

Original Research Article

Efficacy of simvastatin with collagen plug and collagen plug alone following bilateral tooth extraction: a comparative study

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ABSTRACT

Background: The healing process of extraction sockets involves a tightly regulated sequence of events, including blood clot formation, angiogenesis, inflammation resolution, granulation tissue maturation, osteoid deposition, and finally mineralized bone formation. The aim of the study is to evaluate the efficacy of simvastatin with collagen plug and collagen plug alone in healing of an extraction socket.

Methods: A total of 30 patients were scheduled for bilateral extractions in two sessions, with 1 week interval in between. The extraction on either side will be divided into two groups: GROUP A sockets were filled with simvastatin with collagen plug and closure was done using 3-0 silk sutures. GROUP B sockets were filled with collagen plug alone and closure was done using 3-0 silk sutures. The patients were assessed for bone density, post-operative pain, swelling, soft tissue healing in extraction sockets of the two groups.

Results: Radiographic bone density at three months favored the simvastatin-augmented sites markedly. Group A exhibited a greater numerical reduction in pain by one week, though differences did not reach statistical significance. Objective measures of facial swelling were minimal and equivalent between groups at baseline, 24 hours, and one week. Soft tissue healing scores at 24 hours and one week were similar, with no significant between-group differences.

Conclusions: Simvastatin offers a bioactive alternative or adjunct to conventional socket preservation techniques such as collagen plugs, mineralized bone allografts, and PRF.

Keywords: Simvastatin, Collagen plug, Socket preservation

INTRODUCTION

Bone regeneration plays a crucial role in maintaining the structural integrity and function of the maxillofacial skeleton, especially in the context of tooth extraction and subsequent rehabilitation procedures. The healing process of extraction sockets involves a tightly regulated sequence of events, including blood clot formation, angiogenesis, inflammation resolution, granulation tissue maturation, osteoid deposition, and finally mineralized bone formation. This intricate biological cascade closely mimics the process of normal fracture healing and bone

remodelling. Central to this process is the activity of osteoblasts, the bone-forming cells, which lay down new bone matrix and mediate its mineralization.¹

Recent developments in regenerative medicine and pharmacology have highlighted the potential of commonly available medications for off-label use in promoting tissue regeneration. One such group is statins, widely prescribed for their lipid-lowering properties. Statins function by inhibiting the enzyme 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase, which catalyzes the rate-limiting step in cholesterol biosynthesis.²

Interestingly, beyond their cardiovascular benefits, statins exhibit significant pleiotropic effects, including anti-inflammatory, angiogenic, and osteogenic actions.

Among the statins, simvastatin has received substantial attention as it is a semi-synthetic methylated derivative of lovastatin, synthesized by fermentation of *Aspergillus terreus*, and possesses a potent osteoanabolic effect.³ The studies have demonstrated that simvastatin can upregulate BMP-2 expression, stimulate osteoblastic differentiation, increase alkaline phosphatase activity, and enhance mineral deposition.⁴ Furthermore, simvastatin also exhibits anti-resorptive properties by reducing osteoclast differentiation and activity, contributing to an overall favorable bone healing environment.⁴

For simvastatin to exert its osteogenic effects locally, it requires an appropriate delivery system. Various carriers have been tested, including polylactic-co-glycolic acid, gelatin sponges, methylcellulose, and collagen-based scaffolds. Among these, collagen plugs have demonstrated notable clinical utility due to their favorable properties. Collagen is the most abundant protein in the extracellular matrix and plays a crucial role in wound stabilization and cellular migration.⁵

Collagen plugs, derived from purified bovine collagen, are biodegradable, hemostatic, and biocompatible. They provide a structural matrix that supports clot formation, preserves socket architecture, and serves as an effective drug delivery vehicle. Collagen plugs are commonly used in routine dental extractions, their resorption time of approximately 4–6 weeks matches the critical early stages of bone healing, making them an ideal choice for temporary socket coverage and local agent delivery.

In combination with simvastatin, the collagen plug not only provides structural integrity but also enhances the localized, sustained release of the drug at the target site.² The present study was designed to compare the healing outcomes of extraction sockets managed with simvastatin-loaded collagen plugs versus collagen plug alone.

In conclusion, with growing emphasis on minimally invasive and biologically driven approaches in oral surgery, the integration of pharmacologic agents like simvastatin into commonly used biomaterials presents a promising frontier.

The aim of the study is to evaluate the efficacy of simvastatin with collagen plug and collagen plug alone in healing of an extraction socket. The objectives are to compare bone density, post-operative pain, swelling, soft tissue healing in extraction sockets.

METHODS

This was a prospective study conducted on 30 patients who reported to the department Of Oral and Maxillofacial Surgery (January 2024 to November 2025), Swami Devi

Dyal Hospital and Dental College, for the bilateral extraction of mandibular 1st/2nd molars .

A total of 30 patients were evaluated. Preoperative IOPA was taken for all the molar extraction sites. After obtaining written informed consent, patients were scheduled for bilateral extractions in two sessions, with 1 week interval in between. For the purpose of data collection, the extraction on either side will be divided into two groups: GROUP A sockets were filled with simvastatin and collagen plug and closure was done using 3-0 silk sutures. GROUP B sockets were filled with collagen plug alone and closure was done using 3- 0 silk sutures.

Inclusion criteria

Patients in age group 18-60 years were selected requiring extraction of mandibular 1st / 2nd molars, in good physical health with no clinically significant and relevant medical history, understanding and willing to follow all study procedures.

Exclusion criteria

Patients unwilling to sign the informed consent form, having teeth associated with periapical pathology, with history of allergy to any product used in study, immunocompromised individuals, suffering from hemorrhagic diathesis, past history of deep vein thrombosis or use of anticoagulants, pregnant, lactating, female participants taking oral contraceptives, teeth requiring transalveolar extraction.

Procedure

Pre-operative preparation of simvastatin with collagen plug simvastatin tablet (10 mg) was crushed with mortar and pestle until particulate powder was formed. This powder was mixed with 2 ml saline to form a paste in which collagen plug was dipped.

Parameters evaluated

Pre-operative parameters

Swelling: Horizontal distance between lower attachment of the earlobe to corner of mouth and vertical distance between the angle of mandible to the outer canthus of the eye was measured by means of a tape.

Post-operative parameters

Postoperative pain : Evaluated using visual analog scale (VAS) of 10 units. Pain was assessed after 24 hours, 3,7 and 15 days.

Swelling: Evaluated by the method defined by Amin and Laskin. The horizontal distance from the lower attachment of the earlobe to corner of the mouth and the vertical distance between the angle of the mandible to the outer

canthus of the eye was measured by means of a tape. It was rated on scale from 1-3. 1-Swelling visible but not sufficient to alter patients face, 2-Swelling sufficient to alter patients face, 3-Swelling associated with decreased mouth opening.

Soft tissue healing: Evaluated after 7 days, 1-3 months. By Landry et al soft tissue healing index were 1-Very poor, 2-Poor, 3-Good, 4-Very good and 5-Excellent.

Bone Density: RVG were taken post-operatively, the bone fill was recorded counting the radiolucent squares in the socket and then compared with RVG taken on recall after 3 months.

Statistical analysis

Data was analyzed using statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p < 0.05$. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference between the groups was done using Mann Whitney U test and within group comparison was done using FRIEDMAN TEST followed by BONEFERRONI POSTHOC TEST(>2 intervals) and Wilcoxon sign rank test.

RESULTS

Comparison of mean age

The mean age of participants in Group A (45.2 ± 10.37 years) was comparable to Group B (45.2 ± 10.37 years). The difference was not statistically significant (Mann-Whitney $U = Z = 0.0$, $p = 0.99$) (Table 1).

Comparison of age groups

The distribution of participants according to age groups was comparable between the two study groups. In both Group A and Group B, 43.4% of the participants belonged to the 31–40 years age category, followed by 36.7% in the 41–50 years age group and 20% who were aged above 51 years. The comparison using the Chi-square test showed no statistically significant difference between the two groups ($\chi^2 = 0.0$, $p = 0.99$) (Table 2).

Comparison of gender

The gender distribution was identical in both study groups. In Group A, 56.7% of participants were male and 43.3% were female, which was the same proportion observed in Group B. Statistical comparison using the Chi-square test revealed no significant difference between the two groups ($\chi^2 = 0.0$, $p = 0.99$) (Table 3).

Comparison of bone density

The comparison of bone density demonstrated a clear advantage for Group A (Simvastatin + Collagen Plug) in

the postoperative period. Preoperatively, both groups were comparable in bone density, with Group A (Figure 1) recording 121.73 ± 34.76 and Group B (Figure 2) 124.43 ± 31.76 , and this difference was not statistically significant ($Z = 0.32$, $p = 0.74$). However, at the three-month evaluation, Group A exhibited markedly higher bone density (94.6 ± 18.89) compared with Group B (52.4 ± 16.38), and this difference was highly statistically significant ($Z = 7.88$, $p = 0.0001$). The improvement observed within groups from preoperative to three months also differed significantly, with Group A showing a mean gain of 27.13 ± 24.76 compared to a much larger increase of 72.03 ± 26.76 in Group B ($Z = 6.37$, $p = 0.0001$), indicating superior regenerative response when simvastatin was incorporated. Intragroup analysis using the Wilcoxon Signed Rank Test showed statistically significant improvements in both groups (Group A: $Z = 4.22$, $p = 0.0001$; Group B: $Z = 10.01$, $p = 0.0001$) (Table 4).

Comparison of pain

Pain scores recorded postoperatively demonstrated notable reductions over time in both treatment groups. At 24 hours, Group A (Simvastatin + Collagen Plug) reported a mean pain score of 5.2 ± 0.74 , slightly higher than Group B (4.86 ± 0.92), though the difference was not statistically significant ($Z = 1.61$, $p = 0.11$). At the one-week interval, pain continued to decrease in both groups; however, Group A demonstrated lower pain intensity (1.67 ± 0.78) compared with Group B (1.97 ± 0.89), and this difference was also statistically non-significant ($Z = 1.64$, $p = 0.14$). Importantly, the reduction in pain between 24 hours and one week a key indicator of postoperative recovery was greater in Group A (3.53 ± 0.76) than in Group B (2.89 ± 0.90). Although this trend suggests a more favorable reduction in pain with the use of simvastatin, the difference did not reach statistical significance ($Z = 1.77$, $p = 0.10$). Intragroup comparisons using the Wilcoxon Signed Rank Test revealed that pain reduction over time was statistically significant in both groups (Group A: $Z = 17.98$, $p = 0.0001$; Group B: $Z = 12.36$, $p = 0.0001$) (Table 5).

Comparison of swelling (horizontal)

The comparison of horizontal swelling measurements showed no statistically significant differences between Group A (Simvastatin + Collagen Plug) and Group B (Collagen Plug alone) at any of the observed time intervals. Preoperatively, both groups demonstrated identical mean values (1.06 ± 0.24), with no measurable difference ($t = 0$, $p = 0.99$). At 24 hours, swelling remained comparable between Group A (1.06 ± 0.24) and Group B (1.08 ± 0.45), and the difference was statistically nonsignificant ($t = 0.66$, $p = 0.87$). By the end of the first week, both groups again showed similar mean values (1.00 ± 0.01), with no meaningful difference ($p = 0.99$). Intragroup analysis using the Friedman test demonstrated no significant change in swelling across the three-time points in either Group A ($Z = 0.93$, $p = 0.39$) or Group B ($Z = 1.03$, $p = 0.46$) (Table 6).

Table 1: Mean age.

		Group A	Group B	Z value (Mann Whitney U Test)	p value
Age	Mean	45.2	45.2	0.0	0.99

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Table 2: Age groups.

	Group A	Group B	Chi square test	p value
31-40	13 (43.4%)	13 (43.4%)	0.0	0.99
41-50	11 (36.7%)	11 (36.7%)		
51+	6 (20%)	6 (20%)		

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Table 3: Gender.

		Group A	Group B	Chi square test	p value
Gender	Male	17 (56.7%)	17 (56.7%)	0	0.99
	Female	13 (43.3%)	13 (43.3%)		

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Table 4: Comparison of bone density.

	Group A	Group B	Mean difference	Mann Whitney U test p value
Pre operative	121.73±34.76	124.43±31.76	2.7±32.54	0.74 (Z=0.32)
3 months	94.6±18.89	52.4±16.38	42.2±17.34	0.0001* (Z=7.88)
Pre-operative 3 months difference	27.13±24.76	72.03±26.76	44.9±25.67	0.0001* (Z=6.37)
P value (Wilcoxon Sign rank test)	0.0001* (Z=4.22)	0.0001* (Z=10.01)	0.0001* (Z=7.56)	

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Table 5: Comparison of pain.

	Group A	Group B	Mean Difference	Mann Whitney U test p value
24 hours	5.2±0.74	4.86±0.92	0.34±0.84	0.11(Z=1.61)
1 week	1.67±0.78	1.97±0.89	0.30±0.83	0.14 (Z=1.64)
24 hrs-1 week difference	3.53±0.76	2.89±0.90	0.64±0.84	0.10 (Z=1.77)
P value (Wilcoxon-sign rank test)	0.0001* (Z=17.98)	0.0001* (Z=12.36)	0.35 (Z=0.92)	

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Comparison of swelling (vertical)

The assessment of vertical swelling revealed no statistically significant differences between the treatment groups at any postoperative interval. At baseline, Group A recorded a mean vertical swelling of 1.06 ± 0.24 compared with 1.10 ± 0.37 in Group B, with no significant difference ($t=0.23$, $p=0.88$). At 24 hours postoperatively, swelling remained comparable between the groups (1.06 ± 0.24 in Group A and 1.12 ± 0.47 in Group B), with the difference not reaching statistical significance ($t=0.34$, $p=0.80$). By the end of one week, swelling had almost resolved in both groups (1.00 ± 0.01), with no measurable difference ($p=0.99$). The reduction in swelling from baseline to one

week was also not statistically significant between Group A (0.06 ± 0.23) and Group B (0.16 ± 0.35) ($t=0.19$, $p=0.10$). Intragroup analysis using the Friedman test indicated that the changes across time points were not statistically significant for either Group A ($Z=0.93$, $p=0.39$) or Group B ($Z=0.88$, $p=0.24$) (Table 7).

Comparison of soft tissue healing

Soft tissue healing was evaluated at 24 hours and one week postoperatively. At 24 hours, both Group A and Group B demonstrated identical mean soft tissue healing scores (3.00 ± 0.01), with no significant difference ($Z=0$, $p=0.99$). After one week, healing showed a slight improvement in both groups, with Group A scoring 3.16 ± 0.44 and Group

B scoring 3.26 ± 0.49 ; however, difference was not statistically significant ($Z=0.66$, $p=0.60$). The change in soft tissue healing from 24 hours to one week also did not significantly differ between the groups ($Z=0.46$, $p=0.65$).

Intragroup comparison using the Wilcoxon Signed Rank Test revealed that the improvement in healing over time was not statistically significant in either Group A ($Z=1.98$, $p=0.13$) or Group B ($Z=2.05$, $p=0.09$) (Table 8).

Table 6: Comparison of swelling (horizontal).

	Group A	Group B	Mean difference	Mann Whitney U test P value
Pre -operative	1.06 $\pm$ 0.24	1.06 $\pm$ 0.24	0.0 $\pm$ 0.0	0.99 (t=0)
24 hrs	1.06 $\pm$ 0.24	1.08 $\pm$ 0.45	0.02 $\pm$ 0.28	0.87 (t=0.66)
1 week	1 $\pm$ 0.01	1 $\pm$ 0.01	0.0 $\pm$ 0.01	0.99 (t=0)
Pre-operative - 1 week	0.06 $\pm$ 0.24	0.06 $\pm$ 0.32	0.0 $\pm$ 0.01	0.99 (t=0)
P value (Friedman test)	0.39 (Z=0.93)	0.46 (Z=1.03)	0.92 (Z=0.23)	
P value	Pre operative vs 24 hrs	0.99	0.88	0.88
(Bonferroni Posthoc test)	Pre operative vs 1 week	0.46	0.71	0.99
	24 hrs vs 1 week	0.46	0.23	0.89

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Table 7: Comparison of swelling (vertical).

	Group A	Group B	Mean difference	Mann Whitney U test
Pre-operative	1.06 $\pm$ 0.24	1.10 $\pm$ 0.37	0.04 $\pm$ 0.30	0.88 (t=0.23)
24 hours	1.06 $\pm$ 0.24	1.12 $\pm$ 0.47	0.06 $\pm$ 0.32	0.80 (t=0.34)
1 week	1 $\pm$ 0.01	1 $\pm$ 0.01	0.0 $\pm$ 0.01	0.99 (t=0)
Pre-operative –1 week	0.06 $\pm$ 0.23	0.16 $\pm$ 0.35	0.10 $\pm$ 0.28	0.10 (t=0.19)
P value (Friedman test)	0.39 (Z=0.93)	0.24 (Z=0.88)	0.35 (Z=0.68)	
P value	Pre-operative vs 24 hrs	0.99	0.14	0.78
(Bonferroni Posthoc test)	Pre-operative vs 1 week	0.46	0.17	0.35
	24 hrs vs 1 week	0.46	0.67	0.69

Group A: Simvastatin + Collagen plug; Group B: Collagen plug alone

Table 8: Comparison of soft tissue healing.

	Group A	Group B	Mean difference	Mann Whitney U test P value
24 hours	3 $\pm$ 0.01	3 $\pm$ 0.01	0.0 $\pm$ 0.01	0.99 (Z=0)
1 week	3.16 $\pm$ 0.44	3.26 $\pm$ 0.49	0.10 $\pm$ 0.46	0.60 (Z=0.66)
24 hrs-1 week difference	0.16 $\pm$ 0.37	0.26 $\pm$ 0.44	0.10 $\pm$ 0.40	0.65 (Z=0.46)
P value (Wilcoxon sign rank test)	0.13 (Z=1.98)	0.09 (Z=2.05)	0.83 (Z=0.51)	

Group A: Simvastatin + collagen plug; Group B: Collagen plug alone

DISCUSSION

Postoperative ridge preservation following mandibular molar extraction is a frequent clinical challenge in oral and maxillofacial practice, particularly when subsequent

prosthetic rehabilitation or implant placement is anticipated. This study aims to contribute to the evidence base supporting the use of bioactive drug-loaded scaffolds for enhancing post-extraction healing. Radiographic analysis at three months demonstrated a pronounced

advantage for the simvastatin-augmented grafts. Although baseline densities were comparable (Group A 121.73 ± 34.76 ; Group B 124.43 ± 31.76 ; $Z=0.32$, $p=0.74$), the three-month evaluation revealed markedly higher density in Group A (94.6 ± 18.89) versus Group B (52.4 ± 16.38), a difference that was highly significant ($Z=7.88$, $p=0.0001$). Intragroup change from baseline to three months also differed significantly, with Group A showing a mean gain of 27.13 ± 24.76 compared with 72.03 ± 26.76 in Group B ($Z=6.37$, $p=0.0001$), and both groups demonstrating statistically significant within-group improvements by Wilcoxon Signed Rank testing (Group A: $Z=4.22$, $p=0.0001$; Group B: $Z=10.01$, $p=0.0001$). Taken together, these data indicate that the addition of simvastatin to a grafting matrix significantly enhanced early radiographic bone density in our cohort.

These findings align with prior clinical reports: Saifi et al split-mouth work and Oliveira et al, pilot RCT both documented superior socket fill or ridge preservation with simvastatin-augmented scaffolds, while Morris et al reported favorable results with injectable simvastatin in periodontal and ridge defects.^{8,11,12} At the same time, population-level observations such as those by Saxlin et al counsel caution, reminding us that systemic health, oral hygiene, and comorbidities can modulate bone outcomes and that early radiographic density is a surrogate that requires longer follow-up to confirm durable volumetric preservation.¹⁰

Both treatment arms exhibited significant reductions in postoperative pain over time. At 24 hours the mean pain score in Group A was 5.2 ± 0.74 versus 4.86 ± 0.92 in Group B ($Z=1.61$, $p=0.11$), and by one week pain had fallen to 1.67 ± 0.78 in Group A and 1.97 ± 0.89 in Group B ($Z=1.64$, $p=0.14$). The reduction in pain between 24 hours and one week was numerically greater in the simvastatin group (3.53 ± 0.76) than in the graft-only group (2.89 ± 0.90), although this difference did not reach statistical significance ($Z=1.77$, $p=0.10$). Intragroup comparisons confirmed highly significant pain reduction over time in both groups (Group A: $Z=17.98$, $p=0.0001$; Group B: $Z=12.36$, $p=0.0001$). Thus, while the simvastatin + graft combination showed a favorable numerical trend in symptomatic recovery, the evidence here is reassuring rather than conclusive. These clinical observations are consistent with the broader literature: Degala et al, Chauhan et al and Saifi et al have reported analgesic benefits with topical or local statin applications in oral surgery, whereas Christiansen et al found no significant pain advantage in an exploratory mini-flap model, underscoring the influence of dose, delivery method, and surgical context on analgesic outcomes.^{5,7,8,2}

Objective assessment of facial swelling in horizontal and vertical dimensions revealed minimal and transient edema in both groups, with no statistically significant differences at baseline, 24 hours, or one week. Horizontal measures were identical preoperatively (mean 1.06 ± 0.24 ; $t=0$, $p=0.99$), comparable at 24 hours (Group A 1.06 ± 0.24 ;

Group B 1.08 ± 0.45 ; $t=0.66$, $p=0.87$), and equivalent by one week (both 1.00 ± 0.01 ; $p=0.99$). Vertical measures followed the same pattern (baseline Group A 1.06 ± 0.24 ; Group B 1.10 ± 0.37 ; $t=0.23$, $p=0.88$; 24 hours Group A 1.06 ± 0.24 ; Group B 1.12 ± 0.47 ; $t=0.34$, $p=0.80$; one week both 1.00 ± 0.01 ; $p=0.99$).

Friedman testing and post hoc comparisons confirmed the absence of meaningful temporal or between-group differences. In short, adjunctive simvastatin did not alter the early inflammatory swelling profile compared with graft alone. This equivalence mirrors prior clinical reports in which simvastatin reduced swelling in some cases (Sezavar et al, Pradeep et al and Saifi et al), while epidemiological data (Saxlin et al) suggest that anti-inflammatory benefits may not be universal across all patient subgroups.^{6,9,8,12}

At 24 hours both groups recorded identical mean scores (3.00 ± 0.01 ; $Z=0$, $p=0.99$), and by one week the scores were 3.16 ± 0.44 for Group A and 3.26 ± 0.49 for Group B ($Z=0.66$, $p=0.60$), with no significant difference in the change from 24 hours to one week ($Z=0.46$, $p=0.65$). Wilcoxon Signed Rank testing showed that improvements over time did not reach statistical significance within either group (Group A: $Z=1.98$, $p=0.13$; Group B: $Z=2.05$, $p=0.09$).

Thus, within the short postoperative window examined, soft tissue healing progressed satisfactorily and comparably in both arms. These clinical results are concordant with several reports (Cruz et al.³, Sezavar et al and Saifi et al) that document enhanced soft tissue outcomes with local statin use in some contexts, while again acknowledging that population-level variability (Saxlin et al) may temper expectations in certain patients.^{3,6,8,10} From a practical standpoint, simvastatin-augmented grafting represents a low-complexity adjunct that may enhance early bone quality and thereby facilitate earlier or more predictable implant rehabilitation. Given the absence of increased early morbidity in our cohort, clinicians may consider this approach in cases where maximizing early bone fill is desirable.

Limitations

Short follow-up and modest sample size. Larger, multi-center randomized trials with standardized, histologic, and implant-level endpoints, dose-finding and carrier comparisons to confirm durability, optimize delivery, and identify patient subgroups most likely to benefit before routine clinical adoption are recommended.

CONCLUSION

This split-mouth trial of 30 patients compared extraction sockets treated with simvastatin incorporated into a collagen plug versus collagen plug alone following bilateral mandibular first/second molar extractions. Radiographic bone density at three months favored the

simvastatin-augmented sites markedly: baseline densities were comparable, but Group A demonstrated significantly higher density at three months with both intragroup improvements reaching statistical significance. These data indicate an early osteogenic advantage when simvastatin is combined with a grafting matrix.

Recommendations

The collective evidence demonstrated that simvastatin exerts consistent and clinically meaningful benefits in socket healing. In clinical practice, this approach may improve the quality of healing bed and enhance primary stability for earlier implant placement, particularly in patients where maximizing early bone fill is desirable. Because local delivery concentrates drug action within the socket and minimizes systemic exposure, simvastatin-augmented grafting is especially attractive for patients with gastrointestinal sensitivity. Together, these findings establish simvastatin as a promising adjunct in oral surgery and periodontal therapy.

For medically compromised patients, such as those on anticoagulant therapy, collagen plugs remain validated standards, but simvastatin could provide additional regenerative benefits if carefully tailored. This positions simvastatin as both a stand-alone agent and a synergistic enhancer of established biomaterials.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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