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**Original Article**

# Evaluation of Alveolar Bone Preservation and Papillary Dynamics Using Sticky Bone versus DBM-CSH in Immediate Implant Therapy: A Randomized Clinical Study

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## ABSTRACT

Immediate implants in recently vacated sockets are considered a predictable and efficient approach; however, the processes of healing and osseointegration associated with specific grafting substances, such as sticky bone and demineralized bone matrix containing calcium sulfate hemihydrate (DBM-CSH), warrant further exploration. This investigation is designed to appraise these grafts in the context of concurrently inserted implants. A total of 18 subjects (6 men and 12 women) requiring at least 1 dental extraction were randomly assigned to 2 groups. Group I received sticky bone grafts, whereas group II received DBM-CSH treatment. Both clinical and imaging evaluations were performed at the commencement, then at 3 months, and again at 6 months post-insertion, with outcomes statistically analyzed. The trial corroborated that the insertion of immediate implants employing non-traumatic protocols successfully safeguards the hard and soft tissue architecture around the extraction locus. Throughout the 6-month observation window, both groups demonstrated meaningful soft-tissue gains, with the sticky bone cohort showing greater crestal bone height gain than the DBM-CSH cohort. Immediate implant insertion with either sticky bone or DBM-CSH grafts yields esthetically pleasing results and poses no risk of contamination or pathogen transfer. The integration of DBM into autologous fibrin glue (sticky bone) may augment the performance of immediate implants.

**Keywords:** Bone augmentation, Dental implants, Demineralized bone matrix, Immediate implant, Platelet-rich plasma, Sticky bone

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## Introduction

Dentistry has progressed with an overarching ambition to retain natural teeth, ensuring they remain functional, structurally robust, and visually attractive. The traditional remedies for tooth loss comprised detachable or fixed false teeth; however, the pioneering work of Professor Branemark in 1952, which introduced endosseous implants, was a transformative milestone, providing a reliable prosthetic substitute [1]. The conventional implantation sequence mandates preparing the recipient site for optimal fusion with the osseous bed, requiring a latency interval of 6 to 12 months following extraction to permit bone regeneration [2]. This phase can precipitate ridge atrophy. Placing the fixture immediately after exodontia exploits the existing bony housing, helping curb the dimensional shifts that typically occur within the first 3 months of socket repair [3].

To address the predicament of alveolar ridge contraction, tactics have emerged combining immediate implants and bone grafts (BGs) [4]. This development occurs despite the recognized merits of autografts and allografts, each hampered by inherent constraints: the need for a secondary operative site and

the potential for disease transmission, respectively [5]. Xenogenic demineralized bone matrix paired with calcium sulfate hemihydrate (DBM-CSH) has demonstrated utility for filling and sculpting within the socket, with DBM functioning as a robust osteoinductive stimulus [6].

Novel methods incorporate platelet-rich plasma (PRP) and platelet-concentrated fibrin glue during grafting to potentiate tissue repair, with the latter possibly expediting the timeline by releasing growth factors (GFs) that drive wound repair [7]. Accordingly, the proposition of using fibrin glue to plump up alveolar ridge deficiencies seems compelling because this glue harbors far more platelets than PRP [8], a quality that also catalyzes the BG recovery cascade [9].

A fresh modality makes use of "sticky bone," a GF-saturated matrix generated with autologous fibrin glue, to anchor the graft, which refines the healing response and curtails bone depletion [10]. To the best of our knowledge, no prior investigations have evaluated the performance of a sticky bone paired with DBM-CSH in a two-phase implant inserted into a fresh post-extraction defect. The present inquiry is the inaugural effort of its kind to assess the utility of DBM-CSH and sticky bone in augmenting crestal bone and interproximal papillae adjacent to implants, evaluating their efficacy through clinical and radiographic assessment.

## Materials and Methods

The study focused on individuals slated for single-tooth removal in either the upper or lower dental arch. All participants furnished written informed consent. The protocol was granted ethical sanction (Ethical committee No. CKS/Acad/IECC/2017) by the institutional ethical board of CKS Theja Institute of Dental Sciences, Tirupati, on 01/12/2017.

Qualifying subjects were between 25 and 50 years of age, displaying commendable oral cleanliness, sufficient bony buttress, and a favorable soft tissue silhouette on the facial tooth surfaces, featuring a normal to thick flat gingival phenotype. Candidates were excluded if they presented with systemic pathologies, a smoking history, parafunctional grinding, deficient posterior biting contacts, ongoing infectious processes around the designated tooth, or collapse of the labial cortical plate upon extraction.

*Preoperative evaluation*

Following a meticulous triage procedure, 18 patients were recruited based on an exhaustive baseline workup that included hematological blood panels, diagnostic casts, medical and dental history reviews, bone topography plotting, and radiographic documentation. Subjects were sorted at random into two arms: arm 1 was assigned to sticky BGs, while arm II was managed with DBM-CSH alone. Each arm included 9 participants, classified according to whether a sticky bone was used during a two-phase implant insertion in the fresh socket. The study transpired from August 2018 through October 2019.

Arm 1 (Sticky Bone – consisting of nine volunteers) encompassed two-phase implant insertion into fresh sockets alongside the deposition of sticky bone mixed with DBM-CSH, with soft tissue metrics appraised via the papillary index (PI) and probing depth (PD), and hard tissue appraisal conducted via radiovisiography (RVG) at baseline, 3, and 6 months.

Arm 2 (DBM-CSH – consisting of nine volunteers) encompassed two-phase implant insertion into fresh sockets alongside the deposition of DBM-CSH, with soft tissue metrics appraised via the papillary index (PI) and probing depth (PD), and hard tissue appraisal conducted via radiovisiography (RVG) at baseline, 3, and 6 months.

*Implant selection*

Endosseous implants of the two-staged, two-piece, threaded Titanium root-form variety, manufactured by the ADIN Dental Implant System and available in lengths from 8 to 13 mm and diameters from 3.6 to 5 mm, were selected to match the anatomical particulars of each case per the operative protocol.

*Presurgical procedure*

All individuals received complete-mouth scaling and root planing in addition to training in oral self-care. Informed consent was documented for every subject. One single prophylactic dose of an antibiotic (amoxicillin 500 mg) together with clavulanate potassium (125 mg) was provided 1 hour before the surgical event.

*Surgical procedure*

The surgery began with a 0.2% chlorhexidine (CHX) oral rinse for 1 minute. Once the local anesthetic had taken effect, an incision within the sulcus was executed, and a flap of full thickness was reflected. The designated teeth were eased out with a periotome, taking great care to keep the socket walls intact; thereafter, the sockets were thoroughly cleansed of granulation material with curettes and flushed with povidone-iodine. A UNC-15 probe was then applied to locate the optimal trajectory and position for the implant. The osteotomy preparation progressed through a graduated drilling sequence, ensuring that 3

to 4 mm of bone apical to the socket floor was fully engaged.

Graduated drilling proceeded with bur diameters of 2.2, 2.8, 3.2, 3.65, and 4.3 mm, turning at rates from 500 to 1200 rpm while being bathed in abundant saline coolant to prevent temperature rise and subsequent devitalization of alveolar bone. The two-stage implant was thereafter lowered into the finished osteotomy with controlled hand pressure or a Hex ratchet, delivering torque in the band of 40–55 N cm, and the fixture was firmly driven into the bone. An RVG image was obtained to confirm complete seating and to verify that the implant ran parallel to the adjacent teeth.

Where the deficiency was less than 1.5 mm, and all socket walls were sound, implants were set without supplementary grafting. Larger defects (characterized by a three-wall morphology or a circumferential space greater than 1.5 mm) were packed with sticky bone **(Figure 1)** and DBM-CSH **(Figure 2)**. The repositioned flap was then secured with sutures and protected with a coe-pack.

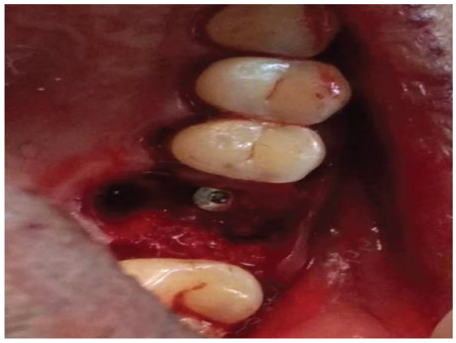


**Figure 1.** Placement of the sticky bone.

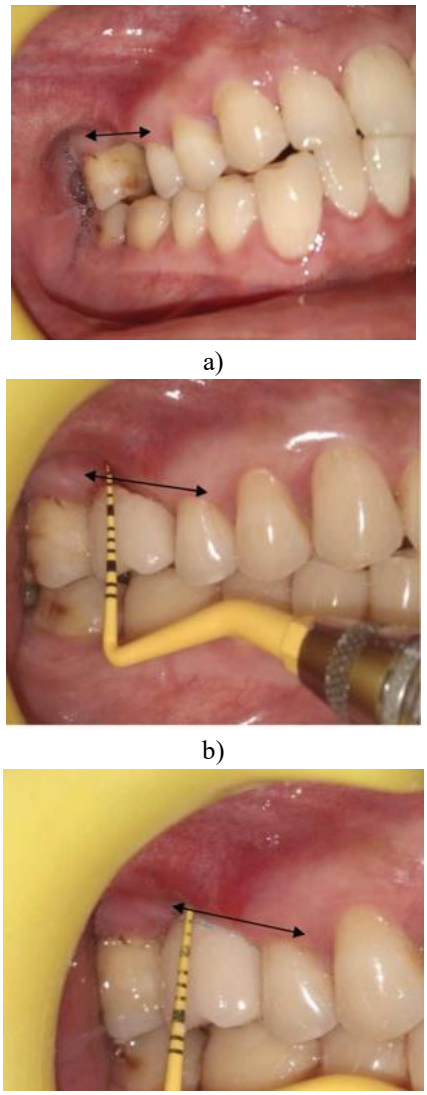
**Figure 2.** Placement of demineralized bone matrix.

*Postsurgical procedure*

The initial post-surgery care schedule comprised amoxicillin/clavulanic acid (625 mg twice daily for 5 days), diclofenac potassium 50 mg + paracetamol 325 mg + serratiopeptidase 10 mg (over 5 days), and 0.2% CHX mouth rinse (twice daily for 7 days). A follow-up visit for suture removal was arranged at the 14-day mark, at which point oral hygiene coaching was reiterated. The permanent metal-ceramic crown restoration was seated between 1 and 3 months postoperatively. Check-up appointments were set at 1, 3, and 6 months.

*Clinical and radiographic assessment*

The trajectory of soft tissue transformation was tracked by noting PD and PI at both the mesial and distal papillae at the initial examination, and then at 1, 3, and 6 months **(Figures 3 and 4)** after implant insertion, utilizing a plastic UNC-15 colorvue implant probe (North Carolina–Hu-Friedy, Chicago, IL, USA). Crestal bone-level modifications on the mesial and distal implant aspects were captured on RVG images at the initial evaluation and at 1, 3, and 6 months post-placement **(Figures 5 and 6)**.



a)

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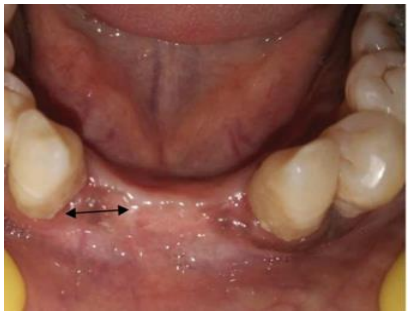
**Figure 3.** Probing depth and papillary Index (group 1): (a) at baseline, (b) at 3 months, and (c) at 6 months.



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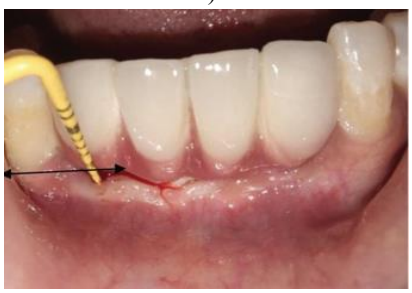
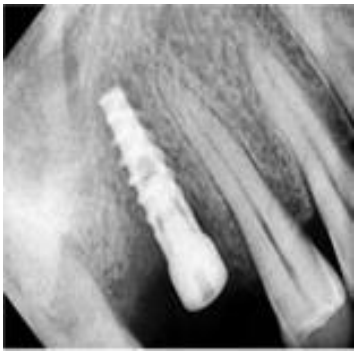


b)

c)

**Figure 4.** Probing Depth and Papillary Index (Group 2): (a) at Baseline, (b) at 3 months, and (c) at 6 months.



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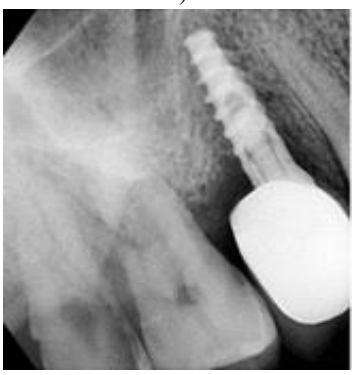

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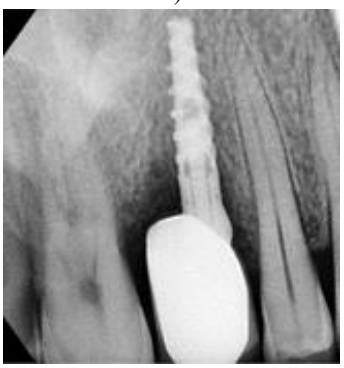
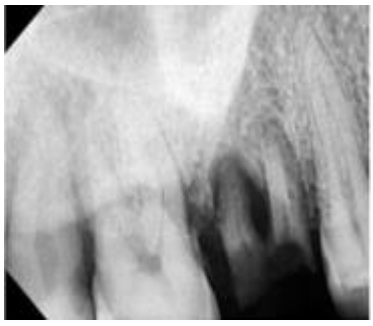


e)

**Figure 5.** Radiographic evaluation (group 1): (a) before extraction, (b) at baseline, (c) at 3 months, (d) 3 months after crown placement, and (e) at 6 months.



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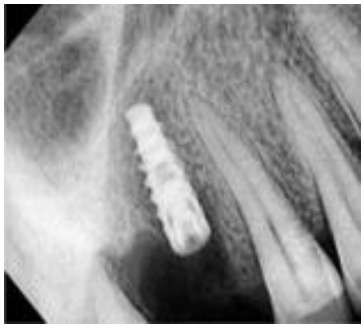

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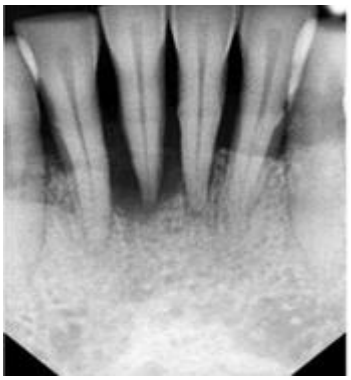

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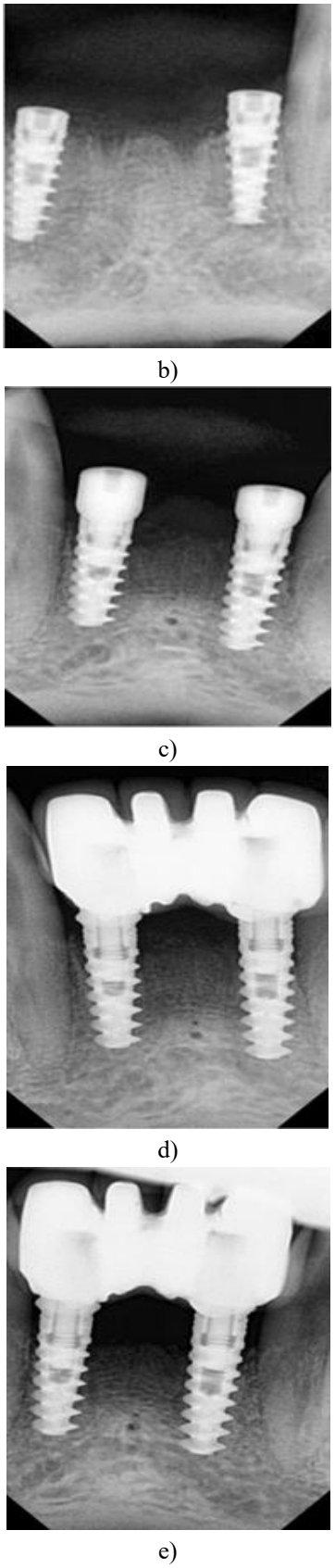

**Figure 6.** Radiographic evaluation (group 2): (a) before extraction, (b) at baseline, (c) at 3 months, (d) 3 months after crown placement, and (e) at 6 months.

*Statistical analysis*

A cohort of 18 subjects was enrolled, a number deemed sufficient to achieve statistical power above the 80% threshold. The analytic routine included computation of the mean, standard deviation, and standard error, with a P-value of <0.05 as the cutoff for significance. The Wilcoxon signed-rank test was used to compare clinical measures at each time point with baseline readings, and the Mann–Whitney U test was used to detect differences between the two study arms at each assessment point. Parametric variables, notably PD and the height of marginal bone, were investigated via the Student t-test, with Tukey's post hoc correction applied to handle multiple comparisons across varied time intervals within the same arm. Cross-arm contrasts were additionally carried out using the independent Student's t-test.

**Results and Discussion**

The investigation recruited a total of 18 participants, allocated into two cohorts: the sticky bone cohort (cohort 1, 9 individuals) and the DBM-CSH cohort (cohort II, 9 individuals). Over the full 6-month period from the initial evaluation, implant survival was 100% in both cohorts, with appreciable clinical gains evident, particularly in cohort I **(Tables 1–3)** compared with cohort II. The mesial papillary index (PPI) increased in both cohorts, rising from 1.780 ± 0.441 to 1.330 ± 0.500 within cohort I **(Table 4)** and from 1.780 ± 0.441 to 1.220 ± 0.441 within cohort II **(Table 4)**. When the mesial papilla PPI was weighed in the two cohorts at distinct temporal checkpoints (baseline, 3 months, and 6 months) **(Tables 1 and 2)**, the differences failed to reach statistical significance (P > 0.05) **(Table 5)**. Mirroring this trend, the distal PI also progressed upward from baseline to the 6-month juncture [cohort I 1.670 ± 0.500 to 1.330 ± 0.500 **(Table 4)** and cohort II 1.780 ± 0.441 to 1.220 ± 0.441 **(Tables 4, 6, and 7)**. A between-cohort comparison once more yielded no statistically meaningful disparity **(Table 5)**. Scrutiny of PD brought to light a noteworthy inter-cohort difference stretching from baseline all the way to 6 months, underscoring treatment-dependent variation in results (P < 0.005): at the starting point (0.000 ± 0.0000 for cohort I vs. 0.000 ± 0.0000 for cohort II) and at the 6-month mark (1.000 ± 0.000 for cohort I vs. 1.667 ± 0.500 for cohort II) **(Tables 4 and 8)**. Fluctuations in mesial and distal crestal bone (DCB) displayed no statistically meaningful departure either at study entry or study closure, whether examined within a single cohort or across the two: at baseline (0.000 ± 0.000 for cohort I vs. −0.222 ± 0.441 for cohort II) (P > 0.05). At 6 months (−0.954 ± 1.148 for cohort I vs. −1.060 ± 0.860 for cohort II) (P > 0.05) **(Table 4)**, suggesting

that the specific graft material employed bore no consequence for skeletal stability. Mesial crestal bone (MCB) dynamics showed no statistical significance between cohorts at the baseline assessment; however, the 3- and 6-month time points showed statistically meaningful shifts **(Table 8)**. In contrast, DCB quantities stayed below the threshold of statistical significance ($P > 0.05$) at baseline (0.000 ± 0.0000 (a) for cohort I, 0.000 ± 0.0000 (a) for cohort II), while statistically meaningful alterations ($P < 0.05$) surfaced at 3 months (−0.782 ± 1.037 for cohort I vs. −0.577 ± 0.590 for cohort II) and at 6 months (−0.948 ± 1.008 for cohort I vs. −1.187 ± 0.189 for cohort II) **(Tables 8–10)**, accentuating the possibility of differential material effects unfolding across the monitored timeframe.

**Table 1.** Group I, PPI (Mesial) at different time intervals expressed in percentage

| Score | Measure | 6 months | 3 months | Baseline | P-value | Pearson chi-square |
|---|---|---|---|---|---|---|
| 1 | Count (N) | 6 | 9 | 2 | 0.000 | 18.277 |
| | Percentage (%) | 66.70 | 100.00 | 22.20 | | |
| 2 | Count (N) | 3 | 0 | 7 | | |
| | Percentage (%) | 33.30 | 0.00 | 77.80 | | |
| **Total** | Count (N) | 9 | 9 | 9 | | |
| | Percentage (%) | 100.00 | 100.00 | 100.00 | | |

PPI: Papillary Index.

**Table 2.** Group II, PPI (Mesial) at different time intervals expressed in percentage

| Score | Parameter | 6 Months | 3 Months | Baseline | Significance (P) | Chi-square (Pearson) |
|---|---|---|---|---|---|---|
| 1 | Frequency (N) | 7 | 9 | 2 | 0.001 | 16.062 |
| | Proportion (%) | 77.80 | 100.00 | 22.20 | | |
| 2 | Frequency (N) | 2 | 0 | 7 | | |
| | Proportion (%) | 22.20 | 0.00 | 77.80 | | |
| **Total** | Frequency (N) | 9 | 9 | 9 | | |
| | Proportion (%) | 100.00 | 100.00 | 100.00 | | |



**Table 3.** Wilcoxon signed rank test to compare between two groups at different points in time for the mesial papilla and distal papilla

| Outcome variable | Group | Time Comparison | P Value | Z Statistic | Significance |
|---|---|---|---|---|---|
| **Mesial papilla** | Group I | Baseline vs 3 Months | 0.004 | −3.289 | S |
| | | Baseline vs 6 Months | 0.065 | −1.844 | NS |
| | | 3 Months vs 6 Months | 0.065 | −1.844 | NS |
| | Group II | Baseline vs 3 Months | 0.004 | −3.289 | S |
| | | Baseline vs 6 Months | 0.05 | −0.615 | NS |
| | | 3 Months vs 6 Months | 0.43 | −1.458 | NS |
| **Distal papilla** | Group I | Baseline vs 3 Months | 0.169 | −1.374 | NS |
| | | Baseline vs 6 Months | 0.169 | −1.374 | NS |
| | | 3 Months vs 6 Months | 1.000 | 0 | NS |
| | Group II | Baseline vs 3 Months | 0.004 | −3.289 | S |
| | | Baseline vs 6 Months | 0.05 | −0.615 | NS |
| | | 3 Months vs 6 Months | 0.43 | −1.458 | NS |

**Table 4.** Descriptive statistics: all means and standard deviations of mesial papilla, distal papilla, probing depth, mesial crestal bone levels, and distal crestal levels.

| Groups | | Distal crestal bone levels | Mesial crestal bone levels | Probing depth | Distal papilla | Mesial papilla |
|---|---|---|---|---|---|---|
| Group I baseline | Mean | 0.000 | 0.000 | 0.000 | 1.670 | 1.780 |
| | SD | 0.000 | 0.000 | 0.000 | 0.500 | 0.441 |
| Group I 3 months | Mean | −0.782 | −0.542 | 1.000 | 1.330 | 1.000 |
| | SD | 1.037 | 0.855 | 0.000 | 0.500 | 0.000 |
| Group I 6 months | Mean | −0.948 | −0.954 | 1.000 | 1.330 | 1.330 |
| | SD | 1.008 | 1.148 | 0.000 | 0.500 | 0.500 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Group II baseline | Mean | 0.000 | −0.222 | 0.000 | 1.780 | 1.780 |
| | SD | 0.000 | 0.441 | 0.000 | 0.441 | 0.441 |
| Group II 3 months | Mean | −0.577 | −0.744 | 1.111 | 1.000 | 1.000 |
| | SD | 0.590 | 0.902 | 0.601 | 0.000 | 0.000 |
| Group II 6 months | Mean | −1.187 | −1.060 | 1.667 | 1.220 | 1.220 |
| | SD | 0.567 | 0.860 | 0.500 | 0.441 | 0.441 |
| Total | Mean | −0.541 | −0.500 | 0.796 | 1.310 | 1.280 |
| | SD | 0.782 | 0.781 | 0.683 | 0.464 | 0.451 |

**Table 5.** Groupwise comparison using the Mann–Whitney U test at different points in time for mesial papilla and distal papilla

| Outcome measure | Time point | Group | P-value | U statistic | Sample size (N) | Significance |
|---|---|---|---|---|---|---|
| **Mesial papilla** | Baseline | Group I | 1 | 40.5 | 9 | NS |
| | | Group II | | | 9 | |
| | 3 Months | Group I | 1 | 40.5 | 9 | NS |
| | | Group II | | | 9 | |
| | 6 Months | Group I | 0.609 | 36 | 9 | NS |
| | | Group II | | | 9 | |
| **Distal papilla** | Baseline | Group I | 0.60 | 36 | 9 | NS |
| | | Group II | | | 9 | |
| | 3 Months | Group I | 0.065 | 20.5 | 9 | NS |
| | | Group II | | | 9 | |
| | 6 Months | Group I | 0.609 | 36 | 9 | NS |
| | | Group II | | | 9 | |

**Table 6.** Group I, PPI (Distal) at different time intervals expressed in percentage.

| Score | Measure | 6 months | 3 months | Baseline | P-value | Pearson chi-square |
|---|---|---|---|---|---|---|
| 1 | Count (N) | 6 | 6 | 3 | 0.029 | 9.000 |
| | Percentage (%) | 66.70 | 66.70 | 33.30 | | |
| 2 | Count (N) | 3 | 3 | 6 | | |
| | Percentage (%) | 33.30 | 33.30 | 66.70 | | |
| **Total** | Count (N) | 9 | 9 | 9 | | |
| | Percentage (%) | 100.00 | 100.00 | 100.00 | | |

**Table 7.** Group II, PPI (distal) at different time intervals expressed in percentage.

| Score | Parameter | 6 months | 3 months | Baseline | P-value | Chi-square (Pearson) |
|---|---|---|---|---|---|---|
| 1 | Frequency (N) | 7 | 9 | 2 | 0.001 | 16.062 |
| | Percentage (%) | 77.80 | 100.00 | 22.20 | | |
| 2 | Frequency (N) | 2 | 0 | 7 | | |
| | Percentage (%) | 22.20 | 0.00 | 77.80 | | |
| **Total** | Frequency (N) | 9 | 9 | 9 | | |
| | Percentage (%) | 100.00 | 100.00 | 100.00 | | |

**Table 8.** Student's t-test between two groups: probing depth, mesial crestal bone change, and distal crestal bone change

| Time point | Outcome measure | Group | N | Significance | P-value | t value | Std. error mean | Std. deviation | Mean |
|---|---|---|---|---|---|---|---|---|---|
| **Baseline** | Probing Depth | Group I | 9 | NS | 0.150 | 0.000 | 0.0000 | 0.00000(a) | 0.000 |
| | | Group II | 9 | | | | 0.000 | 0.00000(a) | 0.000 |
| | Mesial Crestal Bone Change | Group I | 9 | | | 1.512 | 0.000 | 0.000 | 0.000 |
| | | Group II | 9 | | | | 0.147 | 0.441 | −0.222 |
| | Distal Crestal Bone Change | Group I | 9 | | | 0.000 | 0.000 | 0.00000(a) | 0.000 |
| | | Group II | 9 | | | | 0.000 | 0.00000(a) | 0.000 |
| **3 Months** | Probing Depth | Group I | 9 | NS | 0.587 | 0.555 | 0.000 | 0.000 | 1.000 |
| | | Group II | 9 | | | | 0.200 | 0.601 | 1.111 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mesial Crestal Bone Change | Group I | 9 | NS | 0.632 | 0.488 | 0.285 | 0.855 | −0.542 |
| | | Group II | 9 | | | | 0.301 | 0.902 | −0.744 |
| | Distal Crestal Bone Change | Group I | 9 | NS | 0.612 | 0.517 | 0.346 | 1.037 | −0.782 |
| | | Group II | 9 | | | | 0.197 | 0.590 | −0.577 |
| **6 Months** | Probing Depth | Group I | 9 | S | 0.001 | 4.000 | 0.000 | 0.000 | 1.000 |
| | | Group II | 9 | | | | 0.167 | 0.500 | 1.667 |
| | Mesial Crestal Bone Change | Group I | 9 | NS | 0.828 | 0.221 | 0.383 | 1.148 | −0.954 |
| | | Group II | 9 | | | | 0.287 | 0.860 | −1.060 |
| | Distal Crestal Bone Change | Group I | 9 | NS | 0.544 | 0.620 | 0.336 | 1.008 | −0.948 |
| | | Group II | 9 | | | | 0.189 | 0.567 | −1.187 |

**Table 9.** Post hoc test multiple comparisons Tukey HSD for group I: mean probing depth (pd), mesial crestal bone change, and distal crestal bone change at different time intervals

| Outcome variable | Time comparison | 95% CI upper | 95% CI lower | P-value (Sig.) | Std. Error | Mean difference (I–J) |
|---|---|---|---|---|---|---|
| **Probing depth** | Baseline vs 3 months | −0.0005 | 0.000 | 0 | 0.00000 (a) | 0.000 |
| | Baseline vs 6 months | −0.0005 | 0.000 | 0 | 0.00000 (a) | 0.000 |
| | 3 Months vs 6 months | −0.0005 | 0.000 | 0 | 0.00001 | 0.0001 |
| **Mesial crestal bone change** | Baseline vs 3 months | 1.511 | −0.426 | 0.439 | 0.357 | 0.542 |
| | Baseline vs 6 months | 1.923 | −0.014 | 0.055 | 0.357 | 0.954 |
| | 3 Months vs 6 Months | 1.381 | −0.556 | 0.660 | 0.357 | 0.412 |
| **Distal crestal bone change** | Baseline vs 3 Months | 1.837 | −0.273 | 0.206 | 0.389 | 0.782 |
| | Baseline vs 6 Months | 2.003 | −0.107 | 0.091 | 0.389 | 0.948 |
| | 3 Months vs 6 Months | 1.221 | −0.809 | 0.974 | 0.389 | 0.166 |

HSD: Honestly Significant Difference. The mean difference is significant at the 0.05 level.

**Table 10.** Post hoc test multiple comparisons Tukey HSD for group ii: mean probing depth, mesial crestal bone change, and distal crestal bone change at different time intervals

| Outcome variable | Time comparison | 95% CI upper | 95% CI lower | Sig. | Std. Error | Mean difference (I–J) |
|---|---|---|---|---|---|---|
| **Probing depth** | Baseline vs 3 Months | −0.5798 | −1.6424 | 0 | 0.21276 | −1.1111(*) |
| | Baseline vs 6 Months | −1.1353 | −2.198 | 0 | 0.21276 | −1.6667(*) |
| | 3 Months vs 6 Months | −0.0242 | −1.0869 | 0.039 | 0.21276 | −0.5556(*) |
| **Mesial crestal bone change** | Baseline vs 3 Months | 1.4123 | −0.3679 | 0.399 | 0.32852 | 0.5222 |
| | Baseline vs 6 Months | 1.7279 | −0.0523 | 0.071 | 0.32852 | 0.8378 |
| | 3 Months vs 6 Months | 1.2056 | −0.5745 | 0.772 | 0.32852 | 0.3156 |
| **Distal crestal bone change** | Baseline vs 3 Months | 1.2994 | −0.146 | 0.156 | 0.26674 | 0.5767 |
| | Baseline vs 6 Months | 1.9094 | 0.464 | 0.001 | 0.26674 | 1.1867(*) |
| | 3 Months vs 6 Months | 1.3327 | −0.1127 | 0.122 | 0.26674 | 0.61 |

HSD: Honestly Significant Difference. The mean difference is significant at the 0.05 level.



Therapeutic protocols involving dental implants have solidified their standing as an exceptionally successful and reliably foreseeable modality for rehabilitating toothless regions. As success rates continue to rise, interest has intensified in shortening the overall care timeline. Earlier conventions urged a postsurgical latency of 6 months following exodontia to permit socket maturation. Nevertheless, scholarly reports have identified post-extraction osseous collapse as an obstacle, prompting a shift toward directly inserting fixtures into pristine sockets to conserve alveolar architecture [11].

To reduce infectious complications and prevent apical epithelial downgrowth along the implant shaft, clinicians have widely adopted a two-stage operative sequence coupled with delayed prosthetic loading [12]. Still, achieving primary anchorage remains a nonnegotiable prerequisite for favorable osseointegration. In the quest to bolster this process, an assortment of BGs has been introduced to address the spatial discrepancy between the fixture and the bony envelope, sourced from xenogeneic, allogeneic, and alloplastic materials; each variety possesses osteoconductive properties and provides a structural template for cellular adherence and population growth [13].

PRF, a copious repository of GFs—namely PDGF, TGF-β1, TGF-β2, and VEGF—stored inside thrombocytes, shoulders a crucial responsibility in summoning mesenchymal elements, stimulating neovascularization, directing cell movement, spurring mitotic activity, and reinforcing osteogenesis,

collectively quickening tissue repair and the osseous integration surrounding implants [14].

Merging autologous fibrin glue with granular BGs produces a consistent conglomerate within which the graft fragments are enmeshed and immobilized by the fibrin scaffold, averting particulate drift [15]. GF discharge from the entombed thrombocytes catalyzes nascent bone synthesis through engagement with mesenchymal progenitor cells. Owing to the elevated fibrinogen concentration in this concoction, compared with PRP, a more robust fibrin mesh is formed, with enhanced cohesive properties that firmly lock the BGs in place [9].

Fibrin glue, which is largely engineered in the laboratory by converging fibrinogen and thrombin solutions, has been deployed across a spectrum of dental contexts—among them ridge augmentation, instant fixture insertion, socket repair, and elevation of the maxillary sinus floor. In the year 2001, Hallman *et al*. [16] elucidated the osteoconductive potential inherent in a mixture of bovine hydroxyapatite, autogenous particulates, and fibrin glue applied to sinus grafting procedures. Building on this, Kenji *et al*. [5]. In 2006, chronicled markedly improved osseous neogenesis when tissue-engineered constructs supplemented with fibrin glue were utilized for alveolar enhancement alongside synchronized implant seating. Further corroboration arrived from Lee *et al*. [9], whose canine experiments demonstrated that pairing autogenous osseous matter with platelet-enriched fibrin glue substantially advanced both osseointegration and vertical bone height in sinus lift operations accompanying concurrent fixture installation.

Notwithstanding its virtues, industrially manufactured fibrin glue poses risks of bloodborne pathogen transmission and immune-mediated hypersensitivity [9]. In response to these shortcomings, an innovative methodology reliant on a GF-saturated BG amalgam—coined “sticky bone” and derived entirely from autologous fibrin glue—has come to the fore. The merits of sticky bone are manifold: it exhibits pliability to conform to irregular defect geometries, suppresses both subtle and overt movement of the transplanted osseous material, accelerates restoration of both soft and mineralized tissues in the absence of extraneous biochemical adjuvants, and curtails the encroachment of non-osseous tissue [10].

Research by Sohn *et al*. [10] and Joshi *et al*. [15] established sticky bone as a feasible substitute for collagen barrier films and titanium meshwork, highlighting marked volumetric improvements in the alveolar ridge [15].

The investigation at hand represents the first clinical deployment of DBM integrated with autologous fibrin glue (sticky bone) to systematically assess papillary form and marginal bone height in two-phase immediate implant protocols.

The cosmetic appeal of single-crown implant restorations is partially governed by the morphology and congruence of the emergent papilla between the implant and its neighboring tooth. Variables such as the cervico-incisal location of the interproximal contact region with adjacent dentition and the degree of bony scaffold conservation around the implant profoundly shape the reformation of interdental papillae. Choquet *et al*. [17] underscored the importance of these parameters. At the same time, Jemt [18, 19] formulated a classification to quantify the dimensions and outline of papillae adjacent to implant-supported prostheses, noting that spontaneous soft tissue recovery occurred in nearly 60% of cases, regardless of the presence of interim restorations. Priest [20] cataloged total papillary infilling in 75% of examined cases, wherein regeneration materializes in 83.9% of the reviewed instances.

Data from this trial reveal an increase in the averaged mesial PI from the original reading to the 6-month mark in both study arms, accompanied by statistically significant differences between the two arms ($P < 0.05$). In a commensurate manner, the averaged distal PI was identical over the same period across both arms, yet still featured measurable inter-arm discrepancies. Conversely, the averaged PD spanning baseline to 6 months remained relatively unchanged in both arms, though cross-arm comparisons showed a statistically significant difference ($P < 0.05$).

Marginal osseous variations were similarly tracked; a decline in MCB was documented in both arms from the preliminary measurement through to the half-year assessment, yet these alterations lacked statistical significance when the two arms were compared ($P > 0.05$). The course of DCB adhered to an equivalent trajectory, exhibiting no settlement of meaningful disparity between the arms by the 6-month evaluation point ($P > 0.05$). It bears mention that the sticky bone arm displayed a non-statistically relevant uptick in crestal bone dimension between the 3-month and 6-month intervals relative to its DBM-CSH counterpart. The resorption observed in the DBM group may plausibly stem from customary peri-implant bone remodeling triggered by the seating of the definitive prosthesis, a scenario that could heighten force concentration at the bone–implant junction.

The present inquiry was constrained by two central limitations: a limited observation window and a small

cohort size, both of which could affect the reliability and broad applicability of the collected evidence. Ensuing research initiatives should be designed around larger participant pools and extended surveillance horizons to permit an exhaustive dissection of how sticky bone and DBM-CSH shape peri-implant soft tissue health and crestal bone dynamics during two-phase implant insertion into recently vacated sockets.

**Conclusion**

The experiment evaluated the bearing of sticky bone and DBM-CSH on implant receptor sites. Autologous fibrin glue was highlighted as a promising restorative biomolecule that could enhance the vitality of tissues surrounding implants. Dissection of the gathered metrics indicated that the sticky bone contingent achieved higher crestal bone heights than the DBM contingent, with noteworthy differences in papillary registrations between the cohorts, even though both camps showed progress. Both groups logged a rim in PD values, with observable intergroup distinctions. The collective outcomes accent the utility of harnessing DBM in combination with autologous fibrin glue for osseous alveolar reinforcement, while foregrounding its cost-conscious character and its viability as an alternative to traditional graft substrates. Continued examination through large-scale randomized controlled experimentation encompassing amplified sample sets and lengthier tracking periods is strongly endorsed to authenticate these early-stage observations.

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