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ORIGINAL ARTICLE

Role of Nanofat Injection Before Hair Transplant in Cicatricial Alopecia

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ABSTRACT

Background: One of the most successful treatments for secondary cicatricial alopecia worldwide is hair transplantation, which restores irreversible hair loss and profoundly changes the patient's life. This study aimed to evaluate the role of nanofat injection before hair transplant and in Improving the survival rate of hair grafts after transplantation with follicular unit extraction technique in restoration of hair in secondary cicatricial alopecia.

Methods: Prospective case series study was conducted on 18 patients with cicatricial alopecia in the scalp, beard or moustache. Nano Fat applied first and then waited for 2 weeks after the FUT was done. Fat was harvested from abdomen and transformed into nano fat then injected at the scar. Follow-up for 6 months using trichoscope to visualize the number of hair grafts in one cubic centimeter.

Results: The median number of hair follicles among our studied cases 525(325–962.5) with range (70-1600), the mean transplanted area/cm² was 30 (±17.72SD) with range (5-60), the mean inserted grafts/cm² was 19.47 (±4.41SD) with range (11-24) and the mean survived grafts/cm² was 16.22(±4.29SD) with range (8-24). According to donor area after 3 days all our patients were completely healed, after 10 days there were 1(5.6%) with folliculitis all over donor area symptoms come and go (irregular), 1(5.6%) with severely inflamed, 2(11.1%) with slightly inflamed, 1(5.6%) with blood steal phenomena (Blood steal phenomena occur in vascular malformations) and 13(72.2%) with hair starts to get taller and hide the site of punch and after 6 months all patients were totally normal and no abnormality detected.

Conclusion: The nanofat is rich in stem cells so it will promote the quality of the skin and its blood supply.

Keywords: Cicatricial alopecia; Nanofat Injection; follicular unit extraction

INTRODUCTION

Cicatricial alopecia is a number of disorders that lead to permanent hair follicles destruction with replacing it by scar tissue. There are two types of cicatricial alopecia, rare primary alopecia is due to multiple types of inflammatory conditions of unknown origin, commonest secondary alopecia mainly due to external factors like:

Road Traffic Accidents, Burn, Radiation, and may include infections [1].

One of the most effective ways for treatment of secondary cicatricial alopecia worldwide is hair transplant, for restoration of permanent loss of hair, which will change the patient's life dramatically. The best technique in hair transplant is follicular unit extraction that was first introduced by Rassman & Bernstein, 2002. The advantages in Follicular Unit Extraction rather than other techniques are

leaving no scars at donor area with rapid recovery [2].

The challenging part of hair transplant in secondary cicatricial alopecia is diminished vascularity and sever fibrosis that decrease the chance of graft survival. The scar has to be mature enough before transplant that requires a time frame of 6 months at least, to be sure that scar is stationary and permanent hair loss is confirmed in this area [3].

Autologous fat grafting has become popular in tissue reconstruction and augmentation over the last decades, Its regenerative properties and beneficial effects with respect to skin texture have been observed in several studies. Furthermore, Nanofat injection was mentioned as a useful way for scar maturation and improvement due to its small size and the fact that it contains stem cells [4].

Hyperpigmentation, skin texture, and scar quality may equally play an important role in determining a suitable treatment and resulting outcome. The use of nanofat in improving hair follicle survival after hair transplantation was mentioned by **Barr and Barrera [4]**. They have noted that the use of fat grafting before the placement of hair follicles assists in proper placement and optimal growth of the grafts in this attenuated tissue [4].

Autologous hair transplantation or tissue expansion are exquisite methods for achieving feasible reconstruction of the scalp in the cicatricial alopecia. Meticulous attention to every step starting from patient selection ending by careful follow-up is necessary to reduce the incidence of complications and improve the outcome. For that, the choice of management plans for such patients needs special consideration to the cause, age, site of alopecia, area of alopecia and also to the socioeconomic status of the patient as the use of tissue expander is of higher cost. Also, combination of both procedures in the same case would give higher results. Both hair transplantation and skin expansion are very useful in the field of cicatricial alopecia treatment, while hair transplantation has less hazards during anesthesia, less post-operative scars and less recovery time, skin expansion

is a good solution for bigger problems like big area of alopecia or younger patients [5].

Aim of the work:

This study aimed to evaluate the role of nanofat injection before hair transplant and in Improving the survival rate of hair grafts after transplantation with follicular unit extraction technique in restoration of hair in secondary cicatricial alopecia.

METHODS

This prospective case series study was carried out at Zagazig University Hospital's Plastic & Reconstructive Surgery Department, Faculty of Medicine, for 6 months from April 2024 to October 2024. 18 patients with cicatricial alopecia in the scalp, beard, or mustache. Approval was taken from the research ethical committee and the institutional review board (IRB# 10350) of Zagazig University's Faculty of Medicine. Every patient gave their consent to take part in the trial. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

The inclusion criteria were patients medically free without any chronic diseases, 6 months after the trauma and range 18- 60 years old. The exclusion criteria were cases of patients refusing the technique, patients refusing consent, and the American Society of Anesthesiologists physical status classification grade III and IV.

All patients were subjected to full history taking, clinical examination either general for any associated diseases or local examination to see the scar diameters and the number of hair grafts to fulfill the scar. standard laboratory tests, such as complete blood counts (CBCs), coagulation profile, liver and kidney function. Fat was harvested from abdomen and transformed into nano fat then injected at the scar. Potential donor locations were found to be the thighs and lower abdomen.

Nano Fat applied first and then waited for 2 weeks after the FUT was done.

Nanofat process

The emulsified fat is passed through the nano transfer block one time, which contains a double filter of 0.50 mm and 0.30 mm single use cartridge net and into a 20-cc syringe. This nanofat is transferred into 1 cc Luer Lock syringes for injection

Follicular Unit Transplant (FUT)

A scalp is removed from the occipital donor region, reaching the temporal regions, and the FUs are separated under the microscope. In the Follicular Unit Extraction (FUE) method, FUs are taken individually from the entire safe donor area where there is no risk of miniaturization. Punch diameters ranging from 0.8 mm to 1.0 mm are used in most cases. These microincisions heal by secondary intention, with no need for sutures.

Donor area for FUT

The lower abdomen and thighs were identified as potential donor sites.

Surgical technique

(500 ml of 0.9% saline solution, 1/2 ampoule of adrenaline 1 mg /ml, and 10-25 ml of lidocaine hydrochloride 2%, 10mEq/L NAHCO₃) is infiltrated through a 2mm incision made with a number 11 blade in the donor area. Using a 20-mL Luer Lock syringe and a 2.5mm-15cm harvesting cannula, we manually harvested 120 cc of mixed fat with tumescent solution from subcutaneous fat.

The harvest syringe is placed vertically to decant for 3-5 minutes, allowing the layers to separate. The yellow adipose grafts quickly separate from the underlying infranatant fluid within the syringe based on their density, resulting in the grafts floating in the middle, with the lipid layer on top. We can expect a yield of 1.5 mL of fat graft for every 5 mL of aspirate, and we get about 40 cc of micro fat. To reduce post-operative bruising, the donor area was covered with a sterile dressing with compression. The top layer of liquid is removed. The oil layer above the harvested graft should not be aspirated into the syringe for micro fat preparation because it can cause oil cysts. A single wash with Ringer's lactate solution should be sufficient to eliminate any remaining local anesthetic solution and red blood cells.

The cleaned micro fat is loaded into 20cc syringes and mechanically emulsified by shifting the contents back and forth 30 times between two 20cc syringes connected by a 2.5mm connector, then 30 times with a 1.5mm connector, and finally 30 times with a 1.0mm connector, until the fat is liquefied and obtains a whitish appearance.

Nanofat process

A 20-cc syringe is filled with the emulsified fat after it has been once through the nano transfer block, which has a double filter of 0.50 mm and 0.30 mm single use cartridge net. This nanofat is put into injection-ready 1cc Luer Lock syringes. (fig 1A).

Nanofat injection

Betadine is used to prepare the skin, and then nanofat is injected intradermally (0.05–0.1 cc per injection site). When the injection is finished, a yellowish discoloration appears over the injection site.

Cut the hair of the occipital area of scalp to the length of 1 mm length on the day of operation. The patient lies in a prone position on the operating table. Using a solution of xylocaine 30ml with the addition of 100 ml of normal saline with adrenaline (1:1000) for donor and recipient block. The posterior occipital nerve is blocked by injecting the posterior hair line. The supraorbital and supra-trochlear nerves are blocked by injecting 3 cm on each side into the supraorbital notch. The zygomatico-temporal nerve is blocked by injecting the hairline in the temporal region. Punches with a diameter of 0.85 mm were used to harvest follicular units. During the process, hair follicle transplants are stored in cold saline on gauze.

The recipient sites are created in the recipient area using a needle holder and sapphire stones that are about 1.4 mm wide. employing implantation forceps to insert the transplant. Because of the inadequate blood supply, the recipient sites' graft densities shouldn't be more than 15-20 graft/cm² (Fig.1B).

Postoperative care

Following an autologous fat injection, all patients received analgesics, anti-edematous medications, and antibiotics for seven days. The donor location was bandaged upon

transplantation. The patient was instructed to abstain from solid food for five days in order to prevent excessive muscle tightness. The donor area was shampooed 24 hours after surgery, and the transplanted area was cleansed using regular saline at this time. For three more days, the patient was instructed to continue cleaning the transplanted area with saline. The patient was instructed to wash both areas till the crusts totally disappeared after the three days.

2-4 days after surgery, the closed dressing was taken off. The average operating time for the post-traumatic or post-burn scar was between two and four hours. After 30 days following transplantation, shaving was permitted in order to prevent any harm or recurrent infection.

Follow up

Follow-up at outpatient clinic after 3 days from hair transplant to remove dressing over the donor area (Fig.1C), then after 10 days to remove crust over transplanted area and wash hair, after that follow-up at outpatient clinic every month for 6 months using trichoscope

Table 1. The most common injury site was scalp in 16 (88.9%) cases, according to cause of injury there were 8 (44.4%) burn, 5 (27.8%) RTA and 5 (27.8%) trauma and the mean duration since injury was 2.58 (± 1.06 SD) with range (1-5) as shown in Table 1.

The mean duration of operation of the studied cases was 155.83 (± 76.51 SD) with range (45-300) and the mean amount of nanofat was 14.44 (± 10.83 SD) with range (5-40) as shown in Table 2.

The median number of hair follicles among the studied cases 525 (325 – 962.5) with range (70-1600), the mean transplanted area was 30 (± 17.72 SD) with range (5-60), the mean inserted grafts was 19.47 (± 4.41 SD) with range (11-24) and the mean survived grafts was 16.22 (± 4.29 SD) with range (8-24) as shown in Table 4.

According to donor area after 3 days all patients were completely healed, after 10 days there were 1 (5.6%) with folliculitis all over the donor area come and go, 1 (5.6%) with severely inflamed, 2 (11.1%) with slightly

to visualize the number of hair grafts in one cubic centimeter.

Statistical analysis

IBM SPSS software package version 20.0 was used to examine the data that was fed into the computer. (IBM Corp., Armonk, NY) Numbers and percentages were used to describe the qualitative data. The normality of the distribution was confirmed using the Kolmogorov-Smirnov test. Range (minimum and maximum), mean, standard deviation, median, and interquartile range (IQR) were used to characterize quantitative data. At the 5% level, the results' significance was assessed.

RESULTS

We had 22 patients in our study, but 4 of them were removed (3 didn't fit our inclusion criteria, and 1 refused to participate), leaving us with 18 cases. The examined cases ranged in age from 18 to 30, with a mean age of 23.22 (± 3.87 SD). Of these, six (33.3%) female and 12 (66.7%) male as shown in is the result after 6 months

inflamed, 1 (5.6%) with steal phenomena and 13 (72.2%) with hair starts to get taller and hide the site of punch and after 6 months all patients were totally normal and no abnormality detected as shown in

Table 5.

According to donor area after 3 days all patients were with some blood clots over the hair, after 10 days there was 1 (5.6%) with an ischemic patch formed at the scalp, 1 (5.6%) with slightly inflamed and 16 (88.9%) started washing the hair and after 6 months there were 1 (5.6%) with scalp slightly inflamed but the hair density is good, 1 (5.6%) with some grafts didn't survive with weak density, 1 (5.6%) with hair density is very good but need some time to grow, 11 (61.1%) with hair started to grow and the scar disappeared, 1 (5.6%) with inflammation at the scalp still exists with some itching, 2 (11.1%) with some sort of delay but most of the hair started to grow and 1 (5.6%) with total loss of hair grafts at the ischemic part but the scalp healed very well with no skin loss as shown in

According to donor area after 3 days all patients were completely healed, after 10 days there were 1 (5.6%) with folliculitis all over the donor area come and go, 1 (5.6%) with severely inflamed, 2 (11.1%) with slightly inflamed, 1 (5.6%) with steal phenomena and 13 (72.2%) with hair starts to get taller and hide the site of punch and after 6 months all patients were totally normal and no abnormality detected as shown in

Table 5.

6.

Case Presentation

Case 1; Male patient 19 years old suffered from RTA 3 years ago, nano fat was injected and FUE was done 2 weeks after, it took 250 grafts, and this is the result after 6 months

Table 1: Distribution of the studied cases according to demographic data

	Subjects (n = 18)	
Age in years		
• Range.	18 – 30	
• Mean \pm SD.	23.22 \pm 3.87	
Sex	No.	%
• Female	6	33.3
• Male	12	66.7
History data		
• Beard	1	5.6
• Moustache	1	5.6
• Scalp	16	88.9
Cause of injury		
• Burn	8	44.4
• RTA	5	27.8
• Trauma	5	27.8
Duration since injury		
• Range. in years	1 – 5	
• Mean \pm SD.	2.58 \pm 1.06	

Data are presented as frequency (%) unless otherwise mentioned, SD: Standard deviation

Table 2: Distribution of the studied cases according to operation data:

	Subjects (n = 18)
Duration of operation (mins)	
• Range.	45 – 300
• Mean \pm SD.	155.83 \pm 76.51
Amount of nanofat	
• Range.	5 – 40
• Mean \pm SD.	14.44 \pm 10.83

Data are presented as frequency (%) unless otherwise mentioned, SD: Standard deviation

Table 4: Distribution of the studied cases according to transplant data:

	Subjects (n = 18)
No. Hair follicles	
• Range.	70 – 1600
Mean	525 (325 – 962.5)
Transplanted area/ cm2	
• Range.	5 – 60

Mean \pm SD.	30 \pm 17.72
Inserted grafts/ cm2	
• Range.	11 – 27
• Mean \pm SD.	19.47 \pm 4.41
Survived grafts/ cm2	
Range.	8 – 24
• Mean \pm SD.	16.22 \pm 4.29

Data are presented as frequency (%) unless otherwise mentioned, SD: Standard deviation, IQR: interquartile range

Table 5: Distribution of the sequences of studied cases according to donor area data:

	Subjects (n = 18)	
After 3 days	No.	%
• Complete healing	18	100.0
After 10 days		
• Folliculitis all over donor area come and go	1	5.6
• Severely inflamed	1	5.6
• Slightly inflamed	2	11.1
• Steal phenomena at donor area	1	5.6
• The hair starts to get taller and hide the site of punch	13	72.2
After 6 months		
• Totally normal no abnormality detected	18	100.0

Data are presented as frequency (%) unless otherwise mentioned

Table 6: Distribution of the sequences of studied cases according to recipient area data:

	Subjects (n = 18)	
After 3 days	No.	%
• Some blood clots over the hair	18	100.0
After 10 days		
• Ischemic patch formed at the scalp	1	5.6
• Slightly inflamed	1	5.6
• Start washing the hair	16	88.9
After 6 months		
• Scalp slightly inflamed but the hair density is good	1	5.6
• Some grafts didn't survive with weak density	1	5.6
• The hair density is very good but need some time to grow	1	5.6
• The hair started to grow and the scar disappeared	11	61.1
• The inflammation at the scalp still exists with some itching	1	5.6
• There was some sort of delay but most of the hair started to grow	2	11.1
• Total loss of hair grafts at the ischemic part but the scalp healed very well with no skin loss	1	5.6

Data are presented as frequency (%) unless otherwise mentioned


1A
Fig. 1A: Nanofat injection at scar.

1B
Fig. 1B: Donor area and transplanted area the day of operation.

1C
Fig. 1C: Donor area after 3 days.

DISCUSSION

Regarding the demographic and clinical data in our study, the average age of the cases under study was 23.22 (± 3.87 SD) the most common injury site was scalp in 16 (88.9%) cases. According to cause of injury, there were 8 (44.4%) burns, 5 (27.8%) RTA and 5 (27.8%) trauma and the mean duration since injury was 2.58 (± 1.06 SD) with range (1-5). The mean duration of operation of the studied cases was 155.83 (± 76.51 SD) and the mean amount of nanofat was 14.44 (± 10.83 SD).

Contrary to our results and in a similar study by Saad et al., the mean age of the studied cases was 29.1 \pm 6.37. However, in agreement with us, the most common injury site was scalp. According to cause of injury, there were 11 (55%) cut wound, 9 (45%) burn and the mean duration since injury was 6.3 \pm 2.21) [6].

However, Saeed et al. found that four (20%) of the cases they reviewed were female, and sixteen (80%) were male. 18.85 (± 2.94 SD) was the average age. Nine (45%) of the cases under study had trauma scars, one (5%) had surgery scars, two (10%) had post-expander injuries, and eight (40%) had burn injuries. Of the cases they examined, the average time from injury was 11.45 (± 6 SD), with a range of 2–20 [7].

Furthermore, a study conducted by Shao et al. on 37 patients with secondary CA during a 5-year period, with a mean age of 24.68 \pm 5.88, produced results that were inconsistent with our findings [8].

The mean transplanted area was 30 (± 17.72 SD), the mean inserted grafts were 19.47 (± 4.41 SD) with range (11-24), the mean survived grafts were 16.22 (± 4.29 SD), and the median number of hair follicles among our examined patients was 525 (325 – 962.5) with range (70-1600).

After three days, all of our patients were fully recovered, but after ten days, one patient (5.6%) had folliculitis that spread throughout the donor area and came and went, one patient (5.6%) had severe inflammation, two patients (11.1%) had mild inflammation, one patient (5.6%) had steal phenomena, and thirteen patients (72.2%) had hair that began to grow taller and cover the punch site. After six months, all of our patients were completely normal, and no abnormalities were found.

According to the donor area, all of our patients had some blood clots on their hair after three days. After ten days, one patient (5.6%) had an ischemic patch form on their scalp, one patient (5.6%) had a slightly inflamed scalp, and sixteen patients (88.9%)

began washing their hair. After six months, one patient (5.6%) had a slightly inflamed scalp but good hair density, one patient (5.6%) had some grafts that didn't survive with weak density, and one patient (5.6%) had excellent hair density but needed time to grow. Two (11.1%) had some delays, but the majority of the hair began to grow, one (5.6%) had complete loss of hair grafts at the ischemic part, but the scalp healed very well with no skin loss, and eleven (61.1%) had hair that began to grow, and the scar vanished.

Saad et al. revealed that the success rate was over 90% and that the average number of hair grafts transplanted on each side was 223 (range: 178–357) [6].

According to us, 62 patients in all, with an average age of 26.3 years, took part in the Oh et al. trial (41 men and 21 women). The burn on the scalp lasted for three years [9].

Additionally, in a study of 25 scar tissue transplant patients, Jung et al. found that the majority of graft harvesting came from the posterior auricular and occipital regions. One person (5.6%) had intermittent folliculitis across the donor area, while another person (5.6%) had extremely inflammatory [10].

Furthermore, Ghazal et al. conducted a study consisted of 30 patients, used the occipital scalp as a donor area for most cases where accessibility with less transection rate were noticed, while temporal and thin supra-auricular hair were used for a lesser extent to mimic the natural appearance of areas with normally thinner hair growth [11].

In the Saad et al. trial, there was no statistically significant difference between groups A and B in terms of the quantity of hair grafts (transplanted and stayed after 6 months). Furthermore, the study's groups A and B did not differ statistically significantly in their global photography [6].

Contrary to our findings, Tesauro et al. noticed that early hair regrowth began between the second and third month after hair transplantation in scarring alopecia. It's rare to see the procedure's first outcomes after 4 months [12].

Yoo et al.'s study found that the average survival rate for follicular unit extraction hair transplanting was 80.67 percent (range: 70-90 percent) [13].

However, Kuka et al. found that when all patients were evaluated at 24 weeks, there were no statistical differences in terminal hair count or width. In the Norwood Hamilton 3 subgroup, there were increases (mean change from baseline) in terminal hair count for the low-dose adipose-derived regenerative cells group at weeks 6 (13.90 16.68), week 12 (11.75 19.42), week 24 (16.56 14.68), and week 52 (2.78 16.15). The difference in hair count between the low-dose adipose-derived regenerative cell group and the no-fat saline control group at week 24 was statistically significant ($P = 0.0318$) in this subgroup [14]. To assess the outcomes, Zeltzer et al. also conducted patient photographs and physical examinations. Our investigation was backed by the positive outcomes of sharp needle. Intradermal fat grafting took longer than expected for resorbable dermal fillers, lasting more than a year (3 to 6 months) [15].

However, 30 patients with secondary cicatricial alopecia were the subjects of a study by Ghazal et al. Ten patients each were split into three groups. PRP and hair transplantation were given to group A, nanofat injections and hair transplantation were given to group B, and hair transplantation alone was performed on patients in group C (control group). After the follow-up period, they found that group A's mean hair growth was $83.76 \pm 7.06\%$, group B's was 84.73 ± 8.4 , and group C's was 83.70 ± 3.29 [11].

The groups in the Saad et al. experiment did not differ statistically significantly in terms of satisfaction, complications, or the quartile grading scale, but they did differ statistically significantly in terms of improvement [6].

According to Tesauro et al., repeat hair transplant surgeries may be unnecessary if scar tissue that has received therapy is transplanted with greater density. These methods give the patient positive post-operative outcomes and reduce post-operative complications [12].

Zeltzer et al. discovered sharp needle intradermal fat grafting to be a safe and alternative to resorbable dermal fillers for patients who can accept the little discomfort of fat harvesting from the donor area. There were no significant postoperative complications; bruising and edema were the most common mild effects [15].

Yoo et al. demonstrated a considerable increase in postoperative patient and observer satisfaction [12]. Additionally, Ghazal et al. found no discernible variation in patient satisfaction across all groups [11].

Furthermore, Saeed et al. showed that, on average, no patient assigns great results; 12 cases (60%), decent results (30%), and bad results (10%) indicated very good results [7]. Similarly, Shao et al. reported that 30 patients had 100% patient satisfaction, five patients had 90% to 100% satisfaction, and two patients had less than 90% satisfaction [8].

Nassih et al. found that the skin expansion technique is a reliable and efficient treatment for cicatricial alopecia of the scalp, which is in contradiction to our findings. When the area of alopecia exceeds 50 cm², the only surgical option is skin expansion [16].

CONCLUSION

Because the nanofat contains a lot of stem cells, it will improve the skin's blood flow and quality. The results of hair transplantation combined with nanofat injections are superior to those of hair transplantation without any local injection. In light of the new guidelines for the therapy of CA, we advise taking into account hair transplantation with nanofat injection beforehand as a unique approach to improve results. Additionally, more research is needed to examine every facet of this problem.

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Citation

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