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CLINICAL AND RADIOGRAPHIC EVALUATION OF PLATELET RICH FIBRIN MIXED WITH NANOCRYSTALLINE HYDROXYAPATITE BONE GRAFT FOR HEALING OF MAXILLARY BONY DEFECTS

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ABSTRACT

Introduction: Platelet Rich Fibrin (PRF) combined with Nanocrystalline Hydroxyapatite bone graft offers a promising approach for enhancing bone regeneration in maxillary bony defects. **Aim:** To evaluate postoperative clinical and radiographic outcomes of maxillary intrabony defects using a mix of nanocrystalline hydroxyapatite (nHA) bone graft with platelet rich fibrin (PRF) after removal of maxillary cystic lesions. **Materials and Methods:** Sixteen patients necessitating the surgical removal of intra-bony cystic lesions were enrolled in a randomized controlled investigation and subsequently allocated to one of two study arms. Eight patients, forming the control cohort (Group I), underwent conventional healing without the use of grafting materials following surgical excision of the cystic lesions. In contrast, the study cohort (Group II), also comprising eight patients, received a graft composed of nanocrystalline hydroxyapatite and platelet-rich fibrin following lesion removal. **Results:** Analysis of the collected data demonstrated a statistically significant lower pain score in study group in the seventh day ($p = 0.012$). The study group showed a more rapid resolution of edema compared to the control group, although differences between groups at individual time points did not reach statistical significance ($p = 1.000$). Notably, the study group exhibited a highly statistically significant increase in bone density at the T1 time interval compared to the control group ($P < 0.001$). In contrast, baseline bone density measurements (T0) showed no statistically significant disparity between the two groups ($P = 0.466$). No Postoperative complications for both groups as infection, wound dehiscence, or looseness of adjacent teeth at 1-, 7-, and 14-days post-operative.

Conclusion: PRF combined with nanocrystalline hydroxyapatite may be considered a potential material for promoting bone repair following the enucleation of maxillary cystic lesions.

INTRODUCTION

Modern dentistry increasingly uses bone graft techniques to improve the quantity and quality of the bone substrate. While autologous bone blocks are still the "gold standard" for treating large bone defects, synthetic materials are among the most popular when treating smaller defects that only require improving the quality of the natural bone that is still present and ensuring that the surgical wound will heal predictably[(1)].

Osseous tissue possesses an inherent capacity for self-repair, characterized by processes of bone formation and subsequent remodeling [2]. The only way to repair a major bone deficiency brought on by trauma, tumor surgery, or a craniofacial deformity like cleft palate is with a bone graft [3]. The use of bone grafts in cleft palate repair plays a crucial role in facilitating both tooth eruption and subsequent orthodontic tooth movement [4].

In ideal circumstances, autologous bones are used in the repair of craniofacial defects by surgeons, who frequently use advanced therapeutic approaches and multidisciplinary involvement. This technique is limited by several factors, including the finite quantity of available bone, the potential for complications at the donor site, and the necessity of careful consideration in pediatric cases. Furthermore, extended surgical procedures in challenging defects, which may be associated with free flap failure, anesthetic risks, patient-specific issues, and contour irregularities, present additional challenges. In circumstances where the use of autologous bone proves difficult or unfeasible, tissue engineering, employing synthetic materials in conjunction with cellular components to augment or substitute biological functions, may offer a promising alternative within the domain of craniofacial surgery [5].

Tissue regeneration aims to facilitate the body's inherent reparative processes through the implantation of a scaffold. This scaffold functions as a transient framework, undergoing gradual degradation while concurrently enabling the restoration of host tissue at the site of implantation. The use of synthetic scaffolds presents certain advantages in comparison to natural scaffolds. Notably, controlled manufacturing processes enable large-scale production with consistent dimensions and design, as well as predictable physicochemical properties[6].

A bioactive ceramic substance known as hydroxyapatite stands out for having chemical and structural characteristics that are similar to those of bone. This enables it to form a chemical bond with the bone's native tissue[7]. In bone regeneration therapy, hydroxyapatite is a frequently employed material, either alone or in combination with other substances [8, 9].

The mineral phase of bone is largely composed of carbonated appetite, which is generally present in a nanoscale and amorphous state during its initial deposition. While synthetic hydroxyapatite (HA) has gained considerable traction as a bone graft substitute due to its osteoconductive properties, its behavior differs from that of natural bone mineral. Specifically, macroscale HA exhibits are limited to no resorption and are characterized by a brittle nature[10]. The advent of nanotechnology has facilitated the development of nanoscale hydroxyapatites (nHA), which exhibit a crystal structure more analogous to that of native bone. The synthesis of nHA particles can be achieved chemically by a variety of techniques, such as solid state, microwave processing, emulsion-based, hydrothermal, sol–gel, and wet precipitation procedures [11].

The advantageous characteristics of hydroxyapatite, including its biocompatibility, bioactivity, osteoinductivity, and osteoconductivity, contribute to its widespread use as a scaffold in bone regeneration. Hydroxyapatite scaffolds are currently employed in various forms, such as granules, pastes, cements, coatings, and porous or dense blocks. Despite these benefits, concerns remain regarding the inherent brittleness and limited, slow degradation rate of hydroxyapatite [12].

Numerous studies are being conducted in this area to determine the best method for using this material in accordance with the therapeutic necessity in order to fully exploit the osteoconductive and osteoinductive properties of Hydroxyapatite [13, 14].

Platelet concentrations combined with bone transplants are used more frequently in regenerative operations. Intra-bony defects have traditionally been treated using platelet concentrates such as platelet-rich plasma and platelet-rich fibrin. Platelets are a good source of leukocytes and growth factors that promote faster wound healing and tissue regeneration. First-generation platelet concentrates, also known as platelet-rich plasma, are liquid formulations created by mixing anticoagulants with blood samples before centrifuging them. It has long been employed in the medical industry. Anticoagulants, however, delay healing because they are added [15].

Subsequently, platelet-rich fibrin (PRF), a second-generation platelet concentrates devoid of chemical additives, emerged. PRF is prepared by collecting blood in a glass tube and immediately subjecting it to centrifugation. This process yields a coagulum that can be utilized directly or transformed into a membrane via compression within a PRF box[16].

Further modifications to the centrifugation process have led to the development of various other platelet concentrates, including concentrated growth factors (CGF), advanced PRF (A-PRF), and titanium PRF (T-PRF), each exhibiting unique properties due to these variations [13, 17].

This study aimed to evaluate postoperative clinical and radiographic outcomes of maxillary intrabony defects using a mix of nanocrystalline hydroxyapatite (nHA) bone graft with platelet rich fibrin (PRF) after removal of maxillary cystic lesions.

PATIENTS AND METHODS

Ethics Committee (REC) at the Faculty of Dentistry, Suez Canal University (Protocol approval number 707/2023). Informed written consent was obtained from all patients. All patients were selected from the outpatient clinic of the Suez Canal University hospital and the clinical phase was held in the oral and maxillofacial department in Suez Canal University. All patients received full explanations of the surgical procedures, any complications, the entire study schedules, and the photographs that were used in the scientific study and signed the consent form.

This randomized controlled clinical study was carried out by 16 patients who required surgical removal of intra-bony cystic lesions, aged between 20 to 50 years, with intra bony lesions of moderate size, good oral hygiene and healthy patients with type I American Society of Anesthesiologists (ASA) classification.

This study commenced following the acquisition of ethical clearance from the Research

Exclusion criteria were medically compromised patients, pregnant, lactating mothers, postmenopausal women, heavy smoking (>10 cigarettes/day), history of alcohol abuse and uncooperative patients.

Patients were divided into two equal groups as follows: Group I (control): were left for conventional bone healing. Group II (Study): received a nanocrystalline hydroxyapatite bone graft mixed with platelet-rich fibrin.

Clinical examination

The clinical examination of cystic lesions of the jaw began with a thorough history, including the chief complaint such as swelling, pain, or facial asymmetry, and details regarding the duration, progression, and any associated symptoms like discharge or numbness. Past dental history, including trauma, extractions, or untreated infections, along with relevant medical history, were reviewed. On extraoral examination, there was facial

asymmetry, swelling, temperature, tenderness, fluctuation, and regional lymphadenopathy. Intraoral examination involved inspecting for tooth discoloration, cortical expansion, mucosal changes, or sinus tract formation. Palpation revealed eggshell crackling and doughy soft swelling. Affected teeth were tested for mobility, vitality, and displacement. Percussion elicited a dull sound. In some cases, the patients did not present with any symptoms, and the cystic lesions were found incidentally during routine radiographic investigation.

Aspiration biopsy

Using a syringe with a 5-gauge needle the biopsy was taken as shown in figure 1 and light straw-colored cystic fluid was seen, brown in long standing infection cases. On microscopic level, there were cholesterol crystals and epithelial cells. **Figure 1**

Fig. (1) Aspiration biopsy

Radiographic examination:

By using CBCT to determine the position and size of the lesions. There were well defined unilocular radiolucent lesions related to periapical area of maxillary teeth.

Figure 2 shows the use of CBCT in diagnosis of cystic lesion.

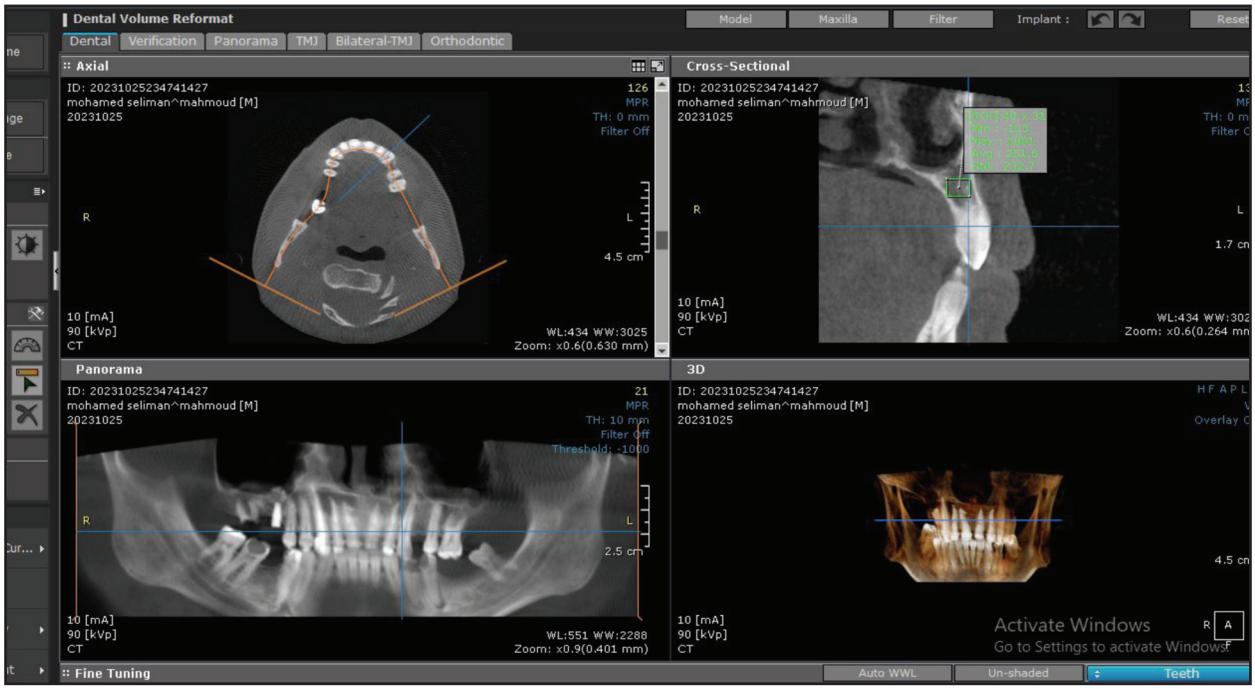

Fig. (2) Cystic lesion on CBCT

Surgical procedure

Management for both groups

Scrubbing and draping of patients were carried out in a standard fashion. Local anesthesia 4% Articaine hydrochloride with 1:100,000 epinephrine (Artinipsa, Inibsa dental S.L.U) was injected around the planned surgical site. Full mucoperiosteal flap with an envelope design was made on the labial mucosa and elevated to expose the lesion to allow full removal as shown in figure 3 A. The bone covering the defect was removed using a surgical bur for full exposure of the cyst and apex of the involved tooth as shown in figure 3 B.

After the periapical cyst was visible, enucleation was performed using a curette until the entire cyst was removed as shown in figure 3 C.

The removed cyst tissue was kept in 10% formalin for examination in the oral pathology laboratory. Apicoectomy was done by amputating approximately 3 mm from the root apically at an angle of 45°, then debridement of the cavity was done as shown in figure 3 D.

Management for study group

PRF and bone graft preparation:

Around 5 ml of whole venous blood is collected (as shown in figure 3 E) in sterile vacutainer tubes of 5 ml capacity without anticoagulant. The vacutainer tube was then placed in a centrifugal machine at 3000 rpm for 10 minutes.

After centrifugation was done, blood was separated into the following layers: lower red layer containing red blood cells, upper straw colored cellular plasma layer and the middle layer containing the fibrin clot. The upper straw-colored layer and middle layers were collected, 2 mm below lower dividing line, which is the PRF as shown in figure 3 F.

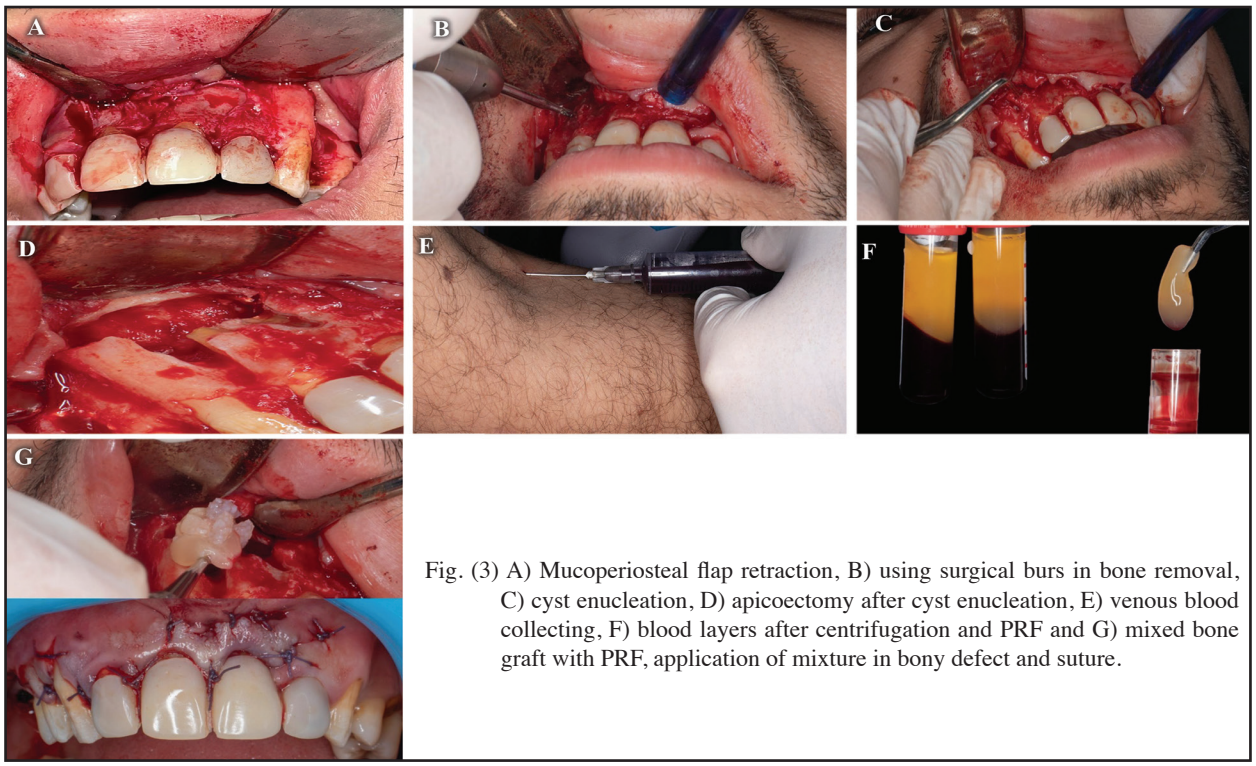

Fig. (3) A) Mucoperiosteal flap retraction, B) using surgical burs in bone removal, C) cyst enucleation, D) apicoectomy after cyst enucleation, E) venous blood collecting, F) blood layers after centrifugation and PRF and G) mixed bone graft with PRF, application of mixture in bony defect and suture.

PRF plug was cut into small pieces and then mixed with Nano crystalline Hydroxyapatite alloplast (NanoBone QD SPX Putty, Artoss – US) and inserted into the bony defect, the flap was repositioned and stabilized by simple interrupted sutures using vycril 3/0 as shown in figure 3 G.

Management for control group

The bony defect was left empty without bone grafting as shown in figure 4.

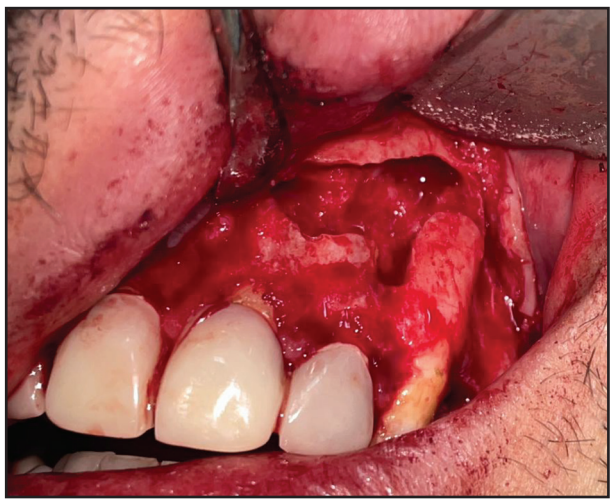

Fig. (4) Removal of cystic lesion without bone grafting

Post-operative Instructions

- All patients were informed of the expected occurrence of facial swelling, pain, and trismus.
- Sterile gauze pack was kept on the wound and the patients were advised to bite for one hour.
- Avoid rinsing or spitting for 24 hours after surgery.
- If you found blood bite on a sterile gauze for another two hours.
- Avoid of hot drinks, hot foods, and hard foods.
- Avoid Smoking.

Post-operative Medications:

All patients in both groups were subjected to the following drugs after the surgery:

- Amoxicillin with Clavulanic acid (Augmentin)[1] available as 1 gm tabletsevery 12 hrs for 7 days.
- Metronidazole (Flagyl)[2] available 500 mg tablet every 8 hrs for 7 days.
- Acetaminophen (Panadol)[3] available as tablets as required.
- Chlorhexidine antiseptic mouth wash (Hexitol)[4] available as 15 ml of 0.12 % Chlorhexidine mouth wash twice daily starting 8 hours after surgery for 7 days postoperatively.

Post-operative Assessment:

Clinical evaluation

Subjective parameters

Pain was evaluated with visual analog scale (V.A.S) at a measure from 1 to 10 postoperatively, where 0 indicates no pain and 10 indicates the most terrible pain. The level of pain was recorded, as the patients needed to take analgesic tablets after the surgery at 1, 3, and 7 days post-operative.

Objective parameters:

Facial swelling (edema) was evaluated at 1, 3, and 7 days postoperatively by using a subjective clinical grading system based on visual inspection and

1 Augmentin is produced by medical union pharmaceuticals, Abu Sultan, Ismailia under license from the GlaxoSmith-Kline group of companies.

2 Flagyl is produced by Sanofi-Aventis Egypt s.a.e. under license of Sanofi-Aventis France.

3 Panadol is manufactured by gsk middle east.

4 Hexitol produced by The Arab Drug Company, Cairo, A.R.E..

palpation. Edema was classified into four categories according to its apparent severity, no grade, low grade, intermediate grade and high grade edema. [18]

Postoperative complications were evaluated if there was any infection, wound dehiscence, or fistulation, and looseness of adjacent teeth at 1, 7, and 14 days post-operative.

Radiographic evaluation

Bone density and healing were evaluated by CBCT in Hounsfield units (HU) at 6 months postoperative to determine the mineralization and structure of bone tissue quantitively.

RESULTS

Statistical analysis

The statistical analyses were conducted using IBM SPSS Statistics version 25. The software was employed to perform a variety of tests aimed at comparing outcomes between the study and control groups and assessing changes over time.

A p-value of less than 0.05 was considered statistically significant for all tests, ensuring the robustness and reliability of the findings. Both groups accepted the graft material successfully.

The study sample had 8 males and 8 females with mean age 36.79 11.40(±) as shown in figure 5 and table 1:

Table 1. *The demographic data*

Parameter	Category	All Cases (n=16)
Age (years)	Mean ± SD	36.79 ± 11.40
	Median (IQR)	41.00 (26.25–45.75)
Gender	Male	8 (50.0%)
	Female	8 (50.0%)

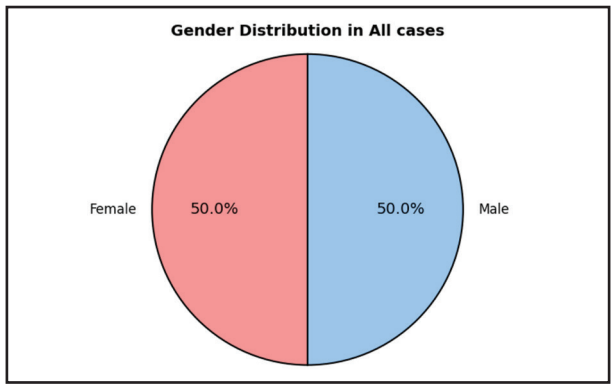

Fig. (5) Gender distribution

Pain on visual analog scale (VAS)

A. Comparison of Pain score at different times in each group by VAS score

According to the VAS pain scores, both the study and control groups exhibited a significant decline in pain levels over time. In the **control group**, the pain score decreased significantly from **8.43** on Day 1 to **5.57** on Day 7 (**p<0.001**), and further dropped to **1.29** by Day 14 (**p<0.001**). A statistically significant reduction was also observed between Day 7 and Day 7 (**p<0.001**). In the **study group**, the pain started at **8.57** on Day 1, decreasing to **3.71** on Day 3 (**p<0.001**), and further to **0.29** on Day 7 (**p<0.001**). The reduction between Day 3 and Day 7 was also statistically significant (**p<0.001**). Although both groups improved over time, the **study group** demonstrated a steeper drop by Day 7, while the **control group** showed a more gradual and consistent reduction. **Table 2, Figure 6.**

Table 2. *Comparison of pain by VAS scores at different times in each group*

Comparison		Study Group				Control Group			
		Mean ± SD	95% CI of Diff	t-value	p-value	Mean ± SD	95% CI of Diff	t-value	p-value
Pain Day1 vs Day3	Day1	8.57 ± 0.53	[4.22, 5.50]	18.62	<0.001	8.43 ± 0.79	[2.51, 3.21]	20	<0.001
	Day3	3.71 ± 0.76				5.57 ± 0.98			
Pain Day1 vs Day7	Day1	8.57 ± 0.53	[7.83, 8.74]	44.93	<0.001	8.43 ± 0.79	[6.50, 7.78]	27.39	<0.001
	Day7	0.29 ± 0.49				1.29 ± 0.76			
Pain Day3 vs Day7	Day3	3.71 ± 0.76	[2.93, 3.92]	16.97	<0.001	5.57 ± 0.98	[3.41, 5.17]	11.92	<0.001
	Day7	0.29 ± 0.49				1.29 ± 0.76			

t: Paired t test, CI: Confidence interval

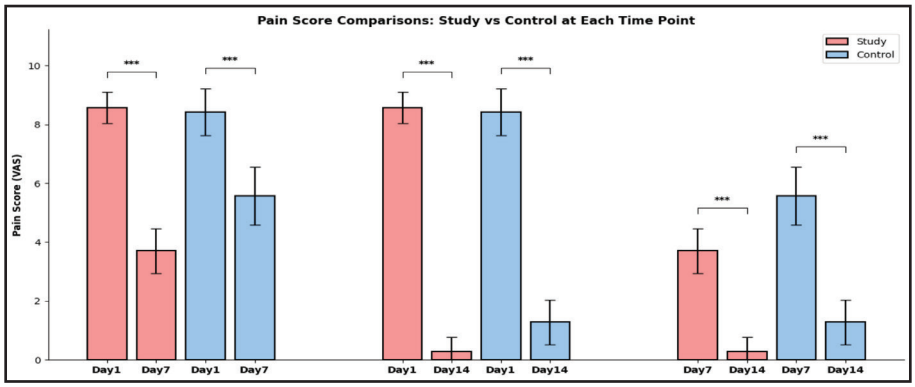

Fig. (6) Comparison of pain by VAS scores at different times in each group.

B. Comparison of VAS score between the two groups

According to the comparison of VAS score between the two groups, the **study group demonstrated significantly greater pain relief than the control group**, particularly on the **3rd and 7th days**.

On **Day 1**, the mean VAS pain score in the study group was **8.43 ± 0.79**, which was not significantly different from **8.57±0.53** in the control group (**p=0.698**, NS), suggesting comparable baseline pain levels.

By **Day 3**, a **significant difference** emerged, with the study group reporting a lower pain score (**3.71±0.76**) compared to the control group (**5.57±0.98**, **p =0.002**, HS), indicating faster pain reduction in the study group.

On **Day 7**, the difference remained significant, with pain levels of **0.29±0.49** in the study group and **1.29±0.76** in the control group (**p = 0.012**, S).

These findings suggest that while both groups experienced pain relief over time, the study group achieved **earlier and more substantial pain reduction**. **Table 3, Figure 7.**

Table 3. *Comparison of VAS score between the two groups*

Parameter	Category	Study group (n=8)	Control group (n=8)	p-value	Significance
Pain Day1	Mean ± SD	8.57 ± 0.53	8.43 ± 0.79	t:0.397, p=0.698	NS
Pain Day3	Mean ± SD	3.71 ± 0.76	5.57 ± 0.98	t:-3.980, p=0.002	HS
Pain Day7	Mean ± SD	0.29 ± 0.49	1.29 ± 0.76	t:-2.941, p=0.012	S

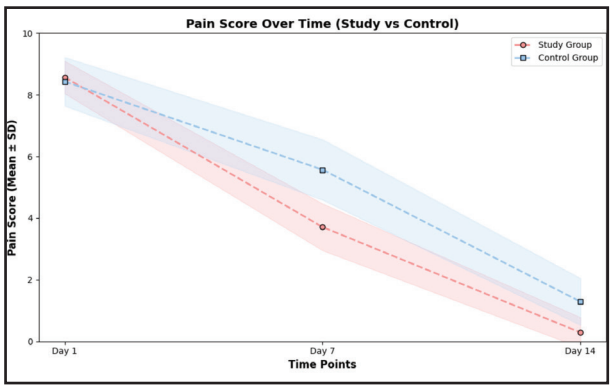

Fig. (7) Comparison of VAS score between the two groups

Facial swelling (Edema):

A: Comparison of edema scale at different times in each group

The clinical assessment of edema (edema) revealed a **progressive improvement over time** in both the **study** and **control groups**, as evidenced by shifting proportions from "High" edema to "No" edema across follow-up days.

In the study group, on Day 1, the majority of patients exhibited high edema (75.0%), with 25.0% showing intermediate edema. By Day 3, edema improved substantially, with 75.0% of patients presenting low edema and 25.0% achieving no edema. By Day 7, complete resolution was observed, with 100% of patients showing no edema. The reduction in edema over time was statistically significant with pairwise comparisons showing **p1 = 0.001** (Day 1 vs Day 3), **p2 < 0.001** (Day 1 vs Day 7), and **p3 = 0.007** (Day 3 vs Day 7).

In the control group, initial edema on Day 1 was slightly less severe, with 62.5% exhibiting high edema and 37.5% intermediate edema. By Day 3, edema status diversified, with 37.5% still showing high edema, 25.0% intermediate, 25.0% low, and only 12.5% achieving no edema. By Day 7, 87.5% of patients achieved no edema, with 12.5% remaining with low edema. Improvement over time was statistically significant for **p2 = 0.001** and **p3 = 0.020**, while **p1 = 0.296** (Day 1 vs Day 3) was not significant, indicating a relatively slower early resolution compared to the study group.

These findings suggest that although both groups demonstrated a reduction in edema, the study group achieved an earlier and more complete resolution ***(Table 4, Figure 8).***

Table 4. *Edema Distribution at Different Time Points in Each Group*

	Time	High	Intermediate	Low	No	Pairwise Comparisons
Edema - Study Group	Day1 vs Day 3	6 (75.0%)	2 (25.0%)	0 (0.0%)	0 (0.0%)	p1=0.001*
	Day 1 vs Day 7	0 (0.0%)	0 (0.0%)	6 (75.0%)	2 (25.0%)	p2<0.001*
	Day 3 vs Day 7	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (100.0%)	p3=0.007*
Edema - Control Group	Day1 vs Day 3	5 (62.5%)	3 (37.5%)	0 (0.0%)	0 (0.0%)	p1=0.296
	Day 1 vs Day 7	3 (37.5%)	2 (25.0%)	2 (25.0%)	1 (12.5%)	p2=0.001*
	Day 3 vs Day 7	0 (0.0%)	0 (0.0%)	1 (12.5%)	7 (87.5%)	p3=0.020*

p1*: Comparison between Day 1 and Day 3*
p2*: Comparison between Day 1 and Day 7*
p3*: Comparison between Day 3 and Day 7*

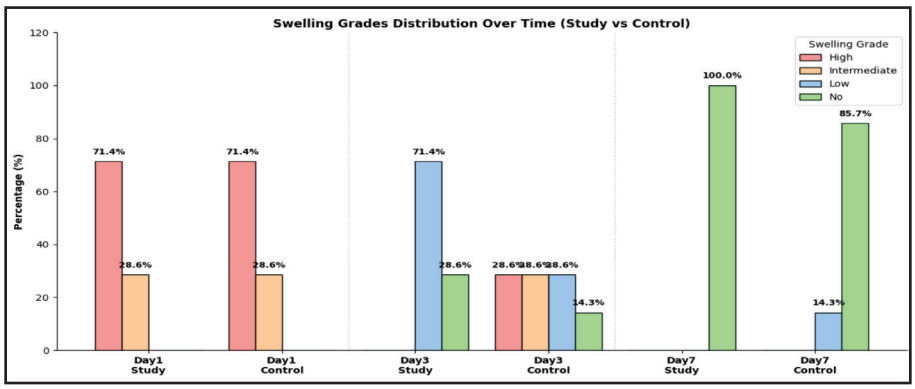

Fig. (8) Edema Distribution at Different Time Points in Each Group

B: Comparison of edema scale between the groups

Edema status was compared between the study and control groups at Day 1, Day 3, and Day 7 to evaluate differences in the rate and extent of inflammation resolution.

On Day 1, the study group showed 75.0% high edema and 25.0% intermediate edema, while the control group had 62.5% high edema and 37.5% intermediate edema. No statistically significant difference was noted between the groups (**p = 1.000**, NS).

By Day 3, the study group demonstrated considerable improvement, with 75.0% low edema and 25.0% no edema, compared to the control group, which still exhibited 37.5% high, 25.0% intermediate, 25.0% low edema, and 12.5% no edema. Although there was a trend toward better outcomes in the study group, the difference did not reach statistical significance (**p = 0.062**, NS).

On Day 7, complete resolution of edema was achieved in the study group (100% no edema), while in the control group, 87.5% of patients exhibited no edema and 12.5% still had low edema. This difference was not statistically significant (**p = 1.000**, NS).

In summary, the study group showed a more rapid resolution of edema compared to the control group, although differences between groups at individual time points did not reach statistical significance ***(Table 5).***

Table 5. *Edema Assessment comparison between study group and control group*

Parameter	Category	Study group (n=8)	Control group (n=8)	Test Results	Significance
Edema Day1	High	6 (75.0%)	5 (62.5%)	X^2: 0.000, p=1.000	NS
	Intermediate	2 (25.0%)	3 (37.5%)		
Edema Day3	Low	6 (75.0%)	2 (25.0%)	X^2: 7.333, p=0.062	NS
	No	2 (25.0%)	1 (12.5%)		
	Intermediate	0 (0.0%)	2 (25.0%)		
	High	0 (0.0%)	3 (37.5%)		
Edema Day7	No	8 (100.0%)	7 (87.5%)	X^2: 0.000, p=1.000	NS
	Low	0 (0.0%)	1 (12.5%)		

χ^2:Chi square test

Postoperative complications

There were no postoperative complications such as infection, wound dehiscence or fistulation in both groups at each time interval.

Bone density

A: Comparision of bone density at different times in each group

The radiographic assessment of bone density showed a significant increase from baseline (T0) to follow-up (T1) in both the study and control groups. In the **control group**, the mean bone density increased from **176.81±45.52 HU** at T0 to **489.57±58.56 HU** at T1. This change was statistically significant (**p<0.001**). Similarly, the **study group** exhibited a significant increase in bone density, from **201.24±72.77 HU** at T0 to **947.63±103.64 HU** at T1 (**p <0.001**). These findings suggest that significant bone healing occurred in both groups, with high statistical reliability. **Table 6, Figure 9.**

Table 6. *Within-Group Comparison of Radiographic Bone Density (T0 vs T1)*

Comparison		Study Group				Control Group			
		Mean ± SD	95% CI of Diff	t-value	p-value	Mean ± SD	95% CI of Diff	t-value	p-value
T0 vs T1 Density	T0	201.24 ±72.77	[-886.76,-606.01]	-13.01	<0.001	176.81±45.52	[-393.88, -231.63]	-9.43	<0.001
	T1	947.63±103.64				489.57±58.56			

t: Paired t test, CI: Confidence interval

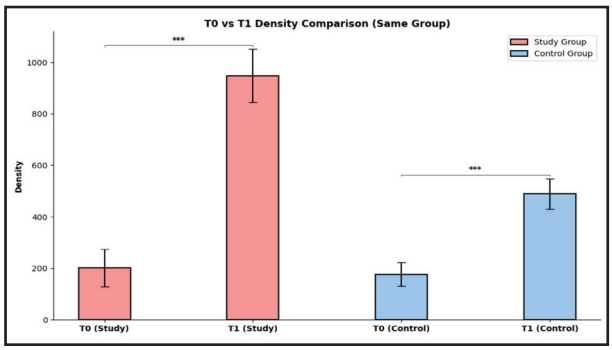

Fig. (9) Within-group comparison of radiographic bone density (T0 vs T1).

B: Comparision of bone density between the two groups

The intergroup comparison of bone density revealed **no statistically significant difference at baseline (T0)** between the study and control groups. The **study group** had a mean T0 bone density of **201.24 ± 72.77 HU**, while the **control group** had **176.81 ± 45.52 HU** (**p = 0.466**, NS), confirming that both groups began with **comparable preoperative bone conditions**.

By the follow-up period (T1), a **highly significant difference** emerged in favor of the study group. Patients in the **study group demonstrated a markedly higher bone density** of **947.63 ± 103.64 HU** compared to **489.57 ± 58.56 HU** in the control group (**p < 0.001**, HS).

These results indicate that **application of PRF with nHA bone graft** in the study group was associated with **enhanced bone regeneration**, leading to a **superior radiographic healing response** compared to the control group. **Table 7. Figure 10**

Table 7. *Comparison of Radiographic Bone Density at T0 and T1 between the two groups*

Parameter	Measure	Study group (n=8)	Control group (n=8)	p-value	Significance
T0 Density	Mean ± SD	201.24 ± 72.77	176.81 ± 45.52	t:0.753, p=0.466	NS
T1 Density	Mean ± SD	947.63 ± 103.64	489.57 ± 58.56	t:10.181, p<0.001	HS

t: Student t test

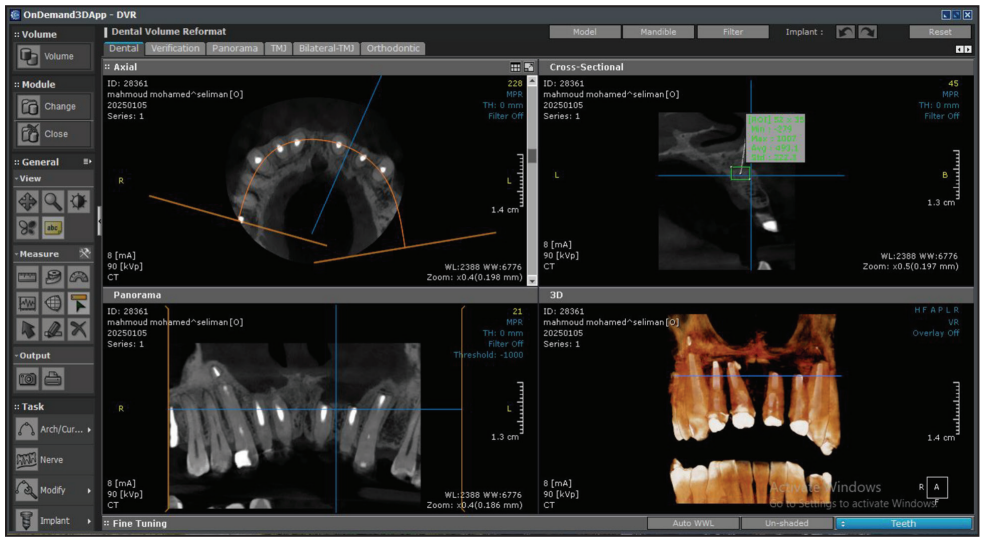

Fig. (10) Bone density and healing on CBCT

DISCUSSION

The aim of this study was to evaluate the efficacy of applying nanocrystalline hydroxyapatite mixed with platelet rich fibrin for healing of bony defects after cysts enucleation.

In agreement with our study, **Nair *et al.*** [19], **Shadap *et al.*** [20] and **Deepa *et al.*** [21] who used PRF mixed with nano hydroxyapatite bone graft to fill the bony defect.

Consistent with our study, **Anis *et al.*** [22] measured the edema scale using different methods like VAS of edema which had 4 grades, A denoted no edema, B slight edema, C average edema, and D for much edema.

In contrast, **Patil *et al.*** [23] used the sum of the length of 3 lines along the predetermined facial reference points from tragus to soft tissue pogonion, tragus to corner of the mouth and from gonion to lateral canthus for measuring the edema scale.

In our study, we used Cone Beam CT (CBCT) because it's an important diagnostic method to determine the position and size of the cystic lesion precisely. This was in agreement with **Eldibany and Shokry.** [24]

On the other hand, **Shadap *et al.*** [20] employed Radiographs using VistaScan with a mesh to analyze the bone density and bone regeneration. The parameters used to analyze the radiographs included gray scale analysis, residual bone defect calculation in pixels both performed in CorelDraw version 13 software, and radiopaque scoring scale.

In our study, we used OnDemand 3d software to measure bone density preoperatively and 6 months postoperatively. This is in agreement with **Eldibany and Shokry.** [24]

In contrast **Elsakka and Nabil** [25] used Planmeca Romexis software for the assessment of healing of the bony defects regarding both defect volume and size and bone density.

In agreement with our study, **Sharma & Pradeep** [26] proved that, as compared to natural healing, the application of PRF combined with bone graft in intrabony defects was associated with a modestly positive benefit by reducing postoperative pain.

In contrast, a study by **Uyanık et al.** [27] evaluated the effect of PRF application post-extraction and showed that there was no statistically significant difference in postoperative pain scores was observed between the PRF and control groups. The authors concluded that PRF did not provide a significant advantage in terms of reducing pain, although there were minor improvements in healing.

Edema is common after most oral surgeries. Our results were in agreement with **Francisco** [28] who demonstrated that edema got worse for three days before starting to improve until complete subsiding by the seventh day. There was no difference between both groups.

In contrast, **Dutta *et al.*** [29] found a significant difference in edema reduction between the group who received PRF in extraction sockets and the group who left with empty socket. PRF group showed less edema than control group.

The study's findings demonstrated that the nHA/PRF combination enhanced the quantity and quality of the regenerated bone while also speeding up bone repair in study group Compared to control group where the lesions were allowed to heal naturally without the use of a bone graft, the rate at which the bone density increased was noticeably higher. This was in agreement with **Elsakka and Nabil** [25]

In contrast with a study by **Miron *et al.*** [30] there was no significant impact on final bone density in PRF and bone graft group compared to normal healing group.

CONCLUSION

The study examined PRF's regeneration efficacy in treating maxillary bone cystic lesions in conjunction with nanocrystalline hydroxyapatite. The study group's radiographic improvement was larger, according to the results. Therefore, PRF combined with nanocrystalline hydroxyapatite may be considered a potential material for promoting bone repair following the enucleation of maxillary cystic lesions.

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