

Evaluation of Crestal Bone Loss after Placement of Bone Graft around the Oral Implant with/without Platelet-rich Plasma

Mohammad Jalaluddin¹, Naman Awasthi², Ibrahim S Aljulayfi³, Naveen EP Cheriya⁴, Ananjana Balakrishnan⁵, Angitha Koodali⁶

Received on: 24 May 2024; Accepted on: 24 June 2024; Published on: 30 October 2024

ABSTRACT

Aim: The current investigation aimed to evaluate the crestal bone loss after placement of bone graft around the oral implant with/without platelet-rich plasma (PRP).

Materials and methods: Forty patients seeking for crown supported by dental implants to replace at least one lost tooth were included in the present study. The participants were divided into two groups at random ($n = 20$): Group I: Received tricalcium phosphate (TCP) along with PRP and group II: Received TCP without PRP. Digital radiographs were used to quantify the crestal bone levels on the mesial, distal, buccal, and lingual side of each implant after surgery, also at 3 months and 6 months follow-up period. Data were recorded and subjected to statistical analysis.

Results: After 3 months, the crestal bone level in TCP with PRP group, mesial side was 1.02 ± 0.18 , distal was 1.14 ± 0.11 , buccal was 1.18 ± 0.12 and lingual was 1.16 ± 0.16 . In only TCP group, mesial side was 1.14 ± 0.02 , distal was 1.24 ± 0.10 , buccal was 1.38 ± 0.12 and lingual was 1.30 ± 0.08 . There was a statistically significant difference between the two groups. After 6 months, the crestal bone level in TCP with PRP group, mesial side was 1.26 ± 0.02 , distal was 1.38 ± 0.14 , buccal was 1.44 ± 0.09 , and lingual was 1.52 ± 0.12 . In only TCP group, mesial side was 1.40 ± 0.10 , distal was 1.56 ± 0.12 , buccal was 1.62 ± 0.06 , and lingual was 1.84 ± 0.04 . There was a statistically significant difference between the two groups at 3 and 6 months.

Conclusion: On conclusion, considerable crestal bone loss was observed in both treatment regimens. But TCP bone graft with PRP group found decreased bone loss around the dental implants than only TCP bone graft group.

Clinical significance: The most important aspects of controlling crestal bone loss are choosing the right implant design and bone transplant materials. Also, platelet-rich fibrin plays an important role in accelerating the healing process, improving bone regeneration, and repairing as it contains a high amount of growth factors and inflammatory chemicals.

Keywords: Bone graft, Crestal bone, Oral implant, Platelet-rich plasma, Tricalcium phosphate.

The Journal of Contemporary Dental Practice (2024): 10.5005/jp-journals-10024-3694

INTRODUCTION

Modern dentistry uses several developments in technology to restore lost teeth. Dental implants emerged as a means of restoring the shape, function, and aesthetics of the edentulous site in addition to the other options available, such as a complete denture, fixed partial denture, and removable partial denture. For an implant to survive following loading, crestal bone levels are crucial. It has been advocated that at least 2 mm should exist to avoid bone loss. Usually, a minimum of 1.5 mm of crestal bone loss and 0.2 mm of crestal bone loss after 1 year of loading is usual and physiologically acceptable.¹

Long-term crestal bone loss can be influenced by several demographic factors, such as age and gender; dental implant characteristics, such as height and diameter; treatment plan factors, such as number of implant units; and crestal bone height or operating bone graft agent.²

Bone replacements are frequently utilized in the treatment of peri-implantitis to restore the missing bone. Tricalcium phosphate (TCP) is one of the materials frequently used in dental implantation, in peri-implantitis treatment, and to build bone after tooth extraction.³ Since they do not cause unfavorable cellular reactions, β -tricalcium phosphate (β -TCP) and HAp/ β -TCP are utilized. Depending on the substance's degrading qualities,

¹Department of Periodontics and Oral Implantology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India

²Department of Dentistry, Birsu Munda Government Medical College and Hospital, Shahdol, Madhya Pradesh, India

³Department of Prosthodontics, College of Dentistry, Prince Sattam bin Abdulaziz University, Al-Kharj, Saudi Arabia

⁴⁻⁶Department of Prosthodontics, Kannur Dental College, Anjarakandy, Kerala, India

Corresponding Author: Mohammad Jalaluddin, Department of Periodontics and Oral Implantology, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India, Phone: +91 9338131843, e-mail: drjalal1979@gmail.com

How to cite this article: Jalaluddin M, Awasthi A, Aljulayfi IS, *et al.* Evaluation of Crestal Bone Loss after Placement of Bone Graft around the Oral Implant with/without Platelet-rich Plasma. *J Contemp Dent Pract* 2024;25(7):645–648.

Source of support: Nil

Conflict of interest: None

the material eventually becomes integrated into the body or is replaced by bone.⁴

Table 1: Comparison of crestal bone level between two groups at baseline

Groups	Measured sites			
	Mesial (Mean ± SD)	Distal (Mean ± SD)	Buccal (Mean ± SD)	Lingual (Mean ± SD)
Group I: TCP with PRP	0.38 ± 0.10	0.28 ± 0.01	0.26 ± 0.04	0.28 ± 0.08
Group II: TCP without PRP	0.36 ± 0.06	0.32 ± 0.12	0.24 ± 0.02	0.30 ± 0.02
t-value	9.126	9.742	8.922	8.814
p-value	0.732	0.678	0.884	0.816

The process of centrifuging blood produces platelet concentrates, also known as platelet-rich fibrin. With high quantities of inflammatory molecules (IL1 β , IL4, IL6, and TNF α) and growth factors (PDGF, TGF β , IGF, and VEGF), these materials may improve the healing process and promote better bone regeneration and repair. It has been demonstrated that in extraction situations, platelet concentrates accelerate the healing process for both the oral mucosa and cutaneous soft tissue.⁵ There is limited information on the comparison of placing a bone graft around an oral implant with or without platelet-rich plasma (PRP). Hence current investigation was carried out to evaluate the crestal bone loss after placement of bone graft around the oral implant with/without PRP.

MATERIALS AND METHODS

Selection of Participants

The current *in vivo* investigation was conducted at the Department of Periodontics and Oral Implantology, Kalinga Institute of Dental Sciences, Bhubaneswar, India. Forty patients seeking for crown supported by dental implants to replace at least one lost tooth were included in the present study. Patients' age ranged from 25 to 45. Any history of systemic disease, drinking, smoking, chewing tobacco, pregnancy and breastfeeding, parafunctional behaviors, poor dental hygiene, use of bisphosphonates, chemotherapy, radiation therapy, and those who had a clinical evaluation distance between neighboring teeth and dental implants of less than 3 mm were not included in the study.

All participants were divided into two groups (20 participants in each group) randomly as follows:

- Group I: Tri calcium phosphate with PRP
- Group II: Tri calcium phosphate without PRP

Preparation of Platelet-rich Plasma

Before implant placement, the patient's samples were collected for PRP and only group I patients underwent the procedure. Platelet concentrates were obtained by centrifugation of blood samples of the patient in 10 mL tubes with no adjuvant anticoagulant, centrifuged at 3000 rpm for 10 minutes. A portion of the platelet-rich centrifuged blood was chopped and combined with β -TCP particle. Autologous rich fibrin membranes were obtained by physically pressing fibrin-rich parts between gauze and afterward suture was placed at the surgical site.

Implant with Graft Placement and Measurement of Crestal Bone Level

Under local anesthesia, with 2% lignocaine and 1:80,000 adrenaline (*Lignox 2%*, Indoco Remedies), a full-thickness mucoperiosteal flap was made to elevate gingiva and expose the alveolar bone. The

dental implant's (Nobel Biocare) marginal level was set at the same level as the crestal bone to enable the cover's apex to be at the same level as the bone crest during the healing process. It should be noted that 20 of the individuals received PRP in addition to TCP, while the remaining 20 received TCP bone grafts exclusively. The surgical site was sutured with 4-0 prolene (Ethicon, India). The same operator performed all of the operations. Postoperative instructions were given, which included 500 mg of Amoxicillin (Novamox, Cipla Ltd) and 400 mg of ibuprofen (Ibruwell 400, Wellona Pharma) as an analgesic for 5 days, as well as instructions to rinse the mouth with 0.12% chlorhexidine for 10 days.

Digital radiographs were obtained after the surgery to determine the distance between the top of each implant and the first crestal bone-to-implant contact level along the collar/body surface of each implant. These values served as the first reference points for calculating future bone loss. Following 3 months after implant implantation, a second stage of surgery was performed to cover the implants with healed abutments. Digital periapical radiographs were used to evaluate the crestal bone levels on the mesial, distal, buccal, and lingual sides of each implant. Implant level impressions were obtained postoperatively to the healing abutment surgery connection, and the amount of crestal bone loss was computed by subtracting the baseline reference bone levels from the current levels. Following impressions, the permanent metal ceramic crown was delivered. Digital periapical radiographs of the dental implants were taken at three separate intervals: baseline, 3 months, and after 6 months.

Statistical Analysis

The collected data was analyzed using SPSS software version 20.0. The analysis was done using paired *t*-test to assess before and after the placement of bone graft with/without PRP. The threshold for statistical significance was set at $p < 0.05$.

RESULTS

Table 1 shows the crestal bone level between the two groups at baseline. The crestal bone level after placement of TCP with PRP in the mesial side was 0.38 ± 0.10 , distal was 0.28 ± 0.01 , buccal was 0.26 ± 0.04 , and lingual was 0.28 ± 0.08 . After placement of only TCP in the mesial side was 0.36 ± 0.06 , distal was 0.32 ± 0.12 , buccal was 0.24 ± 0.02 and lingual was 0.30 ± 0.02 . There was no statistically significant difference between the two groups.

After 3 months, the crestal bone level in TCP with PRP group, the mesial side was 1.02 ± 0.18 , distal was 1.14 ± 0.11 , buccal was 1.18 ± 0.12 , and lingual was 1.16 ± 0.16 . In only TCP group, the mesial side was 1.14 ± 0.02 , distal was 1.24 ± 0.10 , buccal was 1.38 ± 0.12 and lingual was 1.30 ± 0.08 . There was a statistically significant difference between the two groups (**Table 2**).

Table 2: Comparison of crestal bone loss between two groups after 3 months

Groups	Measured sites			
	Mesial	Distal	Buccal	Lingual
Group I: TCP with PRP (Mean ± SD)	1.02 ± 0.18	1.14 ± 0.11	1.18 ± 0.12	1.16 ± 0.16
Group II: TCP without PRP (Mean ± SD)	1.14 ± 0.02	1.24 ± 0.10	1.38 ± 0.12	1.30 ± 0.08
t-value	10.014	11.368	12.016	11.708
p-value	0.001	0.001	0.001	0.001

Table 3: Comparison of crestal bone loss between two groups after 6 months

Groups	Measured sites			
	Mesial	Distal	Buccal	Lingual
Group I: TCP with PRP (Mean ± SD)	1.26 ± 0.02	1.38 ± 0.14	1.44 ± 0.09	1.52 ± 0.12
Group II: TCP without PRP (Mean ± SD)	1.40 ± 0.10	1.56 ± 0.12	1.62 ± 0.06	1.84 ± 0.04
t-value	12.034	12.198	13.024	12.128
p-value	0.001	0.001	0.001	0.001

After 6 months, the crestal bone level in TCP with PRP group, the mesial side was 1.26 ± 0.02 , distal was 1.38 ± 0.14 , buccal was 1.44 ± 0.09 , and lingual was 1.52 ± 0.12 . In only TCP group, the mesial side was 1.40 ± 0.10 , distal was 1.56 ± 0.12 , buccal was 1.62 ± 0.06 , and lingual was 1.84 ± 0.04 . There was a statistically significant difference between the two groups (Table 3).

The inference of the present study indicated that the TCP bone graft with PRP found decreased bone loss around the dental implants than only the TCP bone graft.

DISCUSSION

Implant success is dependent upon precise pre-operative treatment planning and monitoring constantly during the healing phase to assess osseointegration. The assessment of bone via radiography is a crucial and practical method for determining the integrity and health of the bone around the hard tissue of the implant. A drop in crestal bone level signifies a loosening of the implant's bony anchoring.⁶

Although crestal bone loss has been studied using a variety of instruments, the gold standard approach is to quantify it directly through surgery, which is an invasive and delicate procedure. Because serial radiography is less invasive and has very little measuring error (magnification error), it may be more effective. While there is a chance of erroneous estimations due to metal artifacts around dental implants, cone beam computed tomography (CBCT) is not appropriate for crestal bone loss evaluation. On the other hand, it is thought that crestal bone demineralization is similarly regarded as bone loss in peri-apical radiography.⁷ Since digital peri-apical radiography is more accurate at measuring bone loss, it is currently employed.

Platelet-rich plasma has been widely employed as a bone graft material in dental implant procedures because it has a promising effect on bone and muscle regeneration and strong healing capacity. In the current investigation, employing PRP and β -TCP as a bone graft material dramatically lowered crestal bone loss. Marx et al.⁸ employed it in dental implant procedures for the first time. PRP was also utilized as a bone graft material by Kon et al.⁹ and Tschon et al.,¹⁰ who reported significant improvement.

In the current investigation, the group that received TRP with PRP noticed less crestal bone loss than the group that received

TRP without PRP. This result is in contrast to the study conducted by Elkarargy¹¹ which stated that one group received β -TCP and PRP, and another group received β -TCP and this study found that both groups showed gain of alveolar bone width and increase in bone density around dental implants. However, there was no discernible difference between the two groups in the relative amounts of newly generated tissue and mineralized bone generated around the implants.

Patients in this study had dental implants either supra-crestally or at the level of the bone. This could be the cause of the increased loss of crestal bone in every way. According to a study by Shalash and Abdalsamad,¹² posterior implants positioned at bone level appear to have less crestal bone loss than implants positioned at tissue level. On the other hand, Al Amri¹³ systematic review study could not find any evidence of a distinction in crestal bone loss between dental implants placed crestally and those placed sub-crestally. According to Palacios-Garzón et al.¹⁴ dental implants placed sub-crestally may reduce the incidence of implant exposure and peri-implantitis. On the other hand, Piattelli et al.¹⁵ revealed that implants positioned at the bone level are more likely to come into contact with inflammatory cells and that even a tiny bit of contact between the rough surface of the implant and soft tissue can cause inflammation in the mucosal tissues of the mouth.

The reduction of crestal bone loss in platform switching is accomplished by decreasing the micro gap on crestal bone and by moving the inflammatory cell infiltration inward and away from neighboring crestal bone, maintaining the biological width and increasing the distance from crestal bone level. A carefully planned series of biological processes involving multiple factors must occur for bone repair. Because PRP is autologous and has no danger of disease transmission, it was chosen as the delivery method for growth and differentiation factors in this investigation. It also plays a significant role in bone development.¹⁶

Roffi et al.¹⁷ reported that applying PRP to bone graft material promoted soft tissue repair and bone regeneration. After 3 and 6 months of follow-up, respectively, there was a statistically significant increase in bone height loss in the implant side group. In contrast to this investigation, Hürzeler et al.¹⁸ observed bone remodeling 1-year follow-up after implant placement. Over the course of all treatment periods 6 months, 9 months, and 1 year

the implant side treated with PRP had a statistically significant improvement in bone height.

The present study encounters certain limitations, including a small sample size, an insufficient evaluation of implant stability, and the need for longer-term follow-up studies involving a larger number of patients. Despite these limitations, further research and clinical trials are required to explore the possible potential application of PRP in dental implant surgery.

CONCLUSION

The present study, though has limitations, concluded that considerable crestal bone loss was observed in both treatment regimens. But TRP bone graft with PRP group found decreased bone loss around the dental implants than only the TRP bone graft group.

REFERENCES

- Kim SY, Dudson TB, Do DT, et al. Factors associated with crestal bone loss following dental implant placement in a longitudinal follow-up study. *J Oral Implantol* 2015;41(5):579–585. DOI: 10.1563/AAID-JOI-D-12-00193.
- Quoc JB, Vang A, Evrard L. Peri-implant bone loss at implants placed in preserved alveolar bone versus implants placed in native bone: A retrospective radiographic study. *Open Dent J* 2018;12:529–545. DOI: 10.2174/1874210601812010529.
- Klimecs V, Grishulonoks A, Salma I, et al. Bone loss around dental implants 5 years after implantation of biphasic calcium phosphate (HA β /TCP) granules. *J Healthc Eng* 2018;1–7. DOI: 10.1155/2018/4804902.
- Sheikh Z, Abdallah MN, Hanafi AA, et al. Mechanisms of in vivo degradation and resorption of calcium phosphate based biomaterials. *Materials* 2015;8:7913–7925. DOI: 10.3390/ma8115430.
- Dohan DM, Choukroun J, Diss A, et al. Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part I: technological concepts and evolution. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101(3):e37–e44. DOI: 10.1016/j.tripleo.2005.07.008.
- Boora P, Manu Rathee M, Bhorla M. Effect of platelet rich fibrin (PRF) on peri-implant soft tissue and crestal bone in one-stage implant placement: A randomized controlled trial. *Journal of Clinl Diagn Res* 2015;9(4):ZC18–ZC21. DOI: 10.7860/JCDR/2015/12636.5788.
- Puisys A, Auzbikaviciute V, Minkauskaite A, et al. Early crestal bone loss: Is it really loss? *Clin Case Rep* 2019;7(10):1913–1915. DOI: 10.1002/ccr3.2376.
- Marx RE, Carlson ER, Eichstaedt RM, et al. Platelet-rich plasma: Growth factor enhancement for bone grafts. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1998;85(6):638–646. DOI: 10.1016/s1079-2104(98)90029-4.
- Kon E, Filardo G, Di Martino A, et al. Platelet-rich plasma (PRP) to treat sports injuries: Evidence to support its use. *Knee Surg Sports Traumatol Arthrosc* 2011;19(4):516–527. DOI: 10.1007/s00167-010-1306-y.
- Tschon M, Fini M, Giardino R, et al. Lights and shadows concerning platelet products for musculoskeletal regeneration. *Front Biosci (Elite Ed)* 2011;3(1):96–107. DOI: 10.2741/e224.
- Elkarargy A. The use of beta-tricalcium phosphate with platelet-rich plasma in maxillary anterior ridge expansion with simultaneous implant placement. *Egyptian Dent J* 2009;55. Available from: https://www.researchgate.net/publication/259298774_The_Use_Of_Beta-Tricalcium_Phosphate_With_Platelet-Rich_Plasma_In_Maxillary_Anterior_Ridge_Expansion_With_Simultaneous_Implant_Placement/link/00b4952aeb2095fd85000000/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxyY2F0aW9uliwicGFnZSI6InB1YmxyY2F0aW9uIn19.
- Shalash M, Abdalsamad A. Crestal bone loss around tissue level implants with platform matching abutments versus bone level implants with conical/platform switched abutments in the posterior mandible: A comparative study. *Bulletin of the National Research Centre* 2020;44(1):184.
- Al Amri MD. Crestal bone loss around submerged and nonsubmerged dental implants: A systematic review. *J Prosthet Dent* 2016;115(5):564–570.e1. DOI: 10.1016/j.prosdent.2015.11.002.
- Palacios-Garzón N, Velasco-Ortega E, López-López J. Bone loss in implants placed at subcrestal and crestal level: A systematic review and meta-analysis. *Material* 2019;12(1):154. DOI: 10.3390/ma12010154.
- Piattelli A, Vrespa G, Petrone G, et al. Role of the microgap between implant and abutment: A retrospective histologic evaluation in monkeys. *J Periodontol* 2003;74(3):346–352. DOI: 10.1902/jop.2003.74.3.346.
- Prasad DK, Shetty M, Bansal N, et al. Crestal bone preservation: A review of different approaches for successful implant therapy. *Indian J Dent Res* 2011;22(2):317–323. DOI: 10.4103/0970-9290.84311.
- Roffi A, Filardo G, Kon E, et al. Does PRP enhance bone integration with grafts, graft substitutes, or implants? A systematic review. *BMC Musculoskelet Disord* 2013;14:330. DOI: 10.1186/1471-2474-14-330.
- Hürzeler M, Fickl S, Zuhre O, et al. Peri-implant bone level around implants with platform switched abutments: Preliminary data from a prospective study. *J Oral Maxillofac Surg* 2007;65(7 Suppl 1):33–39. DOI: 10.1016/j.joms.2007.03.024.