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Reconstruction of giant full-thickness lower eyelid defects using a combination of palmaris longus tendon with superiorly based nasolabial skin flap and palatal mucosal graft

Wangshu Wang^a, Hao Meng^b, Shujian Yu^c, Tianyi Liu^b and Ying Shao^a

^aDepartment of Plastic and Cosmetic Surgery, First Hospital of Jilin University, Changchun, China; ^bDepartment of Neurosurgery, First Hospital of Jilin University, Changchun, China; ^cDepartment of Otorhinolaryngology-Head and Neck Surgery, First Hospital of Jilin University, Changchun, China

ABSTRACT

Reconstruction of a full-thickness lower eyelid defect is challenging. We aim to use palmaris longus tendon to improve clinical outcomes in eyelid reconstruction. We generated a novel “three-layer structure” tissue by combination of palmaris longus tendon with superiorly-based nasolabial skin flap and palatal mucosal graft and applied in eyelid reconstruction surgery in 34 patients with significant full-thickness lower eyelid defects. The satisfaction scores were assessed in each patient to evaluate their cosmetic and functional outcomes in follow-up visits. The mean follow-up period was 15 months (range, 6–24 months). Satisfactory results were obtained in 100% patients. No patients reported deformities, obvious scars at the donor sites, or abnormalities of hand function on the surgical side. Our results demonstrated that the three-layer structure incorporating palmaris longus tendon for the reconstruction of giant full-thickness defects in lower eyelid is an effective procedure with satisfactory long-term results.

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Introduction

Eyelid defects caused by tumor resection, trauma, and burns are commonly seen in plastic surgery departments, and their repair is complex [1]. The lower eyelid is composed of fragile skin, a small tarsal plate, protractors, and retractors. Dysfunction of the lower eyelid can cause significant functional and cosmetic problems, and contribute substantially to the morbidity of facial paralysis. Therefore, reconstruction of a full-thickness lower eyelid defect is partially challenging.

To date, a great variety of new materials and techniques have been applied to repair and reconstruct the eyelid [2–5]. For example, a tarsal plate structure can be reconstructed using an auricular cartilage-skin composite tissue, nasal septal, mucosa cartilage composite tissue, or upper eyelid transconjunctival flap, and the overlying tissues can be reconstructed using rotation flaps [6,7]. Generally, the designed local flaps, including buccal, temporal, nasolabial, and forehead skin flaps have good results in clinical outcomes in terms of function and appearance. However, the complications of lower eyelid reconstruction surgery (i.e. eyelid retraction, ectropion, and hypophasis) due to soft tissue contracture or gravity during lower eyelid reconstruction is still common [8]. Management of these complications requires corrective plastic surgery (i.e. graft application for tarsal plate and eyelid regeneration), which may place substantial clinical and financial burden on patients [9].

Previous studies suggest that common complications of lower eyelid reconstruction may occur from lack of lower eyelid support or insufficient anchoring of the reconstructed tarsal plate structure at the inner and outer canthus [6,7,10]. Therefore, restoring the “layer-by-layer” structure and anchoring of tissue at canthus could

provide the lower eyelid with support, thus avoid such common complications. Previous studies have demonstrated that tendon has sufficient tension to support a thick reconstructed tissue, and share similar structure as that of the inner and outer canthus [11,12]. Furthermore, the functions of wrist and palm are not affected after the removal of palmaris longus tendon. Therefore, in this study, we generated a novel “three-layer structure” tissue by combination of palmaris longus tendon with superiorly-based nasolabial skin flap and palatal mucosal graft, which may provide better long-term support for the lower eyelid and restore anchoring function the inner and outer canthus. We then applied the tissue in eyelid reconstruction surgery in 34 patients with giant full-thickness lower eyelid defects. After follow-up for a mean of 15 months, the satisfaction scores were assessed in each patient to evaluate their cosmetic and functional outcomes.

Patients and methods

Patients and surgery

We retrospectively reviewed the medical records of 34 patients who underwent reconstruction of giant full-thickness defects in the lower eyelids at the First Hospital of Jilin University, China, between 2015 and 2018. The reconstruction was performed in patients using a superiorly-based nasolabial skin flap combined with a palatal mucosal graft and the palmaris longus tendon. Eyelid surgery was performed under general anesthesia (Figure 1). The area of the eyelid (including the skin and tarsal plate) was measured. The study protocol was approved by the local ethics committee of the First Hospital of Jilin University.



Figure 1. Surgical procedure: An upper pedicled nasolabial skin flap is designed (A); part of the palmaris longus tendon is harvested (B); the strip-shaped hard palatal mucosa composite tissue graft is harvested as the lining (C). The dotted line shows the hard palate mucosa graft, with the mucosa facing the eyeball with everting sutures. The arrow indicates the palmaris longus tendon graft, whose width is less than 1/3 of the hard palate mucosa graft. The graft is anchored to the periosteum of the inner and outer canthus on both sides. If the tumor involves the periosteum and the periosteum of the inner and outer canthus is excised, the palmaris longus tendon graft is lengthened and anchored slightly further beyond the inner and outer canthus. * indicates nasolabial fold flap.

A free composite graft of hard palate mucosa was used to repair the posterior layer of the eyelid. Because the oral mucosa has a texture similar to the palpebral conjunctiva, and supportive features similar to the tarsal tissue, both the eyelid conjunctiva and tarsal plate could be reconstructed. The palatal mucosa grafts measuring 0.5×3 cm to 1.5×3 cm were harvested from the hard palate and then sutured to the residual bulbar conjunctiva in the fornical area of the lower eyelid using resorbable stitches (Figure 2). The palmaris longus tendon 3.5–4 cm in length and 0.3–0.5 cm in width was harvested according to the size of the palpebral fissure in individual patients. If the palmaris longus tendon was too wide, blood circulation within the inner layer of the free hard palatal mucosa composite tissue would be affected, thus leading to necrosis. If the palmaris longus tendon was too narrow, it would not generate sufficient tension to support the reconstructed eyelid. The two sides of the palmaris longus tendon were riveted on the periosteum, corresponding to the inner and outer canthus, and the central part was sutured intermittently with the free hard palatal mucosa graft.

To repair the anterior layer of the eyelid, an upper pedicled nasolabial skin flap was designed according to the size of the defect, and full-thickness skin graft was incised according to the designed size. The superficial layer of muscle was dissociated upwards from the nasal side of the distal skin flap. Morphologically, the subcutaneous fat on the nasal side of the distal skin flap is relatively less compared with that on the buccal side of the distal skin flap. When the lower eyelid skin defect was repaired by rotation, the subcutaneous fat on the buccal side was thinned because the defect included the eyelid and buccal side margins. The wounds at the donor sites of the upper limb and cheek were closed directly.



Figure 2. Harvested hard palatal mucosa composite tissue graft, the mucosal surface of the graft is oriented towards the eyeball during suturing, and the palmaris longus tendon graft was riveted to the periosteum (arrow).

Postoperatively, erythromycin eye cream was applied to the palpebral fissure to protect the eyes, especially at night during sleep. Antibiotic prophylaxis was administered for the first two days after surgery. A pressure bandage was applied to the operated eye for two days or more depending on swelling. Low molecular dextraglycosides were given to promote blood supply in the flap and the survival of the graft. If there were symptoms such as abrasion, pricking, or sore eyes, the position of the suture or the pressure bandage was adjusted. Artificial tears were administered to lubricate the eyes. In general, stitches were removed 8–10 days after surgery for the facial wound, and 12–14 days after surgery at the donor site on the hand.

Table 1. Scoring systems used to assess patient satisfaction after surgery.

Criterion	Point scores		
	0 point	1 point	2 points
Eyelid morphology (compared with control)	Completely asymmetrical and skin flap was swollen	Slightly asymmetrical	Symmetrical
Color and texture of the skin on Eyelid	Have significant scars, a hard texture, or an obvious chromatic aberration and pigmentation.	Have a slight scar or pigmentation	Concealed scar, soft skin, and similar eyelid skin color as the surrounding skin
Secondary deformity at the donor site	Obvious deformation (apparent facial bilateral asymmetry or obvious abnormal hand function) AND affected activities of daily living	Obvious deformation (apparent facial bilateral asymmetry or obvious abnormal hand function), but activities of daily living not affected.	No deformation, Activities of daily living not affected.
Eyelid closure status	Hypophasis occurred when the eye was normally or forcibly closed.	Hypophasis occurred when the eye was normally closed, but not occurred when the eye was forcibly closed.	The eyelid could be closed completely when the eye was normally closed.
Isolation of eyelid from eyeball	Completely isolated	Partial isolated	No isolation
Eyelid ectropion	Severe (exposure of the palpebral conjunctiva reached the area of tarsal plate)	Slight (exposure of the palpebral conjunctiva did not exceed the area of tarsal plate).	No eyelid ectropion
Palpebral fissure	less than half of the normal side	More than half, but less than the normal side	Same bilateral palpebral fissures
Tearing	Severe tearing or dry eyes requiring long-term application of eye ointment	Occasional tearing or dry eyes, but no long-term application of ointment	No tearing, no symptoms of dry eyes

Patients follow-up

Patients were followed up at 6, 12, and 24 months after surgery, and the cosmetic and functional outcomes were evaluated at each time point. The cosmetic outcome was assessed based on the morphology and skin color and secondary deformity at the donor site. The patient satisfaction score was calculated using the points system (Table 1), and classified to satisfied (13–18), generally satisfied (7–12), and dissatisfied groups (0–6).

Results

Totally, 34 patients at an average age of 43.5 years (range 23 to 61) were included in our study (Table 2). The skin flaps, grafts, and transplanted tissues survived in all 34 patients, and all incisions achieved primary healing.

Patients were followed up for between 6 and 24 months, with a mean of 15 months. At the follow-up, 100% of patients belonged to the “satisfied” group, including 30 patients (88.2%) with a score of 18, two patients (5.9%) with a score of 16, and two patients (5.9%) with a score of 14 (Table 3). No patients reported deformities (i.e. eyelid ectropion, eyelid retraction, and hypophasis), obvious scar at the donor sites, or abnormalities of hand function on the surgical side. Only two patients reported puffiness in the lower eyelids. Skin flap thinning surgery was performed one year after eyelid reconstruction, and both patients gained satisfactory outcome after the secondary postoperative surgery (Figures 3 and 4).

Discussion

In our study, we successfully applied a novel “three-layer structure” (palmaris longus tendon, superiorly-based nasolabial skin flap and palatal mucosal graft) in eyelid reconstruction in 34 patients with giant full-thickness lower eyelid defects. After follow-up for a mean duration of 15 months, 100% patients are classified as the “satisfied” group. No patients reported deformities,

Table 2. Basic characteristics of patients (N = 34).

Variable	Number
Gender	
Female	21
Male	13
Site of defect	
Left eye	15
Right eye	19
Cause of defect	
Tumor resection	9
Trauma	25

obvious scar at the donor sites, or abnormalities of hand function on the surgical side.

Several new covering materials have been applied for eyelid reconstruction [13]. For example, although a local rotational flap at the temporal or zygomatic side can act as a protective covering tissue, it could not provide sufficient volume and cause tension deformation if the eyelid defection size is large. In particular, the rotation of a buccal flap can lead to the retraction of the reconstructed eyelid. Another example is that forehead skin flap has sufficient volume, but the scar cannot be concealed easily. Therefore, we used an upper pedicled nasolabial skin flap as the covering tissue, and inner canthus blood vessels are taken as the supplying vessels [14,15]. Because the inner canthus artery arises from the ophthalmic artery, the blood supply is stable and reliable even if the rotation angle is large. In addition, the scar at the donor site can be concealed fairly easily [16,17].

Different supportive materials have been used to provide sufficient and long-term support for the reconstructed eyelid. Traditionally, the auricular skin flap is used to replace the palpebral conjunctiva; however, because of their different structure and physiological characteristics, the clinical outcome needs to be improved. In our study of patients with giant full-thickness lower eyelid defects, we chose hard palatal mucosal graft as supportive materials because its structure is similar to the palpebral conjunctiva and has supportive features similar to the tarsal tissue, and



Figure 3. Case 1: A 56-year old man presented with a left full-thickness lower eyelid defect due to trauma. The skin defect area was approximately 5 cm × 4 cm, and the tarsal plate was completely absent. The patient underwent lower eyelid reconstruction (A) with a satisfactory outcome at 1 year after surgery (B).



Figure 4. Case 2: A 39-year old man presented with a left full-thickness lower eyelid defect due to trauma. The skin defect area was approximately 3.5 cm × 2 cm. The patient underwent lower eyelid reconstruction (A) with a satisfactory outcome at 1 year after surgery (B).

also due to its sufficient volume and rapid and invisible wound healing of the donor site [18].

To date, a two-layer structured material, including the covering and supportive materials, was applied in most eyelid reconstructions. Although patient satisfaction is generally high, most studies are still limited by small sample size and relatively short-term follow-up. The long-term complications, such as eyelid retraction, ectropion, and hypophosis, were not reported. Because the reconstructed tarsal plate is not directly anchored with the canthus, the support will decrease over time. In addition, the lower eyelid can gradually shrink and become lower in patients due to local scar contracture. Therefore, we propose combining additional material in order to provide better long-term support for the lower eyelid and restore anchoring function of the inner and outer canthus. In our study, in addition to choosing an upper pedicled nasolabial skin flap and hard palatal mucosal graft as covering and supportive materials, we generated a novel “three-layer structure” tissue by adding the palmaris longus tendon into eyelid reconstruction. After a relatively extended follow-up of 15 months (range, 6–24 months), patients reported a 100% satisfaction rate.

Conclusion

In summary, a three-layer structure using the palmaris longus tendon for the reconstruction of giant full-thickness defects in the lower eyelids is an effective procedure with satisfactory long-term results, although a few patients may require secondary postoperative surgery.

Ethics approval and consent to participate

The study protocol was approved by the ethics committee of the first hospital of Jilin University. Written informed consent to participate was obtained from the patient described in this article.

Consent for publication

Consent for publication was obtained from the patient described in this article.

Disclosure statement

All the authors declare that they have no conflict of interest.

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Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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