

Removal of intraocular foreign body in anterior chamber angle with prism contact lens and 23-gauge foreign body forceps

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Abstract

• **AIM:** To introduce a novel approach in removal of anterior chamber angle foreign body (ACFB) using a prism contact lens and 23-gauge foreign body forceps.

• **METHODS:** Data of 42 eyes of 42 patients who had undergone removal of ACFB using a prism contact lens and 23-gauge foreign body forceps from January 2008 to October 2013 were collected and analyzed. Twenty eyes in group A received the conventional approach by using toothed forceps through corneal limbus incision, and 22 eyes in group B underwent the novel method through the opposite corneal limbus incision.

• **RESULTS:** The success rate of ACFB once removal was 75% (15/20) in group A, and 100% (22/22) in group B. The average operation time of group A was significantly longer compared with group B (34.9±9.88min vs 22.13±8.85min; $P<0.05$). The average size of corneal limbus incision in group A was significantly larger than that of group B (4.85±1.89 mm vs 3.95±1.17 mm; $P<0.05$). The corneal limbus incision suturing were conducted in all eyes in group A, and only 5 eyes in group B.

• **CONCLUSION:** Removal of ACFB using a prism contact lens and 23-gauge foreign body forceps is a safer, more effective, and convenient technique compared with the conventional approach.

• **KEYWORDS:** prism contact lens; intraocular foreign body; anterior chamber angle; 23-gauge foreign body forceps

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INTRODUCTION

Most intraocular foreign body (IOFB) in the anterior chamber angle (ACFB) is caused by penetrating injury. This can be diagnosed and treated correctly if the patient visits the clinic immediately. However, some patients do not take immediate action because the wound is very small and they do not feel any discomfort. If ACFB was not removed in time, it could be embedded in anterior chamber angle and wrapped by inflammatory membrane after long period of time. Sometimes, if accompanied with cornea edema, chronic uveitis, iron siderosis, copper chalcosis, or endophthalmitis, it becomes very difficult to diagnose and treat, even for small nonmagnetic or vegetative ACFBs, because of limited visualization and narrow space of anterior chamber angle. From January 2008 to October 2013, we performed the new technique for removing ACFB using prism contact lens and a 23-gauge foreign body forceps. We found that it could expose ACFB and adjacent tissue more clearly, ensuring a safer and more convenient removal, and decreasing the risk of intraoperative and postoperative complications.

SUBJECTS AND METHODS

This prospective case study comprised of 42 patients (42 eyes) who underwent removal of ACFB from January 2008 to October 2013 at Xiamen Eye Center Affiliated to Xiamen University. They were randomly divided into two groups (random number table taxonomy) including groups A and B. Twenty eyes in group A received the conventional approach of removing ACFB using toothed forceps through corneal limbus incision, and 22 eyes in group B underwent the novel method of removing ACFB using a 75° prism contact lens and a 23-gauge foreign body forceps through the opposite corneal limbus incision. All the operations were performed by a surgeon alone (Huang YM). This study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Review Board of Xiamen Eye Center Affiliated to Xiamen University. All patients were provided informed

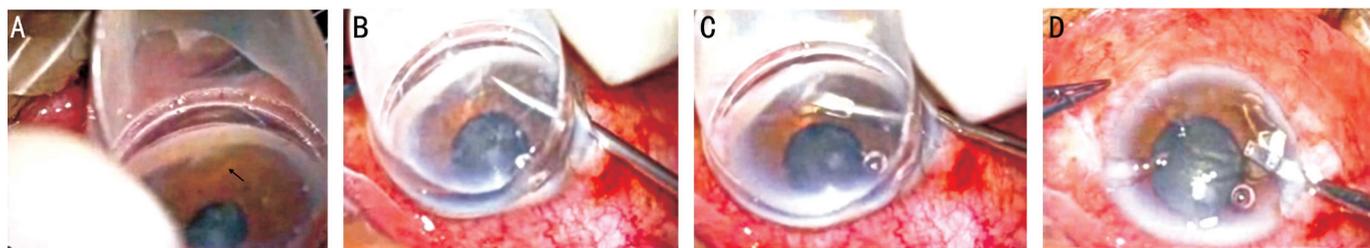


Figure 1 Surgical procedures A: The ACFB (black arrow) was exposed under 75° prism contact lens combined with the indentation on anterior chamber angle; B: The membrane wrapped ACFB was dissected by 20-gauge sclera scalpel; C: The ACFB was grasped with 23-gauge foreign body forceps; D: The prism contact lens were removed and the ACFB was taken out through clear corneal incision.

consent. In every case, the location of ACFB was confirmed by two of the following examinations at least which included gonioscopy, ultrasound biomicroscopy (UBM), orbital computed tomography (CT) scanning, plain X-ray, anterior segment optical coherence tomography (AS-OCT), and magnetic resonance imaging (MRI) (in nonmagnetic ACFB). The mean follow-up was 9.41 ± 1.67 mo in all patients.

The exclusion criteria of removing ACFB with prism contact lens and a 23-gauge foreign body forceps included primary history of corneal disease (large area of corneal scar or corneal endothelial defect), iris laceration, traumatic cataract, glaucoma, vitreoretinopathy, and multiple IOFBs in different part of eyeball.

Surgical Procedures A surgeon performed all the surgeries with operating microscope (Zeiss 700). Preoperatively, the pupil was constricted with a topical 1% pilocarpine (Wujing Pharmaceutical, Wuhan, China). All operations were performed under local anesthesia using periorbital injection of 2% lidocaine 4 mL. In group A, after conjunctival incision and hemostasis were performed, a short scleral tunnel incision was made about 0.5 mm posterior to corneal limbus at the position close to the ACFB embedded. Viscoelastic material (Viscoat, Alcon, USA) was injected into anterior chamber to stabilize it and to protect the corneal endothelium during the surgery. The ACFB was carefully separated from adjacent tissue or wrapping material, then was removed using toothed forceps. After the viscoelastic material was extracted, the incision was sutured with a stitch of 10-0 nylon thread (10-0 nylon, Alcon, USA). In group B, a clear corneal incision was made with a double-blade corneal scalpel at the position opposite to the ACFB embedded. After injecting viscoelastic material into the anterior chamber, a 75° prism contact lens (Volk, Germany) was put on the cornea with the top pointed to the foreign body's site (Figure 1A). A drop of the viscoelastic material was placed between the lens and the cornea to prevent collection of blood or air bubbles between the lens and the cornea for better visualization. The prism contact lens was fixed and pressed on the anterior chamber angle using a titanium alloy episclera compressor (TC4, Suzhou, China). This allowed clear visualization of the ACFB and how it was wrapped by adjacent tissue through the slope of the prism contact lens. If

it was wrapped by iris or proliferative membrane, it would be gently dissected by a 20-gauge sclerectome or a 23-gauge syringe needle (Figure 1B). Then, the IOFB was removed with a 23-gauge foreign body forceps (Figure 1C). Finally, irrigation-aspiration was performed to remove the viscoelastic, and the corneal incision was closed by hydration (Figure 1D). If the incision could not be closed by hydration, suturing with 10-0 nylon thread would be adopted. Postoperative treatment consisted of 0.3% levofloxacin (Cravit, Santen Pharmaceutical, Japan) and compound neomycin sulfate (Allergan Pharmaceutical, Ireland) eye drops 4 times a day for about 2-4 wk. Some patients with severe anterior segment inflammatory reaction were prescribed an additional topical combination of 0.5% tropicamide and 0.5% phenylephrine hydrochloride (Mydrin-P, Santen pharmaceutical, Osaka, Japan) 4 times a day. The suture was removed in 4-8 wk after operation.

Main Outcome Measures Primary success rate, operation time, size of incision, and necessity of incision suturing were recorded and compared between the two groups. The incidence of intraoperative complications such as bleeding, iris prolapse, lens and iris injury in both groups were observed. Data on visual acuity, intraocular pressure, and incidence of postoperative complications were collected and analyzed at 1d, 1wk, 2, 3, 6, 12 and 24 mo after operation. Postoperative complications that were observed in both groups included discoria, corneal neovascularization, corneal decompensation, nucleus sclerosis, and secondary glaucoma.

Statistical Analysis All statistical analyses were performed with a statistical software package (SPSS 16.0; SPSS Inc., Chicago, IL, USA). Differences between patient groups were analyzed by student's paired *t*-test and χ^2 test. A *P*-value of <0.05 was considered to be statistically significant.

RESULTS

Medical records of 42 eyes of 42 patients who underwent removal of ACFB were analyzed. The mean age was 25.71 years old in group A and 27.21 years old in group B. The ratio of gender (male/female) was 16/4 in group A, and 18/4 in group B. The interval time from eye injury to surgery was 27.9d in group A, and 29.25d in group B. Mean follow-up was 297.13d in group B, and it was significantly longer than that in group A (282.51d) ($P < 0.05$).

In group A, the average size of ACFB was 3.15 mm, ACFBs were magnetic in 11 eyes, and nonmagnetic in 9 eyes. In group B, the average size of ACFB was 3.34 mm, ACFBs were magnetic in 13 eyes and 9 nonmagnetic eyes. Preoperative corneal edema and chronic uveitis were 15 eyes and 11 eyes in group A, and 16 eyes and 12 eyes in group B respectively ($P>0.05$). There were 2 eyes with infection in both groups. There was no statistically significant difference in demographic data and preoperative characteristics in the two groups ($P>0.05$).

The success rate of ACFB once removal was 75% (15/20) in group A, and 100% (22/22) in group B. The intraoperative condition of two groups were summarized in Table 1. The incidences of intraoperative bleeding and iris prolapse of group A were significantly higher than that of group B ($P<0.05$). More patients in group A needed suturing of corneal incision than that in group B ($P<0.05$). As shown in Table 2, the average operation time in group A was obviously longer than that in group B (34.9±9.88min vs 22.13±8.85min; $P<0.05$). The average size of corneal limbus incision in group A was significantly larger than that of group B (4.85±1.89 mm vs 3.95±1.17 mm; $P<0.05$) (Tables 1 and 2).

In the final follow-up observation, the best corrected visual acuity was 0.6±0.35 in group A, and 0.7±0.18 in group B. The intraocular pressure was 11.5±5.78 and 14.0±4.99 mm Hg in groups A and B respectively. There was no significant difference in best corrected visual acuity and intraocular pressure between two groups. Postoperative complications were summarized in Table 3. Postoperative complications in group A included discoria in 9 eyes, corneal neovascularization in 6 eyes, and nucleus sclerosis in 1 eye. In contrast, the only postoperative complication in group B was discoria in 6 eyes. No secondary glaucoma, corneal decompensation, or endophthalmitis were observed in either group during the follow-up (Table 3).

DISCUSSION

IOFB can cause mechanical and chemical injury to the eyeball, but the biggest risk of a retained IOFB is infection^[1-4]. According to references, incidence of endophthalmitis associated with IOFB after penetrating injury ranged from 4.7% to as high as 13.5%^[5-7]. An ACFB could also rub the corneal endothelial cells. This long-term friction on the endothelial cells causes severe corneal endothelium lesions, which results in corneal edema or corneal decompensation. IOFB also stimulates pigmentation and chronic uveitis of the anterior segment^[8]. In addition, metallic foreign body usually releases metallic ions such as iron and copper, which are toxic to intraocular tissues. This can induce iron siderosis, copper chalcosis, secondary optic atrophy, and eventually glaucoma. For these reasons, ACFB need prompt evaluation and management as they may quickly lead to sight-threatening

Table 1 Comparison of intraoperative conditions between groups A and B

Parameters	Group A (n=20)	Group B (n=22)
Primary successful cases	15	22
Bleeding	16	9
Iris prolapse	17	0
Lens injury	1	0
Suture incision	20	5

Table 2 Intraoperative parameters of groups A and B

Parameters	Group A	Group B	P
Size of incision (mm)	4.85±1.89	3.95±1.17	0.011
Operation time (min)	34.9±9.88	22.13±8.85	0.003

Table 3 Postoperative complications in groups A and B

Parameters	Group A (n=20)	Group B (n=22)
Discoria	9	6
Corneal neovascularization	6	0
Secondary cataract	1	0

complications.

IOFB resulting from penetrating injuries are usually detected at first sight. If IOFB is too small and the wound is not closed, we can use AS-OCT^[9], plain X-ray, or CT scanning to diagnose and confirm the position of the IOFB. Presence of a piece of mild corneal scar, keratin precipitates (KP) stained on endothelia, inflammatory response in anterior chamber, partial corneal edema, or pigmentation, would highly implicate a prolonged period of presence of ACFB. Management of such cases is not always easy because certain ACFB made of inert materials (stone, plastic, glass, and inert metals such as gold, silver, or platinum) excite minimal inflammation and may remain quiescent for a long period of time. Many reports advise that gonioscope and UBM are the most useful methods in detecting and locating foreign bodies^[10-11]. We need to carefully review the patient's traumatic history and choose appropriate examination to get correct diagnosis and avoid ignoring the ACFB. Furthermore, decreased visibility through the cornea due to severe whole corneal edema and lots of KP with pigmentation, imposes an even greater challenge for many surgeons in ACFB removal procedures. This challenge holds true even if the exact location of the foreign body is determined by meticulous investigation and examination. For the conventional method of removing ACFB, most incisions were short steep tunnel incision made at about 0.5 mm posterior to the corneal limbus at the position close to the ACFB embedded. The translucent limbus and opaque overlying sclera of this incision limited visualization. Furthermore, if the ACFB was too big and could not be removed through the incision, the incision should be extended horizontally or posterior to the sclera, but the bigger incision is

apt to bleeding because many blood capillaries are located in limbus. At the same time, repeating iris prolapse through the short steep tunnel incision interrupts visualization in detecting the the foreign body and adjacent tissue during operation. Poor visualization can increase the likelihood of iris and lens injury and bleeding, or possibly pushing the IOFB against the posterior chamber or ciliary sulcus. In cases where the latter occurs, another operation would have to be rescheduled to treat the missing foreign body^[12]. Sometimes if a tiny foreign body has already been separated smoothly, incision would still have to be enlarged to ensure that the thick toothed forceps can grasp the IOFB from the anterior chamber angle. After the ACFB was removed, it was necessary to suture the weak self-closure incision because of its short tunnel. Otherwise, an sutureless incision would cause iris impaction and incision leak. If the ACFB was magnetic, attracting it with a magnet makes removal easier. Primary removal of a small nonmagnetic foreign body can be very challenging^[12-14].

In our study, the primary success rate in group A was 75%, which was substantially lower than that of group B (100%). Bleeding and iris prolapse were more likely to occur in group A than that in group B. All incisions in group A needed to be sutured, whereas only 5 patients (who had big ACFB) in group B needed suturing. During the final follow-up, 9 eyes and 6 eyes of discoria were detected in group A and group B respectively. Six eyes in group A turned into corneal neovascularization, whereas there was no occurrence of corneal neovascularization in group B. Our data showed that the new method can improve the safety and effectiveness for removing ACFB during operation. We summarized the reasons as follows. First, we chose a long tunnel corneal incision opposite to direction of ACFB embedded. This made it more convenient to grasp the ACFB, better sustain the anterior chamber, and avoid iris prolapse. Secondly, we infer that the low incidence of postoperative corneal neovascularization and discoria in group B was owed to the small incision that did not need suturing and minimal injury of the iris. Thirdly, bleeding was unlikely to permeate into the anterior chamber through the long tunnel incision, thus preventing impairment of operation visualization. Fourthly, the 75° prism contact lens that was pressed on the anterior chamber angle provided excellent visualization of the IOFB and its wrapping by adjacent tissue. If the ACFB was wrapped by the iris or proliferative membrane, it would be dissected by a 20-gauge sclerectome or a 23-gauge syringe needle. Excellent visualization during operation is very important to increase possibility of success and decrease the danger of missing foreign body or iatrogenic injury. Finally, the 23-gauge foreign body forceps is more reliable for grasping the IOFB compared to the toothed forceps.

Nicoara *et al*^[15] and Valmaggia *et al*^[16] reported that the predictors of poor visual outcome of IOFB includes a poor initial presenting of visual acuity, presence of an afferent

papillary defect, and vitreous hemorrhage. Bai *et al*^[17] reviewed 84 eyes of 80 patients with IOFB over five years of clinical data, and found a relation of poor visual outcome to initial presenting of visual acuity, larger size of IOFB, posterior segment of IOFB, and preoperative retinal detachment. Chow *et al*^[18] showed no statistically significant difference in regards to visual outcome when comparing the use of an internal or external (external magnet) approach in metallic IOFB removal. To our knowledge, there is no literature that has studied the different approaches of removal IOFB from the anterior chamber and their affect on visual outcome until now. Our study showed no statistically significant difference with regards to visual outcome between the two groups at the final follow-up. Besides the incision size, we also found that the location and size of wound in cornea, intensity of injury to corneal endothelium, IOFB' size, shape and diameter of pupil, and complications have an influence on the final visual outcome between the two groups. The small sample size of our study may have also contributed to the lack of difference in visual outcome between the two groups. Further research is needed to compare corneal astigmatism induced by the different incision size between two methods.

As we known, the size of corneal incision is the most important factor that can influence astigmatism induced by surgery^[19]. Many studies^[20] showed that surgically induced corneal astigmatism increases greatly when the corneal incision is larger than 3.0 mm. Hashemi *et al*^[21] calculated that if the incision was reduced by 0.5 mm, the surgically induced corneal astigmatism was reduced by 0.25 D. To those patients with corneal wound, reducing surgically induced corneal astigmatism as much as possible will improve the visual outcome. Wylegala *et al*^[22] reported a novel method for extracting a 13 mm wire-like longitudinal IOFB from the cornea through the anterior chamber and embedded to the retina. He performed pars plana vitrectomy, inserted the IOFB into a 24-gauge needle placed in the sclerotomy, and then pulled the IOFB through the needle tunnel. His carefully controlled extraction had minimal surgical trauma and brought 20/20 visual acuity to the patient. Lin *et al*^[13] reported that he successfully removed a nonmagnetic metallic ACFB using an endoscopy after a failed conventional surgery through the limbal incision. He used a 2.0 mm tunnel limbus incision, where a 20-gauge light endoprobe was introduced into the anterior chamber. A 1 mm×0.5 mm ACFB was removed through another clear corneal incision using a curved suture tying forceps. Compared to Lin *et al*'s^[13] method, our novel approach is advantageous as small incision and the process is relatively simple. For small unwrapped ACFB, it was removed by the 23-gauge foreign body forceps using prism contact lens through a 1 mm corneal incision. This procedure is quick and relatively simple. The disadvantage of endoscopy-assisted method is the requirement of too many tools operated in the narrow anterior chamber angle, which increases the risk of

injury to adjacent tissue such as corneal endothelium and lens. Another disadvantage of the endoscopy-assisted method is the requirement of more expensive equipment and a long time learning curve.

Surgical management of IOFB depends on localizing and visualizing and determining whether the IOFB is encapsulated. Before hand, it is very important to obtain a detailed history of any possible trauma, investigate the nature of the IOFB and mechanism of injury, and plan proper examinations to confirm the diagnosis and location of the IOFB. The latter can be performed using gonioscopy, AS-OCT, CT scanning, or MRI. A successful outcome is more likely if the distinct IOFB or IOFB's enclosure is located using gonioscopy preoperatively. In cases that are accompanied with corneal edema, secondary glaucoma, or chronic uveitis, prompt treatment is necessary to decrease inflammation and corneal edema. If the corneal edema is too severe that it diminishes visibility of the anterior chamber angle, scraping of the corneal epithelium would be necessary. If the iris is injured with continuous bleeding, viscoelastic should be injected into the anterior chamber. Pressure is applied until bleeding stops, then blood is extracted to ensure clear visualization. Separation of the ACFB from the capsule should be performed gently starting from the back of the ACFB to the front to avoid injury of anterior chamber angle. The entire capsule should be also removed as it may contain metallic ions.

In comparison to other surgical techniques, our novel technique has special advantages in treatment of small, nonmagnetic, or encapsulated ACFB because it exposes the ACFB and around tissues more clearly through the prism contact lens. In most cases of ACFB, the gonioscope and UBM are the most sensitive and reliable detection methods. Prompt management is necessary to avoid sight-threatening complications, especially in severe cases with long-term metallic IOFB and vegetative IOFB.

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