B-HEX pupil expander in vitreoretinal surgery – A case series

Debdulal Chakraborty, Ayan Mohanta, Arup Bhaumik

We describe the successful use of the B-HEX pupil expansion device in four cases of combined phacovitrectomy with significant cataract, non-dilating pupil, and surgical vitreoretinal pathologies including vitreous hemorrhage, inferior retinal detachment (RD) with proliferative vitreoretinopathy in an oil filled eye, recurrent rhegmatogenous RD, and macular hole with RD localized to the posterior pole in an eye with uveitic sequelae. The B-HEX remained well engaged and maintained excellent mydriasis throughout the surgery despite wide fluctuations in intraocular pressure and anterior chamber fluidics. This is the first series describing use of B-HEX for combined phacovitrectomy due to myriad causes.

Key words: B-HEX, phacovitrectomy, pupil expander, vitreoretinal surgery

Videos Available on: www.ijo.in

Access this article online

Quick Response Code:

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_1675_19

Adequate pupillary dilatation is a prerequisite for most intraocular surgeries including cataract and vitreoretinal surgeries and a dilated pupil facilitates adequate visualization and completion of most of the steps of surgery uneventfully. Several strategies have been proposed to tackle a small

Disha Eye Hospitals, Kolkata, West Bengal, India

Correspondence to: Dr. Debdulal Chakraborty, Deptartment of Vitreoretina Services, Disha Eye Hospitals, Ghosh Para Road, Barrackpore, Kolkata - 700 120, West Bengal, India. E-mail: devdc@rediffmail.com

Received: 24-Sep-2019 Revision: 12-Dec-2019
Accepted: 24-Dec-2019 Published: 25-May-2020

Cite this article as: Chakraborty D, Mohanta A, Bhaumik A. B-HEX pupil expander in vitreoretinal surgery – A case series. Indian J Ophthalmol 2020;68:1188-91.

pupil at the time of surgery including mechanical stretching, pharmacological agents, viscoelastic assisted mydriasis, sphincterotomy, use of iris hooks, and pupil expansion rings.[1] Use of pupil expansion rings has gained widespread acceptance over the past decade due to ease of insertion and removal through the main cataract surgical wound and good iris engagement leading to sustained mydriasis until the device is *in situ*. The Malyugin ring[2] is the most popular amongst expansion rings with extensive literature on it,[2-4] while the B-HEX is a relatively newer device with the evolving literature over its clinical applications.[5,6]

The application of pupil expansion rings for vitreoretinal surgery is much different from their use in cataract surgery due to very different fluidic dynamics and pressure fluctuations during retinal surgeries. In this report, we describe applications of the B-HEX pupil expander in a series of vitreoretinal surgeries with different pathologies and, hence, different surgical maneuvers.

Case Reports

Case 1

Patient demographics and clinical characteristics are presented in Table 1. At the time of phacoemulsification, the pupil started constricting despite the use of intracameral adrenaline and visco-dilatation [Fig. 1a and Video 1], and, hence, we placed a B-HEX pupil expander [Fig. 1b] using the sinskey hook and 25G intra ocular forceps taking care not to engage the capsulorhexis margin. The wide pupillary dilatation enabled phacoemulsification and 25 gauge parsplana vitrectomy [Fig. 1c] to be uneventfully completed. The wide angled contact lens viewing system (Oculus Surgical Inc., Port St. Lucie, Florida, USA) was used for visualization during the vitrectomy. The pupil was engaged well with maintained mydriasis throughout the procedure. Following vitrectomy, the flanges of the B-HEX were easily disengaged and the ring was removed through the main entry wound using the intraocular forceps revealing a round symmetric pupil [Fig. 1d]. There was minimal anterior chamber collapse while removing the ring. The 25G ports were removed in the end ensuring adequate intraocular pressure. Postoperative period was uneventful and patient regained 20/30 vision at final checkup.

Case 2

Patient demographics and clinical characteristics are summarized in Table 1. Patient had a non-dilating pupil [Fig. 2a] of approximately 3.5 mm along with nuclear cataract and inferior retinal detachment with PVR in an oil filled eye [Fig. 2b]. Following uneventful phacoemulsification, three 25G cannulas were placed in the parsplana and silicone oil was removed. The ReSight (Carl Zeiss Meditech AG, Germany) wide angled viewing system was used for the visualization of the posterior segment. Although the PVR membranes were in the extreme inferior periphery, the pupillary dilation by the B-HEX helped visualization [Fig. 2c] and membrane dissection [Video 2]. Some of the membranes could be visualized through the potential space between the IOL margin and the pupillary margin widened due to the B-HEX. Even with all these manoeuvres, the B-HEX maintained mydriasis and did not disengage. Surgery was completed with silicone oil tamponade [Fig. 2d]. The anterior chamber was partially filled with viscoelastic, the B-HEX was disengaged from the pupillary margins and removed through the side port, and viscoelastic was washed thoroughly from the anterior chamber.

Case 3

Patient demographics and clinical characteristics are summarized in Table 1. She was a one-eyed patient with history of retinal detachment surgery 10 years back and presented with mature cataract [Fig. 3a], an eccentric fibrosed pupil of approximately 3.5 mm in size and recurrent RD picked up on preoperative ultrasound [Fig. 3b]. After placing the B-HEX, phacoemulsification was completed and a rigid PMMA IOL was placed due to financial constraints. We decided not to do a stretch pupilloplasty as we felt that this would be unnecessary given the resilience of the hexagonal B-HEX. The sclerocorneal wound and the peritomy were then sutured. After placing 25 gauge cannulas, the Oculus contact lens system was used for posterior segment visualization. The wide pupillary dilation enabled us to see the shallow RD [Fig. 3c] with peripheral laser marks. After ensuring that there was no residual vitreous, a drainage retinotomy was made and retina was reattached easily with fluid gas exchange [Video 3]. A 360° barrage laser was done, and this was followed by silicone oil injection (5000 cs) [Fig. 3d]. Then, the B-HEX was disengaged and removed through the side port completing the surgery.

Case 4

Patient demographics and clinical characteristics are summarized in Table 1.

At initiation of surgery, the constricted pupil of approximately 3.5 mm size [Fig. 4a] was stretched with two dialers to break the posterior synechiae. With some further injection of viscoelastic, the B-HEX pupil expander was placed into the AC and the pupillary margins were engaged using a 25 G intra-ocular forceps [Fig. 4b]. This was followed by uneventful phacoemulsification and implantation of a multipiece intraocular lens. The ReSight wide angled viewing system was used for the visualization of the posterior segment. During 25G parsplana vitrectomy, a shallow RD limited to the posterior pole with a macular hole and pigmentary change in the posterior fundus was noted. There was a whitish preretinal membrane noted along with sclerosed vessels in the inferior quadrant [Fig. 4c]. The membrane was segmented using the cutter and aspirated followed by pan retinal laser in view of extensive vascular sclerosis. Before proceeding with fluid gas exchange, we removed the B-HEX by disengaging it from the pupillary margins and removed it through the side port [Fig. 4d]. Then, the posterior pole was reattached by performing fluid exchange through the macular hole, and light green laser was applied around the old macular hole in view of one-eyed status and unhealthy RPE over the posterior pole. Finally, air was exchanged with C3F8 gas.

Discussion

In this series, we present four different surgical vitreoretinal scenarios combined with a small pupil and cataract. Each case had a different surgical demand ranging from the easier vitreous hemorrhage in case 1 to difficult dissection of peripheral PVR membranes in case 2, recurrent rhegmatogenous RD in case 3, and uveitis-related macular hole with RD limited to the posterior pole in case 4. Similarly, each case had a different range of fluctuations in intraocular pressure (IOP) with resultant turbulence in the anterior chamber and iris configuration. The IOP can become suddenly low at the end of silicone oil removal, while the anterior chamber can become very shallow with forward movement of the iris and pupil

during fluid air exchange and injection of tamponading agents. Despite these fluctuations, the B-HEX remained stable, showed excellent engagement of the pupillary margin and did not disengage in any of these complicated cases.

Modern wide angled visualization systems help in visualization even with smaller pupils. However, these were difficult cases with the risk of continued progressive miosis during surgery, not responding to more conservative means of mydriasis. The experienced operating surgeon felt the need for mechanically assisted mydriasis in these cases; hence, the B-HEX was used.

Other advantages of the B-HEX in vitreoretinal surgery are the ease of insertion and removal even via the 0.9 mm side port incision with an intraocular forceps without any collapse of the anterior chamber despite the presence of tamponading agents behind the IOL. Additionally, despite being very flexible, we also found the B-HEX to be extremely resilient so that the hexagonal pupil is maintained at 6 mm size throughout the study. Lastly, we found that the B-HEX retained its hexagonal memory very well after explanting from the eye thereby showing its tensile strength. There have been some reports on the ease of application and efficacy of maintaining mydriasis using the B-HEX for cataract surgery with small pupils.[5,6] To the best of our knowledge, this is the first study highlighting its usefulness in combined cataract and parsplana vitrectomy for different etiologies.

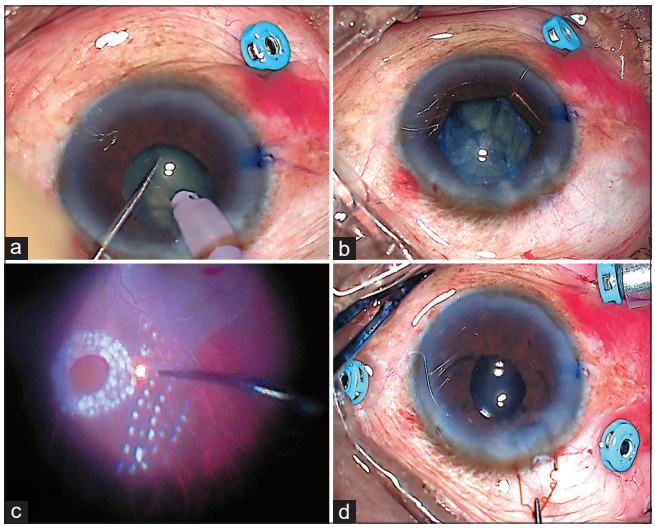

Figure 1: (a) Dense cataract with small pupil before cataract surgery. (b) B-HEX placed *in situ* after capsulorhexis. (c) Branch retinal vein occlusion with coexistent retinal tear treated with sectoral laser photocoagulation and barrage laser, respectively. (d) Image showing a round and symmetrical pupil at the end of surgery

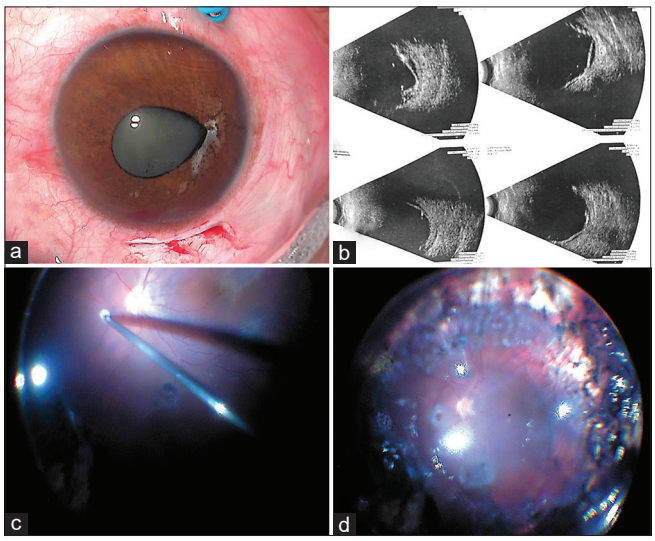

Figure 3: (a) Small rigid pupil with mature cataract. (b) Ultrasound Bscan image showing the retinal detachment. (c) Shallow retinal detachment seen intraoperatively. (d) Silicone oil filled eye

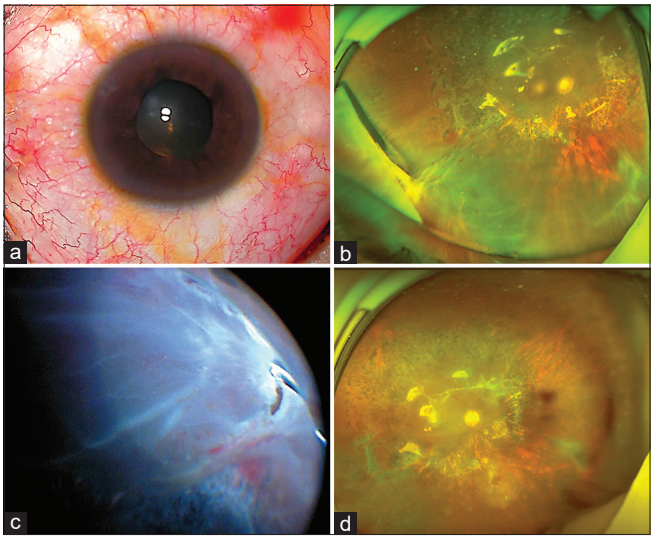

Figure 2: (a) Non-dilating pupil due to long-term tamsulosin therapy for prostatic hypertrophy. (b) Ultra widefield retinal image showing inferior retinal detachment with PVR membranes. (c) Intraoperative image showing PVR membranes being dissected in the extreme inferior periphery via the expanded pupil. (d) An attached retina with silicone oil tamponade (Postoperative ultra widefield image)

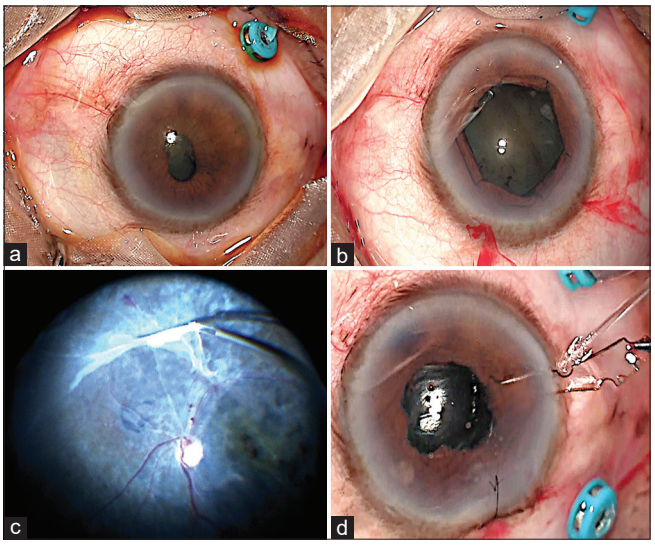

Figure 4: (a) Anterior segment image showing posterior synechiae, complicated cataract, and poor mydriasis. (b) Wide dilatation provided by the B-HEX. (c) Retinal detachment localized to the posterior pole and associated with macular hole and preretinal membrane secondary to resolved uveitis. (d) B-HEX being taken out by the 0.9 mm side port

Table 1: Showing the demographics, clinical details and outcomes of each case

Case#	Age/ Gender	BCVA preop	Retinal pathology	Cause of small pupil	Lens	Time of B-HEX placement	PPV gauge	Surgical details	Complications	Final BCVA
1	60/M	PL+	Vit heme + BRVO + tear	Tamsulosin IFIS	Dense cataract	After capsulorhexis	25G	PPV + EL + Gas	Nil	20/30
2	56/M	20/120	Inf RD with PVR in oil filled eye	Tamsulosin IFIS	NS II	Before capsulorhexis	25G	SOR + MP + EL + ReSOI	Iatrogenic retinal break	20/80
3	34/F	PL+	Recurrent RD*	Multiple surgeries	Mature cataract	Before capsulorhexis	25G	Retinotomy MP + FGE + EL + SOI	Nil	20/60
4	56/F	PL+	RD with macular hole, rotatory nystagmus, resolved uveitis*	Chronic Uveitis	Advanced cataract with PS	Before capsulorhexis	25G	PPV + MP + FGE + EL + Gas injection	Nil	20/400

M=Male, F=Female, Vit heme=Vitreous hemorrhage, PPV=Parsplana Vitrectomy, EL=Endolaser, SOR=Silicone oil removal, MP=Membrane peeling, SOI=Repeat silicone oil injection, Inf=Inferior, RD=Retinal detachment, PVR=Proliferative vitreoretinopathy, *One-eyed status, FGE=Fluid Gas exchange, PS=posterior synechiae, BRVO=Branch retinal vein occlusion, IFIS=Intraoperative Floppy iris syndrome

Conclusion

In conclusion, the B-HEX helps to maintain excellent mydriasis throughout combined phacovitrectomy, is easy to engage and disengage using intraocular forceps, and remains in place despite wide fluctuations in IOP during various surgical maneuvers.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Malyugin BE. Recent advances in small pupil cataract surgery. Curr Opin Ophthalmol 2018;29:40-7.
2. Nderitu P, Ursell P. Iris hooks versus a pupil expansion ring: Operating times, complications, and visual acuity outcomes in small pupil cases. J Cataract Refract Surg 2019;45:167-73.
3. Bucci FA Jr, Michalek B, Fluet AT. Comparison of the frequency of use of a pupil expansion device with and without an intracameral phenylephrine and ketorolac injection 1%/0.3% at the time of routine cataract surgery. Clin Ophthalmol 2017;11:1039-43.
4. Agarwal A, Malyugin B, Kumar DA, Jacob S, Agarwal A, Laks L. Modified malyugin ring iris expansion technique in small-pupil cataract surgery with posterior capsule defect. J Cataract Refract Surg 2008;34:724-6.
5. Bhattacharjee S. Pupil-expansion ring implantation through a 0.9 mm incision. J Cataract Refract Surg 2014;40:1061-7.
6. Bhattacharjee S. B-HEX pupil expander: Pupil expansion redefined. Indian J Ophthalmol 2017;65:1407-10.