TÜBİTAK

Turkish Journal of Medical Sciences

http://journals.tubitak.gov.tr/medical/

Research Article

Turk J Med Sci
(2018) 48: 592-601
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doi:10.3906/sag-1711-42

Fat grafting to the face with adjunctive microneedling: a simple technique with high patient satisfaction

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Received: 06.11.2017 • **Accepted/Published Online:** 04.04.2018 • **Final Version:** 14.06.2018

Background/aim: Even though new techniques are emerging to overcome the inconsistent long-term viability of fat grafts, current methods for increasing fat graft survival are not routinely adaptable to all clinical environments. The purpose of this study was to determine the efficacy of microneedling as an adjunct to fat grafting to the face.

Materials and methods: Twenty-two patients that underwent fat grafting to the face with adjunctive microneedling were evaluated in terms of improvement in facial skin quality and facial volume and their results were compared to those in 18 patients that underwent fat grafting without microneedling. The evaluation was conducted with a modification of the Global Aesthetic Improvement Scale at the postoperative third month.

Results: All patients that underwent fat grafting and microneedling demonstrated "much improvement" in skin quality and volume at the postoperative third month while "improvement" was noted in patients that underwent fat grafting alone. The difference between skin quality and volume improvement scores was found to be significantly in favor of the patients that received adjunctive microneedling.

Conclusion: Fat grafting to the face with adjunctive microneedling is a practical and potentially mutual-acting technique that can be used both for its significant effect on increasing fat graft survival and improving skin quality.

Key words: Dermaroller, fat graft, fat graft survival, microneedling, percutaneous collagen induction, skin quality

1. Introduction

The popularity of autologous fat grafting for facial rejuvenation is a growing trend in the field plastic surgery as for the first time in 2015 fat grafting to the face entered the list of top surgical procedures as the 9th most common cosmetic surgery in the United States (1). This can be attributed to the characteristics of fat tissue that deem it as close to an ideal soft tissue filler as possible. Its abundant availability, nontoxic and nonallergic nature, low cost, and safety as well as its unique consistency that is harmonious to the natural texture of facial skin make it very popular for both aesthetic and reconstructive facial recontouring procedures (2–4). Fat tissue is also considered one of the most abundant reservoirs for mesenchymal-derived regenerative cells and has been widely used to increase the quality of the skin, which again makes it very popular for patients who seek facial rejuvenation and increased skin quality (5–7). Despite such beneficial factors, the main disadvantage of utilizing fat grafts is the inconsistency that is faced regarding their long-term viability. This has led to a stream of literature studies that aim to increase fat graft survival through a variety of techniques that pertain to harvesting, processing, and application (8–11). The properties of the recipient site are also of main importance as the transferred fat tissue goes through the stages of graft-take and a healthy, vascular bed is mandatory for adipocyte viability prior to angiogenesis (12–15). This has been the exit point for an experimental study on rats recently conducted by the authors that demonstrates increased fat graft survival through preconditioning of the recipient site with microneedling 1 week prior to fat transfer (16). An increase in vascularity was achieved in the recipient site with microneedling, which led to a significant increase in fat graft survival at the end of 15 weeks.

Microneedling, on the other hand, has numerous favorable effects on the skin as it is used for various purposes including facial rejuvenation and improvement in scars and skin laxity (17–19). The procedure consists of rolling a cylinder-like tool equipped with microneedles of varying length over the skin and creating thousands of dermal microchannels and a controlled microtrauma environment. The technique, introduced by Fernandes, has since been widely used as a regenerative modality by triggering the skin's wound healing cascade and promoting

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collagen induction without ablating the overlying epidermis (17).

In light of the experimental data from the authors' previous study and the scientific data that promotes the beneficial effects of microneedling on skin quality, the authors conducted a comparative study to determine the efficacy of microneedling as an adjunct to facial fat grafting in both aesthetic and reconstructive indications. The technical aspects of this procedure have also been discussed in detail.

2. Materials and methods

Following the approval of the study protocol from the institutional review board, patients that underwent fat grafting to the face between January 2014 and December 2016 were recruited for this study. Informed consent was obtained from each patient.

All demographic information was thoroughly reviewed and patients with any known chronic illnesses such as diabetes mellitus and those receiving any type of treatment along with smokers and those that had undergone previous fat grafting procedures to the face were excluded from the study.

A total of 40 patients had fat grafting to the facial region during this time. Twenty-two of these patients presented to the plastic surgery department with aesthetic or reconstructive indications for facial fat grafting and were operated on with the adjunctive microneedling and fat grafting technique, while 18 of these patients underwent conventional fat grafting to the face without adjunctive microneedling. The majority of the conventional fat grafting patients underwent surgery prior to the clinical introduction of adjunctive microneedling to our department.

2.1. Fat grafting technique

Microneedling was first performed 1 week prior to fat grafting in the outpatient clinic for those patients who underwent fat grafting with adjunctive microneedling. Following 30 min of topical anesthetic cream (EMLA, Astra Pharmaceuticals, Westborough, MA, USA) application, the facial skin was prepped with an antiseptic solution and all of the face was treated with microneedling, independent of the area of anticipated fat grafting. The dermal thickness of the facial skin was taken into consideration and a microneedling device with 1.5 mm needle length (Deeproller 1.50 mm, Assos Pharmaceuticals, İstanbul, Turkey) was used for the procedure to ensure adequate full-thickness needle penetration into the dermis (Figure 1). Each area was treated in three directions (vertical, horizontal, and oblique) with care given to pass at least 20 times over each area. The treatment was considered sufficient with the visualization of pin-point bleeding spots overlying generalized erythema on the facial skin.

Figure 1. A 1.5-mm microneedling device was chosen for patients undergoing microneedling-assisted fat grafting to the face.

One week following the outpatient microneedling procedure, the patients were taken into the operating room and the microneedling technique was repeated under sterile conditions, followed by same-session fat grafting. Patients that had conventional fat grafting only underwent the same fat grafting procedure.

Fat tissue was obtained mainly from the lower abdominal region with a 3-mm round-tip harvesting cannula attached to a 10-mL syringe with the Coleman technique (2,3). Harvesting was performed with a vacuum that was created manually to ensure low-pressure aspiration. The obtained fat was centrifuged at 3000 rpm for 3 min and separated systematically from its bloody (bottom layer) and oily (top layer) counterparts. This fat was then gently distributed to smaller 2-cc syringes and injected into the desired area through blunt-tip 0.9-mm cannulas with single lateral openings. Care was taken to inject fat as tiny droplets in multiple passages with precision in the recipient area and overcorrection was generally avoided. Postsurgical care mainly consisted of 2% mupirocin ointment application to the face and oral amoxicillin-clavulanate (2 g/day) for 5 days.

Patients were followed up regularly 1 week, 1 month, and 3 months postoperatively. In order to avoid the potential misleading effect of early postoperative edema and to be able to discuss fat graft survival, the evaluation of efficacy was conducted 3 months postoperatively. Each patient and an independent surgeon scored two different variables on a scale from –1 to 3, modified from the Global Aesthetic Improvement Scale (GAIS), ranging from "worse" to "exceptionally improved" (Table 1). The two variables that were evaluated were the improvement in facial volume and the improvement in facial skin quality, which were determined through comparison of preoperative and 3-month postoperative photographs. The general appearance of the skin, fine wrinkles, pigmentation, and scarring were evaluated for determining the difference in skin quality, while the general volumetric improvement was taken into consideration for evaluating the difference

Table 1. The modified Global Aesthetic Improvement Scale for patient evaluation.

Score	Degree of improvement	Description
3	exceptionally improved	The ideal result has been achieved
2	much improved	The result is much improved but suboptimal
1	improved	The result is improved but an additional procedure is recommended
0	no difference	The result is the same when compared with the preoperative state
–1	worse	The result is worse when compared with the preoperative state

in facial volume. The mean values of the surgeon and the patient scores were calculated and a mean facial skin quality improvement and facial volume improvement score was determined for each patient.

The patients were also asked at this time by an independent observer if they would consider undergoing the same procedure in the future should they require it and the answers given were evaluated in terms of patient satisfaction regarding the ease and efficacy of the procedure.

2.2. Statistical analysis

Facial volume and skin quality improvement scores were analyzed for significance with SPSS for Windows (v. 23, SPSS, Inc, an IBM Company, Chicago, IL, USA). Mean values and standard deviation were calculated for all data and the results are expressed as mean ± standard deviation. Data analysis was conducted by intergroup comparison with the Mann–Whitney U test, a nonparametric test designed to compare independent variables.

An intergroup comparison was carried out for the patient groups that did and did not receive adjunctive microneedling, along with their respective aesthetic and reconstructive subgroups. A P value less than 0.05 was considered statistically significant.

3. Results

A total of 40 patients were included in the study, 18 of which underwent a fat grafting-only procedure to the facial region (control group) and 22 that underwent fat grafting with adjunctive microneedling (microneedle group). The mean age of the patients was 39.5 years (17–65 years). Thirty-one patients were female while nine were male. Twenty-four patients had aesthetic indications for facial fat transfer including facial rejuvenation and the correction of asymmetry, while 16 patients presented with scars as a result of trauma, burns, and other diseases such as en coup de sabre. The average amount of fat that was transferred to the face was 19.12 cc (10–35 cc). This amount was 19.91 ± 5.92 cc for the microneedle group and 18.17 ± 5.88 cc for the control group. The volume of fat transfer between the two groups was insignificant ($P > 0.05$). The average follow-up period was 13.5 months (4–27 months) (Table 2).

No complications resulting from the procedure such as infection or hematoma were encountered during the follow-up period. Some patients experienced mild bruising, which subsided by the end of postoperative week 1. Each patient only had one session of fat grafting before evaluation, although some were recommended secondary procedures after the evaluation was finalized.

Table 2. Demographic characteristics of patients.

	Microneedle group	Control group
Number of patients	22	18
Female	16	15
Male	6	3
Age	42.6 years (19–61 years)	35.7 years (17–65 years)
Surgical indication		
Aesthetic	13	11
Scar	9	7
Mean fat volume	19.91 cc (11–35 cc)	18.17 cc (10–32 cc)
Average follow-up	11.2 months (5–27 months)	16.7 months (4–36 months)

3.1. Skin quality improvement scores

The overall facial skin quality improvement (FSQI) score for the microneedle group was 2.27 ± 0.40. This translated to "much improved" skin quality within the patient population that received adjunctive microneedling.

The evaluation of the aesthetic and reconstructive subgroups within the microneedle group demonstrated a FSQI score of 2.46 ± 0.32 ("much improved") and 2 ± 0.35 ("much improved"), respectively (Figure 2). Statistical analysis demonstrated a significant difference in FSQI scores between the two subgroups of the microneedle group, in favor of the patients with aesthetic indications ($P < 0.05$).

The overall facial skin quality improvement (FSQI) score for the control group was 1.33 ± 0.59, translating to "improved" skin quality following conventional fat grafting. The score was determined to be 1.5 ± 0.6 ("improved") for the patients with aesthetic indications, while the score was 1.07 ± 0.45 ("improved") for the patients that underwent fat grafting for reconstructive purposes (Figure 3). Although the FSQI score of the control group's aesthetic subgroup was higher, no significant difference was noted between the subgroups of the control group ($P > 0.05$) (Table 3).

The improvement in facial skin quality was compared between the microneedle and control groups and the difference was found to be significant and in favor of the microneedle group ($P < 0.05$). The same significant difference was found between the FSQI scores of the aesthetic and reconstructive subgroups among both the microneedle and control groups ($P < 0.05$).

3.2. Volume improvement scores

The overall facial volume improvement (FVI) score for the study group was 2.32 ± 0.39, which again translated to "much improved" results 3 months following the procedure (Table 4). The average FVI score for the aesthetic subgroup was 2.46 ± 0.38, while this score was 2.11 ± 0.33 for the

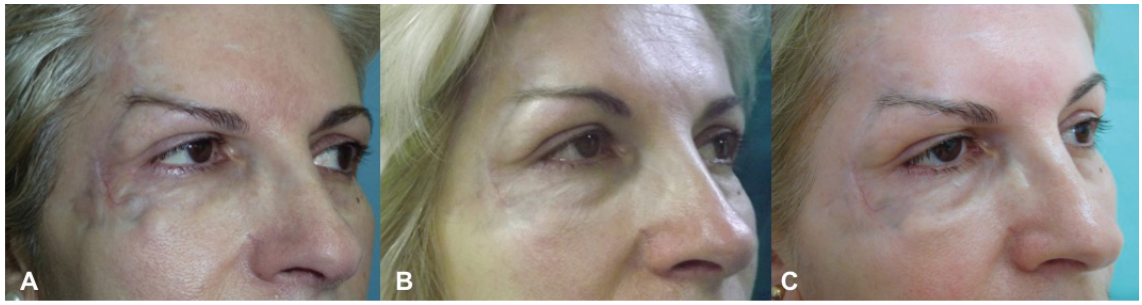

Figure 2. A 59-year-old female patient that underwent microneedling-assisted facial fat grafting for a posttraumatic scar over her right frontotemporal and lateral periorbital region; preoperative view (A). Postoperative month 3 of the same patient. A total of 22 cc of fat was injected into the patient's right frontotemporal and malar areas. Both the FSQI and FVI score of this patient was 2.5 (B). Postoperative month 27 of the same patient with no additional fat grafting procedures. The fat grafts have maintained volume, resulting in a stable appearance (C).

Figure 3. A 49-year-old female patient that underwent conventional fat grafting for a postsurgical scar located in her left upper perioral region; preoperative view (A). Postoperative month 3 of the same patient. A total of 12 cc of fat was injected into the patient's left perioral and cheek area. This was the highest scoring patient of the conventional reconstructive fat grafting group with an FSQI score of 1.5 and FVI score of 2 (B). Postoperative month 16 of the same patient with no additional fat grafting procedures. The patient had undergone a left commissuroplasty during this time (C).

Table 3. Facial skin quality improvement scores of patients.

FSQI score	Group	
	Microneedle	Control
Aesthetic subgroup	2.46 ± 0.32	1.5 ± 0.6
Reconstructive subgroup	2 ± 0.35	1.07 ± 0.45
Overall	2.27 ± 0.40	1.33 ± 0.59

FSQI: Facial skin quality improvement

Table 4. Facial volume improvement scores of patients.

FVI score	Group	
	Microneedle	Control
Aesthetic subgroup	2.46 ± 0.38	1.72 ± 0.52
Reconstructive subgroup	2.11 ± 0.33	1.29 ± 0.49
Overall	2.32 ± 0.39	1.56 ± 0.54

FVI: Facial volume improvement

reconstructive patients. Both subgroups demonstrated "much improved" overall facial volume, but a significant difference was seen in the scores in favor of the aesthetic subgroup ($P < 0.05$) (Figures 4A–4D).

The overall facial volume improvement (FSQI) score for the control group was 1.56 ± 0.54, reflecting an overall "improved" result. The score was 1.72 ± 0.52 for the patients with aesthetic indications while the score was 1.29 ± 0.49 for the patients that underwent fat grafting for reconstructive purposes and the difference between the subgroups was insignificant ($P > 0.05$) (Figures 5A–5D).

The improvement in facial volume was compared between the microneedle and control groups and the difference was found to be highly significant and in favor of the microneedle group ($P < 0.05$). A significant difference was also found between the FVI scores of the aesthetic and reconstructive subgroups among both the microneedle and control groups ($P < 0.05$) (Table 5).

Figures 4A and B. A 48-year-old female patient that underwent microneedling-assisted facial fat grafting for facial rejuvenation; preoperative frontal (A) and oblique view (B).

Figures 4C and D. Postoperative frontal (C) and oblique (D) view at the fourth month of the same patient. A total of 16 cc of fat was injected into the patient's malar, nasolabial, and tear trough areas. Both the FSQI and FVI score of this patient was 2.5.

Figures 5A and B. A 44-year-old female patient that underwent conventional fat grafting for facial rejuvenation; preoperative frontal (A) and oblique view (B).

3.3. Patient satisfaction

Patients that underwent fat grafting with adjunctive microneedling were asked whether or not they would consider having the same treatment again, should they require it in the future. Twenty of the 22 patients answered "yes", which correlated with 90.9% of the patients agreeing to undergo the same procedure again in the future in the event that they require it.

4. Discussion

Fat grafting to the face has become increasingly popular over the last few years as plastic surgeons not only resort to fat grafting to optimize their surgical results after facial surgery, but also to increase the quality of facial skin and to achieve harmony that is otherwise much more difficult to obtain with other techniques (20–23). The increase in skin quality is mainly attributed to the stromal vascular component that is transferred alongside the adipocytes, which contains mesenchymal-derived stem cells that offer the regenerative benefits of fat grafts (6,7,24). Yet, despite these advantageous characteristics that make fat grafts ideal soft tissue fillers, the ongoing concern is their unpredictable long-term outcome.

Although there are several studies that report increased fat graft viability with the addition of various growth factors, hormones, or drugs, many clinicians do

Figures 5C and D. Postoperative frontal (C) and oblique (D) view at the fourth month of the same patient. A total of 26 cc of fat was injected into the patient's malar, nasolabial, marionette, and tear trough areas. The FSQI of the patient was 2.5 while the FVI score was 1.5.

Table 5. Distribution of FSQI and FVI scores among patient groups.

Parameter	Group	Value	P-value
FSQI score	Microneedle	2.27 ± 0.40	0.000*
	Control	1.33 ± 0.59	
FVI score	Microneedle	2.32 ± 0.39	0.000*
	Control	1.56 ± 0.54	
Transferred fat (cc)	Microneedle	19.91 ± 5.92	0.326
	Control	18.17 ± 5.88	

FSQI: Facial skin quality improvement, FVI: Facial volume improvement,
*The comparison between the variables is considered significant if $P < 0.05$.

not advocate their use and emphasize the importance of preventing mechanical and chemical damage to vulnerable adipocytes (2,3,25). Thus, while it is important to sustain the viability of the grafts with gentle harvesting and processing techniques, the question remains as to how we can increase the rate of fat graft survival. The enrichment of fat grafts with adipose-derived stem cells has become one of the most popular methods to overcome this issue. Several clinical studies report successful results with the technique yet the effect is still questionable, and the method remains a high-cost procedure that requires a standardized environment for stem cell extraction that is not routinely applicable (26–28). More practical methods that can be adapted to all clinical environments are still needed to support the ever-so-popular fat grafting procedures. Although the graft itself and the technical details all play very important roles in the process, the properties of the recipient site are just as important when dealing with successful graft survival (14,15,29–31). Therefore, basic procedures that can enhance the vascularity of the recipient area can potentially increase fat graft survival. The aforementioned previous study by the authors demonstrated that microneedling was effective in increasing fat graft survival through the same mechanism (16). This technique is unique as it can easily be adapted to the clinical environment for patients requesting fat grafting. What is more interesting is that candidates for facial fat grafting also seek an increase in skin quality, which can be achieved individually by both fat grafting and microneedling (18,28).

Despite its first appearance in the literature in the late 1990s, microneedling has recently gained much popularity and acceptance as a practical, safe, low cost, and effective minimally invasive procedure typically used for skin rejuvenation and the induction of collagen in the skin. Although the first concept of microneedling was introduced by Orentreich et al. and Camirand, the cylindrical tool equipped with microneedles that constitutes today's technique was described by Fernandes in 2006 as "percutaneous collagen induction" (17,32,33). The standard microneedling device has a handle that connects to a drum-like cylinder that is studded with microneedles, varying in lengths usually between 0.5 and 3 mm. The appropriate needle length is chosen according to the area that is to be treated and the indication for microneedling. As full dermal penetration was required in our study, the dermal thickness of the human facial skin was taken into account and a 1.5-mm-length microneedling device was used (34,35). Microneedling has been actively used for skin rejuvenation, scar treatment, alopecia, pigmentation problems, stretch marks, and other indications with reported significant effective results (36–40). An experimental study by Aust et al. demonstrated an increased expression in vascular endothelial growth factor in the skin of rats that underwent percutaneous collagen induction (19). This finding signifies that microneedling is an important stimulator for angiogenesis, among its many other cutaneous benefits.

The clinical results of the present study demonstrated that patients undergoing fat grafting with adjunctive microneedling were satisfied in terms of an increase in skin quality and volume gain as they stated that both parameters were "much improved" at the end of 3 months. The postoperative 3rd month was taken into consideration for evaluation in light of both experimental and clinical fat grafting studies that report that fat grafts stay relatively stable after 3 months (8,23,28). This time frame was also thought to be appropriate as the inflammatory effects of microneedling will have subsided, preventing the misleading evaluation of skin quality due to edema.

When compared to the conventional fat grafting patients, the scores were significantly in favor of the adjunctive microneedling group, demonstrating increased efficacy both for skin quality and graft volume retention. Although the combination of microneedling significantly improved skin quality and graft survival results in patients with reconstructive indications, the lowest scores were still seen in these subgroups. This result can be attributed to the fact that dermal fibrosis is expected to be more intense in scar patients, which would interfere with the penetrative effect of microneedling. Moreover, the baseline regarding skin quality for these patients is lower, which would explain why achieving significant improvement would be more challenging. Nevertheless, patients undergoing fat grafting with adjunctive microneedling for both aesthetic and reconstructive indications all demonstrated significant improvement in comparison to their baseline state. The technique can easily be applied in an office-based setting for the preconditioning stage. Patients can easily tolerate the procedure under topical anesthesia and are easily convinced due to its simplicity and its renowned positive impact regarding skin quality. The second microneedling procedure is done mainly to amplify the beneficial effects of microneedling on skin quality and only takes an extra few minutes prior to fat transfer. The patients' point of view regarding the ease of the procedure and satisfaction was supported by the high percentage of patients that claimed to consider undergoing the procedure again in the future if they were to need it.

There are limitations to this study, which include the fact that the study was designed with a nonrandomized group of patients undergoing fat grafting for different indications. Although care was taken to address the evaluation at the exact timing of 3 months postoperatively, some patients from the control group evaluated skin quality and volume improvement with the postoperative 3-month photographs at later stages in their follow-up. Although the evaluation was done exclusively with photographic comparison, this could have potentially resulted in a recall bias that could mislead patients during this evaluation. The evaluation of the improvement in both skin quality and facial volume was determined clinically and was based on patient satisfaction along with a blinded, semiquantitative evaluation through photographic comparison of preoperative and postoperative images. Recently, quantitative analysis has become possible with the help of topographic analysis devices and ultrasonography. Future clinical studies employing devices like these will be beneficial for determining quantitative results following fat grafting procedures. Further investigations and prospective randomized split-face studies with a higher number of patients are needed in order to make more accurate determinations regarding the effect of adjunctive microneedling in fat grafting patients.

In conclusion, fat grafting is an important tool in the hand of the plastic surgeon, for improving both facial volume and skin quality. Microneedling increases skin quality through a nonablative regenerative process by triggering wound healing in the dermis, while also increasing tissue vascularity and thereby increasing fat graft survival. The mutualistic effect of this combination treatment modality can be an effective, target-specific, and practical method for facial harmonization in both aesthetic and reconstructive settings.

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