

Re-formation of absent anterior chamber by iris incision using a 20-gauge knife in eyes with advanced paediatric vitreoretinopathies

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Abstract

Background To present the novel usage of iris incision in paediatric patients lacking an anterior chamber due to various advanced vitreoretinopathies.

Methods Forty-one patients (41 eyes) were enrolled in this consecutive, prospective study. Iris incision was performed in all patients. The number of iris incision times, surgical procedures, and intraoperative and postoperative complications were collected. Patients were followed up for at least 6 months.

Results Anterior chamber formation was achieved with only 1 initial episode of iris incision in 28 (68.3%) eyes, with 2 episodes in 11 (26.8%) eyes, and with 3 episodes in the remaining 2 (4.9%) eyes, which also underwent 1 episode of external SRF drainage. Except for iris incarceration, which occurred in 7 (17%) of the eyes during surgery, no other related complications were noted at the last follow-up.

Conclusions This novel use of iris incision is effective, simple and safe in the management of an lost anterior chamber.

Background

Paediatric retinal detachment (RD) induced by advanced vitreoretinopathies is challenging for surgeons in planning surgical management. Compared with adults, paediatric RDs are more likely to present as macular-off detachment, proliferative vitreoretinopathy (PVR), chronic duration, and worse-presenting visual acuity.[1, 2] In addition, the aetiology of paediatric RDs is complex and heterogeneous. The most common vitreoretinopathies that can cause RDs include familial exudative vitreoretinopathy (FEVR), Norrie disease, Coats disease, persistent hyperplastic primary vitreous (PHPV) syndrome, and retinopathy of prematurity (ROP).

With disease progression, advanced vitreoretinopathies may cause the absence of the anterior chamber (AC). If left untreated, this can cause many complications, such as secondary glaucoma, corneal degeneration, or even phthisis bulbi. To avoid these complications, lensectomy with or without vitrectomy is recommended. However, while AC formation is challenging, it is required for further manoeuvres. Traditionally, external drainage of subretinal fluid (SRF) could be indicated to achieve AC formation in cases with flat AC secondary to an advanced paediatric vitreoretinopathy.[3-5] However, external drainage is associated with complications, such as retinal incarceration, subretinal haemorrhage, and loss of vitreous.[6, 7] Additionally, some sight-threatening complications have been associated with SRF drainage; these include subretinal haemorrhage, retinal incarceration, and iatrogenic retinal holes.[8, 9] The author's personal experience suggests that a sudden rapid outflow of SRF may also lead to iridodialysis. In addition, a constant flow of SRF could decrease the definition of the surgical field. These disadvantages associated with the external drainage of SRF demonstrate that more effective and safer techniques are needed to support the management of absent AC in paediatric patients with advanced vitreoretinopathies. To resolve these issues, we performed iris incision instead of external drainage of SRF in paediatric patients with absent AC.

Over the past few years, paediatric patients with absent AC caused by various advanced vitreoretinopathies have been referred to the authors' clinical centre. In this study, we describe the novel usage of iris incision in these paediatric patients.

Methods

Patients and Methods

This study adhered to the tenets of the Declaration of Helsinki and was approved by the institutional review board of Tianjin Medical University Eye Hospital. Informed written consent was obtained from the parents or guardians of each participant because they were all under-aged children. This study is a consecutive, prospective, interventional case series.

Patients

Forty-one patients (41 eyes) with absent AC resulting from advanced vitreoretinopathy (including 30 eyes with FEVR, 6 with PHPV, and 5 with ROP) were collected in the present study between January 2016 and October 2017. In this study, the AC completely disappeared in all patients with intraocular pressure ranging from 19 to 59 years old. All 41 patients underwent preoperative and postoperative complete ophthalmologic examinations, including anterior and posterior examination by biomicroscopy, B-scan (Digital B 2000 and Ultrascan Imaging System; Alcon), axial length by A-scan (Digital B 2000 and Ultrascan Imaging System; Alcon), intraocular pressure, and fundus photography by Retcam (Clarity Medical Systems, Pleasanton, CA). The patients were followed up for at least 1 month. Corneal endothelial cell density testing was not performed in uncooperative patients.

Surgical technique

After the administration of general anaesthesia, the procedure was performed under a surgical microscope. The main steps are shown in Fig. 1. The iris incision was performed using a 20G Vitrectomy Microsurgical Knife through a corneal incision. The position of each corneal incision was chosen according to further manoeuvres. The two priority positions were the location of the vitrectomy cutter (superotemporal and superonasal) and the location of infusion (inferiortemporal or inferionasal). Thus, the puncture incision(s) could still be used in further manoeuvres without requiring additional incisions. The high pressure in the posterior chamber can cause the posterior aqueous humour to flow out after the first iris incision (Fig. 1D). If AC formation could not be achieved with the assistance of Healon after one episode of iris incision, a second or third iris incision was performed.

The procedure was combined with external drainage of SRF if AC formation failed after three episodes of iris incision. In the current study, a combination procedure including SRF drainage was performed in two (4.8%) patients. In these two patients, the SRF was drained trans-sclerally using a penetrating needle (27-gauge needle) near the position on the equator overlying the portion of detached retina with the greatest retinal detachment height. After an AC was formed with the assistance of Healon, an infusion cannula

connected to a balanced salt plus solution (Alcon, Laboratories, Inc) was injected into the AC through a corneal incision followed by lensectomy with or without vitrectomy. If posterior iris synechia was found, Healon was used to separate the iris from the lens before lensectomy.

Results

The patients' information is shown in Table 1. There were 18 female and 23 male patients with a mean age of 9.5 ± 7.5 months old. A novel iris incision approach was successfully performed in 41 eyes (41 patients) with total absent AC resulting from advanced vitreoretinopathy (including 30 eyes with FEVR, 6 eyes with PHPV, and 5 eyes with ROP). Typical patients are shown in Fig. 2. AC formation was achieved in 28 (68.3%) eyes treated with only 1 initial episode of iris incision, 11 (26.8%) that required two episodes of iris incision, and 2 that required 3 episodes of iris incision (4.9%), with this last group of patients combined with 1 episode of external SRF drainage.

The clinical characteristics and surgical procedures applied in these procedures are shown in Table 2. A major intraoperative complication of iris incision is iris incarceration, which occurred in 7 (17%) of 41 eyes (Fig. 3). Among these cases, the incarcerated iris was successfully returned to the AC in all 7 eyes. The AC remained deep and stable in all cases. No iris incarceration or other related complications were observed at the last follow-up. All external SRF drainage-related complications are presented in Fig. 4.

Discussion

In the current study, 41 patients (including 30 eyes with FEVR, 6 with PHPV, and 5 with ROP) with a total absence of AC were enrolled. We found that this novel iris incision approach was simple, safe, and effective in supporting the formation of absent AC in a paediatric population with advanced vitreoretinopathies. AC formation was achieved in 95.1% of the eyes after 1 or 2 episodes of iris incision.

Advanced paediatric vitreoretinopathies tend to be more aggressive and to lead to severe complications. [10] Surgeries for vitreoretinopathies are more challenging in paediatric than in adult patients. In advanced paediatric vitreoretinopathies complicated with total retinal detachment, the disappearance of the AC can be caused when the lens and iris are pushed into a more frontal position. Traditionally, external drainage of SRF could be indicated to achieve AC formation in cases with flat AC.[3, 4, 6] However, this procedure could be complicated by haemorrhage, incarceration of the retina, and/or vitreous or retinal perforation.[6, 7] In addition to these conventional complications, the author's personal experience indicates that the sudden rapid outflow of SRF can also lead to iridodialysis. The constant outflow of SRF can decrease the definition of the surgical field and lead to subconjunctival effusion. Thus, to address these external SRF drainage-related problems, the authors were inspired by the notion of iridotomy to make creative usage of iris incision to assist in the formation of AC in patients with absent AC due to advanced vitreoretinopathies. In these cases, as the pressure in the posterior chamber was high, the aqueous humour in the posterior chamber could have outflowed through the iris incision site(s), thus reforming the AC for further manoeuvres.

The use of iris incision has several advantages over the use of external drainage of SRF. First, the use of iris puncture is effective in the formation of AC. In the current study, AC formation was achieved in 95.1% of the eyes that underwent up to 2 episodes of iris incision. Second, the use of iris puncture simplified the surgical procedures and resulted in a shorter total operative time. Third, the site(s) of puncture was (were) chosen according to the requirements of further surgical manoeuvres. Thus, no extra incisions were required. Fourth, there were few related complications. In the current study, only iris incarceration was observed during the surgery, and no related complications were observed in any cases at the last follow-up. Fifth, iris incision, unlike external drainage of SRF, does not affect the surgical visual field. Sixth, this technique is simple to perform and has a short learning curve.

In the current study, AC formation was achieved in 28 (68.3%) eyes with only 1 initial episode of iris incision and in 11 (26.8%) eyes with 2 episodes of iris incision. Only 2 (4.9%) patients needed a combination that included 1 episode of external SRF drainage. The major intraoperative complication of this iris incision approach was iris incarceration, and the iris was easily returned to the AC. The AC remained deep and stable in all cases.

Our study has limitations. Due to a lack of cooperation, ultrasound biomicroscope was not performed in all patients. However, all patients underwent indirect ophthalmoscopy to detect the condition of the AC. In addition, all surgical procedure were performed by a single surgeon, thus minimizing the effect of surgical procedures.

In conclusion, the creative use of iris incision proposed here was effective, simple and safe in the management of absent AC caused by various advanced paediatric vitreoretinopathies. Compared to the external drainage of SRF, this technique involved a simpler surgical manoeuvre and decreased the incidence of surgical complications.

Abbreviations

Retinal detachment, RD

Proliferative vitreoretinopathy, PVR

Familial exudative vitreoretinopathy, FEVR

Persistent hyperplastic primary vitreous, PHPV

Retinopathy of prematurity, ROP

Anterior chamber, AC

Subretinal fluid, SRF

Declarations

Ethics approval and consent to participate

This study adhered to the tenets of the Declaration of Helsinki and was approved by institution review board of Tianjin Medical University Eye Hospital. The written informed consent to participate was obtained from each patient or his or her parent(s)/ legal guardian(s).

Consent for publication

The written consent for publication of the individual details and images was obtained from each patient. For patients under 18-year old, the written consent was obtained from his/her parent (s) or legal guardian(s).

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CL C and T T have designed the study, collected and analyzed the data, wrote the manuscript. PQ Z and XR L designed the study, performed all the treatment and agreed to be accountable for all aspects of the work. All authors read and approved the final manuscript.

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Tables

Table 1. Patients Information

Variable	No. Patients (%)
Sex (N=41)	
Male	23 (56%)
Female	18 (44%)
Age (N=41)	
Mean ± SD	9.5 ± 7.5 months
Etiology	
FEVR	30 (73%)
PHPV	6 (15%)
ROP	5 (12%)

FEVR = familial exudative vitreoretinopathy; ROP = retinopathy of prematurity; SD = standard deviation

PHPV = persistent hyperplastic primary vitreous

Table 2. Clinical Characteristics and Surgical Procedure of Study Subjects

No.	Sex	Age	Eye	Diagnosis	Puncture site(s),n	Combine SRF Drainage	Surgical Procedure	Intraoperative Complications	Postoperative Complications
1	M	2 months	OD	FEVR	1	N	Lensectomy	None	None
2	F	1 year	OS	FEVR	2	N	Lensectomy	None	None
3	M	4 months	OS	FEVR	1	N	Lensectomy	Iris incarceration	None
4	F	4 months	OS	PHPV	2	N	Lensectomy	None	None
5	M	4 months	OD	ROP	1	N	Lensectomy	None	None
6	M	10 months	OD	FEVR	1	N	Lensectomy	None	None
7	F	8 months	OS	FEVR	2	N	Lensectomy	None	None
8	M	2 years	OS	FEVR	1	N	Lensectomy +Vtx	None	None
9	M	2 years	OD	FEVR	1	N	Lensectomy +Vtx	None	None
10	F	2 months	OS	PHPV	2	N	Lensectomy	None	None
11	M	5 months	OD	ROP	1	N	Lensectomy +Vtx	None	None
12	F	10 months	OS	FEVR	1	N	Lensectomy +Vtx	Iris incarceration	None
13	M	2 years	OD	FEVR	2	N	Lensectomy	None	None
14	F	8 months	OD	FEVR	1	N	Lensectomy+Vtx	None	None
15	F	1 year	OS	ROP	1	N	Lensectomy +Vtx	None	None
16	M	2 months	OD	FEVR	1	N	Lensectomy	None	None
17	F	1 year	OD	ROP	1	N	Lensectomy+Vtx	None	None
18	M	1 year	OS	FEVR	2	N	Lensectomy	None	None
19	F	6 months	OS	PHPV	1	N	Lensectomy+Vtx	None	None
20	F	6 months	OS	FEVR	1	N	Lensectomy+Vtx	None	None
21	M	6 months	OD	FEVR	1	N	Lensectomy	Iris incarceration	None
22	M	5 months	OS	FEVR	1	N	Lensectomy	None	None
23	M	2 years	OS	FEVR	1	N	Lensectomy	None	None
24	M	2 years	OS	FEVR	1	N	Lensectomy+Vtx	None	None
25	F	7 months	OD	FEVR	2	N	Lensectomy	None	None
26	F	2 years	OS	FEVR	1	N	Lensectomy+Vtx	Iris incarceration	None
27	F	1 year	OD	PHPV	3	Y	Lensectomy	None	None
28	M	2 months	OD	FEVR	2	N	Lensectomy	None	None
29	F	1 year	OD	FEVR	2	N	Lensectomy	None	None
30	F	1 year	OS	FEVR	2	N	Lensectomy+Vtx	None	None
31	F	1 year	OD	PHPV	2	N	Lensectomy+Vtx	None	None

32	M	3 months	OD	FEVR	1	N	Lensectomy	None	None
33	M	1 month	OD	PHPV	1	N	Lensectomy+Vtx	Iris incarceration	None
34	F	8 months	OD	FEVR	1	N	Lensectomy+Vtx	Iris incarceration	None
35	M	2 months	OS	FEVR	3	Y	Lensectomy	None	None
36	M	6 months	OS	FEVR	1	N	Lensectomy+Vtx	None	None
37	F	1 year	OS	FEVR	1	N	Lensectomy+Vtx	None	None
38	M	2 months	OS	FEVR	1	N	Lensectomy	None	None
39	M	9 months	OD	FEVR	1	N	Lensectomy	None	None
40	M	7 months	OS	ROP	1	N	Lensectomy+Vtx	None	None
41	M	7 months	OD	FEVR	1	N	Lensectomy	Iris incarceration	None

FEVR = familial exudative vitreoretinopathy; ROP = retinopathy of prematurity; PHPV = persistent hyperplastic primary vitreous; Vtx = vitrectomy; M = male; F = female; OD = right eye; OS = left eye; N = none; Y = yes

Figures

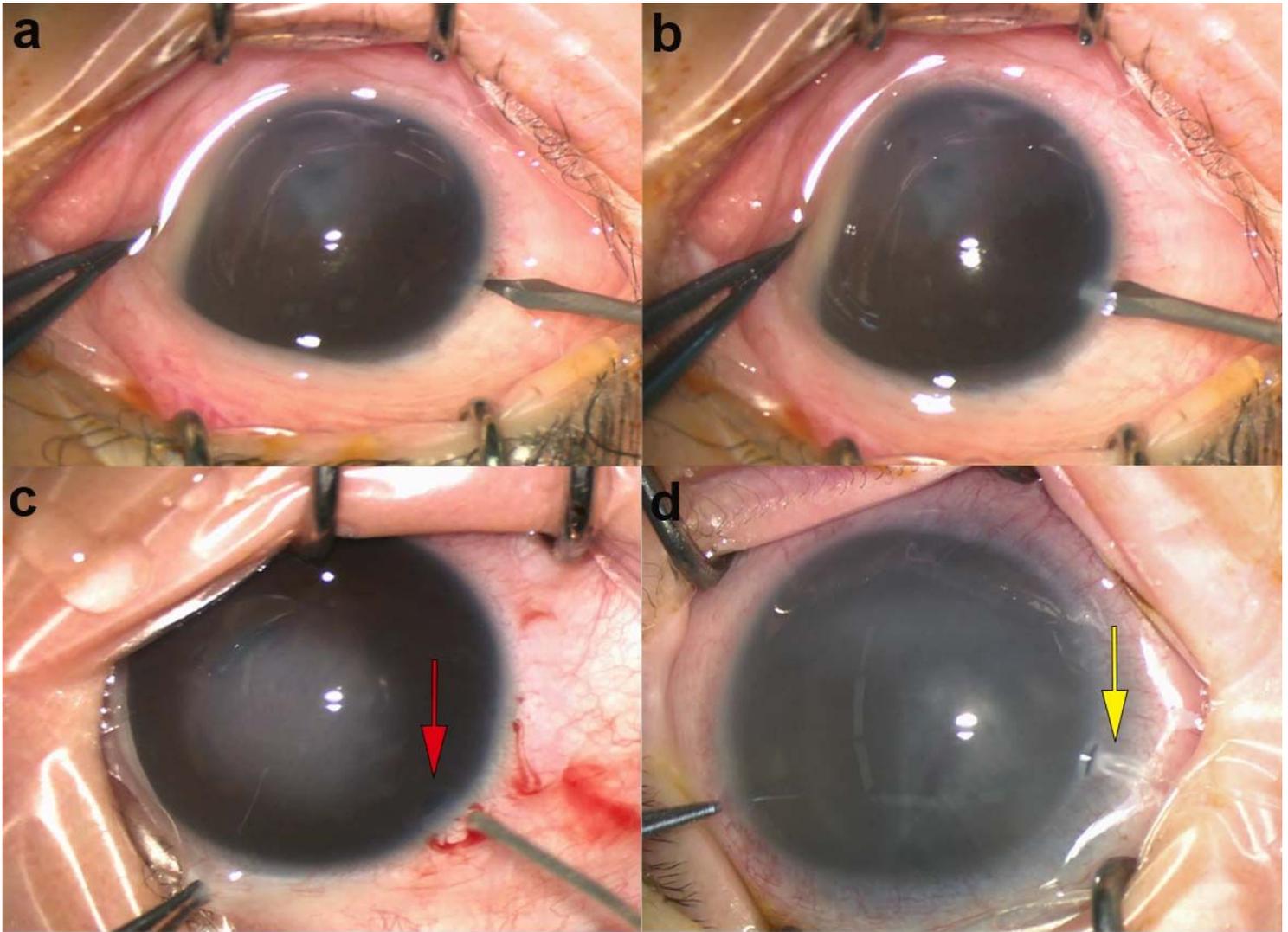


Figure 1

The major surgical steps of iris incision. The iris incision was performed using a 20G Vitrectomy Microsurgical Knife through a corneal incision (a, b). After puncture, the iris incision was observed (c). (Red arrow) The posterior aqueous humour flowed out from the incision (d, yellow arrow).

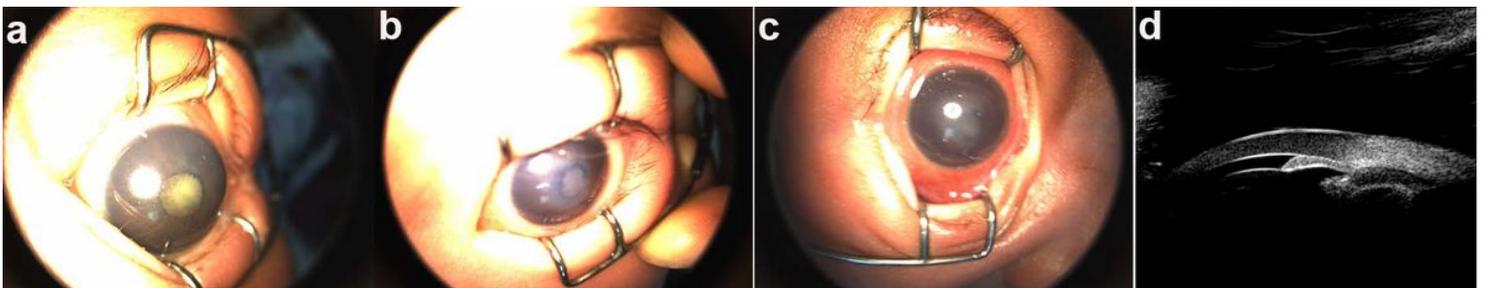


Figure 2

Preoperative colour photo and UBM in typical patients. Retcam images (a, b, c) and UBM (d) showed total absent anterior chamber and corneal opacity.

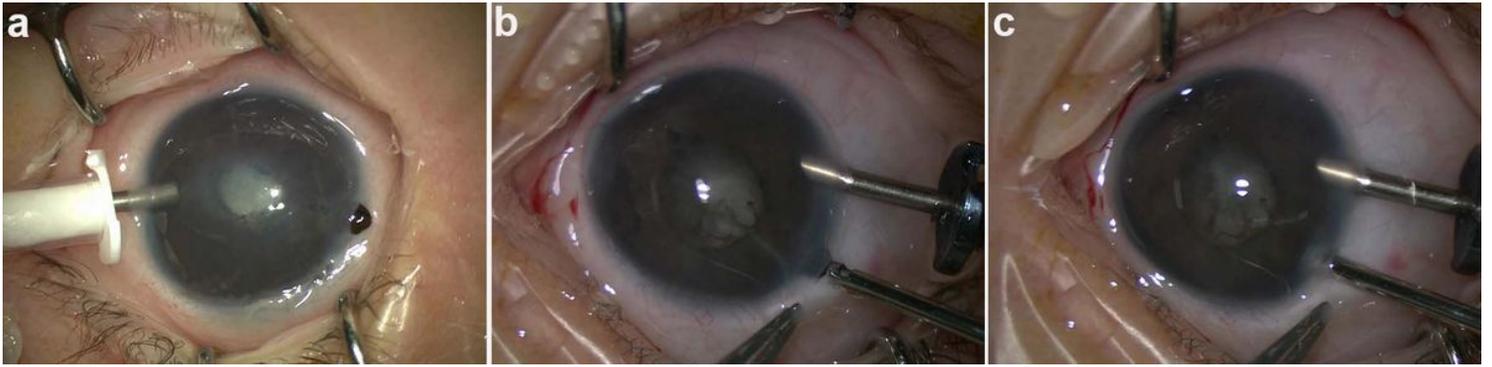


Figure 3

Intraoperative complications in iris incision. The major intraoperative complication encountered in iris incision was iris incarceration (a). The incarcerated iris can be easily returned to the anterior chamber with the assistance of surgical instruments or viscoelastic agent (b, c).

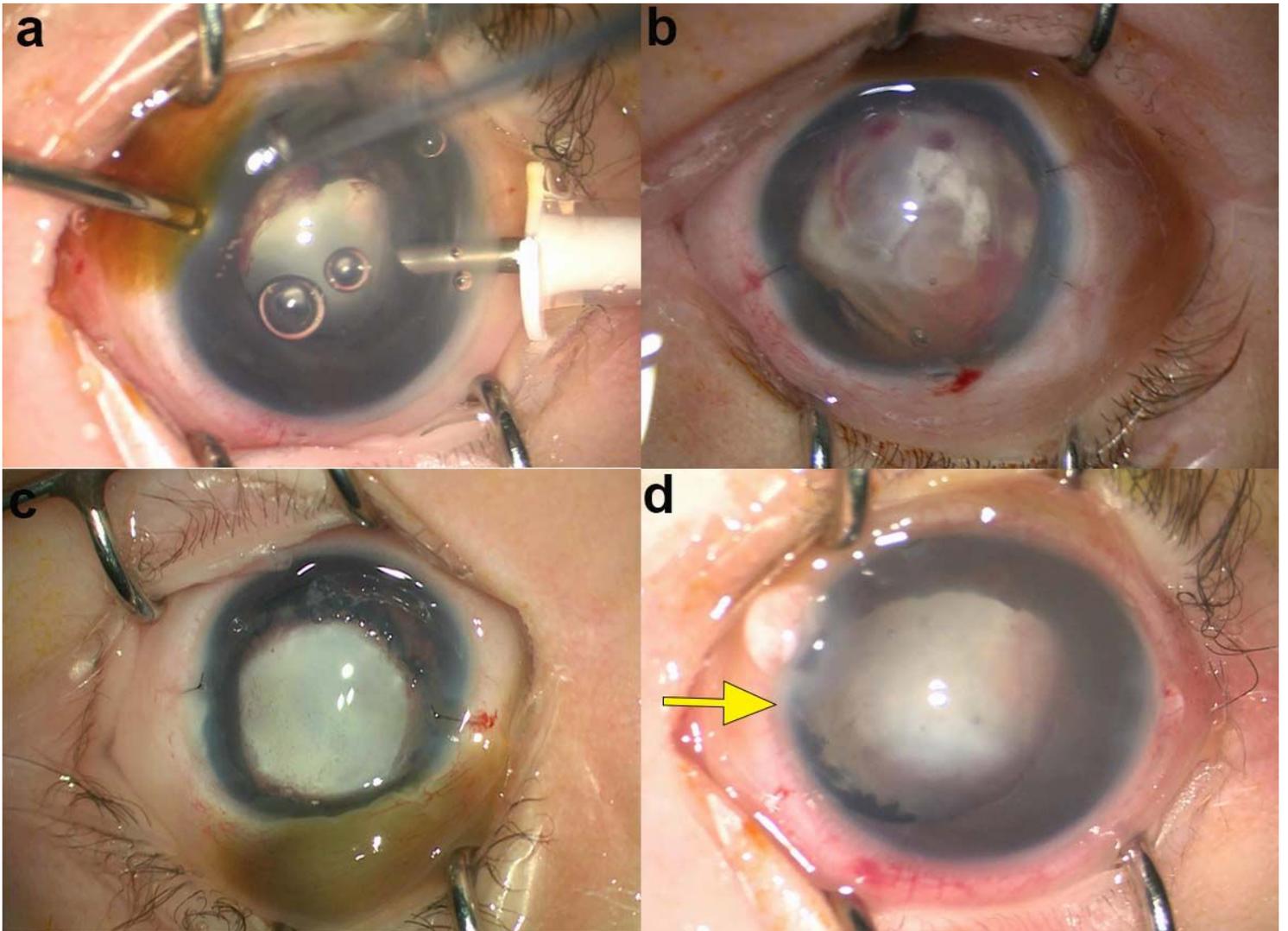


Figure 4

The disadvantages of external drainage of subretinal fluid (SRF). The constant outflow of SRF can affect the surgical manoeuvres and decrease the definition of the surgical field (a). The constant outflow of SRF can cause subconjunctival effusion (b, c). Iridodialysis (yellow arrow) can be caused by the sudden rapid outflow of SRF (d).