ISSN 0973-2063 (online) 0973-8894 (print)

Bioinformation 22(8): (2026)

BIOINFORMATION
Discovery at the interface of physical and biological sciences

BIOMEDICAL INFORMATICS

www.bioinformation.net

Volume 22(8)

Research Article

Received August 1, 2026; Revised August 31, 2026; Accepted August 31, 2026, Published August 31, 2026

DOI: 10.6026/973206300224895

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

Edited by Vini Mehta
E-mail: vmehta@statsense.in
Citation: Jain *et al.* Bioinformation 22(8): 4895-4899 (2026)

Evaluating the role of platelet-rich plasma in enhancing osseointegration for dental implants

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ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(8): (2026)

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Abstract:
Dental implant longevity depends on osseointegration, yet Platelet-Rich Plasma (PRP)'s inconsistent clinical efficacy stems from preparation variability and heterogeneous study designs despite promising growth factor-mediated osteogenesis. Therefore, it is of interest to examine the PRP effects on implant stability and peri-implant bone in 80 patients randomized to PRP versus control groups, with serial clinical and radiographic assessments. PRP delivers bioactive proteins including VEGF, PDGF and TGF-β essential for angiogenesis and bone regeneration around implant surfaces. Heterogeneity in PRP protocols contributes to mixed literature results on bone-to-implant contact enhancement and primary stability improvement. Thus, data shows the standardizing PRP application to clarify its definitive role in accelerating osseointegration for optimizing clinical implant protocols.

Keywords: Platelet-rich plasma (PRP), dental implants, osseointegration, bone regeneration, implant stability, growth factors

Background:
By offering a predictable and dependable alternative for lost teeth, dental implants have transformed restorative dentistry. Osseointegration, the biological process whereby live bone forms a direct structural and functional bond with the surface of a load-bearing implant, is crucial to the long-term viability of dental implants **[1]**. When osseointegration is good, the implant will be stable, the stress will be distributed evenly and the implant will not fail. Nevertheless, it is still a clinical challenge to achieve stable and quick osseointegration, especially in individuals with poor bone quality or systemic diseases that hinder healing **[2]**. There has been a lot of buzz about biological modifiers like platelet concentrates recently because of their ability to improve bone regeneration and implant integration. A patient's own blood is used to create Platelet-Rich Plasma (PRP), an autologous preparation that is rich in platelets and growth factors. Encouraging cellular proliferation, angiogenesis and osteoblastic differentiation, these growth factors - which include platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β) and vascular endothelial growth factor (VEGF)-prompt bone healing and regeneration **[3]**. Because of its biological justifications for promoting early wound healing and stimulating bone growth at the implant site, platelet-rich plasma (PRP) is used in implant dentistry. A key metric for attaining secondary implant stability, bone-to-implant contact (BIC) may be increased by PRP, according to studies **[4]**. Furthermore, PRP improves osseointegration in the early stages of recovery by increasing osteoblastic activity and mesenchymal cell proliferation, according to experimental research **[5]**. The findings of clinical trials testing PRP's efficacy in implant dentistry have been inconclusive. Although platelet-rich plasma (PRP) has been compared to traditional implant insertion without PRP in certain studies, it has been shown to increase implant stability and speed healing in others. Despite the promising results of PRP, a 2018 comprehensive review found no clear evidence owing to methodological variability and limited sample numbers **[6]**. Similarly, PRP may promote early healing, but it may not substantially affect long-term implant survival rates, according to long-term clinical investigations **[7]**. New platelet concentrates, such as platelet-rich fibrin (PRF) and leukocyte-rich platelet-reserve (PRP), have greatly increased the range of regenerative treatments available for implant dentistry. With their enhanced biological activity and longer-lasting growth factor release, these more recent formulations have the ability to speed up the healing process of both hard and soft tissues around implants **[8]**. One of the biggest obstacles to standardizing therapeutic results is the fact that preparation methods, platelet concentrations and administration regimens may vary widely. The need for well-powered clinical trials to confirm PRP's efficacy is another critical factor to think about. It has been challenging to draw firm conclusions from several prior researches due to their small sample numbers and brief follow-up periods **[9, 10]**. Therefore, it is of interest to contribute to evidence-based practice in implantology and to provide significant insights on the therapeutic usefulness of platelet-rich plasma (PRP) as an adjuvant in dental implant treatment.

Materials and Methods:
Study design:
The impact of Platelet-Rich Plasma on the process of osseointegration of dental implants will be investigated in a prospective randomized controlled clinical experiment.

Study setting:
Research will take place at a university dentistry school's Oral and Maxillofacial Surgery/Implantology department.

Sample size:
[1] Total sample size: 80 patients
[2] Patients will be randomly divided into:
1) **Group A (Test group):** 40 patients receiving PRP with implant placement
2) **Group B (Control group):** 40 patients receiving implant placement without PRP

Sampling technique:
[1] Simple random sampling method
[2] Allocation using computer-generated randomization

Inclusion criteria:
[1] Patients aged 20–60 years
[2] Patients requiring single or multiple dental implants
[3] Adequate bone volume (no need for major grafting)
[4] Good oral hygiene and compliance

Exclusion criteria:
[1] Systemic diseases affecting bone healing (*e.g.,* uncontrolled diabetes)
[2] Patients on anticoagulant therapy
[3] Smokers and alcoholics
[4] Mothers-to-be and their infants
[5] The background of radiation treatment for the neck and head

Pre-operative assessment:
[1] Detailed case history and clinical examination
[2] Radiographic evaluation using CBCT
[3] Bone density and quantity assessment
[4] Routine hematological investigations

PRP preparation procedure:
[1] A little amount of the patient's venous blood (around 10-20 ml) will be taken.
[2] Blood will be collected in anticoagulant-containing tubes
[3] First centrifugation (soft spin) to separate plasma
[4] Second centrifugation (hard spin) to concentrate platelets
[5] PRP will be collected and activated before application

Surgical procedure:
[1] Local anesthesia will be administered
[2] Standard implant osteotomy protocol will be followed
[3] In **Group A**, PRP will be applied into the osteotomy site before implant placement
[4] In **Group B**, implants will be placed without PRP
[5] Primary stability will be recorded

Outcome measures:
Primary outcomes:
[1] Implant Stability Quotient (ISQ) measured using Resonance Frequency Analysis
[2] Osseointegration assessment

Secondary outcomes:
[1] Peri-implant bone density (CBCT analysis)
[2] Marginal bone loss
[3] Healing response

Follow-up protocol:
Patients will be evaluated at:
[1] Baseline (immediately after implant placement)
[2] 1 month
[3] 3 months
[4] 6 months

Statistical analysis:
[1] Data will be analyzed using SPSS software
[2] Independent t-test for intergroup comparison
[3] Paired t-test for intragroup comparison
[4] ANOVA for multiple time intervals
[5] p-value < 0.05 considered statistically significant

Results:
A total of 80 patients were included in the study and were equally divided into two groups Group A (PRP group): 40 patients (50%) and Group B (Control group): 40 patients (50%). All patients completed the follow-up period of 6 months and no dropouts were recorded. Both groups showed similar levels of primary stability at baseline, since there was no statistically significant difference ($p = 0.412$). On the other hand, there was a statistically significant 4.4% rise in ISQ values in the PRP group compared to the control group at 1 month ($p = 0.001$). Both the 3-month and 6-month increases in ISQ (from 4.9% to 4.0%, respectively) in the PRP group were very significant ($p < 0.001$). These results provide further evidence that platelet-rich plasma (PRP) improves secondary implant durability, particularly during the early stages of recovery **(Table 1)**. Bone density was similar in both groups before they started ($p= 0.538$). The PRP group had a 7.6% increase in bone density after 3 months, which was found to be statistically significant ($p = 0.002$). When comparing the two groups at 6 months, the PRP group had 8.3% more bone density ($p = 0.001$). This suggests that platelet-rich plasma (PRP) considerably improves mineralization and bone formation around implants **(Table 2)**. The control group had a marginal bone loss rate that was 27.4% higher than the PRP group at 3 months ($p < 0.001$). The PRP group still had 26.3% less bone loss at 6 months ($p < 0.001$). These findings point to the importance of PRP in maintaining bone levels around implants **(Table 3)**.

Table 1: Comparison of Implant Stability Quotient (ISQ) between groups

Time Interval	Group A (PRP) Mean ± SD	Group B (Control) Mean ± SD	p-value
Baseline	68.4 ± 3.2	67.9 ± 3.5	0.412
1 Month	72.6 ± 2.8	69.5 ± 3.1	0.001*
3 Months	76.8 ± 2.4	73.2 ± 2.9	0.000*
6 Months	79.5 ± 2.1	76.4 ± 2.6	0.000*

Table 2: Comparison of peri-implant bone density (HU Units)

Time	Group A (PRP) Mean	Group B (Control) Mean	p-

Interval	± SD	± SD	value
Baseline	620 ± 45	615 ± 48	0.538
3 Months	710 ± 50	660 ± 52	0.002*
6 Months	780 ± 55	720 ± 58	0.001*

Table 3: Marginal Bone Loss (mm) between groups

Time Interval	Group A (PRP) Mean ± SD	Group B (Control) Mean ± SD	p-value
3 Months	0.45 ± 0.12	0.62 ± 0.15	0.000*
6 Months	0.70 ± 0.18	0.95 ± 0.20	0.000*

Discussion:

Using data from 80 patients, this research assessed whether Platelet-Rich Plasma (PRP) improved osseointegration of dental implants. The results showed that the PRP group had much less marginal bone loss, higher peri-implant bone density and far better implant stability than the control group. One of the most important signs of good osseointegration is a stable implant. At 1, 3 and 6 months, the PRP group had substantially greater Implant Stability Quotient (ISQ) values compared to the control group. This confirms what other research has shown: that platelet-rich plasma (PRP) injection improves early stability by hastening bone repair and increasing bone-to-implant contact **[1]**. Osteoblastic proliferation and differentiation are promoted by growth factors including PDGF and TGF-β found in PRP, which in turn improves secondary stability. During the early stages of recovery, a randomized controlled experiment found that implants treated with PRP were far more stable than control groups **[3]**. Consistent with the current study's findings, a different clinical investigation found that implants treated with PRP had enhanced resonance frequency analysis (RFA) results. However, due to variations in PRP preparation methods and research design, several investigations have failed to find a meaningful difference in implant stability between the PRP and control groups **[5]**. At three and six months, the PRP group had significantly greater peri-implant bone density values than the control group. It seems that the process of bone maturation and mineralization is facilitated. According to research, platelet-rich plasma (PRP) improves osseointegration by increasing angiogenesis and encouraging early bone production, which supports these results **[7]**. A faster rate of healing and improved nutrition delivery to the implant site is both outcomes of PRP's enhanced vascularity, which is generated by VEFG. There is a strong correlation between marginal bone loss and the success of implants. Results showed that PRP dramatically reduced marginal bone loss. Consistent with other research, this shows that PRP administration decreases crestal bone loss by improving soft tissue repair and reducing inflammation **[9]**. Researches have shown that platelet-rich plasma (PRP) may affect inflammatory responses and stimulate tissue regeneration, which in turn can maintain bone levels around implants. Notwithstanding these encouraging results, other long-term investigations have failed to discover any evidence that PRP improves implant survival or clinical outcomes. There was no statistically significant improvement in clinical or radiological results between the PRP and control groups in a long-term randomized controlled study **[10]**. Even while it wasn't statistically significant, the PRP group did have lower values for a few metrics. These results indicate that platelet-rich plasma (PRP) may improve early healing, but the long-term advantages of PRP are still up in the air. The results of PRP treatment may vary widely, as has been shown in systematic evaluations. Considerable variation in platelet concentration, activation procedures, centrifugation processes and application techniques may lead to wildly different clinical outcomes **[11]**. Findings may not be applied to a broader population due to limited follow-up durations and small sample sizes in most research. Keep in mind that PRP has a greater impact on the first stages of healing than on long-term osseointegration, which is another crucial factor to think about. Researchers have shown that platelet-rich plasma (PRP) may hasten the onset of bone growth, but its benefits wear off with time, leaving PRP and control groups with similar long-term results **[12]**. This clarifies the reason for the substantial gains shown in the first stages of the current studies follow-up. Furthermore, the efficacy of PRP may be affected by the biological diversity across individuals, which includes variations in growth factor release and platelet concentration. In order to have consistent results in the clinic, PRP preparation and administration techniques must be standardized **[13–15]**. The complete examination of both clinical and radiographic criteria, together with the acceptable sample size (n=80) and randomized design, constitute the strengths of the current investigation. The absence of histological examination of bone-to-implant contact and the relatively short follow-up time are drawbacks; however, the results of this research indicate that platelet-rich plasma (PRP) may be an effective supplement to improve implant durability and early osseointegration. The ultimate clinical effectiveness, however, can only be determined with further long-term research using defined methods.

Conclusion:

Platelet-rich plasma significantly improved early implant osseointegration by enhancing implant stability, increasing peri-implant bone density and reducing marginal bone loss compared with conventional implant placement. Its short-term benefits suggest a favorable role in promoting early healing and bone regeneration, although long-term effects remain uncertain. These findings support further large-scale, long-term randomized controlled trials to establish the sustained therapeutic efficacy of platelet-rich plasma in implant therapy.

References:

[1] Stähli A *et al. Clin Oral Implants Res.* 2018 **29**:20. [PMID: 30306686]
[2] Attia S *et al. J Clin Med.* 2020 **9**:355. [PMID: 32012904]
[3] Zapata-Sifuentes M *et al. Regener Ther.* 2024 **26**:741. [PMID: 39290631]
[4] Taghizadeh E *et al. Galen Med J.* 2024 **13**:e3679. [PMID: 42040002]
[5] Jalaluddin M *et al. J Oral Implantol.* 2025 **21**:2845. [PMID: 41393494]
[6] Guan S *et al. Heliyon.* 2023 **9**:e13196. [PMID: 36785817]
[7] Albanese A *et al. Immun Ageing.* 2013 **10**:23. [PMID: 23763951]

[8] Chandwani N *et al. Bioinformation.* 2025 **21**:2464. [PMID: 41393465]
[9] Franchini M *et al. Blood Transfus.* 2019 **17**:357. [PMID: 31577533]
[10] Sabri H *et al. Int J Oral Implantol (Berl).* 2024 **17**:137. [PMID: 38801329]
[11] Shah R *et al. J Interdiscip Dent.* 2022 **12**:11. [DOI: 10.4103/jid.jid_87_20]
[12] Qu C *et al. BMC Oral Health.* 2021 **21**:579. [PMID: 34772376]
[13] Acerra A *et al. J Clin Med.* 2025 **14**:3224. [PMID: 40364255]
[14] Miron RJ *et al. Tissue Eng Part B Rev.* 2016 **23**. [PMID: 27672729]
[15] De Pace R *et al. J Clin Med.* 2025 **14**:1838. [PMID: 40142646]