Correction of Sunken Upper-Eyelid Deformity in Young Asians by Minimally-Invasive Double-Eyelid Procedure and Simultaneous Orbital Fat Pad Repositioning: A One-Year Follow-up Study of 250 Cases

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Abstract

Background: Double-eyelid procedure to construct a supratarsal fold is the most common aesthetic surgery in young Asian adults. More complex surgical procedures, such as fat grafting or filler injection, are often indicated during traditional, long-incision, double-eyelid procedures to achieve better aesthetic results for patients with hollowness of the upper eyelids.

Objectives: The authors sought to determine the efficacy of minimally-invasive double-eyelid procedures with concurrent repositioning of the orbital fat pads to correct sunken upper eyelids in young Asian adults.

Methods: The study included 250 patients treated between June 2008 and July 2103. Preoperatively, all patients complained of upper-eyelid hollowness and had positive findings on a lower-eyelid compression test. All patients underwent a minimally-invasive double-eyelid procedure plus repositioning of orbital fat.

Results: After the minimum follow-up period of 1 year, the overall patient satisfaction rate was 76%. The relapse rate was 10% within the first year, and the complication rate was 8%.

Conclusions: This minimally-invasive combination procedure may be an option for young Asian adults who have single upper eyelids and sunken eyes. The surgery resulted in a natural double eyelid and more youthful orbital appearance in the majority of patients in this study. Proper patient selection and evaluation, including lower eyelid compression testing, are essential to achieve long-term correction.

Level of Evidence: 4

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The double-eyelid operation is the most common aesthetic surgery among young Asian adults. Various modifications of traditional surgical techniques, including cutting or suturing methods, reportedly have yielded more permanent folds and fewer unfavorable complications. The advantages and disadvantages of a given surgical technique may correlate with each surgeon’s skill level and experience. For Asians with single eyelids, a common goal among double-eyelid operations is to construct a more persistent supratarsal fold and achieve more aesthetically pleasing eyes.

In the last decade, the concept of minimally-invasive surgery has been introduced in double-eyelid blepharoplasty. The validity of a shorter-incision, cutting-type surgery is supported by several highly-skilled surgeons who have achieved long-lasting and satisfactory aesthetic outcomes. However, for young Asian adults with single eyelids in addition to sunken upper eyelids, ancillary surgical procedures to correct...
the hollowing, such as autologous fat transfer or filler injection, usually are combined with a conventional double-eyelid procedure. This more complex eyelid condition requires the shorter-incision cutting surgery, a highly challenging and difficult technique. In the present study, we describe our experience and success with a minimally-invasive double-eyelid procedure combined with simultaneous repositioning of the orbital fat pads in patients with sunken upper eyelids. With this single-stage combination procedure, traditional long-incision cutting surgery can be avoided.

**METHODS**

This study was comprised of 250 Asian young adults patients who sought a minimally-invasive double-eyelid procedure and correction of sunken eyes were included in this study and were treated between June 2008 and July 2013. All patients provided written informed consent. Patients were screened preoperatively with a compression test of the lower eyelid (Figure 1). Patients not concerned about sunken eyes, or whose compression test results were negative, were not eligible for participation. All surgical procedures were performed by the senior author (C-CC).

The hollowness was primary in 179 patients, posttraumatic in 25 patients, and secondary to blepharoplasty in 28 patients. The other 18 patients had a history of massive weight loss. Of the 179 primary cases, 80 had a history of allergic rhinitis.

**Technique**

Prior to the procedure, a small incision (0.5-0.8 cm) was marked by a fine-tip pen in the center of the upper eyelid, along the simulated supratarsal fold, at the patient’s desired height. Approximately 0.5 mL of local anesthetic solution (2% lidocaine with 1:200,000 epinephrine) was infiltrated subdermally in the incision line on each side. After a 5-minute wait to allow for the vasoconstriction effect of epinephrine and the hydro-dissection effect of the local anesthetic, the surgery commenced, aided by magnifying surgical loupes. A number 11 surgical blade was utilized to create the small incision. Dissection was performed with a microsurgical tissue scissor down to the surface of the tarsal plate and the aponeurosis of the levator (Figure 2). The small skin incision served as the surgical window of the upper eyelid and was tractioned by double-prong hooks in four directions to fully expose the excursion surface of the aponeurosis and depressed area. Care was taken to avoid injury or severing of the aponeurosis.

The pre-aponeurotic space is a potential space that can be widely undermined and dissected up into the orbital cavity. At this point in the surgery, a lower-eyelid compression test was performed with the index finger to push the orbital fat pads (which are covered by the thin membranous orbital septum) forward and slide them into the potential space. Through the small incision in the upper eyelid, the orbital septum was cut by a tissue scissor to expose the underlying fat pads. Occasionally, some adhesion fibers or a scarring band around the orbital septum may be encountered, which must be divided to release the tethering retraction (Figure 3). The exposed fat pads can be delivered outside the orbital cavity by fine-tip tissue forceps to reach the eyelid incision. Both the medial (nasal) and central (preaponeurotic) compartments of the orbital fat pads can be mobilized further and delivered forward to the surface of the aponeurosis at the pre-undermined area. Again, lower-eyelid compression may facilitate the delivery process. If the medial side of the upper eyelid is severely sunken, the pedicle base of the fat pad can be severed laterally and partially by electro cautery and be transposed medially to provide tension-free filling of the...

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**Figure 1.** This 25-year-old woman was assessed preoperatively with the lower-eyelid compression test. (A) Oblique view shows depression of the left upper eyelid, with deep superior sulcus. (B) The left upper eyelid appears puffy when the eye is closed. (C) Gentle compression of the left lower eyelid with a finger produces flattening and improved appearance of the deep superior sulcus; therefore, her test result was positive. Repositioning of orbital fat pads may be indicated in blepharoplasty for correction of sunken upper eyelids.
Figure 2. The minimally-invasive double-eyelid procedure performed in a 28-year-old woman. (A) A small incision (<1 cm long) is made along the skin crease, in the center of the upper eyelid. (B) The pre-aponeurotic space is dissected and traced upwards to expose the glistening surface of aponeurosis of the levator. (C) The orbital septum can be cut to expose the underlying orbital fat pads. (D) The orbital fat pads are delivered forward from the orbital cavity by tissue forceps. The lower-eyelid compression test may be useful to facilitate harvesting. (E) The medial compartment of the fat pad is dissected and mobilized. (F) The central compartment of the fat pad is dissected and mobilized.

Figure 3. Surgical technique of adhesiolysis. (A) A 26-year-old woman; adhesion fibers around the orbital septum that may limit the transposition of fat pads should be identified and released. (B) A 32-year-old woman; an abnormal scarring band, which compressed the fat pad, was noted and dissected.
The supratarsal fold is constructed by anchorage fixation of the aponeurosis to the inferior dermal edge of the skin incision by 3 sutures of 7-0 nylon. The transposed fat pads are draped smoothly on the surface of the aponeurosis. The distal portion of fat pad is inset to the nasal depressed area without tension. The middle portion of the fat pad is fixated to the aponeurosis and along the small wound by 3 mattress sutures of 7-0 nylon. The small wound is closed by 2 or 3 sutures of 7-0 nylon, which can be removed 5 days later. Patients received routine follow-ups at 1 month, 3 months, and 1 year for evaluation of the aesthetic outcome.

The level of patient satisfaction was measured by a 5-point scale (satisfactory, acceptable, average, fair, and poor) during follow-up interviews conducted with patients in the clinic or over the telephone by a senior nurse. (A copy of the questionnaire is available online as Supplementary Material).

RESULTS

The age range of the 250 patients was 19 to 36 years (mean, 28 years). Most patients were female (n = 220), and most cases were bilateral (n = 155). The follow-up period ranged from 1 to 5 years (mean, 15 months). The patients rated the surgical result after the 1-year follow-up as satisfactory in 76% (n = 190), acceptable in 4% (n = 10), average in 0 (n = 0), fair in 18% (n = 45), and poor in 2% (n = 5) of cases.

At the 1-year follow-up, 190 patients (76%) had a satisfactory aesthetic result at (Figures 5-7 and Supplementary Figures S1-S3).

Within the first postoperative year, 25 patients experienced relapse (unilateral or bilateral) of upper-eyelid depression. The relapse rate was 10%. To improve the recurrent depression, 8 patients underwent revision surgery consisting of repeat orbital fat-pad transposition, performed through the same wound, with acceptable results. The repeat orbital fat-pad transposition was refused by 12 patients, who instead underwent autologous free-fat grafting to improve the hollowness. The remaining 5 patients refused all revision procedures.

Minor complications such as suture extrusion, hematoma, mild fold asymmetry, and temporary chemosis were experienced in 20 patients. The complication rate was 8%. No diplopia, strabismus, or other significant complication was reported. An overall satisfaction rate of 76% was achieved by this single-stage, minimally-invasive surgery.

DISCUSSION

The shorter-incision double-eyelid procedure performed by some Asian plastic surgeons entails minimally-invasive surgery intended to decrease incisional scarring, recovery time, and the complications commonly associated with a traditional full-cutting double-eyelid procedure. An ancillary procedure, such as the extraction of excessive orbital fat and plication of the aponeurosis of the levator, also can be performed through a single, small incision. Long-term aesthetic outcomes and fold permanence are reportedly comparable to those achieved by the full-cutting method. Moreover, the small-incision technique can result in natural-appearing double-eyelid folds and a scar that is virtually invisible. Although this minimally-invasive surgery is challenging to perform, it has gained greater popularity and acceptance among young adults at our institution in recent years.

The upper-eyelid depression associated with the single eyelid is frequently encountered in aesthetic practice. Fat loss in the upper eyelid may produce an aged and unnatural appearance for young adults. The hollowness caused by the deep superior sulcus and “skeletonized” eye makes the
The double-eyelid fold operation is more complex. Because the severity of hollowing varies among patients, a simple suturing or cutting double-eyelid procedure alone may not be sufficient to create a satisfactory result. Some physicians advocate adjuvant injection of filler (such as hyaluronic acid) in mild cases to replace the volume of eyelid depression, which produces an immediate cosmetic effect. However, early recurrence may appear weeks or months later, due to the rapid absorption of most fillers. The cumulative cost of repeated filler injections is high and may not be affordable to all patients. Some plastic surgeons support autologous free-fat grafting or fascial fat grafting in moderate to severe cases, and long-term effects have been promising. However, such treatments require a donor site (making them more invasive) as well as complex surgical techniques.

In some patients with upper-eyelid depression, both the medial and central compartments of the orbital fat pads may become very mobile. A common clinical phenomenon is present in these patients: when opening their eyes and looking forward, the upper eyelids become sunken, as if the orbital fat is deficient. The upper-eyelid skin envelope may deflate due to the lack of support and the expanding volume of fat pads. Multiple wrinkles or folds may appear. Paradoxically, when these patients close their eyes, the upper eyelids become puffy and bulge, meaning that the fat pads still exist and are even abundant. Although this clinical observation has not been proven anatomically, it indicates that the fat pads of these patients can slide back and forth along the pre-aponeurotic space, from the orbital cavity to the palpebral skin. This suggests that the sliding fat pads could be identified and harvested as a natural filler to fill the sunken area during blepharoplasty. Furthermore, upper-eyelid depression coupled with lower-eyelid “bags” is not uncommon in Asian patients with allergic rhinitis. In our study, 45% of patients with primary hollowness had a history of allergic rhinitis since childhood. These patients are presented with upper-eyelid depression during their adult life.

Figure 5. A 28-year-old woman with bilateral sunken eyelids. (A) Preoperative photograph. (B) Immediately after bilateral fat pad repositioning. Minimal swelling and bruising are apparent. (C) One week postoperatively. (D) One year postoperatively. Note the natural supratarsal fold and improved contour of the upper eyelid.
often present with an aged-eye appearance in early adulthood. The association between allergic rhinitis and upper-eyelid hollowness should be clarified by further studies.

The lower-eyelid compression test is a simple and effective method to determine whether sufficient fat exists for harvesting, transposition, and replacement. Because the orbital walls are rigid and the orbital contents are pliable, the compressible fat comes forward, into the upper eyelid, when gentle pressure is applied to the lower eyelid with a finger or pen. If this gentle force produces significant bulging of the upper eyelid in patients with sunken eyes, orbital fat-pad repositioning may be a feasible surgical alternative. If the compression test result is not significantly positive or only borderline positive, the amount of orbital fat may be inadequate for successful correction of the hollowness. In such cases, the outcome of fat repositioning may be suboptimal or unfavorable, and therefore other methods to correct the sunken eyelids should be considered.

There are many advantages to simultaneous fat-pad repositioning and the minimally-invasive double-eyelid procedure. The surgery is performed in just one stage, and the recovery period is short. Hollowness can be partially improved by the volumetric enhancement from supratarsal fold plication and the better layout of skin with muscle bunching. Moreover, in Asian patients, the fat pad is transposed to its original anatomic position of palpebral skin. The fat pad is soft and pliable enough to form a smooth and natural contour for the double-eyelid fold. The edge or border of the fat pad is not overly demarcated and thus is not visible or palpable. This repositioned fat pad is not a free-fat graft but rather a pedicled adipose tissue flap with an intact and reliable vascular supply. It is able to maintain long-term correction if secure tension-free fixation of the fat pads has been achieved. If fibrosis or absorption of the fat pad can be minimized, relapse is less likely to occur. The high patient satisfaction rate in our study may indicate

Figure 6. A 30-year-old woman with bilateral sunken eyelids of differing severity. (A) Preoperative photograph. (B) Immediately after bilateral fat pad repositioning. (C) One week postoperatively. (D) One year postoperatively. Mild relapse of the right upper eyelid is apparent.
the long-term viability of the repositioned fat pads, with minimal or low absorption of fat.

It has been reported that orbital adipose-derived stem cells from the medial and central fat pads have the potential to differentiate into adipocyte and other cell lineages. The medial fat pad is highly abundant in neural crest progenitor cells. Further studies are warranted to clarify the long-term consequence of filling efficacy by the pluripotent stem cells after transposition of orbital fat pads.

Although the traditional upper blepharoplasty (using fat transposition to fill the orbite-glabellar groove) has produced successful long-term results in elderly patients, the younger patients seen at our institution prefer the shorter incision and minimally-invasive technique. However, this method also has limitations. Only properly-selected patients may benefit from this procedure; therefore, appropriate patient selection is mandatory to achieve patient satisfaction and a favorable aesthetic outcome. If the result of the lower-eyelid compression test is not significantly positive, the volume of the transposed fat pads may not be sufficient, resulting in post-transposition tension that may be too high to hold the fat pads in place. In such cases, relapse of the eyelid depression will be inevitable. During preoperative consultation, patients should be advised that adjuvant filler injection or free-fat grafting may be necessary to achieve the desired outcome.

When harvesting fat pads through a small surgical window, meticulous dissection with microsurgical techniques and the release of any adhesion fibers around the fat pads are essential to achieve an optimal result. In patients with a history of previous periorbital trauma, more adhesion fibers or bands may exist, which must be identified during dissection and divided. Caution must be exercised to ensure adequate pocket dissection above the pre-aponeurotic space at the depressed area, as well as tension-free transposition of the fat pads. In some patients, the most depressed area is the

Figure 7. A 36-year-old woman with bilateral sunken eyelids (of different severity) and unilateral ptosis. (A) Preoperative photograph. (B) Immediately after minimally invasive double-eyelid procedure, plication of aponeurosis, and repositioning of the orbital fat pads. (C) One week postoperatively. (D) One year postoperatively. Note the symmetric double-eyelid folds and improved contour.
medial aspect of the upper eyelid, which is difficult to fill by the medial fat pad alone. In such cases, the pedicle base of the central fat pad can be severed partially, by fine-tip electrocautery, to permit further advancement and placement without high tension.

Cases of failed double-eyelid procedures with sunken-eye lid complications are common for most plastic surgeons who perform this procedure. Free-fat grafting from another donor site is usually required in conventional long-incision revision surgeries. However, such complications may be addressed by a minimally-invasive surgery in which the supratarsal fold is reconstructed through a short incision. If the lower-eyelid compression test produces a positive result, it may be possible to harvest the residual orbital fat pads for transposition, allowing them to serve as fillers for depression as well as an interposed graft after adhesiolysis.

In the present article, we reported our preliminary experience with a minimally-invasive double-eyelid procedure plus simultaneous orbital fat-pad repositioning in selected Asian patients with sunken upper eyelids. In most cases, a very aesthetically-pleasing upper-eye lid contour was achieved by this combination procedure. The overall patient satisfaction rate was 76%. The relapse rate was 10%. Although the complication rate was 8%, all adverse events were mild and transient. We acknowledge that the rates of relapse and complications are relatively high. Greater refinement of the surgical technique and enhanced patient selection may increase the satisfaction rate and reduce the relapse rate. Surgeons who are well-trained in minimally-invasive eyelid surgery may consider offering this single-stage treatment option to patients who are appropriate candidates. Larger series and longer follow-ups are necessary to fully elucidate the clinical utility of this combination surgery.

It is important to emphasize that our study represents only preliminary findings and thus should be regarded solely as a phase 1 trial. There was no blinding or randomization in this study. The improvements reported are strictly subjective, and blinding was not utilized in the assessments. More randomized, controlled trials and meta-analyses should be performed to compare the effectiveness of different techniques of double-eyelid procedure for correction of sunken eyes in Asian patients.

CONCLUSIONS

A minimally-invasive double-eyelid procedure with simultaneous orbital fat-pad repositioning may be appropriate for carefully-selected Asian patients who present with single eyelids and sunken eyes. This single-stage operation may provide a natural-looking double eyelid and improve upper-eye lid contour. Patient selection by proper clinical assessments is imperative to achieve favorable long-term results, as is tension-free transposition of the fat pads during surgery.

Supplementary Material

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