



Autologous Fine Particles Fat Filling Under Direct Vision in the Repair of Sunken Upper Eyelid After Double Eyelid Surgery



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Abstract

Background To explore the clinical effect of filling the preaponeurotic fat with autologous fine particles fat under direct vision to correct the sunken upper eyelid after double eyelid surgery.

Methods From June 2017 to May 2020, 134 cases of sunken upper eyelid after double eyelid surgery were treated by sharp needle injection of autologous fine particles fat under direct vision, and the surgical effect of each case was analyzed and evaluated.

Results The sunken upper eyelid was corrected, the appearance was satisfactory, the shape was in good state, and there was no lump and obvious displacement of the transplanted fat. And in the sunken upper eyelid group after double eyelid surgery, 5 patients had severe upper eyelid adhesions and lost plenty of preaponeurotic fat; among them, 4 patients underwent secondary repair surgery, and one did not.

Conclusion The sharp needle injection method of filling autologous fat in the preaponeurotic fat under direct vision can accurately correct the sunken upper eyelid and replenish the preaponeurotic fat. The positioning is accurate, the filling amount is easy to control, and the transplanted fat particles survive well.

Level of evidence IV This journal requires that authors assign a level of evidence to each article. For a full

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Keywords Sunken upper eyelid · Autologous fat graft · Preaponeurotic fat · Direct vision · Sharp needle

Sunken upper eyelid tends to give the impression of aging. For eastern Asians, in addition to senile upper eyelid depression, sunken upper eyelid after double eyelid surgery is also very common [1]. Surgeons try to correct upper eyelid depression to rejuvenate the eye area with a variety of ways, and among them, autologous fat graft is usually preferred for correction of the sunken upper eyelid [2]. In the process of surgical repair, our team adopted the method of transplanting autologous fine particles fat under direct vision to fill the preaponeurotic fat for patients with sunken upper eyelid and severe preaponeurotic fat loss, and we achieved satisfactory results. This paper discussed the clinical application of filling the preaponeurotic fat with autologous fine particles fat under direct vision to correct the sunken upper eyelid after double eyelid surgery.

Background and Surgical Technique

Patients enrolled in this group complained about poor morphology and different degrees of upper eyelid depression after double eyelid surgery. Patients who had previously received autologous fat filling to correct upper eyelid depression and who had cardiovascular and cerebrovascular diseases, diabetes, and were on long-term use of immunosuppressive agents or anticoagulant drugs were not

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included in this group. A total of 134 cases were enrolled, including 132 females and 2 males, aged 21–58 years old, with an average of 37 years old. The time interval between the first and the revision surgery ranged from 1.5 years to 14 years, with an average of 5.5 years. The enrolled patients received autologous fine particles fat filling under direct vision to correct upper eyelid depression during the double eyelid repair surgery.

1. The medial thigh or lower abdomen was chosen as the donor site to harvest and purify fat particles. The tumescent fluid (0.02% lidocaine solution containing 1:1000, 000 epinephrine) was injected evenly into the liposuction area. We chose a liposuction needle with the diameter of 2mm and two side holes, and the diameter of the side hole was 1.5mm. The liposuction needle was connected to a 20-ml syringe and used to suck evenly the fat particles in the fat layer under negative pressure. After the obtained fat particles' suspension was washed twice with normal saline, it was put into a small centrifuge under sterile conditions and centrifuged at 1000 r/min for 3 min. The centrifugal fat particles were loaded into a 10-ml syringe, which was then connected to another empty 10-ml syringe through a connector with an inner diameter of 1.2 mm. The fat particles were pushed repeatedly at a constant speed for 20 times for further refining between these two syringes (Fig. 1). After that, the fat particles were transferred into a 1-ml Luer Lock syringe and stored in an environment of 4–10 °C for later use [3, 4].

2. Upper eyelid surgery: Multi-angle photographs of the sunken area will be taken for the enrolled patients. Surgeons will pre-assess the amount of fat needed to correct the upper eyelid depression based on the preoperative photograph measurement, preoperative assessment and previous clinical experience. The incision line was marked on the upper eyelid. After local anesthesia with 1% lidocaine containing 1:200,000 epinephrine, the skin and muscles were cut along the designing line. The scar



Fig. 1 The centrifugal fat particles were loaded into a 10-ml syringe, and it was then connected to another empty 10-ml syringe through a connector with an inner diameter of 1.2 mm. The fat particles were pushed repeatedly at a constant speed for 20 times for further refining

adhesions in front of the tarsus and the orbital septum, which caused upper eyelid depression, were fully loosened to expose the anterior tarsal fascia and the orbital septum, and then the cutting went obliquely upward into the gaps behind the orbital septum to check and release the preaponeurotic fat that had been shifted backward and upward, so as to reset as much as possible the residual fat (Fig. 2). According to the residual fat amount and the upper eyelid depression extent of patients, the location and degree of preaponeurotic fat loss (medial loss, lateral loss or simultaneous loss) were evaluated. After the evaluation, for the sake of even injection, the filling area of preaponeurotic fat was marked into several regions and levels, and autologous fat particles were injected into those regions and levels, respectively, to achieve that effect. Afterward, a 19 G sharp needle was put onto a Luer Lock syringe containing purified fine particles fat, and parallel to the tangential direction of the eyeball surface, the needle was punctured into the preaponeurotic fat or the fat lobule under direct vision. It should be noted that autologous fat particles should be injected into the preaponeurotic fat within visible range to prevent the needle from piercing into the levator palpebral muscle, which might otherwise lead to ectopic injection. During the surgery, the needle tip was adjusted constantly and the plunger rod was pushed two scales further for each injection at one time, so the fat particles injected at each injection point were 0.02ml (see video). Considering that there was a certain degree of absorption of the transplanted fat, the fat filling amount was 20% more than assessment amount required (Fig. 3). Then, the residual fat after being loosened and released and the preaponeurotic fat that had been newly injected were fixed to the upper edge of the tarsus with 2–3 stitches [5]. Afterward, according to the preoperative design, the double eyelid folds were reconstructed, and the upper edge of the tarsus and small amount of subcutaneous orbicularis oculi muscle under the lower edge of the double eyelid incision was sutured intermittently with 3 or 4 stitches to form a



Fig. 2 Release of the preaponeurotic fat that had been shifted backward and upward, so as to reset as much as possible the residual fat



Fig. 3 A 19 G sharp needle was put onto a Luer Lock syringe containing purified fine particles fat, the needle was punctured into the preaponeurotic fat under direct vision, and the needle direction should be parallel to the tangential direction of the eyeball surface

good double eyelid fold arc [6]. The skin incision was sutured with 7-0 nylon thread intermittently, and examination was done to make sure that the bilateral double eyelid folds were well formed, the upper eyelid depression was well corrected, and the bilateral upper eyelid morphology was basically symmetrical.

Postoperative treatment: Local intermittent cold compresses were applied within 48 hours after operation, routine cleaning and dressing were changed 2 days after operation, and stitches were removed 5-7 days after operation.

Results

In this group, patients with sunken upper eyelid after double eyelid surgery were treated with autologous fine particles fat to supplement the preaponeurotic fat during double eyelid revision surgery. The postoperative appearance was satisfactory in most of the cases, and the shape was in good state. There were no lumps in the upper eyelid area, and no abnormalities such as obvious displacement of the transplanted fat. Five of the enrolled patients had severe upper eyelid scar adhesions and preaponeurotic fat loss before the operation; although the sunken upper eyelid had been improved to a certain extent, some areas still needed to be filled with fat again. Four patients underwent secondary autologous fat filling in 6–12 months after, and one patient did not. In terms of fat filling volume, the unilateral filling volume for the enrolled patients was 0.7–1.7 ml, with an average of 1.3 ml.

Patients were followed up for 6–24 months, with an average of 12 months. The patients took standardized preoperative photographs and postoperative follow-up photographs according to the principles of plastic surgery. Two senior plastic surgeons who did not participate in the operation and the patient themselves scored the effect of

the operation, respectively. The scoring criteria were as follows: satisfied (3 points), relatively satisfied (2 points), fair (1 point) and dissatisfied (0 points). The scores of the 3 raters of each patient were averaged, and if the result score was greater than or equal to 2 points, it was recorded as a satisfactory surgical result. In the end, there were 119 patients with satisfactory results, and the satisfaction rate was 88.81% (119/134).

Surgical results

Score	Satisfied (3 points)	Relatively satisfied (2 points)	Fair (1 point)	Dissatisfied (0 points)
Case number	68	51	15	0

Case Report

Case1 A 32-year-old female had undergone an incision double eyelid surgery 3 years ago, but the effect was not satisfactory. At present, there were upper eyelid depression, depression scar inside the double eyelid incision line and uneven folds (Fig. 4a, b). The width of the double eyelid was redesigned to be 7 mm, and the skin area to be removed included the original scar. After applying local anesthesia, the upper eyelid was cut along the design line, and the scar adhesions were separated to reveal the anatomical level needed for the reconstruction of the double eyelid. After the orbital septum was fully exposed, it can be seen that there were partial adhesions between the orbital septum and the surrounding tissues, and the preaponeurotic fat was retracted and displaced. The abdomen was selected as the fat donor area, and the patients' bilateral upper eyelids were, respectively, filled with about 0.7 ml of fine particles fat. Six months after the operation, bilateral upper eyelid depression and upper eyelid ectopic adhesions were significantly corrected and double eyelid folds were significantly improved, and there were no fat lumps or fat nodules (Fig. 4c, d).

Case2 A 38-year-old female had undergone an incision double eyelid surgery 13 years ago, there were upper eyelid depression and uneven folds, and the upper eyelid depression can be seen when the female closed her eyes (Fig. 5a, b). About 1.5 ml of fine particles fat was injected into the patient's preaponeurotic fat for the sunken area of the left eye, and 1.3ml for that of the right eye. Fourteen months after correction of upper eyelid depression, the bilateral upper eyelid depression was significantly corrected, and the shape of double eyelid folds was significantly improved (Fig. 5c, d).

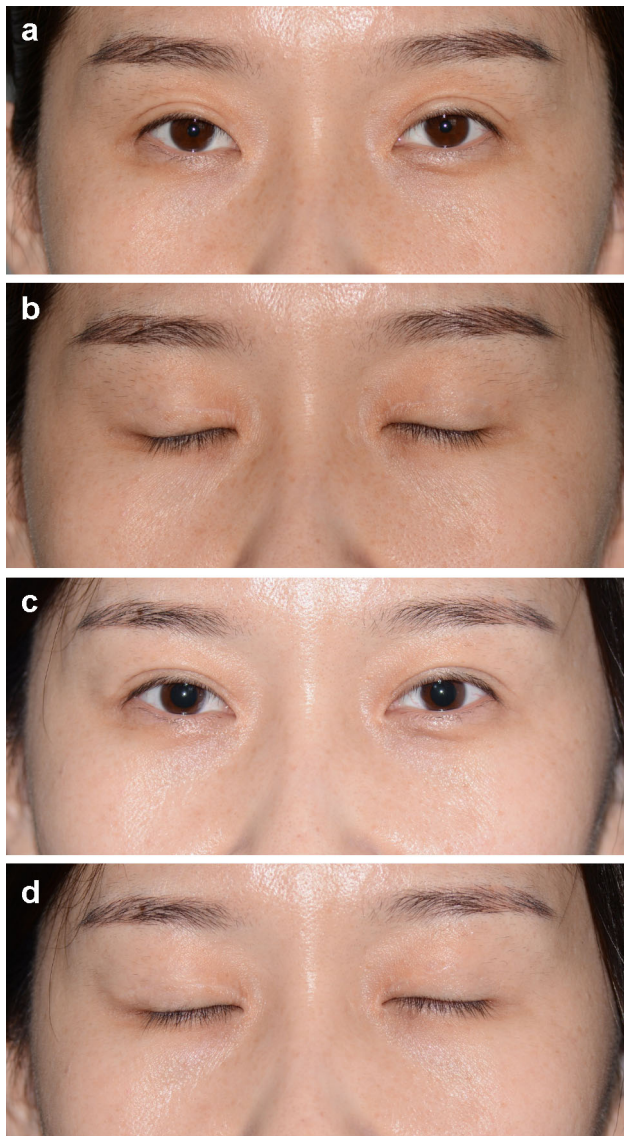


Fig. 4 **a** Case 1 A 32-year-old female had undergone an incision double eyelid surgery 3 years ago; there was upper eyelid depression. **b** Case 1 Upper eyelid depression and depression scar can be seen when the female closed eyes. **c** Case 1 6 months after correction of upper eyelid depression. The female looked forward, bilateral upper eyelid depression and upper eyelid ectopic adhesions were significantly corrected, and double eyelid folds were significantly improved. **d** Case 1 6 months after correction of upper eyelid depression. The female closed eyes, and there were no fat lumps or fat nodules.

Case 3 A 41-year-old female had undergone an incision double eyelid surgery 14 years ago, there were upper eyelid depression, abnormal upper eyelid tissue adhesions and uneven folds. Upper eyelid depression and the depression scar inside the double eyelid incision line can be seen when the female closed her eyes (Fig. 6a, b). The scar adhesions were separated to reveal the anatomical level needed for the reconstruction of the double eyelid. About 1.3 ml of fine particles fat was injected into the patient's

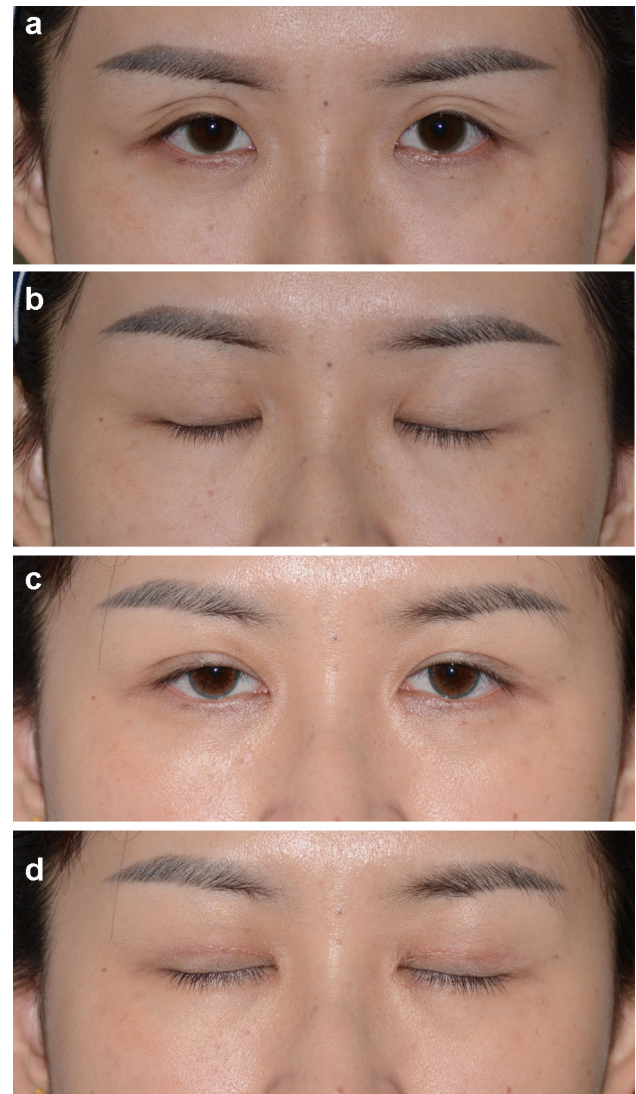


Fig. 5 **a** Case 2 A 38-year-old female had undergone an incision double eyelid surgery 13 years ago, and there was upper eyelid depression and uneven folds. **b** Case 2 Upper eyelid depression can be seen when the female closed eyes. **c** Case 2 14 months after correction of upper eyelid depression. The female looked forward, bilateral upper eyelid depression was significantly corrected, and double eyelid folds were significantly improved. **d** Case 2 14 months after correction of upper eyelid depression. The female closed eyes, and there were no fat lumps or fat nodules.

preaponeurotic fat for the sunken area of the left eye, and 1.1 ml for that of the right eye. Ten months after correction of upper eyelid depression, when the female looks forward, bilateral upper eyelid depression was significantly corrected, and the shape of double eyelid folds was significantly improved. There were no fat lumps or fat nodules (Fig. 6c, d).

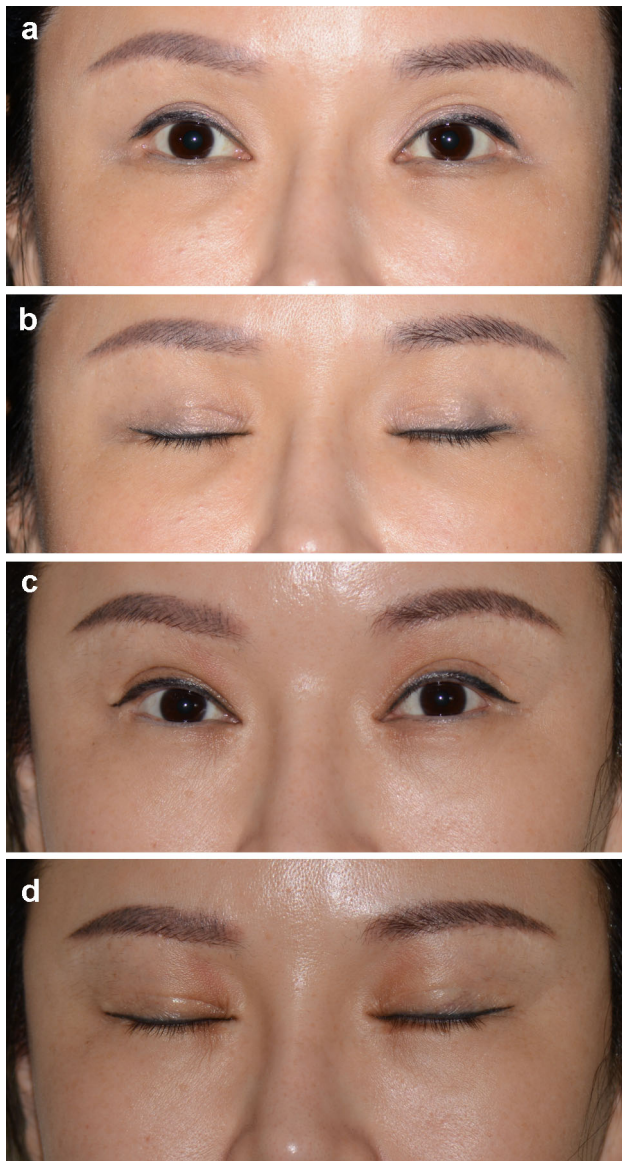


Fig. 6 **a** Case 3 A 41-year-old female had undergone an incision double eyelid surgery 14 years ago, and there was upper eyelid depression, abnormal upper eyelid tissue adhesion and uneven folds. **b** Case 3 Upper eyelid depression and depression scar inside the double eyelid incision line can be seen when the female closed eyes. **c** Case 3 10 months after correction of upper eyelid depression. The female looked forward, bilateral upper eyelid depression was significantly corrected, and double eyelid folds were significantly improved. **d** Case 3 10 months after correction of upper eyelid depression. The female closed eyes, and there were no fat lumps or fat nodules.

Discussion

Unlike Caucasians, the joint position of the orbital septum and the levator aponeurosis in many Asians is low, and moreover, it is in front of the tarsus, making the upper eyelid of some Asians relatively bloated [7]. In order to form a stable double eyelid fold, some surgeons will

remove part of the preaponeurotic fat during double eyelid surgery for Asians. But if too much preaponeurotic fat is removed, it may cause upper eyelid depression after surgery in the long term. The preaponeurotic fat acts as a bursa when the levator palpebral muscle slides upward, and if the volume of the preaponeurotic fat is insufficient or it shifts backward and upward, the upper eyelid depression will also occur. Traditional double eyelid surgery may cause abnormal orbital septum position and abnormal upper eyelid tissue adhesions, which may all lead to sunken upper eyelid and abnormal morphology of double eyelid folds [8].

For factors that cause sunken upper eyelid, the commonly used methods for filling upper eyelid mainly include autologous fat transplantation and hyaluronic acid filling [9]. Although hyaluronic acid filling is easier, it will be degraded by hyaluronidase after entering the body, and the upper eyelid depression will gradually reappear after a period of time. What's more, the hyaluronic acid filling is carried out under blind vision, and there are risks of vascular embolism, ectopic masses, etc. And for East Asians, the amount of HA injection within the upper eyelid should be limited; otherwise, the excessive use of it will make the retro-orbicularis oculi fat too thick, which will easily affect the appearance of double eyelid folds. With autologous particles fat transplantation on the contrary, a certain proportion of adipose tissue will survive for a long time, and the effect of filling will remain relatively long-lasting [10, 11].

At present, the methods for obtaining autologous fat mainly include suction and incision. Common fat donor areas for suction include the abdomen, medial thighs, waist, etc., and the donor areas for incision include such hidden parts as the armpits and groin, from which fat lumps and large fat particles can be obtained less obviously. Autologous fat transplantation includes large particles fat transplantation, medium and fine particles fat transplantation, etc. [12, 13]. By reviewing the literature and comparing the survival rates of different sizes of fat particles, more surgeons tend to transplant fine particles fat. Studies have shown that fine particles fat are easier to obtain nutrients from the surrounding tissue fluid, they are easier to be distributed evenly, and they are suitable for filling the delicate parts such as the eyes [14]. The distribution of blood vessels in the orbital septum is relatively dense and can provide good nutrition for the preaponeurotic fat. The transplantation of fine particles fat into the preaponeurotic fat not only conforms to the idea of repairing with the same tissue, but also improves the survival rate of transplanted fat particles [15]. Filling the preaponeurotic fat with autologous fine particles fat can reconstruct the glide zone, which can reduce the occurrence of postoperative ectopic

adhesions and help to improve the morphology of the double eyelid while correcting the sunken upper eyelid.

In previous literature reports, blind vision and/or blunt needle injection is adopted, which makes it difficult to accurately target the layer needed to be filled and easier to inject the fat particles into wrong parts and thus leads to fat accumulation and lumps. Besides, fat filling under blind vision can easily cause damage to the upper eyelid soft tissue and levator palpebral muscle. Since the orbital septum is tougher than fat tissue, it is not easy to be pierced with a blunt needle. Thus, using a blunt needle for fat filling is more likely to cause injection displacement. Moreover, if the filled fat accumulates in the posterior orbital space to form a mass, the ectopic fat mass will hinder the movement of the levator palpebral muscle, increase the load, and cause iatrogenic ptosis [16]. On the contrary, parallel to the tangential direction of the eyeball surface, using a sharp needle under direct vision can evenly inject and fill the fine particles fat into the preaponeurotic fat, so as to accurately supplement the fat loss, improve the depression of upper eyelid and correct the deficiency of upper eyelid tissue.

In the method introduced here, the autologous fat particles are refined; under direct vision, the sharp needle can inject the fat particles more accurately into the preaponeurotic fat, and the multi-tunnel and multi-point injection can distribute the fat particles more evenly into the preaponeurotic fat. This method is conducive to rebuilding the glide zone, thereby improving the upper eyelid depression. It provides a good vision for accurate injection, distributes fat particles evenly and maintains a high fat survival rate, and therefore, it is more suitable for accurate injection around eye areas [17].

Conclusion

Autologous fat grafting to correct sunken upper eyelid is an effective and relatively long-lasting surgical method. Under the condition of direct vision, using a sharp needle to inject the autologous fine particles fat in the preaponeurotic fat to correct the sunken upper eyelid can be more accurate and can distribute fat particles more evenly. It conforms to the physiological structure of the preaponeurotic fat and induces low incidence of complications.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

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