· Clinical Research ·

Efficacy of microcatheter-assisted trabeculotomy on secondary glaucoma after congenital cataract surgery

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Abstract

● **AIM:** To evaluate efficacy of microcatheter-assisted trabeculotomy (MAT) in eyes with secondary glaucoma after congenital cataract surgery and explore its correlation with the different degree of trabeculotomy.

● **METHODS:** A retrospective analysis was conducted on patients who underwent the said procedure between September 2019 and September 2020. The patients were classified into two groups according to the degree of trabeculotomy (group 1: ≤240-degree; group 2: 240–360-degree). The intraocular pressure (IOP) and anti-glaucoma drugs before and after operation was collected during the 12-month follow-up.

● **RESULTS:** Totally 27 eyes of 25 patients were included: 11 (40.7%) eyes in group 1 and 16 (59.3%) eyes in group 2. The mean IOP of all patients was 34.67±9.18 mm Hg preoperatively and 8.74±4.32, 9.95±5.65, 14.39±5.30, 16.02±4.37, 15.82±3.28, and 16.19±3.56 mm Hg 1d, 1wk, 1, 3, 6, and 12mo after surgery, respectively. In all patients, there were significant differences in IOP at each time point (F=65.614, P<0.01). In each group, IOP after surgery was lower than that before surgery (all P<0.01), but there was no difference in the rate of IOP reduction between the two groups (P=0.246). Furthermore, the amount of anti-glaucoma medications reduced to 0.30±0.67 (0–2) at 12mo from 2.63±0.49 (2–3) preoperatively (P<0.01), and there was no difference between the two groups (P>0.05). At the end of follow-up, the partial success rate was 81.8% in group 1 *vs* 93.75% in group 2 (P=0.549). Various amount of intraoperative and postoperative hyphema occurred in all eyes, which spontaneously absorbed or cleaned through paracentesis and irrigation. No other serious complications was observed.

● **CONCLUSION:** MAT can effectively reduce IOP in patients with secondary glaucoma after congenital cataract surgery with a high success rate and safety. And it can be used as the first choice for the treatment of secondary glaucoma after surgery for congenital cataracts.

● **KEYWORDS:** secondary glaucoma; congenital cataract; microcatheter-assisted trabeculotomy; illuminated microcatheter; intraocular pressure

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INTRODUCTION

Congenital cataract is one of the leading causes of visual impairment and blindness in children[1]. At present, the incidence in worldwide population is 0.6/10 000 to 9.7/10 000[2-4], in which China and other developing countries account for approximately 75% of the total population[5]. Currently, surgical treatment is the most effective treatment for congenital cataract[6]. Glaucoma is a potentially sight-threatening complication following congenital cataract surgery[7], with incidences ranging from 0 to 75.9%[8-10]. High intraocular pressure (IOP) may cause ganglion cell necrosis and apoptosis leading to irreversible vision loss[11]. Therefore, reducing the IOP is the key to treat secondary glaucoma in children. And the most important way to reduce IOP is surgery, with medications being useful as temporizing measures or adjunctive treatment. Meanwhile, surgical options include angle surgery, filtering surgery, glaucoma drainage devices, and cyclodestructive procedures[12-14]. However, due to the strong metabolic and repair ability of children, glaucoma drainage device implantation and traditional filtering surgery may increase the risk of scar formation by organized filtration channels. In addition, the traditional trabeculotomy can only cut 120-degree Schlemm's canal (SC), and accurate positioning of the SC is the key to this surgery. Without the guidance of visual devices, there existed the risk of straying into other structures to form false path and damaging the surrounding tissues[15]. Later, a modified trabeculotomy was proposed to achieve the purpose of SC incised completely with sutures. However, due to the difficulty in locating the SC and controlling the sutures, the operation became more difficult and there were many postoperative complications. Therefore, it is necessary to develop a surgical method that can enlarge the incision range of the SC and avoid the above risks at the same time[16-17].

In recent years, with the advent of illuminated flexible microcatheters (iTrack™ 250A, iScience Interventional Corporation, Menlo Park, CA, USA), microcatheter-assisted trabeculotomy (MAT) has also been gradually used in the treatment of glaucoma. Under the instruction of luminescent microcatheter, the SC is cut partially or completely so that the aqueous directly inflows the SC through the anterior chamber. In addition to extending the incision range of the SC, the filtering channel and implant-related risks of traditional surgery are avoided. According to current studies, MAT is mostly used for the treatment of glaucoma in children. Hu *et al*[18] reported the results of MAT in children with primary congenital glaucoma (PCG) after failed previous glaucoma surgeries, in which the success rate varied from 80% to 84%. Hoffmann *et al*[19] found a higher success rate than conventional probe trabeculotomy, filtering and cyclodestructive surgery, and other studies also found similar results[18,20-21]. Therefore, we hypothesized that MAT may also have a better effect in patients with secondary glaucoma after congenital cataract surgery. Currently, the feasibility and effects of MAT in these patients have not been systematically reported. In our study, we reported the surgical outcomes of MAT in patients with secondary glaucoma after congenital cataract surgery. In addition, previous studies have found that different degrees of SC incision also have an impact on postoperative IOP after MAT. Therefore, we divided the children who received MAT surgery into groups according to the degree of SC incision and compared the effect between the groups.

SUBJECTS AND METHODS

Ethical Approval A retrospective, consecutive case series study was conducted. All procedures used in this study were approved by the Ethics Committee of the First Affiliated Hospital of Zhengzhou University (2021-KY-0642) and performed in accordance with the Declaration of Helsinki. All patients had a complete ocular examination and detailed medical history. Informed consent was obtained from subjects.

Subjects Patients with secondary glaucoma after congenital cataract surgery who were treated with MAT at the First Affiliated Hospital of Zhengzhou University between September 2019 and September 2020 were reviewed.

The inclusion criteria were as follows: 1) all eyes diagnosed with secondary glaucoma after congenital cataract surgery; 2) IOP>21 mm Hg (1 mm Hg=0.133 kPa), with the maximum tolerated amount of medications; 3) all patients followed up for at least 12mo; and 4) without other glaucoma surgeries performed. Patients with the following were excluded: 1) congenital glaucoma; 2) high IOP before cataract surgery; 3) other ocular diseases that may cause increased IOP, such as Sturge-Weber syndrome, ocular and facial hemangioma, *etc.*; and 4) any eye suffering from ocular inflammation.

Measurement of Clinical Indicators All patients underwent a comprehensive preoperative ophthalmologic examination, including best-corrected visual acuity, IOP measurement, anterior segment examination using a slit lamp, fundus photography, and B-scan of the eye. For older children, visual field tests can be performed if vision is permitted. All clinical indicators were measured by a single physician. Uncorrected visual acuity and best spectacle-corrected visual acuity were examined using standard logarithmic visual acuity chart. And the IOP was determined by taking the average of the three measurements obtained using the Icare tonometer (ICARE, Finland). In addition, we observed corneal transparency and diameter, anterior chamber depth, pupil size, the pupillary light reflex and lens state through slit lamp examination, observed the vitreous body and retina by B-scan so that the diseases related to these structural lesions could be excluded. According to the degree of cooperation of the children, the ophthalmoscope or fundus photography was selected to observe the fundus of the children, and evaluate the color and size of the optic disc, cup-disk ratio, macula, and other fundus structures.

Information on the following clinical characteristics were collected: sex, age of congenital cataract surgery, age of secondary glaucoma, age of operation of secondary glaucoma, IOP, number of anti-glaucoma medications, status of intraocular lens (IOL) implantation, and complications. The postoperative follow-up period was at least 12mo. The IOP, amount of anti-glaucoma medications, and complications were measured at 1d, 1wk, 1, 3, 6, and 12mo postoperatively. The main types of anti-glaucoma drugs are carbonic anhydrase inhibitors, adrenergic receptor blockers, prostagrandin derivatives. And the complications to be observed mainly include hyphema, shallow anterior chamber, low IOP, malignant glaucoma, choroidal detachment, and other postoperative complications.

Surgical Procedure All procedures were performed by an experienced glaucoma specialist (Qi Y). Briefly, after satisfactory general anesthesia, a conjunctival peritomy was performed. Superficial and deep scleral flaps were then made. Next, the outer wall of the SC was cut. The luminescent microcatheter was inserted into the SC and pushed forward until it penetrated out from the opposite side. The two ends of the microcatheter were clamped to perform a 360-degree incision of the SC. Based on the location of the luminescent point, we can see the path of the microcatheter. When the tip was obstructed or misdirected, a cohesive viscoelastic was injected to dilate the canal, and an attempt was made to pass through the catheter from the other end. In cases where a 360-degree incision was not achieved, a new scleral flap was made at the blocked site and the catheter tip was pulled out to complete the partial incision of the SC if the catheter was advanced to at least 120-degree. Otherwise, a partial trabeculotomy was performed using Harms trabeculectome.

Definition of Groups and Success The patients were divided into two groups according to the degree of trabeculotomy: group 1: ≤240-degree; group 2: 240–360-degree. The status of the IOL implantation can be divided into three groups: no IOL implantation, IOL of one-stage implantation, and IOL of second-stage implantation.

Referring to the definition of surgical success in previous studies[9,22], we defined success criteria in our study as follows: complete success was characterized by IOP≤21 mm Hg and a 20% reduction without anti-glaucoma medications. A qualified success was defined as IOP≤21 mm Hg and a 20% reduction with the use of anti-glaucoma medications. Failure was defined as IOP≥21 mm Hg with anti-glaucoma medications, or the performance of a second operation.

Statistical Analysis Statistical analysis was performed using SPSS 26.0 statistical package. The demographic and preoperative data were analyzed by independent *t*-test or Fisher's exact test. The IOP were expressed as mean±standard deviation (SD), while the number of anti-glaucoma drugs were expressed as mean±SD (range). The IOP between the two groups was compared using an independent *t*-test, while the number of anti-glaucoma drugs was compared using the Wilcoxon rank sum test. The IOP and number of anti-glaucoma medications at each follow-up point before and after surgery were analyzed by repeated measures analysis of variance, and multiple linear regression was employed to estimate the relationship between sex, oculus sinister or oculus dexter, age at operation of congenital cataract, age at secondary glaucoma, age at operation of secondary glaucoma, status of IOL implantation, degree of trabeculotomy, and IOP at 12mo after surgery. Kaplan-Meier life table analysis was used to evaluate the success of the surgery. The success rate of surgery was analyzed using Fischer's exact test. Statistical significance was set at $P<0.05$.

RESULTS

Demographics and Preoperative Parameters A total of 25 patients (27 eyes) were included in the study. Among them, 14 (56%) were men and 11 (44%) were women, and their overall mean age was 6.56±4.58y. All the patients were treated with MAT. The mean preoperative IOP was 34.67±9.18 mm Hg, with 2.63±0.49 (2–3) IOP-lowering medications used. We divided all patients into two groups according to the degree of trabeculotomy to analyze the factors influencing the curative effect of surgery. Eleven eyes were in group 1 (≤240-degree), and 16 eyes were in group 2 (240–360-degree). For all eyes in group 1, the degree of SC incision was over 120-degree. Furthermore, there were no significant differences between the two groups in terms of sex ($P=0.689$), age at congenital cataract surgery ($P=0.285$), age at secondary glaucoma ($P=0.180$), age at operative time of secondary glaucoma ($P=0.268$), preoperative IOP ($P=0.069$), and number of preoperative medications ($P=0.125$; Table 1).

Surgical Results The average IOP of all patients before surgery, 1d, 1wk, 1, 3, 6, and 12mo after surgery were 34.67±9.18, 8.74±4.32, 9.95±5.65, 14.39±5.30, 16.02±4.37, 15.82±3.28, and 16.19±3.56 mm Hg, respectively (Figure 1). The difference in IOP before and after surgery was statistically significant ($F=65.614$, $P<0.01$). There were also statistically significant differences in IOP before and after surgery between the two groups. The postoperative IOP was significantly smaller than that before the operation ($F_{group1}=82.164$, $F_{group2}=109.008$, all $P<0.01$; Table 2). However, no difference was found between the two groups at any follow-up time point (all $P>0.05$; Figure 2). Further comparisons were made at any two follow-up time points; both in all patients and in the two groups, there were significant differences between the preoperative and postoperative IOP at all follow-up times ($P<0.01$). However, the IOP began to stabilize 3mo after surgery (in all patients: 3mo *vs* 6mo, $P=0.712$; 3mo *vs* 12mo, $P=0.632$; 6mo *vs* 12mo, $P=0.278$. In group 1: 3mo *vs* 6mo, $P=0.919$; 3mo *vs* 12mo, $P=0.629$; 6mo *vs* 12mo, $P=0.518$. In group 2: 3mo *vs* 6mo, $P=0.295$; 3mo *vs* 12mo, $P=0.938$; 6mo *vs* 12mo, $P=0.346$). The mean reduction rate of IOP was 53.7%±15.3% in group 2 and 45.7%±19.5% in group 1 at 12mo after surgery compared with that before surgery. There was no significant difference between the two groups ($P=0.246$).

In both groups, the number of anti-glaucoma medications was significantly reduced from baseline at all postoperative visits ($F_{group1}=65.625$, $F_{group2}=179.400$, both $P<0.001$, repeated measures analysis of variance). There was no statistical difference between the groups at all follow-up time points (all $P>0.05$; Table 3).

In this study, multiple linear regression analysis was used to predict IOP at 12mo after surgery according to sex, oculus sinister or oculus dexter, age at operation of congenital cataract, age at secondary glaucoma, age at the operation of secondary glaucoma, status of IOL implantation, and degree of trabeculotomy. It was verified that the observed values in the study were independent of each other (Durbin-Watson value of 2.272). In addition, because the variance inflation factor (VIF) is less than 10, there is no multicollinearity among the observed variables. According to the results of the analysis, the

Table 1 Comparison of clinical characteristics of two groups treated with microcatheter-assisted trabeculotomy mean±SD

Characteristics	Total	≤240-degree	240–360-degree	*P*
No. of patients (*n*, %)	25	9 (36)	16 (64)	-
No. of eyes (*n*, %)	27	11 (40.7)	16 (59.3)	-
Gender (male/female)	14/11	7/4	7/7	0.689
OD/OS	13/14	7/6	6/8	0.706
Age of congenital cataract surgery (mo)	12.56±13.65	8.82±8.44	15.13±16.07	0.285
Age of secondary glaucoma (y)	4.56±3.50	3.59±3.21	5.23±3.63	0.180
Age of secondary glaucoma surgery (mo)	6.46±4.55	5.27±4.20	7.28±4.73	0.268
Preop. IOP (mm Hg)	34.67±9.18	30.82±7.10	37.32±9.69	0.069
No. of preop. medications (mean±SD, range)	2.63±0.49 (2–3)	2.75±0.45 (2–3)	2.45±0.52 (2–3)	0.125
Status of IOL (*n*, no IOL implanted/one-stage implanted/second-stage implanted)	9/7/11	5/2/4	4/5/7	0.616

OD: Oculus dexter; OS: Oculus sinister; IOP: Intraocular pressure; IOL: Intraocular lens.

Table 2 IOP of two groups treated microcatheter-assisted trabeculotomy mean±SD

Follow-up	Total (*n*=27)	≤240-degree (*n*=11)	240–360-degree (*n*=16)	[a]*P*
Preop.	34.67±9.18	30.82±7.10	37.32±9.69	0.069
Postop.				
1d	8.74±4.32	9.73±5.64	8.07±3.15	0.337
7d	9.95±5.65	12.82±7.26	7.98±3.16	0.058
1mo	14.39±5.30	16.09±6.55	13.23±4.06	0.172
3mo	16.02±4.37	15.73±5.61	16.23±3.47	0.777
6mo	15.82±3.28	15.82±4.26	15.82±2.56	1.000
12mo	16.19±3.56	16.09±4.68	16.26±2.71	0.905
F	65.614	82.164	109.008	-
[b]*P*	0.000	0.000	0.000	-

IOP: Intraocular pressure. [a]Comparison between the two groups; [b]Repeated ANOVA.

Table 3 Number of medications of two groups treated with microcatheter-assisted trabeculotomy mean±SD (range)

Follow-up	Total (*n*=27)	≤240-degree (*n*=11)	240–360-degree (*n*=16)	[a]*P*
Preop.	2.63±0.49 (2–3)	2.45±0.52 (2–3)	2.75±0.45 (2–3)	0.125
Postop.				
1d	0.00±0.00 (0–0)	0.00±0.00 (0–0)	0.00±0.00 (0–0)	1.000
7d	0.07±0.27 (0–1)	0.18±0.40 (0–1)	0.00±0.00 (0–0)	0.082
1mo	0.22±0.58 (0–2)	0.36±0.67 (0–2)	0.13±0.50 (0–2)	0.162
3mo	0.30±0.72 (0–3)	0.36±0.67 (0–2)	0.25±0.77 (0–3)	0.382
6mo	0.30±0.67(0–2)	0.36±0.67 (0–2)	0.25±0.68 (0–2)	0.422
12mo	0.30±0.67 (0–2)	0.36±0.67 (0–2)	0.25±0.68 (0–2)	0.422
F	141.868	65.625	179.400	-
[b]*P*	0.000	0.000	0.000	-

[a]Comparison between the two groups. [b]Repeated measures analysis of variance.

regression model was not statistically significant (F=1.456, P=0.241, adjusted R^2=0.109). Among the independent variables included in the model, sex, oculus sinister or oculus dexter, age at operation of congenital cataract, age at operation of secondary glaucoma, and the degree of trabeculotomy

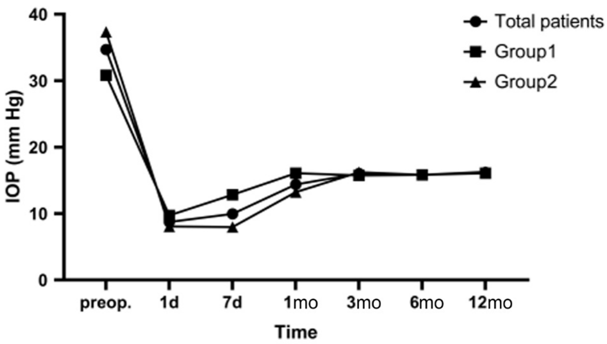

Figure 1 The IOP at preoperative and postoperative follow-up time points in total patients and two groups.

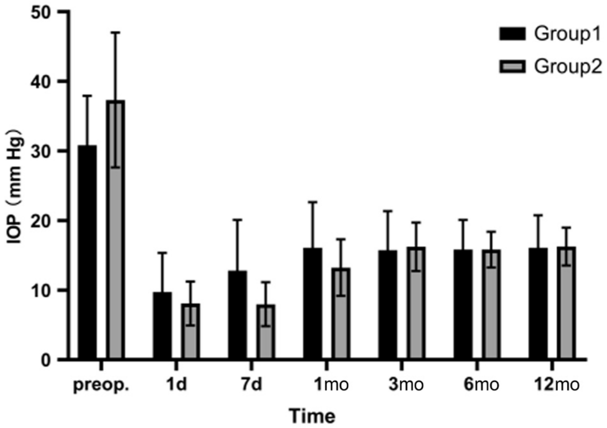

Figure 2 The IOP of two groups at preoperative and postoperative follow-up time points.

had no significant predictive power over the IOP at 12mo after surgery (all P>0.05). Furthermore, the IOP of the group without IOL implantation was significantly lower than that of the group with primary IOL implantation at 12mo after surgery (P=0.038). There was no significant difference in the IOP between the group with secondary implantation of IOL and those without IOL implantation or those with primary implantation of IOL at 12mo after surgery (all P>0.05).

The Kaplan-Meier method was used to compare the surgical success rates between the two groups (Figure 3). At the end of follow-up, group 2 achieved an 87.5% complete and 93.75%

Table 4 Success rate of two groups treated with microcatheter-assisted trabeculotomy %

Follow-up	Complete success			Qualified success		
	Total (*n*=27)	≤240-degree (*n*=11)	240–360-degree (*n*=16)	Total (*n*=27)	≤240-degree (*n*=11)	240–360-degree (*n*=16)
1d	100	100	100	100	100	100
7d	92.6	81.8	100	92.6	81.8	100
1mo	85.2	72.7	93.75	85.2	72.7	93.75
3mo	81.5	72.7	87.5	88.9	81.8	93.75
6mo	81.5	72.7	87.5	88.9	81.8	93.75
12mo	81.5	72.7	87.5	88.9	81.8	93.75

qualified success rate, whereas group 1 achieved 72.7% and 81.8%, respectively. There was no statistical difference between the two groups (complete success, P=0.549; qualified success, P=0.370; Table 4).

Complications and Secondary Procedures Complications included 27 (100%) eyes with hyphema. No serious complications such as suprachoroidal hemorrhage, choroid detachment, or endophthalmitis were found in any of the patients. According to the degree of blood deposition, the hyphema was divided into four grades[23]: grade I, layered blood occupying less than one-third of the anterior chamber; grade II, blood filling of one-third to one-half of the anterior chamber; grade III, blood filling of more than 1/2 but less than the entire anterior chamber; and grade IV, total clotted blood. All patients developed hyphema during and after the surgery. If it was an intraoperative hyphema, the douche of the anterior chamber was administered during the surgery. In all postoperative hyphema, 24 (88.9%) eyes were grade I, of which 10 (37.3%) were in group 1 and 14 (51.9%) were in group 2. Three eyes were grade II, of which 1 (7.4%) eye was in group 1, and 2 (3.7%) eyes were in group 2 (Table 5). In all eyes with grade I hyphema, the layered blood was completely absorbed within 1wk. In the eyes with grade II, only one eye was completely absorbed at 1wk, and the other two eyes underwent douche of the anterior chamber on the fifth day after surgery due to the slow absorption of blood. One eye was not included in the statistical analysis due to the cyclocryosurgery performed because of IOP.

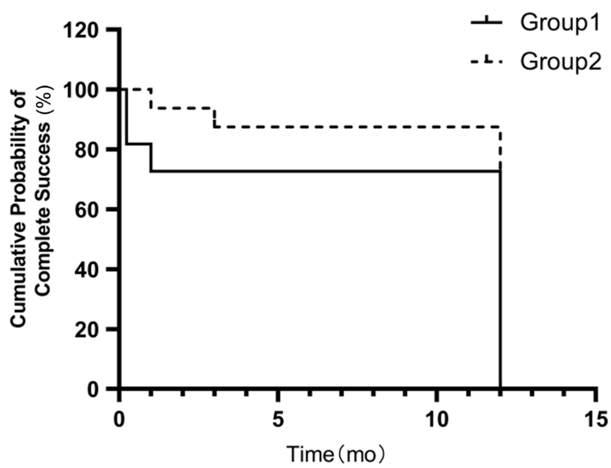

Figure 3 Kaplan-Meier survival chart of cumulative probability of success for eyes with different degree of trabeculotomy (group 1: ≤240-degree, group 2: 240–360-degree) after microcatheter-assisted trabeculotomy for secondary glaucoma after congenital cataract surgery over 12mo.

Table 5 Postoperative hyphema of two groups treated with microcatheter-assisted trabeculotomy *n* (%)

Grades of hyphema	Total	≤240-degree	240–360-degree
I	24 (88.9)	10 (37.0)	14 (51.9)
II	3 (11.1)	1 (3.7)	2 (7.4)
III	0	0	0
IV	0	0	0

DISCUSSION

Secondary glaucoma is a serious complication of congenital cataract[7], with an incidence rate reaching as high as 75.9%[8-10]. According to previous studies, the causes of secondary glaucoma can be summarized as follows: 1) early secondary uveitis after cataract surgery leads to pupil adhesion; 2) early cataract surgery may hinder the maturation of the developing trabecular meshwork, such as injury to surgical instruments, the residual cortex of the lens, and the influence of the materials produced after vitrectomy; and 3) the trabecular meshwork is prone to collapse and deformation without the support of the lens, and its function in promoting metabolism and filtration of the aqueous solution can be significantly reduced. Anti-glaucoma drugs and surgery are two commonly used methods to reduce IOP. Due to the children too young, the coordination and effect is not good, so most children often need surgical intervention. Conventional trabeculectomy has a high failure rate, and 50% of patients require a second operation[24]. Trabeculotomy is the main surgical method in the treatment of glaucoma. In recent years, MAT has become increasingly mature as a surgical method for glaucoma. Through this surgery, the inner wall of the SC is partially or completely cut under the guidance of a luminescent microcatheter to establish a direct connection between the anterior chamber and the SC. This connection can facilitate the outflow of aqueous fluids into the SC.

It was first introduced into the clinic in 2010, mainly used for the treatment of glaucoma in children and adolescents, and achieved ideal surgical results[25]. At present, there is a lack of study of MAT for the treatment of secondary glaucoma after congenital cataract surgery. Therefore, we proposed this study. Sarkisian[25] first reported in 2010 that MAT can be used for the treatment of glaucoma, which significantly improved the accuracy and degree of the incision of the trabecular meshwork, thus enhancing the success rate of surgery. At 6mo after surgery, IOP was reduced by 47% in their study. This is similar to the results of our study, in which the postoperative effect of children with secondary glaucoma after congenital cataract surgery was mainly evaluated after MAT. We found that the IOP of all the children was reduced by 50.42% on average after 12mo of follow-up. Due to changes in the structure of the anterior chamber angle after cataract surgery, the anterior chamber angle of some children could not achieve full incision of SC. Therefore, according to the scope of SC incision, we divided the children into two groups: the IOP of the partial incision group decreased 45.7%±19.5%, and the IOP of the complete incision group decreased 52.7%±15.3%. This is consistent with the results obtained by El Sayed and Gawdat[26] in 2017 in the study of children with congenital glaucoma, in which there is no significant difference in the rate of IOP reduction between complete and partial trabeculotomy assisted by microcatheter. This may be related to the segmental outflow of aqueous humor. The function of SC is segmental and active, and outflow of aqueous humor is segmental rather than uniform throughout the eye[27]. Therefore, we speculated that the SC in the incised part could play a role of adequate outflow of aqueous humor, which could explain why there was no difference in the reduction of IOP in different scope of SC incision. Nevertheless, Sarkisian[25] observed 16 patients with PCG and found that the IOP of complete trabeculotomy was significantly lower than that of partial trabeculotomy. Due to the limitations of inclusion criteria, time of follow-up, different types of glaucoma and small sample size, further research and exploration are required on the basis of a unified type of large sample size.

In addition, according to our criteria of success, 22 eyes achieved complete success at the end of follow-up, accounting for 81.5% of the total eyes, and 24 eyes achieved qualified success at the end of follow-up, accounting for 88.9%, which is similar to the results of previous studies on congenital glaucoma treated by MAT. M Elwan *et al*[28] performed MAT for pediatric glaucoma and showed a partial success rate of 88.0% and a complete success rate of 76.0%, which were comparable to our results. Traditional surgical methods, such as goniotomy or trabeculotomy with trabeculotome, have a success rate of 66.7% according to previous studies[7], which is lower than MAT. In addition, according to previous studies of childhood glaucoma, the success rate of MAT is higher than that of trabeculectomy and trabeculectomy combined with trabeculotomy. This may be due to the limited scope of trabecular meshwork opened by surgical methods, resulting in limited removal of aqueous outflow resistance[19-21,29].

According to the state of IOL implantation after cataract surgery, we divided the children three groups: no IOL implantated, one stage IOL implantion and secondary implantation of IOL. We found that at 12mo after surgery, the IOP of the group of no IOL implantated was obviously lower than the other two groups. The reason may be that the process of IOL implantion may has influence on structure of anterior chamber angle.

The key to the success of SC incision is the accurate positioning and the correct passage through the SC. Due to the difficulty in positioning, crossing of SC and suture control in traditional trabeculotomy, it is common for suture or trabeculotome to stray into suprachoroidal or other structures, resulting in related complications[16-17]. In recent years, with the emergence of luminescent microcatheter, the above risks have been avoided. In our study, because under the guidance of the luminescent microcatheter, we could see the catheter's path, and timely find and correct the deviation of the catheter tip, so as to avoid the occurrence of serious complications.

We observed that all of our included patients had different degrees of hyphema, which was consistent with the results of previous research related[20,25,28]. However, most hyphema were grade I, which was less than 1/3 of the anterior chamber volume and could be absorbed spontaneously in about 1wk. No serious surgical complications were found. Some scholars regarded the intraoperative and postoperative hyphema as a sign of success, indicating that the patency of outflow pathway of vascular side was unblocked.

There are some limitations in this study. First of all, this study was a retrospective study, so it was not able to comprehensively collect the parameters of anterior chamber angle and changes in the thickness of retinal nerve fiber layer before and after surgery. Second, our sample size was small, and the follow-up time was short. In addition, because children are still in the learning stage, with the growth of age, the degree of cooperation to the examination will change, which may lead to the existence of measurement errors. Future prospective studies with larger sample sizes and longer follow-up are needed to investigate the long-term effectiveness of MAT in children with secondary glaucoma after congenital cataract surgery.

In summary, the results of this study indicate that MAT is a better surgical method for the treatment of secondary glaucoma after surgery for congenital cataracts. This surgery had a higher success rate, good effect of reducing IOP and providing safety, and can be used as the first choice for the treatment of secondary glaucoma after surgery for congenital cataracts. Further research is needed to determine the long-term success rate of this surgery.

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