Surgical Technique

The claw: A novel intraocular foreign body removal forceps

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Removal of intraocular foreign body (IOFB) from the posterior segment of the eye is challenging. In addition to surgical skill, it requires specific instrumentation to grasp and remove the IOFB. Small metallic IOFB can be removed using intraocular rare earth magnets but metallic IOFB larger than 3 mm and nonmetallic IOFBs like shot gun pellets, stones, or large glass fragments require specialized IOFB grasping forceps for removal. We describe the design and case-based clinical applications of a novel IOFB removal forceps, "the claw" that consists of a titanium handle and a 27-mm, 19-G metallic shaft that houses four retractable prongs made of nitinol wire. When completely extended, the prongs measure 14 mm in length and open up to 8–8.5 mm in the widest extent. The four prongs offer a very secure grip without crushing or splintering the IOFB leading to minimal chances of IOFB slippage and inadvertent retinal trauma.

Key words: Large intraocular foreign body, nonmagnetic intraocular foreign body, spherical, the claw

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Open globe injuries (OGI) are associated with retained intraocular foreign body (IOFB) in 18–41% of cases.[1,2] Retained IOFB, especially in the posterior segment, is an important cause of visual morbidity and blindness, especially in working age population. It has been shown by many studies that OGI associated with posterior segment IOFB have a poor visual outcome than OGI without IOFB.[1–3] Many studies have demonstrated that standard three port pars plana vitrectomy (PPV) is an effective method for removal of IOFB.[1,3,4] Advent of small gauge vitrectomy has led to improved visual and anatomical outcomes over the past decade.[1,3]

Removal of IOFB from the posterior segment is challenging and successful removal without much collateral damage is probably the single most important factor determining recovery and visual prognosis. Parsplana Vitrectomy is preferred over external surgical removal due advantages such as better visualization, and better anatomic and functional outcomes.[4] However, instrumentation required to remove the IOFB depends on its size and magnetic nature. Small metallic IOFB can be removed using intraocular rare earth magnets but metallic IOFB larger than 3 mm and nonmetallic IOFBs like shot gun pellets, stones, or large glass fragments require specialized IOFB grasping forceps for removal.[1] A few specialized IOFB removal forceps have been described previously in literature.[5,6] However when the IOFB is nonmetallic and/or large in size, there are limited options available for holding the IOFB securely and prevent excess collateral damage. To overcome this, we describe an IOFB removal forceps ("the claw") with a novel design to assist removal of large IOFBs from the posterior segment.

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Description of the Novel Intraocular Foreign Body Removal Forceps

The claw [Fig. 1] (Epsilon, Chino, CA, USA) is an extendable foreign body forceps consisting of a titanium handle and 19-G stainless steel shaft. A Teflon plunger is housed inside the titanium handle. To-and-fro movement of the plunger is controlled by a knob placed at center of the shaft [arrow in Fig. 1a]. When deployed, the plunger pushes the claw-shaped prongs housed inside the stainless steel shaft in a symmetrical manner [Fig. 1b]. The shaft has a length of 27 mm [Fig. 1c] with an outer diameter of 1.2 mm and inner diameter of 0.9 mm. The retractable prongs are made of four prongs of nitinol wire [Fig. 1b and c]. Nitinol is an alloy of nickel and titanium which shows excellent shape memory and psuedoelasticity. Because of its biocompatible nature, nitinol is widely used in many medical devices. When completely extended, the prongs measure 14 mm in length and open up to 8–8.5 mm in the widest extent [Fig. 1b and c] The distal ends of the prongs are rounded and hence nontraumatic to the retina.

The prongs are retracted fully into the shaft while introducing into the eye. Conjunctival peritomy and enlargement of a sclerotomy are needed to introduce the forceps inside the vitreous cavity. The forceps can be held comfortably and the prongs can be extended or retracted to the extent required with the knob on the titanium handle using one of the fingers. Once the IOFB is grasped, the

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prongs twine around it to hold it securely following which the claws are retracted (by releasing the knob) to get an even better and firm grip. The forceps along with the IOFB can then be removed from the eye via the appropriately enlarged sclerotomy.

Clinical Applications

We present two case scenarios demonstrating the application of the claw for IOFB removal from the posterior segment following OGI. Fig. 2 shows a large radio-opaque IOFB with collapsed eyeball following OGI in a 42-year-old gentleman. After suturing the scleral entry wound, a large stone IOFB along with total retinal detachment and vitreous hemorrhage were noted during 23-G PPV. Posterior vitreous detachment was absent. IOFB was released of all vitreous attachments, lensectomy was performed, and IOFB was lifted to the pupillary plane using the claw [Fig. 3a]. A 180° limbal section was fashioned superiorly and the IOFB, measuring 10 mm × 5 mm × 4 mm [Fig. 4], was removed with superior rectus holding forceps by handshake technique. Fig. 3b shows the claw-holding IOFB *in vivo* immediately after removal. Fig. 5 shows the claw being used to remove one of many pellets from the eye of a young patient from an additional sclerotomy at 12 o'clock position. These pellets are made of lead, are spherical in shape, and have a smooth surface, resembling ball bearings making them exceedingly difficult to grasp and remove from posterior segment of the eye. Additionally, the claw has also been used *in vitro* experiments to grasp various objects like large glass pieces without crushing them into smaller splinters [Fig. 6].

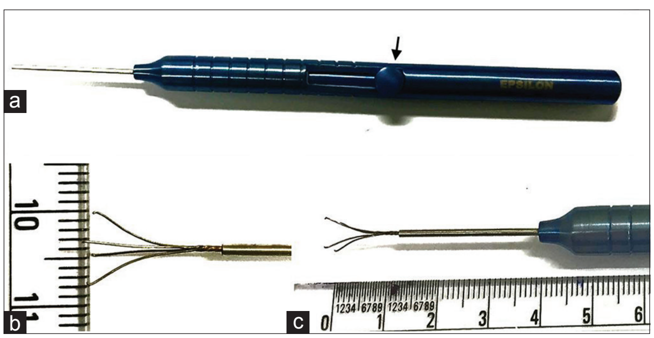

Figure 1: (a) The claw forceps with the handle consisting of the knob (arrow) and stainless steel metallic shaft that houses the prongs, (b) widest extent of the prongs, and (c) length of the shaft with open prongs

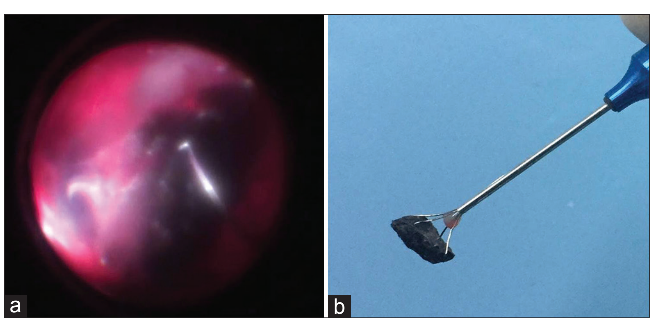

Figure 3: (a) Large intraocular foreign body (stone) being held in mid-vitreous cavity using the claw, and (b) large intraocular foreign body (stone) being held *in vivo* immediately after removal

Discussion

Removal of IOFB from the posterior segment in setting of OGI is one of the most challenging scenarios for vitreoretinal surgeons. In majority of cases, the IOFBs are small in size and magnetic in nature,[1–3,6] which makes removal of these IOFB amenable to magnets for removal. However when the IOFB is nonmetallic and/or large in size (3 mm or more), there are limited options available for holding the IOFB securely inside the vitreous cavity.

The claw design was based on the concept of dormia basket that has been extensively used in urology for removal of proximal ureteric stones. The dormia basket consists of retractable basket of nitinol cables which is passed beyond the ureteric stone in retracted state and then deployed while it is pulled out so as to catch the stone within the basket and then removed. Similar principle is also used in sialoendoscopy for removal of salivary stones. However, in case of IOFBs in ocular trauma, the major differences from prior mentioned applications of basket design are variability in shape of IOFBs rather than uniform spherical shape of ureteric or salivary stone; the IOFBs are lying on a relatively flat surface rather than a tubular lumen and can potentially float in different directions inside the vitrectomized eye prior to removal. The novel claw design enables the surgeon to hold the IOFB securely by approaching it in the anteroposterior direction and grasping it up from retinal surface.

Various authors have described a snare or loop design made of thick sutures and nitinol loops that can hold an irregular IOFB.[7–11] Although all these elegant snare devices can be effectively used to remove linear IOFB, it is difficult

Figure 2: Computed tomography scan images showing deformed eyeball with large retained nonmetallic intraocular foreign body

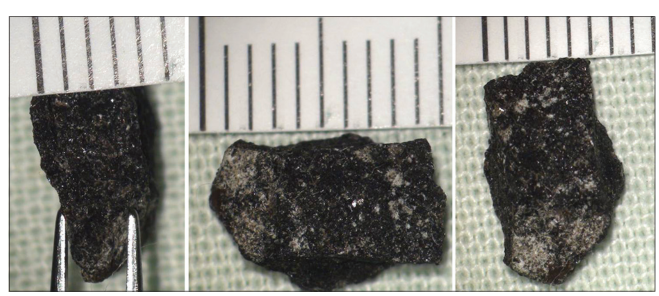

Figure 4: Composite image depicting size of the intraocular foreign body

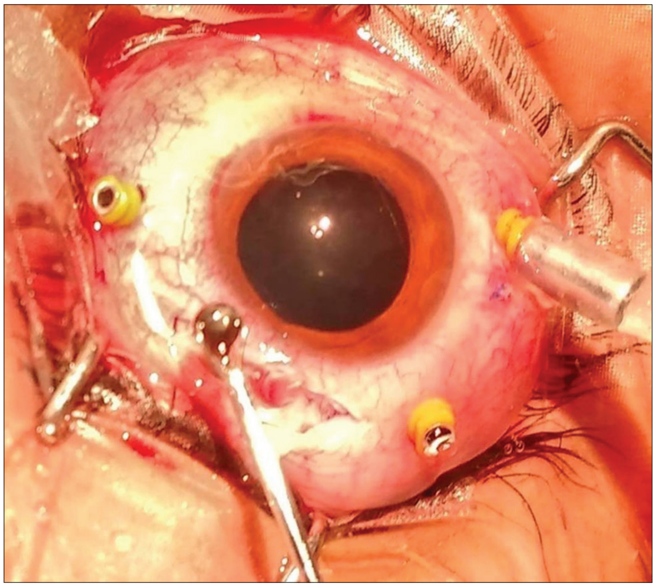

Figure 5: Shotgun pellet grasped with the claw after removal from eye

to hold larger and spherical IOFB. Snare design devices are also prone to repeated slippage of IOFB leading to iatrogenic retinal trauma. Different types of forceps have also been used to remove large IOFBs. Hickingbotham *et al*.[12] have described diamond-coated forceps to hold IOFB in vitreous cavity. However, the opening of prongs is not quite as wide to hold large IOFB and presence of two prongs makes removal of spherical IOFB difficult. Liang *et al*. have recently described a microallegator forceps for removal of large IOFB.[5] This forceps need very large sclerotomy to introduce it and the potential crushing force of the forceps can lead to splintering of the IOFB which may further complicate the surgery. McCarthy *et al*. have used ureter stone forceps itself. This has a very large handle and needs an assistant to operate the instrument.[13] Acar has described a basket-shaped design of IOFB forceps.[14] The basket is made of nitinol and opens up to 14 mm vertically and 8 mm horizontally. The basket can be moved forward and backward by slide knob placed at center of handle. However, it needs bimanual technique to engage the IOFB and has a metal element coming in contact with retinal surface while engaging the IOFB.

The claw offers various advantages over all of the aforementioned devices. The four prongs offer a very secure grip without crushing or splintering the IOFB. Chances of IOFB slippage and thereby causing retinal trauma are minimized. As mentioned before, the IOFB can be approached in anteroposterior direction and picked up from flat retinal surface. The firm grip makes other maneuvers like creating limbal incision or enlargement of sclerotomy with other hand while IOFB is securely held with one hand in mid-vitreous cavity or at the pupillary plane easier. The forceps can be sterilized with standard methods and is thus reusable and cost-effective.

Conclusion

In conclusion, we describe the design and case-based clinical applications of a novel IOFB removal forceps. In our opinion, this forceps allow removal of all types of IOFB, ranging from spherical IOFB with smooth surface to very large IOFB with irregular surface. The unique design, inspired from the dormia basket concept, offers excellent grip of the IOFB with minimal slippage, thus avoiding collateral retinal damage and improving chances of good visual outcome in eyes with OGI and retained IOFB.

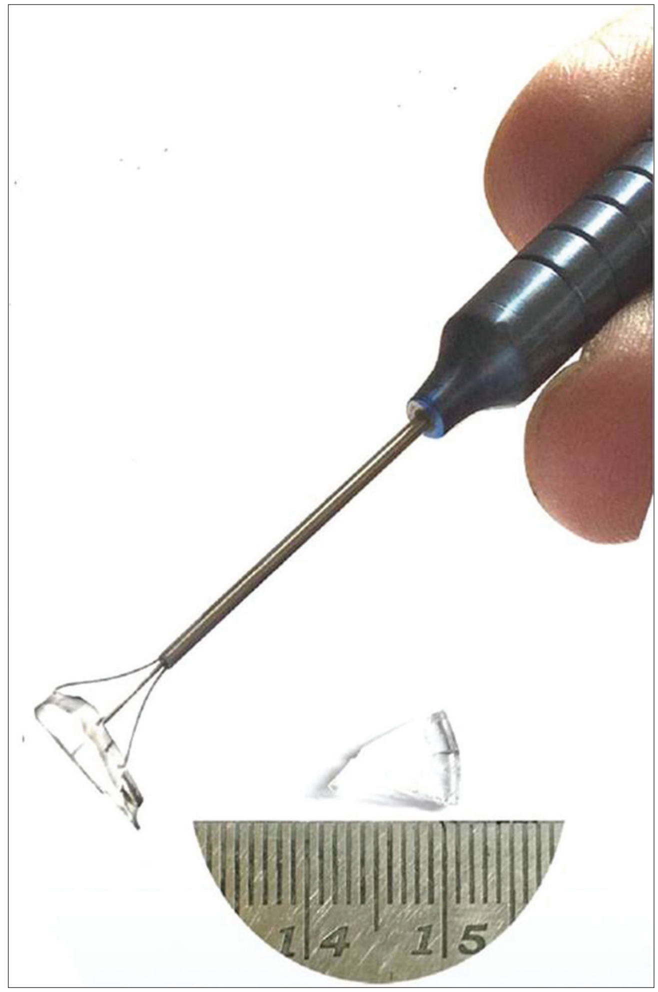

Figure 6: Irregular shaped glass piece held *in vivo* with the claw

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Conflicts of interest

There are no conflicts of interest.

References

1. Loporchio D, Mukkamala L, Gorukanti K, Zarbin M, Langer P, Bhagat N, *et al.* Intraocular foreign bodies: A review. Surv Ophthalmol 2016;61:582-96.
2. Zhang Y, Zhang M, Jiang C, Qiu HY. Intraocular foreign bodies

in China: Clinical characteristics, prognostic factors, and visual outcomes in 1,421 eyes. Am J Ophthalmol 2011;152:66-730.

3. Yeh S, Colyer MH, Weichel ED. Current trends in the management of intraocular foreign bodies. Curr Opin Ophthalmol 2008;19:225-33.
4. Mester V, Kuhn F. Ferrous intraocular foreign bodies retained in the posterior segment: Management options and results. Int Ophthalmol 1998;22:355-62.
5. Liang S, Wan G, Li X, Liu X, Zhu Y. Removal of a giant nonmagnetic intraocular foreign body using micro alligator forceps. Ophthalmic Surg Lasers Imaging Retina 2014;45:228-30.
6. Weichel ED, Yeh S. Techniques of intraocular foreign body removal. Tech Ophthalmol 2008;6:88-97.
7. Erakgun T, Akkin C, Mentes J. Management of the posterior segment foreign bodies with a simple snare. Retina 2003;23:858-60.
8. Murthy KR, Murthy PR. Foreign body snare for the removal of large non magnetic intravitreal foreign bodies and dislocated lens nuclei/iols. Retina 2003;23:584.
9. Eckardt C, Eckert T, Eckardt U. Memory snare for extraction of intraocular foreign bodies. Retina 2006;26:845-7.
10. Smith JM, Hwang RY, Erlanger M, Olson JL. A new multifunctional expandable memory loop device. Retina 2015;35:2154-7.
11. Yedlicka JW Jr., Carlson JE, Hunter DW, Castañeda-Zúñiga WR, Amplatz K. Nitinol gooseneck snare for removal of foreign bodies: Experimental study and clinical evaluation. Radiology 1991;178:691-3.
12. Hickingbotham D, Parel JM, Machemer R. Diamond-coated all-purpose foreign-body forceps. Am J Ophthalmol 1981;91:267-8.
13. McCarthy MJ, Pulido JS, Soukup B. The use of ureter stone forceps to remove a large intraocular foreign body. Am J Ophthalmol 1990;110:208-9.
14. Acar N. A new design intraocular foreign body forceps. Retina 2017;37:2378-80.