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ORIGINAL ARTICLE

Comparative Study Between Nanofat and Platelet Rich Plasma Injections in the Treatment of Recent Scars

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Abstract

Background: ***Post traumatic scars remain a nightmare for both the patient and the surgeon. Nanofat is a new tool used in regenerative medicine its action depends mainly on adipose derived stem cells (ADSCs). ADSCs play an important role in scar rejuvenation. Platelet-rich plasma is an advanced scar therapy that has shown positive alteration in the treatment of scars through the highly concentrated autologous platelets that release numerous growth factors, cytokines, and fibrin, which may be valuable in improving the whole scar quality.***

Objective: ***To compare nanofat and PRP injections in recent scar treatment.***

Patients and Methodology: ***This prospective randomized clinical study included 20 patients divided into two equal groups: Group (A): Post traumatic scar treated by nanofat injection. Group (B): post traumatic scar treated by PRP injection. Their ages ranged between 18 and 40 years. The duration of the scar varied between 1 and 6 months.***

Results: ***The results of this study showed higher cosmetic improvement and patient satisfaction in group (A) treated by nano fat injection versus group (B) treated by PRP injection. There was a highly significant improvement in scar height, Pigmentation, and vascularity when comparing group (A) to group (B), but scar pliability improved equally in both groups.***

Conclusion: ***Nano fat and platelet-rich plasma (PRP) are reliable tools in dealing with recent post-traumatic scars. Patients treated with nonfat injection showed much improvement in scar height, Pigmentation, and vascularity compared to PRP-treated patients.***

Keywords: Adipose-derived stem cells; Growth factors; nanofat; PRP

1. Introduction

The physical, psychological, and social effects of scarring can be unpleasant. Tenderness, soreness, scar contractures, stiffness, and itching are examples of physical symptoms. Reduced self-esteem, stigma, interruption of everyday activities, anxiety, and sadness are some of the psychosocial repercussions of unsightly scars.[1]

Currently, Numerous scar management techniques have been proposed for the treatment and prevention of unsightly scars. These include tissue repositioning, pressure garments, silicone administered topically, intralesional steroids, scar revision, and scar excision with skin grafting. tissue expansion, laser therapy, platelet-rich plasma (PRP) and fat grafting.[2]

Nano fat is composed of fat cells, extracellular matrix, and adipose-derived stem cells (ADSCs). Growth factors (G.F.s) and cytokines secreted by ADSCs are responsible for the anti-inflammatory, angiogenic, regenerative properties, remodelling and anti-scarring process.[3]

Platelet-rich plasma (PRP) has received significant attention since the 1970s in tissue repair and regenerative medicine. The amount of plasma fraction from autologous blood that has platelet concentrations six to seven times higher than usual can be used to define platelet-rich plasma (PRP).[4]

Platelet-derived growth factor (PDGF), transforming growth factor (TFG), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF) are among the growth factors found in PRP. Through the stimulation of tissue remodelling, regulation of collagen synthesis, and encouragement of tissue regeneration, these growth factors are linked to improved scars.[5]

This study aims to compare nanofat and PRP injections in recent scar treatment.

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2. Patients and methods

A prospective randomized comparative intervention study included 20 patients with recent post-traumatic scars. We admitted our patients to the Plastic Surgery Department of Al-Zahraa University Hospital during the period from June 2021 to December 2021. After that, the patients were followed up individually for a period of 6 months, during which the final assessment for the scar quality was documented according to the Vancouver Scar Scale (VSS) and patient satisfaction questionnaire.

Inclusion criteria: Patients, both male and female. ranging in age from 18 to 40. Scar duration ranged from 1 to 6 months in different areas on the body.

Exclusion criteria: Blood disorders such as anemia or coagulopathy. Old scars more than 6 months. Depressed scars and keloid scars. Patients refused injection.

The study's cases were divided into two separate groups: Group A: Included 10 patients having post traumatic scars treated by monthly intralesional nanofat injection for 3 session. Group B: ten patients with post-traumatic scars were treated by PRP injection every 2 weeks for 6 sessions. The treatment duration for each patient in both groups was three months.

Group (A) Nanofat injection: Operative technique; The harvesting donor site was marked over the lower abdomen or medial thigh. The procedure was done under local tumescent and I.V. sedation under complete aseptic conditions. The donor site was infiltrated with 100ml tumescent solution (500 ml normal saline + 30 ml lidocaine 2% + 0.5 mg adrenalin). Prophylactic antibiotic in the form of 2nd generation cephalosporin was given intravenously.

After 20 minute, a multiport 2mm canula with sharp side holes connected to a 20ml syringe was used to harvest micro fat. The aspirated fat in syringes was left vertically for 20 minutes and after settlement, the lower fluid was discarded.

By moving the contents of two 10-cc syringes back and forth 30 times, each connected by a 1.4 mm female-to-female Luer-Lok connector, the micro fat was mechanically emulsified until it melted and took on a yellowish color.

Following this process of emulsification, the fatty liquid was filtered using Nano-filter. This was done in order to prevent the fine needles from being blocked by connective tissue remnants and would facilitate injection. This effluent is called "Nanofat".

Sharp needles with a gauge of 24, 25, or 27 were used to inject the nano fat into the scar tissue. When the scar started to show signs of yellowish discolouration, the injection's endpoint was attained. In every case, cold compresses and antibiotic cream were applied right away after the injection of Nanofat, which had been gently distributed digitally in all directions.

Post-operative care: On the first post-operative day, all patients were directed to elevate their heads and apply cold compresses for 15 minutes every hour in addition to applying antibiotic ointment to the injected area.

Group (B) PRP injection: The procedure was done according to the following steps: The blood sample was withdrawn approximately 3 - 10 cm, depending on the scar length, using sterile syringes. The blood was collected in tubes containing Sodium Citrate. The blood was immediately centrifuged (double spin method). The first spin was at 3500 RPM for 10 min, and after the removal of red blood cells, the second spin (hard spin) at 4000-4500 RPM for 15 min to obtain platelet concentrate, PPP at the upper two-thirds which was removed and PRP at the lower third.

PRP was activated using calcium gluconate solution 10%as 1 ml for each 10 ml of PRP. Immediately after cleansing the wound, the activated PRP was injected into in the scar with a fine needle (30G) using sterile syringes.

Post-operative follow up; Scar assessment and medical photographs were taken in each follow up visit. After 6 months, A final visual score system (VSS) was assigned to the scar, and preoperative views and lighting were replicated in subsequent scar photos.

3. Results

The cause, scar site, type, duration and relation of the scars to langer's lines in both groups were summarized in Table 1 which shows no statistically significant difference between both groups.

Table 1. Comparing the two groups under study in accordance with cause, scar site, type, duration and relation of scar to langer's lines

	NANOFAT (N=10)		PRP (N=10)		TEST OF SIG.	P
	No.	%	No.	%		
CAUSE (TRAUMATIC)	10	100	10	100	–	–
SITE OF SCAR					χ^2=	^{MC}p=
ARM	1	10.0	0	0.0	10.838	0.568
BACK	1	10.0	0	0.0		
CHIN	0	0.0	1	10.0		
DORSUM OF HAND	0	0.0	1	10.0		
FACE	3	30.0	1	10.0		
FACE (CHECK)	2	20.0	1	10.0		
FOREARM	1	10.0	2	20.0		
FOREHEAD	0	0.0	1	10.0		
LOW EYELID	0	0.0	1	10.0		
NECK	2	20.0	0	0.0		
NOSE	0	0.0	1	10.0		
UPPER EYE BROW	0	0.0	1	10.0		
TYPE OF SCAR						
NORMA TROPHIC	6	60.0	6	60.0	χ^2= 0.000	^{FE}p= 1.000

HYPER	4	40.0	4	40.0		
DURATION OF SCAR (MONTH)						
MIN – MAX	1.0 – 6.0		2.0 – 6.0		t=	0.780
MEAN ± SD	3.50 ± 1.72		3.70 ± 1.42		0.284	
MEDIAN (IQR)	3.0 (2.0 – 5.0)		3.50 (3.0 – 4.0)			
RELATION OF SCAR TO LANGER'S LINES						
WITH	6	60.0	5	50.0	χ^2= 0.202	^{FE}p= 1.000
AGAINST	4	40.0	5	50.0		

IQR: Inter quartile range, SD: Standard deviation, χ2: Chi square test, FE: Fisher Exact, MC: Monte Carlo, t: Student t–test

Regarding vascularity, pigmentation and hight, there is a statistically significant difference in nano fat group pre treatment and after 6 month of follow up (p0<0.05). While no statistically significant difference in pRP group pre treatment and after 6 month of follow up (p0>.05).

On other hand ,no statistically significant difference between both groups as the p value is more than 0.05 as shown in Table 2,3,4.

Table 2: Comparing the two groups under study based on vascularity

VASCULARITY	NANOFAT (N=10)		PRP (N=10)		X^2	^{MC}p
	No.	%	No.	%		
BEFORE						
NORMAL	0	0.0	0	0.0	0.311	0.855
PINK	3	30.0	3	30.0		
RED	5	50.0	4	40.0		
PURPLE	2	20.0	3	30.0		
AFTER FOLLOW UP						
NORMAL	5	50.0	3	30.0	1.643	0.649
PINK	3	30.0	4	40.0		
RED	2	20.0	2	20.0		
PURPLE	0	0.0	1	10.0		
MH (P_0)	28.286 (0.040)		14.810 (0.186)			

χ2: Chi square test MC: Monte Carlo MH: Marginal Homogeneity Test

p: p value for comparing between the studied groups

p0: p value for comparing between before and after follow up

Table 3. Comparison of the two groups under study based on pigmentation

PIGMENTATION	NANOFAT (N=10)		PRP (N=10)		X^2	^{MC}p
	No.	%	No.	%		
BEFORE						
NORMAL	2	20.0	1	10.0	0.410	0.814
HYPER	6	60.0	7	70.0		
HYPO	2	20.0	2	20.0		
AFTER FOLLOW UP						
NORMAL	8	80.0	4	40.0	5.333	0.069
HYPER	0	0.0	4	40.0		
HYPO	2	20.0	2	20.0		
MH (P_0)	9.6 (0.008)		2.618 (0.270)			

Table 4. Comparison of the two groups under study based on height

HEIGHT	NANOFAT (N=10)	PRP (N=10)	U	P
BEFORE				
MIN – MAX	2.0 – 3.0	2.0 – 2.50	34.50	0.247
MEAN ± SD	2.25 ± 0.35	2.05 ± 0.16		
MEDIAN (IQR)	2.0 (2.0 – 2.50)	2.0 (2.0 – 2.0)		
AFTER FOLLOW UP				
MIN – MAX	0.0 – 2.0	0.0 – 2.0	39.0	0.436
MEAN ± SD	1.20 ± 1.03	1.80 ± 1.08		
MEDIAN (IQR)	2.0 (0.0 – 2.0)	2.0 (0.0 – 2.0)		
Z (P_0)	2.401* (0.016*)	0.556 (0.579)		

IQR: Inter quartile range SD: Standard deviation

U: Mann Whitney test Z: Wilcoxon signed ranks test

As regard pliability no statistically significant difference between pretreatment and after 6month of follow up in both groups (p0>0.05),Also no statistically significant difference between both groups as p value is more than 0.05 as shown in Table 5.

Table 5. Comparison of the two groups under study based on pliability

PLIABILITY	NANOFAT (N=10)		PRP (N=10)		X^2	^{MC}p
	No.	%	No.	%		
BEFORE						
NORMAL	0	0.0	0	0.0	2.318	0.740
SUPPLE	1	10.0	1	10.0		
FIRM	5	50.0	7	70.0		
ROBE	2	20.0	2	20.0		
YIELDING	2	20.0	0	0.0		
AFTER FOLLOW UP					2.265	0.599
NORMAL	2	20.0	2	20.0		
SUPPLE	6	60.0	4	40.0		
FIRM	0	0.0	2	20.0		
ROBE	2	20.0	2	20.0		
YIELDING	0	0.0	0	0.0		
MH (P_0)	19.500 (0.101)		16.500 (0.275)			

(p. value less than 0.05).

As regarding the total VSS for all cases under both groups, there were statistically significant improvement in nanofat group as compared to PRP group as shown in Table 6.

Table 6. Comparison of the two research groups based on the VSS overall score (p. value less than 0.05).

		Nano fat	PRP	Test value	P-value	Sig.
		No. = 10	No. = 10			
Before	Min - Max	5 – 9	5 – 10	1.015	0.310	NS
	Mean ±SD	8.10 ± 1.29	8.40 ± 1.65			
	Median (IQR)	8.5 (8 – 9)	9 (8 – 9)			
After 3 months	Min - Max	0 – 7	3 – 8	2.270	0.023	S
	Mean ±SD	3.10 ± 2.18	5.20 ± 1.32			
	Median (IQR)	3 (1 –4)	5 (5 – 6)			
After follow up (6 months)	Min - Max	0 – 6	2 – 8	2.340	0.019	S
	Mean ±SD	2.50 ± 1.96	4.80 ± 1.81			
	Median (IQR)	2 (1 – 4)	5 (4 – 6)			

IQR: Inter quartile range, SD: Standard deviation, t: Student t–test

p: p value for comparing between the studied groups

Regarding patient satisfaction questionnaire, there was statistically significant difference in the total score of nanofat compared to PR group as shown in Table 7.

Table 7. Comparison of the two research groups based on the satisfaction questionnaire.

Satisfaction score		Nano fat	PRP	χ^2	P-value	Sig.
		No. = 10	No. = 10			
Colour	Not satisfied	2 (20.0%)	5 (50.0%)	1.978	0.160	NS
	Satisfied	8 (80.0%)	5 (50.0%)			
Texture	Not satisfied	2 (20.0%)	5 (50.0%)	1.978	0.160	NS
	Satisfied	8 (80.0%)	5 (50.0%)			
Countour	Not satisfied	0 (0.0%)	5 (50.0%)	6.667	0.010	S
	Satisfied	10 (100.0%)	5 (50.0%)			
Scar apperance	Not satisfied	1 (10.0%)	4 (40.0%)	2.400	0.121	NS
	Satisfied	9 (90.0%)	6 (60.0%)			
Pain	Not satisfied	0 (0.0%)	2 (20.0%)	2.222	0.136	NS
	Satisfied	10 (100.0%)	8 (80.0%)			
Total score	Min - Max	2 – 5	0 – 5	2.395^{U}	0.017	S
	Mean±SD	4.50 ± 1.08	2.90 ± 1.73			
	Median (IQR)	5 (5 - 5)	3 (1 - 4)			

The results after nanofat and PRP treatment are presented in Figures (1,2,3,4,5)

Figure 1. Male patient 36 years old before and after 6 months following 3 sessions of nanofat injection.

Figure 2. The result of nanofat sessions done to the same patient (A)after first session (B)after second session (C)after third session.

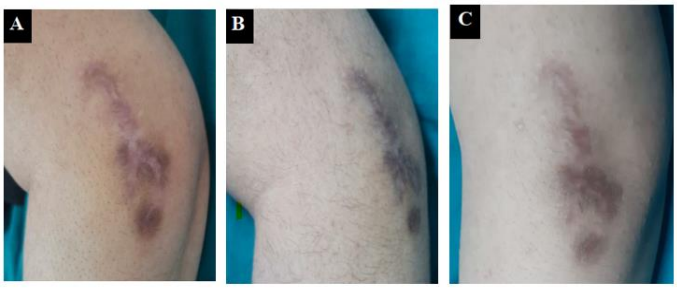

Figure 3. The result of nanofat injection (A)after first session (B)after second sessions (C)after third session

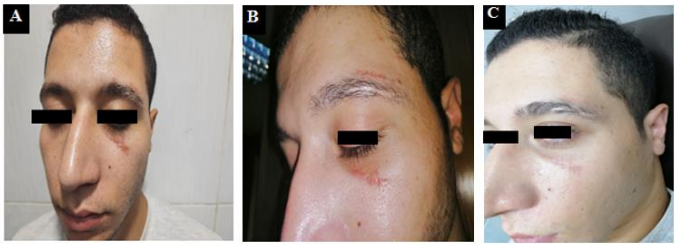

Figure 4. Male patient 22 years old before, after 6 sessions of PRP injection, (A)Before (B)After 6 sessions (C) After 6 months of follow up.

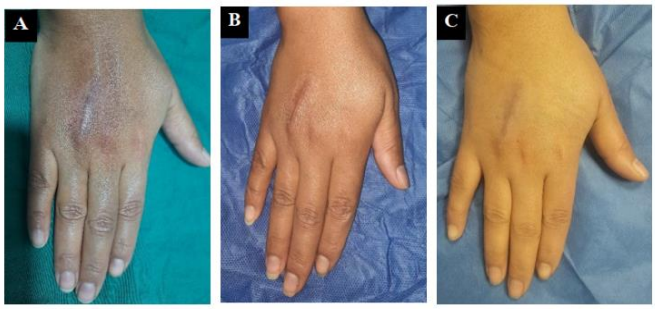

Figure 5. Female patient 39 years old before, after 6 sessions of PRP injection, (A) Before (B) After 6 sessions (C) After 6 months of follow up.

4. Discussion

Scars are composed of fibrous tissue that grows in place of healthy tissue after wounds, injuries, and certain illnesses. Although scars are generally benign, they can result in significant issues with appearance, functionality, and social interaction.[6]

The discovery of multipotent stem cells in the stromal vascular fraction (SVF) of adipose tissue by Zuk et al.,[7] added a significant advancement in the field of fat grafting. The phrase "Nanofat grafting" originated with Tonnard et al.[8] Their research on Nanofat grafting has demonstrated that the Nanofat sample contains a sufficient amount of ADSCs with the capacity to regenerate tissue, despite the fact that emulsified fat, or Nanofat, lacks functional adipocytes. The filling ability of Nanofat is obviously highly limited due to the decreased amount of viable adipocytes in the emulsified fat.[9]

Adipose-derived stem cells (ADSCs) exhibit anti-

apoptotic, anti-inflammatory, proangiogenic, immune-modulatory, and anti-scarring characteristics in addition to their unusual and remarkable propensity for developing into the tissues into which they are injected. Thus, nano fat is unavoidably valuable in regenerative and rejuvenating treatments, such as scar rejuvenation.[10]

Furthermore, growth factors such as insulin-like growth factor 1, vascular endothelial factor, basic fibroblast growth factor, and platelet-derived growth factor are present in the SVF of adipose tissue. As such, ADSCs could also be potential key players in scar rejuvenation. After the t-SVF is further processed using an enzyme that breaks down the matrix, the cellular SVF is produced. This is a combination of growth factors and pluripotent cells that lack the connective tissue matrix.[11]

Klinger et al.,[12] confirmed that the treated areas return to normal skin characteristics and are clinically assessable, yielding both functional and aesthetic outcomes. In the current study, there is improvement in the scar quality, but still, the scar doesn't return to normal skin characters.

The effectiveness of AFG in treating scars was evaluated in a systematic study conducted by Riyat et al.[13] 1158 patients had assessments completed on their color, thickness, volume, and regained functions following therapy.

Additionally, the results of the current study matches with Gu et al.,[14] and Jan et al.,[9] Using nanofat for post-burn and atrophic face scars resulted in a considerable reduction in scar pigmentation. Nanofat blocks the tyrosinase enzyme and the formation of melanin, scars may seem whiter.

Rageh et al.,[15] showed a statistically significant difference in height, Pigmentation, and the overall VSS score demonstrated a high statistically significant difference before and after nanofat treatment. In the current study, there is a statistically significant difference in vascularity, height, and pigmentation (Tables 2, 3, and 4). The total score of VSS showed statistically significant differences between pretreatment and after six months of nano fat treatment, as shown in Table 6.

Platelet-rich plasma (PRP) is a concentrated plasma volume produced from autologous blood that is enhanced with platelets, growth factors, and chemo/cytokines. PRP has drawn a lot of interest when it comes to tissue regeneration and repair since the 1970s.[5]

Many researchers have shown very good results of PRP injection in traumatic scar treatment, whether it was used alone or combined with further scar therapy techniques. PRP's beneficial effects on scar modulation rely on the fact that it has the ability to penetrate the target area and inject a high concentration of growth factors, which will promote cell division and proliferation toward tissue regeneration.[16]

Alassaf et al.,[17] have out research on fifty-five atrophic scar patients of different etiologies. Injections of platelet-rich plasma, either with or without subcision, were used to treat each patient. Patients received at least monthly follow-up. Before and after treatment, the patient and two fixed observers—a dermatological nurse and a professional in the field—evaluated the results using a score ranging from 1 to 10. More than 25% (excellent) scar improvement was seen in all cases. Eight patients (15%) showed improvement of at least 75% (good). 37 patients (67%) showed improvement of 50% to 75% (very good). Ten patients (18%) showed improvement of 25% to 50% (good). Every patient experienced a minimum of 25% improvement. These results are higher than the results of the present study in which 50% of cases treated by PRP were unsatisfied, as shown in Table 7. At the same time, there is no statistically significant difference between the pretreatment and 6-month follow-up after six sessions of PRP injections (table 2,3,4) p. value of more than 0.05.

We conducted a prospective interventional, randomized clinical study done on 20 patients with recent post-traumatic scars. The study was carried out at the Department of Plastic Surgery at Al-Zahraa University Hospital. Cases under the study are classified into two groups: The first group consists of ten patients treated with monthly nanofat injections for three months. The second group includes 10 patients treated with platelet-rich plasma injections every two weeks for six months.

This study's findings demonstrate that there is no discernible difference between PRP and Nanofat as regard site, type and duration of the scar, but there is a significant improvement in a scar located in the relaxed skin tension lines in both groups more than scar against, and this agrees with the study of Sakria[18] who stated that the scars running with Langer lines have better cosmetic outlook than scars crossing Langer lines.

On the same time, the results of the present study showed that there is no statistically significant difference between the site of the scar on the face and the rate of scar improvement. These results are correlated with the results of Shalaby et al.,[19] whom concluded that there was no correlation between the site of the scar in the face and the improvement of scar quality.

According to the total VSS the present study showed that there is a statistically significant difference between nanofat and PRP as regard vascularity, height and Pigmentation. There is

higher improvement in nanofat group than PRP group.

While regarding pliability there is no statistically significant difference between both groups. but there is much improvement in nanofat group after treatment and follow up more than PRP group (table 5).

4. Conclusion

Nanofat and platelet rich plasma (PRP) are reliable tools in dealing with recent post traumatic scars. Patients treated with naonfat injection showed much improvement regarding scar height, Pigmentation and vascularity as compared to PRP treated patients. Scar pliability improved equally in both groups with no statistically significant difference.

Disclosure

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Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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