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Lower eyelid tension balance reconstruction: A new procedure for the repair of congenital epiblepharon with epicanthus

Ben Chen, Jia Liu, Jianxin Ni, Shengjie Zhou, Xi Chen*

Eye Hospital of Wenzhou Medical University, No. 270, Xueyuan West Road, Wenzhou, 325027 Zhejiang, PR China

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KEYWORDS
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Summary *Background:* Congenital epiblepharon with epicanthus (CEE) is a common eyelid malposition in Asian children, which generally involves the lower eyelid. The induced cilial entropion may cause constant ocular irritation that requires surgical repair. The purpose of this study is to report the outcomes and surgical details of a novel procedure, lower eyelid tension balance reconstruction (LETBR), for the correction of CEE.
Methods: Patients diagnosed with CEE underwent LETBR, which consists of modified half Z epicanthoplasty, and fixation between marginal orbicularis oculi muscle and lower eyelid retractor was reviewed retrospectively. The outcomes were classified as 'good' with no cilia-ocular surface contact, 'fair' with 5 or fewer asymptomatic cilia-ocular surface points of contact and 'poor' with most of the eyelashes remaining in contact with the eyeball. The surgical outcomes (good, fair or poor), recurrence and complications were evaluated.
Results: One hundred and forty-nine eyelids of 78 patients (43 females and 35 males; mean age 6.6 ± 2.4 years, range 4–17 years) were evaluated in this study. The mean follow-up time was 14 months (range 9–24 months). At the last follow-up time, 144 of 149 eyelids were judged as 'good' (96.6%), the other 5 eyelids were judged as 'fair' (3.4%) and no eyelid was assessed with a 'poor' outcome. There were no significant complications or complaints about scarring on eyelids from patients or their parents.
Conclusion: LETBR is effective, safe and stable for patients with CEE.

Introduction

Congenital epiblepharon with epicanthus (CEE) is a characteristic eyelid malposition commonly seen in Asian chil-

* Corresponding author.
E-mail address: ysgchenxi@163.com (X. Chen).

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dren.[1,2] In most cases, the epicanthal fold stretches the pretarsal skin and the underlying pretarsal orbicularis oculi muscle (OOM) rides over the eyelid margin. These anatomical abnormalities of the OOM may induce tension imbalance of the lower eyelid and finally lead to the cilial entropion. Induced tearing, photophobia and keratitis are indications for surgical repair.[1-4]

Numerous surgical procedures have been reported previously.[2,5-7] The Hotz procedure and its modifications are most commonly performed to correct the induced cilial entropion.[2,6] However, for Asians, congenital epiblepharon is commonly associated with epicanthus. In such cases, part of the medial inverted eyelashes may be left uncorrected or promptly recur because with the Hotz procedure the traction of the epicanthal fold is difficult to release. Associated epicanthoplasty is sometimes applied to correct the cilial entropion caused by epicanthus.[8,9] In addition, the case numbers in reports on the epicanthoplasty have been low. Further, it is considered to be a supplementary technique or remains controversial because of the extra scarring. Among these reports, CEE was not considered as a tension imbalance state of lower eyelid that needed to be corrected integratedly.

We believe the induced cilial entropion is secondary to tension imbalance formed by epicanthus, the pretarsal OOM, and the lack of lower eyelid retractor (LER) anchorage. Thus, releasing the abnormal traction of the epicanthus, redirecting the tension of marginal OOM, and reconstructing the tension balance of the lower eyelid as an integrated procedure is a more fundamental solution to repair CEE. However, there is no reported literature that considers this procedure as a primary management. In this study, we designed a novel procedure that consists of modified half Z epicanthoplasty and fixation between the marginal OOM and the LER. In this series, the surgical experience and outcome of our procedure, lower eyelid tension balance reconstruction (LETBR), are reported.

Patients and methods

A retrospective chart review was performed for all patients undergoing the repair of CEE by LETBR at the Eye Hospital of Wenzhou Medical University between January 2010 and November 2016. The study followed the tenets of the Declaration of Helsinki and was approved by the hospital ethics committee. Written consents and clinical photograph permissions were obtained from all the parents.

Between January 2010 and November 2016, a total of 149 patients diagnosed with CEE by characteristic appearance and ocular irritations were enrolled in the study. All patients underwent LETBR by the same surgeon. Patients were followed up for 9 to 24 months after the surgery. The outcomes were graded as 'good' with no cilia-ocular surface contact, 'fair' with 5 or fewer asymptomatic cilia-ocular surface points of contact and 'poor' with most of the eyelashes remaining in contact with the eyeball. Recurrence was defined as the presence of a 'poor' outcome or when the patient required a subsequent surgical repair. The outcomes were judged by two individuals; one of them was a member of the surgical team and the other was an independent surgeon. Results were assessed based on clinical examination of the patients. Photographs were subsequently taken for documentation. Postoperative ocular surface sensations that were reported by patients/parents were also recorded. Complications such as excessive haemorrhage, canalicular injury and extra scarring were recorded.

Surgical procedure

The surgery was performed under general anaesthesia or local anaesthesia if the patient was cooperative. The epicanthal fold was pulled medially to expose the lacrimal lake. The Z-flap incision lines were drawn at the epicanthal fold as follows: Point A corresponded to the medial end of the lacrimal lake; points B and C were the confluences of the epicanthal fold with the upper and lower eyelid skin, respectively; point D was the lateral end of the Z, next to the medial end of the lacrimal lake. The lower eyelid incision line was drawn 3 mm below the eyelashes from the lateral end of the inverting eyelashes to the medial end, which connected the Z-flap lines (Figure 1A and B). After the eyelid was infiltrated with 1 to 2 mL of 2% lidocaine with 1:100,000 epinephrine, the incision was made meticulously along the marked line. Line AB would be adjusted and incised later according to the transposition of flap BCD (Figure 1C). The dissection at the medial canthus should free the OOM until the anterior branches of medial canthal tendon are exposed (Figure 1D). After the OOM was completely freed, the flap BCD and the flap ABC were transposed without any tension. The flap ABC turned into AB' C' and would be excised last (Figure 1E). The dissection at the lower eyelid should expose the tarsal plate and separate the marginal OOM, and then continue to dissect inferiorly to expose the LER (Figure 1F). After the LER was exposed thoroughly, 6-0 absorbable sutures were placed to fix the marginal OOM and LER. The sutures were adjusted and placed at 3 to 4 points along the eyelid until the angle between the eyelashes and the cornea was improved to 80–110° (Figure 1G). After the fixation, the flap AB'C' became redundant and was excised. The redundant skin and the OOM under the lower eyelid incision were then marked and excised (Figure 1H and I). The method of identifying the redundant OOM was as follows: After the marginal OOM was fixed with the LER, the tissue under the skin incision was situated back, and the overlapping excessive muscle flap was identified as the redundant OOM. The entire incision was closed by 8-0 sutures (Figure 1J). Oral antibiotics were administered for 1 day postoperatively, and the sutures were removed 7 days after the surgery. In cases with low cooperation, suture removals were performed under inhalational anaesthesia.

Results

From January 2010 to November 2016, a total of 149 eyelids of 78 patients with CEE underwent surgical repair by LETBR. Seventy-one cases were bilateral, and 7 cases were unilateral (5 right and 2 left). The mean follow-up period was 14 months (range 9–24 months). For all the patients, the cilia-ocular surface touch was corrected, and the corneal irritation resolved several days after the surgery. There was

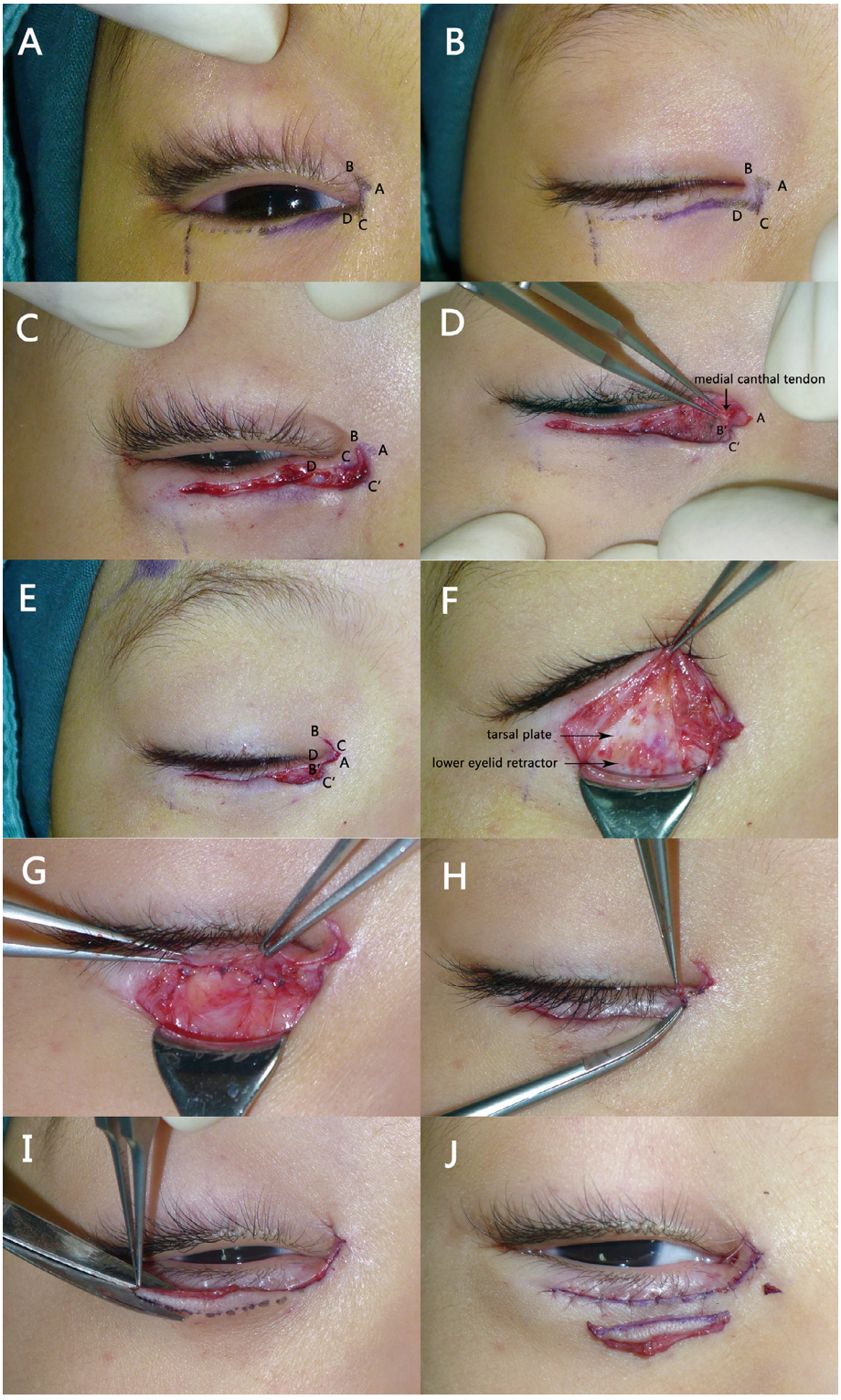

Figure 1 Clinical photographs of the surgical procedure. (A) Preoperative appearance and the incision design. Point A corresponds to the medial end of the lacrimal lake. Points B and C are the confluences of the epicanthal fold with the upper and lower eyelid skin, respectively. Point D is the lateral end of the Z, connecting with the lower eyelid incision line. The incision line is 3 mm below the eyelashes from the lateral end of the inverted eyelashes to the point D. (B) The incision line with the skin stretched. (C) The initial incision ended at point B. The line AB would be adjusted and incised later according to the transposition of flap BCD. (D) The Z flap is released until the dissection depth reaches the medial canthal tendon. (E) The immediate appearance after the transposition of flap BCD and flap AB'C'. (F) The marginal orbicularis oculi muscle (OOM) is separated from the tarsus, and the lower eyelid retractor (LER) is exposed. (G) The OOM is fixed with the LER by 6-0 sutures at 3 to 4 points. (H) After the fixation, the redundant flap AB'C' is excised. (I) The redundant skin below the incision line is marked and excised. (J) The immediate appearance of the completed surgical procedure.

no excessive haemorrhage during the surgery. Scar gradually faded to barely visible or unnoticeable under common gaze during the follow-up period. Patients/parents were not concerned by the final appearance and found it acceptable during follow-up. At the last follow-up visit, 144 of 149 eyelids had a 'good' outcome (96.6%), 5 eyelids had a 'fair' outcome (3.4%) and no eyelid had a 'poor' outcome. The cilia-ocular surface contact points were observed at the medial eyelid among the cases of 'fair'. Four eyelids were observed to have 1 eyelash in contact with the globe when looking down at 3 months follow-up time, and 1 eyelid had 2 eyelashes contacting with the globe when looking down at 6 months follow-up time. Two of these patients with one residual cilia-ocular surface point of contact reported occasionally mild irritations when looking medially downward. Examination found the cilia-ocular surface point of contact was improved from inward rotation to be parallel to the ocular surface. Thus, these 2 cases were graded as 'fair'. The eyelash was epilated, and no recurrent touching was observed during the following routine visit.

Discussion

The characteristic anatomic features of CEE are the pretarsal OOM riding over the lower eyelid margin and part of the muscle fibres blending with the upper eyelid OOM beyond the lateral side of the medial canthal tendon. The tractional forces consistently misdirect the tensions of the OOM and leave the LER relatively weakened, eventually causing the cilial entropion and epicanthal fold.[1,3,4,10] As a result, it is important to reconstruct the tension balance of eyelid margin, OOM, and epicanthus. Many procedures were reported to repair the CEE.[2,5-7,9,11-13] Kakizaki et al. reported that 49 eyelids with cilial entropion were successfully repaired by the modified Hotz procedure solely.[6] However, only a small portion of the cilial entropion, especially the medial part, was induced merely by epiblepharon; the traction of the epicanthus also accounted for much of the cilial entropion (Figure 2A, C, E, and G). During the Hotz procedure, the complete correction near the medial canthus is difficult; furthermore, it may induce punctum eversion. In such cases, the inverted eyelashes may be corrected only partially, leaving the medial part uncorrected. Although various modifications of epicanthoplasty have been applied to repair the CEE with the aim of correcting the medial part of the cilial entropion, they were not considered to be primary procedures. Furthermore, scar formation and recurrence remain the challenges in surgical design and outcome.[9,12,14,15] Thus, the key point of surgical repair of CEE is to consider releasing the abnormal traction of epicanthus and redirecting the tension of pretarsal OOM as an integrated procedure so as to reconstruct the tension balance of the lower eyelid.

In our LETBR procedure, modified half Z epicanthoplasty was performed first, and the incision depth should reach the anterior branches of the medial canthal tendon to achieve the thorough dissection of the malposed OOM (Figure 1D). Then, the flap BCD would be rotated without tension after the OOM was incised by the line CD (Figure 1E). This manipulation is critical to release the inverted tractional force by the epicanthus and reconstruct the normal OOM tension direction without everting the inferior canalicular punctum. Moreover, the portion of the OOM beneath the inferior canaliculus area should not be detached so as to preserve the canalicular pump.[16] The incision line at the medial canthus connected to the lower eyelid incision could help achieve tensionless suture and reduce scarring. After the epiblepharon was corrected, the flap AB'C' became redundant and was excised. Thus, our modification is called half Z epicanthoplasty. In previous reports, the recurrences or uncorrected cilial entropion were most commonly observed at the medial part of the eyelid.[9,12,17] In our series, 144 of 149 eyelids had an outcome of 'good', and 5 eyelids had a 'fair' outcome with residual cilial entropion near the medial canthus. There was no eyelid judged as a 'poor' outcome nor any irritations at primary gaze were reported during the follow-up period (Figure 2). Possible explanations for the cases with a 'fair' outcome include that in cases with a large epicanthal fold, a large Z-flap addresses the entire epicanthal fold, which may result in excessive scarring. Thus, these patients may have had a slight under correction. Besides, in certain cases, a complete correction of the cilial entropion would have resulted in punctal ectropion and, therefore, the degree of correction was titrated with the extent of punctal ectropion, resulting in a slight residual cilial entropion medially (Figure 2H). Residual epicanthal fold was noted in some cases with a 'good' outcome, and it is not considered a drawback of the Z plasty (Figure 2D and F). First, the Z plasty was primarily performed to release the inverting force of the epicanthal fold. In certain cases, the medial cilial entropion could be corrected without a complete epicanthal fold correction. Second, a complete correction of the epicanthal fold may require a larger flap design, resulting in the formation of more noticeable scar. This is especially the case in Asian people. In general, our modified half Z epicanthoplasty was shown to be necessary and effective in the repair of CEE.

The loss of tension balance between the OOM and the LER may induce the malposition of the lower eyelid margin.[1,5,18] In many reported Hotz procedures, the lower eyelid incision had not been discussed in detail. In our series, the incision line, i.e. 3 mm beneath the eyelashes, could preserve enough OOM to maintain the transversal tension, which is helpful in keeping the margin stable from entropion or ectropion. Furthermore, the incision could make the marginal OOM closer to the LER, which facilitates the fixation between the OOM and the LER. In previous reports, lower OOM management was either not discussed in detail or surgically fixed to the inferior tarsal plate. Direct fixation of the OOM to the tarsus may induce simultaneous ectropion of eyelashes and margin, and ultimately result in incomplete correction. In our modified procedure, the marginal OOM was separated from the tarsal plate before fixation with the LER, which could help to adequately evert the eyelashes without excessively everting the margin too much. Moreover, the incision line was generally consistent with the lower eyelid crease, and gradually faded to barely noticeable, so that there was no complaint about the lower eyelid scar at the last follow-up visit (Figure 2B, D, F, and H).

The LER can pull the margin, causing it to evert and retract.[6,18] Conversely, the transverse tension of the OOM can maintain the inversion of the margin. It is the combined ten-

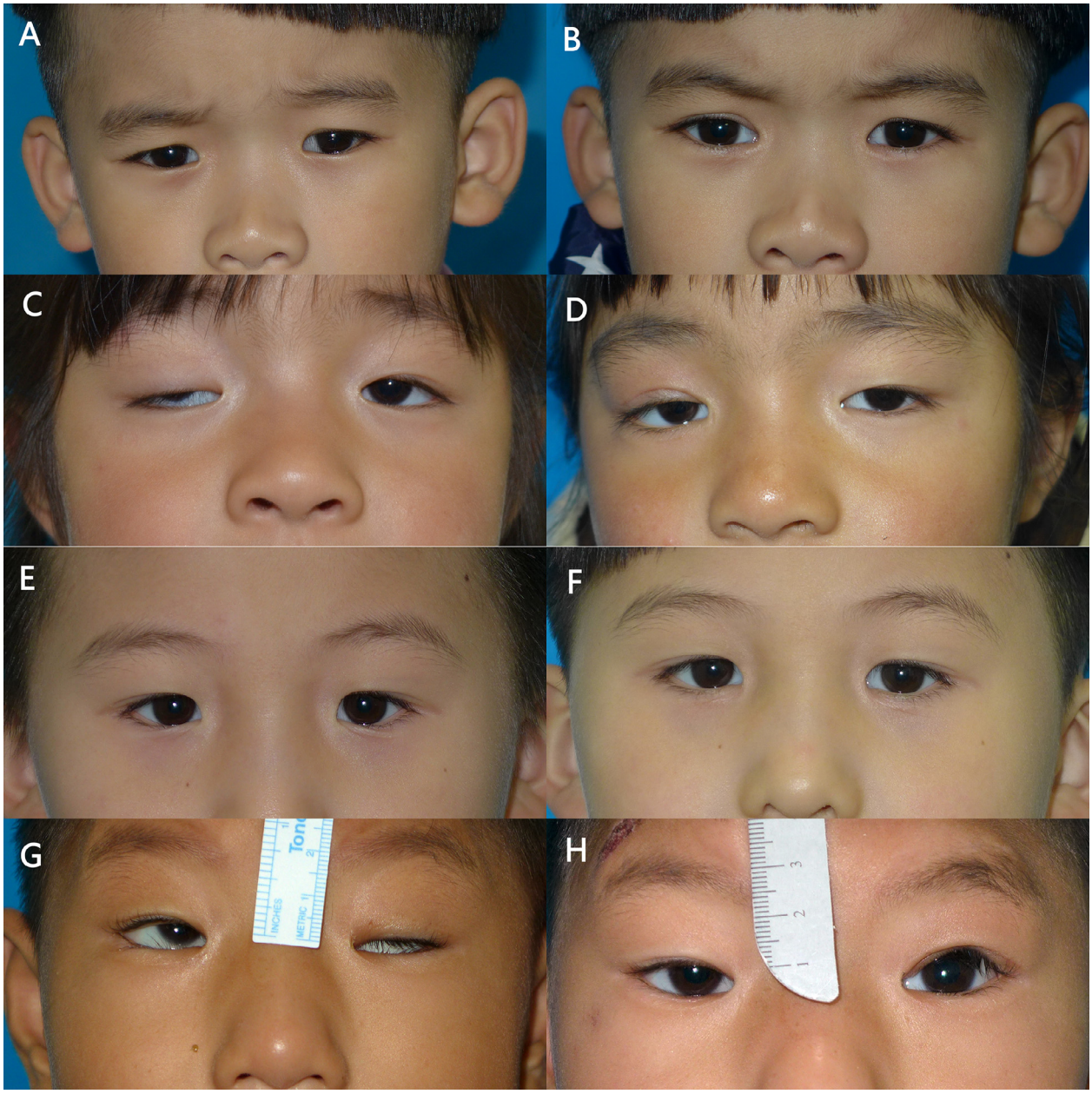

Figure 2 The clinical photographs of patients. (A).A 5-year-old boy presented with congenital epiblepharon with epicanthus (CEE) in both eyes. (B) The postoperative 15-month appearance of the boy judged as 'good'. (C) A 4-year-old girl presented with congenital ptosis in the right eye and CEE in both eyes. The repair for the CEE was in the right eye only because the ocular irritation in the left eye was mild. (D) The postoperative 12-month appearance of the girl judged as 'good'. The ptosis had been corrected for 4 months. (E) A 5-year-old boy presented with CEE in both eyes. (F) The postoperative 9-month appearance of the boy judged as 'good'. (G) A 4-year-old boy presented with congenital ptosis in the left eye and CEE in both eyes. (H) The postoperative 8-month appearance of the boy judged as 'fair' in the left eye with 2 residual offending eyelashes near the medial canthus. The ptosis had been corrected for 2 weeks.

sion balances that maintain the normal position of the eyelid margin. For patients with CEE, the marginal OOM rides over the margin so that it disrupts the tension balance of the lower eyelid. In many reported Hotz procedures, the marginal OOM is fixed with the inferior end of the tarsal plate, or partially excised and fixed with the adjacent tarsal plate.[2,9,13] Although the tarsal plate is strong enough to fix the OOM, it is not strong enough to evert the margin by itself. Furthermore, in the paediatric population with CEE, the tarsal plates are often too narrow and soft to serve as an anchor to counteract the tension of pretarsal OOM. The everting tractional force of the LER has not been used to reconstruct the normal tension balance. This may be another reason for recurrence. In our series, the marginal OOM was fixed with the LER, which redirected the tension of the OOM and made use of the LER to maintain the stability of the eyelashes' everted position. At the last follow-up visit,

there was no case with a 'poor' outcome, and no ectropion or punctum eversion was observed.

In summary, the LETBR consists of a modified half Z epicanthoplasty and fixation between the marginal OOM and LER. The procedure, fundamentally releasing and reconstructing the tension balance of the eyelid margin, OOM and LER, is an effective and stable technique for the repair of CEE.

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Xi Chen designed the study, performed the surgeries, and revised the article. Ben Chen collected the data, searched the literature, and wrote the article. Jia Liu, Jianxin Ni, and Shengjie Zhou helped to collect the data.

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