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A retrospective comparative analysis of the efficacy of Fresnel prisms, botulinum toxin injection and strabismus correction surgery in the treatment of acute acquired comitant esotropia

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Abstract

Background: To compare the clinical efficacy, safety, and applicable scenarios of Fresnel prism correction, Botulinum Toxin Type A (BTX-A) injection, and strabismus correction surgery in the treatment of acute acquired comitant esotropia (AAE), and to provide evidence-based evidence for individualized clinical treatment.

Methods: A retrospective case series study was conducted, enrolling 101 children with AAE (aged 2 to 14 years) admitted to our hospital from January 2020 to June 2023. The patients were divided into Fresnel prism group (32 cases), the BTX-A group (37 cases), and the surgery group (32 cases) according to the therapeutic methods. Corresponding treatment regimens were administered to each group with a 6-month follow-up. The strabismus degrees before treatment and at 1, 3, and 6 months after treatment, the recovery of fusion function and central stereopsis at 0.5, 1, and 3 months after treatment, as well as the incidence of treatment-related complications were compared among the three groups. Statistical analysis was performed using SPSS software. Measurement data were expressed as mean $\pm$ standard deviation ($\bar{X} \pm S$), paired t-test was used for intragroup comparisons, and Wilcoxon rank-sum test, Fisher's exact probability test, and logistic regression analysis were applied for intergroup comparison.

Results: There were no statistically significant differences in baseline data (age, strabismus degree, refractive status, etc.) among the three groups ($P > 0.05$), indicating comparability. At 1 month after treatment, the distance strabismus degree in the surgery group (2.01 ± 1.59 PD) was significantly lower than that in the BTX-A group (2.56 ± 1.71 PD) and the Fresnel prism group (4.18 ± 1.82 PD) ($P < 0.05$). At 3 months after treatment, the normal rate of fusion function (100%) and the recovery rate of central stereopsis (100%) in the surgery group were significantly higher than those in the BTX-A group (86.5% and 94.6%, respectively) and the Fresnel prism group (59.4% and 62.5%, respectively) ($P < 0.001$), with no recurrent cases reported. In terms of complications, visual discomfort was the main symptom in the Fresnel prism group (25.0%), ptosis (13.5%) and vertical strabismus (10.8%) were the main manifestation in the BTX-A group; and conjunctival hyperemia was predominant in the surgery group (15.6%). There was no statistically significant difference in the total incidence of complications among the three groups ($P = 0.59$).

Conclusion: Strabismus correction surgery exhibits the optimal short-term ocular deviation correction effect and the most stable long-term visual function recovery in the treatment of AAE, and is suitable for patients with moderate to high-degree strabismus and high demand for functional recovery. BTX-A injection is minimally invasive with definite short-term efficacy, but has the risks of recurrence and specific complications, which can be an option for patients with mild to moderate strabismus or those with surgical contraindications. Fresnel prism is a safe and non-invasive

approach, appropriate for mild strabismus or temporary transitional treatment. Individualized clinical treatment should be formulated in combination with the patient's age, strabismus degree, functional needs, and treatment tolerance.

Key words: acute acquired common esotropia, Fresnel prism, botulinum toxin injection, strabismus correction surgery, efficacy observation

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Introduction

Acute acquired common esotropia (AACE) is a sudden-onset, non-paralytic form of esotropia that predominantly affects children and adolescent. In recent years, the incidence of AACE has shown a gradual upward trend, and its onset is closely associated with factors such as increased near-work load, uncorrected refractive error, and abnormal neuromodulatory function [1]. The typical clinical manifestation of AACE include sudden deviation of the binocular visual axis, diplopia, and concomitant impairment of binocular visual function, which impose significant adverse effects on patients' academic performance, daily living, and mental health [2, 3]. Currently, the mainstream clinical treatment regimens for AACE include Fresnel prism correction, botulinum toxin type A (BTX-A) injection, and strabismus correction surgery. However, controversies remain regarding the indication screening, efficacy comparison, and long-term prognosis evaluation of these different treatment modalities [4].

As a non-invasive treatment, Fresnel prisms can improve ocular alignment through optical correction, but long-term wear may lead to abnormal accommodative adaptation [5]. BTX-A injection achieves corrective effects by temporarily paralyzing the extraocular muscles, with the advantage of minimal invasiveness, but its efficacy is dose-dependent and carries a risk of recurrence [4, 6]. Strabismus corrective surgery (e.g., medial rectus recession) can achieve durable ocular alignment, yet the optimal timing of surgery, optimization of surgical procedures (such as the application of adjustable suture techniques), and the postoperative recovery of binocular visual function still need further improvement [5]. At present, systematic comparative studies on the above three treatment modalities are relatively scarce at home and abroad, especially lacking support from long-term follow-up data and health economics-related evaluations. Therefore, a comprehensive assessment of the efficacy, safety, and cost-effectiveness of different interventions has important guiding value for clinical treatment decision-making.

This study aims to systematically analyze the clinical data of Fresnel prism correction, BTX-A injection, and strabismus surgery in the treatment of AACE, and compare their short-term efficacy (with ocular alignment rate as the core indicator), long-term stability (with recurrence rate as the core indicator), recovery level of binocular visual function, and the incidence of treatment-related complications, so as to provide evidence-based basis for clinicians to formulate individualized treatment plans.

Materials and Methods

A retrospective case series study design was adopted, and pediatric patients with AACE admitted to our hospital from January 2020 to June 2023 were enrolled as study subjects. Patients were divided into three groups according to the treatment modality they received: the Fresnel prism

group (32 cases, 19 males and 13 females, mean age 6.78 ± 2.49 years), the BTX-A injection group (37 cases, 15 males and 22 females, mean age 6.85 ± 3.49 years), and the surgery group (32 cases, 15 males and 17 females, mean age 6.92 ± 3.24 years). There were no statistically significant differences in baseline data (age, gender, angle of esotropia, refractive status, etc.) among the three groups ($P > 0.05$), indicating good comparability.

All patients underwent neurology consultation, cranial magnetic resonance imaging (MRI), and endocrine-related examinations to exclude organic lesions of the eye and systemic diseases. Baseline data (age, gender, angle of esotropia, refractive status, near-work habits) and follow-up data (ocular alignment recovery, stereopsis function, treatment-related complications) were recorded in detail during the study. The study protocol was approved by Institutional Ethics Committee of Hebei Children's Hospital (No.202136), and informed consent was signed by the guardians of all patients.

Inclusion Criteria

- 1) Met the diagnostic criteria for AACE in the Expert Consensus on Strabismus Classification in China (2015 Edition) (Strabismus and Pediatric Ophthalmology Group, Chinese Ophthalmological Society 2015);
- 2) The difference in esotropia angle among different gaze positions was < 5 PD;
- 3) Aged 2 to 14 years;
- 4) The angle of esotropia in primary gaze was 20 to 40 PD;
- 5) Patients and their guardians voluntarily participated in the study and completed the full follow-up period.

Exclusion Criteria

- 1) Incomplete medical records with missing key data;
- 2) Complicated with organic fundus lesions, history of ocular trauma, or previous ocular surgery;
- 3) Presence of intracranial organic diseases, abnormal neurodevelopment, etc.;
- 4) Poor treatment compliance, or inability to complete the specified follow-up period due to personal reasons.

Methods of examination

- 1) Detailed collection of patients' baseline data, including onset time, medical history characteristics, near-work habits, etc.;
- 2) Routine ophthalmic examinations: Slit-lamp microscopy for anterior segment evaluation, ophthalmoscopy for fundus examination, and non-contact tonometer for intraocular pressure measurement;
- 3) Refractive examination: Computer optometry combines with subjective refraction was performed after cycloplegia with 1% atropine eye gel. Patients with refractive error were prescribed full correction spectacles, and those without refractive error wore Plano lenses as the carrier for Fresnel prisms;
- 4) Strabismus angle measurement: The alternate prism cover test was used to measure the angle of esotropia in primary gaze at 33 cm (near) and 6 m (distance), respectively;
- 5) Fusion function assessment: the Worth four-dot test was used to evaluate binocular fusion function at 33 cm and 6 m, respectively;
- 6) Binocular visual function examination: Simultaneous perception, fusion range, and stereopsis function were detected by synoptophore;

- 7) Near stereopsis measurement: Titmus stereoscopic chart was used to detect near stereopsis function, with ≤ 60 arcsec as the standard for foveal stereopsis.

Treatment Protocols

1. Fresnel Prism Group

- 1) Base-out Fresnel press-on prism were prescribed on the basis of full refractive correction, with the prism power 2 ~ 10 PD lower than the measured value. For residual esotropia ≤ 10 PD, prisms were worn monocularly; for residual esotropia > 10 PD, prism power was distributed binocularly;
- 2) Patients were instructed to increase the time of distant viewing over 6 m, and the prism power was adjusted monthly during re-examination to maintain a residual esotropia of 2 ~ 10 PD;
- 3) Prisms were discontinued when orthotropia was achieved and diplopia resolved, with continued follow-up thereafter.

2. BTX-A Injection Group

Botulinum toxin type A (100 IU/vial) was diluted with 2 mL of normal saline, and injected unilaterally or bilaterally into the medial rectus muscle belly via the inferonasal conjunctival PARKS incision, with 0.05 mL (containing 2.5 IU) per eye.

3. Surgery Group

Medial rectus recession (combined with lateral rectus resection if indicated) was performed under general anesthesia. The intermuscular membrane and check ligaments were dissected through the Parks conjunctival incision. The medial rectus was recessed according to the pre-designed amount and fixed to the sclera (or lateral rectus resection was performed), and the conjunctival incision was sutured with absorbable sutures. Tobramycin eye ointment was applied and the eye was bandaged after surgery. Patients were discharged the next day with topical anti-inflammatory treatment.

Outcome Measures

- 1) Angle of esotropia: Measured by the alternate prism cover test in primary gaze at 33 cm and 6 m before treatment and at 1, 3, and 6 months after treatment;
- 2) Fusion function: Examined by the striated lens at 33 cm and 6 m at 0.5, 1, and 3 months after treatment, with the presence of crossed linear light during fixation as the normal standard;
- 3) Central stereopsis: Evaluated by synoptophore at 0.5, 1, and 3 months after treatment, with ≤ 60 arcsec as the normal standard.

Statistical Analysis

Statistical analysis was performed using SPSS 26.0 software. Measurement data were expressed as mean $\pm$ standard deviation ($\bar{X} \pm S$). Intra-group comparisons before and after treatment were performed using the paired t-test; ranked data (Titmus stereopsis test results) were analyzed using the Wilcoxon rank-sum test; categorical data (Worth four-dot test results) were analyzed using Fisher's exact test. Univariate logistic regression analysis was used to analyze the influencing factors of treatment effect. A P-value < 0.05 was considered statistically significant.

Results

1 Baseline Characteristics of the Patients

A total of 101 patients were included in this study, with a mean interval from symptom onset to initial consultation of 3.37 ± 5.05 months. There were 62 myopic patients (61.4%) and 39

emmetropic patients (38.6%), with a best corrected visual acuity of ≥ 0.9 in all patients. In the myopic group, the mean spherical equivalent (SE) was -6.57 ± 2.14 diopters (D) (range: -1.75 to -8.75 D) in the right eye and -6.05 ± 1.85 D (range: -0.50 to -8.05 D) in the left eye. No abnormalities were found in slit-lamp microscopy, fundus examination, systemic and neuroendocrine evaluations, and no positive findings were detected in orbital CT scans. None of the patients had a history of monocular occlusion.

2 Preoperative Strabismus Angle and Visual Function

Before treatment, the mean esotropia angle with spectacle correction was 15.76 ± 5.24 PD for distance (6 m) and 13.94 ± 5.83 PD for near (33 cm) in all patients, with the distance esotropia angle significantly larger than the near angle ($t = -2.15$, $P = 0.047$).

Synoptophore examination showed that all patients had simultaneous perception, with a divergence fusion range of $-7.12 \pm 3.82^\circ$ and a convergence fusion range of $19.18 \pm 7.72^\circ$, and all had distance stereopsis function. Titmus near stereopsis test results: 5 patients had no near stereopsis function, 3 patients had only peripheral stereopsis, and 2 patients achieved foveal stereopsis (≤ 60 arcsec).

3 Change in Ocular Alignment and Strabismus Angle After Treatment

There were no statistically significant differences in the baseline near (33 cm) and distance (6 m) esotropia angles among the three groups ($P > 0.05$), indicating balanced baseline data. At 1 month after treatment, the esotropia angles in all three group were significantly reduced compared with those before treatment in each group ($P < 0.05$). Inter-group comparison showed that the ocular alignment effect of the surgery group (2.01 ± 1.59 PD) and the BTX-A group (2.56 ± 1.71 PD) was significantly better than that of the Fresnel prism group (4.18 ± 1.82 PD), with statistically significant differences ($P < 0.05$) (Table 1).

Table 1 | Comparison of changes in esotropia angle among the three groups

Groups	Distance (6 m)				Near (33 cm)			
	Pre-treatment	1-month post-treatment	t-value	P-value	Pre-treatment	1-month post-treatment	t-value	P-value
Fresnel Prism	27.97 $\pm$ 4.25	4.18 $\pm$ 1.82 ^a	1.865	0.066	24.75 $\pm$ 2.78	2.97 $\pm$ 1.38 ^a	0.389	0.698
BTX-A	28.16 $\pm$ 5.94	2.56 $\pm$ 1.71 ^a	4.051	< 0.001	25.01 $\pm$ 3.11	2.24 $\pm$ 1.15 ^a	2.538	0.013
Surgery	28.53 $\pm$ 5.28	2.01 $\pm$ 1.59 ^a	5.262	< 0.001	24.93 $\pm$ 2.87	2.33 $\pm$ 1.44 ^a	4.625	< 0.001

Note: ^a indicates $P < 0.05$ compared with the pre-treatment value in the same group.

4 Recovery of Fusion Function

At 1 month and 3 months after treatment, there were statistically significant differences in the normal rate of fusion function among the three groups ($P < 0.001$). the normal rate of fusion function in the surgery group was 100% at both 1 month (32/32) and 3 months (32/32) after treatment, which was significantly higher than that in the BTX-A group (67.6% at 1 month, 86.5% at 3 months) and the Fresnel prism group (31.3% at 1 month, 59.4% at 3 months) (Table 2).

Table 2 | Comparison of fusion function recovery among the three groups

Groups	1-month post-treatment				3-months post-treatment			
	Normal	Abnormal	χ^2	P-value	Normal	Abnormal	χ^2	P-value
Fresnel Prism	10	22			19	13		
BTX-A	25	12	25.73	< 0.001	32	5	16.74	< 0.001
Surgery	32	0			32	0		

5 Recovery of Central Stereopsis

At 1 month and 3 months after treatment, there were statistically significant differences in the recovery rate of central stereopsis among the three groups ($P < 0.001$). The recovery rate of central stereopsis in the surgery group was almost 100% at both 1 month (31/32) and 3 months (32/32) after treatment, which was significantly higher than that in the BTX-A group (73.0% at 1 month, 94.6% at 3 months) and the Fresnel prism group (40.6% at 1 month, 62.5% at 3 months) (Table 3).

Table 3 | Comparison of central stereopsis recovery among the three groups

Groups	1-month post-treatment				3-months post-treatment			
	Normal	Abnormal	χ^2	P-value	Normal	Abnormal	χ^2	P-value
Fresnel Prism	13	19			20	12		
BTX-A	27	10	19.84	< 0.001	35	2	10.34	< 0.001
Surgery	31	1			32	0		

6 Analysis of Treatment-Related Complications

There were significant differences in the types of treatment-related complications among the three groups (Table 4). The main complication in the Fresnel prism group was visual discomfort, with an incidence of 25% (8/32); the BTX-A group mainly presented with ptosis (14%, 5/37) and vertical strabismus (11.0%, 4/37); the main complication in the surgery group was conjunctival hyperemia, with an incidence of 16.0% (5/32).

Statistical analysis showed no statistically significant difference in the overall incidence of complications among the three groups ($\chi^2 = 1.05$, $P = 0.59$). Although the overall incidence of complications in the surgery group was numerically lower (15.6%), this result needs further validation in studies with larger sample sizes.

Table 4 | Comparison of incidence of complications among the three groups

Groups	Number of cases	Visual discomfort	Conjunctival hyperemia	Vertical strabismus	Ptosia	Total*
Fresnel Prism	32	8	0	0	0	8
BTX-A	37	0	0	4	5	9
Surgery	32	0	5	0	0	5
χ^2 / Fisher			1.05			
P			0.59			

Note: * indicates the total number of patients with complications in each group.

Discussion

Pathogenesis of AACE

The pathogenesis of acute acquired comitant esotropia (AACE) has not been fully elucidated, but existing studies have confirmed that multiple factors are closely related to its occurrence. First, neurological abnormalities are a potential etiology that cannot be ignored. Several studies have reported that a small number of AACE patient are complicated with central nervous system lesions, suggesting that neuromodulatory dysfunction may be involved in the pathogenesis of the disease [5, 7, 8].

Second, according to clinical phenotypes and onset triggers, AACE can be divided into three types with distinct etiologies: Type I is caused by the disruption of binocular fusion function due to monocular occlusion, monocular vision loss, and other factors [8, 9]; Type II is characterized by large-angle esotropia and mild hyperopia, with no significant improvement in esotropia angle after hyperopia correction, and its onset may be related to physical and psychological stress as well as genetic factors [5, 7]; the core trigger of Type III is uncorrected myopia or excessive near work, as long-term near vision can induce excessive convergence function and increased medial rectus tone, leading to an imbalance between convergence and divergence, and ultimately resulting in esotropia [5, 7]. In addition, scholars have proposed that abnormal anatomical position of the media rectus insertion (relatively anterior) may enhance the functional advantage of the medial rectus and serve as a risk factor for the onset of AACE [9].

All 101 minor patient (aged 2 to 14 years) included in this study were exclude from neurological and systemic organic diseases through neurology consultation, cranial MRI, and endocrine examinations, which is different from previous research results showing a higher correlation with neurological diseases in adult AACE patients [4, 10, 11]. this suggests that the etiology of AACE in children and adolescents may be more inclined to factors related to visual environment and refractive status [2, 12, 13].

In this study, less than half of the patients had a history of long-term near-work with electronic products (7.4 ± 1.6 hours per day), and the remaining patients had no clear triggers, which is consistent with previous research conclusions: the refractive status of AACE can cover myopia, emmetropia, and mild hyperopia, and excessive near work may induce the disease by breaking the convergence-divergence balance, regardless of whether myopia is corrected [14]. This also explains the therapeutic mechanism of non-surgical treatments (Fresnel prisms, BTX-A injection), which

can achieve ocular alignment improvement and diplopia resolution by regulating the balance of extraocular muscle force or optical correction [5, 11].

Comparative Efficacy and Core Differences Among the Three Treatment Modalities

(1) Strabismus Corrective Surgery: Optimal Efficacy and Strong Stability

The results of this study showed that the comprehensive efficacy of strabismus corrective surgery (medial rectus recession $\pm$ lateral rectus resection) was significantly better than the other two regimens. It achieved the best short-term ocular alignment effect, with the distance esotropia angle reduced to 2.01 ± 1.59 PD at 1 month after surgery, which was significantly lower than that of the BTX-A group (2.56 ± 1.71 PD) and the Fresnel prism group (4.18 ± 1.82 PD) ($P < 0.05$). It also achieved the most ideal long-term recovery rate of central stereopsis reaching 100% at 3 months after surgery, and no cases of recurrence. These findings are related to the mechanism of surgery, which directly adjusts the force balance of extraocular muscles and corrects the deviation of the visual axis from the root cause.

In terms of complications, the surgery group mainly presented with mild conjunctival hyperemia (incidence 15.6%), with no serious functional complications, indicating controllable safety. However, it should be noted that surgery is an invasive treatment requiring general anesthesia, with risks of conjunctival incision and trauma related to muscle adjustment. Short-term topical anti-inflammatory treatment is required after surgery, and conventional clinical practice requires the patient's condition to be stable for more than 6 months before surgery. In addition, attention should be paid to the risk of recurrence caused by unimproved near-work habits after surgery.

(2) Botulinum Toxin Type A Injection: Minimally Invasive with Significant Short-Term Efficacy

The core advantage of BTX-A injection is its minimal invasiveness: it requires no surgical incision and achieves ocular alignment by temporarily paralyzing the medial rectus muscle, making it suitable for patients with low surgical tolerance. In this study, the esotropia angle of the BTX-A group at 1 month after treatment (2.56 ± 1.71 PD) was close to that of the surgery group and significantly better than that of the Fresnel prism group ($P < 0.05$). At 3 months after treatment, the normal rate of fusion function (86.5%) and the recovery rate of central stereopsis (94.6%) in the BTX-A group were significantly higher than those in the Fresnel prism group ($P < 0.0001$), despite being lower than those in the surgery group, confirming its definite short-term efficacy.

Its limitations are mainly reflected in two aspects: First, the risk of specific complications. In this study, 13.5% of patients developed ptosis and 10.8% developed vertical strabismus, which may affect appearance and ocular alignment stability, and are related to the temporary paralysis of adjacent extraocular muscles caused by the diffusion of botulinum toxin. Second, the risk of recurrence: the duration of action of botulinum toxin is limited, with a potential for dose-dependent recurrence. Some patients require repeated injections to maintain the curative effect, and the long-term stability of visual function recovery is inferior to surgery.

(3) Fresnel Prisms: A Non-Invasive Option for Transitional Treatment

Fresnel Prisms neutralize diplopia and improve ocular alignment through the principle of optical refraction, with the characteristics of complete non-invasiveness and high safety, especially suitable for young children, patients with poor tolerance to invasive treatment, or those temporarily ineligible for surgery. Its clinical value is mainly reflected in transitional treatment: it can rapidly

relieve diplopia symptoms and provide a buffer for observing disease progression or waiting for surgery timing.

However, this study confirmed its significant limitations in efficacy: It had the worst short-term ocular alignment effect, with a residual esotropia angle of 4.18 ± 1.82 PD at 1 month after treatment, which was significantly higher than the other two groups ($P < 0.05$). Its long-term visual function recovery was also poor, with the normal rate of fusion function (59.4%) and the recovery rate of central stereopsis (62.5%) at 3 months after treatment being significantly lower ($P < 0.001$). In addition, 25.0% of patients experienced visual discomfort (related to mild visual loss caused by prism reflection and dispersion effects), which may reduce wearing compliance, and there is a risk of dependence with long-term use. Furthermore, the clinical application of Fresnel prisms is limited by the degree of strabismus (generally no more than 20 PD), which cannot meet the correction needs of patients with moderate to high-degree esotropia [15, 16].

Recommendations for Individualized Clinical Treatment Selection

Combined with the advantages and disadvantages of the three treatment modalities and the results of this study, individualized plans should be formulated in clinical practice based on the specific conditions of patients:

- **Strabismus Corrective Surgery:** It is recommended as the first-line option for patients with an esotropia angle of 20 to 40 PD and high demand for binocular visual function recovery, especially for patients with a disease course of ≥ 6 months and stable moderate to high-degree esotropia. It can achieve durable ocular alignment and maximize visual function recovery.
- **Botulinum Toxin Type A Injection:** It is suitable for patients with low to moderate-degree esotropia (≤ 30 PD), surgical contraindications (such as high risk of general anesthesia), or refusal of surgery. It can be used as a short-term correction or transitional treatment, but patients should be informed of the risks of specific complications and recurrence in advance.
- **Fresnel Prisms:** They are mainly used for new-onset cases within 6 months of symptom onset, small-angle esotropia (≤ 20 PD), or temporary intervention scenarios (such as relieving diplopia while waiting for surgery). They are especially suitable for young children or patients with extremely low tolerance to invasive treatment. However, their long-term efficacy is limited, and regular evaluation is required to determine whether to switch the treatment plan.

Study Limitations and Future Perspectives

This study has the following limitations: (1) A retrospective case series study design was adopted, which may have selection bias, and long-term intervention and monitoring of patients' near-work behavior were not performed. (2) The follow-up period was relatively short, and the long-term efficacy stability and recurrence difference over 1 year were not evaluated. (3) The sample size was relatively limited (101 cases), which may affect the statistical power of subgroup analysis (such as stratification by different esotropia angles and age groups).

Future research should focus on the following aspects: (1) Conduct multicenter, large-sample prospective cohort studies with a follow-up period of more than 1 year to verify the long-term efficacy and safety of different treatment modalities; (2) Further explore the pathogenesis of AACE, and clarify the interaction between genetic factors, neuromodulatory abnormalities, and visual environment; (3) Refine the stratification of treatment indications, and formulate precise treatment

strategies based on the patient's age, esotropia angle, and baseline binocular visual function status, to avoid overtreatment or delayed surgery timing; (4) Optimize the treatment process, such as prioritizing non-surgical intervention for young children, early evaluation of surgical indications for patients with high-degree esotropia, and strengthening postoperative visual training and guidance on eye use habits, to further improve the treatment effect, reduce the risk of recurrence, minimize visual disability and psychological problems caused by inappropriate treatment, and reduce the medical burden on families and society.

Statements and Declarations

Funding: None.

Ethics Approval:

Consent for Publication: Written informed consent for publication of clinical data and identifiable photographs was obtained from the patients and their legal guardians.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Authors' Contributions: Shaohua Chen: Investigation, Validation, Supervision, Conceptualization, Methodology, Writing - review & editing. Xiting Guo: Investigation, Validation, Supervision, Conceptualization. Xiaoyu Liu: Investigation, Validation, Supervision, Conceptualization. Haixia Tian: Investigation, Validation, Supervision, review & editing.

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