



# Full-Incision Double-Eyelid Blepharoplasty with Selective Neurovascular Preservation Method

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## Abstract

**Backgrounds** Double-eyelid blepharoplasty remains popular in east Asia. To avoid rigid eyelids and sinking scar after double-eyelid blepharoplasty, a new surgical approach with selective neurovascular preservation (SNVP) method is proposed to create more physiological and dynamic double-eyelid crease.

**Methods** During the full-incision double-eyelid surgery, a strip of preseptal orbicularis oculi muscle was resected. The longitudinally spreading upper eyelid nerves and vessels were preserved carefully. Four to five anchoring points between these neurovascular branches were made to reach the pretarsal fascia. Skin- orbicularis oculi muscle-pretarsal fascia sutures were placed on the anchoring points.

**Results** From May 2018 to April 2020, 385 patients received double-eyelid surgery with SNVP method. Eyelid edema resolved quickly within a week and generally disappeared in 4 weeks. In total, 259 (67.27%) patients scored very satisfied, and 109 (28.31%) patients scored satisfied on six-month follow-up.

**Conclusions** The SNVP approach can produce reliable and dynamic palpebral crease with inconspicuous scar. Vital neurovascular branches of upper eyelid could be saved, thus reducing postoperative complications and recovery period.

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**Keywords** Upper blepharoplasty · Double-eyelid surgery · Asian blepharoplasty

## Introduction

Double-eyelid blepharoplasty has remained the most popular cosmetic surgery in China for years. Although the mechanism of double-eyelid formation has not been fully clarified, the main surgical approach is to connect the levator aponeurosis and the pretarsal skin [1]. Various surgical methods have been proposed since the introduction of double-eyelid surgery. However, the full incision method remains most popular in China because the upper eyelids appear puffy with more soft tissue fullness and abundant skin [2]. On comparing with the mini-incision or non-incision method, full-incision double-eyelid blepharoplasty can create a stable and lasting palpebral crease. However, because the orbicularis oculi muscle (OOM) and pretarsal fascia are partly resected, full incision eyelid surgery is likely to produce a rigid fold and sinking scar. Furthermore, excessive resection of pretarsal soft tissue will result in prolonged postoperative ecchymosis, edema, and recovery time.

To obtain a more natural and vivid double-eyelid fold with quick recovery and less complications, we introduced a novel full incision technique with the selective neurovascular preservation (SNVP) method for double-eyelid blepharoplasty. The SNVP method keeps the vital upper eyelid nerves and vessels intact; thus, it produces more natural eyelid creases with less complications.

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## Materials and Methods

Between May 2018 and April 2020, a total of 469 patients (927 eyes) underwent full incision double-eyelid blepharoplasty with the selective neurovascular preservation (SNVP) technique. A total of 84 patients who were lost to follow-up were excluded from this study. All the remaining subjects had undergone follow-up for more than 6 months. Finally, 37 men and 348 women ranging in age from 16 to 48 years (mean age, 23.6 years) were enrolled in this study. A total of 117 patients underwent epicanthoplasty simultaneously. All of the surgeries were performed by a single senior surgeon. Postoperative evaluations included patient's satisfaction, maintenance of double eyelid, symmetry, double-fold curve, palpebral skin numbness, infection, and scar formation. All of the patients provided written informed consent including consent for publication of photographs. This study followed the principles outlined in the Declaration of Helsinki.

## Design

Before the operation, a thorough evaluation of the eyes was performed. Asian patients with bulky upper eyelids and loose skin were the most suitable candidates for full-incision double-eyelid surgery. Patients with thin upper eyelids and tight skin were generally recommended to undergo mini-incision surgery. Patients who had blepharoptosis or previous blepharoplasty were excluded from this study. Preoperative marking was performed with the patient in an upright position. The height and curve of the double-eyelid crease were determined with the patient after complete consultation. The height of the palpebral crease was usually made at 6.5–7.5 mm for Asian patients. The appropriate extent of skin excision was determined by clamping of the skin above the palpebral crease. A tension-free closure and adequate removal of skin were carefully planned.

## Operation

Surgery was performed under a 2.5x surgical loupe. All of the operations were performed under local anesthesia alone. Total 3 ml of 2% lidocaine containing 1:100,000 epinephrine was infiltrated subcutaneously on both sides of the eyelid. Caution was exercised to avoid breaking the visible subcutaneous vessels. The incision was then made through the skin with a No. 11 scalpel along the marked line. A strip of skin was removed subcutaneously. The subcutaneous vessels were coagulated with needle tip monopolar electrical cautery. The underlying preseptal OOM was transected sharply, and a small strip of preseptal OOM was resected; after that, the orbital septum was

exposed. The terminal nerves and vessels were found spreading vertically to the palpebral margin below the OOM. Care was taken to preserve the major longitudinally running nerves and vessels (Fig. 1a). Only the lateral orbital septum was opened, and the herniated septum fat pad was removed. The retro-orbicularis oculus fat (ROOF) was partially resected in patients with an excessively bulky eyelid. The deep OOM on the inferior rim was removed meticulously sparing the superficial OOM and its vascular network. The dissection was maintained 2 mm away from the palpebral margin to avoid disruption of the cilia. The pretarsal fibroadipose tissue was resected vertically between the visible nerves and vessels (Fig. 1b). Four to six anchoring points were made to reach the pretarsal fascia (Fig. 1c). Skin-OOM–pretarsal fascia sutures were placed on the anchoring points using 8-0 nylon (Fig. 1d). The first suture was placed near the mid-pupillary point. The patient was asked to open the eyes for adjustment of height and shape of the palpebral crease. Symmetry was obtained through bilateral anchoring sutures. The remaining incision was closed with an interrupted skin suture.

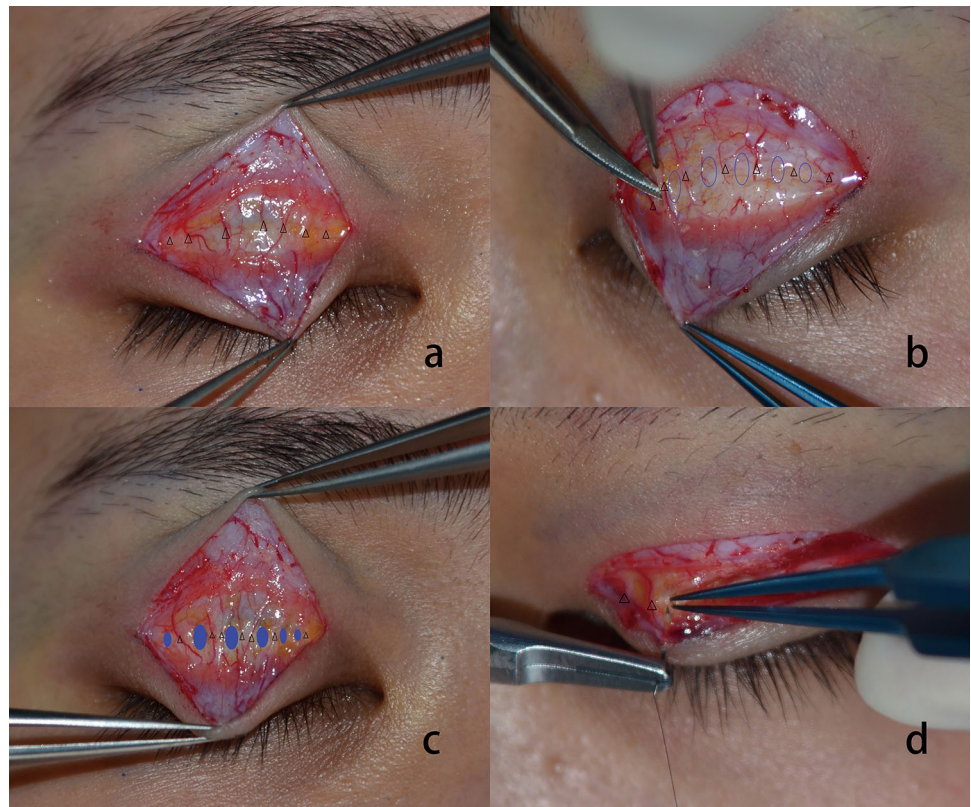
## Postoperative Care

The incisions were smeared with thin aureomycin ointment and covered with none-pressure dressing for one day after the operation. Intermittent cold compression was recommended during the first 72 h, followed by warm compression in the next 4 days. Eyelid incisions were cleaned with saline twice a day. Sutures were removed on the 7th day after surgery. Patients were asked to undergo follow-up for 6 to 18 months. Efficacy evaluation was based on the patient's satisfaction scale. Very satisfied, satisfied, neutral, unsatisfied, and very unsatisfied were rated from 5 to 1. Complications were assessed at follow-up. The blepharoplasty postoperative complications included hematoma, stitch abscess, eyelid numbness, scarring, palpebral crease asymmetry, and fold loss (Figs. 2, 3, 4).

## Results

A total of 385 patients (765 eyes) ranging in age from 16 to 48 years (mean age, 23.6 years) were enrolled in this study. All of the patients underwent full incision double-eyelid blepharoplasty with the SNVP technique by a single senior surgeon. A total of 117 patients underwent “Z” epicanthoplasty simultaneously. Eyelid edema was apparent in the initial three postoperative days, and it resolved quickly within a week and generally disappeared in 4 weeks. A total of 367 (95.3%) patients showed consistent and smooth palpebral creases. A total of 18 (4.68%) patients developed palpebral crease asymmetry. Among these patients, 8 eyes

**Fig. 1** The key processes of SNC double-eyelid blepharoplasty. **a** After resection of a strip of skin and orbicularis ocular muscle, the terminal branches or palpebral nerves and vessels (*black triangles*) were exposed on preseptal panel. **b** Perforating dissections (*hollow blue circles*) were taken vertically between neurovascular branches. **c** Pretarsal fascia was dissected until tarsal fixation could be secured at the anchoring sites (*solid blue circles*). The main neurovascular branches were kept intact. **d** Skin-OOM-pretarsal fixations were performed at the anchoring sites



(1%) had fold loss and 10 eyes (1.3%) had unsatisfactory shallow folds. None of the patients complained of a high-level fold. Fifteen patients received revision surgery; of these, 6 of them received short-incision method revision and 9 patients received full incision revision. Scars of the incision were smooth in 381 patients. The incision scar appeared erythematous at one month after surgery, and it returned to the normal level in 3–6 months. Temporary hypertrophic scar formation was observed in four patients (eight eyes) (1%). Intralesional triamcinolone injections were performed, and the scars resolved at 3 months after treatments. No postoperative blepharoptosis and other significant complications were noted. The evaluation criteria included fold appearance, symmetry, scar, eyelid numbness, hematoma, and patient satisfaction. The measurement was taken 6 months after surgery when edema and fold shape were almost stable.

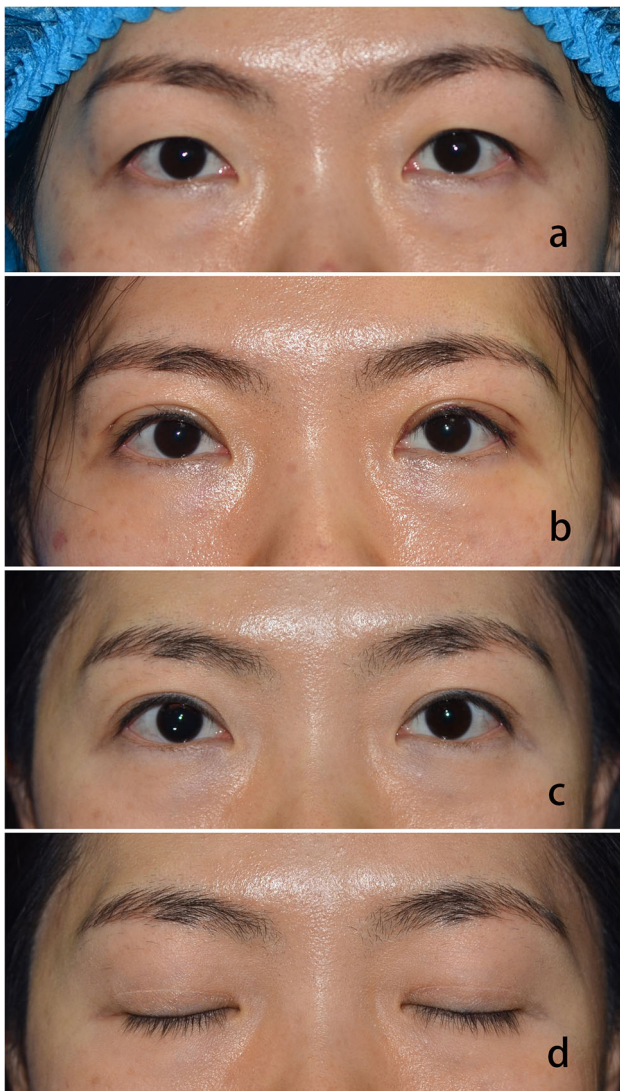
### Efficacy

Patients were asked to rate their satisfaction with surgery at the 6-month follow-up. The satisfaction questionnaire was graded from 1 to 5, with 1 being very unsatisfied to 5 being very satisfied. The overall satisfaction rate (score > 3) was

95.57%. A total of 259 (67.27%) patients were very satisfied, and 109 (28.31%) patients were satisfied.

### Complications

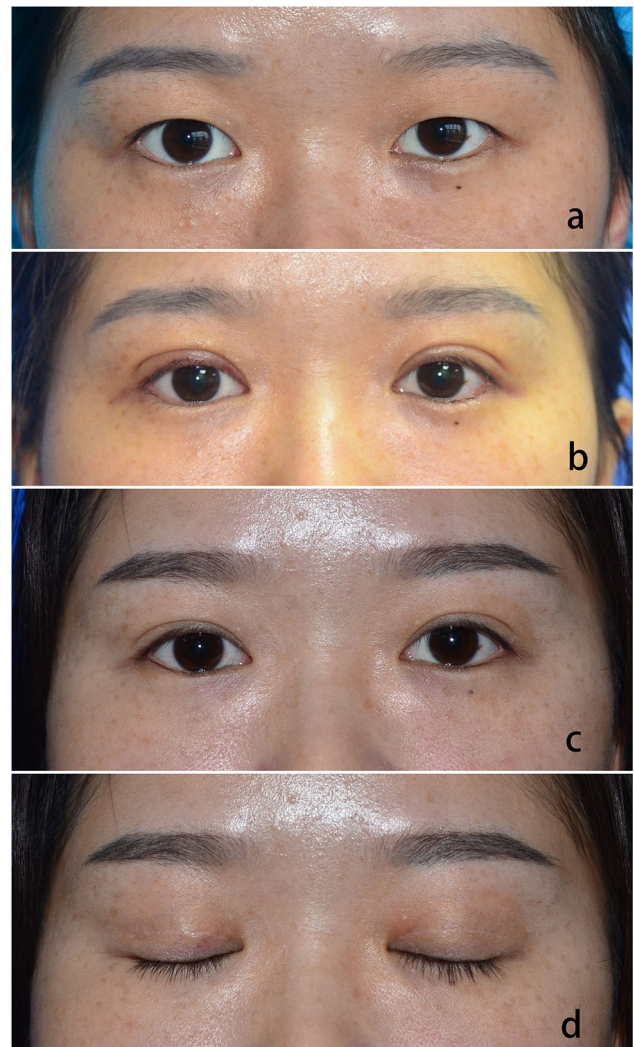
Postoperative complications included loss of the double-eyelid crease in 8 patients (8 eyes), hypertrophic scar formation in 4 cases, and asymmetric shallow fold in 10 cases (Table 1). Seven eyes showed a mild depressed incision scar, but it did not lead to any dissatisfaction. The loss of palpebral crease occurred probably because of inadequate adhesion of the pretarsal fascia and OOM at the anchoring points. The height of the crease is decided not only by the incision height, but also by other factors, like laxity of the skin above the crease, thickness of the orbicular muscle, the suture position, and the position of the brow. To avoid crease asymmetry, the anchoring suture was performed simultaneously on both sides, and the patient was asked to cooperate with opening the eyes. Occasional mild stitch abscess formation was mostly observed in patients with thin skin. Stitch abscess was treated by topical application of mupirocin and removal of stitches.



**Fig. 2** **a** Preoperative view of a 24-year-old woman with bulky single eyelids. **b** Seven-day postoperative view after SNC double-eyelid blepharoplasty. **c** Six-month postoperative view with eyes open. **d** Six-month postoperative view with eyes closed

## Discussion

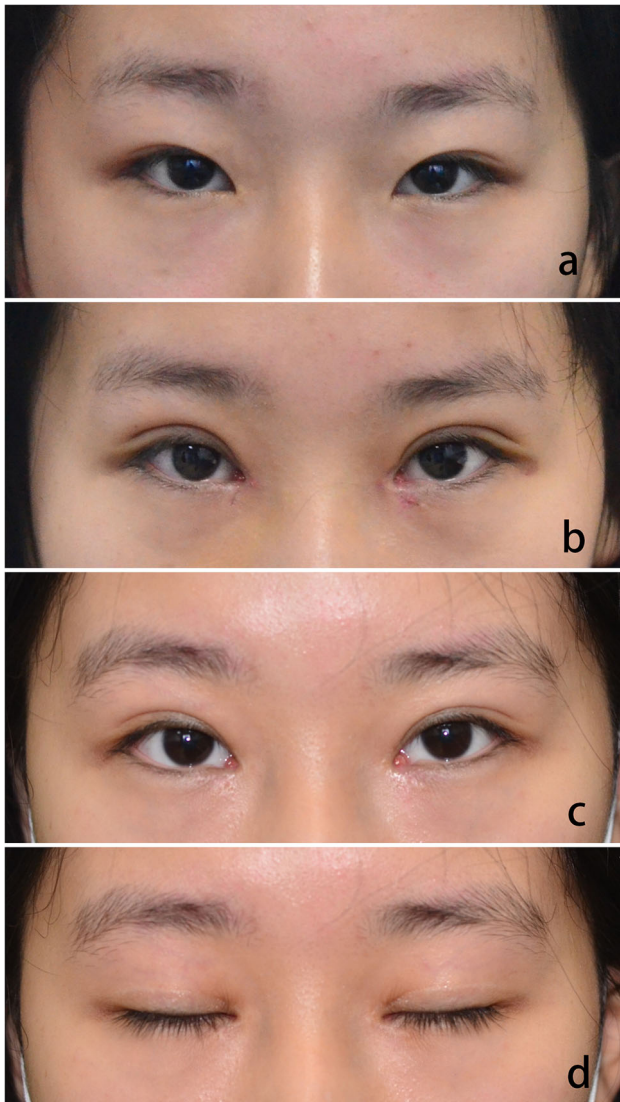
Double-eyelid operation has become the most popular cosmetic procedure in China in recent years, mainly because of the influence of media and fashion. The levator expansion theory by Sayoc is popular for double-eyelid crease formation [3]. It is postulated that the levator aponeurosis penetrates the orbital septum and OOM and then rises to the palpebral dermal tissue, thus creating an eyelid crease [4]. However, a cadaver histological study by Kakizaki et al. showed that levator extension was noticed in both single and double eyelids [5]. They found that a thinner orbicularis oculi and thinner skin at the palpebral



**Fig. 3** **a** Preoperative view of a 36-year-old woman with droopy single eyelids. **b** Seven-day postoperative view after SNC double-eyelid blepharoplasty. **c** Six-month postoperative view with eyes open. **d** Six-month postoperative view with eyes closed

crease might be the major causative factors for double-eyelid formation. Recent research revealed that the skin–OOM–tarsus complex is one of the most important factors causing double eyelids. Asian single eyelid showed a slightly thicker skin and orbicularis oculi complex both in the pretarsal area and at the eyelid crease but not at 5 mm above the eyelid crease level [6]. When double eyelid opens, the complex is lifted as an integrated unit and the crease forms at the thinnest palpebral line. In the single eyelid, when the levator muscle pulls up, the skin–OOM–tarsus complex is very loose and only the hard tarsal plate rises, thus causing the soft skin and OOM to slip down [7].

Since the beginning of double-eyelid surgery, various techniques have been developed to connect the palpebral skin to the levator system. The palpebral crease in



**Fig. 4** **a** Preoperative view of a 20-year-old woman with single eyelids and epicanthus. **b** Seven-day postoperative view after SNC double-eyelid blepharoplasty and “Z” epicanthoplasty. **c** Six-month postoperative view with eyes open. **d** Six-month postoperative view with eyes closed

**Table 1** Postoperative complications ( $n=385$ )

Complications	Number (%)
Asymmetry	18 (4.68%)
Loss of fold	8 (2.08%)
Shallow crease	10 (4.68%)
Eyelid numbness	0
Stitch abscess	3 (0.78)
Hematoma	0
Hypertrophic scar	4 (1%)
No complications	360 (93.5%)

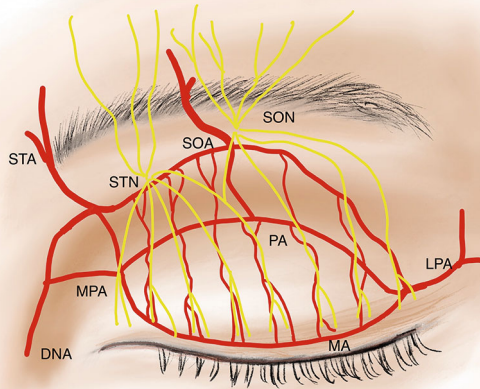
traditional blepharoplasty is achieved by rigidly connecting the skin to the tarsus or aponeurosis. In traditional double-eyelid operations, the pretarsal orbicular muscle and fascial tissue are resected extensively to fully expose the pretarsal fascia or the levator aponeurosis. Resecting loose pretarsal soft fascial tissue contributes to the connection between the palpebral skin and tarsus. The advantage of the traditional method is securing of double-eyelid creases. However, this commonly performed technique tends to produce a static palpebral crease and sinking scar. It is difficult to perfectly manage the amount of pretarsal tissue resection. The thick pretarsal fatty tissue by removing little tissue may lead to loosening or loss of the crease after surgery, while removing excessive pretarsal tissue can result in the formation of sinking scars and rigid eyelids.

To overcome these disadvantages, various techniques have been proposed. Park et al. introduced the orbicularis oculi-levator aponeurosis fixation technique which provides a solid suture fixation that outlasts any other fixation technique [8]. Kim et al. developed a double-eyelid approach using septo-aponeurosis junctional thickening (SAJT) to form a dynamic double-eyelid fold [9]. The crease line is not fixated directly onto the tarsus. The soft tissue between skin and tarsus makes the fold soft and movable with the eye movement. Pan et al. proposed a flexible suspension technique connecting the septal extension rim with the OOM. They claimed that this method could obtain a more natural and vivid appearance [10]. Li et al. also introduced a method of suturing the orbital septum with the OOM, and they found that this technique could produce a stable and natural double-eyelid crease [11].

Patients occasionally complained about eyelid numbness for several months after upper blepharoplasty. The vertically oriented eyelid terminal nerves are usually neglected and transected during full-incision double-eyelid surgery. Kenneth et al. reported the anatomy of the upper eyelid terminal nerves [12]. They found that the upper eyelid sensory nerves were mainly located in the medial half and anterior to the orbital septum in the suborbicularis fascia. Most of the eyelid nerve branches travelled vertically within the suborbicular plane of the upper eyelid until they reached the caudal part of the tarsal plate. In a recent cadaver study, Higashino et al. observed the sensory nerve distribution in the upper eyelid based on a cadaveric microanatomical study [13]. They showed that the upper eyelid nerve branches are mainly derived from the supra-trochlear and supraorbital nerves. The vertically oriented branches travelled mainly in the suborbicular plane. In addition, the cutaneous branches of the lacrimal nerve were distributed around the lateral canthal region.

Vascular network of the upper eyelid is another key point for double-eyelid surgery. Excessive compromise of

upper eyelid vessels may lead to prolonged postoperative edema. A thorough understanding of the upper eyelid vascular anatomy could facilitate surgery with less trauma

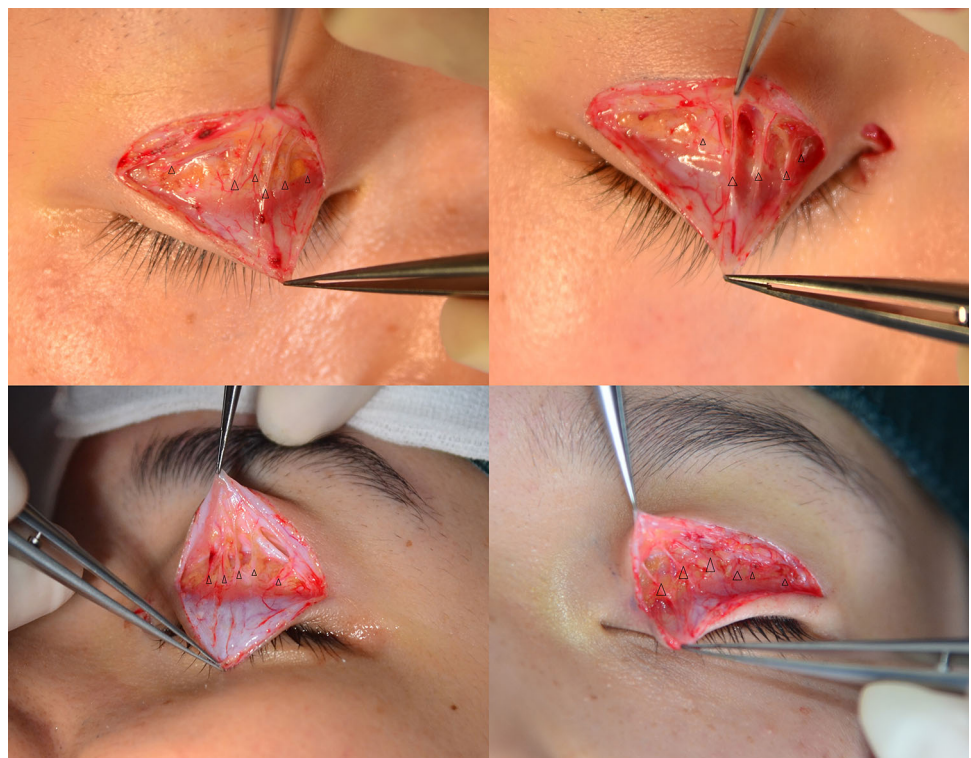


**Fig. 5** Schematic neurovascular microanatomy of the upper eyelid. *STN* supratrochlear nerve branches, *SON* supraorbital nerve branches, *SOA* supraorbital artery, *STA* supratrochlear artery, *DNA* dorsal nasal artery, *MPA* medial palpebral artery, *PA* peripheral arcade, *LPA* lateral palpebral artery, *MA* marginal arcade

and quicker recovery. Senem Erdogan investigated the arterial anatomy of the eyelid<sup>14</sup>. This research showed that the main blood supply of the upper and lower lids was provided by arterial arcades, including the marginal, peripheral, superficial, and the deep ones. Within the eyelids, these arteries ran between the orbicularis oculi and the tarsus, and the major branch usually lays along the free margin of the lid. This small vertical branch communicated through a digitiform anastomotic network of vertical branches (Fig. 5). Similar eyelid neurovascular distribution pattern was found in our surgeries, and the visible branches mainly located at the central and medial part of the eyelid (Fig. 6).

A vivid double eyelid should mimic the features of inborn double-eyelid crease. It should be movable and not adherent to the tarsal plate; the pretarsal skin is smooth without a noticeable sinking scar when closing the eyes, and the crease emerges dynamically when opening the eyes. To achieve these objectives, double-eyelid surgery should limit the resection of soft tissue and preserve the essential nerves and vessels, thus protecting the upper eyelid physiological function and flexibility. Our novel modification to full-incision double-eyelid blepharoplasty was based on clinic and microanatomy discoveries. Using this method, only the abundant skin, fat, and OOM are resected; meanwhile, the major arteries and nerves branches are selectively preserved. These tiny vessels provide

**Fig. 6** Anatomic findings during the SNC double-eyelid blepharoplasty. The terminal branches or palpebral nerves and vessels (*black triangles*) run vertically through suborbicular plane. The visible branches mainly located at the central and medial part of the eyelid



blood supply and drainage system to the upper eyelid, and the nerve branches provide sensory functions. Therefore, this maneuver saves the essential soft tissue physiological functions of the upper eyelid, thus reducing the postoperative complications after surgery. Limited resection of the pretarsal tissue and neurovascular network preservation reduces surgical trauma and facilitates recovery. In addition, preservation of neurovascular branches restores the fullness and flexibility, which makes the double-eyelid crease smooth and vivid.

According to our experience, intermittent anchoring fixations between neurovascular branches are strong enough for the formation of a palpebral crease. It is firm and stable, and there is no need to transversely resect all pretarsal fascia together with the nerves and vessels. Besides that, the preserved neurovascular network and pretarsal fascia maintain the fullness of tissue on the crease line, thus avoiding the formation of a sinking scar.

Nevertheless, microsurgical skill is required to master this technique. A more meticulous dissection is required for the operation. It may require more surgical time at the beginning of the learning curve. However, the total time would become the same as that required for the traditional method as the surgeon completes the learning curve.

## Conclusions

Double-eyelid surgery with the SNVP method can produce a reliable and dynamic palpebral crease with an inconspicuous scar. Vital neurovascular branches of the upper eyelid could be saved with this method, thus reducing the postoperative complications and recovery period.

## Declarations

**Conflict of interest** The authors declare that they have no conflicts of interest.

**Human and animal rights** All procedures performed in studies involving human participants were in accordance with the standards of the institutional ethical committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all patients.

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