Inverted flap technique with air tamponade and one day face down positioning for posttraumatic macular hole surgery in a young male patient in sub-Saharan Africa

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ABSTRACT

Introduction: Surgery has been the mainstay of macular hole treatment since the first description of its success. Different techniques are, however, described. Our case report looks into the use of the inverted flap technique for managing patients with posttraumatic full thickness macular holes with a single day supervised face down positioning and air tamponade. Case Report: A 32-year-old young man sustained blunt ocular trauma to his left eye while under training seven months prior to presentation with reduced central vision and metamorphopsia. On examination visual acuities were best corrected 6/6 in the right and 6/60 in the left, anterior segments were normal. Fundoscopy revealed flat retinae, and extensive linear chorioretinal scars in the posterior pole suggestive of healed choroidal ruptures and a posttraumatic stage 4 full thickness macular hole (FTMH) in the left. The FTMH measured 877 µm on optical coherence tomography (OCT). The patient had a macular hole surgery using the inverted flap technique with one-day face down positioning and air tamponade. Significant hole closure was seen in the first postoperative week and by six weeks after surgery, the macular hole was fully closed and vision improved to 6/6 best corrected. The inverted flap technique with air tamponade and one day face down positioning can offer another option to retina surgeons treating complex macular holes. Early visual recovery and ability to undertake air travel immediately after surgery is an additional advantage. Conclusion: Using the inverted flap technique for surgery provides surgeons with another option for repair of complex FTMHs, like those secondary to trauma that have been known to respond poorly to initial standard repair.

Keywords: Full thickness macular hole, Inverted flap macular hole surgery, Macular hole, Posttraumatic macular hole

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INTRODUCTION

A macular hole (MH) is a full thickness defect of the neurosensory retina in the fovea. It is one of the main vitreoretinal interface disorders with a prevalence varying from 0.2–0.7% in the general population [1]. Macular holes can be idiopathic or secondary to trauma or other vitreoretinal disorders like chronic cystoid macula edema. Idiopathic MHS are caused by abnormal tangential vitreoretinal traction as opposed to anterior posterior traction; hence surgical intervention has been tailored along this line [2, 3]. In 1991, Kelly and Wendel were the first to describe a surgical approach to treat MHS, the rational of the surgery was the identification and treatment of vitreoretinal traction forces, along with removal of the internal limiting membrane (ILM) to facilitate retina mobility and hence hole closure [4].
Currently most of macular holes (around 85–90%) can be successfully closed using a procedure involving pars plana vitrectomy, dye-assisted ILM peeling, and gas tamponade [1]. However for certain types of holes like large MHs (defined as >400 µm, according to the classification in the International Vitreomacular Traction Study) [5], longstanding MHs (>6 months), posttraumatic MHs, and those associated with myopia, surgical failure is more common with closure rates as low as between 8% and 44% [1] in a recent report.

In 2010, Michalewska et al. [6] introduced the inverted flap technique, originally intended to address challenging cases of large macular holes and myopic macular holes. In this technique, the ILM was peeled but was not completely detached from the macular hole edge thus creating a flap. The flap was then tucked into the macular hole before a fluid gas exchange. This technique has now been used by many other researchers with good MH closure rates [6, 7].

Several variations to the initial technique are described; the temporal ILM flap technique peels the ILM only on the temporal side of the fovea and uses it to cover the MH [7]. In the cabbage leaf inverted internal limiting membrane flap technique, multiple ILM flaps are inverted over each other covering the hole [8]. This technique has been proposed for cases of chronic, large, full-thickness macular holes. Our case report looks into the use of the inverted flap technique for managing a patient with posttraumatic macular hole with a single day supervised face down positioning and air as intravitreal tamponade.

CASE REPORT

A 32-year-old young man sustained blunt ocular trauma to his left eye while under training seven months prior to presentation. This was associated with periorbital swelling and immediate reduction in vision. Vision improved over the next two weeks with resolution of the periorbital swelling but he then noticed his central vision was affected. He was unable to read with his left eye and the images appeared distorted. He is not a known spectacle wearer and is otherwise in good health. Examination revealed unaided visual acuities of 6/6 (LogMAR 0) in the right and 6/60 (LogMAR 1.0) in the left with no improvement on refraction. Anterior segments were normal, with round and reactive pupils and full range of extraocular muscle movements in both eyes. Intraocular pressures were 11 mmHg in both eyes by applanation tonometry. Fundoscopy revealed flat retinæ and extensive linear chorioretina scars in the posterior pole of the left eye suggestive of healed choroidal ruptures. There was a posttraumatic stage 4 macular hole measuring 877 µm on optical coherence tomography (OCT) in the left eye (Figure 1A and B). The right fundus was essentially normal.

Following adequate counseling and consent, he had a macular hole surgery using the inverted flap technique. A 25G core vitrectomy was performed with the Alcon Constellation machine. Intravitreal triamcinolone (triamcinolone acetonide 40 mg/mL Aurocort by Aurolab, Madurai, India) was injected to facilitate visualization of the posterior hyaloid after which a posterior vitreous detachment (PVD) was induced. The vitreous detachment was then removed systematically from the posterior pole to beyond the equator. Membrane brilliant blue dye (Aurolab, Madurai 625020, India ocublue plus 0.05% brilliant blue G triphenylmethane dye) was used for a minute with the infusion turned off to achieve better ILM staining.

The ILM was peeled for approximately 2-disc diameters around the macular hole; the peeling was started with a Tano forceps to create an ILM flap and then a 25G Grieshaber ILM forceps (Grieshaber ILM Forceps with Revolution Grip, Alcon Laboratories, Inc., Fort Worth, TX) was used to complete the peeling. During the circumferential peeling, the ILM was not removed completely from retina, it was left attached to the edges of the MH and the periphery trimmed with low vacuum and low cut rate setting on the vitrectomy probe. The ILM was now gently massaged into the MH from all sides until it was fully buried in the hole. A fluid-air exchange was performed. Only 1-day face down positioning was requested and this was supervised while patient was on admission. Optical coherence tomography done one week (Figure 1C) after surgery revealed an early closure of the macular hole with remnants of the inverted flap still identifiable and an unaided visual acuity of 6/36 (LogMAR 0.8).

Figure 1: Traumatic macular hole findings in left eye of young male of African descent before and after inverted flap macular hole surgery with limited face down positioning. (A) Preoperative OCT findings; Full thickness macular hole with cystic changes. (B) Preoperative fundus photo: Posttraumatic macular hole with healed choroidal rupture scars. (C) OCT findings at postoperative week 1 with macular hole closure and a remnant floating linear internal limiting membrane. (D) OCT finding at postoperative week 6 with full macular hole closure.
By six weeks after surgery OCT findings showed a closure of the macular hole with unaided vision of 6/24 (LogMAR 0.6) best corrected with −1.25DS/−0.50dcyl × 180 to 6/6 (LogMAR 0) in the left, vision in the right remained 6/6 unaided. The retina has remained flat over a six month follow-up period with the vision maintained at 6/6 (LogMAR 0) best corrected.

DISCUSSION

Posttraumatic FTMHs usually develop rapidly over weeks [9], in contrast to idiopathic FTMHs that develop over months [10]. Two theories exist to explain the development of traumatic MHs, and these are similar to their idiopathic counterparts, in that tangential and anteroposterior vitreoretinal traction are the main culprits. One theory proposes a trauma induced force vector causing anteroposterior vitreous traction on the fovea and true loss of foveal tissue. Many studies have, however, not found a PVD in traumatic MHs. There is also no consistent evidence of vitreomacular traction on OCT. In addition to this, visual recovery often happens after surgery for these holes, this will not be the case if there was true foveal tissue loss [11, 12]. The second theory proposes that the trauma occurs in the axial direction, causing a decrease in the axial length of the globe and expansion along the equatorial dimension. This results in tangential vitreoretinal forces that are transmitted to the macula, with centripetal forces separating the neurosensory retinal layers at the fovea, resulting in a central defect without any loss of foveal tissue [11].

Since traumatic macular holes have similar pathophysiology to their idiopathic counterparts [11], they have been managed in similar ways. These holes can, however, pose additional challenges to the surgeon because of the possibilities of other associated pathologies like epiretinal membranes, traumatic choroidal ruptures, and scarring [11].

In order to improve anatomic closure rates for traumatic MHs a number of adjuncts used for idiopathic holes have been reported in use with good outcomes. In a series of 12 eyes with traumatic MHs, Rubin et al. [13] reported a 92% final hole closure rate with the use of TGF-beta 2. In another series of 14 eyes Garcia-Arumí et al. [12] injected platelet concentrate over the traumatic MH before infusing sulfur hexafluoride gas (SF6). These patients were kept supine for 1 hour after surgery before adopting strict facedown positioning. They reported a 93% final anatomic closure rate.

In our procedure the ILM flap was left attached to the edge of the hole, trimmed to size and inserted securely into the hole. We did not use a viscoelastic substance as suggested by Morizane et al. [14]. The proposed mechanism for both techniques is that the ILM flap contains residual Mueller cells that can use the flap as a scaffold on which to proliferate and subsequently seal the hole [15].

Sulfur hexafluoride gas, octafluoropropane (C3F8), and silicone oil have all been used as tamponade in traumatic MH surgery. Air tamponade has also been described for idiopathic MHs [16, 17]. Silicone oil might be considered in patients unable to achieve face down positioning for ill health or other reasons or in pediatric patients. The disadvantages, however, are that a second surgery is needed to remove the silicone oil and some individuals can have significant inflammatory reactions to it. Sulfur hexafluoride is our preferred tamponade for most MH surgical cases, we often will advise between 3 and 5 days postoperative face down positioning and ask patients to avoid high altitudes and air flights for a period of eight weeks (six weeks is often adequate). We however noticed a number of our patients struggle to achieve adequate face down positioning especially at home.

The use of air allowed an earlier recuperation, by the first postoperative week the air had been fully absorbed and a good quality OCT image was achievable. Results of OCT on the first postoperative week showed a small floating strand of the ILM flap, this however became more apposed as the MH closure improved (Figure 1C and D). The choice of air as a tamponade was influenced by previous reports of good MH closure with the use of air as tamponade [18, 19].

Initially it was thought that the inverted flap technique resulted in better anatomical outcomes but less favorable visual outcomes. More recent studies now show there is also significant visual improvement [20]. In particular, major visual acuity improvement was achieved as early as one month and in our case report by one week a line improvement in visual acuity was seen. This trend in visual improvement could be achieved regardless of the recovery of outer retinal layers at the foveal site that would seem to occur after at least three months from surgery. This supports the finding of a best-corrected visual acuity of 6/6 at six weeks after surgery for our patient even though the outer retina layers of the fovea were not fully formed (Figure 1D). Some investigators have reported spontaneous closure of posttraumatic MH, Miller et al. [21] described a 39.3% spontaneous hole closure rate in a median of 5.7 weeks. Our patient was seen seven months after the trauma given adequate time for possible spontaneous closure of the MH, which did not occur.

CONCLUSION

In conclusion using the inverted ILM flap technique provides surgeons with another option for initial repair of complex FTMHs like those secondary to trauma, these have been known to respond poorly to initial standard repair. Since ours is a case report, several further studies are required to confirm the safety and efficiency of intravitreal air tamponade with minimal face down positioning for treating posttraumatic MHs.
REFERENCES


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Author Contributions

Olufemi Oderinlo – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Adekunle Olubola Hassan – Conception of the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Conflict of Interest

Authors declare no conflict of interest.
Data Availability
All relevant data are within the paper and its Supporting Information files.

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