

Original Research

The Application of Reverse Z-Plasty Design in Medial Canthal Skin Redundancy Reconstruction Surgery

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Keywords

- Z-plasty
- Medial canthal skin redundancy
- Reconstruction surgery
- Reverse

Abstract

Purpose: To investigate the clinical outcomes of reverse Z-plasty in the reconstruction of epicanthal fold.

Method: A retrospective analysis was conducted on the clinical data of patients who underwent reverse Z-plasty for epicanthal fold reconstruction from September 2019 to January 2023. The surgical procedure involved preoperative design line incision, dissection beneath the orbicularis oculi muscle to form a muscular flap, and using the temporal side muscular flap as the reconstructed epicanthal fold. Postoperative follow-up included assessing the degree of epicanthal fold reduction, the appearance of the epicanthal fold, incision scars, and patient satisfaction. The intercanthal distance was measured in all patients before surgery and at 6 months postoperatively, and the paired t-test was used for statistical analysis with a significance level of $P < 0.05$ indicating statistical significance.

Results: A total of 16 patients (15 females, 1 male) with an average age of 32 years (range: 17-38 years) were included in the study. All patients had a follow-up period of at least 3 months, with an average follow-up of 7 months. Patient satisfaction evaluation showed that 13 patients were very satisfied, 3 patients were satisfied, and there were no cases of dissatisfaction. The degree of exposure of the lacrimal prominence decreased in all patients, the shape of the epicanthal fold was natural, the size of bilateral eyelid fissure was appropriate, and the parallel double eyelids were transformed into fan-shaped double eyelids. The appearance of the incision scars was not prominent and the lines were smooth. The increase in intercanthal distance ranged from 3 to 6mm, with a range of ICD elongation ratio from 9.09% to 28.30%. The preoperative measurement of intercanthal distance ranged from 28 to 35.0mm, with a mean of 31.25 ± 2.32 mm, and the postoperative measurement was 35.19 ± 2.26 mm. The difference was statistically significant ($t = -4.793$, $P < 0.001$). There were no urgent or discomfort sensations in eye movement, and the results were satisfactory.

Conclusion: Reverse Z-plasty design is suitable for epicanthal fold reconstruction. The incision design is clear and precise, and the postoperative outcomes are stable, achieving successful reconstruction of the epicanthal fold.

EBM level: IV

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INTRODUCTION

Epicanthal fold correction surgery is a common procedure in plastic surgery and is often performed in combination with double eyelid surgery. Proper correction of the epicanthal fold can increase the horizontal diameter of the eye and improve facial proportions, making them closer to the “three stops and five eyes” ideal. However, excessive correction of the epicanthal fold due to various reasons can lead to excessive exposure of the lacrimal prominence, downward displacement and enlargement of the inner canthus, and a dull appearance, causing physical and psychological trauma to the patient [1]. Compared to the various techniques for correcting the epicanthal fold, there are very limited methods for reconstructing the epicanthal fold. In 2012, Shin et al. [2], first reported the V-Y plasty for epicanthal fold reconstruction, and Chung et al. [3], subsequently reported the reverse inverted L technique for epicanthal fold reconstruction, followed by improvements on this technique. Inspired by the classic technique for epicanthal fold correction, the Z-plasty, the author reversed the design and reconstructed the epicanthal fold. The newly formed epicanthal fold restored its original natural shape, with minimal scarring. Since September 2019, the reverse Z-plasty design has been used to correct excessively large epicanthal folds in 16 patients seeking aesthetic improvements, and relatively satisfactory results have been achieved. The following report provides more details on the outcomes.

Data and Methods

Clinical Data: This study included 16 cases, with 15 female and 1 male patients, aged between 17 and 38 years old. Among them, 15 cases were bilateral and 1 case was unilateral.

Surgical Design: Surgical Design: With the eyes lightly closed, locate the inner canthus point D horizontally, 1mm away from the lacrimal prominence. Place point B, 4mm below point D vertically. Then, using the thumb pad of the same side, laterally traction the inner canthus towards the outer canthal side, simulating the appearance of the epicanthal fold. Once the aesthetic seeker feels satisfied with the appearance of the epicanthal fold, set point A at the location where the excess skin overlaps with the projection of points B. The distance between A and D is approximately 4mm parallel to the horizontal line, with an oblique angle of 60 degrees upwards and outwards from A to D, extending approximately 5mm towards the direction of the double eyelid crease, known as point C. The lengths of the inner and outer canthus (A-B) are determined by comprehensive examination, considering the degree of excessive eyelid fissure and the laxity between the eyeball and eyelid. Generally, for a single-side eyelid fissure measuring 4-5cm, the incision line A-C or A-B is approximately 3-4mm. For an eyelid fissure measuring 3-4cm, the incision line A-C or A-B is approximately 2-3mm. For an eyelid fissure measuring 2-3cm, the incision line A-C or A-B is approximately 1-2mm (primarily based on the physiological anatomical relationship between the eyeball and eyelid).

Surgical Method: Routine disinfection is performed, followed by local anesthesia of the epicanthal area with 1%-2%

lidocaine mixed with 1:100,000 adrenaline solution. Based on the preoperative angle of the epicanthal fold and the proportion of lacrimal prominence exposure, precise measurements are taken to determine the amount of skin that needs to be released. Prior to the repair surgery, tissue relaxation treatment is applied to the inner can thus, attempting to reposition and separate the muscle and skin tissues that require suturing. Design lines AB and AC are used for sufficient separation and release of the skin flap, particularly thorough separation of deep scar tissue. The range should be appropriately expanded compared to the design during the epicanthoplasty. After sufficient separation, the A angle of the flap CAD is transferred to point B, with tension being assessed. Unlike the tension-free repositioning of the crossed skin flap during epicanthoplasty, there will be a noticeable tension when transferring the CAD flap. At this point, the scar tissue should be gradually peeled off in layers, creating a clear distinction between the flap and the surface of the orbicularis oculi muscle. The range should be large, generally within a circular area with a diameter of 1.5-2.0cm. The orbicularis oculi muscle is repositioned to the state of the epicanthal fold, and horizontal sutures are performed on the muscle to restore the three-dimensional structure of the orbicularis oculi muscle and significantly reduce tension. Subcutaneous tissue is sutured with 6-0 absorbable sutures to reduce tension. Then, the patient's eye movement is checked for any urgency or discomfort, and intermittent skin sutures are performed. The same method is applied to the other side [Figure 1].

a: Excessive correction of the epicanthal fold.

b: Define the inner canthus point D, located 1mm away from the lacrimal caruncle. Place point B 4mm vertically downward from D. Simulate the appearance of epicanthal excess skin, and designate the area overlapping with point B's projection as point A. Points A and D are approximately parallel, with an upward inclination of 60 degrees from A to D. Extend the line approximately 5mm in the direction of the double eyelid crease and designate it as point C.

c: Skin incision - Cut the skin along the C-A-D-B line after visualizing it.

d: Reposition the orbicularis oculi muscle to the state of epicanthal excess skin and perform horizontal muscle suturing to restore the three-dimensional structure of the orbicularis oculi muscle and significantly reduce tension. Use absorbable 6-0 sutures under the skin to reduce tension.

e: After completion, suture the skin to present the repaired epicanthal excess skin.

Postoperative observation indicators may include the

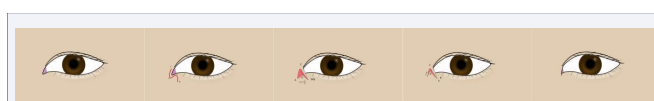


Figure 1 Surgical Technique Illustration

reduction in exposure of the lacrimal caruncle, reduction in asymmetry between the bilateral inner canthi, satisfaction with the natural appearance of the epicanthal excess skin, and the appearance of the incision scar. To measure the intercanthal distance (ICD), a ruler is used, and three measurements are taken and averaged. The increase in ICD is calculated using the following formula: $[(\text{Postoperative ICD/OCD}) - (\text{Preoperative ICD/OCD})] / (\text{Preoperative ICD/OCD}) \times 100\%$. This formula helps analyze the percentage increase in ICD after the procedure compared to the preoperative measurements [Figure 2].

At the last follow-up, the patient was asked to evaluate their satisfaction with the postoperative results, categorizing it into four levels: Very Satisfactory, Satisfactory, Somewhat Dissatisfied, and Dissatisfied.

- Very Satisfactory: The degree of medial canthus reduction is appropriate, the appearance of redundancy is good, the overall appearance is natural and realistic from various angles, and the incision scar is not noticeable.

- Satisfactory: The degree of medial canthus reduction is appropriate, the appearance of redundancy is good, the appearance is natural when viewed straight on, but not as natural from the side, and the incision scar is not noticeable.

- Somewhat Dissatisfied: The degree of medial canthus reduction is insufficient, but the appearance of redundancy is acceptable. The appearance is not natural when viewed straight on, or the incision scar is visible.

- Dissatisfied: The degree of medial canthus reduction is insufficient or excessive, or there is regret over the reduction. The appearance of redundancy is unsatisfactory, the overall appearance is unnatural, and the incision scar is noticeable.

Statistical Analysis

The analysis was conducted using SPSS 20.0 statistical software. The data followed a normal distribution. Descriptive statistics were used for quantitative data. The paired t-test was employed to compare the medial canthal distance before and after surgery, with a significance level set at $P < 0.05$.

RESULTS

Patient characteristics: During the study, a total of 16 surgical patients underwent epicanthoplasty. The average age at the time

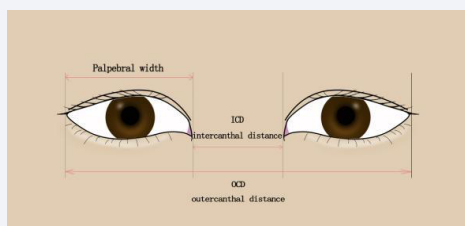


Figure 2 Inner Canthal Distance (ICD), Outer Canthal Distance (OCD), and Palpebral Fissure Width diagram

of surgery was 32 years (range, 17-38 years), and the average follow-up time was 6.3 months (range, 5-9 months).

Out of the 16 patients, 13 (81.25%) were satisfied with the appearance, and 3 (18.75%) reported being generally satisfied with the appearance. There were no cases requiring additional repair surgeries. There were no cases of epicanthal inversion, and no cases of abnormal lacrimal drainage function.

Result assessment: The degree of lacrimal exposure decreased in all patients, and the shape of the inner canthal angle became natural. The parallel double eyelids transformed into fan-shaped double eyelids. The visibility of the scar at the outer exposed area of the inner canthus was not significant (scars from the reverse Z-plasty technique were still visible in the first 1-2 months, but became almost invisible after 3 months). The size of the bilateral palpebral fissures was appropriate, and the newly formed inner canthal appearance closely resembled the initial inner canthal morphology, with smooth contours. The increase in intercanthal distance ranged from 3-6mm, representing an elongation ratio of 9.09%-28.30%. The preoperative measurement of intercanthal distance in patients ranged from 28 to 35.0mm, with an average of 31.25 ± 2.32 mm. After the surgery, the measurement increased to 35.19 ± 2.26 mm [Table 1]. There were no reports of urgent or uncomfortable eye movement, and the results were satisfactory [Figure 3,4].

DISCUSSION

For many East Asian individuals, enlarging the epicanthic fold can help to achieve facial proportions that align with the “Three Stops and Five Eyes” ratio. Some individuals desire a wider and parallel double eyelid, which makes epicanthoplasty a necessary

Table 1: The preoperative measurement of intercanthal distance

	Range	Mean \pm SD	t	P
ICD Preoperative	28-35 mm	31.25 ± 2.32	4.793	<0.05
ICD postoperative	31-40mm	35.19 ± 2.26		
ICD recruitment	3-6mm	3.94 ± 0.85		
OCD	82-91mm	86.88 ± 4.46		
recruitment	9.09%-28.30%			



Figure 3 This patient underwent epicanthoplasty. The left side shows the preoperative image, while the right side shows the image taken one week after the surgery.

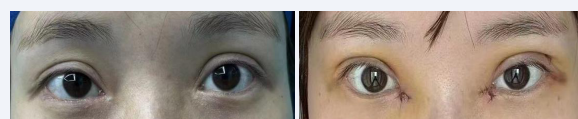


Figure 4 This patient underwent epicanthoplasty and double eyelid surgery. The left side shows the preoperative image, while the right side shows the immediate postoperative image.

step. A small portion of individuals may require reconstructive surgery to repair excessive widening of the inner corners of the eyes due to a strong desire to achieve a significantly larger palpebral fissure. On the other hand, in recent years, there has been a shift towards a more natural and innate aesthetic, with some perceiving the presence of excess skin in the epicanthic area as a sign of a “childish” appearance. Some individuals may also seek corrective measures if the appearance after widening the palpebral fissure is not as pleasing as before, or if they wish to transition from a parallel double eyelid to a tapered one. Additionally, individuals with monolids, small eyes, or those who have excessive epicanthal folds due to trauma may also request correction and reduction of the epicanthic folds.

In recent years, the trend in eyelid plastic surgery has shifted from exaggerated and dramatic results to more natural-looking outcomes. While the commonly seen styles in the past were large parallel double eyelids or European-style eyes, nowadays more individuals are opting for tapered or fan-shaped eyelids. Some cases involve individuals who wish to transition from a parallel to a tapered eyelid shape, while others require correction of issues such as excessive exposure of the lacrimal caruncle, asymmetry, or noticeable scars resulting from previous excessive correction of the inner corners of the eyes [4]. When performing inner corner tightening surgery, it is important to adjust the shape and direction of the inner corners based on the current eye shape of the individual, which includes considerations such as the color and exposure level of the lacrimal caruncle, the position, shape, direction, and angle of the inner corners, the presence of lower eyelid retraction, the location of the tear duct, the curvature of the inner lower eyelid, and the position of the lacrimal caruncle [5,6]. Reconstruction of first or second-degree epicanthic folds can achieve a more natural-looking result and enhance the appearance of a youthful look. It is generally not recommended to recreate the appearance of third-degree epicanthic folds after correction [5,6].

After surgery, it is important to understand that the reconstructed epicanthic fold will not be identical to the natural one and may not withstand a detailed comparison. In most cases, after undergoing epicanthoplasty, there will be no remaining epicanthic excess skin. Following inner corner tightening, the previously parallel double eyelid may become tapered or fan-shaped. In other words, the eye shape prior to epicanthoplasty may give the impression of being elongated and sharp, but after the procedure, the eyes may appear rounder and the length of the palpebral fissure may shorten. After epicanthoplasty, the skin tension in the corner of the eye is already taut, so in the earlier stages after the procedure, there may be more prominent scarring. However, over the course of 3-6 months, the scar will fade. It is important to inform patients in advance and ensure they are mentally prepared for this situation. Within the first three to six months, or even longer, the incisions in the inner corners may appear more visible and slightly red. There may also be a protrusion in the early stages, which will gradually flatten over time. These changes are normal phenomena. Additionally, before undergoing epicanthoplasty, it is recommended for individuals

to provide preoperative photos without epicanthoplasty for the surgeon’s reference. It is not advisable to excessively decrease the length of the palpebral fissure during epicanthoplasty, as many patients find it difficult to accept when the eyes become too small. The outcome will not be exactly like the “initial eyes” as patients may imagine. Blindly pursuing a rounder epicanthic shape and a decrease in palpebral length can have the opposite effect. Similar to all surgeries and particularly those involving symmetry, there is a risk of asymmetry. It is not recommended to seek complete symmetry, as it is difficult to achieve absolute symmetry even with minor differences that may require additional procedures.

There are several methods for medial canthoplasty to reduce the size of the medial canthus:

1. V-Y advancement flap
2. Reverse L-plasty

Points to note:

1. The degree of symmetry should be maintained when reducing the size of the medial corners on both sides.
2. Reducing the size of the inner corners will increase the tension on the skin in the medial canthal area. Adequate separation of the local skin and orbicularis oculi muscle should be performed, and reconstruction of the medial canthal part of the orbicularis oculi muscle with subcutaneous sutures should be done to reduce tension on the skin.
3. After the formation of the new medial canthal angle, it should appear fan-shaped in relation to the upper eyelid crease.
4. Skin sutures should be as flat as possible to minimize visible scarring.
5. Communication with the patient before the surgery is crucial to manage expectations and avoid unrealistic desires.
6. This procedure is recommended for cases where previous repair of medial canthal excess was performed with Z-plasty. If other techniques were used previously, it may increase scarring.
7. It is suitable for mild cases of congenital or acquired widened eyelid slits.
8. For severe cases of Müller’s muscle hypertrophy following Graves’ disease, Müller’s muscle resection is still required for correction.

This study has some limitations: Firstly, for patients who have previously undergone epicanthic excess skin correction using non-Z-plasty techniques, additional scarring may occur as the old incisions cannot be utilized as access points [7-10]. In comparison to V-Y plasty techniques, the scars in this procedure appear as curves. For patients with thin skin and orbicularis oculi muscle, there is still a possibility of recurrence if the sutures are not placed properly. Secondly, for patients with thicker skin and orbicularis oculi muscle, the appearance of the

newly formed epicanthic fold may appear thicker, which can lead to dissatisfaction among certain patients. Additionally, the reconstructed epicanthic fold may not have an identical shape to the naturally formed one, sometimes appearing more rounded or even rectangular. These issues require further exploration and improvement.

DECLARATIONS

Ethics approval and consent to participate

All patients were informed and signed informed consent voluntarily. This study was approved by the Ethics Committee of the Zhejiang Hospital and complied with the guidelines outlined in the declaration of Helsinki were followed. The written consent was received from all participants.

Availability of data and material

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

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