Surgical Technique

Flower-petal inverted flap for internal limiting membrane in myopic eyes with macular hole and rhegmatogenous retinal detachment

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We demonstrate a modified internal limiting membrane (ILM) inverted flap technique for closure of macular holes (MHs) concurrent with rhegmatogenous retinal detachment in myopic eyes. Multiple ILM flaps were created in a flower-petal configuration around the MH over the detached retina after shallowing the retina as much as possible. Traction was always in a direction that allowed the optic disc to act as an anchor to limit iatrogenic breaks and to bridge the hole with multiple, more secure flaps should one of the flaps revert or break away. The technique proved safe and efficient in MH closure in our series of eight cases. The modification described provides an effective approach for challenging myopic cases in which ILM flap creation is needed over a detached retina.

Key words: Internal limiting membrane, inverted flap, macular hole, retinal detachment

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Website: www.ijo.in

DOI: 10.4103/ijo.IJO_2226_21

Quick Response Code:

Macular holes (MHs) coexisting with retinal detachment (RD) in patients with highly myopic eyes present an intractable surgical challenge for ophthalmologists.[1] The inverted flap technique was first proposed by Michalewska *et al*.[2] in 2010 for the treatment of large MHs and subsequently for myopic MHs with or without RD.[3] Multiple studies have since compared this technique with conventional internal limiting membrane (ILM) peeling and reported more effective closure rates, faster recovery, and better visual outcomes in the inverted flap group.[4,5]

However, the use of a single flap carries the risk of flap detachment or loss of flap retention during fluid–air exchange. Recently, Aurora *et al*.[6] described a "cabbage leaf" technique in which multiple leaflets are created to bridge over the MH to ensure better flap stability and physiological tissue orientation. Creating an ILM flap in the presence of RD is more surgically challenging and carries the risk of inducing more breaks. Some surgeons[7] have proposed the use of a stabilizing substance, such as perfluorocarbon liquid (PFCL) or a viscoelastic cap, to stabilize the flap in the presence of RD, but this may introduce PFCL into the subretinal space, which may be difficult to remove and has the potential to cause anatomical disruption, and the rolling of the ILM flap with difficult spread over the hole.

In this work, we describe a modified technique for ILM inverted flap creation in myopic eyes with MH on a detached retina.

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The flower-petal modified ILM flap creation technique is demonstrated in Supplemental Digital Content 1. We performed the described technique on eight myopic eyes of eight patients in the period between January 2019 and June 2020. Six of our patients were males (75%) and two were females (25%). The mean age of the patients was 51.6 years (standard deviation = 13.3 years). All patients had a macula-off rhegmatogenous RD (RRD) (due to one or more peripheral breaks) that was concurrent with a MH at the time of presentation. The study adhered to the tenets of the Helsinki Declaration. The details of the technique, expected outcomes, complications, and prognosis were explained to all patients before obtaining written informed consent.

After sterilization and surgical draping, standard 23- or 25-gauge vitrectomy cannulas were inserted. Core vitrectomy was then performed with the assistance of triamcinolone acetate for vitreous visualization, followed by induction of posterior vitreous detachment, if it was not already present. Shaving of the peripheral vitreous was then performed with adequate indentation to visualize any anterior retinal breaks. We deferred from using PFCL to avoid subretinal escape of the viscoelastic

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Received: 27-Aug-2021 Revision: 08-Sep-2021
Accepted: 21-Sep-2021 Published: 27-Jan-2022

Cite this article as: Habib AM, Mansour A, Fouad YA. Flower-petal inverted flap for internal limiting membrane in myopic eyes with macular hole and rhegmatogenous retinal detachment. Indian J Ophthalmol 2022;70:667-9.

material. Drainage of the subretinal fluid was performed from the peripheral (primary) break(s).

When sufficient retinal shallowing was achieved, ILM flap creation was initiated. Brilliant Blue G dye (Brilliant Peel; Geuder, Heidelberg, Germany) was injected using a soft-tip 25-gauge cannula to visualize the ILM. Using an ILM forceps, multiple flaps were created, starting from the nasal to the MH and away from the papillomacular bundle, with traction being made in the temporal direction or vertically. In this approach, the optic disc always acted as an anchor; this prevented undue traction on an already detached retina that would fold the retina on itself or create more breaks. The multiple flaps were created in a semilunar fashion, with each flap pulled from the edge of the previous one to avoid retinal tissue damage. In each flap, a hinge was maintained connecting the base of the flap to the MH. The flap was then bridged over the MH to cover it. This yields a flower-petal configuration of ILM flaps bridging over the MH [Fig. 1], ensuring more controlled flap creation and the availability of more backup flaps bridging over the MH if one or more flaps were to break away or revert.

Fluid–air exchange was then performed with drainage of as much residual subretinal fluid as possible. This was followed by air–silicone exchange. We used silicone oil (SiO) with a viscosity of 1000 centistokes. Endolaser was then applied to surround the breaks. We opted for barrage laser in all myopic eyes with peripheral breaks. After adequate filling with SO and removal of the vitrectomy trocars, all ports were checked for leakage and sutured if any leak was detected.

Postoperatively, the patients received positioning instructions for 7 days. They were followed up using best-corrected visual acuity (BCVA) and intraocular pressure (IOP) measurements, detailed fundus examination, and optical coherence tomography (OCT) scans. SiO was removed at least 3 months after the initial surgery.

Results

To date, we have performed the flower-petal modified ILM flap technique in eight myopic eyes showing MH concurrent with RRD complicating peripheral break(s). All eyes had a flat macula and a closed MH after a mean follow-up period of 6 months. Fig. 2 demonstrates the OCT scans of one of the studied eyes at 3 and 6 months postoperatively, with the hole completely closed and no signs of neurosensory macular detachment. Fig. 3 demonstrates the preoperative presentation of another case (A) and the postoperative fundus photography (B) and OCT scans (C) at 3 months following the surgery. Seven of the eight eyes had a preoperative visual acuity (VA) of hand motion with good projection and color perception, and one eye had a VA of light perception with good projection and color perception. The mean postoperative BCVA at 6 months was 0.2. No redetachment or MH reopening occurred in any of the operated eyes, but glaucoma developed in two eyes (25%) and was controllable by medical treatment.

Discussion

The inverted ILM flap is becoming the standard of care for myopic MHs with or without RD. In a recent systematic review by Xu and Luan,[8] seven retrospective comparative studies comparing the inverted flap technique against standard ILM

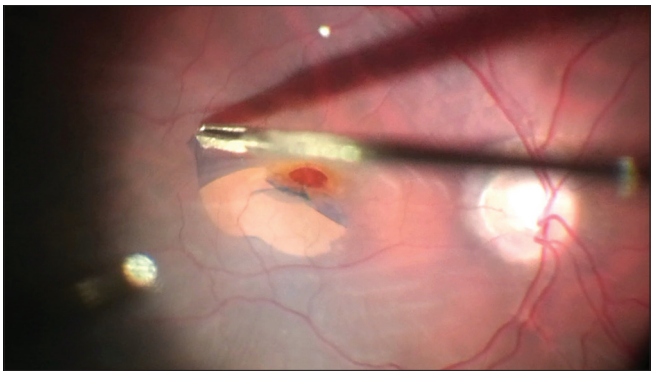

Figure 1: Flower-petal inverted ILM flap creation using ILM forceps. At this stage, two flaps are already created, and a third flap is being grasped

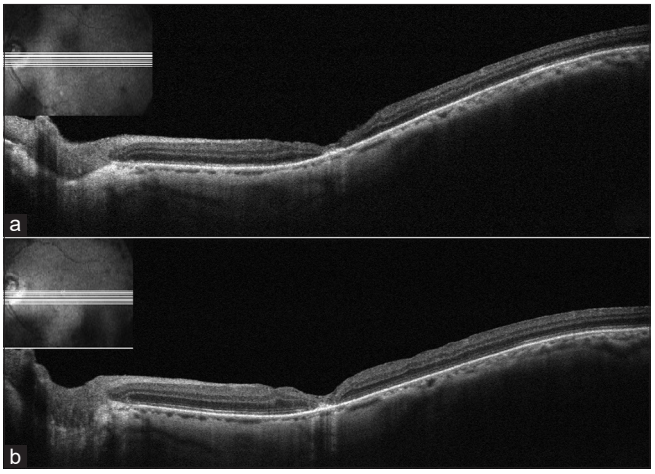

Figure 2: OCT scans of the left eye of a 46-year-old female patient treated with our modified inverted ILM flap technique at 3 months postoperatively (a) and 6 months postoperatively with the SiO removed (b)

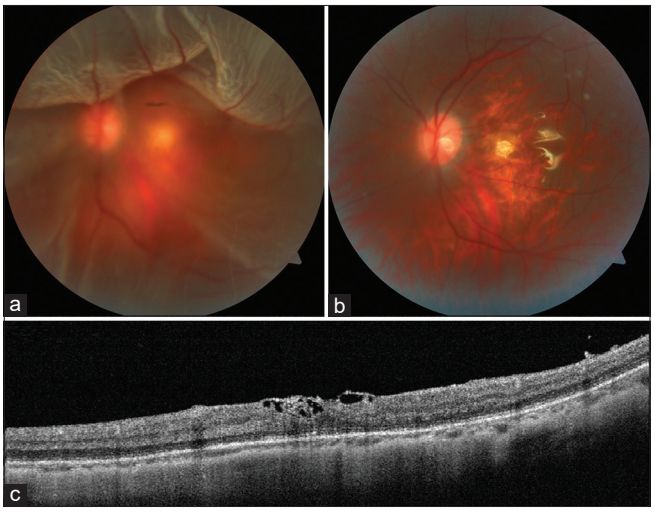

Figure 3: Preoperative fundus photography (a) of the left eye of a 34-year-old male patient at initial presentation with RRD due to a peripheral, horse-shoe upper nasal break, concurrent with a MH detected intraoperatively. Fundus photography (b) And OCT scans (c) At 3 months postoperative demonstrate a flat retina with closure of the MH

peeling in cases with MH and RD were identified, with a combined subject pool of 228 eyes. Higher MH closure rates were detected in the inverted flap group; however, the visual outcome and the rate of intraoperative and postoperative complications among both groups were comparable.

However, notably, most studies in the literature deal with RD resulting from the MH itself (macular hole retinal detachment (MHRD)), and there is little research on the best approach for RRD concurrent with a myopic MH. Singh[9] concluded that combined rather than sequential surgery for RRD associated with MH would be more clinically and economically advantageous, although some MHs demonstrated closure after primary RRD repair surgery. In our experience, the technique suggested in this work can be extended for usage in cases with MHRD and not just for MHs concurrent with RRD due to peripheral breaks (as demonstrated above). In both scenarios, adequate ILM tissue surrounding the MH is an important prerequisite.

Stabilization of the retina during ILM flap creation is of utmost importance during surgery for MH associated with RD. Our flower-petal technique allows for controlled small flap creation, avoids rolling of a single large flap over the MH, and allows the optic disc to behave as an anchor during traction on the petal flaps. The use of viscous fluids such as PFCL carries the risk of subretinal seepage with difficult removal, disruption of anatomical continuity, and a more complex, time-consuming surgery. Furthermore, the multiplicity of our petal flaps, utilizing the concept described by Aurora *et al*.,[6] ensures that some bridging ILM is always covering the hole to induce a gliotic closure.

The limitations of our study include its single-arm noncomparative nature and the small sample size of eyes on which the technique was performed. The technique is also limited to eyes in which sufficient surrounding ILM tissue is present for multiple flap creation and does not provide a solution for eyes in which there is no/minimal surrounding ILM; in such eyes, a free ILM flap or an autologous retinal transplant would be a suitable option.[10]

Conclusion

In conclusion, we have described a modified ILM flap technique as a safe and efficient means for closure of MHs associated with RD.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Supplemental Digital Content

Supplemental Digital Content 1: Video demonstration of the flower-petal inverted flap technique for the internal limiting membrane (ILM) in a case with rhegmatogenous retinal detachments associated with a macular hole. Multiple flaps are created, each starting at the edge of the previous one and connected at the base by a pedicle to the hole. This ensures that traction is performed in a direction where the optic disc acts as an anchor, more bridging ILM tissue is present over the hole, and that multiple backup flaps are in position should one revert or disconnect.