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ORIGINAL ARTICLE OCULOPLASTIC

# Conjoint Fascial Sheath Suspension for Severe Blepharoptosis through Palpebral Margin Incision

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## Abstract

*Background* Conjoint fascial sheath suspension can achieve pleasing surgical efficacy and dynamic eyelid movement in the treatment of severe ptosis. In recent years, the palpebral margin incision technique has been applied for double-eyelid blepharoplasty, which is characterized by inconspicuous scarring, short convalescence, and natural-looking outcome. However, studies of the application of this technique in the treatment of ptosis are scarce. This article aims to evaluate the efficacy and safety of conjoint fascial sheath suspension for treating severe blepharoptosis through palpebral margin incision.

*Methods* From March 2019 to January 2021, 32 patients (37 eyelids) underwent treatment with the modified technique. Preoperatively, levator muscle function and margin reflex distance 1 were documented. Correction effects, symmetry results, and complications were also evaluated postoperatively.

*Results* Adequate or normal correction was achieved in 33 eyelids (89.2%), and 31 patients (96.9%) obtained good or fair symmetry results. Common complications were undercorrection and conjunctival prolapse, which were both observed in four eyelids (10.8%), followed by overcorrection and hematoma.

*Conclusions* The modified technique provides physical eyelid elevation and inconspicuous scarring and is effective for treating severe ptosis. Satisfactory functional and esthetic results could be obtained simultaneously without severe complications.

*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** Blepharoptosis · Conjoint fascial sheath · Palpebral margin incision · Levator muscle

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## Introduction

Blepharoptosis refers to abnormal drooping of the upper eyelid [1]. The ptotic eyelid can result in unappealing appearance and visual disturbances, such as amblyopia and strabismus [2]. Severe ptosis is defined as eyelid drooping of 4 mm or more from the normal level [3]. Many surgical techniques have been reported, such as combined excision of the levator muscle and tarsus, maximal anterior levator resection and frontalis muscle flap suspension [4–8]. Frontalis suspension is the most frequently selected

technique; however, it has many drawbacks, such as lagophthalmos, unnatural eyelid movement, increased forehead furrows, and high recurrence rate [9, 10]. Therefore, a more suitable technique is in need.

The levator muscle is responsible for physiological elevation of the upper eyelid. In the correction of ptosis, resection of 4–5 mm of the levator muscle can result in 1 mm elevation of the upper eyelid. In cases of severe ptosis, levator function is usually poor, and resection of large amounts of the levator muscle can result in conjunctiva prolapse and corneal exposure [11, 12]. In addition, unsatisfactory correction results, such as undercorrection, are common with excessive levator resection [9]. In these circumstances, conjoint fascial sheath (CFS) suspension emerges as an alternative.

The CFS, also known as the "check ligament," is a fibrous tissue that contains collagen, elastin, and smooth muscle fibers. It lifts the upper eyelid in the same direction as that of the levator muscle, which is preferable for postoperative eyelid movement [13]. The CFS was first applied for the correction of blepharoptosis in 2002 by Holmström and Santanelli [14]. In 2019, Zhou developed the technique of minimally invasive CFS suspension for treating mild and moderate ptosis [15]. In 2020, Xing and Wang performed combined CFS–levator muscle complex suspension for severe ptosis [16].

The existing methods of treating severe blepharoptosis can be classified as full-incision methods, which form a double eyelid through a high incision line. A main disadvantage of these methods is the discernible scar formation of the eyelid crease, especially with the eyes closed. Postoperative swelling of the upper eyelid is also evident. In consideration of the demands for esthetic appearance, the palpebral margin incision technique, a new method for double-eyelid blepharoplasty, is worth recommendation [17, 18].

In this article, we introduce a procedure of CFS suspension for the treatment of severe blepharoptosis through a palpebral margin incision. The technique is characterized by dynamic eyelid movement and inconspicuous scarring of eyelid creases. This study aimed to assess the efficacy and safety of this modified technique.

## Methods

### Patients

This is a retrospective study, and 32 patients who underwent CFS suspension through palpebral margin incision performed by the same surgeon were enrolled from March 2019 to January 2021. The inclusion criteria were unilateral or bilateral congenital severe blepharoptosis (lid drooping 4 mm or more), consent to primary eyelid surgery, and follow-up for 6–12 months. Patients with negative Bell's phenomenon, superior rectus dysfunction, dysthyroid ophthalmopathy, myasthenia gravis, or Marcus Gunn jaw-winking syndrome were excluded. Written consent was obtained from all patients or their guardians, and the study followed the principles of the Declaration of Helsinki.

### Pre- and Postoperative Evaluation

Preoperative evaluation included levator muscle function and margin reflex distance 1 (MRD1). Levator muscle function was measured by Berke's method, which blocked the movement of the frontalis muscle [19, 20]. MRD1, the distance between the corneal light reflex and the level of the center of the upper eyelid margin in neutral gaze [21], was regarded as the main standard for assessment of correction. If the drooping eyelid covered the light reflex, the eyelid was raised until the reflex was seen, and the distance that the eyelid was raised was documented as the MRD1 in negative numbers.

Postoperative evaluation was performed during the follow-up visit. The MRD1 of the operated side was measured, and ptosis correction was considered adequate if MRD1 was $\geq$5 mm, normal if 5 mm > MRD1 $\geq$4 mm, and undercorrected if MRD1 was <4 mm. Symmetry was evaluated as follows. A difference between bilateral upper eyelid margins <1 mm was considered a good result; a difference between bilateral upper eyelid margins between 1 and 2 mm (including 1 mm) was considered a fair result; and a difference between bilateral upper eyelid margins >2 mm was considered a poor result [9]. Postoperative results were evaluated by a patient satisfaction survey. The esthetic outcome and incision scar were rated as satisfactory, fair, or unsatisfactory. The incidence of complications, including overcorrection, undercorrection, hematoma, exposure keratitis, and conjunctival prolapse, was also recorded postoperatively.

### Surgical Technique

Preoperatively, an incision line (line A) located 1.5 mm above the lash line was marked along the upper eyelid with methylene blue. Another incision line (line B) was marked above line A. The distance between lines A and B depended on the laxity of the upper eyelid skin, and the excised skin was spindle shaped. The eyelid crease line (line C) was planned according to the patient's preference and skin laxity (Fig. 1A). Local infiltration anesthesia by 2% lidocaine with 1:100,000 epinephrine was applied by subcutaneous injection. The incisions were made along lines A and B, and part of the skin and the orbicularis oculi muscle was removed. Then the orbital septum was opened,

and the orbital fat was dissected to expose the levator aponeurosis–Müller's muscle composite (Fig. 1B). When searching for the CFS, the 2% lidocaine without epinephrine was injected under the conjunctiva if necessary. The composite was detached from approximately 3 mm above the tarsus with a width of 1–1.5 cm, forming a pedicle flap, upward to the superior conjunctival fornix, and the CFS was exposed (Fig. 1C). After the redundant aponeurosis on the tarsus was excised, the CFS was sewn to approximately 2 mm below the upper margin of the tarsus using 3-0 silk sutures (Fig. 1D). The patient was told to sit up and open their eyes to recheck the level of the upper eyelid margin. In unilateral blepharoptosis, the corrected eyelid margin should be 1 mm higher than that of the unaffected side. In bilateral cases, the corrected eyelid margin should be 1 mm above the upper margin of the cornea. The suture was knotted when a satisfactory eyelid level was achieved, and two additional sutures were placed at the medial and lateral sides of the middle suture. By turning the eyelid with a retractor, the projection on the posterior surface of the orbicularis oculi muscle vertically from line C was confirmed, and an incision was made along the projection to expose the dermis (Fig. 1E). The dissected levator flap was sequentially sutured to the broken ends of the orbicularis oculi muscle and the dermis by three to five stitches using 8-0 nylon sutures, forming a double eyelid (Fig. 1F). The curve and symmetry of the bilateral eyelid creases were examined, and the skin incision was closed with interrupted 8-0 nylon sutures (Fig. 1G). Finally, a Frost suture of the lower eyelid was made using 3-0 silk to protect the cornea, and standard postoperative care was prescribed. The diagram of the surgical procedure is presented in Fig. 2.

### Statistical Analysis

Statistical analysis was performed with IBM SPSS version 23.0 (IBM Corp., Redmond, WA, USA). Measurement values are presented as mean ± standard deviation. Differences in MRD1 values before and after surgery were analyzed by the paired *t*-test. Differences were considered statistically significant at $P < 0.05$.

## Results

Thirty-two patients (37 eyelids) with severe blepharoptosis, including 8 men and 24 women, were treated by this technique. The patients' ages ranged from 20 to 42 years (average, 27 years); 27 patients had unilateral ptosis and 5 had bilateral ptosis (Table 1). The average preoperative MRD1 and levator muscle function values were 0.79 ± 0.86 mm and 2.16 ± 1.01 mm, respectively (Tables 1 and 2).

The mean follow-up period was 8 months (range, 6–12 months). The average postoperative MRD1 was 4.71 ± 0.52 mm, a significant difference from preoperative MRD1 ($P < 0.05$) (Table 2). With regard to correction effects, 18 eyelids (48.6%) had adequate correction, 15 (40.5%) had normal correction, and 4 (10.8%) had undercorrection. With regard to symmetry results, 23 patients (71.9%) had good results, 8 patients (25%) had fair results, and 1 patient (3.1%) had poor results (Table 3).

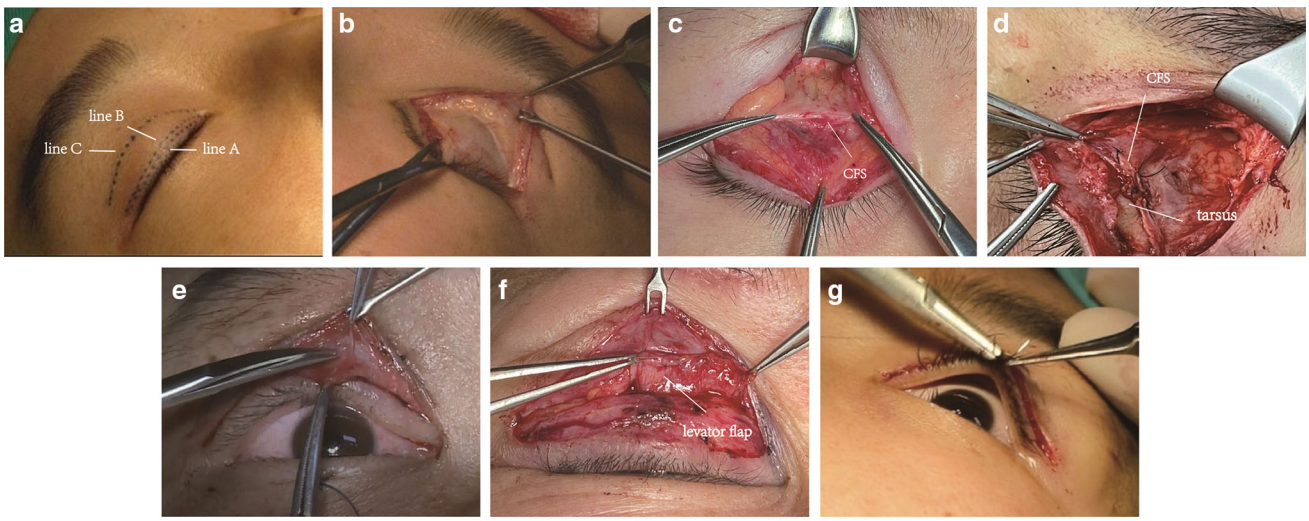


**Fig. 1** Operative procedure of CFS suspension combining levator flap linkage. **A** Sign of the eyelid incisions (a and b) and eyelid crease line (c). **B** Exposure of the levator aponeurosis–Müller's muscle composite and tarsus. **C** Dissection of levator muscle to expose CFS. **D** Suspension of the tarsus to CFS. **E** The orbicularis oculi muscle is incised to expose the dermis. **F** The levator flap is sutured to the broken ends of the orbicularis oculi muscle and the dermis. **G** The incision is closed with interrupted sutures.

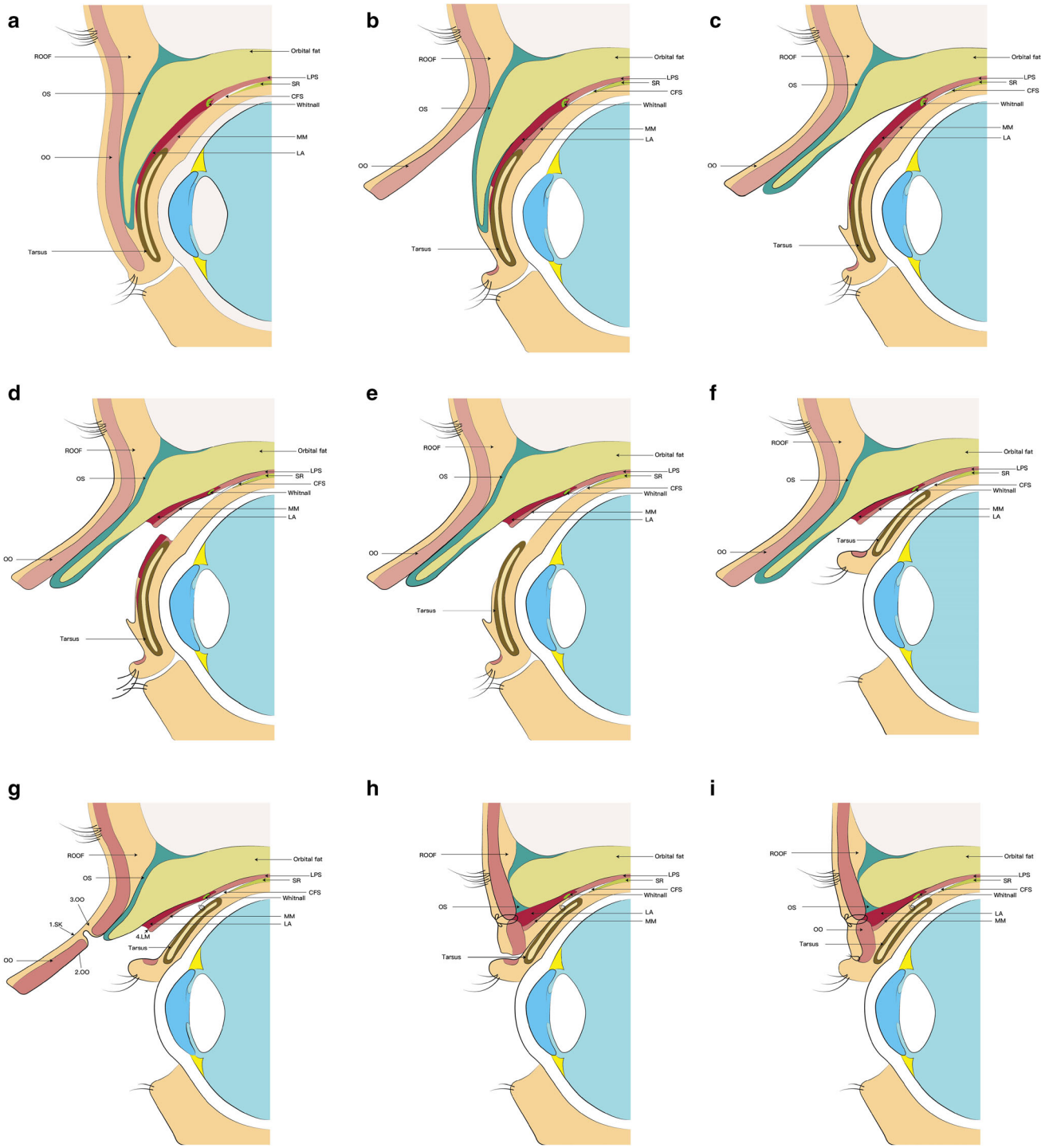


**Fig. 2** Diagram of operative procedure. **a** The anatomy of the upper eyelid. **b** Dissection of the skin and the orbicularis oculi, dissection of levator muscle and exposure of CFS. **c** Exposure of the levator aponeurosis–Müller's muscle composite and tarsus. **d** Detachment of the composite from the tarsus and formation of the levator flap. **e** Exposure of the CFS and excision of the redundant aponeurosis on the tarsus. **f** Suspension of CFS to the tarsus. **g** The orbicularis oculi muscle is incised to expose the dermis. **h** Linkage of the levator flap to the orbicularis oculi muscle and the dermis. **i** Closure of the skin incision. ROOF, retro-orbicularis oculi fat; OO, orbicularis oculi; OS, orbital septum; LPS, levator palpebrae superioris; SR, superior rectus; CFS, conjoint fascial sheath; SR, superior rectus; MM, Müller's muscle; LA, levator aponeurosis; SK, skin.

**Table 1** Dermographics and preoperative evaluation of patients

| Patients' information | Number |
|---|---|
| Sex | |
| Male | 8 |
| Female | 24 |
| Age | |
| 20-30 | 23 |
| 30-40 | 8 |
| >40 | 1 |
| Unilateral | |
| Left eye | 15 |
| Right eye | 12 |
| Bilateral | 5 |
| Levator function of eyelids (mm) | |
| 0-1 (including 0) | 11 |
| 1-2 (including 1) | 11 |
| 2-3 (including 2) | 12 |
| 3-4 (including 3) | 3 |

**Table 2** MRD1 value

| Preoperative MRD1 (mm) | Postoperative MRD1 (mm) | *P* value |
|---|---|---|
| 0.79 ± 0.86 | 4.71 ± 0.52 | <0.05 |

*$P$ value <0.05 was considered statistically significant

Twenty-eight patients found the esthetic outcome satisfactory, 3 patients found it fair, and 1 patient found it unsatisfactory because of undercorrection and poor symmetry results. Three patients with undercorrection found the esthetic outcome satisfactory because their preoperative levator function was <1 mm. Twenty-six patients found their incision scars satisfactory, 6 found them fair, and no patient found them unsatisfactory (Tables 4 and 5).

Postoperative complications included two eyelids (5.4%) with overcorrection, four eyelids (10.8%) with undercorrection, four eyelids (10.8%) with conjunctival prolapse (10.8%), and one eyelid (2.7%) with hematoma. There were no eyelids with exposure keratitis (Table 6). One patient who was unsatisfied with undercorrection underwent levator muscle resection combined with CFS suspension. Two patients with overcorrection did not require a revision. The other complications received postoperative treatment, such as eye lubricants and ice packs, and were resolved spontaneously.

## Typical Cases

*Case 1:* A 32-year-old man presented with severe bilateral blepharoptosis. The preoperative MRD1 value was −0.6 mm of his left eyelid and −0.8 mm of his right eyelid, and his bilateral levator muscle function was 1 mm. The patient underwent the described technique and returned for a 6-month follow-up assessment, which showed a normal correction result and good symmetry (Fig. 3).

*Case 2*: A 28-year-old woman suffering from severe unilateral blepharoptosis received the described technique. The preoperative MRD1 value was -0.7 mm, and her levator muscle function was 1 mm. Six months later, the two eyelids presented a normal correction result and good symmetry (Fig. 4)

## Discussion

Among traditional surgical approaches for severe blepharoptosis, frontalis suspension is the most frequently advocated method. However, it often causes unnatural movements of the upper eyelids and results in bothersome complications, such as lagophthalmos, exposure keratitis, and obvious forehead furrows. In addition, high rates of recurrence and low rates of satisfaction have been reported [22, 23]. These less satisfactory results may be largely due to the external orbital lifting force of the frontalis muscle.

The CFS is the fascial fusion part of the superior rectus and levator muscles and attaches to the conjunctival sac at the level of the superior fornix [13, 24, 25]. It is 8–14 mm long, 0.5–1.5 mm wide, and 1–1.2 mm thick [14, 25]. The CFS alone suspension reported by Holmström and Santanelli in 2002 marked a new approach to ptosis correction [14]. As mentioned above, the movement of the upper eyelid is mainly powered by the levator muscle. According to the anatomy of the eyelid, the main driving force of the CFS comes from the superior rectus muscle, which moves parallel to the levator muscle [13]. Therefore, it can also lift the upper eyelid in a physiological manner. Compared with the frontalis muscle, it provides better coordination of the movements of the eyelid and eyeball.

**Table 3** Correction and symmtery results

| Ptosis correction results *n* (%) eyelids | | | Symmetry results *n* (%) cases | | |
|---|---|---|---|---|---|
| Adequate | Normal | Undercorrection | Good | Fair | Poor |
| 18 (48.6) | 15(40.5) | 4 (10.8) | 23 (71.9) | 8 (25) | 1 (3.1) |

**Table 4** Postoperative patient satisfaction survey

| Satisfaction degree | | Evaluation standard |
|---|---|---|
| Satisfactory | Aesthetical outcome | Ptosis becomes normal when preoperative levator function ≥1 mm or becomes mild when preoperative levator function <1 mm; good or fair symmetry results |
| | Incision scar | Linear incision scar inconspicuous in color and texture |
| Fair | Aesthetical outcome | Ptosis becomes mild when preoperative levator function ≥1 mm; good or fair symmetry results |
| | Incision scar | Minor scar formation |
| Unsatisfactory | Aesthetical outcome | Ptosis becomes moderate or remains severe; poor symmetry results |
| | Incision scar | Hypertrophic scar |

**Table 5** Analysis of patient satisfaction

| | Aesthetical outcome | Incision scar |
|---|---|---|
| Satisfactory (patients n. and %) | 28 (87.5%) | 26 (81.3%) |
| Fair (patients *n*. and %) | 3 (9.4%) | 6 (18.8%) |
| Unsatisfactory (patients *n*. and %) | 1 (3.1%) | 0 (0%) |

**Table 6** Complications *n* of eyelids (%)

| | |
|---|---|
| Overcorrection | 2 (5.4%) |
| Under-correction | 4 (10.8%) |
| Conjunctival prolapse | 4 (10.8%) |
| Hematoma | 1 (2.7%) |
| Exposure keratitis | 0 (0%) |

The palpebral margin incision technique was first introduced in 2018 [17]. The advantages of this technique are as follows: The upturned lashes and eyelash roots can mask the incision, resulting in inconspicuous scarring even at the early postoperative stage; the incision will eventually be an inconspicuous dermatoglyph, leaving the eyelid crease natural and esthetic; the upper eyelid skin is kept relatively complete and the vascular network injury is limited, which reduces the time of postoperative recovery; the surgeon can remove excess skin and subcutaneous tissue through the incision, indicating that this technique is particularly suitable for patients with bulgy or slack upper eyelids.

Our technique is the first to apply the palpebral margin incision in the treatment of severe blepharoptosis. In our procedure, the levator aponeurosis is dissected to expose the CFS, and after correction of the ptosis, the broken end of the levator flap is connected to the dermis and

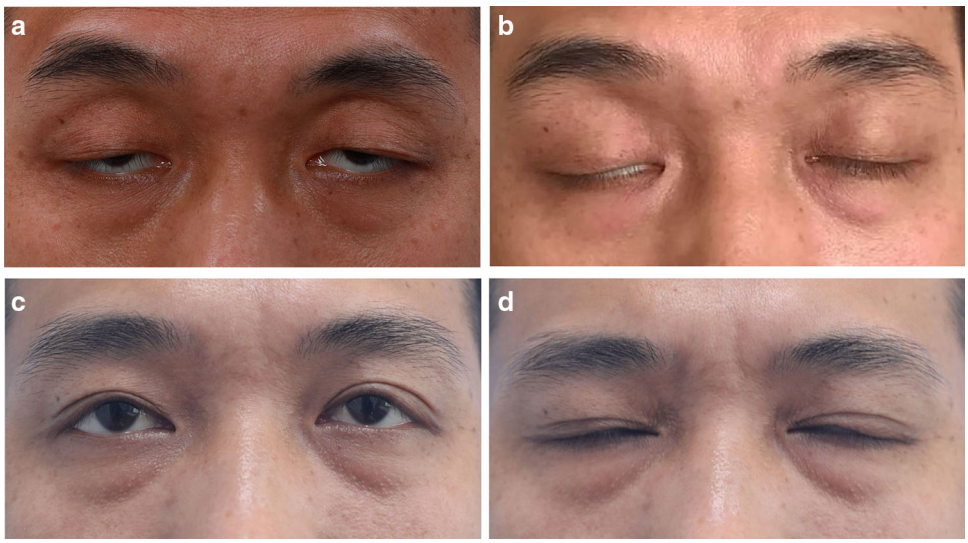


**Fig. 3** A 32-year-old man presented with severe bilateral blepharoptosis who underwent the described surgery and achieved good outcomes. **a** Preoperative straight-ahead gaze **b** Preoperative closure of eyes **c** 6 months postoperative result with eyes open **d** Postoperative closure of eyes

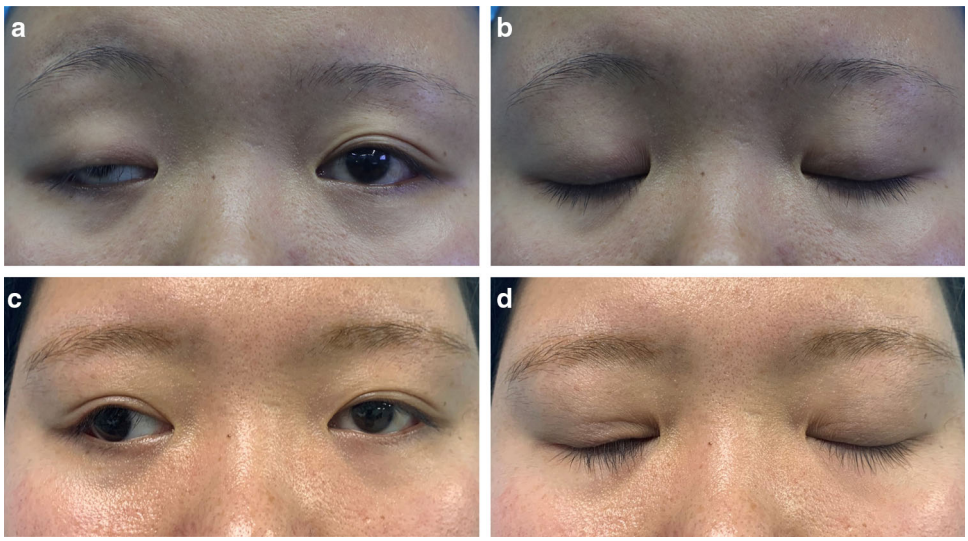


**Fig. 4** A 28-year-old woman presented with severe unilateral blepharoptosis who underwent the described surgery and achieved good outcomes. **a** Preoperative straight-ahead gaze **b** Preoperative closure of eyes **c** 6 months postoperative result with eyes open **d** Postoperative closure of eyes

orbicularis oculi muscle to form a double eyelid. Simulating the anatomic factors responsible for eyelid crease formation, this approach can avoid a high-position incision and utilize the already dissected levator flap. Compared with the "nonincisional" technique reported by Tae Joo Ahn [26], which was indicated in patients who had mild or moderate ptosis, our technique tended to focus on patients with severe blepharoptosis. During the operation, we could intuitively adjust the position of CFS suspension according to the height of the upper eyelid, and the efficacy and safety were satisfactory according to the follow-up.

In addition to these advantages, the frontalis muscle is not involved in the operation, and the structures of the eyebrows remain intact, resulting in less tissue injury. Moreover, eyelid elevation is not powered by the frontalis muscle, which reduces the appearance of forehead furrows [25, 27]. Another advantage of our technique is that it can be a revision procedure for patients who have undergone primary surgery. The CFS can be easily sewn to the tarsus after careful dissection of the eyelid tissues, and the limited anatomic scope makes the procedure quick and repeatable.

The skin incision should not be located too close to the palpebral margin to avoid damage to the lash follicles. According to previous reports and our experience, an incision 1.0–1.5 mm above the lash line is recommended [17, 18]. Care should be taken to protect the lash root when clamping tissues with surgical instruments.

During the surgery, the levator aponeurosis is detached from 3 mm over the superior border of the tarsus to avoid damaging the vessels of the tarsus, thus reducing the operating time. In our experience, we observed that dissection along the posterior surface of the superficial tissues facilitated detachment of the CFS. If a satisfactory eyelid margin has been achieved after suspending the tarsus to the CFS, the flap is utilized to form an eyelid crease, as mentioned above; otherwise, levator advancement should be performed. In addition, attention should be paid when dissecting the deep CFS to avoid damage to the superior rectus muscle, which could result in abnormal postoperative eye position and diplopia.

In this technique, the amount of skin excision is less than that through a traditional incision. Preoperatively, its effect on the shape and height of the eyelid crease should be confirmed with the patient. For patients without loose skin, we only designed one incision line (Line A), which located 1.5 mm above the lash line, and the upper eyelid skin could be preserved. We find that the upper eyelid is usually less bulgy in patients with severe ptosis, and therefore a smaller amount of skin excision is still acceptable. Moreover, relatively loose skin facilitates postoperative eyelid movement, thus we tend to preserve enough skin for patients.

With regard to surgical outcomes, the adequate or normal correction rate was 89.2%, and the recurrence rate was 10.8%. In Lee's report [28] of frontalis suspension and Santanelli's report [29] of simple CFS suspension, the recurrence rates were 12.5 and 22.7%, respectively, indicating that the scarless technique has a similar corrective effect as these two approaches.

It's worth noting that due to Hering's law, contralateral eyelid sometimes drops postoperatively. Therefore, a lifting test should be performed for preoperative evaluation. If a drop is observed preoperatively, simultaneous surgery is recommended for bilateral ptosis. For unilateral ptosis, we would wait for 2 weeks and reevaluate the difference between bilateral eyelid margins [30]. A revision of the contralateral eyelid should be performed when the difference was $\geq$1mm. In this study, preoperative drop was observed in three cases (one in bilateral ptosis and two in

unilateral ptosis). According to the follow-up, we found that none of these cases required a secondary operation.

With regard to complications, exposure keratitis and hematoma were not observed in this study. The elasticity of the CFS helps to correct severe blepharoptosis while maintaining better eye closure function, which greatly reduces the occurrence rate of exposure keratitis. Conjunctival prolapse was observed in four eyelids (10.8%), and all of them regressed spontaneously within 7 days. Prolapse can be treated by placing a 5-0 double-armed suture into the superior fornix entering the conjunctiva and exiting the skin, then tying the suture over a cotton pledget and leaving it in for 1 week.

This technique has several disadvantages, especially for beginners, such as the difficulty to master the procedure, and the complex anatomy. Surgical outcomes are closely related to the surgeon's experience. Several limitations of this study should also be noted. The period of follow-up needs to be prolonged to further evaluate the outcome. Because the patients were all adults, the efficacy of the technique in treating children's ptosis, which is performed under general anesthesia, should be further studied. To further compare the efficacy and safety between marginal incision and traditional incision, a multicenter, large-scale, prospective randomized clinical trial, with a longer follow-up period, should be performed in the future. Other indexes such as the operative time, and surgeon's learning curve also need to be compared between the two techniques.

## Conclusion

CFS suspension through palpebral margin incision is able to maintain physiological eyelid movement, create almost scarless double eyelids, and achieve powerful ptosis correction. With satisfactory efficacy and a low incidence of serious complications, such as exposure keratitis, this technique is reliable for the treatment of severe blepharoptosis.

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**Declarations**

**Conflict of interest** The authors declare no potential conflicts of interest with respect to the research, authorship, or publication of this article.

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