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Effect of platelet-rich fibrin on wound healing, adhesions, and hemostasis after inferior turbinoplasty surgery

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Abstract

Background Inferior turbinate enlargement is a prevalent cause of chronic nasal obstruction, often requiring surgical intervention when medical treatment fails. Platelet-rich fibrin (PRF) has been reported to mitigate post-operative complications following nasal surgeries. This work aims to evaluate the efficacy of PRF on hemostasis, adhesions, crust formation, and mucosal healing post-turbinoplasty.

Results Demographic characters showed no statistical differences in age ($p=0.62$) or gender ($p=0.342$), but the mean operative time was significantly shorter in the non-PRF group (22.80 ± 2.02) compared to the PRF group ($p>0.001$). Early hemostasis and prevention of crustation were significantly better in the PRF group ($p=0.03$ and $p=0.024$, respectively). No significant difference was observed regarding adhesions between the groups ($p=1$).

Conclusion The PRF membrane is an affordable and easy method that acts as a protective layer, reducing crusting, ensuring hemostasis, promoting healing by shortening the period of recovery post inferior turbinoplasty and so improving the quality of life of the patients.

Keywords Hypertrophied inferior turbinate, Platelet-rich fibrin, Turbinoplasty, Crustation, Hemostasis, Healing

Background

Chronic nasal obstruction, mostly caused by hypertrophied inferior turbinate (HIT), is often refractory to medical treatments, necessitating surgical intervention after persistent symptoms for at least 3 months [1, 2]. Various surgical techniques have been developed for HIT reduction, including mucosal-preserving procedures (e.g., extra-mucosal and submucosal cauterization) and non-mucosal-preserving procedures (e.g., turbinectomy) [3, 4].

Platelet-released mediators and growth factors play a crucial role in tissue regeneration, positioning platelet-rich fibrin (PRF) as a promising therapeutic option for enhancing tissue healing post-surgery [5, 6].

The aim of this study was to evaluate the impact of the PRF membrane on hemostasis, development of adhesions, crustation, and tissue regeneration and healing when applied to the inferior turbinate post-turbinoplasty surgery.

Methods

Study design and population

This randomized controlled interventional study included 40 patients treated at the ENT outpatient clinic of Benha University Hospitals between February 2023 and December 2023. All patients presented with nasal obstruction and were diagnosed with HIT resistant

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to medical treatment for at least 3 months, confirmed through the nasal endoscopic evaluation and computed tomography (CT).

Exclusion criteria comprised patients aged below 16 years and above 40 years old, those with adenoid hypertrophy, uncontrolled systemic diseases, or coagulopathy.

Ethical approval was obtained from the university's Research Ethical Committee, and informed written consent was secured from all participants.

Randomization method

Randomization was done using computer-generated random numbers. To ensure unbiased allocation of participants to the study arms, the allocation sequence was concealed from the study investigators in sealed envelopes. Envelopes containing the allocation data were selected sequentially by the patient in the presence of the study nurse.

Patients were divided into two groups: Group A ($n=20$) underwent surface bipolar cauterization of HIT and Group B ($n=20$) underwent surface bipolar cauterization followed by PRF membrane application over the inferior turbinate.

Each participant was submitted for full history taking, general examination, labs (CBC, coagulation profile, serum creatinine, random blood sugar, and virology), preoperative diagnostic endoscopic examination, and radiological examination (CT scan of the nose and paranasal sinuses, mainly coronal cuts). At that point, patients were split into two bunches, A and B.

PRF preparation

PRF preparation at the beginning of the operation for group B. Thirty milliliters of the patient's entire venous blood was poured into two sterile 15-ml plain test tubes. At this point, the test tubes were centrifuged at 3000 rotations per minute (rpm) for 10 min [7] (Fig. 1).

The item created is composed of three layers: The upper layer is a cellular platelet-poor plasma (PPP), the PRF within the center, and red blood cells (RBCs) below. The PRF was then separated and dehydrated over sterile surgical dressing and compressed to make a film with uniform thickness [7].

Surgical technique

Under general hypotensive anesthesia, all patients had surface bipolar cauterization of HIT while supine and in the anti-Trendelenburg position, with their heads slightly elevated. A rigid, 4-mm-diameter, 18-cm-long, 0° endoscope was used during the procedure.

A bipolar cautery forceps is inserted into the nasal cavity, making contact with the turbinate's superior and inferior surfaces. A foot switch was used to operate the bipolar cautery. For group B, the previously prepared PRF membrane was applied to the inferior turbinate (Figs. 2 and 3).

An anterior nasal merocel pack was inserted under endoscopic visualization to keep the PRF membrane in place and prevent rapid shedding of the membrane.

All patients were admitted to the ENT ward for 2 days on antibiotics and analgesics. The pack was removed on the third day, and endoscopic evaluation was made after pack removal, then weekly for the first month and monthly for 3 months.

Post-operative evaluations

Post-operative evaluations were conducted after pack removal then weekly for the first month and monthly for 3 months through endoscopic examinations assessing crustation, adhesion, hemostasis, and healing. Subjective assessments were conducted using the nasal obstruction symptom evaluation (NOSE) scale [8].

Sample size

Open Epi software version 3.01 was used to calculate the required sample size according to Sari et al., with a level of significance = 0.05, and type II error = 0.2 [9]. So

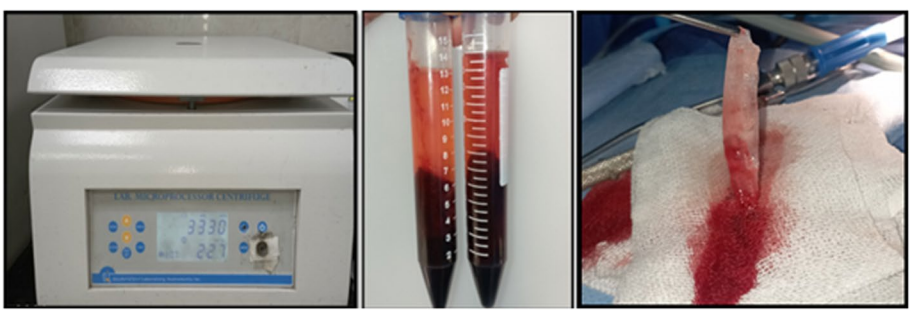

Fig. 1 Steps of preparation of PRF membrane

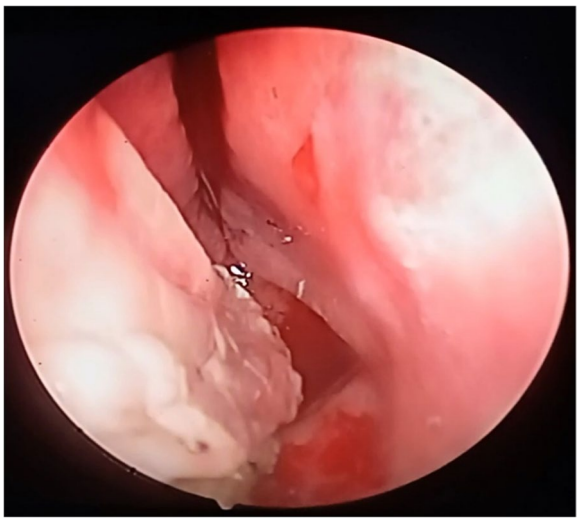

Fig. 2 Endoscopic view of inferior turbinates covered with PRF membrane

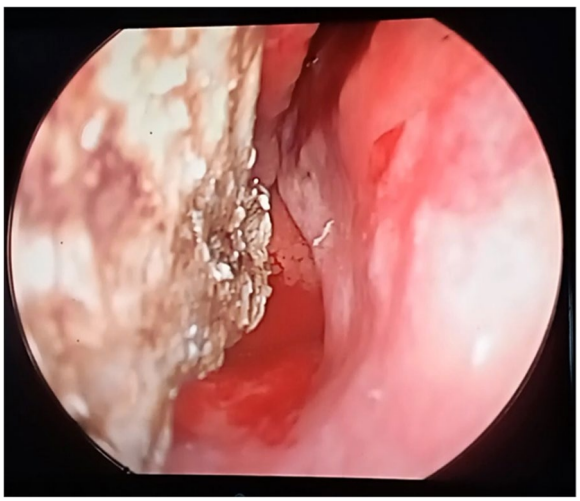

Fig. 3 Endoscopic view of inferior turbinates after bipolar cauterization

minimal calculated sample size was 28 participants with 14 in each group to be increased to 20 in each group accounting for dropout.

Statistical analysis

To analyze the data that was entered into the computer, IBM SPSS software version 20.0 was utilized. (Armonk, New York: IBM Corp.) The qualitative data was described using percentages and numbers. The Shapiro–Wilk test was run to verify the normality of the distribution. To describe quantitative data, the terms range (minimum and maximum), mean, standard deviation, median, and interquartile range (IQR) were utilized. At the 5% level, the findings were considered significant.

Results

In this study, 55 patients were evaluated for eligibility; 10 did not meet the inclusion criteria, and 5 patients refused to participate. The remaining 40 patients were randomly assigned into two groups of 20 each: Group A, which underwent bipolar cauterization of hypertrophied inferior turbinates (HIT), and Group B, which underwent bipolar cauterization followed by the application of platelet-rich fibrin (PRF) membrane on the inferior turbinate. All patients were then followed up and statistically analyzed (Fig. 4).

Table 1 shows no significant difference in gender distribution between Group A (55% male, 45% female) and Group B (40% male, 60% female) ($P=0.342$). The median age for Group A is 19.50 years (IQR, 18.0–21.50) and for Group B is 20.0 years (IQR, 19.0–23.0), with no significant difference ($P=0.620$). However, a significant difference is noted in operation time: Group A has a mean operation time of 22.80 min (SD: 2.02) compared to 27.85 min (SD, 1.84) for Group B ($P<0.001$).

Both groups have a similar range of NOSE scores (15.0–30.0) with no significant difference ($P=0.159$). The mean NOSE score for Group A is 22.75 (SD, 4.72), while for Group B, it is 20.75 (SD, 4.06), indicating a slightly higher mean score in Group A, but this difference is not statistically significant (Table 2).

Table 3 and Fig. 5 compare crustation between Group A and Group B at different time points. At 1 week, both groups had 50% mild and 50% moderate crustation, with no significant difference ($P=1.000$). At 2 weeks, Group A had 10% no crustation, 60% mild, 20% moderate, and 10% severe crustation, while Group B had 50% no crustation, 40% mild, 10% moderate, and 0% severe crustation, showing a significant difference (MCp = 0.024*). At 3 weeks, Group A had 45% no crustation and 55% mild crustation, while Group B had 70% no crustation and 30% mild crustation, with no significant difference ($P=0.110$). At 1 month, Group A had 80% no crustation and 20% mild crustation, while Group B had 85% no crustation and 15% mild crustation, with no significant difference (FEp = 1.000).

Regarding the development of adhesions between the groups at 3rd week, in Group A, 90% had no adhesion, 10% had mild adhesion, and 0% had moderate or severe adhesion. In Group B, 95% had no adhesion, 5% had mild adhesion, and 0% had moderate or severe adhesion. There was no significant difference between the groups (FEp = 1.000) (Table 4).

In terms of the bleeding between the groups, postoperative oozing showed no significant difference, with 45% of Group A and 60% of Group B having no oozing ($P=0.342$). However, with pack removal, a significant difference was observed (MCp = 0.030*), with 0% in Group

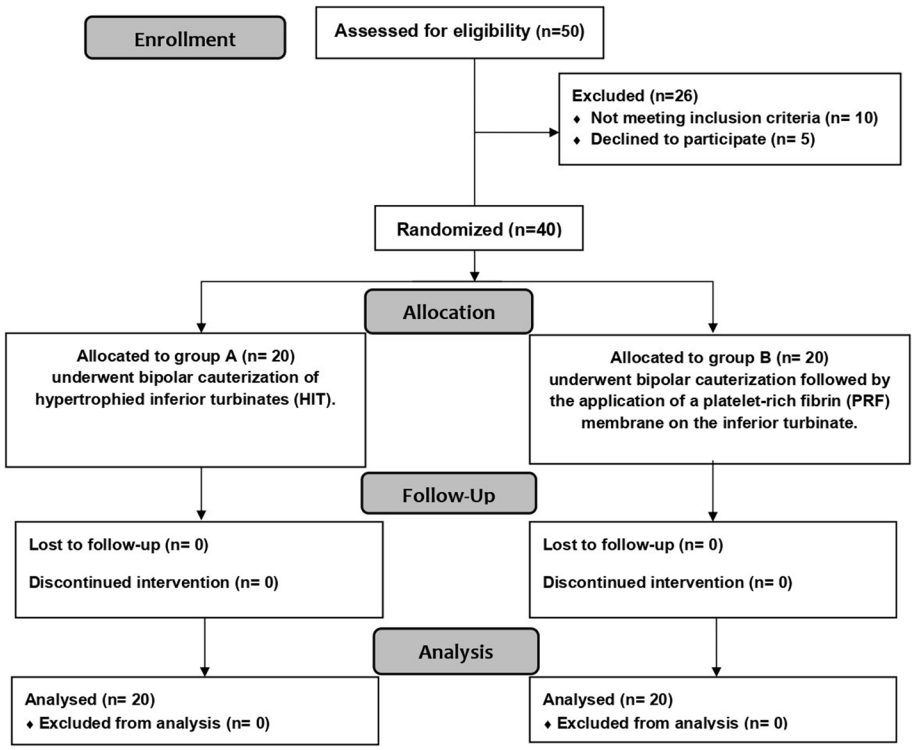

Fig. 4 Consort flow diagram of patients that were enrolled

Table 1 Comparison between the two studied groups according to demographic data

	Group A (*n* = 20)		Group B (*n* = 20)		*P*
	No	%	No	%	
Gender					
Male	11	55.0	8	40.0	0.342
Female	9	45.0	12	60.0	
Age (years)					
Min.–Max	16.0–39.0		16.0–34.0		0.620
Median (IQR)	19.50 (18.0–21.50)		20.0 (19.0–23.0)		
Operation time (min)					
Min.–Max	20.0–26.0		25.0–32.0		< 0.001*
Mean ± SD	22.80 ± 2.02		27.85 ± 1.84		

Data were presented as number (percentage), median (interquartile range), and mean (standard deviation), *IQR* interquartile range, *SD* standard deviation

A and 30% in Group B having no bleeding. Mild bleeding was 60% in Group A and 35% in Group B, while moderate bleeding was 40% in Group A and 35% in Group B. At 2 weeks, there was no significant difference, with 85% of Group A and 90% of Group B having no bleeding (FEp = 1.000), and mild bleeding at 15% in Group A and 10% in Group B (Table 5 and Fig. 6).

Table 2 Comparison between the two studied groups according to NOSE score

	Group A (n = 20)	Group B (n = 20)	P
NOSE score %			
Min. – Max	15.0 – 30.0	15.0 – 30.0	0.159
Mean ± SD	22.75 ± 4.72	20.75 ± 4.06	

Data were presented as minimum–maximum and mean (standard deviation)

NOSE Nasal Obstruction Symptom Evaluation, *Min* Minimum, *Max* Maximum, *SD* Standard Deviation

Regarding the healing times between the studied groups, at 1 month, 60% of Group A and 75% of Group B had healed ($P = 0.311$). At 2 months, 40% of Group A and 25% of Group B had healed. The healing times ranged from 1.0 to 2.0 months for both groups, with the median healing time being 1.0 month (IQR, 1.0–2.0) for Group A and 1.0 month (IQR, 1.0–1.50) for Group B, showing no significant difference ($P = 0.429$) (Table 6).

Discussion

Chronic nasal obstruction is mostly caused by HIT; its treatment usually starts medically. However, nasal obstruction in most cases is refractory to medical treatments, so surgical reduction of HIT is considered [10].

Table 3 Comparison between the two studied groups according to crustation

Crustation	Group A (*n* = 20)		Group B (*n* = 20)		*P*
	No	%	No	%	
1 week					
No	0	0.0	0	0.0	1.000
Mild	10	50.0	10	50.0	
Moderate	10	50.0	10	50.0	
Severe	0	0.0	0	0.0	
2 weeks					
No	2	10.0	10	50.0	$^{MC}p = 0.024^{*}$
Mild	12	60.0	8	40.0	
Moderate	4	20.0	2	10.0	
Severe	2	10.0	0	0.0	
3 weeks					
No	9	45.0	14	70.0	0.110
Mild	11	55.0	6	30.0	
Moderate	0	0.0	0	0.0	
Severe	0	0.0	0	0.0	
1 month					
No	16	80.0	17	85.0	$^{FE}p = 1.000$
Mild	4	20.0	3	15.0	
Moderate	0	0.0	0	0.0	
Severe	0	0.0	0	0.0	

Data were presented as number (percentage), *MCp* Monte Carlo Probability, *FEp* Fisher Exact Probability

Platelet-rich concentrates (PRCs), known for their high content of chemical mediators and growth factors released from platelets, play a crucial role in tissue healing and regeneration. Consequently, PRCs have emerged as a promising therapeutic modality to enhance tissue repair post-surgery [11].

PRF has various applications in otorhinolaryngology as a healing promotion material: pharyngeal wall healing after total laryngectomy, rhinoplasty, prevention of recurrence of sinonasal polyps after functional endoscopic sinus surgery, cerebrospinal fluid leakage repair, and myringoplasty surgery [12].

Vieira et al. used PRF membrane to cover the surgical site after inferior turbinectomy; our article is the first to discuss the application of PRF after inferior turbinoplasty by surface bipolar cauterization of inferior turbinate.

In our study, the mean operative time exhibited a statistically significant reduction in Group A (22.80 min) compared to Group B (27.85 min) ($p < 0.001$). This observation corroborates the findings by Vieira et al. (2018), who reported shorter operative times for the control group relative to a group where a PRF membrane was utilized [13].

Despite the observed differences in operative times, the mean reduction in nasal obstruction symptoms did not significantly differ between the groups (77.25 in our study), aligning with findings by Rao et al., who reported a mean reduction of 78.00 following bipolar cauterization of the inferior turbinate [14].

Crust formation, an indicator of epithelialization, showed a statistically significant difference at the 2-week

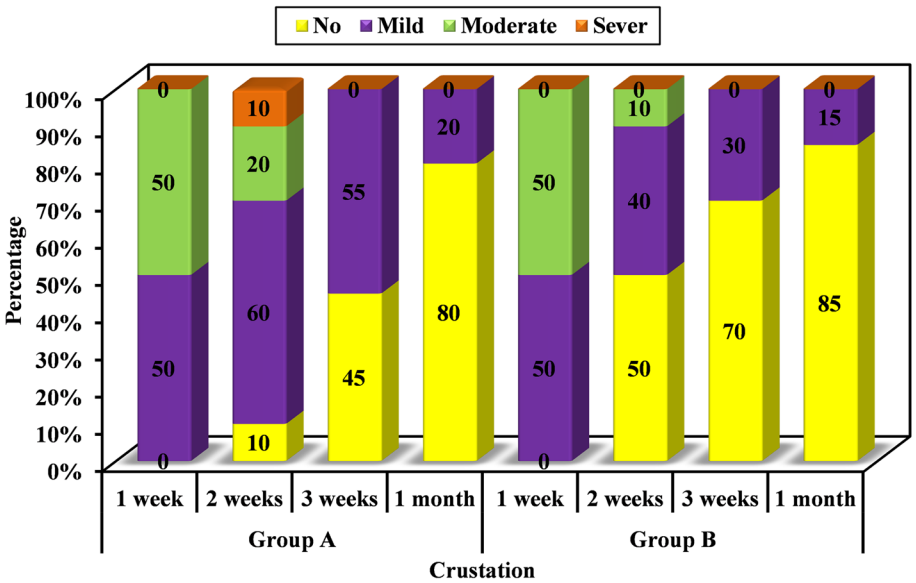

Fig. 5 Comparison between the two studied groups according to crustation

Table 4 Comparison between the two studied groups according to adhesion

Adhesion (3 weeks)	Group A ($n=20$)		Group B ($n=20$)		^{FE}p
	No	%	No	%	
No	18	90.0	19	95.0	1.000
Mild	2	10.0	1	5.0	
Moderate	0	0.0	0	0.0	
Severe	0	0.0	0	0.0	

Data were presented as number (percentage), *FEp* Fisher Exact Probability

Table 5 Comparison between the two studied groups according to bleeding

Bleeding	Group A ($n=20$)		Group B ($n=20$)		*p*
	No	%	No	%	
Post op oozing					
No	9	45.0	12	60.0	0.342
Yes	11	55.0	8	40.0	
With pack removal					
No	0	0.0	6	30.0	$^{MC}p=0.030^{*}$
Mild	12	60.0	7	35.0	
Moderate	8	40.0	7	35.0	
Sever	0	0.0	0	0.0	
2 weeks					
No	17	85.0	18	90.0	$^{FE}p=1.000$
Mild	3	15.0	2	10.0	
Moderate	0	0.0	0	0.0	
Severe	0	0.0	0	0.0	

Data were presented as number (percentage), *MCp* Monte Carlo Probability, *FEp* Fisher Exact Probability

postoperative mark, with the PRF group experiencing less severe crustation ($p=0.024$). This outcome is consistent with findings by Sari et al., which noted severe crustation following bipolar cauterization without PRF coverage. Beyond this period, no significant differences were observed between the groups, and by 2 months, crustation was absent in both groups [9].

Adhesion formation, a notable postoperative complication, showed no significant difference between groups within the first 2 weeks. However, by the third week, mild adhesions were observed in 10% of cases in the non-PRF group and 5% in the PRF group, contrary to Rao et al.'s findings, which reported no adhesions in all cases [13].

PRF's high platelet concentration is hypothesized to enhance hemostasis. Postoperative bleeding following nasal packing removal was significantly less in the PRF group ($p=0.03$), though subsequent evaluations showed no significant differences between the groups, diverging from Sari et al.'s results [9].

Regarding mucosal healing, 75% of cases in Group A and 60% in Group B showed apparent healing after the first month. However, this difference was not statistically significant ($P=0.311$).

Biomaterials such as PRF have been shown to effectively promote hemostasis post-surgery, minimize complications, and reduce the duration of the recovery period, thereby enhancing patients' quality of life. Consequently, research focused on identifying cost-effective materials that provide these benefits needs significant attention.

The study on the effect of PRF on wound healing, adhesions, and hemostasis after inferior turbinoplasty surgery

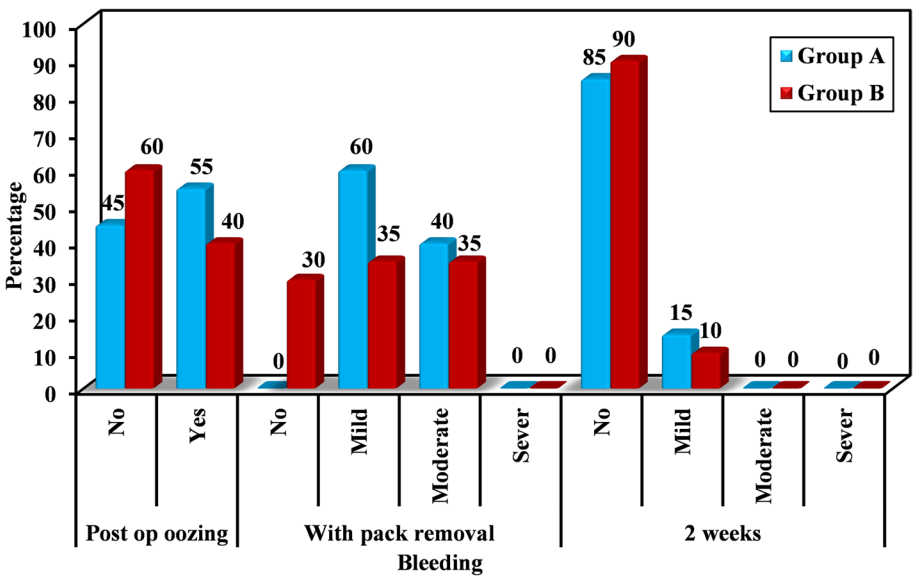

Fig. 6 Comparison between the two studied groups according to bleeding

Table 6 Comparison between the two studied groups according to healing

	Group A ($n=20$)	Group B ($n=20$)	*P*
Healing in months			
1	12 (60.0%)	15 (75.0%)	0.311
2	8 (40.0%)	5 (25.0%)	
Min.–Max	1.0–2.0	1.0–2.0	0.429
Median (IQR)	1.0 (1.0–2.0)	1.0 (1.0–1.50)	

Data were presented as number (percentage), minimum–maximum, and median (interquartile range), *IQR* interquartile range

has several limitations. The sample size was relatively small, with only 40 participants, which may limit the generalizability of the findings. The study duration was also short, restricting the ability to observe long-term outcomes and potential late complications. Additionally, the study was conducted in a single center, which may introduce site-specific biases. The lack of blinding and the subjective nature of some assessments, such as the NOSE score, may have introduced bias. Future studies with larger, multi-center cohorts and longer follow-up periods are needed to confirm these findings and assess the long-term efficacy and safety of PRF in this context.

Conclusion

The PRF membrane is an affordable and easy method that acts as a protective layer, reducing crusting, ensuring hemostasis, promoting healing by shortening the period of recovery post inferior turbinoplasty and so improving the quality of life of the patients.

Abbreviations

PRF	Platelet-rich fibrin
HIT	Hypertrophied inferior turbinate
CBC	Complete blood count
CT	Computed tomography
rpm	Rotations per minute
PPP	Platelet-poor plasma
RBCs	Red blood cells
NOSE	Nasal Obstruction Symptom Evaluation
IQR	Interquartile range
SD	Standard deviation
MCp	Monte Carlo Probability
FEp	Fisher Exact Probability
ENT	Ear, Nose, and Throat
SPSS	Statistical Package for the Social Sciences
PRCs	Platelet-rich concentrates

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There is none to be declared.

Authors' contributions

All authors contributed to the study conception and design. Material preparation and data collection and analysis were performed by AFG, MFS, SPK, and MAA. The first draft of the manuscript was written by MAA and MGE, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability

The data is available upon reasonable request from the authors.

Declarations

Ethics approval and consent to participate

The study was approved from the institutional ethical committee, Benha University. After receiving written informed consent from each subject, the study was carried out with their permission after receiving approval from the Institutional Review Board (IRB) of the Benha University Faculty of Medicine.

Consent for publication

None to declare.

Competing interests

The authors declare that they have no competing interests.

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