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Original Article

Autologous fat grafting to correct lip volume insufficiency: harvest site and injection issues

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Abstrac: *Purpose:* Lip volume insufficiency, a result of various types of congenital or acquired deformity, has a significant impact on patients' appearance and self-esteem. It is difficult for surgeons to achieve satisfactory results with filler injections because the subunit is not reconstructed, which leads to disappointing long-term results. This article recommended an efficient remedy for lip atrophy. *Methods:* Fifty-two patients with congenital cleft lip and acquired lip atrophy underwent autologous fat grafting treatment from August 2012 to July 2017. They were compared pre- and postoperatively. To treat lip tissue insufficiency, a fork-shaped head cannula was used. Fat was harvested from the gluteal fold and injected into various labial zones at different depths and angles in order to reconstruct satisfactory lip appearance and achieve positive long-term effects. To optimize lip shape and volume, the localization, depth and angle of the injections were of critical importance. *Results:* Digital images showed significantly improved aesthetic outcomes from preoperative values of 3.2 ± 0.3 cm^2 to postoperative values of 5.8 ± 0.4 cm^2 ($p < 0.001$). The effective corrective rate was 83.2 ± 8.1%. For the total fifty two treated patients, forty eight patients were scored 0-2 and four were 3-5 by a panel of three plastic surgeons; while the patient self-evaluation scores were: forty six scored 0-2 and six scored 3-5. *Conclusion:* The results of this study suggested this remedy for lip atrophy is efficient: autologous fat-harvested from the gluteal fold with a fork-shaped head cannula-is injected into different labial zones at various depths and angles.

Keywords: Autologous fat grafting, reconstruction, lip atrophy, lip injection

Introduction

The human lip is a delicate organ that is not easy to reconstruct; remodeling the subunit-such as lip peak, lip bead, philtral column-poses particular problems. Lip atrophy and asymmetry are particularly challenging for surgeons. Cleft lip and acquired lip deformity such as hemangioma treated with bleomycin A5 are two major causes of lip insufficiency. With cleft lip, not only is there a volume insufficiency problem, the lip subunit on the affected side is deficient, resulting in lip asymmetry. Lip bleomycin A5 treatment can cause lip asymmetry or a whistle deformity, in which case the subcutaneous and submucosal tissues of the lip become atrophied, and the orbicularis oris muscle undergoes partial fibrosis. Eventually the lip may become very thin, pigmented and stiff in texture. The surgical repair of lip contour while enhancing lip texture and skin color requires considerable surgical skill. Autologous fat grafting or filler injections are appropriate in these cases.

The literature describes aesthetic lip augmentation by the injection of fillers such as hyaluronic acid (HA) [1]; however, hyaluronic acid is expensive and insufficiently durable for use in lip reconstruction. Dermis fat grafts [2, 3] can play a limited role in augmenting lip insufficiency but they provide no remedy for lip texture, skin color problems or the lip subunit. The authors contend that autologous fat grafting is a better option for correcting lip tissue insufficiency.

Patients and methods

Patients

This study was designed as a prospective investigation, which was approved by the Research

Table 1. Demographic and follow-up data for all patients

Characteristic	Mean ± SD	Range
Age, year	22.3 ± 3.4	16~29
Body weight, kg	48.6 ± 5.5	41~65
Height, cm	162.3 ± 5.3	152~180
BMI, kg/m^2	18.5 ± 1.9	17.7~26.7
Interval time between two procedures, months	3.3 ± 1.2	2.7~5.2
Total follow-up time, months	18.1 ± 3.2	12~24

BMI, body mass index.

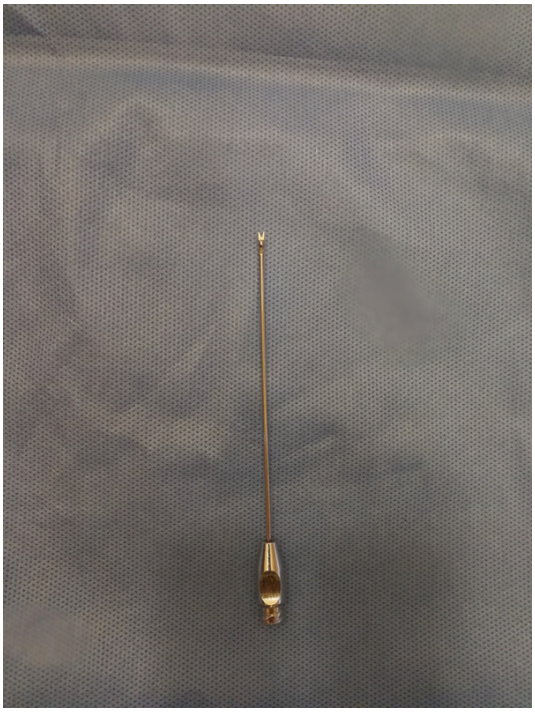

Figure 1. The fork-shaped 18-gauge head cannula is used to break apart the fibrosis and increase the area for grafting autologous fat.

Committee of Shanghai Ninth People's Hospital affiliated to Shanghai Jiao Tong University, School of Medicine. Fifty-two patients-22 male and 30 female patients (mean age, 22.3 years)-with lip atrophy underwent this treatment from August 2012 to July 2017 (**Table 1**). Forty patients had secondary cleft lip and twelve patients had received bleomycin A5 treatment as infants in other hospitals; a consequence of this hemangioma treatment was insufficient lip volume. Thirty patients were male and twenty-two were female. They ranged in age from 16 years to 29 years, the average being 22.3 years. Patients who had previously received lip filler or fat injective operations were excluded. Follow-up occurred at regular three-month intervals.

The precise location and depth of the injections are of critical importance. We discussed the desired result with the patient using a mirror and pointer, using Jacono's [4] lip zone classification to pinpoint the injection sites. Different labial zones were injected at different depths and angles in order to achieve specific lip shape goals.

Superficial injections in the dermis were used to efface lip notching, while deeper injections were placed at the orbicularis oris or the junction between the orbicularis oris and the submucosa, as more superficial injections in the mucosa alone often left visible lumps. The white roll zones were injected to increase the size of the lip as well as modify the curvature of the Cupid's bow; the peristomal zone was injected laterally.

The tissue insufficiency was corrected by injecting various labial zones at different depths and angles. The volume of fat grafted was measured each time, and the type of fat carefully noted. The preoperative and postoperative lip area was measured and compared and the effective corrective rate of the grafting fat was calculated. Lip contour aesthetic appearance was scored after grafting to evaluate the effectiveness of the procedure.

Grafting procedures

The procedures were performed under local anesthesia. The deficient lip area was evaluated and marked. In all instances, fat was harvested from the gluteal fold zone using manual suction with a 20-ml syringe fitted with a liposuction cannula (18 G, 20 porous) for approximately 15 minutes. An average of 1-3 ml 2% lidocaine (1:100,000 epinephrine) was injected at the donor site. A 2% lidocaine tumescent fluid-20 ml, 1% epinephrine 0.5 ml, 0.9% normal saline 500 ml-was used. The mean graft harvest yield was 20 ml (range 15-35 ml). After being washed two to three times with saline to remove any serum, blood and broken tissue, the syringes were left to stand with the plunger up for five minutes. The fluid that separated out

Table 2. Operative data for all patients

Characteristic	Mean ± SD	Range
Total grafted fat harvest yield, ml	20.0 ± 5.5	15.0~35.0
Total grafted fat volume first time, ml	3.2 ± 1.1	3.0~5.0
Total grafted fat volume second time, ml	2.6 ± 0.9	2.5~4.5
Total grafted fat volume third time, ml	2.1 ± 0.7	1.6~2.5
Preoperative area, cm^2	3.2 ± 0.3	2.8~3.5
Postoperative area (18.1 m), cm^2	5.8 ± 0.4	5.4~6.3
Corrective rate (18.1 m), %	83.2 ± 8.1	70.4~91.9

Table 3. Evaluation of the lip appearance in terms of lip thickness, lip symmetry, lip texture and skin color

Score	Description
Lip thickness	
0	Very similar to the other side
1	Better than preoperative status
2	Almost no change
Lip symmetry	
0	Radian, height, width, prominence very similar to the other side
1	Better symmetry than preoperative status
2	Almost no change
Lip texture	
0	Very similar softness to the other side
1	Softer than preoperative status
2	Almost no change
Skin color	
0	Very similar to the other side
1	Better than preoperative status
2	Almost no change

from the fat was discarded, fibrous tissue was removed, and the fat tissue cut into small pieces. The fat was then filtrated on dry gauze. Finally, the micro fat granules were refined and purified, and transferred to a 1-ml syringe. A sharp needle was used to open a channel and then an 18-gauge fork-shaped head cannula (**Figure 1**) was used to inject along the vermilion-cutaneous junction and break apart the fibrosis to increase the grafting area, while maintaining the skin and lip stable with the other hand. An average of 3.2 ml (range 3.0-5.0 ml) was injected into multiple tunnels until the desired amount of correction was achieved. When necessary, the grafted area was massaged to attain the desired contour. A reflux maneuver was carried out prior to each injection to ensure that the needle tip did not enter a blood vessel. All patients received oral antibiotics and 15 mg of metacortandarcin beginning on the day of the operation and continuing for a total of 5 days and 3 days respectively. The donor site was pressure bandaged for 72 hours; after that all patients were required to wear stretch pants continuously for two weeks. Stitches were removed from the donor site 7 days after the operation.

Evaluation

Patients were followed up at the outpatient clinic every three months after the fat grafts. Digital photographs were regularly taken. The volume of fat grafted was measured and recorded (**Table 2**).

Aesthetic outcome was measured at an average of 18.1 months (range 12 to 24 months) by comparing digital images of the patients acquired before and after the grafts. The measurements were performed with a real-size digital photograph of the positive view. The preoperative and postoperative lip area was measured and compared, and the effective corrective rate of the grafting fat calculated. The effective corrective rate of the grafting fat was calculated using the following equation:

$$\frac{postoperative\ area - preoperative\ area}{preoperative\ area} \cdot 100\%$$

Lip appearance outcome was evaluated by a panel of three plastic surgeons who were not involved in the surgery, and by the patients themselves, and an overall score awarded as the total of the lip thickness, lip symmetry, lip texture and skin color scores (**Table 3**). The grafting outcome was defined as satisfactory if the total score was 0 to 2; acceptable, if the score was 3 to 5; and poor, if the score was 6 to 8.

Statistical analysis

The preoperative and postoperative lip area was measured using Photoshop Version CS6;

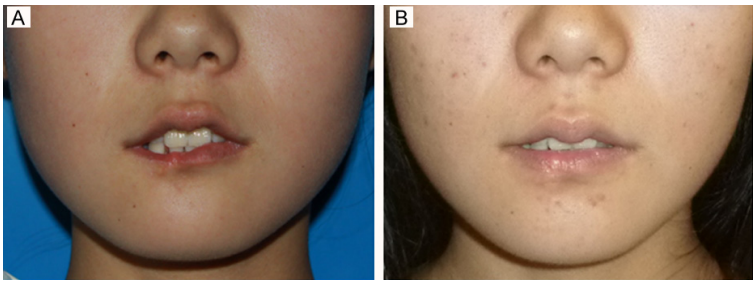

Figure 2. A 19-year-old female patient was given bleomycin A5 intralesional injections in her youth. A. The preoperative positive view shows the right lower lip atrophy. B. The 24-month postoperative positive view shows a significant improvement after autologous fat grafts on three separate occasions; the positive effects persisted over time.

Figure 3. A. The preoperative positive view of a 30-year-old male patient whose right upper lip lacks volume and has a subunit deficiency because of cleft lip. B. The 24-month postoperative positive view shows a significant improvement after autologous fat grafts. Note the reconstruction of the philtrum column. The positive effects persisted over time.

statistical analysis was performed using SPSS Version 23.0. The paired *t* test was used to compare the preoperative and postoperative lip area values. Statistical significance was set at $p < 0.05$.

Results

At the 1-week postoperative consultation, when stitches were removed from the donor site, the grafted lip appeared edematose and more prominent than the adjacent side in most cases, and the Cupid bow shape was relatively indistinct compared with the normal side. One month after the graft, lip contour had improved in appearance and was similar to the adjacent lip. However, at the 3-month postoperative consultation, it had thinned. Patients received a second autologous fat graft at that time, using the same grafting procedure; fat volume was modulated in function of the new lip morphology.

The average volume of fat grafted was 3.2 ± 1.1 ml the first time, 2.6 ± 0.9 ml the second time, and 2.1 ± 0.7 ml the third time; with each procedure, the volume of fat grafts gradually decreased while the grafting fat corrective rate gradually increased.

The aesthetic outcomes measured by comparing digital images of the patients showed a significant improvement from the preoperative values of 3.2 ± 0.3 cm^2 to postoperative values of 5.8 ± 0.4 cm^2 ($p < 0.001$). The effective corrective rate was 83.2 ± 8.1%. Compared with the preoperative images (**Figures 2A** and **3A**), forty-eight of the fifty-two patients had total scores of 0 to 2, with good symmetry of the lip shape, soft texture, improved skin color and significantly improved lip appearance (**Figures 2B** and **3B**). The remaining patients had total scores of 3 to 5, with volume still less than the adjacent side, but better than preoperative status. Patient self-evaluation scores after the operations were: forty-six total scores of 0 to 2, and six total scores of 3 to 5. Since good symmetry of the bilateral volume and morphology were achieved, most patients were satisfied with their aesthetic appearance, and with the natural texture and volume persistence of the graft.

The procedures gave rise to very few short-term complications; two patients suffered mild bruising but this disappeared in two weeks. Two others suffered edema but this cleared up of its own accord within a month. No long-term postoperative complications such as chronic edema, calcification or fibrosis were observed. There were no complications at the donor sites.

Discussion

Grafted fat tissue has been used for several years as a beautifying facial filler [5, 6]. It also has great potential in reconstructive surgery to remedy any area that lacks soft tissue because

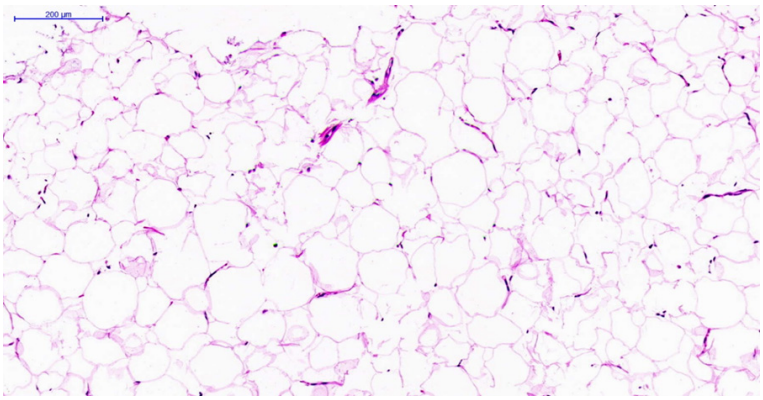

Figure 4. The histopathology image of the gluteal fold fat tissue shows the adipocytic structure is intact and the adipocytes are equidistributed.

of congenital deformities [7, 8], trauma [9], burns [10], scars [11], tumor resection [12] or human immunodeficiency virus-associated facial lipodystrophy [13].

The most important factor in autologous fat grafting is survival rate of the graft fat. As various authors have noted, the major drawback of fat grafting is reabsorption [7, 10, 14, 15]. Hemangioma treatment weakens the blood supply to the lip area, which impacts the survival of the graft fat. Since some fat tissue is absorbed after autologous fat injection, multiple fat injections are required. In our clinical experience, three grafts at 3-month intervals are necessary.

A challenge for surgeons with this procedure is to correctly adjust injection depth, angle and site for each patient. To efface lip notching, avoid lumps and refine both the volume of the lip bead and the contour of the Cupid's Bow, both superficial and deeper injections were required in the vermilion/white roll, subvermilion, philtral column, peristomal and commissural zones.

Scar fibrosis may occur in both secondary cleft lip and acquired lip deformity. Scar fibrosis limits the space for fat grafting and makes it difficult for adipocytes to survive. We contend that the fibrosis should be broken apart with the fork-shaped head cannula before grafting in order to increase the internal lip space, so that it is easier to shape the lip and achieve a better long-term effect.

In lip reconstruction procedures, most plastic surgeons choose fat-donor sites for reasons of convenience [16]. The upper or lower abdomen, the trochanteric region, the inner thigh, knee or flank are the most common fat-donor sites. A Brazilian study [17] conducted in 2007 suggested that the abdomen and inner thigh have higher concentrations of processed lipoaspirate cells and may therefore be better donor sites for adult adipose-derived stem cells, although most studies have been unable to demonstrate a significant fat viability difference between harvesting sites [18-20]. However, while we did not measure the lipoaspirate cell concentration of gluteal fold fat, nor its survival rate compared to fat harvested from other donor sites, the histopathology image of the gluteal fold fat tissue showed that the adipocytic structure was intact and the adipocytes equidistributed (**Figure 4**). In our experience, gluteal fold fat is smoother, finer, purer and softer, leading to better and more durable aesthetic outcomes. Moreover, choosing the horizontal gluteal fold zone as the harvesting site helps lift the gluteal area. A forthcoming study will compare lip reconstruction results using fat harvested from the gluteal folds with fat harvested from the abdomen or inner thigh.

We are pleased to share this new method for correcting lip volume insufficiency which offers satisfactory long-term results.

Disclosure of conflict of interest

None.

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