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Mild to moderate blepharoptosis correction

Outcomes of levator aponeurosis posterior layer plication

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Abstract

Conventional levator aponeurosis plication is a widely accepted technique for correction of mild to moderate ptosis. However, this method is associated with a high recurrence rate. The objective of this study was to investigate the clinical efficacy of levator aponeurosis posterior layer plication technique for correction of mild to moderate ptosis.

A convenience sampling approach was used to recruit 450 patients with mild to moderate blepharoptosis at the Guangzhou Eye-Nose-Face Aesthetic Plastic Surgery Hospital between August, 2015 and December, 2017. All participants were treated with levator aponeurosis posterior layer plication technique. The primary outcome was the postoperative change in marginal reflex distance 1 (MRD1). The paired *t* test was used to determine the clinical efficacy. Outcomes were assessed at 1 week, 1 month, 3 months, and 6 months after surgery.

The mean preoperative MRD1 was 1.7 ± 0.5 mm, and the mean postoperative MRD1 at 6-month follow-up was 3.7 ± 0.4 mm ($P < .0001$). According to the postoperative survey, 427 (94.9%) patients were satisfied with surgical outcomes.

This modified levator aponeurosis plication technique is a simple and effective procedure for correction of mild to moderate blepharoptosis. It results in good MRD1 and high patient satisfaction.

Abbreviations: AL = anterior layer, LPS = levator palpebrae superioris, MM = Müller muscle, OOM = orbicularis oculi muscle, OS = orbital septum, PAF = preaponeurotic fat, PL = posterior layer, SF = superficial fascia, TA = tarsal plate, WL = Whitnall ligament, WLN = white-line.

Keywords: blepharotosis, marginal reflex distance 1, the posterior layer of the levator palpebrae superioris aponeurosis

Key messages

What is already known about this subject?

This operation has not been reported till date. This article is based on my paper about the anatomy of the levator aponeurosis published in *MEDICINE*.

What are the new findings?

Our surgical method is simple and can fold the deep layer of the levator aponeurosis accurately without destroying the orbital septum. It is associated with a low recurrence rate.

How might these results change the focus of research or clinical practice?

This article explains the reason for high recurrence rate after traditional levator aponeurosis plication. Our surgical approach is less invasive. Our findings have implications for clinical practice as it draws attention to the fine anatomy of the levator aponeurosis.

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The authors declare that they have no conflicts of interest.

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1. Introduction

Blepharoptosis (ptosis) refers to the abnormal low positioning of the upper eyelid margin during primary gaze. The condition is defined as iris asymmetry of more than 2 mm between the eyes or positioning of the upper eyelid margin 1 to 2 mm below the superior corneal limbus.[1,2] Based on the extent of upper lid drooping, ptosis is classified as mild, moderate, and severe ptosis.[3] Levator aponeurosis plication is a widely used technique for correction of mild to moderate ptosis. The levator aponeurosis refers to the sheath between the Müller muscle (MM) and the orbital fat. The upper levator aponeurosis has 2 layers: anterior and posterior.[4] Conventional levator aponeurosis plication involves opening of the orbital septum, pushing the orbital fat up, and folding the aponeurosis to the tarsus.[5] However, the fixation may loosen owing to the shallow plication of the aponeurosis. Our technique for levator aponeurosis plication focuses on the posterior layer of the levator aponeurosis without opening the septum; this allows firm fixation with less

tissue damage. This technique has become the standard procedure for correction of mild to moderate ptosis at our department. The objective of this study was to investigate the clinical efficacy of our surgical technique.

2. Methods

2.1. Ethical approval

This study was approved by the Medical ethics committee of Yichun University. 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 Helsinki declaration and its later amendments or comparable ethical standards.

2.2. Patients

Adopting a convenience sampling approach, we recruited patients with blepharoptosis at the Guangzhou Eye-Nose-Face Aesthetic Plastic Surgery Hospital between August, 2015 and December, 2017. The inclusion criteria were mild to moderate ptosis, age >18 years, and provision of patient consent for participation in the study. The exclusion criteria were age <18 years, severe ptosis, and refusal to participate in the study.

2.3. Preoperative evaluation

Before the surgery, data pertaining to demographic characteristics and relevant history including family history of eye abnormalities, history of eye trauma, or any previous eyelid surgery were obtained. The degree of ptosis was graded based on the extent of upper eyelid drooping: mild ≤2 mm and moderate <4 mm.[5] The marginal reflex distance 1 (MRD1) was measured; it was defined as the distance of the central corneal reflex to the upper eyelid margin with the patient in primary gaze.[6] The palpebral fissure asymmetry examination was used to evaluate the symmetry.[7]

2.4. Surgical technique

1. The patient was placed in the supine position on the operating table. A bilateral double eyelid incision line was drawn as per routine, and the peeled skin area was decided according to the upper lid skin flaking condition. After local infiltration with 2% lidocaine and 5 μg/mL (1:200,000) epinephrine, an incision was made according to the preoperative plan (Supplementary Fig. 1A and B, http://links.lww.com/MD/D725).
2. The skin and orbicularis oculi muscle were incised (Supplementary Fig. 1C and D, http://links.lww.com/MD/D725) to expose the underlying tissue and the orbital septum. The tissue was separated towards the eyelid direction till the tarsus; on the tarsal surface, a light pale line from the upper edge of the tarsus, which is formed by the orbital septum and anterior layer of levator aponeurosis, was exposed (Supplementary Fig. 1E and F, http://links.lww.com/MD/D725). Some surgeons call it the "white-line (WLN)."
3. The WLN was lifted and blunt dissection performed below it till a clear potential gap was identified (Fig. 1A and B). If the gap was filled with fat tissue, the dissection was continued until the posterior layer of the levator aponeurosis was reached (Fig. 1C). This technique helps retain an intact orbital septum.

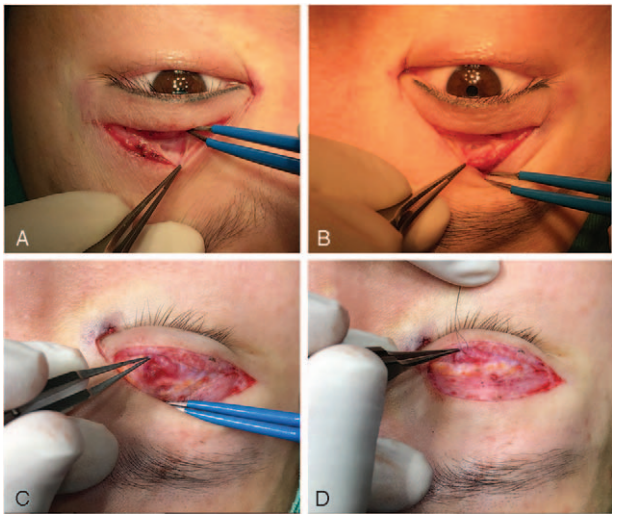

Figure 1. (A, B) Intraoperative photographs showing pulling of the white-line and blunt dissection. (C) Intraoperative photographs of the posterior layer of levator aponeurosis. (D) Intraoperative photographs of the stitch of the tissue between the tarsus and the posterior layer of levator aponeurosis.

4. After ensuring complete hemostasis, the patient was asked to look downwards. According to the mid-point of the pupil, we chose a fixation point. One suture of 7-0 nylon was passed from the superior margin of the tarsus to the corresponding position on the posterior layer of the levator aponeurosis (Fig. 1D). After observing the condition of the opened eyelid and ensuring that the bilateral lids were at the same height, the knots were tied and cut. Two more sutures were placed on both sides of the first suture to reinforce the plication (Fig. 2A and B). For patients with bilateral sagging, we followed the Herring law to adjust the height of the eyelid on both sides (Fig. 2C).[8]
5. After bilateral adjustment, the lower lip orbicularis muscle was fixed with 7-0 nylon thread in the tarsus to form double eyelid. Full-thickness suture incision was performed using 8-0 nylon thread.

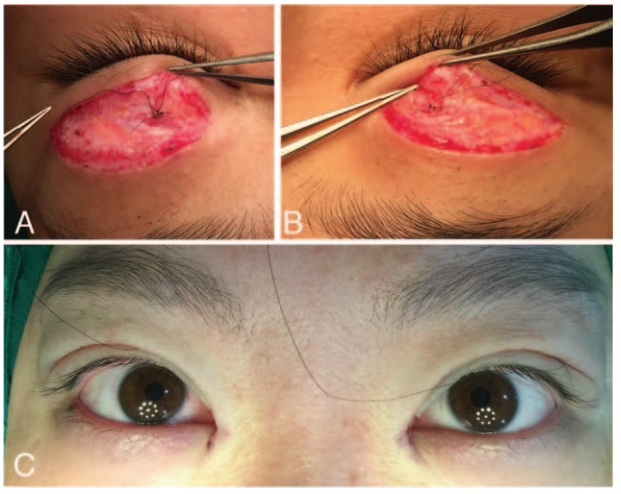

Figure 2. (A, B) Intraoperative photo of final correction of eyelid radians. (C) Completion of bilateral ptosis correction.

2.5. Follow-up

The primary outcome was change in postoperative MRD1 from preoperative levels. A successful outcome was defined as restoration of the operated lid(s) position to normal MRD1 (>4.0 mm). Sutures were removed on the fourth postoperative day. Postoperative assessment was performed at 1 week, 1 month, 3 months, and 6 months after surgery. We assessed MRD1 at each visit. Revision was performed if deemed necessary at any time point. The secondary outcome was patient satisfaction pertaining to the operation, as assessed by postoperative survey at the final visit (6 months). Patient satisfaction was rated on a scale of 1 to 3 (1, not at all satisfied [the range of iris uncovered increased by <5%, significant iris asymmetry]; 2, partly satisfied [the range of iris uncovered increased by 5%–10%, iris asymmetry difference <1.5 mm]; and 3, satisfied [the range of iris uncovered increased by 15%–25%, eyes easily open, larger vision, and glinting eyes).

Measurements are presented as mean ± standard deviation. The mean difference between preoperative and postoperative MRD1 was compared using Student *t* test. All analyses were performed using SPSS Statistics 21.0 (Berlin, Deutschland).

2.6. Patient and public involvement

No patients or public were involved in the design of the study or recruitment, nor were they involved in setting the research question or the outcome measures. All patients participated in this study voluntarily. Results of the study were disseminated to participants by e-mail. The burden of the intervention was not assessed directly by patients; we included a scoring scale which helps evaluate the level of patient satisfaction with treatment.

3. Results

In all, 450 patients (male 55 [12.2%]; female 395 [87.8%]), including 810 eyelids, were included in this study. The mean age of patients was 30 years (range 18–45). A vast majority of the patients (360, 80.0%) had bilateral blepharoptosis (Supplementary Table 1, http://links.lww.com/MD/D726).

After levator aponeurosis posterior layer plication, 427 (94.9%) eyelids achieved the target height and symmetry of palpebral aperture. No lash ptosis, postoperative lagophthalmos, or recurrent ptosis due to relapse was found during follow-up. Only 23 (5.1%) patients underwent revision. The pre-post operation photographs are presented in Fig. 3.

Table 1

Statistical difference between MRD1 at different follow-up time points.

Visit	MRD1	*P*
Preoperative	1.7 ± 0.5	Reference
1 wk	3.5 ± 0.4	.12
1 mo	3.7 ± 0.4	<.001
3 mos	3.7 ± 0.4	<.001
6 mos	3.7 ± 0.4	<.001

MRD1 = marginal reflex distance 1.

3.1. MRD1

The mean preoperative MRD1 was 1.7 ± 0.5 mm, and the mean MRD1 at 6-month follow-up was 3.7 ± 0.4 mm, which represented a statistically significant improvement ($P < .001$). Table 1 shows the postoperative MRD1 at each follow-up time point and the *P* values associated with the corresponding pre-post comparisons.

3.2. Patients' satisfaction

According to the survey results, 427 (94.9%) patients were satisfied with the operation, 18 (4.0%) patients were partly satisfied with the operation, whereas 5 (1.1%) patients were not satisfied.

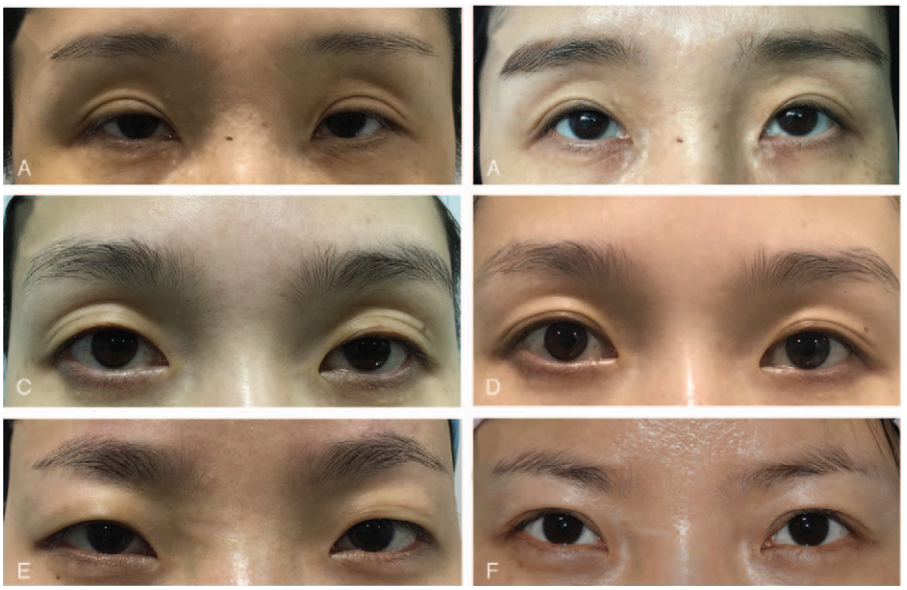

Figure 3. (A) Moderate ptosis before the operation. (B) Follow-up in 19 months after surgery. (C) Mild unsymmetrical ptosis before the operation. (D) Follow-up in 9 months after surgery. (E) Mild ptosis before the operation. (F) Follow-up in 32 months after surgery.

4. Discussion

The classical operations for treatment of ptosis include frontalis suspension, levator resection and plication, and MM-conjunctival resection. Several authors have reported that the key aspect of surgical repair is opening the orbital septum and isolation of the entire levator aponeurosis by dissecting the MM.[9–11] With this technique, the orbital septum is disrupted and the retroseptal fat is removed or excised. Our method makes it possible to preserve the integrity of the orbital septum, which is of functional and cosmetic importance. Moreover, it is associated with shorter recovery in the immediate postoperative period due to lesser bleeding and swelling of the eyelid.

Levator plication is associated with a high recurrence rate. In a study by Ben Simon et al,[12] external levator advancement was associated with up to 20% higher rates of reoperation as compared to MM-conjunctival resection. The high recurrence rate after this surgery is attributable to the lack of strong and permanent adhesion formed by the smooth aponeurosis in the absence of wounds.[13,14] In our clinical practice, we have found that there is a space between the anterior and posterior layers of the levator aponeurosis, which lies below the WLN and near the upper edge of the tarsus. We believe that another possible reason for the high recurrence rate is the traditional levator plication sometimes only folds the anterior layer and cannot reach the posterior layer of the levator aponeurosis. Through our modified technique, the loose adipose tissue present in the gap allows precise exposure of the posterior layer of the levator aponeurosis.[4] In addition, this fibrous layer is folded and adhered to the tarsus (Figs. 1 and 4). The patient satisfaction rate in our study (94.9%) was significantly higher than that in previously reported studies.

According to the conventional belief, levator aponeurosis plays an important role in pulling the upper eyelid, while the MM merely plays an auxiliary role. However, several authors have cited the anatomical characteristics of the MM to demonstrate its vital role in lifting the upper eyelid.[15–17] MM-conjunctival resection has been shown to significantly increase the levator aponeurosis folding adhesion, reduce the recurrence rate, and help achieve superior long-term outcomes.[18–21] However, this procedure also entails the traditional separation of the MM complex, which can lead to unnecessary structural damage. In 2008, Scuderi et al[22] described a technique to strengthen the MM by adjustment of the levator muscle–MM complex into the tarsal plate for correction of ptosis. We believe that augmenting the function of the MM complex is the core element in surgical correction of ptosis. With our method, the posterior layer of the levator aponeurosis is tightly adhered to the MM. Plication of this very layer can also take advantage of the strength of the MM, which improves the efficiency and decreases the recurrence rate.

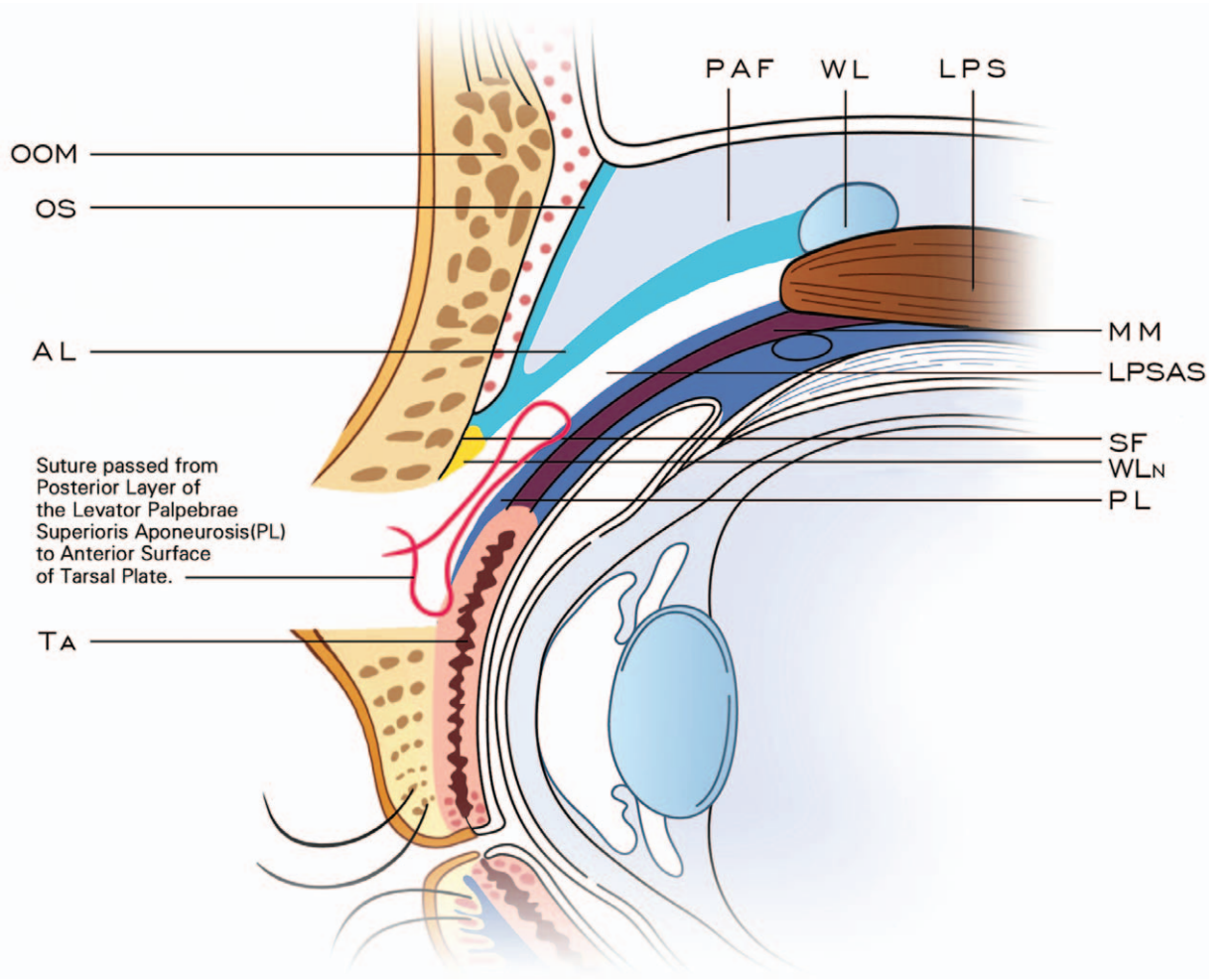

Figure 4. Anatomy of upper eyelids and a schematic illustration of the technique of precision levator aponeurosis posterior layer placation.

The key point of our technique is to identify the posterior layer of the levator aponeurosis without opening the orbital septum. First step entails reaching the WLN, which is a light pale line from the upper edge of the tarsus (Supplementary Fig. 1E and F, http://links.lww.com/MD/D725). Then, the WLN is lifted with a pair of tweezers, and blunt dissection is performed below it. The most difficult step is this detaching process. There are 3 patterns of junction between the anterior and posterior layers of the levator aponeurosis: loose connective-fibrillary tissue connection, uncoated adipose tissue connection, and coated adipose tissue connection. Loose connective-fibrillary tissue is easy to detach. However, the other 2 patterns are a little bit difficult to handle. The adipose tissue is liable to hemorrhage, which prevents the surgeon from visualizing the white and glossy posterior layer of the levator aponeurosis (Fig. 1C). Surgeon should keep dissecting scrupulously with meticulous hemostasis. The technique can be challenging for beginners.

To the best of our knowledge, this is the first study that evaluates this simple and effective technique to modify the conventional levator plication. Our results demonstrate the efficacy of this technique for correction of mild to moderate ptosis. The observational nature of this study is a study limitation; the evidence quality is not as high as that obtained from a randomized clinical trial. More high-quality studies are required to explore the safety and efficacy of this technique.

5. Conclusions

Levator aponeurosis posterior layer plication technique is a simple and effective procedure for correction of mild to moderate blepharoptosis. It results in a predictable proper vertical height of the exposed iris with a high patient satisfaction rate.

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Software: Yi Chen.
Supervision: Yi Chen.
Validation: Wen-li Chen, Sheng-chang Zhang, Yi Chen.
Visualization: Er Pan, Sheng-chang Zhang.

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