

# Fat Grafting for Recontouring Sunken Upper Eyelids With Multiple Folds in Asians—Novel Mechanism for Neof ormation of Double Eyelid Crease

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**Background:** This study reviewed the mini invasive technique, microautologous fat transplantation (MAFT), as a strategy in simultaneously treating sunken upper eyelids with multiple folds and recreating a double eyelid crease in Asian people.

**Methods:** The MAFT was performed with the assistance of a patented medical device, the MAFT-GUN, on 34 patients who had sunken upper eyelids and multiple folds. Each delivered fat parcel was accurately and consistently maintained at 1/240 mL during placement. Follow-up was regularly performed with photography for comparison.

**Results:** Fifty-eight sunken upper eyelids with multiple folds were reconstructed. In addition to the ameliorative recontouring of hollowness, a natural eyelid crease was created postoperatively. Temporary swelling and bruising were noted several days after surgery without morbidities, such as fibrosis or nodulation. All of the patients were satisfied with the 1-time MAFT procedure.

**Conclusions:** Fat grafting for sunken upper eyelids with multiple folds has been reported in the literature. However, temporal effects and complications, such as nodulation and irregularity, have often occurred. A new method, MAFT, demonstrated its reliability as a modality for sunken upper eyelids with multiple folds in Asians. Moreover, MAFT might serve as an alternative for neof ormation of double eyelids in these candidates.

**Key Words:** fat grafting, sunken eyes, double eyelid fold, blepharoplasty

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Over 50% of the Asian population is estimated to possess single-eyelid creases. Asian blepharoplasty (double eyelid surgery) has therefore been a popular operation for more than 100 years.<sup>1–3</sup>

However, among people who have had surgeries for double-eyelid creases, multiple eyelid folds caused by variable insertion levels of levator aponeurosis to the dermal-skin junction have sometimes occurred. To recreate an eyelid crease, numerous modalities have been proposed and demonstrated as evolutionary techniques.<sup>4–6</sup>

Clinically, ageing and over-resection of orbital fat (after blepharoplasty) might lead to a sunken eyelid. The hollowness that appears as tiredness and weakness is typically bothersome and unappreciated. Different methods and techniques of fat grafting were described before, but long-term satisfactory outcomes have not been achieved yet.<sup>7–10</sup>

Microautologous fat transplantation (MAFT), proposed by Lin in 2007, has been proven clinically feasible.<sup>11–15</sup> This article further illustrates how the MAFT technique recontours the sunken upper eyelid and demonstrates the concurrent integration of multiple folds and how MAFT could be an alternative for double eyelid formation.

## MATERIALS AND METHODS

The essential criterion for the study was patients with sunken upper eyelids with multiple folds. The exclusion included previous upper blepharoplasty, any filler injection, or fat injection. Those who requested a recontouring of hollowness with the simultaneous recreation of a double eyelid crease were advised to undergo MAFT. Under intravenous anesthesia, fat was harvested using a 2.5-mm (ø) suction cannula. The lipoaspirate was refined through centrifugation for 3 minutes at 1200g.<sup>7</sup> An atraumatic 18G blunt-tip cannula was used to deliver fat with the assistance of a MAFT-GUN (Fig. 1); each parcel volume was set at 1/240 mL. The surgeon transplanted the fat parcels in both zone I and zone II.

## Detailed Procedure

An insertion was made in the lateral upper eyelid at point x (Fig. 2A).

Zone I consists of several layers where surgeons can transplant the fat:

**Deeper layer**—through insertion point x, the injection cannula is placed on top of the superior orbital rim to the medial side of zone I. The parcel at 1/240 mL is then delivered while the MAFT-GUN is withdrawn (Fig. 2B). Multiple passages in a fan-shaped pattern might be necessary to recontour this basal layer.

**Middle layer**—in this layer, the same maneuver is performed to place the parcel to periorbicularis oculi muscle (inframuscle or supramuscle) (Fig. 2C).

**Superficial layer**—this is the supraorbicularis oculi muscle, which is directly beneath the eyelid dermis. In this layer, the side-hole indication of the MAFT-GUN suggests to turn to N, implying that the fat parcel is delivered upward to the dermis (skin) in a tenting effect.

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**FIGURE 1.** Panoramic view of the MAFT-GUN (Dermato Plastica Beauty, Co., Ltd. Kaohsiung, Taiwan). The lower right circle indicates that the trigger was pulled 240 times to transplant 1 mL of fat. The volume of each fat parcel was 1/240 mL.

In zone II, only a superficial layer is transplanted, and the lowest is on lowest insertion of levator aponeurosis (Fig. 2D).

In zone III, no fat transplantation was performed. Postoperative care was performed regularly.<sup>14,15</sup>

**LIVE VIDEO DEMONSTRATION**

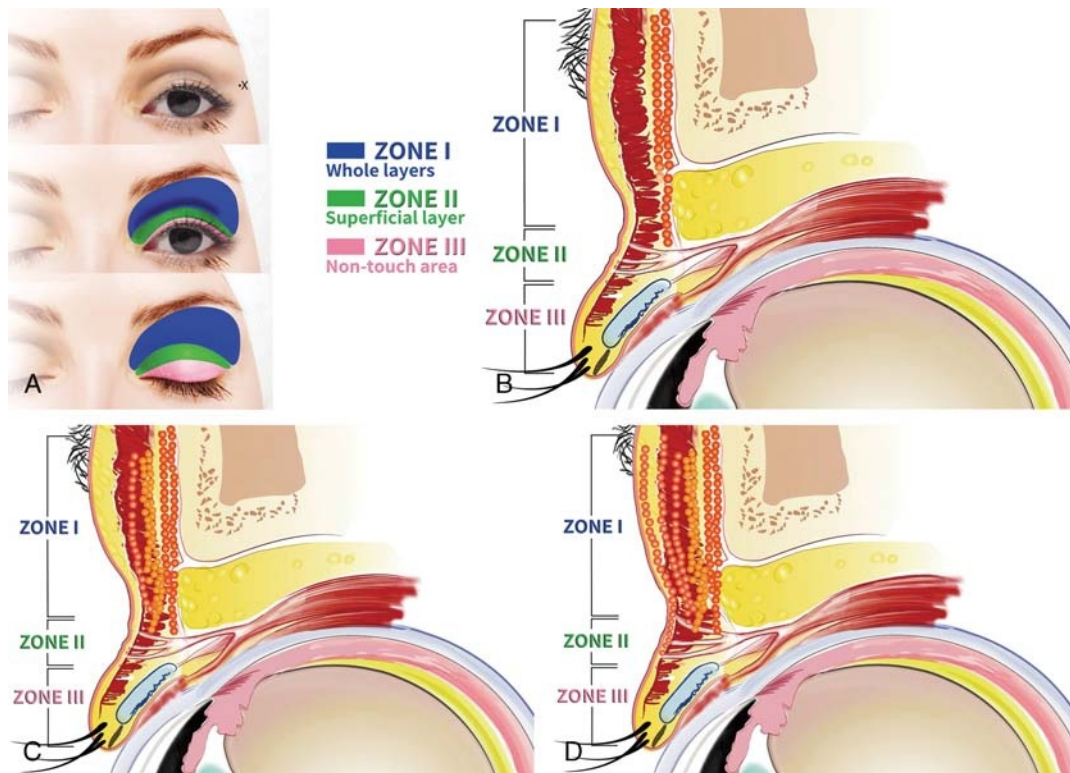
We performed MAFT on case 1 with the assistance of MAFT-GUN in his sunken upper eyelids with multiple folds (see video, Supplemental Digital Content 1, <http://links.lww.com/SAP/A152> which demonstrates MAFT procedure) and found our results to be inconclusive.

**RESULTS**

The MAFT technique was performed in 34 patients (58 eyelids) (30 female patients and 4 male patients, the average age was 35.4 years) with the assistance of a MAFT-GUN during a 3-year period starting from March 2010. The average operative time was 24.5 minutes, and the average injected amount of fat grafting was 1.4 and 1.5 mL for the right and left eyes, respectively. No morbidities, such as fibrosis, nodulation, or visual impairment, were noted, but minor swelling and ecchymosis occurred and recovered completely 7 to 10 days after surgery. The average follow-up duration was 18.5 months, and all patients have noted the fullness of their sunken eyes and a neof ormation of double eyelid crease. Figures 3–5 showed 3 examples of long-term follow up cases. Four patients (12% of 34 cases) including case 3 (Fig. 5A–B) had a secondary touch-up MAFT to enhance the eyelid crease.

**DISCUSSION**

The eyelid anatomy varies between Asian and Occidental populations in many aspects.<sup>16–18</sup> Two primary techniques exist for creating a double eyelid crease: the external incision method and the suture method, with variable modifications in either way. The external incision method cuts along the new crease arch and fixes the levator aponeurosis



**FIGURE 2.** A, Three zones in a sunken upper eyelid, where zone I is the deepest area (indicated in blue); zone II (indicated in green) is the area from the lower margin of zone I to the lowest eyelid crease in a case of multiple folds, or to an assumed eyelid crease in a case of unobvious crease; and zone III (indicated in pink) is the area from the upper ciliary margin to zone II. Zone I consists of several layers (deeper, middle, and superficial layers) where surgeons can transplant the fat. In zone II, only a superficial layer is transplanted, and the lowest is on lowest insertion of levator aponeurosis or an assumed eyelid crease about 6 to 8 mm from upper ciliary margin (D). In zone III, no fat transplantation was performed.



**FIGURE 3.** A 35-year-old male patient with sunken upper eyelids and multiple folds (A, left). One year after a single MAFT session (right/left eyelid: 1.2/1.5 mL), the fullness and double eyelid crease was maintained with a desirable outcome (B, right). Close-up view showed that the sunken eyelids with multiple folds (B, upper) were recontoured and double eyelids appeared apparently (B, lower).

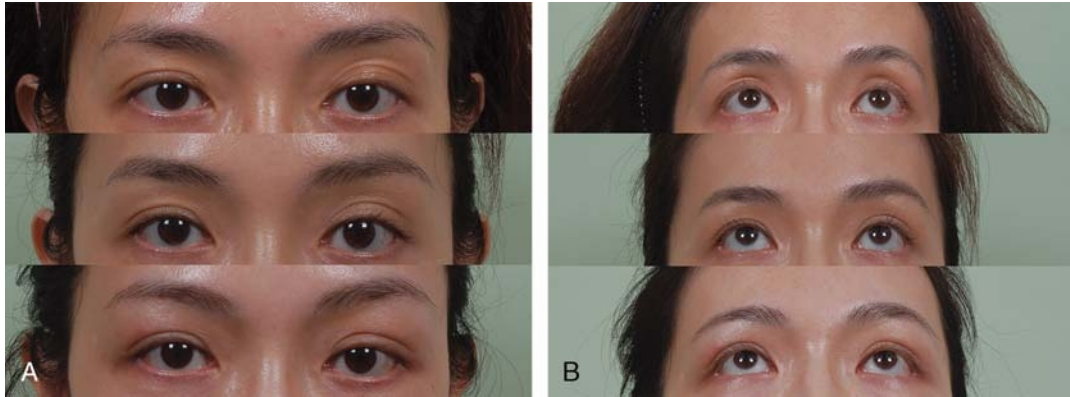
to the dermis, creating a crease while the eyes are open. The suture method creates a crease in the eyelid with a kink by buried, full-thickness sutures.<sup>16</sup>

Fat grafting is a surgical procedure that has been performed for over 12 decades.<sup>19</sup> The common morbidities include unpredictable survival or retention rate, fibrosis, abscess, nodulation, and irregularity in the recipient sites.<sup>20</sup> In 1994, Coleman reported a technique of structure fat graft that demonstrated desirable results in periorbital lipoinfiltration.<sup>7</sup> However, in particular, in locations, such as the periorbital area, each fat parcel had to be grafted in amounts as small

as 1/50 mL to 1/30 mL for optimal results; all surgeons who have attempted this technique have found this challenging. If the fat parcel were grafted in amounts larger than 1/30 mL, misplacements would become irreversible. Carpaneda claimed that, regardless of the shape of the fat graft (spherical or cylindrical), a circumambient zone of  $1.5 \pm 0.5$  mm in the grafting margin improves the survival rate.<sup>21</sup> On the basis of these theories, Lin et al advocated the MAFT technique and developed a patented instrument (Fig. 1) for clinical usage in fat grafting to ensure each of the deliver parcel would be tiny to 1/240 mL (Table 1).<sup>11–15,22</sup>



**FIGURE 4.** A 32-year-old female patient requested both augmentation of her upper eyelid hollowing and creation of a new double eyelid crease (A, left). One session of MAFT (right/left eyelid: 1.8/2.2 mL) produced a natural double crease with fullness in the upper eyelids, as revealed in a follow up after 3 years (A, right). Left quarter view (B, left; pre- and right, post-MAFT), right quarter view (C, left, pre- and right, post-MAFT) and close-up (D; upper, pre- and lower, post-MAFT) demonstrated the effect was reliable and long term.

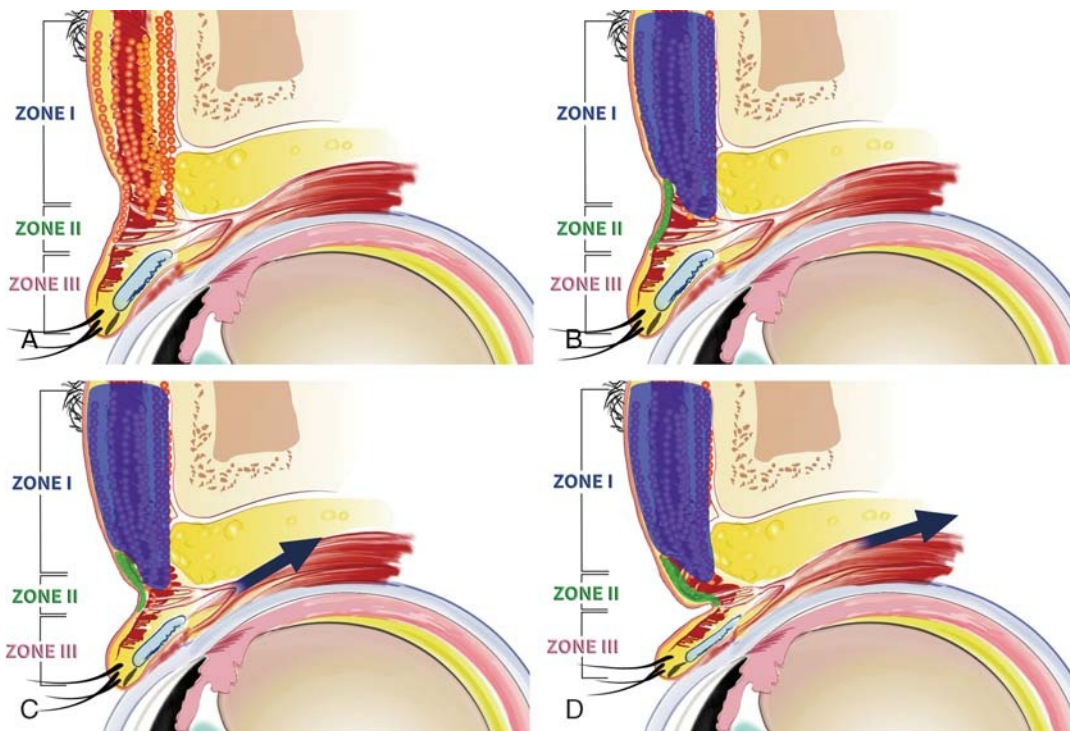


**FIGURE 5.** A 44-year-old female patient with sunken eyelids and multiple folds (asymmetric and more obvious in left) (A, upper) had underwent first MAFT (right/left eyelid: 0.5/1.0 mL) postoperatively 6 months (A, middle) asked for more fullness of sunken eyelid and evidence of double crease. Therefore, the second MAFT (right/left eyelid: 1.5/1.8 mL) was performed. Two years after second touch-up MAFT showed nice re-contouring of her eyes (A, lower). Look-up view demonstrated the efficacy of MAFT in the pre- (B, upper), 6 months after first MAFT (Fig. 5b, middle) and 2 years after second MAFT (Fig. 5b, lower).

**TABLE 1.** The Volume of a Spherical at a Radius of 1.0, 1.5, and 2.0 mm Is Calculated as 4.2, 14.1, and 33.5 mm<sup>3</sup>, Respectively

Radius	Volume of Spherical	Total Injection Frequency for Each 1 mL (1000 mm <sup>3</sup> ) Fat Graft
1.0 mm	4.2 mm <sup>3</sup>	1000 ÷ 4.2 = 240
1.5 mm	14.1 mm <sup>3</sup>	1000 ÷ 14.1 = 70
2.0 mm	33.5 mm <sup>3</sup>	1000 ÷ 33.5 = 30

Therefore, the total injection frequency of 1 mL (1000 mm<sup>3</sup>) of fat is 240, 70, and 30 in sequence.



**FIGURE 6.** A, The condition after MAFT correction of a sunken upper eyelid with multiple folds. The volume of transplanted fat circled in blue demonstrates the MAFT for zone I (B). The thin fat layer circled in green is zone II (B). These 2 zones conjugate into one entity. When the eyes open, a crease is created naturally between zone II and zone III (C, D).

In upper-eyelid hollowing, the space necessitating augmentation is limited and therefore difficult for placing small fat parcels. Therefore, unavoidable dislodgement of larger parcels during grafting and subsequent central necrosis does occur. The instrument used in this study, the MAFT-GUN, facilitated surgeons in adjusting and maintaining each delivered fat parcel in amounts as small as 1/240 mL. While triggering the MAFT-GUN, the fat volume was precise, consistent, and controlled to be transplanted. By avoiding possible central necrosis, potential morbidities, such as visible nodulation, fibrosis, or uneven surfaces, were prevented. The sunken volume was therefore reconstructed to fullness, and the accuracy of the grafting technique demonstrated the advantages of the MAFT technique.

The mechanism by which MAFT effectively reconstructs the hollowness of the sunken upper eyelid and simultaneously forms a double eyelid crease is described as follows. The vacant space of zone I (Fig. 2A–D) was transplanted with fat parcels from the deep layer to the middle and top layer to augment the volume. Each tiny fat parcel (1/240 mL) was structurally transplanted as a bulking agent to fill the original hollowness. In zone II (Fig. 2A–D), a thin layer was transplanted between the lower margin of zone I and the lowest lid crease (or along the presumptive crease). Zones I and II conjugated and blended integrally after MAFT. Zone III remained untransplanted; therefore, a conformation like the boundary along zones II and III might take place. When the eyes opened, the levator aponeurosis contracted to lift the insertion fibers, causing a crease to appear (Fig. 6A–D, and also see animation, Supplemental Digital Content 2, <http://links.lww.com/SAP/A153>).

## CONCLUSIONS

This study developed an easy, simple, and reliable procedure on the basis of the MAFT technique for correction. Candidates in their 20s to early 40s with sunken upper eyelids (typically deficient in the preseptal or pretarsal fat pads) and multiple folds but no redundant skin (dermatochalasis) had superior results. The advantages of MAFT in such clinical candidates not only included the recontouring of the hollowness but also the recreation of a double eyelid crease with sustainable long-term effects, further confirming that this strategy is a suitable alternative. Tentative mechanisms indicated that a double eyelid crease can be created and that the rejuvenated appearance for eyelid hollowness can be effectively maintained.

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## REFERENCES

1. Mikamo K. A technique in the double eyelid operation. *J Chugainpo*. 1896; 17:1197.
2. Uchida K. The Uchida method for the double eyelid operation in 1,523 cases. *Jpn J Ophthalmol*. 1926;30:593.
3. Maruo M. Plastic construction of a 'double eyelid'. *Jpn Rev Clin Ophthalmol*. 1929;24:393–406.
4. Moon KC, Yoon ES, Lee JM. Modified double-eyelid blepharoplasty using the single-knot continuous buried non-incisional technique. *Arch Plast Surg*. 2013; 40:409–413.
5. Fan J, Low DW. A two-way continuous buried-suture approach to the creation of the long-lasting double eyelid: surgical technique and long-term follow-up in 51 patients. *Aesthetic Plast Surg*. 2009;33:421–425.
6. Kim HS, Hwang K, Kim CK, et al. Double-eyelid surgery using septoaponeurosis junctional thickening results in dynamic fold in Asians. *Plast Reconstr Surg Glob Open*. 2013;1:1–9.
7. Coleman SR. The technique of periorbital lipoinfiltration. *Oper Tech Plast Reconstr Surg*. 1994;1:120–126.
8. Seiff SR. The fat pearl graft in ophthalmic plastic surgery: everyone wants to be a donor! *Orbit*. 2002;21:105–109.
9. Frileck SP. The lumbrical fat graft: a replacement for lost upper eyelid fat. *Plast Reconstr Surg*. 2002;109:1696–1705.
10. Lee Y, Kwon S, Hwang K. Correction of sunken and/or multiply folded upper eyelid by fascia-fat graft. *Plast Reconstr Surg*. 2001;107:15–19.
11. Lin TM, Lin SD, Lai CS, et al. The treatment of nasolabial fold with free fat graft—preliminary concept of Micro-Autologous Fat Transplantation (MAFT). In 2nd academic congress of Taiwan Cosmetic Association, Taipei; 2007.
12. Chou C, Lin TM, Chou CK, et al. Micro-autologous fat transplantation (MAFT) for the correction of sunken temporal fossa—long term follow up. *J IPRAS*. 2013;9:25–27.
13. Chou C-K, Lin T-M, Chiu C-H, et al. Influential factors in autologous fat transplantation—focusing on the lumen size of injection needle and the injecting volume. *J IPRAS*. 2013;9:28–29.
14. Lin TM, Lin TY, Chou CK, et al. Introduction the concept of micro-autologous fat transplantation (MAFT) and its application in correction of sunken upper eyelid. *Plast Reconstr Surg Global Open*. 2014;2:e259.
15. Lin T-M. Chapter 11: total facial rejuvenation with micro-autologous fat transplantation (MAFT). In: Pu L-Q, Chen Y-R, Li Q-F, et al., eds. *Aesthetic Plastic Surgery in Asians: Principles and Techniques*. 1st ed. St. Louis: CRC Press; 2015:127–146.
16. Chen WP, Park J-D. Asian upper lid blepharoplasty: an update on indications and technique. *Facial Plast Surg*. 2013;29:26–31.
17. Jeong S, Lemke BN, Dortzbach RK, et al. The Asian upper eyelid: an anatomical study with comparison to the Caucasian eyelid. *Arch Ophthalmol*. 1999;117: 907–912.
18. McCurdy JA Jr. Upper blepharoplasty in the Asian patient: the “double eyelid” operation. *Facial Plast Surg Clin North Am*. 2002;10:351–368.
19. Neuber F. Fettransplantation. *Bericht über die Verhandlungen der Dt Ges f Chir Zbl Chir*. 1893;22:66.
20. Khawaha H-A, Hernández-Pérez E. Fat transfer review: controversies, complications, their prevention and treatment. *Int J Cosmet Surg Aesth Dermatol*. 2002; 4:131–138.
21. Carpaneda CA, Ribeiro MT. Percentage of graft viability versus injected volume in adipose autotransplants. *Aesthetic Plast Surg*. 1994;18:17–19.
22. United States Patent No. US 7,632,251 B2.