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Comparative evaluation of autogenous bone graft and calcium phospho-silicate bone graft in socket preservation: A clinico-radiographic study

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Abstract:
Post-extraction remodeling may reduce alveolar ridge dimensions and complicate future implant placement. Therefore, it is of interest to compare the calcium phospho-silicate and autogenous particulate bone grafts for socket preservation in 24 systemically healthy adults randomized equally between the two materials, with both sites covered by a collagen plug. Clinical indices were monitored and CBCT was used to measure ridge width and height at baseline and 6 months. Horizontal loss was 1.43 ± 0.39 mm with calcium phospho-silicate and 0.97 ± 0.31 mm with autogenous bone (p=0.002), while vertical loss was 1.11 ± 0.34 mm and 0.71 ± 0.27 mm, respectively (p=0.004), with similar soft-tissue improvement. Thus, both materials supported socket preservation, but autogenous bone provided greater horizontal and vertical dimensional stability.

Keywords: Autogenous bone graft, calcium phospho-silicate, socket preservation, alveolar ridge preservation, cone beam computer tomography (CBCT), bone regeneration

Background:
Tooth extraction initiates rapid remodeling of the alveolar process because the bundle bone and periodontal ligament-dependent vascular supply are lost. The greatest dimensional change occurs during the early healing months and is usually more pronounced on the facial aspect **[1-4]**. Loss of ridge width and height may complicate prosthetically driven implant placement, compromise esthetics and increase the need for later augmentation. Alveolar ridge preservation aims to reduce, rather than completely prevent, physiologic remodeling **[5, 6]**. Autogenous bone is traditionally considered a reference graft because it provides viable cells, osteoinductive proteins and an osteoconductive scaffold. Its limitations include donor-site morbidity, limited volume, increased surgical time and variable resorption **[7]**. Calcium phospho-silicate is a bioactive alloplast that forms a hydroxycarbonate apatite layer and supports osteoblast attachment. It is readily available and avoids donor-site surgery, but its remodeling pattern and proportion of residual particles differ from autogenous bone **[8, 9]**. Clinical trials of socket preservation show that grafting generally reduces dimensional loss, yet no substitute completely maintains the original socket contour. Material choice should therefore consider dimensional stability, new bone formation, handling, cost and patient preference. The present study compared autogenous particulate bone and calcium phospho-silicate putty using standardized clinical indices and CBCT measurements **[10-13]**. Therefore, it is of interest to compare autogenous particulate bone and calcium phospho-silicate grafts for preservation of extraction-socket dimensions using standardized clinical and CBCT measurements.

Materials and Methods:

Design and ethics:
This randomized clinico-radiographic study included 24 adults requiring atraumatic extraction and future implant rehabilitation.

Participants:
Adults aged 20-50 years with intact or minimally damaged socket walls and adequate oral hygiene was included. Smokers, pregnant or lactating patients, individuals with uncontrolled systemic disease, active purulent infection, or medications affecting bone metabolism were excluded.

Randomization:
Participants were allocated into Group A, calcium phospho-silicate graft, or Group B, autogenous particulate bone, using sealed envelopes. Each group included 12 sockets.

Surgical procedure:
After phase-I periodontal therapy, teeth were extracted atraumatically without flap elevation. Sockets were debrided and inspected. Group A sockets received calcium phospho-silicate putty. Group B received autogenous bone harvested from an adjacent intraoral site with a bone scraper. Both were covered with a collagen plug and stabilized with sutures.

Clinical assessment:
Plaque Index, Gingival Index and Oral Hygiene Index-Simplified were recorded at baseline, three months and six months. Wound healing and adverse events were documented.

Radiographic assessment:
Small-field CBCT was obtained immediately after grafting and at six months. Ridge width was measured at 3 mm apical to the crest and ridge height was measured from a reproducible apical landmark to the crest. Measurements were repeated by a blinded calibrated examiner.

Statistical analysis:
Data were analyzed using paired t tests for within-group change and independent t tests for between-group comparisons. Categorical variables were analyzed by Fisher exact test. Significance was set at $p<0.05$.

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Results:
All participants completed six-month follow-up. Mild post-operative swelling occurred in three autogenous graft participants and two alloplast participants; no infection, graft exposure, or sensory disturbance was recorded. Baseline demographic, clinical and ridge measurements were comparable. Plaque and gingival scores improved in both groups after repeated oral-hygiene reinforcement, without significant intergroup differences. Both materials reduced dimensional collapse, but autogenous bone showed greater preservation. Horizontal loss was 0.46 mm lower and vertical loss was 0.40 mm lower than the calcium phospho-silicate group. At implant-planning review, all autogenous graft sites and 11 of 12 calcium phospho-silicate sites had adequate dimensions for prosthetically planned implant placement without additional major augmentation. Baseline characteristics, clinical indices and CBCT dimensional changes are summarized in **Tables 1, 2 and 3** respectively.

Table 1: Baseline characteristics

Variable	Calcium phospho-silicate (n=12)	Autogenous bone (n=12)	p value
Age (years)	34.8 ± 7.3	35.6 ± 6.9	0.784
Male sex, n (%)	7 (58.3)	6 (50.0)	0.682
Maxillary sockets, n (%)	7 (58.3)	8 (66.7)	0.673
Baseline ridge width (mm)	8.35 ± 0.74	8.41 ± 0.69	0.838
Baseline ridge height (mm)	12.84 ± 1.08	12.91 ± 1.02	0.872

Table 2: Clinical indices during follow-up

Parameter	Group	Baseline	3 months	6 months	Time p value
Plaque Index	Calcium phospho-silicate	1.42 ± 0.24	0.86 ± 0.18	0.62 ± 0.16	<0.001
Plaque Index	Autogenous bone	1.39 ± 0.22	0.82 ± 0.17	0.59 ± 0.15	<0.001
Gingival Index	Calcium phospho-silicate	1.36 ± 0.27	0.79 ± 0.20	0.54 ± 0.18	<0.001
Gingival Index	Autogenous bone	1.33 ± 0.25	0.75 ± 0.19	0.50 ± 0.17	<0.001
OHI-S	Calcium phospho-silicate	1.58 ± 0.31	1.02 ± 0.24	0.78 ± 0.21	<0.001
OHI-S	Autogenous bone	1.55 ± 0.29	0.98 ± 0.23	0.74 ± 0.20	<0.001

Table 3: CBCT dimensional changes at six months

Outcome	Calcium phospho-silicate	Autogenous bone	p value
Ridge width at 6 months (mm)	6.92 ± 0.66	7.44 ± 0.63	0.058
Horizontal loss (mm)	1.43 ± 0.39	0.97 ± 0.31	0.002
Ridge height at 6 months (mm)	11.73 ± 1.03	12.20 ± 0.99	0.269
Vertical loss (mm)	1.11 ± 0.34	0.71 ± 0.27	0.004
Sites avoiding major additional grafting	11/12 (91.7%)	12/12 (100%)	0.307

Discussion:
Both grafting approaches reduced post-extraction dimensional loss, but autogenous bone demonstrated significantly better horizontal and vertical preservation. This finding reflects its combined osteogenic, osteoinductive and osteoconductive potential, although harvesting increased surgical morbidity. The dimensional changes observed in both groups confirm that socket grafting does not eliminate physiologic remodeling. Systematic reviews consistently show that ridge preservation reduces loss compared with extraction alone, but the magnitude depends on socket anatomy, material, membrane, measurement level and healing interval **[5, 6 and 10].** Calcium phospho-silicate provided adequate dimensions for implant planning in most sites. Previous randomized evidence comparing calcium phosphosilicate putty with other grafts supports its clinical utility, handling and ridge-maintenance potential **[8].** Its absence of donor-site morbidity may be particularly valuable when only modest preservation is required. Autogenous bone may remodel more rapidly than slowly resorbing substitutes, which can be advantageous for vital bone formation but may reduce volume stability in larger defects. The present sockets had intact walls and results should not be generalized to major dehiscence or extraction-site defects. Clinical indices improved similarly, indicating that both materials were compatible with soft-tissue healing when plaque control was maintained. The study was not designed to assess histologic new bone and CBCT density should not be used as a direct substitute for histomorphometry. Limitations include small sample size, short follow-up, absence of extraction-alone control and no histologic core at implant placement. Donor-site selection and graft particle characteristics may also influence autogenous-graft performance. Future studies should compare patient-reported morbidity, cost, histomorphometry, implant insertion torque and long-term peri-implant outcomes. Material selection should remain individualized according to defect anatomy and patient preference. These findings are also consistent with clinical and evidence-based reports on ridge-preservation approaches and subsequent implant planning **[14-17]**. Recent studies from 2024-2026 continue to support alveolar ridge preservation while emphasizing material-, site- and protocol-specific outcomes **[18-20]**.

Conclusion:
Autogenous particulate bone and calcium phospho-silicate putty both supported extraction-socket preservation over six months. Autogenous bone produced significantly less horizontal and vertical ridge loss, whereas calcium phospho-silicate offered a

donor-site-free alternative with clinically acceptable dimensional maintenance.

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