The induction of posterior vitreous detachment (PVD) is an important step in the successful outcome of vitreoretinal surgery for various indications. This may pose a significant challenge intraoperatively in cases of strong adhesion between the posterior hyaloid and retina. Various techniques to achieve intraoperative PVD have been described which involve active aspiration as well as non-aspiration techniques to achieve a plane of separation between the posterior hyaloid and retina. Very frequently, combinations of these techniques might be necessary to achieve successful PVD induction. We describe a novel instrument that combines aspiration as well as non-aspiration techniques for PVD induction, Bapaye aspiration scraper. It is also useful in various vitreoretinal interface procedures due to its design and is compatible with small-gauge vitrectomy systems which are commonly used in modern vitreoretinal surgery.

**Key words:** Bapaye’s aspiration scraper, posterior vitreous detachment, vitreoretinal interface

Vitreoretinal surgery has come a long way since 1971 when Robert Machemer first described pars plana vitrectomy (PPV) with a 17-gauge vitreous infusion suction cutter (VISC).\[3\] In the last decade, small-gauge vitrectomy systems have revolutionized outcomes of vitrectomy surgery in terms of anatomical success rates, reduction in postoperative morbidity, faster postoperative recovery as well as visual outcomes.\[3\] Earlier, small-gauge vitrectomy had relatively fewer indications due to factors associated with instrument rigidity and visualization systems among other factors.\[3\] However, advances in wound construction, instrumentation, fluidics, illumination, wide-angle viewing systems, and cutter technology have helped overcome the initial challenges greatly, expanding the indications of small-gauge vitrectomy surgery.\[4\] Valved cannulae for creating sclerotomy sites are used by an increasing number of vitreoretinal surgeons as they maintain a closed chamber, reduce infusion fluid, and help maintain the intraocular pressure due to compensation features.\[4\] However, it is difficult to pass soft-tipped instruments like cannulae and Tano’s diamond-dusted membrane scraper (DDMS) through the valves.

Successful separation of the posterior hyaloid face (PHF) from the retinal surface is the most important step in the successful outcome of vitreoretinal surgery for different indications like rhegmatogenous retinal detachment, macular surgery as well as vitreoretinal procedures in diabetic patients.\[3\] This step may pose a challenge to surgeons due to the strong adhesion between PHF and the retina. Various techniques to achieve posterior vitreous detachment (PVD) intraoperatively have been described previously. The use of active aspiration using a vitreous cutter or soft-tip cannula as well as non-aspiration techniques like the use of DDMS to create a dissection plane have been described.\[6\] Very frequently, combination of aspiration and non-aspiration techniques might be necessary to achieve successful PVD induction. This needs a frequent change of instruments which prolongs surgical time, and therefore, has the potential for more complications.

In this communication, we describe a novel instrument that combines aspiration as well as non-aspiration techniques for PVD induction, Bapaye aspiration scraper (Epsilon Ophthalmic Surgical Instruments, Chino, CA, USA). It is also useful in various vitreoretinal interface procedures due to its design. We describe our initial experience with this instrument across a spectrum of vitreoretinal surgical procedures.
Innovation

Description of the instrument

The instrument – an aspiration scraper, consists of a curved cannula attached to an ergonomic handle [Fig. 1]. The cannula is made of stainless steel. It is 32 mm long and has a gentle curve. It has an outer diameter of 25 gauge. It can easily enter through a valved cannulae as it is a rigid instrument [Fig. 2]. The tip of the cannula is diamond-dusted to achieve scraping of the vitreous or membranes and is rounded to make it non-traumatic to the retina. The cannula has a 0.2 mm aspiration port positioned just behind the tip. When introduced into the eye, the cannula can reach up to the retinal surface even in highly myopic eyes. The handle has serrations for a firm grip. It can be attached to the aspiration tubing of most vitrectomy machines as well as to the tip of a syringe using an adapter [Fig. 3]. Furthermore, it can be used for suction as well as for the injection of vital dyes. Aspiration settings used typically differ depending on the indication the instrument is used for. In situations where vitreoretinal interface adhesion is denser, higher suction is required. We describe typical settings with each indication.

Clinical applications

Though the initial purpose of the aspiration scraper was to induce PVD in difficult cases, we have found it to be effectively used in other clinical situations as well, which are described below.

i. Rhegmatogenous retinal detachment (RRD):
   In RRD, this scraper is used for induction of PVD at the posterior pole as well as the peripheral retina [Fig. 4]. Dense vitreoretinal adhesions in the anterior periphery can be loosened by scraping and suctioning in frequent succession. The aspiration settings for PVD induction at the posterior pole usually are between 200 and 300 mmHg, while the value is much lower when used for loosening the peripheral vitreous, where usually the value is in the range of 80-100 mm Hg. In phakic patients with RRD, it can be used to drain the subretinal fluid (SRF) from any peripheral break close to ora serrata with less risk of lens touch due to curvature of the instrument. In RRD cases where non-valved cannulae are used, the blunt rounded tip of the aspiration scraper can be used to reposit the retina if it gets incarcerated in the cannulae after turning off the infusion. The scraper can be used to engage and create dissection planes for PVR membranes. It is usually done at much lower settings of 70-80 mm Hg aspiration. Additionally, in our experience, mature PVR membranes can be dissected using an aspiration scraper alone. It is useful in the direct exchange of liquid perfluorocarbon (LPFC) with air or silicone oil (SO). Active suction is useful in aspirating fluid at the interface of LPFC and air or SO, thereby, avoiding flap slippage in cases of giant retinal tear (GRT). We have used it successfully to massage the edge of GRT and reposition a minimal slipped flap. We have used it to remove fresh subretinal blood clots in RRD cases. The instrument can be passed in the subretinal space through the nearest retinal hole along the curvature of the globe. It is positioned over the clot and aspiration-activated to aspirate the blood out of the subretinal space. Gentle scraping of the clot can be done if the clot is densely adherent to the choroid.

ii. Macular surgery:
   The Bapaye aspiration scraper is effective in various cases of macular pathologies. The induction of PVD in these cases usually requires much higher aspiration settings of up to 400 mmHg due to very dense vitreoretinal adhesions. We usually scrape the instrument over PHF at a lower suction of 200-250 mmHg till we can generate focal separation around the optic nerve head. Once it is achieved, a higher suction is used to separate vitreous anteriorly, much like active suction with a cutter. An advantage over the conventional cutter in inducing PVD is that the small diameter of the aspiration port reduces the risk of aspirating retinal tissue which may cause an iatrogenic break at the posterior pole. It can be used for the injection of vital dyes without creating a jet. The instrument can be used to scrape and create an edge of the epiretinal membrane (ERM) and then the aspiration port can be used to peel it off from the retinal surface without the risk of retinal trauma, again requiring very low aspiration settings [Fig. 5]. In select cases, we have also used it to create the flap of the internal limiting membrane (ILM) as well. However complete ILM peeling could be achieved more effectively using ILM peeling forceps.

iii. Vitrectomy for complications of proliferative diabetic retinopathy:
   In diabetic patients undergoing vitrectomy for proliferative diabetic retinopathy, an aspiration scraper was found to be very useful in clearing blood clots off the retinal surface [Fig. 6]. It can also be used to identify flimsy edges of fibrovascular membranes densely adherent to the retinal surface. These maneuvers need to be very gentle at low suction. In cases of combined RD, active suction was used for fluid-fluid exchange to remove the thick subretinal fluid. However, we prefer to use a cutter or curved scissors for the dissection of diabetic preretinal membranes as we do not want to avulse the fibro-vascular strands but get a clean cut to avoid excessive bleeding.

Discussion

The DDMS was described in the late 1990s. It consists of three parts, namely the diamond-dusted flexible silicon tip, which is connected to a metallic rod, which in turn, is attached to a plastic handle. The flexible and diamond-dusted tip of the DDMS is gently moved across the retinal surface to try and identify the free edge of the ERM, which can be then removed by the end-gripping forceps or with DDMS itself. This instrument is also used to initiate PVD induction where it is used to create a break in the vitreous in the posterior pre-cortical vitreous pocket (PPVP) after staining with triamcinolone, and then, extending it peripherally. The ingress of irrigation fluid helps

Figure 1: External photograph of the cannula with a gently curved tip
in the progressive separation of PHF and the retina. When introduced, it was a 20-gauge instrument but with the advent of small-gauge vitrectomy systems, it is available in 23- and 25-gauges as well. However, due to a flexible tip, it is difficult to insert through valved cannulae of the vitrectomy systems. For such cases though, a retractable DDMS is available. However,
reports of breakage of the flexible tip with retention with in-valved cannulae or its loss onto the retinal surface have been described in the literature. Gupta and Goldsmith have reported a case where retained diamond particles were seen on the retinal surface after the use of DDMS. These are a few complications that the authors have not encountered while using the Bapaye aspiration scraper (Video 1).

The induction of PVD remains a challenge in the eyes with dense vitreoretinal adhesions like in the pediatric eyes and highly myopic eyes. Various methods for PVD induction have been described. They include active suction with the cutter at the edge of the optic nerve head (ONEH) or PPVP. Once an edge is created, active suction can be used to pull on the vitreous till the peripheral retina. ‘Hydrodissection’ of the vitreous has been described as a safer method to reduce the possibility of complications. Other techniques include active aspiration of the hyaloid with a silicone-tipped cannula or a diamond dust or a sharp instrument as a pick or barbed micro-vitreoretinal blade to dissect the posterior vitreous cortex off the retina or the edge of the optic nerve.

Liquid perfluorocarbon has also been used for progressive separation where active suction is used to separate vitreous and small amounts of LPFC are used to further complete the procedure. Pharmacotherapeutic methods like ocriplasmin are commercially available while anti-integrin agents are under trial. PVD induction is associated with complications like retinal break formation and intraoperative hemorrhage. In high myopic eyes as well as in diabetic patients, the failure to notice vitreoschisis may lead to the PHF remaining attached to the retina and leading to contraction and causing PVR changes later. We believe the Bapaye aspiration scraper considerably simplifies PVD induction with lesser scope for complications. For inducing PVD at the posterior pole, the PHF is stained with triamcinolone. The aspiration scraper is used to gently scrape and simultaneously aspirate and engage the vitreous in PPVP.

As the PHF separates from the retina, PVD can be extended along the vascular arcades. If any area of dense vitreoretinal adhesion is noted, the vitreous can be scraped off the retinal surface before proceeding with active suction. Once a sufficient amount of PVD is achieved, the vitreous cutter can be used to trim the vitreous and complete PVD with active suction.

In cases of RRD, adhesions between the retina and vitreous are often very dense in the periphery, especially in high-myopic patients. The attempted separation of the vitreous with a vitreous cutter is prone to developing iatrogenic retinal breaks while incomplete separation can lead to anterior proliferative vitreoretinopathy-related changes postoperatively. We found that the use of an aspiration scraper helped in this step. The alternate use of scraping and gentle active suction helps to loosen the vitreoretinal adhesions in the periphery, which can later be trimmed using the vitreous cutter. The curvature of the instrument makes it safe to use in the peripheral retina even in phakic eyes as it can reach the extreme periphery without causing lens touch.

In patients with RRD, the presence of peripheral retinal holes close to ora serrata necessitates making drainage posterior retinotomy to drain subretinal fluid more completely, especially in phakic eyes as straight instruments like flute needle may not reach the peripheral retinal break without causing lens touch. The curvature of the aspiration scraper along with the placement of the aspiration port along the outer curve allows access to peripheral retinal holes in all quadrants including the superior ones. Gentle active suction can be used to drain SRF gradually using fluid-fluid exchange as well as air-fluid exchange techniques to achieve a more complete flattening of the retina [Fig. 7]. It obviates the need for posterior drainage retinotomy in a significant number of cases.

In the RRD cases where non-valved cannulae are used, the highly mobile retina can get incarcerated into the sclerotomy site. With the help of a blunt, rounded-tip aspiration scraper, the incarcerated retina can be pushed back after turning off infusion. When the cutter is used for this purpose, the chances of creating iatrogenic breaks are higher if the suction or cutting is activated. It can also be used to engage and create a dissection plane for the PVR membranes. The authors have noted that mature and thick membranes can be dissected using an aspiration scraper alone.

The aspiration scraper combines aspiration and non-aspiration techniques for surgical induction of PVD as well as thick epimacular membranes with macular pucker. It is also used to create an edge in the epimacular membranes and active suction can be used to peel off the retinal surface in a ‘no-touch’ manner. It reduces the risk of focal retinal hemorrhages, focal retinal edema, and eccentric retinal hole formation which may be associated with these procedures. It can be used for the injection of vital dyes without creating a jet. The tip of the cannula can be placed close to the optic disc and brilliant blue dye can be injected which flows over the macular area through a posteriorly placed hole.

As mentioned before, the aspiration scraper can be used to create a flap for ILM peeling. However, we found the use of ILM peeling forceps more effective and less traumatic to the retina for completion of ILM removal. Kuhn et al. have suggested that the use of DDMS for enlargement of ILM-free area is associated with a higher possibility of trauma to the nerve fiber layer and functional damage. The same would be true with the aspiration scraper and we would not encourage enlargement of the ILM peeling with scraping alone.

During vitrectomy for PDR, intraoperative hemorrhage from fibrovascular proliferation is commonly seen. This hemorrhage can be controlled by raising the intraocular pressure, performing a fluid-air exchange, or the use of diathermy. Once active hemorrhage has ceased, blood clots formed on the retinal surface can potentially hinder the surgical view. Removal of these blood clots can be difficult due to dense adhesion between the organized clot and the retinal surface. The risk of trauma to the underlying retina is very high during the attempted removal of the clots. In our experience, we found the use of non-aspiration and aspiration methods with the aspiration scraper to be safe and effective in the removal of these clots. In the case of active bleeders, the bimanual surgery technique, intraocular cautery, and aspiration scraper can be simultaneously used to identify bleeders and cauterize them. We have used them to identify the edges of densely adherent flat fibrovascular proliferations as well as to drain the thick SRF in cases with combined retinal detachments. In cases of SRF drainage, the aspiration port is held close to the retinal hole. As this port is not at the tip, it usually does not aspirate the retinal tissue making this procedure safer.
Multifunction instruments like aspiration cautery, illuminated picks, and illuminated laser probes have been used effectively before widespread acceptance of small-gauge vitrectomy as these instruments are often 19/20 gauge. However, in the era of small-gauge vitrectomy, such instruments are not very common. With the Bapaye aspiration scraper, we have attempted to combine aspiration and non-aspiration for vitreoretinal interface manipulations. Since the instrument has a 25-gauge diameter, it is compatible with modern small gauge vitrectomy systems.

It is important to note that unlike the DDMS, the presently described scraper is a rigid instrument. While using the non-aspiration function, it has to be brushed carefully and gingerly over the retinal surface. It can traumatize the retina if dragged roughly over it. Iatrogenic breaks can also occur if excessive force is used. The instrument also needs to be frequently cleaned by flushing with BSS as it is liable to get blocked due to its narrow gauge.

**Conclusion**

The author’s initial experience with the Bapaye aspiration scraper suggests that it is a versatile instrument for use in vitreoretinal surgery. Early data show that it is an effective device that has the potential to make various vitreoretinal interface manipulations, hitherto prone to complications, easier. Further studies are needed to compare the techniques and assess the learning curve associated with this instrument.

**Acknowledgements**

We acknowledge contribution of Mr. Mateen Amin of Epsilon in making prototypes of instrument. We acknowledge contribution of Dr. Mahesh P Shanmugam for using the prototype and giving us valuable suggestions.

**Financial support and sponsorship**

Dr. Akshay Gopinathan Nair has received lecture fees from Carl Zeiss Meditec and serves as a consultant for HelpMeSee Inc. None of the authors receive/have received any compensation for the design, use, sales or promotion of the surgical instrument described in the manuscript.

**Conflicts of interest**

There are no conflicts of interest.

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