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OPEN

Changes of Ocular Surface Before and After Treatment of Blepharoptosis With Combined Fascial Sheath Suspension and Frontal Muscle Flap Suspension

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Objective: To explore the ocular surface changes after ptosis surgery in patients with severe congenital blepharoptosis.

Methods: The patients were divided into group A and group B, Group A received conjoint fascial sheath suspension, and group B received frontal muscle flap suspension. The ocular surface changes were followed upon the 7th day and in the 1st and 3rd month after operation, which included Schirmer test (ST), break-up time (BUT), tear meniscus height (TMH). For normal distribution variables, *t* test was used before and after operation, and the Wilcoxon test was used for variables with abnormal distribution.

Results: Compared to preoperative status, the ST and TMH were not significantly changed after surgery ($P > 0.05$), but BUT higher on the 7th day and in the 1st and 3rd month after operation ($P < 0.05$). The fluorescence staining (FL) score was higher in the 3rd month than that in the 1st month ($P < 0.05$), but was not significantly different between the 7th and in the 1st month after operation ($P > 0.05$). The ST, TMH, and BUT after surgery were not significantly different between groups of A and B ($P > 0.05$),

but the FL score lower in the 3rd month than on the 7th day and in the 1st month after operation ($P < 0.05$).

Conclusions: The ST, BUT, and TMH were not significantly changed after surgery between groups of A and B, but the FL score was lower in group A than that in group B in early postoperative time.

Key Words: Fascial sheath suspension, ocular surface, severe congenital blepharoptosis, tear film rupture time, tear river height

Congenital blepharoptosis is mostly caused by dysplasia of the oculomotor nerve nucleus or levator palpebrae muscle. The patients mainly show partial or total ptosis of the upper eyelid. Congenital blepharoptosis not only affects the patient's appearance, but also causes form-deprivation amblyopia due to occlusion of vision, which has a serious impact on the patient's body and mind. According to the severity, ptosis can be divided into 3 grades: mild, moderate, and severe. Mild: the upper eyelid margin is located on the upper edge of the pupil, and the amount of ptosis is 1 to 2 mm; moderate: the upper eyelid margin covers 1/3 of the pupil, and the amount of ptosis is 3 to 4 mm; severe: the upper eyelid margin covers 1/2 pupil, and the amount of ptosis is >4 mm.¹ In the past, levator palpebrae muscle frontalis shortening surgery was used for mild and moderate blepharoptosis, whereas frontal muscle flap suspension was used for severe blepharoptosis.² The appearance of patients after operation was improved to a certain extent, but studies found that postoperative complications such as blepharoplasty, eyelid closure insufficiency, etc will cause certain damage to the ocular surface. The broad definition of ocular surface disease includes keratoconjunctival disease, external eye disease, and lacrimal organ system disease, which are collectively referred to as ocular surface disease.³ A number of studies have compared the effects of levator palpebrae superioris shortening and frontalis muscle flap suspension on the ocular surface. Both of them cause certain degree of damage to corneal epithelium at the early stage after operation, but there is no significant difference between the 2 methods on ocular surface changes.^{4–6} In recent years, many

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This study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of HeBei Eye Hospital. All patients consent to participate in this study.

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scholars have tried to use combined fascia sheath (CFS) suspension to treat severe blepharoptosis. Because the trauma is small, the postoperative upper eyelid shape is good, the eyeball and eyelid are coordinated, it has been widely used in clinical work⁷⁻¹¹; but there is still damage to the ocular surface due to the inability to blink normally after the operation. Regardless of the effect of different surgical procedures on appearance improvement, this article will simply discuss whether different surgical procedures and different time periods of the same surgical procedure affect the ocular surface.

MATERIALS AND METHODS

General Information

Prospective controlled study. Patients with severe congenital blepharoptosis who were treated in our hospital from December 2018 to May 2019 were included in this study. After admission, all patients underwent a comprehensive ophthalmic examination, including visual acuity, slit lamp, fundus examination, etc. The distance of the upper eyelid margin covering the pupil was measured, that is, the amount of ptosis. According to different surgical methods, they were divided into 2 groups, A and B groups. Group A underwent CFS suspension. A total of 33 cases (35 eyes), including 20 males, 13 females, and 19 right eyes, 16 left eyes, with an average age of 19.03 ± 1.21 years old; Group B underwent frontal muscle flap suspension, 20 cases (28 eyes), including 11 males, 9 females, 12 right eyes, and 16 left eyes, with an average age of 21.25 ± 6.71 years old; the amount of ptosis of patients with ptosis before surgery is less than 4 mm.

Inclusion criteria:

- (1) Clinical diagnosis of severe congenital ptosis.
- (2) All patients had positive eyeball turning function in preoperative examination.
- (3) No serious autoimmune diseases and connective tissue diseases.
- (4) No other contraindication for eyelid surgery.

Exclusion criteria:

- (1) Patients older than 50 years old or less than 10 years old.
- (2) Patients with ptosis caused by trauma or systemic diseases.
- (3) A history of eyelid surgery, eye movement disorders, severe corneal or conjunctival surgery, or acute ocular inflammation.
- (4) Suffer from serious systemic diseases.

Methods

Surgical Method

Local infiltration anesthesia is used. The surgery is performed by the same clinically experienced ophthalmologist. Levofloxacin eye drops are instilled 4 times a day for 3 days before the operation.

Combined fascia sheath suspension technique:

- (1) The double eyelid line incision is used as the surgical incision, the height is slightly lower than the general double eyelid line, usually 5 to 6 mm, marked with methylene blue.
- (2) Use ropivacaine plus 1:100,000 epinephrine for subcutaneous local infiltration anesthesia.
- (3) Cut the skin, separate and cut down the orbicularis muscle with a width of about 2 mm before the tarsal plate, expose the tarsal plate, open the orbital septum to properly remove the herniated fat, expose the front end of the levator aponeurosis, flip the upper eyelid and perform subconjunctival local anesthesia above the conjunctival fornix, separate the conjunctiva and

Muller muscle, cut off the levator aponeurosis and Muller muscle at the upper edge of the tarsal plate, and separate about 2 cm along the surface of the conjunctiva to see the white thickened tissue that is the CFS.

- (4) Fix the joint fascia sheath on the upper 1/3 of the tarsal plate with 6-0 absorbable thread, and do 3 to 5 stitches of mattress suture. In this process, the patient is asked to sit up and adjust the upper eyelid height to a satisfactory position.
- (5) Properly trim the severed levator palpebral muscle and Muller muscle complex and leave them open.
- (6) Suture the skin incision with double eyelid surgery.

Frontal muscle flap suspension:

- (1) The double eyelid line incision is used as the surgical incision, the height is slightly lower than the general double eyelid line, usually 5 to 6 mm, and marked with methylene blue.
- (2) Use 2% lidocaine plus 1:100,000 epinephrine for local infiltration anesthesia.
- (3) Cut the skin, separate and cut down the orbicularis muscle with a width of about 2 mm before the tarsal plate, expose the tarsal plate, and perform a sneak separation between the orbital septum and the orbicularis muscle, and separate to the junction of the orbicularis and frontalis, use scissors to cut and flip to the top of the frontal muscle to continue separating the frontal muscle and skin, and separate to 1 cm above the eyebrow. Lift the frontal muscle and separate the tissue below it with scissors, pull the frontal muscle like a flap, and remove the stripped frontal muscle, cut the inner and outer sides from bottom to top to form frontal muscle flaps.
- (4) Fix the frontalis muscle flap on the upper 1/3 of the tarsal plate with 6-0 absorbable thread, and do 3 to 5 stitches of mattress suture. In this process, the patient is asked to sit up and adjust the upper eyelid height to a satisfactory position repeatedly.
- (5) Suture the skin incision with double eyelid surgery.

After operation, sodium hyaluronate eye drops are given 4 times a day and erythromycin eye ointment is given once a day before going to bed.

Observation Indicators

Record the changes of the patient's ocular surface before and at 7 days, 1 month, and 3 months after the operation. The examinations are performed by the same technician. No ocular drugs are used within 2 hours before the examination.

Tear film rupture time (break-up time [BUT]), tear river height (tears meniscus height [TMH]): ocular surface analyzer (Kerato-graph Typ 70670).

Secretion test (ST): tear detection filter paper (produced by Tianjin Jingming). The patient is tested under topical anesthesia and with eyes closed, and the wet length (mm) of the filter paper is observed for 5 minutes.

Fluorescence staining (FL) staining scoring standard¹²: The cornea is divided into 4 quadrants, each quadrant is divided into no, light, moderate, and severe staining, respectively 0 to 3 points, then the FL score of the entire cornea is 0 to 12 points (Fig. 1).

Statistical Processing

Use SPSS Version 21.0 software (SPSS Inc, Chicago, IL) to perform statistical processing and comparative analysis on the data obtained above. First, perform a normal distribution test on the measurement data. If the data conform to a normal distribution, the comparison between the 2 groups uses 2 independent sample *t* tests. If it does not conform to the normal distribution, the rank sum test is used. The χ^2 test is used for the comparison of count data between

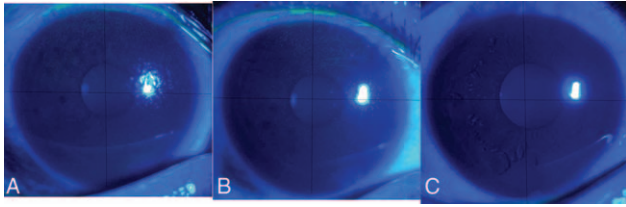


FIGURE 1. The cornea is divided into 4 quadrants. The image above shows the same patient's right eye CFS suspension postoperative examination. (A) Shows the corneal fluorescence staining 7 days after surgery. The corneal fluorescence staining score is 10 points. (B) The corneal fluorescence staining picture of the patient at 1 month after surgery. The corneal fluorescence staining score is 4 points. (C) The corneal fluorescence staining picture at 3 months after surgery. The corneal fluorescence staining score is 1 point. CFS, combined fascial sheath.

groups; $P < 0.05$ indicates that the difference in the comparison test results is statistically significant.

RESULTS

Comparison of General Information

A total of 53 cases (63 eyes) were enrolled in this study, including 33 cases (35 eyes) in group A and 20 cases (28 eyes) in group B. There was no significant difference in gender, eye type, age, and blepharoptosis between the 2 groups ($P > 0.05$), as shown in Table 1. All the 53 patients completed the operation successfully. The operation time was (35.31 ± 11.21) minutes, the intraoperative blood loss was (10.32 ± 5.41) mL, and the hospital stay was (7.31 ± 2.16) days (Shown in Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/C663>).

Observation Index

Sixty-three eyes of 53 patients were followed up for at least 3 months.

- (1) The comparison results of the postoperative tear film rupture time (BUT) of the 2 surgical methods showed no significant difference ($P > 0.05$), (see Supplementary Digital Content, Table 2, <http://links.lww.com/SCS/C663>). The comparison within the group showed that the tear film rupture time prolonged as the postoperative time increased ($P < 0.05$).
- (2) The comparison results of the postoperative tear ST of the 2 surgical methods showed no significant difference ($P > 0.05$), (see Supplementary Digital Content, Table 3, <http://links.lww.com/SCS/C663>). The comparison within the group showed that there was no statistically significant difference in tear ST results as the postoperative time increased ($P > 0.05$).
- (3) The comparison results of the postoperative tear river height (TMH) of the 2 surgical methods showed no statistical significance ($P > 0.05$), (see Supplementary Digital Content, Table 4, <http://links.lww.com/SCS/C663>). The comparison within the group showed that, there was no significant difference in tear river height (TMH) as the postoperative time increased ($P > 0.05$).
- (4) Comparison of corneal FL showed that the scores of corneal FL in group A were lower than those in group B at 7 days and 1 month after surgery ($P < 0.05$), (see Supplementary Digital Content, Table 5, <http://links.lww.com/SCS/C663>), and there was no difference between the 2 groups at 3 months after surgery. Comparison within the group showed that when comparing 1 month and 3 months after operation, the corneal FL gradually decreased as the postoperative time increased ($P < 0.05$).

Sixty-three eyes were completely corrected or basically corrected after the operation. In Group A, 1 case had exposure keratitis in 1 eye, and 1 case in Group B had exposure keratitis in 2 eyes. The symptoms were mild. After instructing them to strengthen eye care, the symptoms improved. All patients had different degrees of eyelid insufficiency after the operation, but all patients had different degrees of upper eyelid retraction after 6 months of postoperative follow-up, the curvature of the upper eyelid margin was satisfactory, it could be closed naturally, and the cornea was smooth without damage as shown as Figure 1.

DISCUSSION

Blepharoptosis is a common eyelid disease in ophthalmology, most of which are congenital. The clinical treatment method is mainly surgical treatment, and there are many surgical methods. Traditional operations include levator blepharoplasty shortening and frontal muscle flap suspension. In recent years, CFS suspension has been used clinically to correct severe blepharoptosis, and it has been widely recognized by clinicians. Regardless of the type of surgical correction, the patient needs to be unable to blink normally for a long time after the operation, and the palpebral fissure cannot be completely closed. The patient thinks that it may cause a certain degree of impact and damage to the ocular surface, and is unwilling to accept surgical treatment.¹³ Therefore, whether different surgical methods have an impact on the ocular surface or whether there is a difference in impact has become an important topic of clinical research. Many literatures have pointed out that for the surgical treatment of severe ptosis, frontalis muscle flap suspension surgery is prone to eye surface complications, thus prolonging the treatment time and leaving sequelae.¹⁴ Compared with frontalis muscle flap suspension, the CFS suspension has more advantages:

- (1) The power source is different. Holmstrom et al¹⁵ pointed out that the superior vault suspensory ligament and the levator palpebral muscle and superior rectus fascia sheath and Tenon capsule are connected, so the eyelid suspended to this ligament can move normally with the contraction of these muscles;
- (2) Multiple literatures report that the double eyelid is not bloated after the surgery of fascial sheath suspension, and the eyelid eyeball movement is coordinated well, the postoperative eye-opening facial appearance is good, the incidence of postoperative blepharoplasty is lower, and the patient's discomfort is less.^{7-11,16,17}

In this study, the early corneal injury caused by the 2 methods may be related to the intraoperative mechanical damage to the cornea, the increased height of blepharoplasty, and the limitation of eyelid movement. The degree of corneal damage in the CFS group was lower than that in the frontal muscle flap suspension group, but there was no significant difference between the 2 groups at 3 months after surgery. Analysis of reasons: in the early frontal muscle flap suspension group, the upper eyelid and forehead were obviously swollen, the upper eyelid margin was higher, the eyelid ball was separated, and the eyelid and eyeball coordination was poor, which resulted in a large and long exposure of the cornea. In the CFS suspension group, the eyelid movement was relatively good, and the upper eyelid swelling was lighter, so the corneal injury was lighter. However, with the extension of healing time, at 3 months after surgery, the frontal swelling in the frontalis muscle flap suspension group gradually subsided, the upper eyelid margin position returned to the preoperative design level, the eyelid closure was improved, and the degree of corneal exposure was similar to that of the CFS group, so the cornea of the 2 groups gradually recovered and the difference gradually decreased. The factors affecting the tear film

after surgery are as follows: all patients were given sodium hyaluronate eye drops after the surgery. Sodium hyaluronate eye drops is a kind of artificial tears that does not contain preservatives, reduces tear film damage and enhances the viscosity of ocular surface tissues. It can alleviate the impact of surgery on the tear film; after the operation, patients were routinely given erythromycin ointment based on petroleum jelly and paraffin for adjuvant treatment. Eye ointment adds a protective layer of lipid to the surface of the patient's tear film, thereby reducing the impact on BUT. In this article, the BUT in each time period after the surgery was higher than that before the surgery, and the difference was statistically significant. Even if the patient did not use any ophthalmic drugs within 2 hours before the BUT examination, this result is still considered to be closely related to the incompletely metabolized eye ointment and has no clinical reference significance. However, the ST and TMH values in each time period are similar, and there is no statistical difference. This result is considered to be related to many factors:

- (1) The results of this article showed that the stability of the tear film was not affected. It is considered that the use of artificial tears and lipid-based eye ointments after the operation maintained the local tear film viscosity, thereby maintaining the stability of the tear film. There is no significant change in tear secretion before and after surgery, because the operation itself does not damage the lacrimal glands and will not cause large fluctuations in tear secretion.
- (2) The 2 groups had relatively few complications. In group A, 1 case (1 eye) developed exposure keratitis, whereas group B (1 case, 2 eyes) developed exposure keratitis.

The causes of exposure keratitis were as follows:

- (1) the ocular surface dynamics of conjunctiva was changed and the sensitivity of conjunctiva was enhanced due to the sudden elevation of upper eyelid position after surgery;
- (2) eyelid swelling caused by the surgery affected the movement of the eyelid, and the stretching of the muscle was painful and irritating, which reduced the number of blinks of the patient and caused abnormal tear film distribution;
- (3) after surgery, the eyelid movement was limited, the palpebral fissure was incomplete, the cornea was exposed, and the tear evaporation was too fast¹⁸;
- (4) bad eye habits, resulting in long postoperative corneal exposure time, which affected tear film stability.

In this study, 2 cases of exposure keratitis were caused by long-term use of electronic products and excessive use of eyes. After changing the habits of using eyes and improving the night care of eyes, they improved. The blepharoptosis correction has no obvious effect on the amount of tear secretion and the height of tear stream, but the drug toxicity of frequent antibiotic eye drops before operation,¹⁹ and the postoperative eyelid swelling leads to incomplete closure of blepharoplasty, resulting in long-term exposure of cornea, which will affect the upper corneal skin. Therefore, it is particularly important to protect the cornea during and after the surgery. The following points should be paid attention to during and after the operation: strengthen the protection of the cornea during the operation, such as making moist cotton sheets to cover the cornea, minimizing the exposure time of the cornea, etc; choose eye drops reasonably after the operation and do not use eye drops containing preservatives; when the eyelid fissure is not completely closed in the early postoperative period, fully apply eye ointment or wear a corneal bandage lens. If

necessary, eyelid sutures can help close the eyelids to minimize damage to the corneal epithelium. In short, through research, it is found that the 2 surgical methods for severe blepharoptosis correction are relatively safe and practical. The combined fascia sheath suspension is better than the frontal muscle flap suspension in terms of the early postoperative impact on the cornea. There is no significant difference in the amount of tear secretion, tear film rupture time, and tear river height between the 2 operation methods. Even if there is exposure keratitis after operation, it can completely return to normal with the disappearance of inflammation and appropriate nursing care.

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