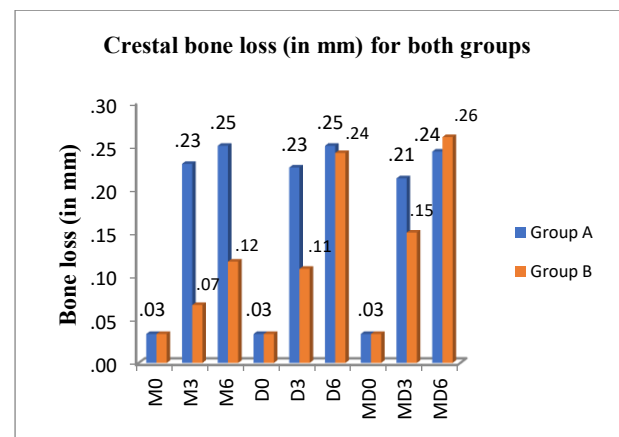


Graph 2: Bone loss in group B

The time points are labeled as M0 (immediately after implant placement), M3 (3 months), M6 (6 months), D0 (at the beginning of the study), D3 (3 months), D6 (6 months), MD0 (baseline), MD3 (3 months), and MD6 (6 months).

5. Discussion

By showing that vitamin D levels strongly affect dental implant osseointegration, the study provides illumination on systemic health and dental implant success.



Graph 3: Bone loss comparison in both the groups

The extracellular fluid and bone tissues must have a balance of calcium and phosphates for the healthy development of bone and mineralization of teeth¹⁰. Raman et al concluded that the primary purpose is to increase the bifunctional active absorption of these ions. On one hand, it alters the enterocyte cells phospholipid membrane structure, increasing their permeability to calcium ions⁸. Reddy et al further suggested that the result of an implant depends on the outcome of osseointegration⁹. Osseointegration is the process where the surface of an implant, that bears functional loads directly, and functionally connects to living, organised bone. The review found that vitamin D levels affect dental implant osseointegration. Vitamin D insufficiency may increase implant failure, hence Buzatu BL et al. recommend pre-surgical vitamin D testing to improve outcomes¹¹. A comprehensive study by F. Javad et al. indicated that vitamin D3 supplementation may affect implant osseointegration, although more research is needed¹⁴.



The current study used the IOPAR grid to examine the connection between the effect of vitamin D supplementation and radiographic crestal bone level. Two groups, A and B, of healthy partially edentulous patients had been involved in the study. These individuals were chosen from the clinical Department of Prosthodontics & Crown and Bridge's outdoor patient pool at Seema Dental College and Hospital in Rishikesh.

In conclusion, there is a clear correlation between healthy vitamin D levels and dental implant osseointegration. These outcomes suggest that systemic variables, including vitamin D levels, could be detrimental during the dental implantology procedure. This will, therefore, integrate the preoperative assessment and management of Vitamin D levels in clinical practice for better improvement of success rates in dental implants and the well-being of the patients.

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