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Modified Lower Blepharoplasty with Fat Repositioning via Transconjunctival Approach to Correct Tear Trough Deformity

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Abstract

Background Over the years, many techniques have been described to correct tear trough deformity (TTD). Fat-repositioning lower blepharoplasty via a transconjunctival approach is increasingly applied due to its satisfactory rejuvenating effect. However, those methods have disadvantages such as a complicated surgical approach, residual scar, and long recovery time.

Objectives We modified the surgical technique of fat-repositioning transconjunctival lower blepharoplasty with an effective but easy internal fixation method via a supraperiosteal approach.

Methods From January 2014 to December 2017, 110 patients underwent bilateral modified lower blepharoplasty with fat-repositioning. Preoperatively, the grade of TTD was evaluated according to Barton's grading system. Postoperative results and complications were assessed during the follow-up period.

Results TTD was ameliorated in 97.73% of the cases; the remaining 2.27% cases with no improvement underwent revision and achieved Grade 0 on Barton's grading system thereafter. All patients were satisfied with the final outcome. Few postoperative complications were observed, none of which led to a permanent condition. Three cases of local depression and one case of local bulge were treated with surgical refinements. One case of postoperative hemorrhage was healed by electrocautery.

Conclusions Our modified method of transconjunctival lower blepharoplasty with fat repositioning is safe and effective to improve TTD without severe orbital skin laxity.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Tear trough deformity · Lower blepharoplasty · Fat repositioning · Transconjunctival approach

Introduction

Tear trough deformity (TTD) is one of the noticeable aging signs in the infraorbital region. Age-related orbital fat herniation and prolapse, thinning of orbicularis retaining ligament, laxity of the orbicularis muscle and skin, and malar retrusion are attributed to this aesthetic problem. Many techniques such as excess fat pad removal [1], autologous fat grafting [2], and intraorbital fat repositioning [3, 4] have been used to correct TTD. Traditional lower

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blepharoplasty with excess fat pad removal can only attenuate TTD, and a sunken, hollow lower eyelid appearance may occur as an unwanted side effect [5]. Percutaneous injection with autologous fat is a minimally invasive method to improve TTD, but it may not last long given the resorption of the grafted fat tissue [6, 7]. Fat repositioning is an advocated technique to address the concave appearance in the infraorbital region and create a more satisfactory rejuvenation effect [8]. Although several modified techniques of fat repositioning have been reported in the past 30 years [4, 6, 8, 9], there is still no effective and easy internal fixation method. In the present study, we describe a modified surgical technique of fat repositioning for transconjunctival lower blepharoplasty with internal fat-flap fixation via a supraperiosteal approach.

Patients and Methods

Between January 2014 to December 2017, patients who underwent a modified transconjunctival lower blepharoplasty with fat-repositioning with a minimum follow-up of 6 months were included. Ethical approval was given by the ethics committee at our institution and written informed consent was obtained from all patients. Patients with both various degrees of TTD and small protrusions of the eye pocket met the inclusion criteria. Patients with obvious skin or orbicularis oculi muscle excess and laxity, or a history of any prior eyelid surgery that could influence our surgical outcome were excluded. All the surgeries were performed by the same senior surgeon.

The TTD and aging characters were assessed using details of the physical examination and preoperative photographs (CANON EOS80D) in the horizontal plane. Two board-certified plastic surgeons independently evaluated the grade of TTD according to Barton's grading system [10] (Table 1). As the eyes were not completely symmetrical, patients may have shown different Barton's grades in different eyes. Therefore, we evaluated each eye independently in this study. The results were evaluated by postoperative photographs, and the safety of our surgical approach was assessed by complications, including infection, contour irregularities, hematoma, residual TTD, local depression and hemorrhage.

Surgical Procedures

The tear trough and fixation points of orbital fats were drawn with a surgical marking pen with the patient in an upright, sitting position. The fixation points were usually designed approximately 0.4 cm below the tear trough, corresponding to the medial and central orbital fat pads (Fig. 1a) Then, the patient was prepped and draped. In brief, 1 mL of local anesthetic containing 2% lidocaine with 1:200,000 epinephrine was injected through the infraorbital foramen for infraorbital nerve anesthesia. Then, 1 mL of the same anesthetic mixture was infiltrated through the inferior fornix transconjunctivally to reinforce the anesthesia. A 2-cm-long conjunctival incision on the lower edge of the tarsal plate was made. Along the deep layer of the orbicularis oculi muscle, dissection was carried until the periosteum was reached at the arcus marginalis, where the orbicularis retaining ligament was released, and the central and medial orbital fats were extruded across the lower eyelid. Next, a blunt dissection in the supraperiosteal plane was made using periosteal stripping, taking care not to damage the levator labii superioris alaeque nasi and levator labii superioris. Dissection was made 0.5–1 cm below the inferior orbital rim to avoid any potential damage to the surrounding nerves [11], and to create an infraorbital pocket to collect the released orbital fat. Precise sculpting of the fat could be performed if necessary, depending on the volume of the inferior orbital space and the amount of fat. After flattening the fat, the part that measured larger than the dissected area was generally debulked. Commonly, medial and central fat pads were repositioned, while the lateral fat pad was reserved.

A metal conductor was inserted into the inferior orbital pocket from the conjunctival incision. Then, a 23-G needle

Table 1 Barton's grading system

Grade	Anatomic analysis
0	Absence of medial and lateral lines demarcating the arcus marginalis or the orbital rim, a smooth youthful contour without a transition zone at the orbit-cheek junction
I	Mild, subtle presence of a medial line or shadow: smooth lateral transition of lid-cheek junction
II	Moderate prominence of a visible demarcation of the lid-cheek junction, extending from medial to lateral
III	Severe demarcation of the orbit-cheek junction, with an obvious step between the orbit and the cheek

Reprinted with permission from Barton et al. [10]. Fat extrusion and septal reset in patients with tear trough triad: a critical appraisal. Plast Reconstr Surg 113(7): 2115–2121; discussion 2122–2113. https://journals.lww.com/plasreconsurg/com

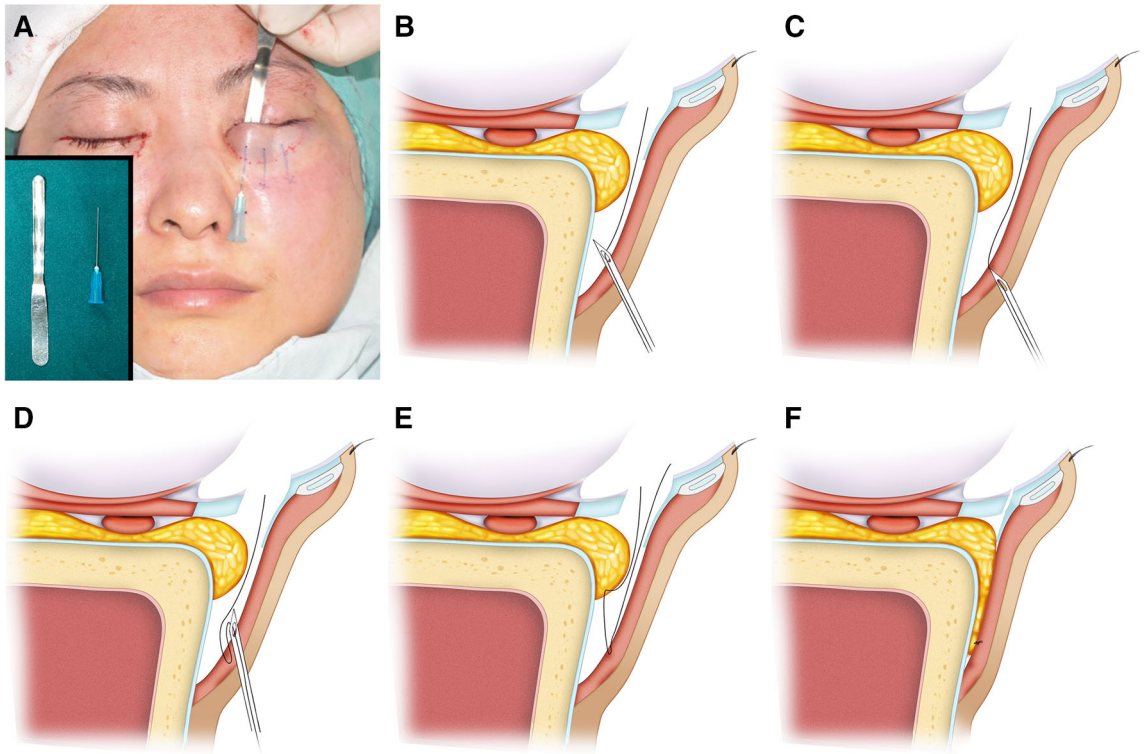

Fig. 1 Surgical technique of fat-flap fixation. **a** A 23-G needle was punctured into the skin from the predesigned marked point with the guidance of a metal conductor. **b** A 6-0 nylon thread was threaded into the needle tip in the transconjunctival incision and left from the needle end. **c** The needle was drawn back without leaving the skin. **d** The needle was deflected a little and punctured into the skin again. **e** When the needle tip came out from the incision, the nylon thread was pulled out and the needle was withdrawn. **f** The fat pad was then sutured with the thread

was perpendicularly punctured into the skin from the marked fixation point predesigned on the skin surface until touching the metal conductor (Fig. 1a). With the guidance of the conductor, the needle passed through the dissected pocket and came out from the conjunctival incision. Holding the needle in the conductor, a 6-0 polydioxanone synthetic absorbable (PDS) suture was threaded into the needle tip in the transconjunctival incision, through the length of needle, then left from the needle end. The needle was drawn back slowly to exit the skin until 2.8 cm out of the total 3 cm of its length was exposed. Then, the needle was punctured perpendicularly into the skin again but slightly changing the angle of the needle, with caution taken not to cut through the PDS suture. The tip touched and moved along the metal conductor, then came out of the conjunctival incision again. The PDS suture was pulled out from the needle tip, the needle and conductor were withdrawn afterward. By this approach, the PDS suture was tied to the soft tissue that was 2 mm deep to the surface of skin. After another end of the suture was threaded through the orbital fat pad, the PDS suture was tied, by which the orbital fat pad was then pulled into the dissected pocket and anchored to the corresponding position of the marked point (Fig. 1b–f). The conjunctival incision did not require sutures.

Results

A total of 110 patients (7 men and 103 women) with a mean age of 32.7 years (range 21–40 years) were included in this study. The mean follow-up period was 25.3 months (range 6–55 months). A total of 110 patients (220 eyes) were available for follow-up, with 82 eyes of Grade I, 98 eyes of Grade II, and 40 eyes of Grade III (Table 2). Seventy-eight (95.12%) of the 82 eyes that were categorized as Grade I in preoperative evaluation improved from Grade I to 0, whereas 4 (4.88%) eyes showed no obvious improvement (Fig. 2). Similarly, 78 (79.59%) eyes of the 98 that were categorized as Grade II improved to Grade 0, whereas 19 (19.39%) eyes improved to Grade I, and 1 (1.02%) showed no obvious improvement (Fig. 3). Thirty-one (77.50%) of the 40 eyes that were categorized as Grade III improved to Grade 0, and 9 (22.50%) improved to Grade I (Fig. 4).

No significant complications occurred postoperatively in any patient. Five cases with unobvious improvement were

Table 2 Preoperative and postoperative Barton's Grades of 110 patients

Preoperative Barton's grades, *n* (%)		Postoperative Barton's grades			
		Grade 0, *n* (%)	Grade I, *n* (%)	Grade II, *n* (%)	Grade III, *n* (%)
Grade I	82 (37.27)	78 (35.45)	4 (1.82)	0 (0.00)	0 (0.00)
Grade II	98 (44.55)	78 (35.45)	19 (8.64)	1 (0.45)	0 (0.00)
Grade III	40 (18.18)	31 (14.10)	9 (4.09)	0 (0.00)	0 (0.00)
Total, *n* (%)	220 (100.00)	187 (85.00)	32 (14.55)	1 (0.45)	0 (0.00)

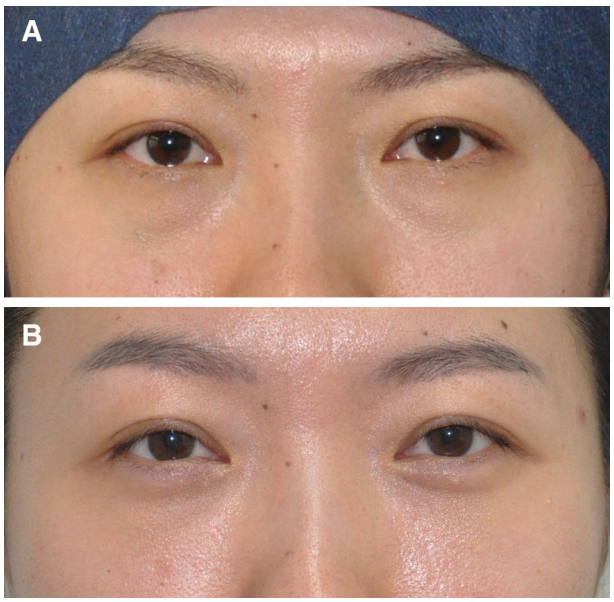

Fig. 2 A 28-year-old female patient with improvement from Grade I to Grade 0 after a modified transconjunctival lower blepharoplasty with fat-repositioning. Upper: Preoperative photograph. Lower: Photograph demonstrating disappearance of lid bag and smoothing of the TTD 6 months after surgery

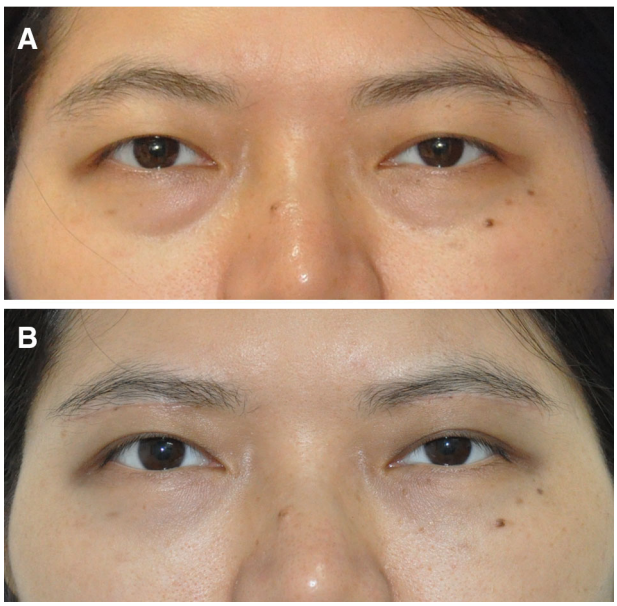

Fig. 3 A 38-year-old female patient with improvement from Grade II in right eye and Grade I in left eye to Grade 0 in both eyes after a modified transconjunctival lower blepharoplasty with fat-repositioning. Upper: Preoperative photograph. Lower: Photograph showing disappearance of lid bag and smoothing of the TTD 6 months after surgery

due to inadequate initial excision of the orbital fat and were revised with transconjunctival excess fat excision, following which the results were improved to Grade 0. Hemorrhage of the operation area occurred in one case a week after the surgery and was healed by electrocautery. Local skin depression at the fixation point occurred in three cases and was revised by surgical adjustment. Five patients showed temporary paralysis as a result of local anesthesia, which lasted for a day and resolved spontaneously. Local bulging of repositioned fat occurred in one case and was solved by surgical extraction of redundant fat. It was noted that various degrees of bruising and local swelling of the fat pocket occurred in half of the cases, but usually disappeared within 3–14 days. None of the patients experienced a lumpy appearance or descent midface that required further revision.

After revision, amelioration of TTD was achieved in all cases, and all patients were satisfied with the final outcome.

Discussion

TTD is considered a result of herniation of orbital fat, atrophy of skin and subcutaneous fat, laxity of the orbicularis muscle, thinness of the orbicularis retaining ligament, and malar retrusion from decreased prezygomatic fat [10]. Many techniques have been used to correct TTD, including nonsurgical treatment [12, 13], excess fat pad removal [1], autologous fat grafting by lipoinjection [2], and intraorbital fat repositioning [3, 4]. Nonsurgical treatment such as hyaluronic filler is popular among patients who prefer noninvasive approaches, but it is only suitable for those with minimal skin laxity. The common complications of this technique are contour irregularities and granulomas, which require surgical revision that the patients formerly avoided [12, 13]. Conventional excision of excess intraorbital fat cannot sufficiently correct contour

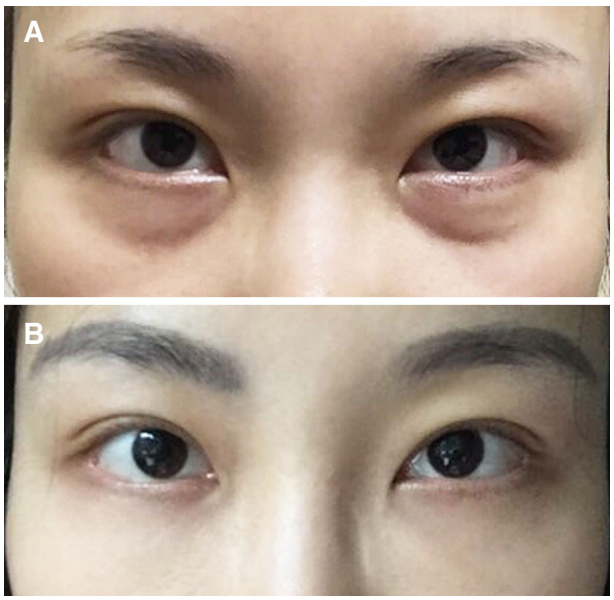

Fig. 4 A 31-year-old female patient with improvement from Grade III to Grade 0 after a modified transconjunctival lower blepharoplasty with fat-repositioning. Upper: Preoperative photograph. Lower: Photograph demonstrating disappearance of lid bag and smoothing of the TTD 6 months after surgery

irregularities [14]. Moreover, it may result in unwanted concavity of the lower eyelid [15]. Autologous tissue transplantation has the advantage of less trauma, quick recovery, and lower cost [16]. Percutaneous lipoinjection can smoothen the lower eyelid contour by a minimally invasive procedure. Chiu et al. reported that autologous fat grafting is suitable for the treatment of mild TTD without obvious skin or orbicularis oculi muscle laxity [17]. However, poor vascularity of these grafts can result in significant resorption [18], and ischemic fat grafts may increase the risk of granuloma formation [6, 7]. Moreover, fat grafting is not suitable for patients who have both skin laxity and TTD [17]. Fat repositioning was first introduced by Loeb [6], and further modified in the past three decades [4, 8, 10, 14, 19]. The main idea is by repositioning the herniated intraorbital fat to fill the depressed groove, combined with releasing the orbicularis retaining ligament to reset the orbicularis muscle and overlying subcutaneous fat and skin [4, 8, 10, 14, 19].

Two planes, including the supraperiosteal plane and the subperiosteal plane, can be chosen to reposition the intraorbital fat. Dissecting through the subperiosteal plane is considered to result in less bleeding and provide more adequate space for intraorbital fat repositioning [9, 20]. However, it is difficult to anchor the repositioned fat to the inelastic overlying periosteum in the narrow field through the transconjunctival incision [9]. Also, various degrees of repositioned fat hardening have been reported in the subperiosteal approach, which are assumed to be associated with resorption of the fat tissue due to decreased perfusion [4, 9].

An advantage of the supraperiosteal approach is that the better blood supply of the supraperiosteal plane may enhance the survival of fatty tissue, with more stable long-term effects [16]. However, abundant vascularity of the supraperiosteal plane may result in more bleeding, in addition to transection of the angular vessels [3–5]. In our experience, bleeding can be controlled by bluntly dissecting the angular vessels to enter the plane below the orbicularis oculi. The supraperiosteal plane is also much easier to dissect than the subperiosteal plane, especially in Asian populations [16, 21]. Moreover, the supraperiosteal approach can provide good exposure and enables a relatively easy repositioning of the fat flap with internal fixation [16]. However, in contrast to the subperiosteal approach, skin irregularities over the tear trough area after fat reposition in the supraperiosteal plane may be seen because of the more superficial dissection in the supraperiosteal approach [21]. Liao et al. reported that there is a slightly lumpy appearance in the initial weeks and some hardening of the fat pocket in the first 2 months after fat repositioning via supraperiosteal dissection, but these side effects usually resolve by 6 months after surgery [16]. In accordance with previous reports [16, 17], one of our cases presented a prolonged postoperative lower-lid bulge that was diagnosed as orbital fat excess. The problem was solved by excision of redundant orbital fat. In our experience, the volume of the released orbital fat pads should be measured in cases with large eye pockets. To assure a smooth appearance after surgery, the volume of each fat pad that is reserved in the pocket should be no more than 1×2 cm, and the redundant part of fat pads required resection. Another concern in using a supraperiosteal approach is the proximity to the infraorbital nerve, which may be injured during the dissection. Careful dissection to a level no more than 10 mm below the orbital rim can reduce the risk of infraorbital nerve injury [11, 16]. In our study, a supraperiosteal dissection was made at a level of 5–10 mm below the orbital rim, and the needle tip was penetrated from the lower border of the dissected pocket. None of the patients presented extended infraorbital nerve dysfunction, except five patients who developed temporary paralysis for 1 day postoperatively, which was likely a result of local anesthesia.

The supraperiosteal dissection with internal fat-flap fixation can allow the repositioned fat to be fanned out over the tear trough with low risks of retraction [16]. Furthermore, long-term maintenance of internal buried sutures is considered a prerequisite for the stability of repositioned fat [9]. However, using hemostatic forceps and thread to anchor the repositioned fat with a conventional internal fixation method can be a difficult task in the narrow

dissected space. In the present study, we modified the internal fixation method by a combined application of a 23-G needle and metal conductor, which fixed the buried sutures easily in the narrow space and did not result in a visible cutaneous scar. Furthermore, compared with a conventional internal fixation, our modified method not only allows the position of the fixation point to be designed directly on the skin but also enables the buried sutures to be easily fixed on the predesigned position. It is worth noting that despite the protective metal conductor, eyeball puncture should still be cautiously avoided when applying this method. The assistant should keep his attention on the needle tip during the whole procedure.

In the present study, we observed local depression at the position of the fixation point in one case. This unexpected complication may be due to the relatively superficial subcutaneous fixed position. Thus, we emphasize that the withdrawn length of the 23G needle should be no more than 2.8 cm to keep the line at least 2 mm under the skin's surface (the whole length of needle is 3 cm). Another possible reason may be that the subcutaneous fixed knot is too tight, which should be avoided. We used 6-0 PDS suture (Ethicon, Inc.) in later cases instead of 6-0 Prolene polypropylene suture (Ethicon, Inc.) as in the early cases. The PDS thread degrades in 6 months, by then the released orbital fat has formed scar tissue and adhered to the surrounding tissue. Hence, the degradation of PDS thread does not induce fat retraction. Absorbable threads could prevent local skin depression in the long-term follow-up and this complication did not occur ever since.

However, in our experience, the transconjunctival approach combined with our unique internal fat-flap fixation method is suitable for younger or middle-aged patients without excess skin. For older patients with flabby lower eyelid skin, the transcutaneous approach is preferable.

Conclusion

For TTD without severe orbital skin laxity, the modified surgical technique of fat repositioning with a transconjunctival lower blepharoplasty and internal fat-flap fixation via a supraperiosteal approach is safe and has a pleasant cosmetic outcome.

Compliance with Ethical Standards

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

Ethical Approval Ethical approval was given by the ethics committee at our institution and written informed consent was obtained from all patients.

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