

# COMPARATIVE CLINICAL ANALYSIS OF CALCIUM PHOSPHOSILICATE PUTTY/NOVABONE DENTAL PUTTY VERSUS PLATELET-RICH FIBRIN (PRF) IN ALVEOLAR RIDGE PRESERVATION PRIOR TO IMPLANT: AN ORIGINAL RESEARCH STUDY

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## ABSTRACT

**Aim:** This study aims to analyze calcium phosphosilicate putty/novabone dental putty versus platelet-rich fibrin (PRF) in alveolar ridge preservation prior to implant.

**Materials and Methods:** A randomized controlled trial conducted which involved 60 participants aged 35 to 60 with chronic generalized periodontitis, requiring extraction and lacking sufficient jawbone for dental implants. Participants were divided into three groups of 20. Comprehensive clinical assessments measured probing pocket depths and radiographic evaluations at baseline, 3 months, and 6 months post-surgery. The study aimed to compare the effectiveness of calcium phosphosilicate putty (Novabone) and platelet-rich fibrin (PRF) for alveolar ridge preservation. PRF was prepared through centrifugation of blood to create a membrane. The surgical protocol randomized the treatment of defects, with Group A receiving Novabone, Group B receiving PRF, and Group C receiving a combination. Post-surgery follow-ups evaluated healing using the same methods as baseline assessments. The study was to provide insights into materials promoting bone healing before dental implantation.

**Statistical Analysis and Results:** The study involved 60 participants, evenly divided into three groups of 20, with a gender distribution of 27 males and 33 females aged 35 to 60. At baseline, analysis showed no significant differences ( $P > 0.05$ ) among the groups regarding clinical and radiographic parameters, establishing comparable clinical severity. Over time, significant improvements were observed in all groups ( $P < 0.01$ ) at the 3-month and 6-month follow-ups. Both Plaque and Gingival Indices declined, with a notable drop in the Gingival Index at 3 months followed by a slight rebound at 6 months, yet still below baseline levels. Probing Pocket Depth (PPD) and Relative Attachment Level (RAL) showed consistent reductions, indicating improved periodontal health. Inter-group comparisons revealed significant differences in improvement: - For Plaque Index, Group C had the most reduction ( $0.68 \pm 0.45$ ), though no significant differences were found at 3 or 6 months. - PPD differences became significant by 6 months ( $P < 0.05$ ) with Group C at  $4.65 \pm 0.72$  mm, followed by Group B at  $4.95 \pm 0.88$  mm, and Group A at  $5.31 \pm 0.48$  mm. - RAL results showed Group C had a higher mean ( $9.10 \pm 1.25$  mm) and greater net gain ( $2.80 \pm 0.65$  mm) compared to Group B ( $1.88 \pm 0.50$  mm) and Group A ( $1.50 \pm 0.80$  mm). While all groups reduced radiographic defect depth significantly ( $P < 0.01$ ), no differences were noted among them ( $P > 0.05$ ). This summary reflects the effectiveness of the interventions and highlights the differences in outcomes between groups.

**Conclusion:** This study concluded that combining Novabone and PRF was most effective for long-term periodontal rehabilitation, with better clinical attachment levels and reduced pocket depth at 6 months. However, all groups were similarly effective at reducing bone defects, with no significant differences on radiographic evaluation. Overall, all three interventions effectively managed periodontal issues, resulting in reduced plaque, decreased gingival inflammation, and improved clinical outcomes.

**KEYWORDS:** Platelet-Rich Fibrin (PRF), Alveolar Ridge Preservation, Dental Implant, Calcium Phosphosilicate Putty/Novabone Dental Putty

## INTRODUCTION

A dental implant serves as a sophisticated solution for individuals missing one or more teeth. Composed primarily of titanium or ceramic, this innovative device is surgically inserted into the jawbone to serve as a robust, artificial root. The structure of a dental implant includes three essential components: the implant post, which is embedded within the jawbone; the abutment that bridges the post to the visible crown; and the custom-made crown itself, which is designed to closely resemble natural teeth in shape, colour, and size.<sup>1,2</sup> The journey toward receiving a dental implant begins with a thorough consultation. During this initial visit, the dentist assesses the patient's overall health and utilizes advanced imaging techniques to scan the jawbone, ensuring a comprehensive evaluation of the condition. Once the patient is deemed an appropriate candidate, the dental procedure proceeded under local anaesthesia. The dentist carefully places the implant post into the jawbone, initiating a remarkable process known as osseointegration.<sup>3,4</sup> Over the course of three to six months, the jawbone begins to fuse seamlessly with the post, providing a stable foundation for the implant. After the healing period, the next steps involve attaching the abutment and the custom crown, restoring both aesthetic appeal and functionality to the smile. Dental implants come in various types, including endosteal implants, which are inserted directly within the jawbone, and subperiosteal implants, which are placed atop the jawbone.<sup>5,6</sup> Innovative techniques such as All-on-4 or All-on-6 enable the support of entire arches of teeth with fewer implants, optimizing efficiency and minimizing patient discomfort. To further enhance the dental implant process, alveolar ridge preservation (ARP) can be performed post-extraction to prevent bone loss, which is crucial for future implant placement. One advanced material used during this procedure is Calcium phosphosilicate (CPS) putty, such as NovaBone Dental Putty.<sup>7,8</sup> Comprising about 70%–75% bioactive glass particles, CPS offers a bimodal particle size distribution. Smaller particles, ranging from 32–125  $\mu\text{m}$ , facilitate rapid ion release, while larger particles, measuring 90–710  $\mu\text{m}$ , provide crucial structural support. This putty is not only easily moldable, thanks to a combination of a PEG additive and glycerin binder, but it also resorbs within 24 to 72 hours, forming a porous network that is conducive to bone regeneration. When CPS comes into contact with blood, it triggers a process dubbed "osteostimulation," releasing calcium, phosphate, and silicon ions that invigorate osteoblast activity and enhance bone formation.<sup>9,10</sup> Additionally, it stabilizes blood clots in extraction sockets, reducing the risk of ridge contraction during the critical three to six-month healing phase. Research indicates that vital bone formation rates after using CPS can range from 32% to nearly 50%, which stands on par with xenografts such as anorganic bovine bone mineral. For effective alveolar ridge preservation, the procedure typically begins with an atraumatic tooth extraction, followed by filling the resulting socket with the graft material and securing it with a protective barrier.<sup>11,12</sup> Platelet-rich fibrin (PRF) derived from the patient's own blood also plays a pivotal role in mitigating bone loss and expediting healing. This autologous concentrate releases growth factors that foster a natural matrix for tissue regeneration. PRF can significantly reduce bone resorption and improve bone and soft tissue healing compared with traditional materials such as Freeze-Dried Bone Allograft, in both hard-tissue healing and aesthetic outcomes.<sup>13,14</sup> This study aims to analyze calcium phosphosilicate putty/novabone dental putty versus platelet-rich fibrin (PRF) in alveolar ridge preservation prior to implant.

## MATERIALS AND METHODS

A randomized controlled trial was conducted in the Department of Prosthodontics and Implantology, focusing specifically on patients with missing or loose teeth requiring extraction, as well as those with insufficient jawbone volume for stable dental implant placement. The study involved 60 participants, evenly divided into three groups of 20, comprising both male and female patients aged between 35 and 60 years. The inclusion criteria for this study mandated that all participants be diagnosed with chronic generalized periodontitis according to the 1999 classification, showcasing probing pocket depths of 5 mm or more and radiographic evidence of vertical bone loss. Additionally, each participant was required to have at least 28 functional teeth and no history of systemic diseases. Exclusion criteria definitively ruled out individuals with poor oral hygiene, pregnant or lactating women, smokers, those undergoing orthodontic treatment, and patients with compromised systemic health. Each participant provided written informed consent that clearly outlined the nature of the study and the surgical procedures involved. Before the surgical intervention, scheduled four to six weeks later, all patients underwent initial therapy that included scaling, root planning, oral prophylaxis, and detailed instructions for maintaining oral hygiene. Comprehensive clinical and radiographic assessments were performed, measuring plaque and gingival indices, probing pocket depths with a UNC-15 probe, relative attachment levels, and intraoral radiographic evaluations of each defect site utilizing specific imaging techniques and settings. The primary objective of this study was to evaluate the effectiveness of calcium phosphosilicate putty (Novabone) in comparison to platelet-rich fibrin (PRF) for alveolar ridge preservation prior to implant placement. Radiographic measurements were meticulously recorded at baseline, and again at 3 and 6 months post-surgery. Key measurements included the distances from the cemento-enamel junction (CEJ) to the base of the defect (BD), designated (D<sub>0</sub>), (D<sub>3</sub>), (D<sub>6</sub>). The resolution of the defect was quantified as a percentage of the original defect resolved at both 3 months and 6 months. For PRF preparation, blood was drawn into sterile test tubes without an anticoagulant and centrifuged for 10 minutes at 3000 rpm, resulting in three distinct layers: acellular platelet-poor plasma, a PRF clot, and red blood cells. The PRF was then processed into a membrane by squeezing out excess fluids. The surgical protocol involved randomly assigning the 60 selected sites into one of three treatment

groups, with 20 patients in each group to ensure balanced distribution. All procedures were executed by a single surgeon under local anaesthesia. A full-thickness mucoperiosteal flap was raised to expose the defect, which was meticulously cleaned and filled according to the group assignment: Group A received only Novabone Putty, Group B received only PRF, and Group C received a combination of both materials. Following placement, the flaps were repositioned and secured with sutures, followed by a periodontal dressing. Post-surgery, sutures and dressings were removed one week later, and the surgical area was thoroughly irrigated. Patients underwent follow-up evaluations at 3 and 6 months to measure healing, employing the same clinical and radiographic methods used at baseline. This study aims to deliver definitive insights into the effectiveness of various filling materials in promoting bone healing and preserving alveolar ridge integrity prior to dental implantation.

### Statistical Analysis

Statistical analysis was conducted using SPSS version 30.0. We employed the chi-square test to assess differences in proportions among groups, ensuring a thorough comparison of categorical data. For continuous variables, one-way ANOVA was used, followed by Tukey's post-hoc test for pair-wise comparisons. Categorical variables were analyzed with a two-tailed Fisher's exact test. A significance level of  $P < 0.05$  was considered statistically significant.

### RESULTS

The study included a total of 60 participants, who were meticulously divided into three distinct groups, each comprising 20 individuals. The participant pool consisted of both male and female patients, with ages ranging from 35 to 60 years. Within this cohort, 27 were male and 33 were female, as illustrated in Table 1 and Graph 1.

**Baseline Comparisons (Homogeneity) Finding:** At the beginning of the study (Baseline), an analysis revealed no statistically significant differences ( $P > 0.05$ ) among Group A, Group B, and Group C across a variety of clinical and radiographic parameters. These parameters included the Plaque Index, Gingival Index, Probing Pocket Depth, Relative Attachment Level, and Radiographic Depth of Defect.

**Implication:** The successful randomization process established that all three groups started with comparable clinical severity. This homogeneity at baseline is critical as it ensures that future comparisons made throughout the study are valid and reliable.

**Intra-Group Analysis (Progress Over Time Within Each Group)** As detailed in Table 2, significant progress was observed in all three groups over time, with highly statistically significant improvements ( $P < 0.01$ ) noted from baseline to the 3-month and 6-month follow-ups:

**Plaque & Gingival Indices:** Both indices showed a continuous decline across the study period for all three groups. Notably, while the Gingival Index exhibited a substantial drop at the 3-month mark, there was a slight rebound observed at the 6-month point. Nonetheless, all groups maintained Gingival Index values significantly lower than their respective baseline levels.

**Probing Pocket Depth (PPD) & Radiographic Depth of Defect:** Both parameters demonstrated a consistent and significant decrease from baseline through to the 6-month evaluation across all groups, indicating effective treatment outcomes.

**Relative Attachment Level (RAL):** The analysis showed clear structural gains in attachment levels, reflected by a decrease in millimetre values over the 6-month follow-up for all groups, showcasing the improvements in periodontal health.

**Inter-Group Analysis (Comparing Groups A, B, and C)** While all groups exhibited improvements within their respective cohorts, Table 1 highlights significant statistical differences in the extent of these improvements among the groups:

**Plaque Index:** Although no significant differences were identified between the groups at the 3-month or 6-month assessments, the Net Change recorded was significantly varied ( $P < 0.05$ ). Group C exhibited the largest overall reduction in plaque levels, with a notable decrease of  $0.68 \pm 0.45$ .

**Gingival Index:** Similar to the Plaque Index, no substantial differences were noted at the 3-month or 6-month checkpoints across the three groups. However, a significant statistical difference in Net Change was observed ( $P < 0.05$ ), indicating differing structural reduction profiles among the groups.

**Probing Pocket Depth (PPD):** By the 6-month assessment, inter-group differences became statistically significant ( $P < 0.05$ ). Group C achieved the lowest remaining pocket depth at  $4.65 \pm 0.72$  mm, closely followed by Group B at  $4.95 \pm 0.88$  mm, and Group A at  $5.31 \pm 0.48$  mm. Additionally, Group B and Group C showcased notably larger Net Reductions, averaging approximately 2.47 mm and 2.45 mm, respectively, compared to Group A, which recorded a reduction of only 1.54 mm.

**Relative Attachment Level (RAL):** At the conclusion of the 6-month period, Group C demonstrated a statistically superior Relative Attachment Level, achieving a mean value of  $9.10 \pm 1.25$  mm ( $P < 0.05$ ), as well as a greater Net Change/Gain of  $2.80 \pm 0.65$  mm, outpacing Group B, which showed a gain of  $1.88 \pm 0.50$  mm, and Group A at  $1.50 \pm 0.80$  mm.

**Radiographic Depth of Defect:** While all groups effectively reduced bone defect depths over the 6-month span ( $P < 0.01$ ), no statistically significant differences ( $P > 0.05$ ) were found among the three groups regarding their final 6-month Radiographic values or their net changes. This detailed breakdown of results underscores the efficacy of the interventions tested and the distinctions in outcomes between the groups, providing valuable insights into the treatment's effectiveness.

**Table 1:** Age & gender based statistical description of contributing patients

| Age Group (Yrs) | Male | Female | Total | P value |
|-----------------|------|--------|-------|---------|
| 35-40           | 4    | 4      | 8     | 0.02*   |

|                     |    |    |    |              |
|---------------------|----|----|----|--------------|
| 41-45               | 6  | 5  | 11 | 0.30         |
| 46-50               | 5  | 7  | 12 | 0.01*        |
| 51-55               | 5  | 7  | 12 | 0.70         |
| 56-60               | 7  | 10 | 17 | 0.40         |
| Total               | 27 | 33 | 60 | *Significant |
| *p<0.05 significant |    |    |    |              |

**Graph 1:** Patients demographic distribution and associated details

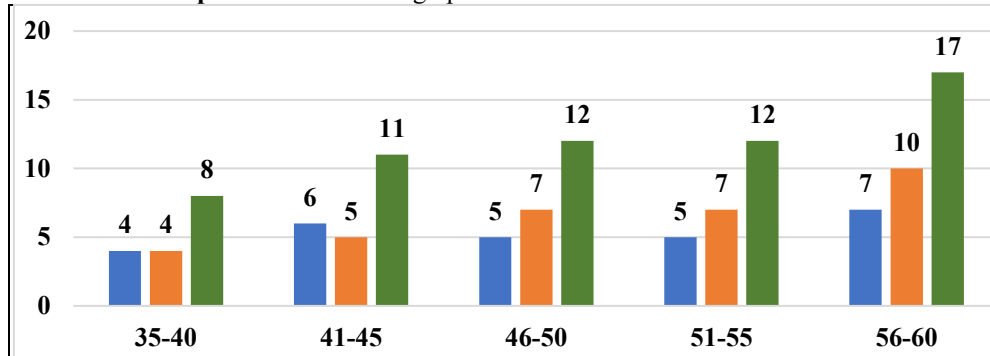


**Table 2:** Inter-group comparison of mean clinical parameters at different time intervals (Total N=60, n=20 per group)

| Index Parameter /                                                            | Time Period | Group A (n=20)<br>(Mean ± SD) | Group B (n=20)<br>(Mean ± SD) | Group C (n=20)<br>(Mean ± SD) | ANOVA Statistical Test<br>(P)-value |
|------------------------------------------------------------------------------|-------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------------|
| Plaque Index                                                                 | Baseline    | 1.48 ± 0.31                   | 1.39 ± 0.28                   | 1.44 ± 0.30                   | (>0.05) (NS)                        |
|                                                                              | 3 Months    | 1.01 ± 0.22                   | 0.94 ± 0.21                   | 0.88 ± 0.19                   | (>0.05) (NS)                        |
|                                                                              | 6 Months    | 0.88 ± 0.19                   | 0.81 ± 0.18                   | 0.76 ± 0.16                   | (>0.05) (NS)                        |
|                                                                              | Net Change  | 0.60 ± 0.49                   | 0.58 ± 0.42                   | 0.68 ± 0.45                   | (<0.05) (Sig)*                      |
| Gingival Index                                                               | Baseline    | 1.35 ± 0.28                   | 1.31 ± 0.25                   | 1.28 ± 0.24                   | (>0.05) (NS)                        |
|                                                                              | 3 Months    | 0.75 ± 0.21                   | 0.71 ± 0.22                   | 0.67 ± 0.20                   | (>0.05) (NS)                        |
|                                                                              | 6 Months    | 0.84 ± 0.18                   | 0.82 ± 0.16                   | 0.79 ± 0.15                   | (>0.05) (NS)                        |
|                                                                              | Net Change  | 0.51 ± 0.45                   | 0.49 ± 0.41                   | 0.49 ± 0.38                   | (<0.05) (Sig)*                      |
| Probing Pocket Depth (mm)                                                    | Baseline    | 6.85 ± 0.82                   | 7.42 ± 1.35                   | 7.10 ± 1.15                   | (>0.05) (NS)                        |
|                                                                              | 3 Months    | 5.62 ± 1.18                   | 5.80 ± 1.22                   | 5.35 ± 1.10                   | (>0.05) (NS)                        |
|                                                                              | 6 Months    | 5.31 ± 0.48                   | 4.95 ± 0.88                   | 4.65 ± 0.72                   | (<0.05) (Sig)*                      |
|                                                                              | Net Change  | 1.54 ± 0.50                   | 2.47 ± 0.79                   | 2.45 ± 0.75                   | (<0.05) (Sig)*                      |
| Relative Attachment Level (mm)                                               | Baseline    | 12.45 ± 2.15                  | 11.20 ± 2.90                  | 11.90 ± 2.60                  | (>0.05) (NS)                        |
|                                                                              | 3 Months    | 11.25 ± 2.50                  | 9.65 ± 2.30                   | 9.95 ± 2.15                   | (>0.05) (NS)                        |
|                                                                              | 6 Months    | 10.95 ± 1.95                  | 9.32 ± 1.38                   | 9.10 ± 1.25                   | (<0.05) (Sig)*                      |
|                                                                              | Net Change  | 1.50 ± 0.80                   | 1.88 ± 0.50                   | 2.80 ± 0.65                   | (<0.05) (Sig)*                      |
| Radiographic Depth of Defect (mm)                                            | Baseline    | 6.05 ± 0.72                   | 6.18 ± 0.62                   | 6.12 ± 0.68                   | (>0.05) (NS)                        |
|                                                                              | 3 Months    | 5.08 ± 0.58                   | 5.05 ± 0.71                   | 4.98 ± 0.64                   | (>0.05) (NS)                        |
|                                                                              | 6 Months    | 4.10 ± 0.65                   | 4.12 ± 0.55                   | 3.85 ± 0.52                   | (>0.05) (NS)                        |
|                                                                              | Net Change  | 1.95 ± 0.42                   | 2.06 ± 0.52                   | 2.27 ± 0.48                   | (>0.05) (NS)                        |
| *Sig = Statistically Significant (P < 0.05); NS = Non-Significant (P > 0.05) |             |                               |                               |                               |                                     |

**Table 3:** Intra-group comparison of mean clinical parameters between time intervals within each group

| Index Parameter / | Group   | Baseline<br>(Mean ± SD) | 3 Months<br>(Mean ± SD) | 6 Months<br>(Mean ± SD) | (P)-value<br>(Within Group) |
|-------------------|---------|-------------------------|-------------------------|-------------------------|-----------------------------|
| Plaque Index      | Group A | 1.48 ± 0.31             | 1.01 ± 0.22             | 0.88 ± 0.19             | 0.01*                       |
|                   | Group B | 1.39 ± 0.28             | 0.94 ± 0.21             | 0.81 ± 0.18             | 0.01*                       |
|                   | Group C | 1.44 ± 0.30             | 0.88 ± 0.19             | 0.76 ± 0.16             | 0.01*                       |
| Gingival Index    | Group A | 1.35 ± 0.28             | 0.75 ± 0.21             | 0.84 ± 0.18             | 0.01*                       |

|                                          |         |              |              |              |       |
|------------------------------------------|---------|--------------|--------------|--------------|-------|
|                                          | Group B | 1.31 ± 0.25  | 0.71 ± 0.22  | 0.82 ± 0.16  | 0.01* |
|                                          | Group C | 1.28 ± 0.24  | 0.67 ± 0.20  | 0.79 ± 0.15  | 0.01* |
| <b>Probing Pocket Depth (mm)</b>         | Group A | 6.85 ± 0.82  | 5.62 ± 1.18  | 5.31 ± 0.48  | 0.01* |
|                                          | Group B | 7.42 ± 1.35  | 5.80 ± 1.22  | 4.95 ± 0.88  | 0.01* |
|                                          | Group C | 7.10 ± 1.15  | 5.35 ± 1.10  | 4.65 ± 0.72  | 0.01* |
| <b>Relative Attachment Level (mm)</b>    | Group A | 12.45 ± 2.15 | 11.25 ± 2.50 | 10.95 ± 1.95 | 0.01* |
|                                          | Group B | 11.20 ± 2.90 | 9.65 ± 2.30  | 9.32 ± 1.38  | 0.01* |
|                                          | Group C | 11.90 ± 2.60 | 9.95 ± 2.15  | 9.10 ± 1.25  | 0.01* |
| <b>Radiographic Depth of Defect (mm)</b> | Group A | 6.05 ± 0.72  | 5.08 ± 0.58  | 4.10 ± 0.65  | 0.01* |
|                                          | Group B | 6.18 ± 0.62  | 5.05 ± 0.71  | 4.12 ± 0.55  | 0.01* |
|                                          | Group C | 6.12 ± 0.68  | 4.98 ± 0.64  | 3.85 ± 0.52  | 0.01* |
| <i>*Significant</i>                      |         |              |              |              |       |

**Table 4:** Detailed Statistical Inferences and Analysis

| Index Parameter /                        | Group   | Std. Dev. | Std. Error | 95% CI | Pearson Square Value | Chi- df |
|------------------------------------------|---------|-----------|------------|--------|----------------------|---------|
| <b>Plaque Index</b>                      | Group A | 2.16      | 1.120      | 1.123  | 1.42                 | 1.356   |
|                                          | Group B | 1.12      | 1.024      | 0.113  | 1.23                 | 1.011   |
|                                          | Group C | 1.10      | 1.014      | 1.035  | 1.20                 | 1.01    |
| <b>Gingival Index</b>                    | Group A | 0.12      | 0.094      | 1.005  | 0.23                 | 0.001 * |
|                                          | Group B | 2.12      | 2.109      | 2.103  | 2.19                 | 2.104   |
|                                          | Group C | 2.10      | 1.106      | 1.103  | 2.09                 | 0.024 * |
| <b>Probing Pocket Depth (mm)</b>         | Group A | 2.08      | 2.012      | 1.038  | 1.23                 | 1.108   |
|                                          | Group B | 2.24      | 2.156      | 2.125  | 2.36                 | 2.126   |
|                                          | Group C | 2.21      | 2.032      | 1.568  | 1.13                 | 1.153   |
| <b>Relative Attachment Level (mm)</b>    | Group A | 2.08      | 2.012      | 1.038  | 1.23                 | 0.002 * |
|                                          | Group B | 1.01      | 1.09       | 1.013  | 1.02                 | 1.251   |
|                                          | Group C | 1.13      | 2.102      | 2.090  | 2.12                 | 1.543   |
| <b>Radiographic Depth of Defect (mm)</b> | Group A | 1.09      | 1.080      | 1.02   | 1.07                 | 1.024   |
|                                          | Group B | 1.23      | 2.165      | 2.043  | 2.15                 | 0.006 * |
|                                          | Group C | 1.32      | 1.433      | 1.21   | 1.44                 | 1.344   |
| <i>*Significant</i>                      |         |           |            |        |                      |         |

**Table 5:** Estimation amongst all studied groups using one-way ANOVA

| Source of Variation (Variables) | Degree of Freedom (df) | Sum of Squares | Mean Sum of Squares | F-Value | Level of Sig. (p) |
|---------------------------------|------------------------|----------------|---------------------|---------|-------------------|
| <b>Between Groups</b>           | 2                      | 1.420          | 0.7100              | 18.362  | <0.001*           |
| <b>Within Groups</b>            | 57                     | 2.204          | 0.0387              | —       | —                 |
| <b>Total (Cumulative)</b>       | 59                     | 3.624          | —                   | —       | —                 |
| <b>Sig*</b>                     |                        |                |                     |         |                   |

## DISCUSSION

Addy LD et al reviewed in their study that dental implants are advanced devices that are surgically placed in the jawbone to replace missing tooth roots. They provide strong support for various artificial teeth, including crowns, bridges, and dentures. With a long-term success rate exceeding 95%, dental implants are the modern standard for tooth replacement, as they closely mimic the function and appearance of natural teeth. A key procedure related to dental implants is Alveolar Ridge Preservation (ARP), which is performed immediately after tooth extraction to minimize bone loss and maintain jaw contour.<sup>15,16</sup> Luke Yeo IS et al reported in their study that without ARP, bone resorption can lead to substantial loss up to 63% of horizontal width and 22% of vertical height within six months. ARP helps prevent bone atrophy by providing immediate support for the jawbone, which is crucial for the successful placement of implants. Patients undergoing ARP have a 90% chance of successful implant placement without extensive bone augmentation, compared to only a 50% chance for those who do not receive this treatment.<sup>17,18</sup> Rutkowski JL et al. included in their study that the ARP procedure involves several steps: atraumatic extraction of the tooth, cleaning the socket, packing it with a bone graft substitute, and placing a protective membrane to prevent gum tissue invasion. A commonly used material for the graft is Calcium Phosphosilicate (CPS) putty, such as NovaBone Dental Putty. This fully resorbable synthetic graft material supports bone regeneration without the need for pre-mixing. Its unique "bimodal" design incorporates both small and large particles to optimize healing, facilitate blood flow, and promote new bone growth ensuring successful future dental implant placement.<sup>19,20</sup> Khehra A et al showed in their study that utilizing CPS putty in implant site development offers numerous clinical benefits, particularly in ridge preservation after tooth extraction. Research indicates that it significantly reduces horizontal and vertical ridge loss within four to five months post-extraction, achieving structural stability comparable to that of anorganic bovine bone mineral.<sup>21,22</sup> Zahedah R et al included in their study that the putty promotes high-quality bone regeneration, with histomorphometric evaluations showing that between 31% and 49% of the newly formed bone is vital, accompanied by minimal residual graft particles at the time of implant placement. One of the key advantages of CPS putty is that it often eliminates the need for a barrier membrane in intact, four-walled extraction sockets. This feature streamlines the surgical process, reducing both time and complexity. Additionally, the putty's formulation provides a transient hemostatic effect, helping to stabilize the blood clot and ensure a clean environment for the procedure. Another effective method for alveolar ridge preservation is the use of platelet-rich fibrin (PRF), an autologous blood concentrate.<sup>23,24</sup> Aribau-Gumà C et al reported in their study that PRF is prepared by centrifuging the patient's blood without anticoagulants, resulting in a matrix rich in platelets, leukocytes, and essential growth factors. This addresses the significant bone remodelling that occurs after tooth extraction where a loss of 3.0 to 4.5 mm in width and 1.0 to 1.5 mm in height can happen within the first six months thus helping to maintain the stability and aesthetics of future dental implants. PRF can serve as a sole grafting material, providing a natural and biocompatible plug that enhances biological healing, accelerates soft-tissue closure, reduces postoperative pain, and decreases the risk of infection.<sup>25,26</sup> Ucer C et al reviewed in their study that however, it has volumetric limitations, as it degrades quickly and does not provide the long-term structural support seen with traditional bone grafts. To maximize the benefits of PRF, clinicians often combine it with structural bone substitutes like xenografts or allografts. This combination creates a synergy where the graft material offers the necessary scaffolding to support the socket walls, while the PRF enriches the graft with growth factors, facilitating faster biological integration and overall healing.<sup>27</sup>

## CONCLUSION

In the study examining the comparative clinical effectiveness of Calcium Phosphosilicate Putty/Novabone Dental Putty versus Platelet-Rich Fibrin (PRF) for alveolar ridge preservation prior to implant placement, the authors concluded that Group C emerged as the most effective treatment protocol for long-term periodontal rehabilitation. This group demonstrated significantly improved outcomes in clinical attachment level gains and pocket depth reduction at the 6-month mark when compared to Groups A and B. In terms of radiographic evaluation, all three treatment groups showed similar effectiveness in reducing bone defects, as no statistically significant differences were noted among them. Overall, the results indicate that while all three interventions are effective in managing periodontal issues evidenced by reduced plaque, decreased gingival inflammation, and improved clinical outcomes all demonstrated universal efficacy within the studied timeframe.

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