

Case report

Glass intraocular foreign body removal with a nitinol stone basket

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ABSTRACT

Purpose: Glass intraocular foreign bodies (IOFBs) complicate up to 14% of all IOFB cases and require specialized instruments for removal. We present a case of ocular trauma with two large glass IOFBs removed using a nitinol stone basket (NSB) designed for kidney stone extraction in the ureter and calyces.

Observations: An adult male suffered a restrained motor vehicle accident. Radiographic computed tomography identified a 9-mm polygonal IOFB within the posterior segment of the right eye. A staged procedure was performed with repair of the ruptured globe followed by 23-gauge pars plana vitrectomy, pars plana lensectomy, and removal of the IOFBs using a NSB.

Conclusion: At post-operative month one, visual acuity was correctable to 20/60. The retina remained attached and the patient was recovering without complication.

Importance: Large glass IOFBs are poorly gripped by standard ophthalmic forceps due to their smooth surface, large size, and irregular shape. The NSB is an effective instrument for controlled removal of glass IOFBs. Further customized design may adapt this device for additional intraocular procedures.

1. Introduction

Glass intraocular foreign bodies (IOFBs) complicate up to 14% of all IOFB cases and are especially common with motor vehicle accidents (MVAs) and explosions.^{1–6} Up to 70% of MVA-associated penetrating ocular trauma have an accompanying glass IOFB present,⁶ which is related to shattering of tempered glass into polygonal fragments with sharp borders that can easily penetrate human tissue.^{3,6} Surgical removal of glass IOFBs is challenging due to their large size, irregular shape, and smooth surface. Different surgical techniques are described in the literature, including the use of forceps, lassos, and suction devices; however, high slippage rates with each of these devices can result in iatrogenic retinal tears and breaks.^{3,7,8}

We present a case of glass IOFB removal using a staged procedure. Initial repair of the ruptured globe was followed by 23-gauge pars plana vitrectomy (PPV), pars plana lensectomy (PPL), and removal of two glass IOFBs through a pars plana incision. To secure the objects prior to removal, we adapted a nitinol stone basket (NSB), designed for retrieval of kidney stones in the ureter and calyces, for intraocular use.

1.1. Case report

A 52-year-old man was the restrained driver in a high-speed, roll-over MVA. The initial trauma survey revealed superficial lacerations to the face, chest, and extremities with several embedded glass fragments. Head computed tomography (CT) showed a deformed right globe with a 9-mm radiodense IOFB in the posterior segment (Fig. 1). On exam, near visual acuity was light perception (LP) in the affected eye and 20/40 in the fellow eye.

The patient underwent ruptured globe repair. Under general anesthesia, two separate scleral lacerations with uveal prolapse were repaired using 8-0 nylon sutures with reposit of uveal tissue. A total hyphema and significant corneal edema prevented intraoperative view of the posterior segment, and the decision was made to defer IOFB removal to a second procedure.

Five days after the initial repair, visual acuity remained LP with direction. Fundus details remained obscured due to a hemorrhagic fibrinous anterior chamber membrane. B-scan ultrasonography demonstrated a formed globe with vitreous hemorrhage and posterior shadowing from the IOFB. Repeat CT showed the globe was now well formed and the IOFB remained in stable position (Fig. 2).

The patient was taken to the OR for IOFB removal under general

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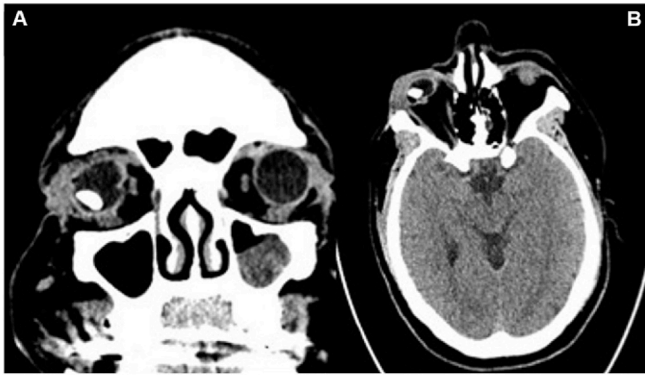


Fig. 1. Coronal (A) and axial (B) CT scan showing a large radiolucent intraocular foreign body embedded in the collapsed right eye prior to ruptured globe repair.



Fig. 2. Post-operative coronal (A) and axial (B) CT images show the IOFB in stable position with improved globe contour following ruptured globe repair.

anesthesia. A 3-port, 23-gauge pars plana vitrectomy (Constellation Vision System, Alcon Inc, Fort Worth, TX, USA) was prepared. Under wide-angle viewing (Resight 500, Carl-Zeiss AG, Oberkochen, Germany), removal of core and peripheral vitreous was performed, and posterior vitreous detachment was induced. Dissection of the adherent hemorrhagic vitreous surrounding the IOFB revealed not one, but two glass IOFBs. After the IOFBs were released, perfluorocarbon (PFO) (Perfluoron, Alcon Laboratories, Fort Worth, TX) heavy liquid was used to displace the objects from the macular surface. This proved ineffective due to the weight of the glass fragments which prevented the PFO from effectively “floating” them into the anterior vitreous. The PFO was removed and further attempts to manipulate the glass fragments resulted in one iatrogenic extramacular retinal break. A cohesive viscoelastic (Healon® GV, 1.4% sodium hyaluronate, Johnson and Johnson, New Brunswick, NJ) was subsequently used instead to displace the IOFB from the macular surface and elevate the edge of the irregularly shaped IOFB. This would later allow for the NSB instrument to be placed just posterior to the IOFB for capture.

A 360-degree peripheral laser barricade was applied, with additional laser to the inferotemporal periphery over the pars plana and pars plicata in anticipation of the sclerotomy. A 20-gauge MVR blade was used to create a pars plana sclerotomy, through which the NSB was introduced. The device has a 1.9 French (equivalent to 23 gauge) tip enclosing a flexible, retractable basket. To operate the device, the surgeon held the proximal end, with the assistant controlling the actuator handle at the other end of a 120-cm wire tube, which was coiled and kept aside (Fig. 3).

The open tines of the NSB were positioned around the first of the IOFBs and retracted, tightly capturing the IOFB and allowing for its

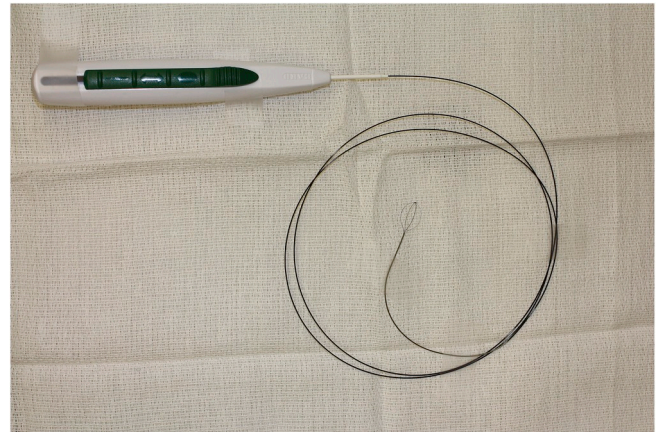


Fig. 3. Nitinol Stone Basket (NSB) shown in the extended position. The NSB is designed for removal of stones in the ureter and renal calyces under direct endoscopic visualization. It consists of a retractable 4-wire basket within a 1.9 French rigid tip (equivalent to 23-gauge) reaching a maximum of 12-mm in width and 18-mm in length. At the other end of the 120-cm long flexible polyimide tubing is an actuator handle, which must be operated by an assistant when adapted for vitrectomy. The shaft fits through a 23-gauge trochar port.

elevation anteriorly. The sclerotomy was enlarged around the NSB shaft along a pre-marked and cauterized 8-mm circumferential scleral incision, through which the IOFB could be removed under direct visualization (Fig. 4). The sclerotomy was closed temporarily using 7-0 vicryl sutures, and removal of the second IOFB was performed in a similar fashion. Each glass IOFB measured about 6 mm.

The sclerotomy was closed with interrupted 8-0 nylon sutures. The iatrogenic retinal break in the superior periphery was surrounded by laser. A fluid-air exchange was performed followed by a 14% C3F8 gas instillation. At the post-operative day 1 visit the retina was noted to be attached and visual acuity was hand motion. At the post-operative month 1 visit, the retina remained attached and visual acuity was 20/60 with aphakic correction (Fig. 5).

2. Discussion

Historically, automobile front windshields were composed of tempered glass, which shattered upon impact. In 1970, the National Highway Traffic Safety Administration required all front windshields to be made of laminated (safety) glass, composed of two layers with an intervening layer of plastic, which prevented shattering of the front windshield on impact. This change resulted in a dramatic reduction in motor vehicle fatalities and glass-associated trauma.^{6,10,11} Side windows are still composed of tempered glass and when IOFB trauma does occur, there is usually shattering of tempered side windows.^{6,12–14} Most likely this is the source of the IOFB in our patient.

Glass IOFBs are often challenging to remove due to their polygonal shape, irregular borders, and smooth surfaces. They are also non-magnetic, precluding use of magnetic intraocular probes or the Bronson rare earth magnet. The ideal instrument for glass IOFB removal would be capable of extracting objects of diverse sizes and shapes without slippage. This would reduce the risk of iatrogenic trauma that may result from droppage during extraction through a sclerotomy.¹⁵ Several tools have been developed, including simple forceps, diamond tipped forceps,¹⁵ lassos,¹⁶ snares,^{17,18} and aspiration/suction cannulas.¹⁹

The Bard® SkyLite™ Tipless Nitinol Stone Basket (NSB) is made from an alloy (nitinol: nickel-titanium) designed for removal of stones in the ureter and renal calyces under direct endoscopic visualization. The NSB consists of a 4-wire basket which is fully retractable within a 1.9 French rigid tip (equivalent to 23 gauge). The basket is advanced through the tip and expanded to the appropriate size, reaching a maximum of 12-mm in width and 18-mm in length. At the other end of the 120-cm long

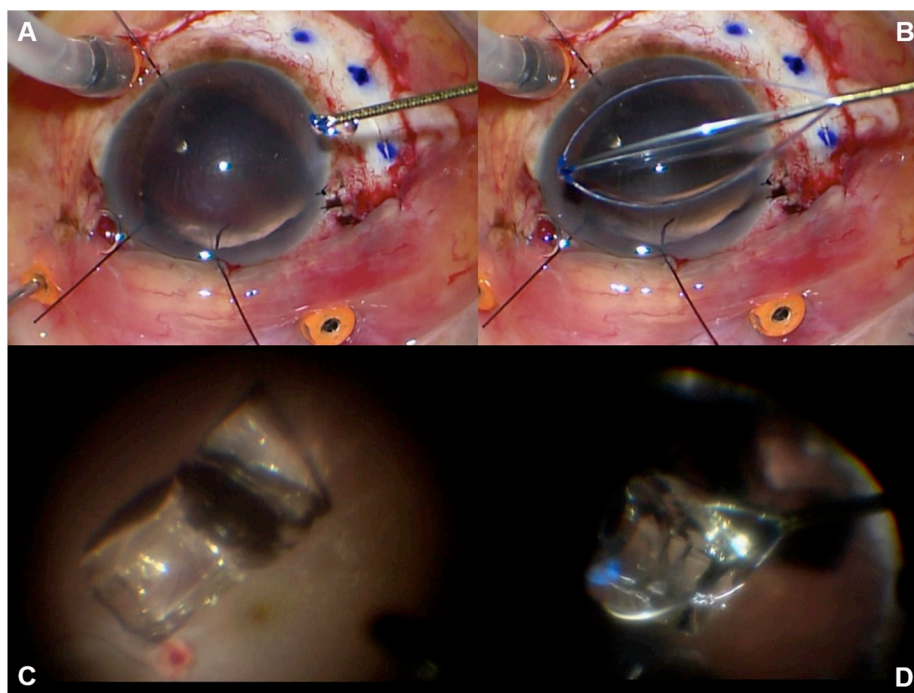


Fig. 4. (A, B). Nitinol stone basket (NSB) in the closed and open position. (C, D). Two glass IOFBs on the retina surface are visualized. Both were securely captured with the NSB and removed through the pars plana.

flexible polyimide tubing is an actuator handle, which must be operated by an assistant when adapted for vitrectomy surgery (Fig. 3). The shaft fits through a 23-gauge trocar port; however, as in this case, removal of large IOFBs necessitates a pars plana or limbal incision.

A review of the literature shows a number of similar reports. The first was in 1990, when Pulido et al. reported using a ureter stone extractor consisting of three retractable open prongs (Van-Tech, Inc., Spencer, Indiana) to remove a glass IOFB in a patient whose glasses were shattered by a BB gun injury.²⁰ Berry et al. later reported using the NSB to explant a dislocated crystalline lens.²¹ More recently, both

Pertile et al. and Durrani et al. have described using the NSB for glass or plastic IOFB retrieval in separate case reports.^{22,23} The NSB could be re-engineered for ophthalmic surgery. The device benefits from a compact design that is compatible with 23-gauge trocar systems, a tipless design that reduces the risk of iatrogenic trauma, an easy-to-operate handle, and a retractable basket that provides precise control with a firm capture. (see Fig. 4).

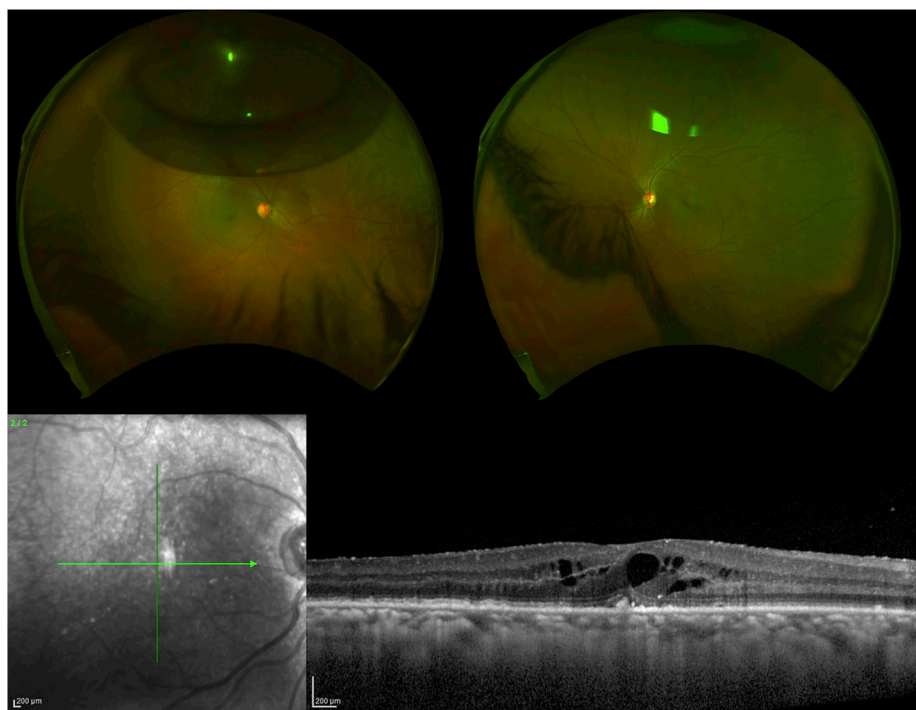


Fig. 5. Wide-angle fundus photographs at post-operative month 1 showing the retina is attached with residual intraocular gas and peripheral laser barricade in the right eye. Optical coherence tomography shows cystoid macular edema and discontinuous outer retinal layers after trauma. Visual acuity with aphakic correction was 20/60.

3. Conclusion

In summary, we report a case of two glass IOFBs successfully removed using a nitinol stone basket, adapted from urologic procedures. This device has many advantages including amenability to standard 23-gauge vitrectomy and firm capture of large, non-magnetic intraocular foreign bodies. Its principal weakness in its current form is its length and the need for a skilled assistant, however we believe re-engineering the NSB to adapt it fully for ophthalmic procedures is possible.

3.1. Patient consent

Written informed consent was obtained for this study.

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Conflicts of interest

None of the authors have any conflicting interests to disclose or proprietary interests in the subject matter of this manuscript. This original work has not been previously published or presented.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

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