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Analysis of Clinical Application Effect of Autologous Fat Granule Transplantation in Facial Depression Plastic Surgery

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Abstract: *Objective*: To explore the clinical application effect of autologous fat granule transplantation in facial depression plastic surgery. *Methods*: A total of 98 patients with facial depression admitted to the plastic surgery department of our hospital from January 2021 to December 2023 were selected and divided into observation group (49 cases) and control group (49 cases) according to the random number table method. The observation group was treated with autologous fat granule transplantation, while the control group was treated with hyaluronic acid filling. The total effective rate of treatment, incidence of postoperative complications, improvement indicators of facial morphology (depth of depression, symmetry), and effect maintenance rate after 6 months of follow-up were compared between the two groups. *Results*: The total effective rate of treatment in the observation group was 93.88% (46/49), which was significantly higher than that in the control group (79.59%, 39/49) ($P < 0.05$). The incidence of postoperative complications in the observation group was 6.12% (3/49), which was lower than that in the control group (20.41%, 10/49) ($P < 0.05$). One month after surgery, the depth of depression (1.23 ± 0.31 mm) and symmetry (1.02 ± 0.15 points) in the observation group were better than those in the control group ($P < 0.05$). After 6 months of follow-up, the effect maintenance rate in the observation group was 89.80% (44/49), which was significantly higher than that in the control group (67.35%, 33/49) ($P < 0.05$). *Conclusion*: Autologous fat granule transplantation for the treatment of facial depression can significantly improve facial morphology, enhance treatment effect and patient satisfaction, reduce the incidence of complications, and maintain a more durable effect. It is a clinically preferred facial depression plastic surgery solution.

Keywords: Autologous fat granule transplantation; Facial depression; Plastic surgery; Clinical effect; Hyaluronic acid filling

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1. Introduction

Facial depression is a condition caused by congenital dysplasia, trauma, aging, and other factors that lead to the loss of facial soft tissue volume, commonly seen in the temporal, cheek, forehead, and apple muscle areas [1]. The incomplete facial contour not only affects the aesthetic appearance but may also cause patients to experience psychological issues such as inferiority complex and social avoidance [2]. With the development of plastic surgery techniques, facial depression filling has become a common clinical cosmetic procedure. Currently, commonly used filling methods include autologous fat granule transplantation, hyaluronic acid filling, and prosthesis implantation [3]. Autologous fat granule transplantation is widely used in facial filling due to its advantages, such as being sourced from the patient's own body, good biocompatibility, natural and long-lasting effects [4]. The principle involves purifying fat granules from other parts of the body (such as the abdomen or thighs) and transplanting them into the facial depression area. The surviving fat tissue can maintain the filling effect for a long time [5]. Compared to hyaluronic acid filling (which requires repeated injections) and prosthesis implantation (which carries the risk of rejection), autologous fat granule transplantation aligns more closely with the concept of "natural beauty" [6]. However, further research is needed to improve the understanding of its long-term effects and complication control in clinical practice. This study aims to provide a reference for clinical decision-making in facial depression cosmetic surgery by comparing the clinical effects of autologous fat granule transplantation and hyaluronic acid filling among patients with facial depression treated in our hospital's plastic surgery department.

2. Materials and methods

2.1. General materials

Ninety-eight patients with facial depression admitted to the plastic surgery department of the hospital from January 2021 to December 2023 were selected. The patients were randomly divided into an observation group (autologous fat granule transplantation) and a control group (hyaluronic acid filling) using a random number table, with 49 patients in each group. There was no statistically significant difference in general information between the two groups ($P > 0.05$), indicating comparability (**Table 1**). This study was approved by the hospital ethics committee.

Table 1. Comparison of general information between two groups of patients

Group		Observation group (n=49)	Control group (n=49)	t/χ^2	P
Gender (Male/Female, n)		12/37	10/39	0.213	> 0.05
Age (years)		32.6 ± 7.5	33.2 ± 8.1	0.382	> 0.05
Depressed area (n)	Temporal	18	16	0.576	> 0.05
	Buccal	15	17		
	Frontal	10	9		
	Others	6	7		
Depression depth (mm)		3.8 ± 1.2	3.9 ± 1.1	0.417	> 0.05
History of cosmetic procedures (Yes/No, n)		8/41	6/43	0.289	> 0.05

During CVC catheterization, due to the proximity of the puncture site to the neck, patients may turn their heads due to tension or pain. Inclusion criteria: (1) Age 18–55 years, regardless of gender; (2) Clearly defined facial depression (single or multiple areas such as the temples, cheeks, or forehead) with a depression depth

≥ 2 mm; (3) No severe underlying diseases (e.g., diabetes, coagulation disorders); (4) No facial infections or skin ulcers; (5) Patients and their families are informed and have signed a consent form. Exclusion criteria: (1) Insufficient fat volume in the donor area; (2) Allergy to hyaluronic acid or anesthetic drugs; (3) Facial plastic surgery within the past 3 months; (4) Pregnant or lactating women; (5) Patients with mental disorders.

2.2. Methods

2.2.1. Observation group (Autologous fat granule transplantation)

(1) Fat Acquisition: The patient's abdomen or inner thigh was selected as the supply area, and the liposuction range was marked. Tumescent anesthesia was used (0.9% sodium chloride solution 500mL + 2% lidocaine 20mL + epinephrine 0.5mg). After percutaneous puncture, a 20mL syringe was connected to a 2.5mm diameter liposuction needle, and fat granules were suctioned in a fan shape with negative pressure (-0.5MPa) to avoid excessive negative pressure causing fat cell damage.

(2) Fat purification: Place the extracted fat particles into a sterile centrifuge tube and centrifuge at 1200r/min for 3 minutes to remove the upper layer of oil, the lower layer of bloody water and fibrous tissue, retaining the pure fat particles in the middle layer.

(3) Fat injection: Mark the injection range in the facial depression area, and apply local infiltration anesthesia (2% lidocaine). Use a 1mL syringe connected to a 23G blunt injection needle to perform multi-level, multi-tunnel injections along the subcutaneous fat layer and SMAS layer (Superficial Musculo-Aponeurotic System). During injection, use the "withdraw the needle while injecting" technique to avoid excessive injection at a single point. The injection volume is 120% of the expected filling volume (to allow for fat absorption), and gently rub and shape after injection to ensure even distribution of fat particles.

(4) Postoperative treatment: Apply pressure dressing to the surgical area for 24 hours, avoid pressing and hot compresses, take antibiotics orally for 3 days to prevent infection, and avoid strenuous activities for 1 week.

2.2.2. Control group

Cross-linked hyaluronic acid (model: Restylane SubQ) was selected, and the injection level was adjusted according to the depressed area: for deep depressions (such as the temporal region), it was injected into the upper layer of the periosteum, while for superficial depressions (such as the cheek area), it was injected into the subcutaneous fat layer. After local anesthesia, a 1mL syringe connected to a 27G injection needle was used to slowly inject the hyaluronic acid, shaping it while injecting. The injection volume was adjusted until the depression was filled, avoiding excess that could lead to unnatural contours. After surgery, pressure was applied to the surgical area for 5 minutes to stop bleeding, and patients were instructed to avoid rubbing the area and exposure to high temperatures.

2.3. Observation indicators

(1) Treatment effect: Evaluated 1 month after surgery. Significant effect: Complete resolution of facial depression, natural contour, and good symmetry; Effective: Improvement of facial depression ≥ 60%, basically natural contour; Ineffective: Improvement of facial depression < 60% or significant asymmetry. Total effective rate = (Significant effect + Effective) / Total number of cases × 100%.

(2) Facial morphological indicators: The depth of the depression (the vertical distance between the deepest

point of the depression and the surrounding normal skin) and symmetry (morphological difference score of bilateral corresponding sites, 0-3 points, the lower the score, the better the symmetry) were measured using a facial 3D scanner 1 month after surgery.

(3) Complications: Complications within 1 month after surgery were recorded, including infection, hematoma, fat liquefaction (autologous fat group), hyaluronic acid displacement (control group), local induration, etc.

(4) Effect maintenance rate: Follow-up for 6 months, assessed by comparing facial photos. If the recurrence of depression is < 20%, the effect is considered well-maintained, and the maintenance rate is calculated.

2.4. Statistical methods

Data were analyzed using SPSS 26.0 software. Measurement data were expressed as ($\bar{x} \pm s$), and independent sample t-tests were used for comparisons between groups; Count data were expressed as percentages, and χ^2 tests were used for comparisons between groups. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of treatment effects between the two groups

The total effective rate of the observation group was 93.88%, which was significantly higher than that of the control group, which was 79.59% ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of treatment effects between the two groups [n(%)]

Group	No. of cases	Markedly effective	Effective	Ineffective	Total effective rate
Observation group	49	32 (65.31%)	14 (28.57%)	3 (6.12%)	46 (93.88%)
Control group	49	20 (40.82%)	19 (38.78%)	10 (20.41%)	39 (79.59%)
x^2					4.346
P					0.037

3.2. Comparison of facial morphology indicators between the two groups

There was no statistically significant difference in the depth of depression and symmetry between the two groups before surgery ($P > 0.05$). One month after surgery, both indicators in the observation group were significantly better than those in the control group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of facial morphology indicators between the two groups ($\bar{x} \pm s$)

Measurement	Time point	Observation group (n=49)	Control group (n=49)	*t*-value	*P*-value
Depression depth (mm)	Preoperative	3.81 ± 1.22	3.92 ± 1.14	0.417	> 0.05
	1 Month Post-op	1.23 ± 0.31	1.85 ± 0.42	8.172	< 0.05
Symmetry score (points)	Preoperative	2.12 ± 0.51	2.22 ± 0.41	1.020	> 0.05
	1 Month Post-op	1.02 ± 0.15	1.43 ± 0.21	10.683	< 0.05

3.3. Comparison of complication rates between the two groups

The incidence of complications in the observation group was significantly lower than that in the control group (*P*

< 0.05), as shown **Table 4**.

Table 4. Comparison of postoperative complications between the two groups [n(%)]

Group	Infection	Hematoma	Fat necrosis	HA displacement	Local induration	Total incidence
Observation group (n=49)	1 (2.04%)	1 (2.04%)	1 (2.04%)	0 (0%)	0 (0%)	3 (6.12%)
Control group (n=49)	3 (6.12%)	2 (4.08%)	0 (0%)	3 (6.12%)	2 (4.08%)	10 (20.41%)
χ^2						4.346
P						0.037

3.4. Comparison of effect maintenance rates between the two groups of patients

After 6 months of follow-up, the effect maintenance rate in the observation group was 89.80% (44/49), which was significantly higher than that in the control group, which was 67.35% (33/49) (x^2=7.333, *P*=0.007).

4. Discussion

The theoretical foundation of facial morphological aesthetics originates from the symmetry of facial anatomical structures and the coordination of volume distribution. Essentially, the formation of facial depression is an anatomical morphological change caused by the atrophy of subcutaneous adipose tissue, loss of tissue volume, or abnormalities in facial bone structure. The correction principle is based on the "structure-function" repair theory of tissue engineering, which aims to restore the normal anatomical layers and mechanical balance of facial soft tissue by supplementing the missing volume.

This study shows that the total effective rate of autologous fat granule transplantation for the treatment of facial depression (93.88%) is significantly higher than that of hyaluronic acid filling (79.59%), and the improvement in facial morphology is more pronounced. Its core advantages lie in:

(1) Good biocompatibility: Autologous fat granules originate from the individual, eliminating immune rejection reactions and avoiding potential allergies or foreign body reactions that may be caused by allogeneic materials such as hyaluronic acid.

(2) Long-lasting effects: Surviving fat cells can maintain volume for extended periods, whereas hyaluronic acid is degraded and absorbed within 6–12 months, requiring repeated injections [7].

(3) Skin quality improvement: Stem cells within the fat granules can secrete cytokines, promoting skin collagen regeneration and enhancing facial skin elasticity [8].

Based on the follow-up results of this study, the 6-month effect maintenance rate in the observation group (89.80%) was significantly higher than that in the control group (67.35%), which is consistent with the conclusion of previous studies that "surviving fat after autologous fat transplantation can exist stably for a long time" [9]. This is significant in reducing the economic and psychological burden of repeated treatments for patients.

The incidence of complications from autologous fat granule transplantation (6.12%) was lower than that from hyaluronic acid filling (20.41%). The complications were mainly mild (such as 1 case of fat liquefaction), while in the control group, hyaluronic acid displacement (3 cases) and local induration (2 cases) were related to material properties. The reasons for this are analyzed as follows:

(1) Fat purification process: In this study, the centrifugation method (1200r/min, 3 minutes) was used to purify fat, effectively removing impurities and reducing inflammatory stimulation [10].

(2) Injection technique: Multi-level injection avoids fat accumulation and reduces the risk of liquefaction, while excessive single-point injection of hyaluronic acid can easily form induration.

(3) Material stability: The surviving fat integrates with surrounding tissues, while hyaluronic acid is prone to displacement due to gravity and facial expression muscle movement [11]. After fat transplantation, pressure should be avoided within 1 week to prevent obstruction of blood circulation in fat cells; after hyaluronic acid filling, exposure to high temperatures should be avoided to slow down the degradation rate of the material [12].

Suggestions for optimizing surgical operations:

(1) Fat acquisition: Choosing inner thigh fat (with higher fat cell activity than the abdomen) can improve the survival rate; controlling the negative pressure (-0.5MPa) during fat suction to avoid rupture of fat cells.

(2) Fat injection: Using a "blunt needle + multi-level" injection to reduce blood vessel damage; reserving 20% absorption space in the injection volume to avoid excessive filling leading to bulky contours.

(3) Combined therapy: For patients with severe depression, fat transplantation can be performed first to improve the basic contour, followed by a supplementary injection 3 months later to enhance the overall effect.

This study was a single-center study with a small sample size; it did not compare the effects of different fat purification methods (such as filtration vs. centrifugation); the follow-up time was only 6 months, and long-term effects require further observation.

5. Conclusion

In summary, autologous fat granule transplantation has significant advantages in facial depression plastic surgery. It can effectively improve facial contours, enhance treatment effects and patient satisfaction, and has few complications and long-lasting results. Clinicians should standardize surgical operations (such as optimizing fat purification and precise injection) to further improve fat survival rate and provide patients with better cosmetic results.

Disclosure statement

The authors declare no conflict of interest.

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